Changing the change
DESIGN VISIONS PROPOSALS AND TOOLS

Designing transition paths for the diffusion of sustainable system innovations

A new potential role for design in transition management?

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Abstract

It is a shared opinion that the transition towards sustainability will be a continuous and articulated learning process, which will require radical changes on multiple levels (social, cultural, institutional and technological). It is also shared that, given the nature and the dimension of those changes, a system discontinuity is needed, and that therefore it is necessary to act on a system innovation level. The challenge now is to understand how it is possible to facilitate and support the introduction and diffusion of such innovations.

Bringing together insights from both *Design for sustainability* and *Transition management* literatures, the paper puts forward a model, called *Transition model of evolutionary co-design for sustainable (product-service) system innovations*, aimed at facilitating and speed-up the process of designing, experimentation, niche introduction and branching of sustainable such innovations.

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1. Introduction

It is a shared opinion that the transition towards sustainability will be a continuous and articulated learning process, which will require radical changes, on multiple levels: social, cultural, institutional and technological. It is also shared that, given the nature and the dimension of the required change, a system discontinuity is needed, and therefore it is necessary to act on a system innovation level.

Assumed that sustainability requires radical innovations in order to operate a system discontinuity, the problem is to understand how these innovations could have place and re-orient the dominant socio-technical regime. Therefore it is clear that it is fundamental not only to hypothesize and design promising system innovation concepts, but also to identify in a strategic way a transition path to facilitate the experimentation, niche introduction and scaling-up of such innovations.

In this paper we delineate a model of *evolutionary* co-design for product service system (PSS) innovations to fulfill needs in a more sustainable way. The paper discusses the potential contribution that System Design for Sustainability can have in creating sustainable system innovations. It outlines the key steps of a possible model of transition, describing how to involve the appropriate stakeholders (universities, public institutions, companies, NGO, user, etc.). how to set the basis for the development of a pilot project (to test and learn), and how to evolve this niche experiment in a self standing and replicable sustainable innovation.

From the discussion a new role for design emerges. A role that may potentially opens new fields of activity alongside the consolidated ones. A role in which design is not only aimed at designing a product sevice system but it is also aimed at promoting, facilitating and setting the conditions for the introduction of that product service system through the strategic definition of the key steps of the evolutionary transition path.

2. System innovation and transition management

Sustainable development is a complex concept, dealing with different temporal and spatial scales and with multiple stakeholders (Martens, 2006). It indicates a process of changes whereby the development goal is not clearly outlined and is subject to changes throughout the process. (van Zeijl et al. 2008). Reduced environmental impacts is one element. This may be achieved through green products and greener production processes. Reduced impacts may also be achieved by system innovations, i.e. transformations changes in systems of provision and behaviour (Weaver et al. 2000; Rotmans et al. 2000; Smith et al. 2004). Examples of system innovation are: the hydrogen economy, industrial ecology and customised mobility.

System innovation cannot be designed in a top-down fashion because system innovations are the outcome of co-evolution processes. New knowledge is being created, new institutions and associations emerge out of processes of sociotechnical aligment. Various designs are explored and get perfected, some of which are abandoned. We have problem sequences and response strategies. System innovations involve various elements and processes, each of which is feeding on the other. There is an element of self-organisation: structure emerges out of interaction. For managing transitions processes the model of transition management has been proposed (Rotmans et al. 2001; Kemp et al. 2007). Transition management is a form of process management against a set of goals set by society whose problem-solving capabilities are mobilized and translated into a transition programme, which is legitimized through the political process (Kemp et al. 2005). Transition management relies on the interaction between processes at three levels (Loorbach 2007):

- *Strategic level:* processes of vision development, strategic discussions, long term goal formulation, etc.

- *Tactical level:* processes of agenda-building, negotiating, networking, coalition building, etc.
- *Operational level:* processes of experimenting, project building, implementation, etc.

The processes and outputs of the processes differ at each level (visions, strategies, agenda's, projects) and 'co-evolve' throughout the process. Through a process of partisan mutual adaptation against collectively chosen goals new interaction patterns, policies and socio-technical trajectories emerge, in a self-organised manner rather than through steering from the top. Sustainability concerns are expressed as part of the process. It is used in the Netherlands for managing the transition to sustainable energy, sustainable mobility, sustainable agriculture, sustainable water use and the biodiversity and natural resource transition.

Transition management breaks with the old planning-and-implementation model aimed at achieving particular outcomes. It is based on a different, more process-oriented philosophy. This helps to deal with complexity and uncertainty in a constructive way.

It is a model for working towards comprehensive changes in society, in an adaptive, forward-looking way, relying on processes of variation-selection-retention. It is not a model for managers who want to successfully manage an innovation process. But as we will show, elements of the model can be used for managing sustainable product-service system innovations.

3. (Product-Service) System innovation and design: the new research challenge

It has been argued above that if we assume sustainability seriously, we need radical innovations in the consumption and production system, and so a system discontinuity is required. Therefore, in order to seriously tackle the transition towards sustainability, system innovations should take place.

Within the wide debate on the definition of system innovation, design researchers have usually referred to the so called Product-Service System. Among the several converging definitions the one given by the United Nations Environment Programme (UNEP 2002) says that a system innovation (referred to as Product-Service System, PSS), is "the result of an innovative strategy that shifts the centre of business from the design and sale of (physical) products alone, to the offer of product and service systems that are together able to satisfy a particular demand". Even though the definition might differ from author to author (or from discipline to discipline), we can agree that we are talking about something broader than just product innovation, and so that it is not only a matter of technological innovation, but socio-cultural and organisational one as well. So when we talk about (product-service) system innovation, it is meant an innovation that involves all the different socio-economic stakeholders in a "satisfaction system". In this sense we mean that it is adopted a satisfactory approach, where the focus is no longer the function delivered by a single product, but on the system of products and services (and related stakeholders) that together fulfill a given demand of needs and desires: in fact a given demand for satisfaction. In other words the design reference has no more to be the "functional" unit but the "satisfactional" unit[5].

About (product-service) system innovation and sustainability, it is a shared opinion that these innovations could potentially lead "to a system minimization of resources, as a consequence of

[5] The use of this terminology meets with other authors' interest. Meadows (Meadows, Meadows and Randers, 2006) uses satisfaction in a formula5 to evaluate the limits of growth, in a 30-year update of the previous book known worldwide, "Limits to Growth", modelling the consequences of a rapidly growing world population and finite resource supplies, commissioned by the *Club of Rome*. Marks et al. (Marks et al. 2006) argues that among various indicators measuring personal well-being in the framework of transition towards sustainability, satisfaction seems to be preferable.

innovative stakeholder interactions and related converging economic interests" (UNEP 2002). In other words the potential eco-efficiency of system innovations derives from a new convergence of interest between the different stakeholders: innovation not only at a product (or semi-finished) level, but above all as new forms of interaction/partnership between different stakeholders, belonging to a particular value chain, or "value constellation" (Normann and Ramirez 1995). In other terms, this innovation model can raise the system eco-efficiency through innovative stakeholders' interactions.

In this perspective by both design researchers and transition management theorists a significant ambit in which to act to promote radical changes for sustainable consumption and production, is the widening possibilities for innovation beyond the product, towards innovation of the system as an integrated mix of products and services (and related supporting stakeholders) that together lead to the satisfaction of a given demand for well-being (Goedkoop et al. 1999; Brezet 2001; Charter and Tischner 2001; Manzini and Vezzoli 2001; Bijma, Stuts and Silvester 2001).

In this framework, what role for design? The introduction of system innovation for eco-efficiency into design has led researchers to work on defining new skills of a more strategic nature, that aim at system eco-efficiency through the stakeholders' strategic convergence of interests, and are coherent with the "satisfaction-based", "multi-life-cycle" perspective. In synthesis, the main characteristics of the system design for eco-efficiency approach are: a satisfactory approach (demand-satisfaction design); a stakeholder interaction approach (stakeholder's configuration design); and a system eco-efficiency approach (ecoefficient-oriented design). In this perspective design activity should focus on (Vezzoli 2007):

- promoting and facilitating new configurations (partnership/interaction) between different stakeholders, to find innovative solutions able to lead to a convergence of economic, social and environmental interests;
- facilitating a participatory design process among all the stakeholders while developing environmentally sustainable products and services together;
- orientating the design process towards eco-efficient solutions.

It has to be underlined that not every (product service) system innovation is eco-efficient (Tukker and Tishner 2006), and therefore it is of key importance to adopt appropriate methods and tools when designing new systems (with the potentialities to be radically sustainable)[6].

At the present time it is possible to state that the concept of (product-service) system innovation has been deeply studied at the academical level, and in the last years knowledge has been produced, accumulated and shared on understanding system innovation's characteristics, potential benefits (for companies, government, society, users and environment), barriers to adopting it, possible rebound effects, etc. In particular, in relation with the design of (product-service) system innovations, we can say that, within the researchers community, different methodologies and tools have been developed (and tested) to orient and support the design process towards the definition of sustainable system innovation concepts.

But to all this knowledge developed at the academical level corresponds a limited application of sustainable (product-service) system innovations by companies. In this sense several barriers can be identified (UNEP 2002; Mont 2002): for the user the cultural shift necessary in accepting a ownerless consumption; for companies the difficult in implementing the substantial changes required in corporate culture and organisation to support a service-oriented business, the

[6] The first design methods and tools that have been recently developed as outcomes of some European projects of the 5th Framework Programme, are PROSECCO (Product & Service Co-Design process), HiCS - Highly Costumerized Solutions (Manzini, Collina and Evans 2004), and MEPSS - Method for PSS development (van Halen, Vezzoli and Wimmer 2005).

resistance in changing the traditional business concept, the lack of knowledge and experience in design methods and tools and service management systems, and the difficult in evaluating the environmental and social features of a (product-service) system innovation; for governamental institutions the difficult in defining and implementing policies to facilitate the companies' adoption of system innovations.

For these reasons it is possible to state that now the research challenge is to understand which could be the proper conditions to: foster the adoption and dissemination of sustainable (product-service) system innovations, foster the knowledge transfer from university research centres to companies, and foster the involvement of the other key stakeholders in supporting these processes.

In this perspective it seems promising to view PSS as the co-design of a radical innovation, but even as transition path to achieve it. Key point is to introduce a process-oriented design, rather than a traditional design-and-implementation approach.

Within this context universities could potentially play an important role. In particular for design universities a field of action could be the involvement of key stakeholders in order to facilitate the ideation of promising and sustainable system innovation concepts, and in order to define new strategies and modalities to accelerate the experimentation of such innovations and foster their introduction in the "real world". In this sense universities can represent the pivotal actor in starting out a transition process, facilitating the strategic conversation between the different socio-economical stakeholders and the community, and facilitating a continuous learning process between them. A model, in which university could become a "facilitator" in starting out and accelerating a partecipated process for the introduction and dissemination of sustainable system innovations, is presented below, integrating objectives and approach of the *Transition management* theory[7].

4. A transition path of evolutionary co-design for sustainable system innovations diffusion

Design and system Innovation for Sustainability (DIS) research unit (Politecnico di Milano – INDACO Department), is currently working on some research projects (for example the *VDS*[8] project and the *University chair for innovation*[9] project), in which the aim is to design a sustainable system innovation concept, together with the strategy for its introduction and subsequent scaling-up, or better still branching.

Within these project has emerged a draft model, called *Transition path of evolutionary co-design for sustainable system innovations diffusion*, aimed at facilitating the designing, experimentation, introduction and branching of sustainable system innovations. It is based on the *Transition management for sustainable consumption and production* model, and at the present time represents a first draft, a work in progress. Nevertheless it is currently tested in the previously mentioned projects, in order to understand its feasibility, strenghts and weaknesses.

We are aware that there is the need for further reaserch and the need to realize field tests; however it has been likewise decided to present the intermediate results to the scientific community, with the intention to start out and stimulate a constructive dialogue and discussion.

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[7] We are talking of the *Transition management for sustainable consumption and production* model, developed in the Netherlands by Rotmans, Loorbach and Kemp (see Kemp et al. 1998, 2001, 2004, 2006)

[8] The Vehicle Design Summit (VDS) project, run by an international Consortium of Universities coordinated by the Massachusetts Institute of Technology (MIT) of Boston, aims at designing, prototyping and producing an eco-efficient vehicle as well as defining an innovative and sustainable business model to introduce and diffuse it into the market. It will be described later in the paper.

[9] Within this research project (run under the UNIDO's umbrella), the role of DIS research unit is to cooperate with some African universities (Universitè Polytechnique De Bobo-Dioulasso, University of Zambia and University of Lagos), in order to design and introduce sustainable mobility solutions for local low-income contexts (see Vezzoli and Ceschin 2008).

Objectives and backgroung assumptions of the model

The main objective of the model is to support, orient and facilitate the development of the conditions for the experimentation, niche introduction and branching of sustainable system innovation concepts, with university research context as starting point.

In other words the model aims at fostering a transition process towards the adoption, dissemination and continuous development of sustainable system innovations.

As it has been pointed out before, system innovations require changes on multiple levels (social, cultural, institutional and technological), and in this sense they can be considered radical innovations. For this reason, when talking about (product-service) system innovations, it is proposed to imagine such innovations not only as static outcome of a design and development process, but it is necessary (first background assumption), within a transition paths to be designed and managed, facilitate and support the introduction and subsequent branching of such innovations.

It is called evolutionary process because it aims at diffusing new “mutation” in the system as a result of the environmental feedbacks reinforcing them, to substitute existing un-sustainable system of production and consumption. The words design and management are added to emphasize that these are not casual mutations, but oriented by the sustainability goals. And these casual mutations are designed and managed in the sense that they draft possible paths to be pro-active, hence speeding up the evolutionary process (that in nature, we know, has its foundation in long time processes).

It is also assumed (second background assumption), that university may represent a possible pivotal actor within that transition process. In this sense they can potentially act facilitating the starting out of this process, orienting it towards sustainability, involving different socio-economical actors and favouring a continuos knowledge exchange. In this sense university could represent the promoter of innovative stakeholder arena (and their interactions), and the facilitator in starting-out and orienting a multi-stakeholders process aimed at designing, introducing and branching sustainale system innovations.

To be more clear university could assume a strong role in the first part of the process (starting-out and orienting), and then could “pass the baton” to the socio-economical actors which in future could become the providers and the users/beneficiaries of the (product-service) system innovation. And so a university that activates the other actors of the system in an increasing involvement: in the beginning they only give feed-backs; then their role become central with universities giving support; and later they become autonomous in realizing and scalin-ug the product-service system concepts.

Characteristics of the model

What are the characteristics of the elaborated model of evolutionary transition path? The model can be defined as a *strategic orientation* and *adaptation* of the steps that, starting from an university research context and through a continuos and iterative multi-stakeholder learning process, brings to the experimentation, niche introduction and scaling-up/branching of sustainable system innovation concepts.

To be more clear, first of all we can say that this is a transition path which is co-elaborated and adapted by a plurality of actors (universities, research centers, public and private companies, NGOs, governamental institutions, community, etc.), and in which university acts as “promoter” and “facilitator”, assuming a key role in the first part of the path, and passing the witness to other socio-economical stakeholders in the second part of it.

Secondly, it has to be remarked that we are dealing with a process of continued learning (for the involved actors), because the transition path is based on continuous experimentations and consequent feed-back processes.

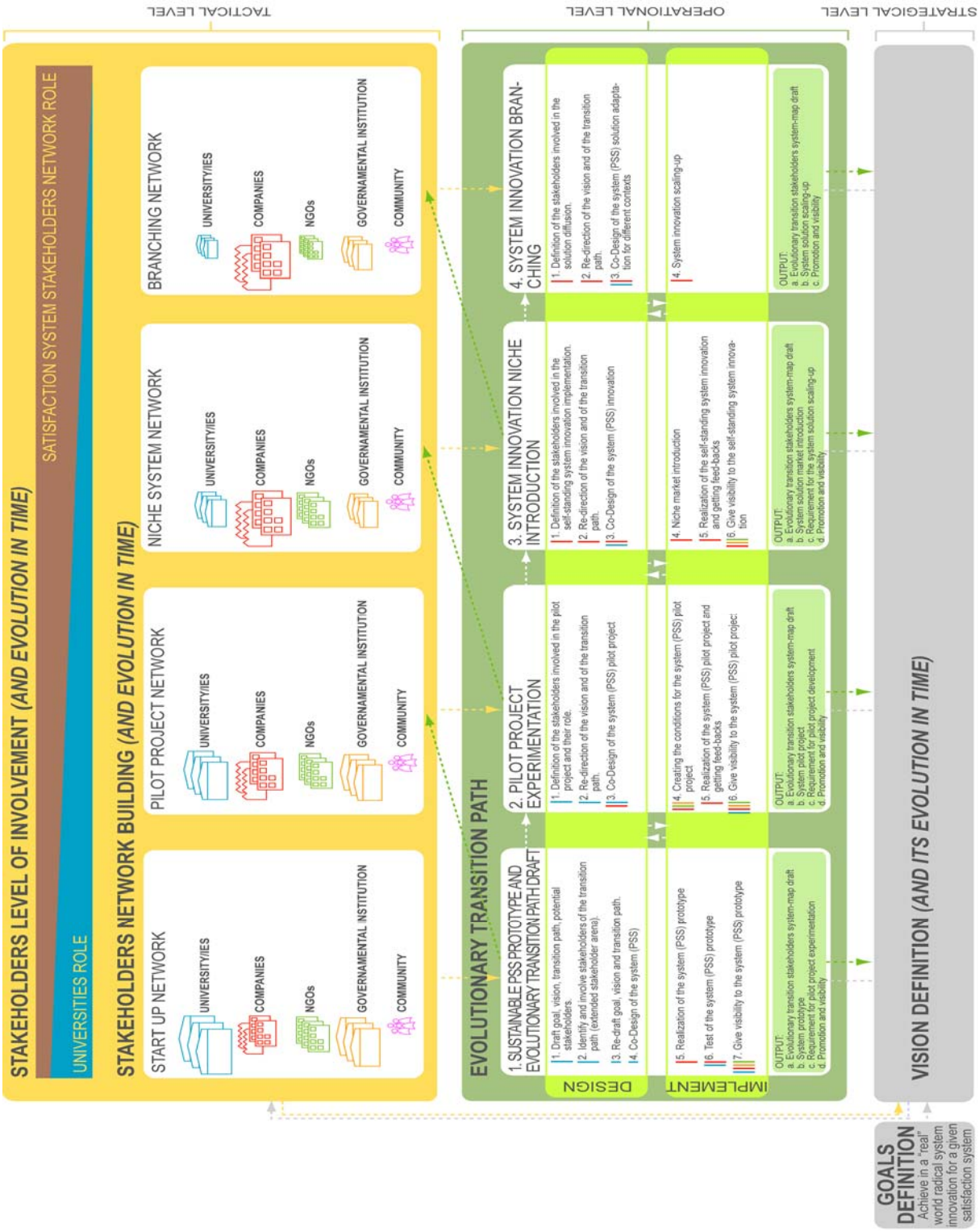

Fig. 1: the transition path of evolutionary co-design for sustainable product service system innovations, in which are illustrated the four transition phases and the stakeholders network evolution needed to carry out each single phase.

Moreover it is a process of *strategic orientation*, in the sense that the transition path is based on the definition of goals (to be achieved), and on the consequent building-up of a vision (of how to achieve these goals); this means that the steps of the transition path are oriented to the achievement of the defined goals, and are affected by the built vision.

Furthermore we are dealing with a process of *adaptation*, just because the transition path is based on a continuous learning; this implies that the vision can be adapted and modified in time (in relation to the context and/or stakeholders evolution), and consequently the same can happen for the single steps of the transition path. Moreover the entire transition path can be defined as a process of mutual-adaptation between the proposed system innovation and the context -or socio-technical regime- inside which such innovation has to be experimented and introduced; in fact both the context and the proposed system innovation evolve and affect each other.

For these reasons the transition model can be defined an “evolutionary” process, because it is characterized by a continuos evolution and adaptation of the transition path, but also of the proposed system innovation, and of the involved socio-economical actors. More precisely we are dealing with a *controlled* and *accelerated* “evolutionary” process, in the sense that the proper conditions to facilitate and speed-up this process are designed and created. And for proper conditions it is meant the conditions by which the involved actors can: collect in an effective way all the feed-backs coming from the experimentations; analyse these feed-backs; and use it for a system improvement. In this perspective it clearly becomes foundamental the setting-up and development of an appropriate stakeholders network, capable to adapt itself in time to better collect and analyse feedbacks (and in general to support the different steps of the transition path).

In synthesis, the model of “evolutionary” transition path (see fig. 1), is based on the definition of goals and the building-up of a vision, which includes the drafting of the stakeholders’ interactions evolution in time; the vision effects the steps of the transition and the stakeholders network configuration needed to carry out each single step; in turn the transition steps influence the vision definition and the stakeholders network building (in a continuous iterative process).

Phases in the “evolutionary” transition path

Seeking for clarity, in the model of “evolutionary” transition path it is possible to identify four main phases. It has to be remarked that the transition path, although being described as linear, in reality is an iterative process, with continued feedbacks; moreover the various steps are not distinctly separeted but overlaps each others. Nevertheless the four conceptualized phases are:

- *Sustainable system innovation prototype and evolutionary transition path draft.* As said before university plays a key role in this phase, representing the promoter and the facilitator. In fact, starting from a given satisfaction system (e.g. urban people mobility), university drafts goals, visions and transition path with relative potential stakeholders. Afterwards it fosters the building-up of a first stakeholders network (including research centers, companies, NGOs, institutions, media, the community etc.), which, in a partecipated process, develops and modifies the previously proposed visions and transition path. Starting from the implemented vision, a co-design process is carried out to define promising sustainable system innovations; the most promising ones are then prototyped and tested. At the same time the network acts in order to give visibility to the project and to the prototype.
- *Pilot project experimentations.* Starting from the results of the previous phase, the stakeholders network (which meanwhile has been adapted and/or integrated, and in which there is a lower university involvement), re-defines and re-directs the previously elaborated visions and transition path. Afterwards the network co-designs, realizes and controls one or more pilot projects, that are socio-technical experimentations to test the system innovation concept. The aim is to facilitate the learning of all the involved actors, in relation to the weaknesses, strenghts, barriers, cultural, political and economical acceptability, etc. of a possible market introduction of such innovation. These experimentations represent a continuous iterative learning process, involving with different roles all the stakeholders in: setting the conditions for the pilot project realization; analysing the pilot project experimentation results; and proposing modifies

and integrations. In other words it is a process of feedbacks that may lead to the adaptation and adjustment not only of the pilot projects characteristics but also of the vision. Moreover these pilot projects could represent an optimum “window” because of its potential to show sustainable innovations ideas to wider communities. In this sense they could be used not only for experiment ideas, but also for attracting new potential interested actors.

- *System innovation niche introduction.* What has been learnt during the experimentations should brought to the adjustment of the characteristics of the (product-service) system innovation, and to the definition of the modalities by which it can become economically sustainable and self-standing. In this sense the most promising pilot projects are selected, implemented and introduced into the market.
- *System innovation branching.* If the market introduction has been positive, it could become a model that can be replicated, imitated, adapted, developed and integrated. In other words it can be scaled-up and potentially contribute in destabilizing and re-orienting the dominant socio-technical regime. It has to be underlined that until the third phase the key actors could remain substantially the same (with an increasing role for companies and a lower university involvement); on the contrary in the fourth phase totally new actors could have a part in autonomously adopting, adapting, replicating and developing the system innovation concept.

As said before the transition path is described as it were linear, but it is important to underline that a cyclical and iterative process takes place. The cycical character of the transition is illustrated in fig. 2, in which are represented the continuous repetition of four main activities (Kemp 2006): establishing and further development of a transition arena (A); development of sustainability visions (B); initiation and execution of projects and transition-experiments (C); Evaluation and monitoring of the transition process (D).

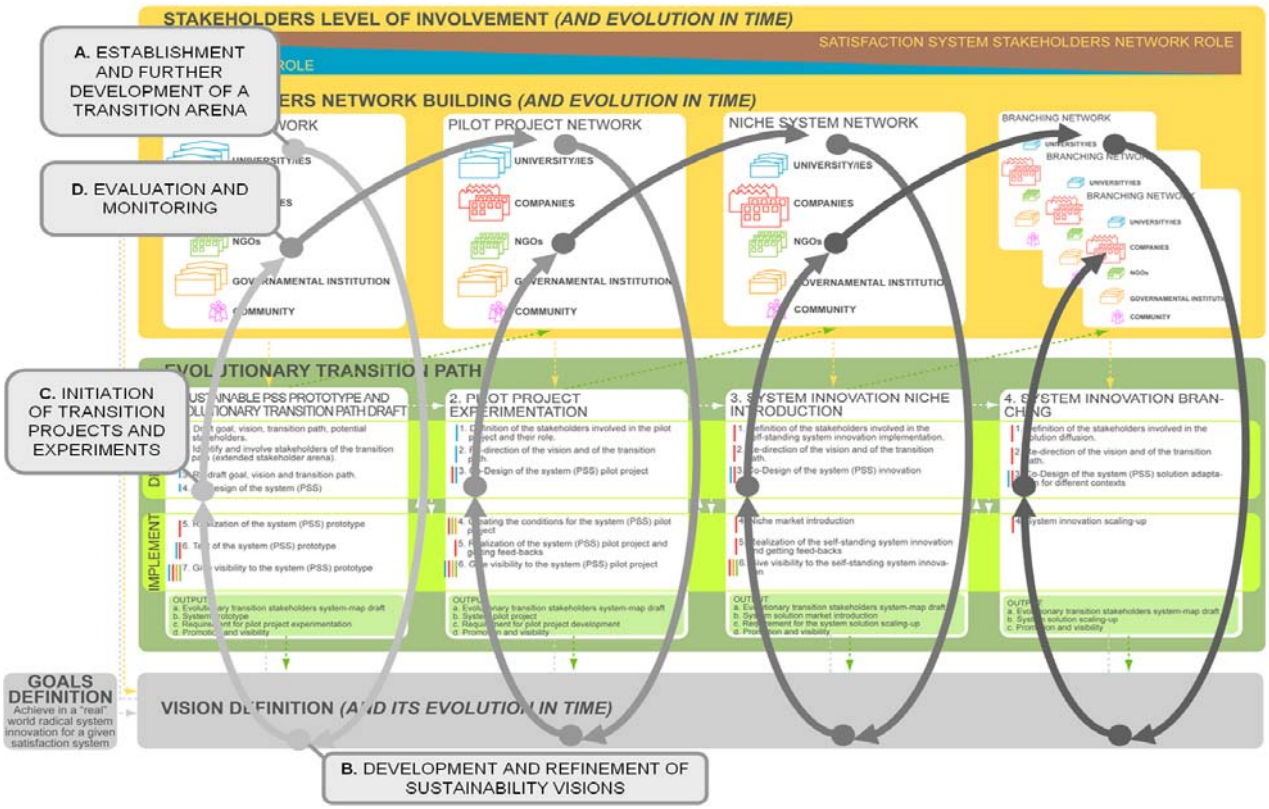

Fig. 2: the cyclical character of the transition path.

Moreover it is important to highlight that in the described transition model we took in consideration a process in which, besides universities, companies assume a key and foundamental role along the entire path. But this is not the only possible way. We can also imagine bottom-up innovations that start from self-managed groups of people –the so called creative communities (Meroni 2007)– and then are implemented, replicated and scaled up by other groups of people; or in alternative these innovations can likewise starts from a particular creative community, but then are developed, industrialised and branched by companies. However in any of these cases university can act as facilitator and promoter.

“Evolutionary” stakeholders system maps: a new tool

It is quite obviuos that, in the previously described transition process, it is very important a multi-stakeholder and multi-disciplinary approach. Therefore the identification of the stakeholders (and of their roles, motivation and mutual interactions), is a fundamental aspect in setting the proper conditions to support this process. In other words it is vital the creation of a network made up of different socio-economical stakeholders. In general terms we can have:

- *Universities,* because, as it has been explained before, they could represent the promoter and facilitator of the process.
- *Companies,* because they can provide technical feed-backs, competences and financial resources; they are interested in participating because there could be the opportunity of a new market, for a possible reputation comeback, or for acquiring new know-how.
- *Local Administrations and Institutions,* because they can provide financial resources or facilitations; they are interested in being part of the process if the system innovation concept is coherent with their objectives.
- *NGOs,* because they can support and create interests around the project; they are interested in participating if the system innovation concept is coherent with their values.
- *Media,* because they have to create interest around the project.
- *Users,* because of course they are fundamental in testing and experimenting the system innovation.

All these actors take part (with different roles and levels of involvement), in a process of co-production of knowledge and co-definition of the transition path. Nevertheless it is important to remark that the stakeholders involvement is not an action that starts and ends in the beginning of the process, but is a continuous and iterative activity along the entire transition process. This means that there is the need to define not only which actors include but also when involve them (in which phase of the transition process), and at what kind of level they have to be involved.

In other words we are dealing with a stakeholders network which is not static, but dynamic, because the actors and also the related interactions could deeply change along the path. A network that has to be capable to evolve in time in relation to the specific needs. And it has to be underlined that this evolution represents an important and fundamental element of the entire transition path. Element that represents itself a design activity.

If we can use a metaphor we can say that it is a sort of relay race in which we have several “baton passages” between different stakeholders networks. And to cross the finishing line more quickly (as the sustainability challenge requires), different actors/runners have to use their energies, each for its piece of path. A common path in which the first actors/runners have to know to which actors pass the baton, as well the second actors/runners have to know which are the third ones, and so on until the achievement of the goal. In this sense, in order to speed up the process, it becomes foundamental forsee which potential actors could be involved and have a part in each phase. And in this strategic anticipation a key role could be played by design.

In fact what is new here is the proposal to design, together with the draft of the transion path, the evolutionary stakeholders system map (ESSM), that is the potential stakeholders network, and its evolution in time, needed to carry out the transition path. And this ESSM represents itself a new tool to be used to forsee the appropriate stakeholders to be increasingly involved, and to facilitate the strategic conversation with them. In this sense the tool can be used in the beginning of the process by universities (that it is assumed to be the promoter of the process), to draft the transition steps and the potential stakeholders to be involved. In other words it is used to draft a first vision of how the transition path could be and which actors involve; and this vision could result fundamental in stimulating a first discussion with the potential stakeholders to be involved. In this sense the model is also a tool to start and facilitate the strategic conversation with other actors, and to build-up a shared vision.

What the model aims at

It has been already said that the main objective of the model is to orient and facilitate the development of the conditions for the experimentation, niche introduction and scaling-up of sustainable system innovation concepts, starting from a university research context. So, in general terms, the model aims at supporting a complex process by facilitating multi-stakehoders activities towards the achievement of a shared vision. In other words it is a methodological framework by which facilitate, foster and orient such transition processes.

In particular the model helps to define which key general actions have to be carried-out in the various transition phases, in relation to the system design activities and the system implementation activities (see fig. 1). It helps in defining the activities that have to be done but also the actors that potentially could manage each single activities. In other words the model facilitates the setting-up of a flexible stakeholders network to support the accomplishment of each single phase.

Before it has been underlined the importance of involving various socio-economical stakeholders, and that this can be considered a design activity. In this sense the model can facilitate the design process towards the definition, integration and adaptation in time of a system of multiple actors, identifying the proper stakeholders, understanding and converging together their motivations, defining their roles, mutual relationships and levels of involvement. In synthesis the model supports the stakeholder network definition and its continuous evolution in time.

Moreover the model fosters the adoption of an anticipative, cyclical and iterative approach (the previously mentioned cyclical character of the transition), based on continuous experimentations, feedbacks collection and analysis, and system improvements. In this sense it facilitates a continuous learning process and knowledge exchange between the various stakeholders involved.

Finally the model represents a methodological framework that allows the use of other design tools and method in a coordinated way. Tools such as the *Design Plan Tool-box* (Jégou, Manzini and Meroni 2004), to help different stakeholders in communicating and developing solutions together, and *the Sustainability Design Orienting (SDO) tool-kit* (Vezzoli and Tishner 2005), to orient the design process towards the definition of sustainable solutions; methods such as the *Scenario building* (Manzini and Jégou 2004), to facilitate the generation of shared visions. In this sense the model facilitates an integrated and coordinated use of these tools, supporting co-design processes aiming at accelerating the stakeholders adoption of new and sustainable production and consumption patterns.

As said in the beginning of the section we are aware that this model represents a first semplified version. Nevertheless it is currently tested in some research projects, for example the Vehicle Design Summit (VDS) one, run by an international Consortium of universities coordinated by the Massachusetts Institute of Technology (MIT) of Boston. The Consortium’s goal is to design and realize a low environmental impact vehicle as well as the definition of the conditions for its

introduction into the market (firstly the Indian one), through innovative and radical sustainable "mobility offers". The final aim is to influence and re-orient the whole automotive sector towards the adoption of radically more sustainable offer modalities and consequent production strategies. In this framework Politecnico di Milano work team[10] designed an innovative and eco-efficient business model[11], and delineated, using the previously mentioned model, a promising transition path to introduce and diffuse this model into the market. At the present time the produced results are now used by other work teams to select and involve the potential stakeholders to test and implement the proposed system innovation concept.

Of course the model needs to be developed and detailed, and in this sense it will be tested in further researches. At the same time we believe it was already worthwise to put it to the attention of the scientific community to open-up a debate, we hope, fruitfull of interesting results.

5. Conclusions: a new potential role for design in transition management?

At this point a proper question could be: which role could be played by design and design university in transition management?

Before it has been underlined the importance of adopting a general design attitude to pursuit (product-service) system innovation. In this sense design could result strategic not only in the definition of the system innovation characteristics, but also in drafting and adapting in time the stakeholders networks, in order to set the basis for the introduction and proliferation of that kind of innovations.

In other words design could play a key role not only in orienting and supporting the design process towards the definition of environmental and socio-ethical sustainable system innovation concepts, but also in designing the proper conditions to foster and speed-up the experimentation, niche introduction and branching of such innovations, through the design of innovative stakeholders' interactions, and their evolution in time. In this sense design could act as "promoter" and "facilitator" for the co-creation of the conditions to foster and speed up such kind of transition processes.

Moreover, as we have seen before, in such transition paths universities could result foundamental, representing the pivotal actor capable to involve, enable and guide other socio-economical actors in experimenting, introducing, adopting and developing system innovation concepts.

In conclusion the paper pones two main working hypothesis to be verified with further research and field tests:

- that design could result strategic in facilitating the setting-up of the conditions for the experimentation, introduction and scaling-up of sustainable system innovation concepts, through foreseeing the potential actors to be involved and facilitating the strategic converstation between them;
- that in this transition path university could act as key actor, promoting and facilitating the whole process.

[10] The work team is made up by the students Lorenzo Davoli, Francesca Fiocchi and Jun Lin, coordinated by Carlo Vezzoli and Fabrizio Ceschin (research unit Design and system Innovation for Sustainability, INDACO dept., Politecnico di Milano).

[11] In brief he alternative business model is characterized by: an approach to mobility as the scope of design; an innovative stakeholders network (including actors like energy supplier, insurance company etc, which usually work autonomously with the value chain); a shift from selling products (car, fuel, etc) to selling results (access to mobility); a change in product ownership; and a consequent change in vehicle design. For details see: Vezzoli and Ceschin 2008 (II).

The hypothesis seem worthy to be further investigated, that means new source of funding should be search and before institutions should understand the importance to assume these as one of the articulate research strategies and fund-raising.

References

Bijma A., M. Stuts and S. Silvester. 2001. Developing Eco-efficient Product-Service Combinations. Paper presented at the 6th International Conference 'Sustainable Services and Systems. Transition towards Sustainability?', October, in Amsterdam, The Netherlands.

Brezet, H., and C. van Hemel. 1997. *Ecodesign. A promising approach to sustainable production and consumption*. Paris: UNEP

Charter, M., and U. Tischner. 2001. *Sustainable Solutions. Developing Products and Services for the Future*. Sheffield: Greenleaf publishing.

Goedkoop, M., C. van Halen, H. te Riele, P. Rommes. 1999. *Product Services Systems, Ecological and Economic Basics*, *report 1999/36.* The Hague: VROM.

Jégou, F., E. Manizini and A. Meroni. 2004. Design plan. A design tool-box to facilitate solution oriented partnerships. In *Solution oriented partnership,* ed. Manzini, E., L. Collina and S. Evans, 107-118. Cranfield: Cranfield University.

Kemp, R., J. Schot and R. Hoogma. 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technology analysis and strategic management, 10:175-196.

Kemp, R. and J. Rotmans. 2001. The Management of the Co-Evolution of Technical, Environmental and Social Systems, Paper presented at the international conference Towards Environmental Innovation Systems, September 27-29, Garmisch-Partenkirchen.

Kemp, R. and J. Rotmans. 2004. Managing the transition towards sustainable mobility. In *System innovation and the transition to sustainability: theory, evidence and policy,* ed. Elzen B., F. Geels and K. Green, 137-167. Cheltenham: Edgar Elgar.

Kemp, R., S. Parto and R. B. Gibson. 2005. Governance for Sustainable Development: Moving from theory to practice, *International Journal of Sustainable Development*, Vol 8 (Nos 1/2): 13-30.

Kemp, R., D. Loorbach and J. Rotmans. 2007. Transition management as a model for managing processes of co-evolution, *The International Journal of Sustainable Development and World Ecology* (special issue on (co)-evolutionary approach to sustainable development), 14: 78-91.

Kemp, R., J. Rotmans and D. Loorbach. 2006. Transition management as a model for managing processes of co-evolution towards sustainable development. Paper presented at the conference Perspectives on Radical Changes to Sustainable Consumption and Production (SCP), Sustainable Consumption Research Exchange (SCORE!) Network, November, in Copenhagen, Denmark.

Kemp, R. and P. Martens. 2007. Sustainable Development: how to manage something that is subjective and that never can be reached? *Sustainability: Science, Practice & Policy* 3(2): 1-10.

Loorbach, D. 2007. *Transition management : new mode of governance for sustainable development*. Erasmus Universiteit & Utrecht : International Books.

Manzini, E., L. Collina and S. Evans. 2004. *Solution oriented partnership*. Cranfield: Cranfield University.

Manzini, E., and F. Jégou. 2004. Design degli scenari. In *Design multiverso. Appunti di fenomenologia del design*, ed. Bertola, P., and E. Manzini, 177-195. Milano: Edizioni POLI.design.

Manzini, E., and C. Vezzoli. 2001. Strategic design for sustainability. Paper presented in TSPD conference, in Amsterdam, The Netherlands.

Marks, N., S. Abdallah, A. Simms and S. Thompson. 2006. *The (un)happy planet. An indext of human well-being and environmental impact*. London: New Economics Foundation and Friends of the Earth.

Martens, P., 2006. Sustainability: science or fiction? *Sustainability: Science, Practice and Policy* 2: 1-5.

Meadows, D., D. Meadows and J. Randers. 2006. *Limits to growth. The 30-year update*. Chelsea Green: White River Junction.

Meroni, A., edit. 2007. *Creative communities. Peolple Inventing suatinable ways of living.* Milano: Edizioni Polidesign.

Mont, O. 2002. Clarifying the concept of product–service system. Journal of Cleaner Production, 10, 3, 237-245.

Normann, R., and R. Ramirez. 1995. *Le strategie interattive d'impresa. Dalla catena alla costellazione del valore*. Milano: Etas Libri.

Tukker, A., and U. Tischner, edit. 2006. *New business for Old Europe. Product Services, Sustainability and Competitiveness*. Sheffield: Greenleaf publishers.

Tukker, A., M. Charter, C. Vezzoli, E. Stø and M.M. Andersen, edit. 2008. *System Innovation for Sustainability 1. Perspectives on Radical Changes to Sustainable Consumption and Production.* Sheffield: Greenleaf Publishing.

Van Halen, C., C. Vezzoli and R. Wimmer, edit. 2005. *Methodology for Product Service System. How to develop clean, clever and competitive strategies in companies*. Assen: Van Gorcum.

Van Zeijl-Rozema, R. Cörvers, R. Kemp and P. Martens. 2007. Governance for sustainable development: a framework, forthcoming in *Sustainable Development*.

Vezzoli, C. and U. Tishner. 2005. Sustainability Design-Orienting toolkit (SDO-MEPSS), www.mepss-sdo.polimi.it.

Vezzoli, C. 2007. *System design for sustainability. Theory, methods and tools for a sustainable "satisfaction-system" design*. Rimini: Maggioli Editore.

Vezzoli, C. and F. Ceschin. 2008. Designing sustainable system innovation transition for low-industrialised contexts. A transition path towards local-based and long lasting sustainable mobility solutions in African contexts. Paper presented at the conference Sustainable Consumption and Production: Framework fo Action, Sustainable Consumption Research Exchange (SCORE!) Network, 10-11 March, in Brussels, Belgium.

Vezzoli, C. and F. Ceschin. 2008. Product service systems in the automotive industry: an alternative business model for a sustainable satisfaction system. Working paper for the ICMR08 conference, 9-11 September, in Brunel, United Kingdom.

UNEP. 2002. Product-Service Systems and Sustainability. Opportunities for sustainable solutions. Paris: CEDEX.