Track: Methods and Technologies for Transformative Planning

A Transdisciplinary Perspective on City Technologies: Touchpoints between Informatics and Urban Disciplines

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Abstract: Current digital technologies are not oriented to support the practices of transformative planning and more in general the management of complex social processes in urban environments. The active engagement of scholars and urban practitioners in defining nature and applications of future city technologies meant to addresses this type of challenges is crucial. However, this path requires to move beyond the disciplinary boundaries and conventional research practices of urban disciplines. Assuming a transdisciplinary perspective is essential to effectively combine the consolidated knowledge on city dynamics and urban transformations developed within urban disciplines with the knowledge and expertise in the design of digital technologies in the domain of Informatics. To contribute in establishing synergies for developing a transdisciplinary research agenda on city technologies, this paper outlines a schema for bridging urban disciplines and informatics, in particular, Urban Planning, Urban Design and Urban Studies on one side, and Computer-Supported Cooperative Work, Human-Computer Interaction Design and Information Systems on the other side. This work maps correspondences and affinities between different fields on both sides, highlighting some essential approaches or concepts in each of them that could benefit from the integration with their counterpart in order to advance our understanding on how to rethink digital technologies for serving social change aims and transformative planning practices.

Keywords: Transdisciplinarity, City technologies, Transformative planning, Social Change

1. Introduction

Nowadays digital technologies applied in cities or to city activities are focused on monitoring urban infrastructures and environmental parameters, elaborating the fluctuations of individual behaviours and social trends from online social networks, and analysing and predicting part of urban phenomena mainly related to traffic issues and energy consumptions. As expected in every other sector of activity, like public administration or enterprise, the practice of urban planning is supposed to benefit from the application of these technologies by improving the capacity of planning departments and professionals to make informed decisions and implement better management of local resources. However, none of these technologies takes into account the essential aspects of transformative urban planning practices such as the negotiation among different stakeholders

involved in urban transformations, the mediation between divergent goals and socio-economic and political instances, the collaborative construction of plans, projects, policies, initiatives for generating local development.

Current urban technologies, intended as technologies looking at the city in its tangible dimension, both physical and functional, are not meant to address the needs associated with the social and political complexity of cities that are only partially reflected by the physical and functional transformations of urban environments. The practical consequence of this state of affairs is that current technologies can provide limited support to the collaboration between urban practitioners and stakeholders engaged at a local level. But at a higher level, this technology gap led to identify a new class of digital technologies, that I am going to call city technologies, that are meant and designed for supporting social change processes in urban regeneration initiatives, co-production of services, and establishment of open governance models for urban resources.

Research on how to design these city technologies presents countless challenges and obstacles. By focusing only on academic milieux, the main challenge is actively engaging scholars and urban practitioners in defining nature and applications of future city technologies at a theoretical and empirical level by undertaking paths beyond the disciplinary boundaries and conventional research practices of urban disciplines. Indeed, while transdisciplinarity is recently gaining popularity in urban research, embracing a transdisciplinary perspective for transferring concepts, theories, and methods consolidated in urban disciplines to new objects, digital technologies and not plans, is not immediate or easy.

This transferring of concepts and methods across disciplines to practically address socially relevant real-world problems (Scholz 2000, Klein 2002 and 2012, Nicolescu 2006, Wickson et al. 2006) requires first to understand logics and approaches of unfamiliar fields and research contexts, and secondly to critically reflect on what disciplinary contributions our discipline can bring to the process. To contribute in establishing synergies for developing a transdisciplinary research agenda on city technologies, this paper outlines a schema for bridging urban disciplines and informatics, by mapping the correspondences and affinities between different fields on both sides, and by highlighting some essential approaches or concepts in each of them that could benefit from the integration with their counterpart.

The remaining of the paper presents the rationale for embracing a transdisciplinary perspective on the design of city technologies (section 2), and then traces the respective contributions of urban and informatics disciplines on this topic (sections 3 and 4) to conclude with their mapping (section 5).

2. Embracing a Transdisciplinarity Perspective

There is a growing consensus on the position that developing information technologies for addressing urban challenges requires a transdisciplinary approach to keep an ecosystemic and ecological vision of issues and specific dynamics of a city environment and accordingly designing the appropriate technological solutions (Foth et al. 2011, Bilandzic et al. 2011, Kukka et al. 2014). On the other side, research domains that traditionally adopted a transdisciplinary approach to deal with issues related to urban ecology models and urban sustainability opened their sphere of interest to information technologies that nowadays are an avoidable component of city life (Black et al. 2005, Buizer et al. 2011, Du Plessis 2011, McPhearson et al. 2016).

Transdisciplinarity (TD) is conventionally considered as complementary to multidisciplinarity and interdisciplinarity (Nicolescu 2002 and 2006, Ramadier 2004, Max-Neef 2005, Darbellay 2015), and specifically oriented to address complex multidimensional problems by serving broader goals across multiple disciplines (Klein 2004, Russell et al. 2008). In this sense, urban problems are the most emblematic examples of wicket problems (Rittel and Webber 1973), and they are the privileged domain of investigation and

experimentation for TD research (Klein 2002, Ramadier 2004). In particular, rethinking existing technologies to better support city processes requires knowledge and expertise on different aspects of the problem and practices related to the use of technology in different urban contexts.

To deal with complexity, Transdisciplinarity is characterized by methodologies oriented toward experimental pluralistic disciplinary fusions. At the same time, Transdisciplinary methodologies and approaches are expected to be responsive to the unpredictable changes and fluctuations of context and problems under analysis (Wickson et al. 2006, Klein et al. 2012). Within this frame, "scientific rigor" is defined as taking into account all existing information to build the arguments and the proposals for addressing a problem (Nicolescu 2002). In this type of explorative processes, Transdisciplinarity become a *"conceptual tool to produce interlanguages"* (Klein 2002) and a *"space for synthesis across, between and beyond disciplines"* (Nicolescu 2002).

In order to outline how holistically approach the research on the design of technologies for cities by adopting a Transdisciplinary perspective, I considered:

- Urban Planning (UP), Urban Design (UD) and Urban Studies (US) because of the stratified, consolidated and applied knowledge about city dynamics and urban transformations

- Information Systems (IS), Computer-Supported Cooperative Work (CSCW) and Human-Computer Interaction Design (HCID) as sub-set of Informatics disciplines characterised by a focus on developing technological solutions embodied into complex social settings.

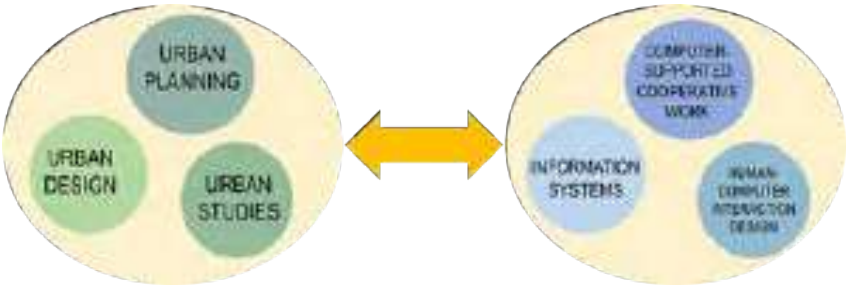

Fig. 1 Diagram of the proposed disciplines to bridge in the research on city technologies

These disciplines have in common the following three essential characteristics:

- **intrinsic permeability**, because all of them are interdisciplinary fields incorporating and transforming external inputs and knowledge from social science, humanities, or engineering

- their **normative nature**, usually expressed by converting theories and empirical findings into normative knowledge for the transformation of the context in which they operate through planning and design interventions.

- their **future-oriented approach to the analysis of current problems** driven by the purpose of understanding how the presents conditions could progress or be innovated.

However, the linguistic differences between the two macro-domains of Informatics and Urban research, and the common misconceptions that experts of one side frequently have about the nature, methods and scope of their counterparts constitutes major obstacles to create a bridge among them for facing the challenges of defining

better technologies for cities. To facilitate the definition of an interlanguages among the selected disciplines and the construction of a common operational space, in the next two sections I am going to highlight the major types of contributions that each discipline can bring to the research and design of city technologies, as well as their complementarity in terms of topics, methods and strategies.

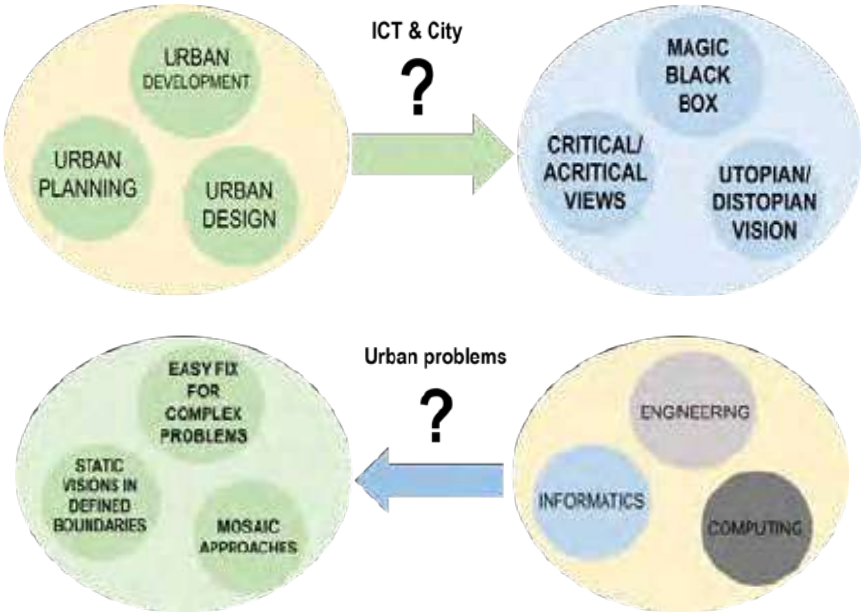

Fig. 2. Illustration of some common misconceptions and positions about urban disciplines and informatics regarding Information Technology and Cities

3. Integrating Urban Disciplines in the Research on City Technologies

The wide macro-domain of research on cities and urban phenomena includes several disciplines, among which many have goals not directly related to the active transformation of the urban context, such as geography, sociology or political science. While their contributions are often essential to clarify important aspects of city dynamics, the approaches and practices of urban planning and urban design (and partially urban studies as well) have substantial affinities and potential application in the research on the design of city technologies. These affinities, in addition to the points highlighted above, can facilitate the construction of a bridge between urban research and research in informatics.

The key type of contributions of these disciplines to the research concerning city technologies come from:

a) the **Approach of Urban Planning** in building shared rules within frameworks of competing goals (economic and social, but also among different stakeholders)

b) the **Design Tactics of Urban Design** to shape public spaces for multiple types of users, activities, systems of values and meanings associated to the "urban interfaces"

c) the **Scope of Urban Studies** to identify the factors determining the local development and build conceptual tools to interpret urban phenomena.

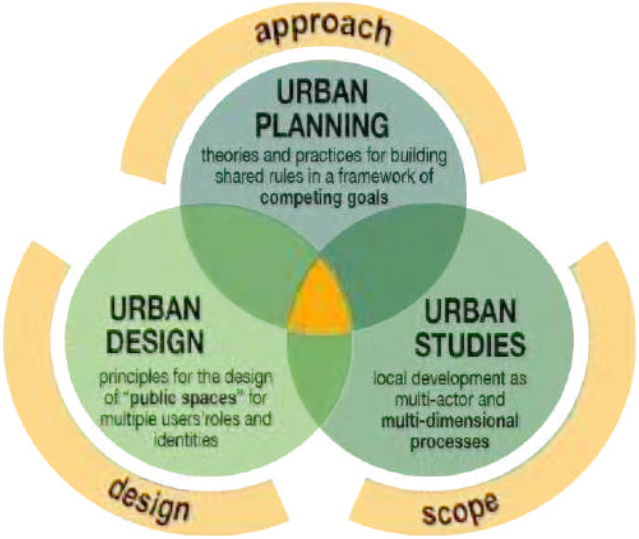

Fig. 3 Schema of the elements extracted from urban disciplines applicable in the research on City Technologies

a) Urban Planning

Urban Planning as academic discipline and professional practice includes both urban planning and city planning traditions, respectively defined as *"design-oriented physical planning"* and *"policy-oriented socioeconomic planning"* (Gleye 2015). Under both perspectives, there is often a convergence of urban planning theories and practices on defining and constructing shared negotiated rules in the public interest, and instantiating these rules in plans or policies to infrastructure future public and private actions for the transformation of a territory considered as built environment complex, economic area or socio-political entity.

While the focus of Urban Planning is on the physical and functional transformation of territories, the modalities to approach the problem of defining shared rules among different stakeholders (public and private players operating in the city) could offer a fundamental contribution in the design of city technologies. Indeed, city technologies cannot simply follows the rules of commercial applications focused on individuals as customers, but requires to be integrated in more complex logics and dynamics shaping the city context. This requires to move the unit of analysis from the individual to upper level social structures (groups, organisations, communities, networks) embedded in a dense net of formal and informal norms regulating their reciprocal interactions and their action in the city.

The need for a shift from the paradigm of the *"user-centred design"* to the *"stakeholder-centred design"* is already indicated as one of the major future challenges for digital technologies (Forlizzi 2018, Forlizzi et al. 2013). To this regards, the lessons learned from the experimentation of collaborative planning practices as well as the insights coming from the critiques to their limits (Innes et al. 1999, Booher et al. 2002, Healey 2003, Brand et al.2007, Innes et al. 2010, Gunder et al. 2018) and the inputs of communicative, pragmatist and phenomenological approaches to planning issues (Friedmann 1987, Forester 1988, Whittemore 2014, Gunder 2010, Gunder et al. 2017) could provide a solid base to build stakeholder-centred design practices looking at the same time at the public interest and at the practical matters of contextual constraints. However, it is important to acknowledge that the *"design dimension of planning"* as defined by Punter and Cardona is one of the most silent and untraced areas of urban research despite its importance, and therefore not necessarily the practice of planning that is grounded on design plans, policies and interventions is adequately conceptualised (Punter & Cardona 1997).

The second important aspect concerning the peculiar way in Urban Planning to approach the construction of shared rules in multi-stakeholder frameworks is the conceptualisation and pragmatic handling of power-related issues (see Schragger 2016). Power and unbalanced forms of power between different social formations in the urban area seems to be an inescapable condition of any city dynamic, both at individual and collective level (Castells 1978). Most of XIX-XX centuries top-down approaches of urban planning tended to favour established forms of power sustained by central and local governments in charge of urban transformations. However, for decades and in particular in the XXI century, the effort of urban thinkers and practitioners start to focus on the way to re-centre and distribute power in civil society acting within and around the net of norms regulating urban life (Friedmann 1987, Miceli 2012, Gunder et al. 2018). In this sense, the radical theories and practices in urban planning such as the *"assemblage theory"* (see Farias 2011 or Gunder et al. 2018 for a detailed account) bring a unique perspective on power relationships: they exist and are not necessarily balanced, but can be actively shaped and reshaped through interventions that enhance the agency of the different actors in the city (De Roo & Hillier 2016). Therefore, the knowledge of power relationships is seen not as an end as common in critical studies, but as a means for action in complex real settings where contingencies profoundly determines whether and how it is possible making plans, projects and policies.

The analytic, pragmatic and strategic approach to power dynamics cultivated in urban planning practices and partially reflected in urban planning theories can be translated also in the analysis and design of Information Technologies. In this new domain, this kind of approach can help designers, researchers, and technology providers in developing a lucid understanding of the consequences of complying, pushing or attempting to disrupt current power dynamics through specific design choices, and by leveraging on the understanding of the current state of affairs to decide the appropriate strategies to pursue these goals. In particular, the approach of urban planning is valuable to frame the design of city technologies as the design of an intangible urban infrastructure based on the social, political and economic reality of cities. Moreover, there is already a fundamental awareness in this discipline that *"Urban planning is all about information"* and that *"Information is power"* [Forester 1988] because determine what we can or cannot understand, transform, negotiate in local actions. This awareness should make easier transferring logics and methods to handle and assess urban information in the domain of Informatics that is literally build around the management of information in digital systems.

What I tried to highlight with the above mentioned arguments is that the contribution of urban planning to the design of city technologies has no reason to be self-referential and focused to understand how to use already existing technologies, or rather limited within the sphere of GIS technologies because of the familiarity with the visual modelling of cities and urban phenomena through maps. On the contrary, it can be extended to rethink the assumptions and systems of technology-mediated relations among people operating in urban environments.

In particular, the inputs of Urban Planning approaches are therefore essential to the research on city technologies in two ways:

- for developing better models of the users of digital technologies in cities and more comprehensive models of urban activities as multi-actor activities

- for structuring transferable strategies to compose different interests and priorities of a variety of city stakeholders intended to be the targets and users of digital technologies in urban environments.

b) Urban Design

Urban Design as complex polymorph and integrative field of design practices for centuries, and more recently established also as academic discipline, concerns primarily the design of the public interfaces of the city by taking into account history, culture, politics, economy of places (Cuthbert 2008 and 2011). On this ground, Urban Design principles are historically aimed at shaping places by reflecting the *"dynamic multiplicity"* of city actors and their needs, perspectives, aspirations (Madanipour 2006), as well as at creating spaces intrinsically opened and able to communicate specific values and identities while leaving the "users" free to use that spaces in multiple ways (see e.g. Carmona 2014, Moughtin 2007, Burton et al. 2006, Sternberg 2000, Trancik 1986).

The importance of transferring urban design principles to inform the design of digital technologies for creating virtual public interfaces supporting people's interactions in cities is already acknowledged and examined by recent works (De Wall 2014, Arango 2018). But what is worth mentioning here is that emerging but influential schools of thought in the design of digital technologies pushes for re-orienting the Research and Design agenda toward principles very much closer to theories and practices typical of Urban Design. For instance, by supporting the value of pluralism in the different views and uses of digital artefacts, by avoiding to flatten users to universal reductive models and considering them as embodied in social and cultural systems, by considering designers as advocacy leaders for groups marginalised in the current practices of technology development, by supporting participatory practices involving the public in setting goals and solutions of technology stratified within an ecology of other technologies already in place (Bardzell 2010).

On this background, the inputs of Urban Design tactics can benefit the research on the city technologies in two ways:

- by helping to model the fluidity of roles and identities of people in the city, and support their agency accordingly to these roles and identities as goal for city technologies

- by hybridizing the design of tangible and virtual public interfaces to make digital environments more consistent with the openness and fluidity of urban systems reflected in city technologies.

c) Urban Studies

Urban Studies is the wide field studying problems, solutions and processes of local development through the analysis of the context in its socio-cultural aspects, focusing on the interactions between people and urban environments, and looking at the organisations of urban systems. Urban studies correspond more to the definition of a common interest across multiple disciplines, than being a domain with defined boundaries, and incorporates the strands of social sciences, political science, urban economics and humanities (Hutchinson 2009) framing local processes as multi-dimensional processes, in which the cultural, economic, social, political components of the context are strictly interdependent and require to be analysed and assessed in an integrated way.

The focus of Urban Studies is mainly theoretical and empirical, instead than applicative as Urban Planning and Urban Design that usually convey the understanding of the context in interventions as plans, projects or policies. As regarding the theoretical contributions, the key inputs of Urban Studies concerns mainly the interpretative frameworks of city dynamics, such as for instance the ASID model (Agency, Structure, Institutions, Discourse model) developed by Moulaert et al. (2016). The value of these models for the design of city technologies rely on the fact that they provide a general schema to build the understanding of local phenomena to be supported by

or through technology, going beyond the observable elements that are the main object of current urban deterministic and predictive models.

As I going to explain below, the study of people and organisational practices in their context is the backbone of disciplines such as Computer-Supported Cooperative Work, but it is relevant also in Information Systems research and in Human-Computer Interaction Design. However, models and analytic framework developed in Urban Studies can extend and deepen the analysis of practices in city context by considering also the structural and representational components of social interactions and consequently their potential transpositions in a virtual shared space. This is particularly important for the development of future digital technologies as *"common artefacts"* accordingly to the definition of Bødker (2015), shared by a multiplicity of actors interacting in a dynamically changing context shaped by a variety of factors and dimensions difficult to analyse and transpose in design solutions (Bødker 2006).

As regarding the empirical contribution of Urban Studies to the design of city technologies, there is also the possibility to build on the critical factors studied in urban transformation projects, city management and social initiatives for orienting the definition of the scope of technology as support to the everyday practices of local stakeholders.

In synthesis, the inputs of Urban Studies in the research about the design of city technologies could support:

- Analysing the landscape of existing technologies under the light of the applicative scenarios in different urban settings
- Modelling the specific role of new technologies in these settings
- Connecting the contingent observations referred to specific technologies in specific contexts to higher-level schema and dynamics, helping to reason on the invariants and contingent uses of technologies in cities.

Within and across the disciplines of Urban Planning, Urban Design and Urban Studies (beyond the theoretical and methodological inputs mentioned before), there are also specific thematic clusters such as the research on Smart Cities, Urban Governance, and Sustainability that are relevant for defining nature and function of city technologies.

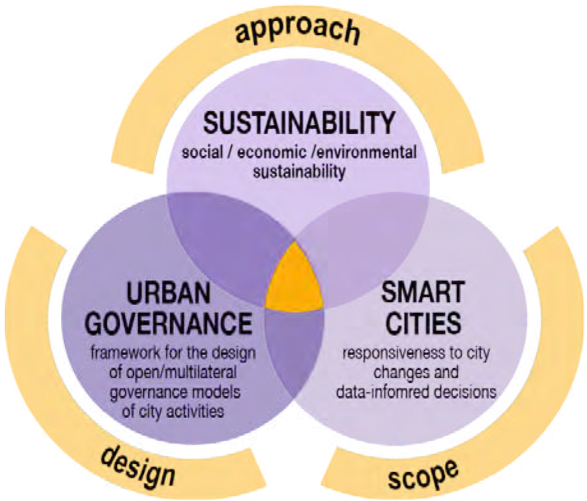

Fig. 4 Schema of the elements extracted from the thematic clusters on governance models, ICT and sustainability issues.

4. Combining the Understanding of Cities and Technologies in Informatics

Computer Science and Informatics are two denomination often confused, or used as synonyms or simply preferred to indicate both accordingly to different traditions in Europe and USA. Nevertheless, they cover different domains related to the study, design and development of information technologies. Computer Science addresses the mathematical modelling of information and operative flows, concerning the internal features, structures, and behaviors of computer systems. Informatics addresses at the same time the technology and its context, focusing on technology design, information system development, human-computer interaction and management of technology in different operative environments (an extensive introduction on the different use of Computer Science and Informatics can be found in Smutny 2016). In addition, there is a third segment of disciplines dealing with information technologies that is Engineering, covering the study and development of software, hardware and infrastructural components of information systems. Lastly, there are also disciplines such as Socio-Technological Studies (STS) focused on studying technologies in their context, but centred on the social components of this interactions instead than on the design of new technologies. In this work, I limit the discussion to a subset of disciplines in Informatics including IS, CSCW and HCID.

Moving from Urban disciplines to Informatics, the research interest in cities is related to the revolution of the computers moving from working environments to everyday life activities as prefigured almost three decades ago (Grudin 1990). Indeed, the Grudin's expression *"the computers reach out"* refers to the fact that digital technologies started since 80's to deal not anymore only with tasks to be accomplished through the use of specific hardware and software solutions, but with the challenges of social progress supported by information technologies. Nowadays, Urban Informatics (Foth & Choi 2011) and Urban Computing (Zheng et al. 2014) are emerging as domains studying urban contexts through/with/for technology.

As highlighted in previous work (Lupi & Antonini 2019), Urban informatics, has the broader scope of rethinking the urban experience through the support or mediation of technology. Differently from Urban Computing, it is based on studying the context to define new potential solutions and intervene to sustain technology-driven changes. While the terms Urban Computing and Urban Informatics are often used interchangeably or as synonyms[1], there are fundamental differences in their goals and orientations, as well as on the technological solutions developed relying on them. Indeed, Urban Computing, like every other sub-domain of computing disciplines, is primarily aimed to extract, organise, elaborate data related to the urban fabric or produced within systems acting as a proxy for urban social dynamics such as online social networks (Zheng et al. 2014). The means to achieve these goals rely on computational methods based on the definition of appropriate algorithms to operationalise and make more efficient or effective the data elaboration for specific purposes and applications. On the contrary, in Urban Informatics, the approach to the development of technological solutions for cities is based on framing the problem to be addressed as a socio-technical problem based on the three pillars of places, people, and technology (Foth 2008) and deeply relies on participatory practices and critical explorations of technology in urban contexts. For these reasons, a solid bridge between urban disciplines and Informatics can find its founding stone in Urban informatics, more easily than in Urban Computing.

[1] Michael Batty, one of the main champions of the "Urban Science" as a new discipline combining data science and urban modelling, is actively involved in the research on "computational planning" and uses the expression "Urban Informatics" to actually indicate "Urban Computing". The same use of the expression "Urban Informatics" is conventionally adopted by most of the scholars in urban disciplines working on Planning Support Systems and Geographical Information Systems.

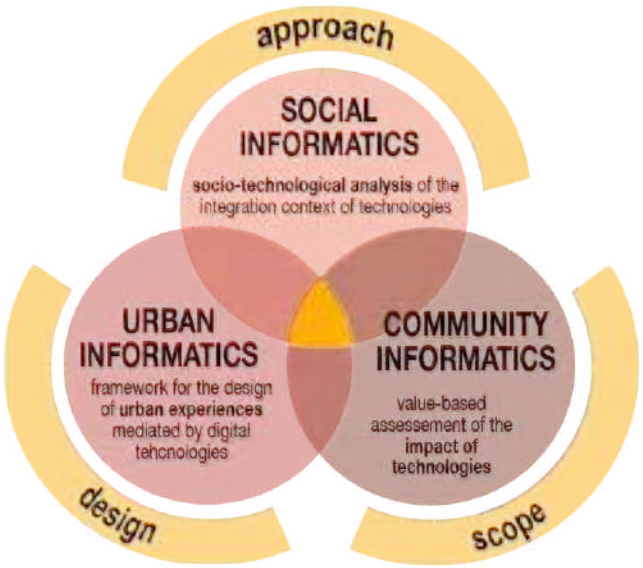

Fig. 5 Schema of the elements extracted from the informatics thematic clusters applied in the present research.

In the design and research on city technologies, it is essential to consider also the perspectives of Community Informatics and Social Informatics[2]. They respectively focus on linking the use of technologies to local development opportunities (Gurnstein 2007) and exploring the issues deriving from the design, implementation and use of technologies (in particular web-based technologies) within specific organisational and social contexts (Kling 2000, 2007, Kling et al. 2005, Sawyer 2005, Sawyer & Eschenfelder 2002).

Urban, Community and Social Informatics provide therefore complementary lenses on technologies in city context (Fig. 5). Urban informatics offers a methodological framework for the design of urban experiences mediated by digital technologies (Bilanzic et al. 2011). Social Informatics provides the theoretical foundation for the analysis of the context in which technologies are integrated, rooted on a systemic visions of roles and relationships within social systems (Kling et al. 2005). Community Informatics set the background for the definition of the scope of city technologies in reference to people empowerment, social change and impact of technology on everyday life (Gurnstein 2007).

By looking at the intersection between Urban, Community, and Social Informatics, CSCW, IS, and HCID had been considered in particular reference to :

d) the **Approach of CSCW research** for understanding nature and practices of cooperative activities supported or potentially supported by digital technologies

e) the **Design orientation of HCID** (as branch of HCI) for clearly connecting people's needs to specific choices to consciously design the interactions between users and technologies in their context of use

f) the **Scope of IS** of connecting human processes and information through the development of knowledge systems (Fig. 6).

[2] Urban, Community, and Social Informatics are not disciplines but thematic clusters uniting researchers working on similar topics, but using different theories and methods, similarly to sustainability or urban governance studies. For instance, see Sawyer & Eschenfelder 2002 about the nature of Social Informatics.

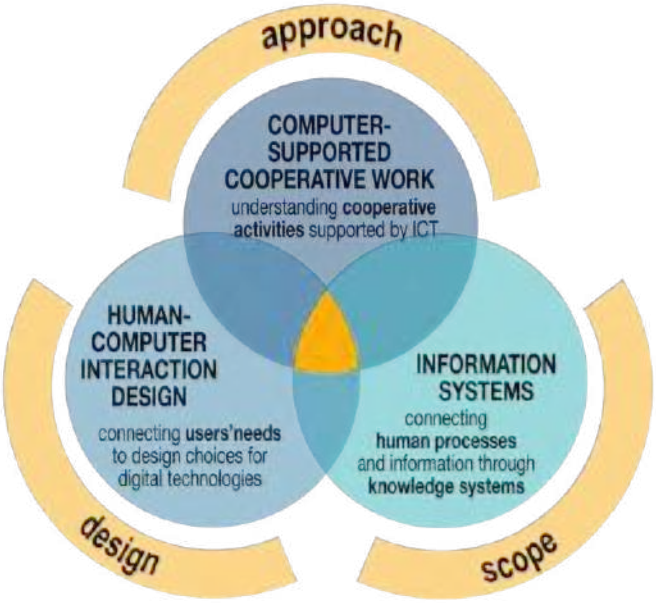

Fig. 6 Schema of the elements extracted from system design disciplines applied in the present research

d) Computer-Supported Cooperative Work

CSCW is the discipline studying how information technologies can support collaborative activities (Castersen & Schmidt 1999). The specific term *"cooperative work"* has been chosen to indicate that the object of interest are not only the activities of groups (sharing the same goals), organisations (sharing protocols) or a collectivity (sharing responsibilities), but more in general the activities performed by "multiple persons working together to produce a product or a service" (Bannon & Schmidt 1989), in the same space or distributed, in synchronous or asynchronous ways (Penichet et al. 2007), and driven by a plurality of goals, norms, value systems, contingencies.

The essential contribution of the consolidate knowledge on cooperative activities and systems in CSCW for urban technologies had been already acknowledged by scholars working on the use of technologies for planning purposes (Silva 2010) or on the construction of geographical information systems (Laurini 2014). Indeed, even though urban disciplines have the potential to unfold the physical and functional correlations of city activities, deeply understanding the "mechanics" of social interactions, as well as their translation in appropriate tools for making people collaborating through technologies, requires to rely on external disciplines having a compatible focus (practices) and orientation (openness to multi-dimensionality of the observed phenomena and problems).

Since its foundation in the '80s, the primary area of CSCW research has been the working environments (organisational and inter-organisational) and not urban settings. However, in recent years, a growing engagement with topics and studies outside common work contexts led CSCW community to deeply investigate location-based systems and how their uses, impacts and solutions are associated with the spaces and places (in urban settings or in the public sphere more in general) in which cooperative activities are performed (see e.g. Ciolfi & Bannon 2005, Dourish 2006). This strand of research provides the basis to already extend the concepts elaborated by studying working environments to new applicative scenarios defined by city stakeholders relationships and related activities in urban dynamics. Building upon that, the key concepts and analytic frameworks developed in the CSCW discipline can inform the research and design of city technologies regarding:

- the development of tools conceived as a *"common information spaces"* (Bannon & Bødker 1997) shared by a plurality of actors implementing their activities in the shared space constituted by the city

- the analysis of the applicative scenarios of city technologies for the appropriate support to local coordinative, cooperative and collaborative practices

e) Human-Computer Interaction Design

Human-Computer Interaction Design is the field at the intersection between Human-Computer Interaction (HCI) and Interaction Design. HCI is the discipline studying the interactions between human and technological systems relying on cognitive science, human factor engineering (a field including psychology, sociology, etc.) and computer science (intended as both computing and informatics) (Dix 2009). Interaction Design is the wide field of the *"design of interactive product to support people communicate and interact in their everyday and working lives"* (Preece et al. 2015). HCID[3] originates from the convergence of the two fields grounded on scientific (and humanistic) knowledge on one side, and design methods and practices on the other side, combined around shaping of experiences mediated or supported by technologies (Fallman 2003, Forlizzi et al. 2008).

Differently form CSCW or IS, the primary focus of HCI (and HCID) research are users as individuals (and not groups or organisations), assumed as voluntarily interacting with technologies. This particular focus has severe limitations to address the study and design of technologies to support city stakeholders in their actions. Indeed, as well-known in urban disciplines every type of social and practical interaction in the city (technology-mediated or not) is always overdetermined, and not voluntary, if not in part. On the other side, the HCI field is theoretically and methodologically equipped to analyse and conceptualize the experiences associated with these interactions in urban context and intentionally shaping integrative technology-mediated experiences. The inputs coming from HCID can be combined in the research on city technologies for:

- Integrating the models of the City reflected in these technologies, by taking into account an experiential perspective for the description of urban systems and activities

- Combining the design and research explorations across real-world experimentations, by isolating what is specific of interactions in urban settings respect to other settings

- Connecting Users, City as context and the role of technology in an organic interactional model.

f) Information Systems

Information Systems is the discipline examining technological systems and social systems and the phenomena emerging from the reciprocal influences between these two systems (Lee 2001) for *"the effective design, delivery, use and impact of information and communication technologies in organizations and society"* (Avison & Fitzgerald 2003). One of the most prominent concerns of Information Systems research is how can we design better information systems to help organisations and society to work better from a strategic, economic, management, and social point of view (Avison & Elliot 2006, Baden 2010). Thus, Information Systems is a

[3] See the schema of the convergence between Hci and Design at: https://hcid.sice.indiana.edu/

design-oriented disciplines having the purpose of structuring the knowledge incorporated in the operational context of technology and in the processes to be supported by technology. Similarly to the use of the context analysis in urban planning or urban design for making plans, projects, and policies, the context analysis is used in Information Systems for designing knowledge structure and architecture of digital technologies.

Under this perspective, it is easy to understand why the earlier conceptualizations and models about smart cities and smart city technologies had been elaborated primarily in the field of IS, and not in urban disciplines (e.g. Nam & Pardo 2011, Chourabi et al. 2012). Indeed, the relationships between technology and the city framed in relation to national and local governmental structures or businesses is an important strand of research in IS. However, the hybridization with urban disciplines for generating an open model of the city not only as a corporate/government entity could potentially help also in building also better information systems to support urban activities.

The inputs of Information Systems research for city technologies can:

- Rely on the extensive corpus of frameworks, theories, conceptual tools developed in IS for dealing with design and research problems concerning a wide range of technologies, by assuming a context-sensitive perspective

- Build upon the existing frameworks for the assessment of technologies to examine the specificities of the processes, activities, organisational and inter-organisational interactions in urban context and, then developing specific assessment protocols for city technologies.

5. Concluding notes

The previous sections outlined a general schema for bridging urban disciplines and informatics, in particular, Urban Planning, Urban Design and Urban Studies on one side, and Computer-Supported Cooperative Work, Human-Computer Interaction Design and Information Systems on the other side (See Fig. 7). Their hybridization is essential for designing new technologies to address more effectively contemporary city challenges, to sustain social innovation processes at the local level, and to enable new distributed and collaborative governance models for city services and resources. Indeed, while a common approach in urban research is investigating how to apply already existing technologies to planning practices and urban initiatives, this is not enough for pursuing transformative planning aims by exploiting the potentialities of digital technologies because the appropriate solutions are not there yet. Transdisciplinarity as approach and research framework can provide the foundations to enhance the generative and future-oriented nature of consolidated knowledge on cities of urban disciplines in new domains for defining the scope, role and applications of appropriate city technologies.

The contribution of the paper is two-fold. At a methodological level, it exemplifies the adoption of a transdisciplinary perspective to bridge distinct knowledge domains by focusing on high-level similarities and complementarities in theories and research practices having a concrete problem in mind, that in this case is understanding how to rethink digital technologies for serving social change aims and transformative planning practices. At a practical level, the synthetic presentation and discussion of disciplinary fields that are often unfamiliar to urban researchers and practitioners indicate some possible entry-points to approach their theories and methods and experiment their application in urban research. On the other side, the paper highlighted how the importance of urban disciplines for developing new theoretical foundations for city technologies do not rely on the technical and procedural knowledge usually associated with planning activities, but on valuable skills and understanding of social dynamics in urban environments. A transdisciplinary research agenda on city

technologies can be developed starting from a shared awareness of the contributions of each discipline across different domains.

Future works will formalize the transdisciplinary research framework built on the disciplinary roots selected and discussed in this paper, and will report on the application of this framework in past and on-going projects finalized at the development of city technologies.

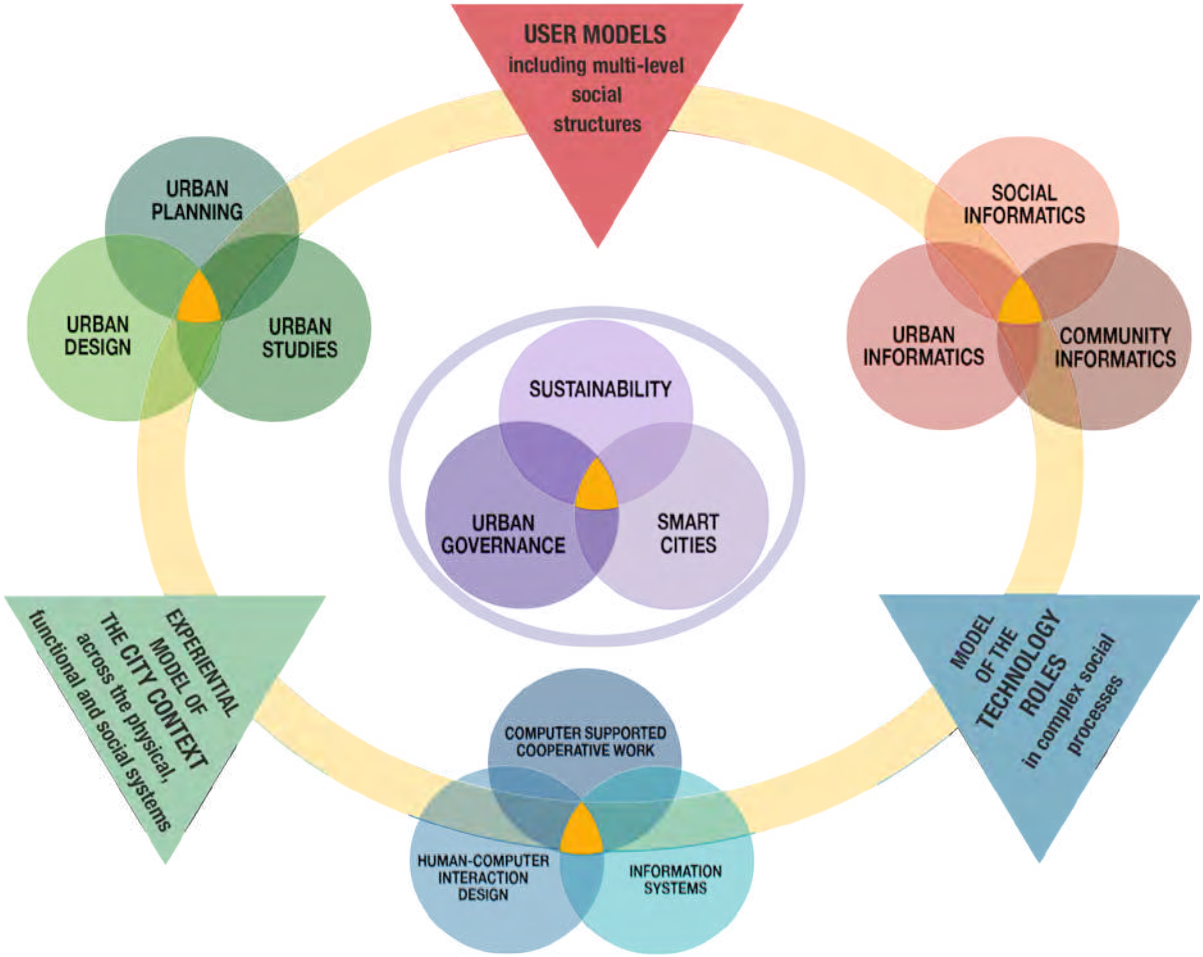

Fig. 7 Schema of the transdisciplinary integration of the disciplines and thematic clusters presented in this work

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