Smart Community for the Smart Governance of the Urban Environment

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Abstract— **In the framework of the Smart Energy Master (SEM) project, carried out by the Department of Civil, Construction and Environmental Engineering (DICEA) in collaboration with four partners from industry, guidelines were drawn up "to promote behaviour and lifestyles aiming to reduce energy consumption in the urban environment". Such guidelines provide general orientation for improving energy efficiency and reducing resource consumption in urban contexts. The study, carried out in a context of networking and sharing research processes, specifically aims to give useful indications for a psycho-social change in local communities with the ultimate objective of the system's environmental health. The purpose is to offer a theoretical and methodological frame of reference to promote ecologically sustainable behaviour and lifestyles of citizens in Europe's smart cities of the future.**

Keywords—smart citizen; smart governance; urban environment; energy

I. INTRODUCTION

Social compliance with the objectives of environmental sustainability in future smart cities makes it necessary to develop local communities and cultural systems which are also "smart", i.e. aware of the limits and opportunities offered by the natural environments in which humankind lives and is able to manage the planet's resources responsibly. To this end, it is worth reflecting upon the methods and tools available to citizens and governments to promote suitable environmental awareness and change people's behaviour and lifestyles with a framework of sustainability. An effective policy of community change thus requires intervention methods to be developed also in the psycho-social context so as to change the final products of cultures, such as behaviours and social practices performed in contexts [1]. A deep-seated change in people's behavioural habits and lifestyles may indeed lead to a significant reduction in energy consumption, in harmful greenhouse gas emissions and, more generally, in anthropogenic environmental pollution, making the citizens themselves "smarter".

II. THEORETICAL FRAME OF REFERENCE

Beside the scientific disciplines concerned in the technological innovation of physical infrastructures, the complex world of human and social sciences offers considerable contributions to understand and change human living systems. This represents a field of fundamental intervention to achieve some prefixed sustainability objectives, highlighting the role of psychological and social dimensions of urban change. A transdisciplinary [2] and ecological [3] approach affords insights into the interconnections between the various biological, environmental and technological systems of humankind, opening up a complex view of the relationship between the psyche and the environment [4]. Environmental psychology [5] [6] [7] [8] is concerned with the study of this relationship, identifying various psychic elements connected with the relationship between humankind and planet Earth.

The theoretical approach considered herein focuses upon the dynamics of local change, the relational models found in geographical contexts and the socio-political implications of living in the community [9] [10] [11] [12].

III. HUMAN BEHAVIUOR AND ENVIRONMENTAL IMPACT

The various psychological factors involved in the processes of social change for the promotion of ecological behaviour include the following:

- Attitudes and habits

- Environmental beliefs

- Social values and norms

- Identity processes

- The sense of individual and collective responsibility

Of the above list, the sense of responsibility is of particular interest for the development of a "smart" environmentally-attentive citizenry. Indeed, this psycho-social element plays a key role in the discourse on environmental competencies and on the possibility of intervening effectively on the behaviour and consumption styles of citizens. Feeling responsible for the available resources in their own living environments leads to better management of the same resources and activation of processes that look after the environment and its vital elements.

It is necessary that an individual, a group or a whole community develops *awareness of the effects* of a given behaviour, or an event connected to it, on the environment and on resource use, and takes on responsibility for what happens. That is, people can formulate an opinion of personal responsibility when they understand that a given event was actually *caused* by them, through a certain *intentional* behaviour, voluntarily performed on the basis of a *free choice* among possible, also feasible, alternatives [13].

IV. STRATEGIES FOR THE ECOLOGICALLY SUSTAINABLE DEVELOPMENT OF COMMUNITIES

Starting from such preliminary considerations we may identify a general intervention strategy to promote greater awareness of the forces involved in the relational processes linked to the environmental impact of human life. The widespread development of a more mature environmental awareness, integrating cognitive and affective components, scientific knowledge and experience, makes citizens, *stakeholders* and *community leaders* more competent in dealing with challenges emerging from the relationship between humankind and the living and working environment.

Besides a general strategy of developing an individual and collective critical consciousness, it is possible to define further strategic indications[1] to create the structural and relational conditions required for this improvement in individual abilities to deal with environmental issues. People may thus be provided with psycho-social tools and methods of effective management of resources (whether material or non-material) available in living environments.

The vitality and sound functioning of a social system which aims to organise itself in a *smart* fashion, i.e. suited to ensuring environmental sustainability and the efficiency of production and consumption processes regarding goods and services, may be chiefly developed as a measure to process the collective experience and knowledge of reference communities. Promotion of network tools, social infrastructures and organisations which are complex yet of easy access and inclusive, can thus activate this process of exchange and elaboration of epistemic elements present in the context, making the system more able to recognize itself, develop decisional autonomy and understand its own needs and possibilities of action [15] [16]. Indeed, acquisition of a more mature environmental awareness spontaneously generates gradual behavioural changes in societies and individuals, leading in the long term to a significant change in citizen lifestyles and consumption.

The strategic orientation proposed is linked to five distinctive characteristics of a sustainable community as described by Bridger and Luloff [17], that is: promotion of local economic diversity, self-sufficiency, reduction in energy consumption, conservation and enhancement of biological and environmental diversity, and social justice. Moreover, what is important for the general orientation of the measures considered are the six forms of community capital described by

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[1] Briefly listed below. For a more extensive description, refer to "Stili di vita e riduzione dei consumi energetici. Linee Guida" [14].

Mark Roseland [18]: natural, physical, economic, human, social and cultural. A key role is assigned to social capital as the set of relational resources accessible to the community, which performs as an infrastructure in which affective experience can be processed, generating new knowledge and new consciousness.

The following strategic guidelines are proposed:

1) To develop critical awareness of the man-environment relationship

2) To enhance individual and collective possibilities of changing awareness and behaviour

3) To develop the sense of community and social identities

4) To develop processes of action sharing

5) To promote and vitalise relational infrastructures for processing experience and complex knowledge on environmental issues

6) To promote the active participation of citizens and stakeholders in such structures and greater inclusion of the population in the vital decisional processes of the community

7) To promote cooperative and collaborative processes within local communities

8) To incentivise autonomy and local systems of production and consumption

9) To supply and support models and experience of environmentally compatible best practices

10) To stimulate the creative use of resources

11) To promote environments which stimulate social and ecological standards

12) To make *smart* behaviours socially desirable

V. TO DEVELOP CRITICAL AWARENESS

As mentioned above, consciously processing information and the emotions experienced by those who use and consume environmental resources leads independently to a change in behaviour into forms that are more suited to the new urban contexts, generating critical awareness and social responsibility. By critical consciousness [19] we mean the ability to understand the forces present in the context which affect the overall health of the system concerned. Instead, Montero and Sonn [20] speak of "coscientization", referring to a dynamic process of mobilising consciousness thanks to which a greater understanding of the way we live in the world can be achieved. In every action to mobilise the individual and collective consciousness it is necessary to consider both a cognitive-informative level and an emotive-experiential level of the complex dynamic which one intends to set in motion. Various possible social interventions also need to consider the cultural universes in which they act, the systems of shared beliefs and meanings in communities. The actions proposed therefore concern the processes of destructuring and restructuring the collective unconscious through a systematic

policy study with images, symbols, representations and models of life which define and characterise the life of the community.

VI. METHODOLOGY AND TOOLS

The working methods and tools which policy makers and citizens can use to activate processes of social change which are important to improve environmental conditions are necessarily poorly defined and structured. The ability of individuals and organisations to influence society depends on their role and their function within society, on the competencies and opportunities which each subject finds in his/her field of work. The tools which may be used in the social context depend on such elements and are in relation to the ability to use available resources on the part of the various social actors for specific political purposes. The intervention techniques offered by the social sciences are thus considered in more abstract forms than the technologies made available by other scientific disciplines, although this is no reason for them to have less value or capacity for application or implementation in humankind's various living environments. The main intervention tool described here is the network, in its role as an organisational structure of relations in local contexts.

A. The Network as a Tool of Social Transformation

The "network" is here intended as an infrastructural device to activate and develop processes of community change.

Network activity is linked to various aspects of importance for changing community paradigms and elaborating new styles of environmental resource consumption. Social networks are interconnected with *social capital* available in local communities, which can be increased through their use and development. They also tend to promote sharing of activities, objectives, commitment, values and other dimensions essential for the construction of social identities and collective consciousness, bearers of innovative views of relationships between humankind and the environment. N*etworks* organise social systems, providing citizens with opportunities to participate in politics and constitute relational platforms for elaborating experiences and knowledge on the part of individuals and groups, in forms suited to developing greater environmental awareness. These various psycho-social aspects linked to network action help generate widespread environmental responsibility, a fundamental element for changing people's behaviour and their ecological footprint on Earth.

In the urban context, according to community psychology, the setting-up of social networks may be considered a useful measure to promote the quality of life of communities [21] and incentivise the development of behavioural models which are more mature and more suited to environmental sustainability. Thus the use of *social networks via the* internet, of associations of individuals and groups with shared objectives, of coordination structures between organisations to achieve common purposes, social forums, networking contracts among local firms or simple discussion groups on specific issues, are all examples of social and political applications of the network as an intervention tool, also for environmental and sustainable energy purposes.

The broad concept of *network* thus concerns activities involving various separate yet inter-connected elements, components of a recognizable organic system which interact, affecting one another and generating their own network products. Social organisations, virtual networks, urban structures and other architectures may be made to function connectedly by means of numerous technologies and psycho-social relations which may be defined in their *network* activity. The whole process of exchange and contamination of information, knowledge and experience promotes a more elaborate collective consciousness and more inclusive forms of identity, with considerable benefits for the implementation of supportive links within the network itself and the consequent development of social and environmental responsibility. Network structures represent recipients of thoughts and emotions in which, through discourse processes, desires, fears and needs concerning social life may be expressed, in an action of consciousness-raising which redefines the meanings of community and its symbolic boundaries.

Network structures thus harness physical and mental energies, channelling them into the identity systems and necessary competencies for effective, healthy functioning. From this standpoint, the network represents the organisational tool of relationships used to convey the symbolic components of a community, which may thus be partly handled and transformed.

The network process also expresses an action of *lobbying*, organising activities to protect specific interests and applying social and political pressure within a dynamic, vital system. Available energies and resources are thus harnessed according to well-defined rules to achieve certain objectives. In this way the network becomes the platform on which a shared collective commitment is expressed and on which social forces are structured efficiently to serve common purposes, such as that of environmental protection.

Several elements characterising the network can be identified whose promotion is significant for the effectiveness of the policy intervention required:

- Collective identity and sense of belonging to the network
- *Shared and recognizable mission* and aims
- Clear, simple and shared rules of functioning
- Active participation in the structure and its functions
- Shared governance

B. Information Tools and Awareness-Raising Campaigns

Besides network processes, other tools and technical devices may be used by policy makers interested in social change with a view to carrying out interventions to reorganise citizens' lifestyles and consumption.

Various information tools, indeed all communication systems which spread environmental values both cognitively and affectively, may help activate and promote the processes of change desired. Techniques of communication and dissemination thus fall within the tools available for pursuing

the strategies indicated, especially in relation to the possibility of supporting the spread of good behavioural practices and the value models from which they originate.

The circulation of information, the creation of links between symbolic and semiotic contents and the processing of the resulting complex knowledge is thus a further necessary measure on top of the structuring and use of social networks as an intervention tool.

Further elements of the psycho-social processes concerning the relationship between humankind and the environment may be considered in organising social interventions that use communication systems, including those concerning motivations for action, desires and needs perceived by the community and falling within the local collective unconscious. The negative impact of human lives upon nature is generally due not so much to the conscious will to destroy ecosystems as the spasmodic search for security, convenience and enjoyment, in other words satisfaction of people's "needs", needs too often induced by the cultural systems in question. In reality, many of the needs perceived as vital and essential are the product of complex socio-cultural processes whose aim is not to protect nature or safeguard human health. The continuous thrust to respond to such needs often compromises even the possibility of satisfying the real primary needs of individuals and society. However, it is possible to work on this level and change meanings connected to the very needs of a culture or a community also by making smart use of communication systems.

An effective awareness-raising campaign thus exploits the links between behaviour to be promoted and emotive gratification which steers human action in specific reference contexts. Communication should thus focus on the association between behaviour to promote and the cognitive and affective elements concerning the consequent personal and community benefits, such as those of convenience, security, enjoyment, utility, wellbeing, effectiveness and still others that may emerge from the study of specific intervention contexts.

The following are some possible elements to be associated to the behavioural models to be disseminated:

- Individual and collective advantage
- Cost benefits
- Efficiency
- Convenience
- Security
- Enjoyment
- Utility for achieving individual and collective aims
- General wellbeing and needs satisfaction

Emotional involvement in significant experiences concerning behaviour to be promoted allows evolution of a more effective process of change of the subject, consolidation of values and norms aiming to achieve desired objectives, and a broader awareness of the personal possibilities of action in their own environment.

An effective technique of conveying information (at a cognitive level yet which also includes substantial emotive activation) concerns the use of significant models that set in train the behaviour advised [22], and is based on Bandura's [23] theory of social learning, associating the observation of behaviour in relation to changes in individual action. Interventions based on this approach would be defined starting from identification of significant models for the specific context in which the various measures are to be developed and for the target referred to in that moment. The specific aspects of local cultures, historical epochs, the organisational characteristics of the social system considered and numerous other factors (such as the age of the individuals involved, specific interests of a certain social category, the degree of overall awareness of the system, etc.) play a part in defining the significance of the possible models to use.

The use of public figures, cultural representatives, those considered prominent in society may thus contribute to the success of the media following the approach and better integrate the role of information contents of communication with the activation of the emotional and affective involvement of the public user.

C. Communication, Technologies and Ecological Behaviour

A further aspect to consider with respect to the use of communication tools in promoting ecological behaviour concerns the linkage between engineering systems and those for the circulation of information data. The purpose of information transmission concerning energy consumption and environmental impact is, as stated above, to develop a more elaborate ecological conscience. Such information transmission may benefit from the use of innovative tools and technologies to control and monitor environmental systems. Providing people with continuous information on their performance may positively affect the behaviour and consumption of individuals and groups, and various *smart* technologies may be useful in this sense.

Fogg [24] uses the term "persuasive technology" to indicate systems and environments designed on the basis of the change in attitudes and cognitive processes underlying human behaviour. According to this approach, intelligent technologies may influence people through relational mechanisms such as social approval, normative activation or social comparison, giving rise to social reactions just as people do (Reeves & Nass, [25].

According to the *feedback* technique [26] behaviour may be influenced by understanding the connections between certain results (such as energy saving) and behaviour designed to achieve the same results. The frequency and simplicity of feedback increase its effectiveness [27], improving the capacity to manage resources and personal consumption. Constant monitoring of domestic energy flows, for example by using displays and visual signals, has shown greater effectiveness at optimising consumption and changing behaviour compared with other systems which offered less frequent feedback [28]. Monitoring processes highlight the role of understanding the effects of human action on the environment, although the circular nature of behavioural dynamics must always be borne

in mind. Indeed, attention paid to the consequences of behavioural data is required in defining social interventions, just as it should be paid to the environmental stimuli that precede behaviour. An integrated approach which contemplates both the influence of behavioural antecedents (elements that stimulate and promote certain behaviour) and of the expected results (objectives that perform as attractors of the same behavioural processes) is more suited to developing significant and efficient interventions.

D. Smart Use of Technologies and Multidisciplinary Scientific Dialogue

It should be borne in mind that *smart systems* include both "intelligent" instruments and technologies and the "intelligent" use that people make of such instruments. It thus becomes fundamentally important to integrate the human aspect and the technological aspect of innovation processes in any discourse and intervention concerning the development of sustainable societies. The important cultural transition from a system which considers technological progress as primary to one which is more attentive to human and relational concerns may occur through more active dialogue among the various scientific approaches, between the physical sciences and the humanistic and social sciences. From the meeting between the various standpoints there may emerge a new integrated model of using *smart* systems for energy and social efficiency in urban communities. The political world should also take account of this integration need within their own programmes and in their commitment on such issues.

As regards the technologies available to citizens and potentially useful to improve consumption efficiency, their proper use should be promoted through appropriate diffusion and simplified procedures to access the services which they offer. Technological innovation may be integrated with human sociality and with people's lifestyles when it manages to be inclusive and easy to understand and use, being of immediate impact in the daily life of individuals. Through campaigns of communication and thorough dissemination of information on the technological tools available, communities may receive suitable training in the ecological significance of the technical resources at their disposal, developing a potential capacity to use such resources effectively.

VII. Conclusions

This document sought to provide an overview of the possible methods and instruments to promote the environmental competencies of citizens in smart cities, aware of the limitations of any such description. However, consideration of psychological dynamics in an environmental and political context makes it possible to achieve a more efficient, complex view in the processes of community adaptation to new urban "smart" contexts. Our aim was precisely to integrate, at least partially, systems of technological engineering knowledge with socio-psychological systems. Reduction in the distance between technical and humanistic sciences thereby considerably improves the ability to develop effective interventions in the urban context, where physical structures and human relations are constantly interconnected and can never be considered separately.

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