



Spaces of knowing. Examining the role of knowledge - and technology - intensive services of development and transformation of building types

Aida Murtić

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Aida Murtić

Master's Thesis

Spaces of knowing

Examining the role of knowledge- and technology-intensive services in development and transformation of building types

Notice analytique
Projet de fin d'etudes

NOM ET PRENOM DE L'AUTEUR: Aida Murtić

TITRE DU PROJET DE FIN D'ETUDES : Les espaces de production du savoir:
Le rôle des services de haute technologie et à haut niveau de savoir dans la développement et la transformation des typologies architecturales

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RESUME

Partant de l'hypothèse que facteurs de production sont manifesté dans l'espace, le projet examine le rôle des services de haute technologie et à haut niveau de savoir dans la développement et la transformation des typologies architecturales.

Étant donné l'accent mis sur le concept de spatialité et de localisation des activités économiques, le projet propose d'étudier deux pôles de connaissances et d'entrepreneuriat (l'écosystème de l'innovation NUMA, Paris et le programme de recherche HOLM, Frankfurt).

Les méthodes d'analyse exploratoire et la discussion théorique permettent d'identifier les attributs urbaines et architecturales.

Par conséquent, les typologies architecturales sont élaborée comme les typologies qui ne sont pas construit en utilisant la logique géométrique de construction et de déconstruction, mais qui sont assemblé d'actants hétérogènes (personne, objet ou organisation).

Les typologies architecturales récentes et émergentes sont en même temps le moyen et le résultat des interactions organisées.

Confirmation of authorship

I certify and that this is my own work and that the materials have not been published before, or presented at any other module, or programme. The materials contained in this thesis are my own work, not a “duplicate” from others’. Where the knowledge, ideas and words of others have been drawn upon, whether published or unpublished, due acknowledgements have been given. I understand that the normal consequence of cheating in any element of an examination or assessment, if proven, is that the thesis may be assessed as failed.

Grenoble, 20th August 2015

Aida Murtić

Abstract

Starting from the assumption that relations of production occur in space, the paper sets out the goal to investigate the role of knowledge- and technology-intensive services, with their particular requirements and practices, in development and transformation of building types.

Given the focus on spatiality of today's economic activity, the paper examines the account of two small-scale metropolitan-based knowledge clusters (entrepreneurship lab NUMA in Paris and research platform HOLM in Frankfurt) as shared spaces for emerging entrepreneurial relationships. The exploratory analysis is followed by the theoretical development that identifies set of relevant urban and architectural properties.

Research results provide understanding of the building type that is not built using the conventional logic of constructing and deconstructing, but it is assembled of heterogeneous networks of people and practices and that is both the medium and the outcome of the interactions it organises.

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Introduction

"Because they are easily visualized, spatial changes can represent and structure orientations to society. Space stimulates both memory and desire; it indicates categories and relations between them."

(Zukin, 1991: 268)

"One of the most disorientating aspects of recent architecture is that some of its spatial and formal inventions are not nameable."

(Markus, 1993: 12)

We live in the world of intense changes and encounters. As societies are undergoing techno-economic transformations, urban life emerges as a complex process organized in a tension between different scales of interaction, ranging from human body to global networks. The dynamic moment we are confronted with brings to light new conceptual vocabularies and new ways of seeing the field of urban studies. Still, spatial realities of the built environment, constituting much of the human cognitive and visual experience, remain constrained by ways of thinking anchored in the object-centred representations. As King (2010: 23) highlights "we now have theorizing about a global social world yet without any reference to the social agency, social function and social meaning of the built environment in constructing and maintaining that social world". In order to make sense of contemporary urban developments, it is necessary to revise the evolving relationships between the physical space, social activities and techno-economic paradigm.

Two questions provide the occasion for this paper. In the first place, the paper questions the relationship between techno-economic transformations on the one side and spatial

transformations on the other. More precisely, the paper investigates what role do knowledge- and technology-intensive services, with their particular requirements and practices, play in development and transformation of building types?

The starting assumption here is that relations of production occur in space. Unlike in the economic models of previous generations (e.g. agrarian, manufacturing, industrial) the scale and shape of the influence of the *new economy* does not reveal itself in plain sight. Accordingly, the paper aims to establish the conceptual link between changing logic of the production activity and the formal quality of the environment shaped through and for the production activities. Such approach enables assessing to what extent are knowledge- and technology-based activities place-bound and what role do they play in the present-day urban transformations. The approach also includes going towards “the staging of uncertainty... irrigation of territories with potential... and discovering unnameable hybrids” (Koolhaas in Graham & Marvin, 2001: 413) as well as exploring “hidden geographies” (Latour, 2005: 15) of contradictions and coherences that divide and gather humans and non-humans, objects and processes.

To provide the foundation for this paper, it is necessary to highlight the key considerations which underpin the work discussed here. What we consider as the transformation and the transition within the production model today is radically different from the shifting conditions that influenced shaping the cities during the industrial revolution or the creative momentum that urbanism gained with the Renaissance. We are witnessing huge, disruptive changes in the means of production, nature of demand and character of final product. From digital printing to crowd-sourcing funding models, ideas and attitudes about *what* could be produced and *in what way* change at an incredible pace. Time, space and physical nature of objects as fundamental dimensions of human experience are transformed with the advent of digital technologies and world of information. Increased mobility of people and information leads us to question usual notions of spatiality as much of the activities shift from classically assigned single-purpose spaces to integrative spaces.

To state the obvious - consolidating the framework of contemporary techno-social and socio-spatial causality remains the task beyond the scope of this work. The paper is

exploratory in its nature and sets out the goal to acquire new insight into the observed phenomenon and indicate the directions for further research and discussions. It attempts to approach the study of knowledge-based economy from a perspective which is different to the one which dominates the academic field. It is concerned equally with the question of *what* constitutes the new economy and with the one of *where* the knowledge-economy is manifested. It deals simultaneously with the processes and the objects and investigates *how* techno-economic transformations influence the nature of architectural programs, generative forms and structures and profile of users as they begin to merge into hybrid structures. Fundamental to this exploratory dialogue is the appreciation of the different scales of research. The paper tackles the scale of the global production space as well as relative small scale of the building type in its pursuit to examine the practical reality of the theoretical concept.

The position developed in this paper is driven by the idea of developing a conceptualization of contemporary building types that are not built using the logic of constructing and reconstructing, but that are assembled of heterogeneous networks of people and practices. These types are still in a process of urban becoming, able to generate variations.

The work is organized as follows. First, it formulates the theoretical framework for understanding the techno-economic developments and urban processes as strongly interrelated. Second, it introduces two case studies, small-scale metropolitan-based knowledge clusters, as emergent environments that reflect the condition of the new production space. It then moves on to elaborate reference points which have arisen from the research work that includes ethnographic fieldwork and methods of visual research and space-syntax analysis. Finally, the paper concludes by drawing out properties that describe building type as an open system that is both the medium and the outcome of interactions it organises.

Research setting

2.1. Techno-economic transformations and development of building types

For the purpose of this paper, Guggenheim's and Söderström's (2010: 4) definition of “type” is adopted, implying that the type emerges when “a form crystalizes to accommodate specific social practices”. Grubbauer (2014: 340) argues that the notion of building type is essential for the discussion of the role of architecture within the present-day socio-economic context. The author argues that while the importance of style in the contemporary architecture is fading, the relevance of building type is emerging as a crucial guideline for visual interpretation of urban space. Additionally, abandoning the discourse of style in the modern architecture enables taking advantage of “the specific achievements of that same modernity: the innovations offered it by present-day science and technology” (Solà-Morales & Whiting, 1999: 117). Furthermore, the notion of type is always an abstraction that does not “link buildings to their site or place of origin, but to other, usually social and functional classifications, devoid of local references” (Guggenheim & Söderström, 2010: 5). That is to say, that by dealing with building type, it is possible to go beyond understanding of architecture as a static object and to acknowledge its status within the broader system of socio-technological meanings.

New forms of knowledge and ways to incorporate them into society have been continually transforming the urban condition (Schneekloth, 2010: 236). In Schumpeter's account (in Scott, 2006: 3) technological shifts and innovation processes can be understood as “creative destruction”, i.e. “periodic abandonment of equipment, production methods, and product designs in favour of newer and more economically performative assets”. Readjustments made to the environment and institutions have been sometimes of “cataclysmic proportions” (Scott, 2006: 3), as when steam replaced water-power in the nineteenth century; more often readjustments have been done incrementally. Although innovations are accompanied by their “own malady, a sense of displacement”, the tendency of new technologies “to overlay, and subtly combine with (rather than replace) earlier ones” should not be forgotten (Graham, 2004: 10). Revolutions are rare, but continuous innovation opens up new “trajectories” and allow institutions to evolve with technology (Dosi in Pratt, 1997: 122).

Throughout history, transition from one mode of production to another, in line with technological and institutional shifts, has been accompanied by significant changes in the urban environment and proliferation of building types that had a purpose to accommodate new social practices. At the urban scale it is possible to illustrate the link between technological styles and urban forms. At the scale of building type, it is possible to indicate the way new specialized, purpose-built structures were created and existing fabrics were transformed as new needs and responsibilities emerged. Therefore, “urban innovation” (Hommels, 2005: 328) can be understood as a mode of sociotechnical change where the technological shaping of society is as important driving force as social shaping of technology.

Markus (1993: xix) provides evidences about “typological explosion” from the time of “Revolutions” (1750-1850) indicating the way towns and buildings had undergone their transformation in line with societal reconfiguring. Cities of that time for the first time hosted new industrial buildings, railway stations, town halls, baths and wash houses, libraries, museums, civic universities, schools, prisons, hospitals etc. Buildings did not only house new

social practices and technological processes, but they were products of new technologies and new models of financing.

Having in mind that the current proliferation of building types has been scarcely theorized among scholars and practitioners, the commercial high-rise office tower remains the isolated reference point and the exhaustively used example of the new building type within which several aspects (form, use and meaning) cohere: it is a structure made of glass and steel, used as office and carrying imagination of corporate/economic power (Schneekloth, 2010: 234). Grubbauer (2010: 64) elaborates that the development of office-towers has been fuelled by number of factors such as: the growth of the service sector, technological change and shift towards entrepreneurial urban politics.

Kelbaugh (2007: 94) suggests that new types are about to appear in order to accommodate and express new conditions, sensibilities and purposes in the same way “the gas station, the motel, the airport terminal, the live-work loft, the storage rental building, and the retractable roof stadium” emerged during the last century.

Building types that are in the focus of interest of this work appear as the result of the restructuring of urban forms, lifestyles and landscapes induced by information and communication technologies as “‘heartland’ technologies of contemporary economic, technological and cultural change” (Graham & Marvin, 2001: 14). After drawing parallels with the urban conditions throughout history, Markus (1993: xx) suggests that today “asymmetries of power hinge not on steam power but on systems for handling information” and rely greatly on those who design systems, e.g. entrepreneurs and engineers.

Indeed, the form that buildings take and the way they perform their functions are influenced by underlying dynamic of the knowledge- and technology-intensive services. It is to be expected that the further evolution of building types will include the “fragmentation and recombination of familiar building types and urban patterns” as well as emergence of completely new compounds (Mitchell, 2000: 3). That is the reason why the present-day research standpoint in urban and technology studies should simultaneously enable retrospection as a process of glancing backwards as well as prospection that would include a goal-setting evaluation of possible future scenarios.

2.2. Contemporary mode of production

As a first step in conceptualizing the current mode of production, it is important to define the terms and the constituents of the new post-industrial economy.

Notwithstanding that the contemporary economic activity is increasingly dominated by so-called knowledge-based activities, labelling it as *knowledge economy* appears problematic as it in a certain way suggests the absence of knowledge in the economies of previous generations. For the purpose of this paper, *knowledge* is understood as “the product of ongoing adjustment to maintain the continuity of activity” (Amin & Cohendet, 2004: 63). Detailed discussion about the rhetorical meaning of knowledge is not an imperative for the further advancement of the argument presented here.

The importance of knowledge as “the central source for the creation of (surplus) value” (Bell in Helbrecht, 2004: 191) was identified in 1970s, but no commonly accepted definition of knowledge economy has been elaborated so far. World Bank (2007: 23) defines it as the economy in which knowledge is “acquired, created, disseminated, and applied to enhance economic development”. Powell and Snellman (2004: 201) underline that in the knowledge economy the reliance on intellectual capabilities is greater than the reliance on physical inputs or natural resources. This paper adopts the definition by Lüthi (in Conventz & Thierstein, 2015: 135) due to the accent that is given to the relational character of the knowledge economy. Lüthi defines knowledge economy as “that part of the economy in which highly specialized knowledge and skills are strategically combined from different part of the value chain in order to create innovations and to sustain competitive advantage”. In the account of Thierstein et al. (in Conventz & Thierstein, 2015: 136) knowledge economy is based on three pillars: advanced producer service (APS), high-tech industries and knowledge-creating institutions such as universities and research establishments.

While acknowledging the dynamics of the present-day economy, this paper highlights the decisive importance that technology and science have for it. The growing application of information and communication technologies (ICTs) brings closer terms and concepts of economy and technology. Use of ICTs and particularly, the rise of the internet as a

communication tool have generated great changes in the geography of business and organisation of work. It has been rapidly influencing all aspects of life including education, transport, entertainment and lifestyle more generally.

For this reason, the knowledge economy is sometimes associated with advances in technology and equated with the *digital economy* (Malecki & Moriset, 2008). Again, there is no single definition of what actually constitutes digital economy, but a set of open and broad understandings are available. According to OECD (2012: 5) “the digital economy is comprised of markets based on digital technologies that facilitate the trade of goods and services through e-commerce”. As information and communication technologies support industries in all sectors, digital economy is not linked with specific sector or described as separate part of the mainstream economy (European Commission, 2014; Tranos & Nijkamp, 2014). Instead, it is omnipresent and has a capacity to transform other industries and activities in terms of productivity and connectivity, (European Commission, 2014: 3).

Use of ICTs is seen as generator of economic opportunities to post-industrial countries, as well as to the developing countries that had different development trajectories and socio-political histories. European Commission sees it as “the single most important driver of innovation, competitiveness and growth” (European Commission, 2015b). The United Nations (in Madanipour, 2011: 90) believes that ICTs “have the potential to assist developing countries 'leap frog' entire stages of development”.

Furthermore, it is worth highlighting that the contemporary production culture acknowledges and, in a way, appropriates the “symbolic and material importance of science” (Castells & Hall in Anttiroiko, 2004: 16). The dynamic of the new economy puts the challenge in front of the science, research and innovation requiring not only generation of the knowledge but also its practical application. Consequently, knowledge economy qualitatively transforms the organization of science towards “more application-focused collaborative research” (Benneworth & Charles, 2004: 2). Resultant patterns appear in the form of “strategic links between firms and other organisations as a way to acquire specialized knowledge from different part of value chain” (Lüthi in Conventz & Thierstein, 2015: 136). Growing interest in understanding the mechanisms which bridge the gap between science inputs and financial outputs brings together wide range of stakeholders such as universities,

governments, high-technology businesses, individuals, creative communities etc. Hence the term *entrepreneurial ecosystem* gains the great importance in describing the network of stakeholders and activities that are the key constituents of the contemporary production culture. OECD (2013) defines entrepreneurial ecosystem as “a set of interconnected entrepreneurial actors (both potential and existing), organisations (e.g. firms, venture capitalists, business angels and banks), institutions (universities, public sector agencies and financial bodies), and processes (...) which formally and informally coalesce to connect, mediate, and govern the performance within the local entrepreneurial environment”.

The term knowledge economy is highly contested once the knowledge as an economic asset is observed within a particular context. Much uncertainty still exists about the question whether the term describes the actual condition of specific places, especially post-industrial capitalist countries or a future to which economies generally aspire (Madanipour, 2011: 7). Nevertheless, the terms knowledge economy, digital economy and entrepreneurial ecosystem are used by international organisations, national governments and local authorities to mobilize forces and advocate wide range of actions.

Finally, as a way to conceptualize the transition from one mode of production to another, this paper adopts the concept of *techno-economic paradigm* (Perez, 2009: 13). Paradigm evolves as the new technologies are not just in use but their impact is multiplied across the economy, entailing “reorganization, reskilling and re-tooling of production processes” (Dosi in Pratt, 1997: 123) and eventually modifying the socio-institutional structures. Paradigm opens the arena for examining the interaction between the adoption of new technologies on the one side and its spatial expressions on the other.

This work attempts to avoid the technological determinism that puts technology in the centre of consideration disregarding the complexity of factors that also influence social forms and processes. Technology itself is not viewed as a single agent of urban change, nor is urban change viewed as linear process. As it was stated in the introduction, it is not only the content of the technology that has changed with the dispersion of digital tools, but also its definition, perception and general understanding of the scope of uses.

Therefore techno-economic paradigm is an entry point that calls for analysing to what extent techno-economic shift supports the diffusion of new social dynamism and its spatial articulation.

3

Literature review

After setting out the goal to construct dialogic relations between societies, techno-economic transformations and built environment, separate clusters of literature needed to be revised. The paper used concepts mainly from work in the social theory, sociology of science, economic geography, cultural studies and architectural theory.

Such approach enabled framing the objective, establishing the concept and consolidating theoretical definitions relevant for the paper. Moreover, it was an attempt to avoid “the inertia of disciplinary and subdisciplinary boundaries” (Graham & Marvin, 2001: 17) that could hinder understanding of certain subjects. At the same time, this approach reflected what Soja (2000: xii) qualified as the character of the present-day field of urban studies that is “so robust, so expansive in the number of subject areas and scholarly disciplines... so permeated by new ideas and approaches... and so theoretically and methodologically unsettled”.

Besides academic texts, the paper evaluated multiple online resources including magazines, newspapers, texts and video materials. The work attempted to get an insight into discourses

established by practitioners in specific fields as well as commercial and activists' points of view built up for the purpose of promoting an idea or a product (Figure 3, pp. 24).

This chapter attempts to provide an overview of the relevant understandings in several academic disciplines. Furthermore, it aims to identify strands of literature that are relevant for this paper and, where possible, find a common thread between fields and disciplines, opening avenues for new critical reflections.

It is worth noting that ever since post-industrial hypothesis entered the conceptual arena and ICTs greatly revolutionized communication, functioning of business and more generally lifestyles, policy makers struggle to put in place appropriate policy responses while scientists struggle to develop tools and datasets that can address these issues (European Commission, 2015a). It is the ongoing challenge, especially for the urban and architectural theory, to find the way to describe, classify if necessary, and explain attributes of the built environment in the conceptual field "characterized by its instability and mobility; by its flexibility and propensity to change" (Graafland & Sohn in Crysler, et al., 2012: 470)

3.1. Social theory: Society, technology, built environment

The starting point for understanding techno-economic shift from an urban perspective is the work of Manuel Castells (2001; 2010a; 2010b) underlying social and economic dynamics of what he calls "Information age".

Castells draws the profile of the "space of flow" as a new spatial form that dominates and shapes society. He defines it as "the material organization of time-sharing social practices that work through flows" (Castells, 2010a: 442). Accordingly, flows are understood as "purposeful, repetitive, programmable sequences of exchange and interaction between physically disjointed positions held by social actors in the economic, political, and symbolic structures of society" (Castells, 2010a: 442). Castells confronts the logic of the new "space of flow" to the logic of traditional "space of places" i.e. experientially rooted understanding where activities literary take place. In Castells's conceptualization, "space of flow" is not placeless; it "redefines distance but does not cancel geography" (Castells, 2001: 207).

Although criticized for the radical revision of time-space relation and, to some extent, technological determinism, Castells's work greatly contributed to the theory of urbanism in the information age. Hence, this paper greatly uses his accounts on the theory of space, transformation of urban form and architecture.

For framing the discussion about infrastructure networks, technological mobilities and contemporary society, the work of Graham and Marvin (2001) offers a very specific angle into the topic. Authors' main argument is that infrastructure networks (e.g. high-speed internet networks) “work to bring heterogeneous places, people, buildings and urban elements into dynamic relationships and exchanges which would not otherwise be possible” (Graham & Marvin, 2001: 11), at the same time fragmenting and splintering the experience of the city. Graham and Marvin advocate bridging the technology-society divide, the notion previously stated as an imperative for the social studies in the seminal work of Bruno Latour (1990; 1993). Latour (1990: 103) argues that for identifying power relation in the society it necessary to go beyond exclusive concern for social relation and acknowledge the importance of “a fabric that includes non-human actants, actants that offer the possibility of holding society together as a durable whole”.

Finally, as this paper deals with the practical reality of the built space, it is worth highlighting that until recently, “one of the main silences in social theory has concerned the built environment” (King, 2004: 403). To be more precise, for the most of social theory “built environment, understood as the physical and spatial contexts, the built forms, the socially-constructed boundaries, material containers, the architectural representations, the socially specialized building types, not only do not exist but play no role whatsoever in the production, and reproduction of society” (King, 2004: 404).

Alternatively, new stand of theorization about building types as “socially classifying device” with subsequent agency is conceptualized by authors such as Guggenheim & Söderström (2010), King (2004), Markus (1993).

3.2. Knowledge economy: The urban dimension of knowledge-based activities

In the last decade, an extensive literature dealing with theories of knowledge and aspects of knowledge economy has emerged (Amin & Cohendet, 2004; Conventz & Thierstein, 2015; Florida, 2005; Helbrecht, 2004; Madanipour, 2011; Scott, 2006).

Madanipour (2011) makes a comprehensive overview of disciplines dealing with knowledge economy as a key theme and highlights the fact that spatial dimension and particularly the dimension of urban space are not in the focus of the interest of these studies. Dimensions discussed in the literature are restricted to economic and social aspects of cities as clusters of firms or networks of people while “environmental dimensions as physical realities - a bare geographic space, a specific place, an urban landscape - are out of view” (Helbrecht, 2004: 192).

Two strands of considerations targetting location patterns of knowledge-based activities are identified as relevant for the further development of argument in this paper. On the one side, the rise of knowledge- and technology-intensive services signifies the evolution of “‘the new economy’ of the inner city” (Hutton, 2006: 1819). Thus the literature on the industrial innovation in the urban core gives the account of the link between historic and contemporary industrialisation processes and restructuring of the inner city.

On the other side, there is a growing recognition of the importance of knowledge-based spatial development for the development of the new generation of suburbia (Keil, 2013). Particularly in the area of expanding European airports (Zurich, Paris, Frankfurt, Amsterdam) growing number and diversity of spatial entities and programmes indicate a new wave of urban transformations and emergence of so called Airport cities. Conventz and Thierstein (2015: 144) suggest that future research must take into consideration the interplay between infrastructure nodes such and knowledge-intensive companies.

3.3. Cultural studies: Global cultural flows

The emergence of the term globalization in cultural studies announced a new protocol of writing about interrelatedness of urban planning, architecture, capital, culture and society on a global scale.

The literature on economic and cultural globalisation (Appadurai, 1996; Guggenheim & Söderström, 2010; King, 2004; Knox & Pain, 2010) encompasses diversity of processes emerging out of the increased mobility of capital, goods, labour, information and ideas. Two themes relevant for this paper emerge from the previous studies: cultural homogenisation and cultural hybridization.

First and foremost, the effect of homogenization could be traced in the appearance of built environment of cities. As Guggenheim and Söderström (2010: 3) suggest, the increasing international homogenisation is determined by five main factors and each of them is linked to one or more of the circulating entities: “market liberalization (capital), international migrations (people), cultural globalisation (ideas), urban entrepreneurialism (images), and changes within architecture and planning (intensified exchanges within the profession and new design technologies etc.).” As a consequence, building types progressively demonstrate “global uniformity” and “standardization” (Grubbauer, 2010: 65).

Second model that touches on interactions between globalization and culture is hybridization. Hybridity is a “quasi-scientific term” (Pieterse, 2001: 248) and refers to the process of mixing and developing new combinations (Ibid: 224), opposite from the homogenizing tendency often associated with globalization.

Hybrid cultural constructions have acquired political and aesthetic significances within the framework of postmodern theory as “border-crossing mark of our times” that enables “transcending binary categories” (Ibid: 239). Simultaneously, hybridity in urban and architectural domains remains vaguely defined and restricted to formal mixing of artefacts and forms from different sources. This paper proposes new way of looking at the process of hybridization that would widen the range of phenomena to which the term applies.

3.4. Architectural theory: Aesthetics or discourse?

In contrast to the large and growing body of academic literature whose research agenda addresses heterogeneity of processes emerging out of the new urban condition, architectural theory still struggles to comprehensively theorize about spatial manifestations. “Silent complicity” (Dovey in Knox & Pain, 2010: 421) characterizes present-day relationship between architecture and social and economic agendas. Authors suggest that the role of urban planning and architecture in the era of neoliberal capitalism is reduced to facilitating “the circulation and accumulation of capital” and helping selling everything “from buildings to cities” (Knox & Pain, 2010: 417). More precisely, architecture is portrayed as an agent that reacts and represents changes while production forces deliberately shape the society.

Indeed, architectural discipline has traditionally been over-focused on spaces inside building envelopes, formatted and interpreted according to geometric and aesthetic principles. In recent years, the architectural discourse, that used to be a discourse of form and style, has generated a new strand of theorization about digitally-driven design (Kolarevic, 2003). It followed the fundamental transformation in architectural working methods under the influence of digital technologies, but as an “artificial component” of architectural production did not manage to tackle implications of technological shift on society, culture and subjectivity (Graafland & Sohn in Crysler, et al., 2012: 468).

Until recently, architectural theory also failed to engage more closely with the concept of material flows. The discipline has invested great interest in “the values of stability, groundedness and longevity” while marginalizing “other mutable, ephemeral and fluid conditions” (Cairns in Crysler, et al., 2012: 451) that also constitute the medium of architecture. Guggenheim and Söderström (2010: 2) are authors who challenge the conventional static notion of place arguing that “a world of circulating entities” is shaping the environment we live in. Furthermore, Sheller & Urry (2006: 212) question what methods are appropriate to a research “in a context in which durable 'entities' of many kinds are shifting, morphing, and mobile” and how adequately to acknowledge the relation between “materialities” and “mobilities”.

Architectural theory is challenged to overcome its internal limitations and develop understanding of the environment and building types on the level of language, design and experience.

Being a highly reflexive field, architecture as a discourse has always had difficulty to position itself in academic structures. “The dichotomy of architecture's multiplicity and singularity” (Stanek & Kaminer, 2007: 1) implies dual interpretation of the architecture: either as an outcome of the multiple economic, political, social and cultural forces, or as a singular, aesthetic, formal event. As the study of building types entails bridging of interest across different paradigms, the paper adopts the concept of transdisciplinarity that provides the context for embedding the object in its political and social context without dismantling its singularity (Rancière in Stanek & Kaminer, 2007: 4).

Additionally, this paper suggests that in contrast to currently fragmented literature, relatively clustered discourses would benefit from an assessment through a multidisciplinary lens. Taken all together, the research developed here would not be possible without original contributions from variety of discourses that significantly enriched understanding of the interplay between mode of production and built environment.

4

Research design

Considering that the paper addresses a contemporary phenomenon, specific to time and space, the proposed research remains largely exploratory and attempts to assess the link between new mode of production and emergence and transformation of building types.

A case study approach was adopted to allow a deeper insight into two particular cases that are explored using variety of sources and types of data, theories and methods. The “cases”, i.e. the objects of study are building types as material artefacts where particular social practices are situated. Paris-based case (NUMA) is an inner-city entrepreneurship lab, the direct outcome of the growth of the local entrepreneurial networks, aspiring to become a model that could be replicated in other contexts. Frankfurt-based case (HOLM) is newly established platform for international collaboration, strategically positioned to use the advantage of the transport networks and existing knowledge infrastructures.

The presence of heterogeneous actors, networks and practices within a particular space was seen as the key criteria for the selection of cases. Both cases are analysed as new types of

shared spaces for emerging entrepreneurial relationships and therefore are being relevant for this paper and the attempt to decode spatial properties of knowledge-based economic activities.

Selection of two case studies was done purposefully on the basis of known attributes and distinctive features. Selection strategy aimed to result in exhibiting important common patterns in spite of variations in contexts of cases. Each case is extreme due to its unique urban setting and location characteristics that are not subjects of comparison. At the same time, cases are conceptually revelatory as they allow examining the logic of emergent environments established as the main goal of the research.

The case study research design is followed by the theoretical development that identifies set of significant features on the basis of which other classes of cases can be analysed. Such approach opens the place for a certain level of analytical generalization.

4.1. Ethnographic methods

A set of observations on the spatiality of selected cases are drawn from fieldwork conducted in spring 2015. Aspects of work organization and interaction patterns within the examined building type are regarded as worthy of consideration as research data.

Ethnographic fieldwork and techniques such as participant observation and walking interview enabled the study of the environment and participating subjects in a motion, rather than isolating them out of their everyday context and asking questions of interest.

Participatory observation

Part of the research strategy was based on direct observation of the situation under study. Having in mind that places selected as case studies have already been hosting coworking activities, being part of the “ecosystem” was a task that did not require developing a particular role. As described by Denscombe (2007: 218), participation in the normal setting meant that the research interests were known to “gatekeepers”, in this case project

managers that were previously contacted, but the most of people working in the setting were unaware of the ongoing small-scale research.

Informal interviewing went hand-in-hand with participatory observation. Interviewing was done in a form of casual conversation without use of structured guide with chosen individuals willing to raise their opinion. Factors considered in selecting interviewees included the age, gender and linguistic abilities of candidates.

While engaging in the fieldwork, it was possible to gain understanding of the setting, working routine and interaction pattern from the point of view of those involved. When starting the observation, no predefined ideas were set out to be tested but observation interests shifted as activities emerged.

Although the time spent in the field was quite limited, this research method provided insider's feel for the contexts and relationships important for project design and interpretation of data.

Walk and talk method

As the role of space itself is the main object of this study, walk and talk method was particularly useful for further development of arguments presented in the paper. Research “on the move” meant that both researcher and participant were exposed to “the multi-sensory stimulation of the surrounding environment” (Evans & Jones, 2011: 850).

Figure 1 & 2: Walk and talk session in NUMA, Paris
(Source: Adrien Blind & Author, 2015)



Walk and talk method was a methodological sequence of the fieldwork and site visit to Paris-based entrepreneurship lab. Conducting the session was possible due to the fact that guided tours to NUMA were organised on a regular basis for potential tenants, guests, clients and business partners aiming to promote the concept, present premises and logistic capacities of the lab, answer individual questions and discuss new ideas. The organizer fixed the route of the walk that participants followed, but the agenda of the talk was set by individuals and their gaze for questioning issues of interest.

The key methodological issue in exploring people's relationship with places was to connect *what* people say with *where* they say it (Evans & Jones, 2011: 851). This type of assessment indicated people's attitudes, reactions and interests about the surrounding environment. Although it took more time than usual interview would do, walking interview was more spatially focussed and provided a multi-dimensioned understanding of the place due to the variety of creative inputs from staff, members of project and participants who undertook the same walk and talk session. The session enabled confronting location attributes of the place with official narrative of the site on the one side and visitors' interpretation on the other.

Unlike walk and talk methods conducted in urban settings where photographing is regularly used to provide a visual description of where the research took place, photographing the interior of the building appeared problematic. Photographing gave unpleasant condition of surveillance to people dealing with their work activities so participants in the walking session intuitively followed the code of appropriateness and reduced the use of mobile phones and cameras.

4.2. Visual research methods

Formal analysis of existing visual material was used as a complementary approach in line with other qualitative methods. It was based on examining what is visible within the single or collection of visual representations. The goal was to go beyond linguistic dimension of research and to take account of different medium for communication of ideas.

Two types of visual materials were analysed: (i) two-dimensional images, drawings, maps, diagrams and (ii) moving images such as video material, web sites etc. Images were not

analysed completely isolated but with reference to the verbal or written information which accompanied it (van Leeuwen & Jewit, 2001: 6) or in a relation to other images examining the flow condition (Figure 3 & 4).

There are two important reasons for using visual research methods. First, images have the power to provoke the synthesis of heterogeneity as they are “narrative” rather than “static icons” (Picon, 2008: 69). Second, advertising and media images are “constructs” rather than “records” (van Leeuwen & Jewit, 2001: 5).

Accordingly, visual materials were analysed not only as a sources of factual information but also as part of the communication strategy having in mind that rhetorical function of images is inseparable from their truth value (Grady, 2007: 70). In Harvey's argument (1990), economic process mobilizes media images and shapes visual imagery, thus exploring the visual language of the contemporary discourse is a tool of revealing the discourse itself.

4.3. Space-syntax analysis

Space-syntax analysis is a research program focused on examining spatial relations between single segments of the configuration in order to describe the entire spatial network based on the topological relationships rather than metric distances. It originated in the work of Hillier and Hanson (1984) as an attempt to quantify and represent the relationship between environment and social life. The focus of space-syntax analysis has subsequently been extended to a number of aspects at both the architectural and the urban level but also in the environmental cognition research. The analyses developed today usually include using one of several software programs for calculating and visualizing space-syntax concepts.

For the purpose of this paper space-syntax analysis is used in a very basic manner as a tool of interrogating plan and section of the selected buildings through which it appeared possible to make a link between “structural spatial programming, representation and lived experience” (Dovey, 1999: 26). Investigation included formal analysis of building plans as well as in-situ testing of communication routes and accessibility of building zones. No particular measurements were done. Spatial analysis diagrams developed for that purpose

provide understandings of the way in which social and entrepreneurial relations are embedded in and mediated through spatial organisation of selected buildings.

The analysis developed here followed three key principles: (i) finding “the irreducible objects and relations, or 'elementary structures' of the system of interest”, (ii) representing “these elementary structures in some kind of notation or ideography” and (iii) showing “how elementary structures are related to each other to make a coherent system” (Hillier & Hanson, 1984: 52).

Space-syntax visualisation (Figure 7 & 8, pp. 36-37) makes use of colour scale to present the level of accessibility and openness of “elementary structures” of the building for coworkers and visitors. Hence, areas with low entry barriers (so called “integrated spaces”) are shown in warm colours like red, orange and yellow, while more distant areas that require fulfilling specific requirement in order to get an access (so called “segregated spaces”) are highlighted in cooler colours like green, turquoise and blue.

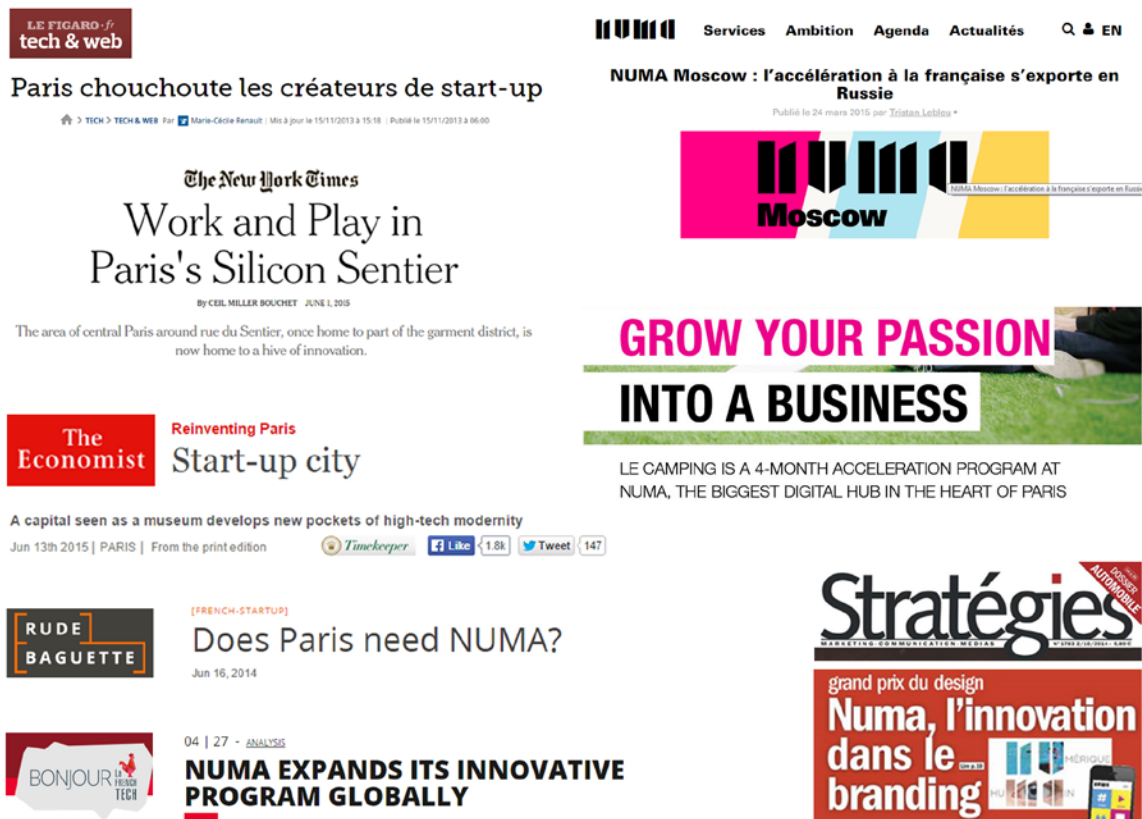
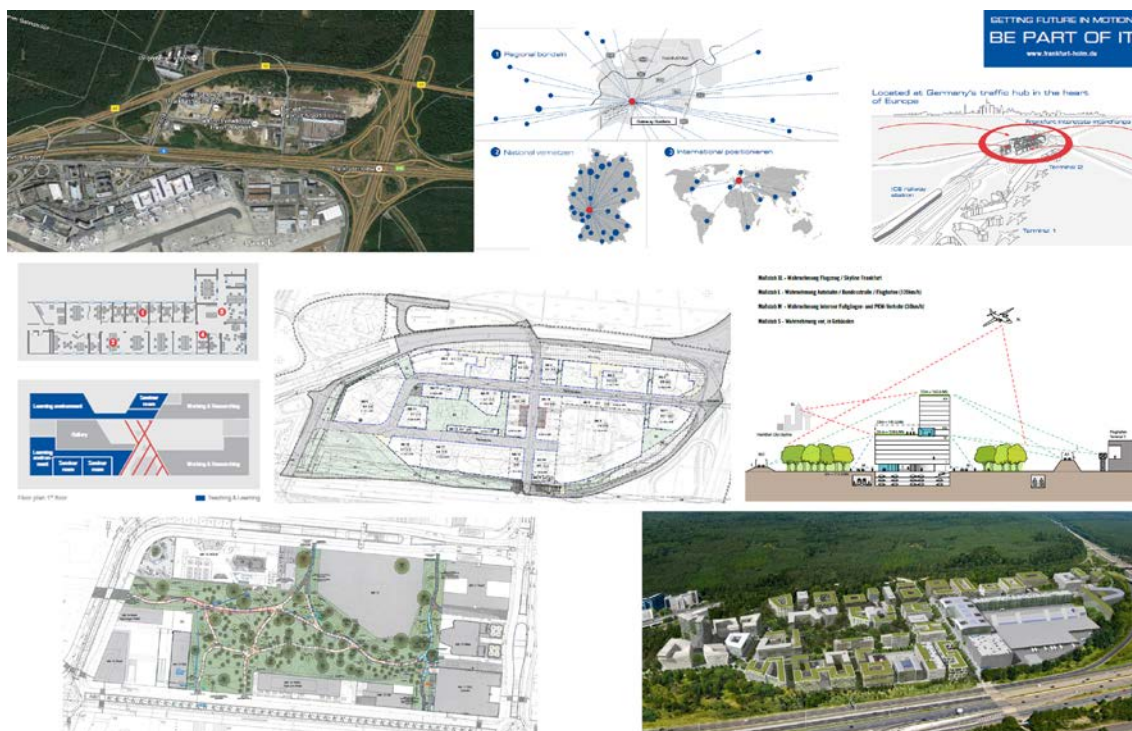


Figure 3: Illustration of the applied method - analysis of written and visual discourses, NUMA, Paris (Source: Author, 2015)

Figure 4: Illustration of the applied method - formal analysis of visual materials, HOLM, Frankfurt/ images, architectural drawings, maps (Source: Author, 2015)



Case studies

The paper proposes the way to study building types of the new economy by looking at the networks of collaboration and investigating emergent environments where collective actions formally take place. Two cases studies that will be examined in the following chapter are small-scale metropolitan-based knowledge clusters that combine “libertarian nature of new technologies, the social nature of knowledge workers, and the logic of scale economies” (Madanipour, 2011: 164).

Both NUMA and HOLM share attributes of knowledge-based economic activities: they are innovation-based and application-focused, nurturing local and regional knowledge systems and tending to have a global reach. They host social activities enhanced by new technologies and while exposing the image of the projects that they stand for, they give a glimpse of what the new production culture brings to the urban environment around us.

The following sections will introduce selected cases, draw out their distinct characteristics and reflect on actors and activities vital for the concept. In the chapter 6 the work will move on analysing theoretical reference points identified as relevant for the debate on the urban and architectural dimension of knowledge-based activities.



Figure 5: NUMA building, Sentier neighborhood, Paris
(Source: Author, 2015)

5.1. Case study: NUMA, Paris

NUMA is the entrepreneurship lab located in central Paris. The name represents a play on words suggesting the link between digital (*NUMérique* in French) and human dimension (*huMAin*) of the association and place (NUMA, 2015).

Officially inaugurated in November 2013, NUMA is the flagship space and the key outcome of the growing process of Silicon Sentier association. Its mission is to support the development of entrepreneurship in Ile-de-France region and more generally, to boost France's digital economy and increase its prominence on the global digital stage. To do that, NUMA provides “methodology and mentorship to individuals, communities, start-ups and large companies” (NUMA, 2015). The foundation of NUMA's relevance for this paper lies in functional and organisational symbiosis of location and activities demonstrated through the concept.

NUMA is situated in Sentier neighbourhood, in the 2nd *arrondissement* of Paris (Figure 7, pp. 34), which is primarily a business district, the home to France's historical stock exchange and a number of financial companies. After high-speed fibre optic internet networks were deployed in early 1990s the area became attractive for the tech businesses. In the early 2000s after the "dot.com bubble" bust, the importance of the area slightly decreased (Moriset, 2013: 14). With the rise of inner-city digital entrepreneurship, Sentier area is witnessing today another episode of urban revival and it is the "key spark in the evolution of France's tech ecosystem" (Bridges, 2013). For this reason, Sentier neighbourhood is often called "Silicon Valley of Paris" referring to Californian Silicon Valley, the leading hub for high-tech innovation. Before adopting the image of Silicon Sentier, the neighbourhood had been known as textile and manufacturing district hosting small tailors and retail shops, a destination for cut-rate fashion.

Each floor of NUMA building has recognisable theme that corresponds to the specific phase of the entrepreneurial thinking: "connect", "cowork", "experiment", "accelerate" and "create". In that way vertical spatial programming reflects the vertically integrated structure of activities. NUMA logo symbolises open windows and, in the words of its founders, it visually communicate the driving idea of the project: "porosity of place and openness towards the city, possibility to see the interior from the outside, chance to get in... to inject the story" (Cousin, 2014).

The following descriptions of functional units and activities as well as space-syntax diagram (Figure 9, pp. 36) as a tool of interrogating the spatial programme of the building are developed on the basis of data gathered in the field and available secondary data.

The ground floor is completely open to the public: glass walls facing surrounding streets entice people to enter, pause and look around. Visitor experience is enhanced by the addition of a reception-desk and a café-bar to help define the space as a meeting place. More important, coworking spaces in the ground floor area are offered freely to the public. The first floor operates as a different category of coworking space, i.e. desk-spaces are available for both long- and short-term rent.

The second floor is currently dedicated to the work of two experimental programmes. "Data Shaker" fosters developing innovative problem-solving approaches for the given scenarios,

while “Schoolab” is based on transversal exchange of ideas and experiences between schools, students as well as entrepreneurs and companies.

The third floor thematically named “accelerator” is the environment that supports accelerated growth for projects that have passed through a selection process. “Le Camping” programme selects every season 12 high potential start-ups that participate in an intense four-month programme attempting to achieve desirable entrepreneurial growth (NUMA, 2015).

The fourth floor is designed to accommodate different formats of events and gatherings (conferences hosting up to 200 people, meetings and workshops) with the terrace overlooking the area. The fifth floor is reserved for NUMA administration while the mini-area on the sixth floor is thematically labelled as “creative”.

Taken all together, the only formally distant zone in the whole building is the “accelerator” area since the programme requires strict selection process and picking up projects with specific qualities that would be settled in that area. To a certain extent the fifth floor could be considered as private zone used by staff and employees. That is the reason why space-syntax diagram uses cooler colours like green and blue to visually distinguish these two zones from other low entry barrier places.

The brief overview of functions gives an illustration of the way heterogeneous activities and specific communities are brought together in the 1500m² space of former manufacturing atelier, specifically redesigned and adapted for the new purpose. The project was labelled as one of “top-ten outstanding projects” by Parisian website dedicated to contemporary French architecture and design scene (Architectes-Paris, 2014). After surveying the renovation projects in Paris in 2014, the project was selected on the basis of its success in reconciling historic preservation of former industrial buildings and a new development.

Back in the eighteenth century when textile industry was booming, typical building such as NUMA's one was made with the purpose of housing the shop in the ground floor, the warehouse on the courtyard, production workshops and sometimes family accommodation on the upper floor. Today Sentier neighbourhood owes part of its historic charm to these tall buildings with neoclassical facade and the reference to the industrial past that they evoke.

NUMA platform is initially established as a public-private partnership initiative involving three stakeholders: the city of Paris, Ile-de-France region and crowdsourcing foundation represented by individuals who took part in the participative financing platform. It is worth highlighting that companies in high-tech industries (Google, Orange) additionally supported the project. As Moriset (2013: 16) assumes, their motive might be the desire to stay connected to local entrepreneurial ecosystems in order to maintain “double networks’ for catching, selecting, and assembling ideas and initiatives that originate outside their main research and development campuses” (Malecki in Moriset, 2013: 16).

After the overall positive effect, NUMA model was seen as having the potential to scale beyond city and tech scenes where it was created. Founders offer the argument that the process of developing start-up systems all around the world needs similar spaces (Ferran, 2015). The first programme was launched in Moscow in March 2015 while the team had set an ambitious target of “exporting” the model in 15 countries on 5 continents.



Figure 6: Interior of HOLM building, Frankfurt
(Source: HOLM, 2015)

5.2. Case study: HOLM, Frankfurt

HOLM sees itself as “a neutral innovation platform for the interdisciplinary and cross-sector collaboration of companies, academies, associations, initiatives and other public institutions” (HOLM, 2015b: 11). The name stands for “House of Logistics and Mobility” as the platform aims to foster collaboration and innovation with the regard to the questions of logistics and mobility emphasizing that global society in 21st century greatly depends on the sustainable models of movement of people, goods, information and ideas (Fraport, 2012).

HOLM opened its door officially in July 2014. In the view of its founders HOLM is “a special building at a special place” (Walter, 2012: 9). Indeed, the locational features are distinct: the building is situated in the centre of the new Gateway Gardens district, in the area of expanding Frankfurt Airport City, with easy access to Frankfurt city centre, direct link to the inter-city express, regional rail network and motorways heading in four directions (Figure 8 pp. 35). Moreover, the whole area is the hotspot of Frankfurt/Rhein-Main region. The

peculiar strength of the region lies in the diversity and functional specialization of towns and municipalities that constitute it alongside the core of Frankfurt.

Regional growth policies of Frankfurt/Rhein-Main region recognise the importance of networks of research and innovation institutions for the strategy of developing the region as “region of knowledge” (Planungsverband Ballungsraum Frankfurt/Rhein-Main, 2005: 5). Accordingly, HOLM is established as a reference institution, which is independent and based on a broad network of partnerships with national and international institutions working in the particular professional field. The mission statement clearly indicates that HOLM aspires to develop, integrate and apply knowledge (HOLM, 2015a: 7). It provides “the roof over the head” for the network of competences that benefit from mutual exchange (HOLM, 2015). According to the principal architect “HOLM is a place, where economic, scientific and social institutions do not only encounter but also coordinate their activities, work together and develop projects” (HOLM, 2015b: 5). To put it in another way, “the entire knowledge supply chain is located in one building” (HOLM, 2015a: 3) from basic research, education and training to application-oriented research and innovations in the form of products, services and consulting concepts.

Research in the field provided opportunity to identify 15 scientific institutes, academic chairs and research centres from the region, as well as 16 other institutions, companies and start-ups that joined the platform and settled their activities in the HOLM building.

HOLM as a building type is designed and programmed to meet needs of heterogeneous collaboration patterns. Moreover, collaboration as a guiding principle of the project is facilitated not just by the conveniently accessed location for regional as well as national and international partners but also by the entire concept of the building. The functional programme of the building was created together with Fraunhofer Centre for Responsible Research and Innovation (CeRRI) applying user- and design- oriented approaches in technology development.

The building concept is based on “non-territorial principles” and is characterized by a high portion of commonly used areas (HOLM, 2015b: 11). The building's most prominent feature is the central communication zone, so called X-Celerator. Arranged as a figure of number

eight, it is “a sculpturally interpreted architectural component” (AS&P, 2015: 36) that builds functional links between working areas and offers place for informal meeting. HOLM Forum and cafeteria located in the ground-floor zone serve as the communication area and the place for presenting research contents. Study, research and business zones are dispersed on the floors 2 to 5. The physical environment provides settings for different learning and knowledge-exchange contexts: group, individual, formal, informal and projects on an as-need basis. The options for use offer the degree of flexibility and possibility to organize activities in the individual workstations as well as seminar and group room. Tenants that require degree of privacy for the type of work they perform (“segregated spaces” in the space-syntax diagram) are located in the distanced corners of the building on every floor.

In the conceptual programme of the building, the idea of nature is highly present. The functional link between green atrium and park articulates the aspiration of the building to be extended into the landscape. Accordingly, the park appears as a mix of sustainability-ideal and techno-utopia: it is designed as a green core of the district as well as an open working space for HOLM tenants providing access to high speed internet.

Landscape project for the central park was carefully planned and designed together with Master plan for Gateway Gardens district that gave the priority to open areas over maximizing site coverage (Gateway Gardens, 2008) respectively demonstrating the importance of urban and architectural quality for the development process. The plan proposed developing mixed-use, walkable district with services and amenities close to workplaces and transit.

Furthermore, the project puts significant importance on architectural appearance and the aesthetic properties of the settings. Quarters, buildings and open spaces are planned and designed for staging the urban event and draw presence of others. As HOLM addresses the topics of mobility, the design of façade attempts visually to suggest effect of movement (HOLM, 2015b: 5). Thus surface ornamentation is composed of vertical strips that change colour and appearance depending on point of view. Proximity to Frankfurt Airport and possibility to see the building from the air specifically required developing design solution for the fifth façade as one of the main views (AS&P, 2014).

Taken all together, it is evident from the space-syntax diagram (Figure 10, pp. 37) that the central communication zone is the key element of the spatial programming of the building. Analysis reveals that the arrangement of functional zones at HOLM makes the building work as an integrative space in both horizontal and vertical terms.

Further studies need to be carried out in order to validate the results of the interplay between different working settings and types of work orchestrated within HOLM building. That is the task beyond the scope of this work. However, it is possible to argue that HOLM concept initiated the process of crystalizing building type for knowledge-based activities, opening space for permanence of actors and enhancing their interaction.

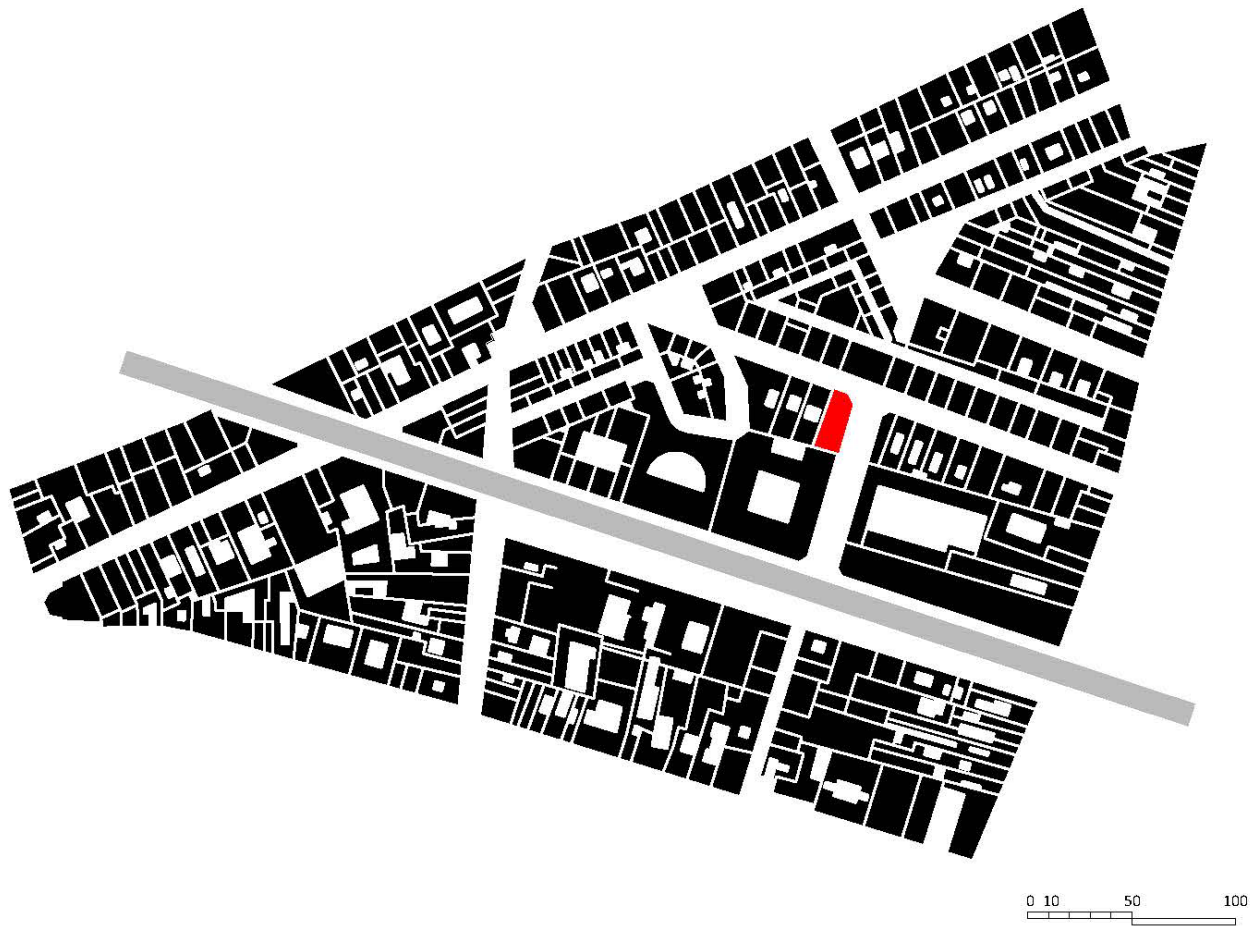


Figure 7: Map of Sentier neighbourhood, Paris
(Source: Author, 2015)

*Interpretation: red colour signifies the location of the examined case - NUMA lab; black colour indicates existing buildings.

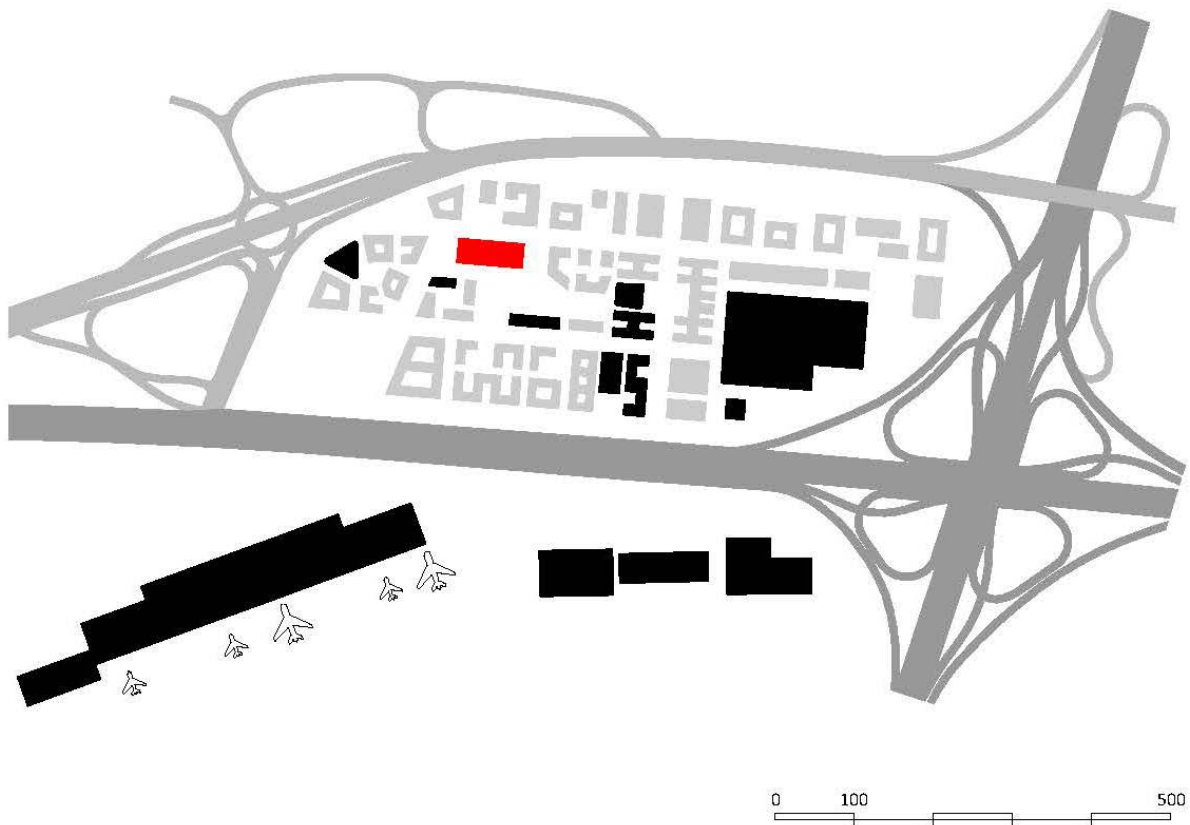


Figure 8: Design concept for Gateway Gardens district, Frankfurt
(Source: Author, 2015)

*Interpretation: red colour signifies the location of the examined case - HOLM centre; black colour indicates existing buildings, grey colour stands for planned buildings.

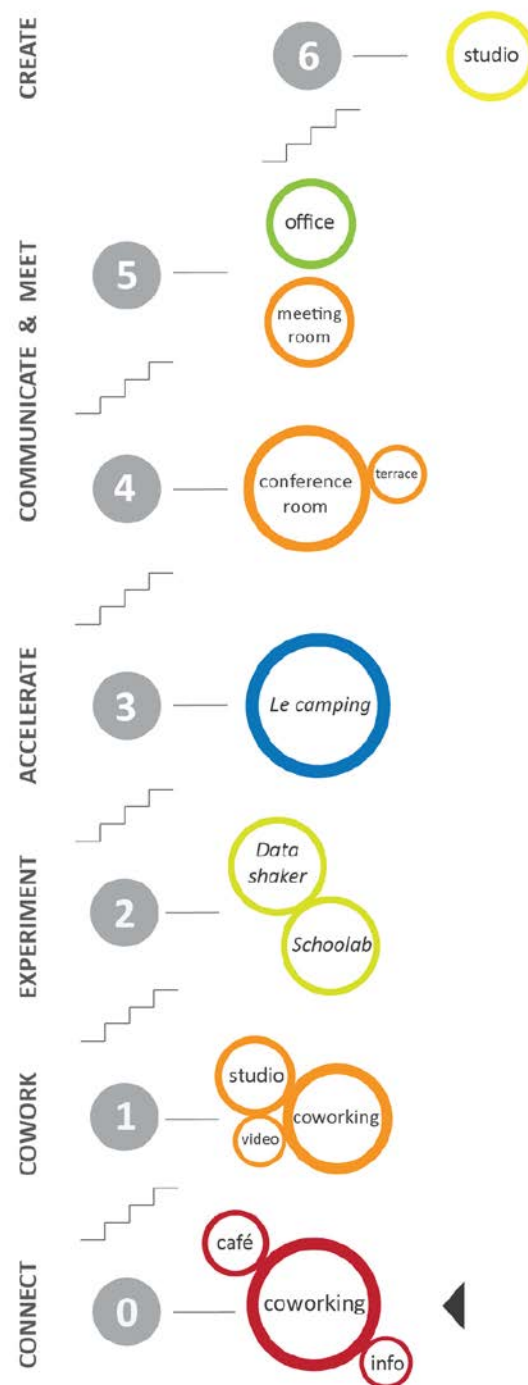


Figure 9: Space-syntax diagram, NUMA building
(Source: Author, 2015)

*Interpretation: Colour scale indicates the level of accessibility and openness of "elementary structures" of the building.



Figure 10: Space-syntax diagram, HOLM building
(Source: Author, 2015)

*Interpretation: Colour scale indicates the level of accessibility and openness of "elementary structures" of the building.

5.3. Intermediary conclusion

The case study investigation suggests the existence of clear trends in the way small-scale knowledge-clusters are organized, guided and presented as well as the way building types for clustering knowledge production are programmed, materialized and branded.

It is worth highlighting that the concept of small-scale-clustering is radically different from the concept of science park, often characterised as "a child of the Fordist organisation of production", i.e. an extension of the dominant mode of large-scale industrial organisation in the twentieth century, additionally tied into "a very hierarchical and fractured production and innovation process" (Massey in Pratt, 1997: 123). Small scale-clustering of knowledge-based activities as analysed in this paper does not have rigid organizational and technological structure nor does it require locating and coordinating places for mass-production, -consumption and -housing; hence it reflects the character of the present-day "weightless economy" (Quah, 2000: 1033).

The idea underlying both NUMA and HOLM concept is that by recombining segmented knowledge and aggregating collaborative practices, regional knowledge system is developed as a "'total innovation capability' that exceeds the sum of its individual ventures" (Storper in Ludovic, 2012: 2358). It is possible to argue that knowledge-clusters as discussed in this paper are "globalizing micro-spaces" where "ordinary" and "extra-ordinary" activities (coworking, conferences, seminars workshops etc.) take place and in that way contribute to global mobility of ideas and policies (Larner and Le Heron in McCann & Ward, 2011: 74). These are spaces where heterogeneous actors, clustered together, scan global opportunities transforming some of them into profitable business model, exporting them in different contexts or leaving them completely aside.

As different forms of knowledge-based activities and classes of professionals emerge, one needs to think about environments that support these changes and host new practices. It is possible to argue that the organization of the examined building types aligns and combines heterogeneous competences within the given space making it work as a formative space.

6

Discussion **Spaces of knowing**

Madanipour (2011: 108) questions whether it is possible at all to pinpoint spatial configurations that reflect current conditions of economic productions, or their expressions should be looked for simply in technological, institutional and behavioural terms. Taking this concern into consideration, this paper set out the goal to examine whether knowledge-intensive activities are placeless processes that can happen anywhere or series of interactions need to be settled in specific places.

To assess impacts that knowledge-based activities raise on micro issues in urban planning, architecture and in selected building types the paper proposed investigating two small-scale metropolitan-based knowledge clusters. Reference cases (NUMA, Paris and HOLM, Frankfurt) were analysed as institutional platforms as well as shared spaces for emerging relationships that promote generation, exchange and application of knowledge by bringing together different actors and technologies.

The main argument developed here is that knowledge-based economy produces its own building types and transforms the existing ones but the scale and shape of influence of the new economy does not reveal itself in plain sight. The crucial findings which have arisen from the research work are organized in relation to two theoretical points: urban dimension and architectural dimension of the new production space. The discussion presents two sets of considerations: on the one hand, thinking on the contemporary urban condition - paying particular attention to the formation and location logic of the spaces of the new economy - and on the other, thinking on the architectural outputs which have been influenced or developed by such thinking.

Theoretical development that follows case-study research design identifies set of significant features on the basis of which other classes of cases can be analysed. Each of the following sections can be read and discussed individually, but putting them all together brings a greater understanding of the central theme here.

6.1. Urban dimension of the new production space

6.1.1. Locational logic

The production of knowledge as a fundamental activity in today's economic space demonstrates organization logic quite different from traditional manufacturing. "The new industrial space" as named and described by Castells (2010: 417) is technologically and organisationally dispersed in different locations while being reintegrated through network linkages. Thus, dispersion and concentration take place simultaneously (Castells, 2010a: 428; Helbrecht & Dirksmeier, 2012: 12). Spatial dispersion is a direct result of a separation of production stages aiming to benefit from location and labour force specificities, while concentration around urban hubs and nodes is explained by agglomeration advantages (Conventz & Thierstein, 2015: 56).

Additionally, Madanipour (2011: 119) draws the attention to the phenomenon of globalized "separation between conception and execution" highlighting that people and places take

part in wide range of production operations that do not necessary have to intersect. In that way the stage of innovation and management can perform its operation without establishing direct contact with the stage of mass production.

Massive internationalization of production and development of simultaneous activities in remote locations as already highlighted call for a different imagination of spatial specificities of urbanism. This paper adopts the understanding that each component of “the new industrial space” performs a specific knowledge-based act and that examining the locational attributes that are decisive for every particular phase in the cycle of production is an agenda for a greater research. Two particular cases examined in this paper give the account of the conception stage of new production space, i.e. the stage of technological innovation and managerial collaboration.

New technological systems are transforming the location patterns of activities making location decisions more diverse and complex. Knowledge-clusters that are in the focus of interest of this paper are situated in the metropolitan areas of the industrialized countries aspiring to achieve a global reach. Still, what makes the location logic of both NUMA and HOLM particular are their relations to the infrastructural networks.

According to several authors, the existence of high-speed internet networks in addition to the availability of cheap office space due to the decline in the local textile industry, made Sentier area attractive for tech-firms (Ludovic, 2012: 2366). Indeed, empirical results indicate that the central Paris constitutes the core of the cluster of digital content industries (Ludovic, 2012: 2365). That acts as a magnet for other companies, thereby a decision to locate new entrepreneurship lab such as NUMA in the core of Silicon Sentier is not surprising at all. The case reported here illustrates the way fiber-optic grids and advanced telecommunication systems act as important drivers of the site selection process for the knowledge-based companies.

Furthermore, the location of HOLM building is completely configured by the condition of the Frankfurt airport as the international hub that combines “worldwide connectivity by air and multimodal landside accessibility” (Conventz & Thierstein, 2015: 143). HOLM platform aims to benefit from the higher degree of accessibility and networking potential of the airport.

That is to say that choosing to settle activities around international airports, knowledge-intensive services nurture “geographical and relational proximity to partners along the value chain and different sources of knowledge” (Conventz & Thierstein, 2015: 142).

Development dynamic that concentrates around “optic fibre 'points of presence'” (Graham & Marvin, 2001: 370), or airports as “key nodes within the networked economy” (Conventz & Thierstein, 2015: 142) demonstrates the locational logic of knowledge- and technology-intensive companies that attempt to benefit from location patterns and organise their physical and virtual flows in a most efficient way.

The problematic dimension of this development dynamic is that it supports “new vectors of flow and interaction between highly valued spaces and users locked into highly sophisticated international divisions of labour” (Peck in Graham & Marvin, 2001: 100). Therefore, it should not be underestimated that the “splintering” experience of the city (Graham & Marvin, 2001) is partially caused by vectors of global-local flows that are given the supremacy over an intra-urban connectivity.

6.1.2. Centrality logic

Centrality is not defined as a function of metric connectedness but rather as relational indicator of the way people, goods and services intersect within the observed area. Until recently, centrality was a product of social order organised “in tension between the centre and the periphery” (Helbrecht & Dirksmeier, 2012: 10). Growth and expansion of cities as well as profile of the new economy challenge the function and the significance of urban centres and the logic of centrality formation.

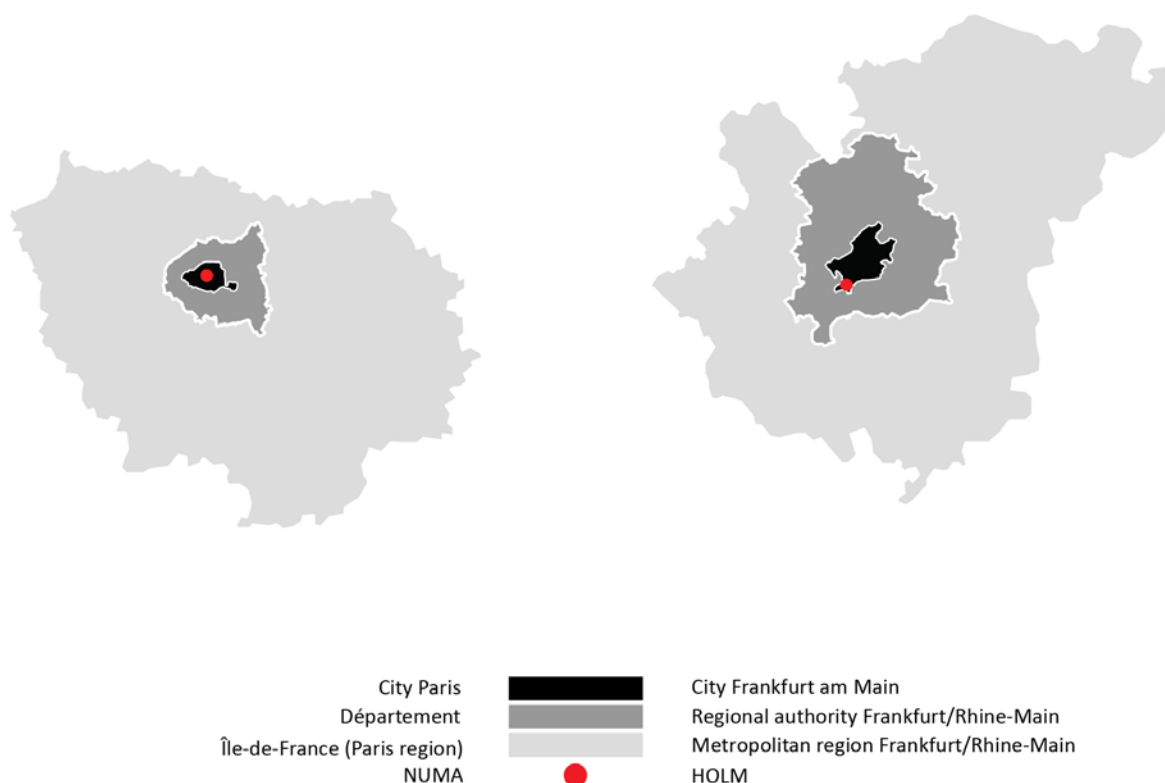
The phenomenon of the centrality in the contemporary urban discourse is situated precisely at the intersection of two capital movements: increased significance of old centres and the emergence of “new centres”. By examining small-scale knowledge-clusters (NUMA, Paris and HOLM, Frankfurt) this paper portrays two different forms of centrality and a role that

knowledge- and technology-intensive services, with their particular practices play in development and repositioning of these centers.

Traditional centre is a product of spatial hierarchy. Organisation requires a centrality and simultaneously, a centrality provides structural advantages. “Old centre” is “quasi-natural” and arises from the attribute of location (Helbrecht & Dirksmeier, 2012: 12). Sentier neighbourhood illustrates this point clearly and the case of NUMA gives the account of the dynamic of innovation in the old urban centre. The fact that NUMA building is located exactly “at 39 rue du Caire, 2nd arrondissement, in the very centre of Paris” is strongly emphasized in almost all written documents, flyers, brochures and websites. Centrality here gets the dimension that Bourdieu (in Helbrecht & Dirksmeier, 2012: 11) qualifies as “a marketable good”, “a rare commodity”.

Additionally, NUMA is a notable example of “the reindustrialization of the inner city”

Figure 9: Location of NUMA and HOLM with reference to the administrative units in Paris and Frankfurt (Source: Author, 2015)



(Hutton, 2006: 1819) and gives a glimpse of the restructuring process of Paris metropolitan core's economy. As already elaborated, the reassertion of new modes of production in Sentier neighbourhood is underpinned by complex mix of factors: infrastructural (high-speed internet networks), market (cheap office space due to the decline in the local textile industry), cultural (social networks). In that way, “a capital seen as a museum develops new pockets of high-tech modernity”, attempting to and restore the lost reputation for innovation (The Economist, 2015).

Gateway Gardens district and HOLM illustrate the formation logic of “new centrality”, i.e. centrality which is in flux and that does not have privileged place in the traditional city centre but arises from the creation of valuable locations within world society (Helbrecht & Dirksmeier, 2012: 12). The formation of a centre is a result of economic, politic and cultural processes and struggles of interests to allow the place to be considered as central.

Centrality of HOLM research platform is configured less by geographical position with respect to Frankfurt downtown and much more by the conditions of building with respect to the international airport. Centrality is thereby measured according to the intensity of the interregional exchange and the position in a world society.

Taken all together, knowledge- and technology-intensive services have the capacity to configure the centrality at the intersect of their interest. In Lefebvre's account (2003: 130) the fact that “centrality is always possible” is the ingredient that makes urban space so fascinating.

6.2. Architectural dimension of the new production space

Having defined what is meant by the urban dimension of the new production space, the paper now moves on to discuss architectural properties identified through the research process.

To understand how influences of knowledge and technology-intensive activities translate into the architectural dimension, it is necessary to assess the intra and inter-disciplinary parameters. As suggested by Frampton (in Jones, 2009: 2519) architectural autonomy is very

limited and architecture as a practice is “conditioned not only by its own technical methods but also by productive forces lying outside itself”. To bridge the gap between “architecture's multiplicity and singularity” (Stanek & Kaminer, 2007: 1) and enable rethinking the building type in relation to the context from which it emerges and which it reflects, this paper embraces the concept of transdisciplinarity. Accordingly, when talking about buildings, the paper does not refer exclusively to objects, but to the systems of spatial relations. The account of Hillier & Hanson (1984: 1) clearly indicates that what makes buildings different from the other physical artefacts is that they are “not just objects but transformations of space through objects”. To put it in another way, the paper proposes going beyond the object-centred approach, exploring the phenomenon from inside and outside disciplinary borders and thinking and looking through multiple topographies.

Knowledge and technology-intensive services - such is the thesis here - play the role in development and transformation of building type. To qualify these influences in an architectural dimension, there are at least three sets of properties worthy to be examined: hybridity, flexibility and materiality/virtuality.

6.2.1. Hybridity

The notion of hybridity is vital for understanding architectural dimensions of the new building types. Small scale knowledge-clusters as examined in this paper are submitted to various kinds of hybridization and epitomize the emblematic spatial configuration of the new economy.

Hybridization is an act that produces new typologies and configurations and whose underlying mechanisms are migration, trade, ICTs, multiculturalism, globalization (Pieterse, 2001: 230). What is new is not mixing as such, but “the scope and speed of mixing” (Ibid: 232). Moreover, hybrid building type deserves a considerable attention particularly because it redefines the relation between form, function, content and context in a very specific manner.

As already highlighted, the theory on cultural hybridization does not comprehensively define hybridity on the urban or the architectural scale. Unlike it is often suggested, hybridization should not be simply understood in terms of combining artefacts from different sources or manipulating the spatial organisation by putting different functions and users next to each other. Alternatively, it is possible to identify a range of phenomena to which the term applies.

The crucial importance of hybridity lies in the fact that it problematizes boundaries (Pieterse, 2001: 221). Within the hybrid building type, the notions of borders and differences are challenged while merging and crossing-cutting appears in structural as well as in functional layer.

The account of two case studies brings to light the way final building programme is co-created by sharing the intensity of individual uses. In the case of NUMA, vertical spatial programming corresponds to the vertically integrated structure of activities and services. Space-syntax diagram (Figure 9, pp. 36) clearly illustrates that each floor is the thematic unit with its own spatial dynamics and strong dependence upon other units. The driving idea that interaction between different entrepreneurial stages animates the whole ecosystem brings together coworking spaces, start-up incubators and accelerators. Additionally, it reflects the global trend of hybridization of workplaces and work practices (Moriset, 2013: 6). HOLM case is characterized by “non-territoriality” approach which rejects functional division of space in terms of formal ownership over units, departments or floors. Instead of separating research, learning and business zones, the functional blending appears in both horizontal and vertical plan while communication areas act as a medium and a crossing point. In architectural terms this is manifested in complete domination of the building’s section opposed to the plan.

Furthermore, hybridity makes it hard to associate a site with a singular building identity. The conventional understanding of architectural typologies allows labeling HOLM building simultaneously as an office building, an education building or even a research laboratory. The classifying dilemma becomes obvious as HOLM challenges precise typologies and appears as the hybrid outcome of blurring the typological borders between several types.

Tracing the roots of the knowledge-clusters reveals that part of their research culture is derived from the universities campuses and the sites of innovation. At the same time they emerge as a result of an evolution of office building. Partly, they are architectural offshoot that “spliced management consultancy with spatial design” (Jones, 2009).

In spite of “accelerated mixing” (Pieterse, 2001: 232) that takes place in conceptual and functional layers, both NUMA and HOLM appear as monolith hybrids. Buildings carry the unifying skin that stresses the unity of the block and does not allow “reading” the internal complexity of the building programme in its appearance.

Having in mind that former manufacturing atelier was refurbished, i.e. un-made and re-made as a form in order to accommodate new practices, NUMA additionally demonstrates the account of structural mixing of old and new spaces and industries that coalesce into a hybrid.

Hybrid types, as this paper argues, are complex systems that combine objects, technologies and socialities. In that way, activities are not separate from places, nor are structures separate from process. Exactly as “the new mobilities paradigm” (Sheller & Urry, 2006: 214) suggests, the distinction between “places” and “people” is replaced by a “complex relationality of places and persons connected through performances”.

Hybridization in terms of blurring the borders between physical and virtual spaces due to the use of internet and communication technologies is the point that will be elaborated in following chapters.

It is worth highlighting that qualifying objects of studies as hybrids becomes a routine across the disciplines (Pieterse, 2001: 237): a car combining petrol and electricity is labelled as a hybrid; a smartphone is seen as a hybrid outcome of merging technological advantages of mobile phone, camera and personal computer. Taken all together, in spite of relative pervasiveness of the term, hybridity is a valuable feature which allows approaching the building type as an object and a process.

6.2.2. Flexibility

The notion of flexibility pervades the contemporary discourse on industrial urbanism and it is seen as the key ingredient in the transition from Fordism to postfordism (Soja, 2000: 171). The topic of flexibility in the present-day production culture could be discussed with regard to several aspects: new labour practices, employment patterns, workforce mobility, types of enterprises, expansion and multiplication of new working districts etc. Nevertheless, the purpose of this section is to provide theoretical reflections on the way flexibility as the coping mechanism of the dominant production model is translated from the global scale into architectural programming of selected building types.

New forms of knowledge-based activities demonstrate trends toward distributed, interorganizational and collaborative work (Castells, 2010a; Spinuzzi, 2012). The importance of open innovation in the contemporary global economy transforms orientations of companies and institutions from a culture of “secrecy and rivalry” to a culture of “limited cooperation” (Ludovic, 2012: 2367). That information and communication technologies provide the infrastructure for greater flexibility in the present-day organization of work is not a completely new thing. New classes of mobile or self-employed professionals emerge; they are a contingent of workforce with specific demand in terms of choice how and where to work (Moriset, 2013; Spinuzzi, 2012). Accordingly, environments that support such changes and host new practices ask for the new interpretation and design of building types, worthy to be investigated.

The fieldwork and the formal analysis of building plans reveal that the core principle employed in spatial programming of selected building types was maximization of opportunities for in-person interaction. Coworking spaces, open-plan working areas and specific patterns of communications are seen as three key elements that empower spatial flexibility and create opportunities for the exchange of tacit knowledge. Their characteristics will be elaborated in following sections.

Both NUMA and HOLM give particular importance to different categories of coworking spaces (free desk spaces, spaces for short- or long-term renting etc.). From the practical point of view, the phenomenon of coworking can be understood either as a type of workspace linked to a style of work or as an activity that encompasses “the good-neighbours and good-partners configurations as well as other possible configurations that similarly attempt to network activities within a given space” (Spinuzzi, 2012: 433). When asked to describe the specificity of the style of work in NUMA coworking area (Figure 10), almost all interviewees demonstrated uniform idea about “the intangible factor” shaping convivial work environments, that could not be found in conventional office buildings. In a way respondents framed their arguments, it was clear that they do not perceive separately the activity and the setting but see them as mutually interdependent. In their accounts, the type

Figure 10: Working and meeting areas in NUMA, Paris
(Source: Clement Guillaume & NUMA, Paris)



of activity gives the character to the setting in a same way the setting influences the work achievements.

In architectural terms, openness of the plan is manifested in total or partial absence of interior walls or replacement of walls with transparent panels. In any case, such spatial arrangement allows an insight into the work of other coworkers and provides spatial transparency of activities, elimination of distance and hierarchy of places.

Considerable number of open-plan work offices are marketed as success stories, but the true evidence about the relationship between properties of a workplace and employee performance is missing (Smith, 2007: 55). Additionally, production of flexible and performative spaces that support more nomadic, group-based working styles is used as a managerial tool attempting to foster productivity and creativity (Thrift, 2002: 207).

The phenomenon of the social visibility of activities is not uniformly understood. It is suggested that while bringing the spatial transparency, open plan simultaneously imposes the condition of “panoptic surveillance” (Jacob, 2013). As Castells puts it (2010a: 71), flexibility could be “a liberating force, but also a repressive tendency”. The evidence of this claim could be clearly seen during the organized tour in NUMA when daily activities of working groups were fully exposed to participants in the walking session.

Furthermore, flexibility means enforcing mobility within the given space and breaking down barriers between formal and informal working. This is evident in the case of HOLM as the architectural programme is organised around the concept of crossing points and visual axes (HOLM, 2015: 17). Lobbies and communication areas are generously spaced (Figure 11) which is not always the case as many architectural programmes aim to maximize the usable floor area of the building. Thus, HOLM building postulates different understanding of space efficiency which is conventionally defined as the ratio of total floor area and usable floor area.



Figure 11: Working and meeting areas in HOLM, Frankfurt
(Source: ILS Institut Dortmund)

It is worth highlighting that spaces in each floor of both NUMA and HOLM are organised in a way that communication is free and frequent, making possible what Markus (1993: 25) describes as “dense encounters between classes, groups and individuals”. This is certainly true in the case of ground floor area of NUMA building which is a low entry-barrier place completely open to the public. The single most striking finding to emerge from the field observation is the heterotopic quality of NUMA ground floor, labelled in that way due to the variety of actors whose presence was acknowledged: entrepreneurs, early-stage company founders, students, even a few homeless persons looking for place to stay safe in cold weather.

Additionally, while doing the research in the setting it was possible to observe patterns of interaction and even follow the process of establishing project partnership. What started as an informal socialization, ended up in making a collaborative deal between a representative of a company and a university start-up. The whole process was highly mediated by individuals present in the setting. Although it is not possible to indicate the final outcome of this activity, the whole situation is seen as an indicator that tacit and explicit knowledge

benefit from once they are liberated from territorial canons and put into non-privileged spaces with an opportunity to intersect.

Overall, the analysis of two selected cases illustrates the dynamic of assembling the space by combining users' plurality while attempting to keep the coherence of the holistic concept. The evidences presented thus far confirm the role of flexible spatial programming in developing the open systems capable of absorbing new attributes, actors and roles without causing instability.

6.2.2. Materiality vs. Virtuality

Technological advancement transforms usual understandings of time and space and call for different imaginations of nature of objects, their materiality and their purpose. Having in mind that physical settings are overlaid with layers of multimedia information, inhabited by digitally equipped individuals able to create effect at a distance, urban and architectural forms cannot be simply defined in terms of their autonomous and static physicality. They should rather be assessed as fusion spaces of technology, performability, online and in-situ sociability.

Therefore, the goal of this section is to describe and discuss the relationship between the nature of knowledge- and technology-intensive work, the acceleration in the use of digital information and communications technologies and practical reality of selected building types. Correspondingly, the paper argues that two examined cases (NUMA, Paris and HOLM, Frankfurt) are techno-social hybrids where physical and virtual domains intersect.

First of all, it is important to mention three assumptions about space relations that are deeply embedded in urban sciences and that are at the same time greatly challenged by the enormous growth in use and diversity of information and communications technologies. These are: (i) space is three-dimensional and shared between actors, (ii) space is solid or void, and (iii) it is possible to be in one place at one time (Novak in Crang, 2000: 130). As further suggested (Ibid: 130), "with mediated presence, distantiated contact and delegated

agency, these conditions no longer hold". The development of technological means to access the Internet from portable devices enables interaction at a distance and locating activities almost anywhere and at any time. The importance of technological devices and processes for recombining people and activities within the physical and virtual space is enormous, but as the section will demonstrate not decisive.

Information and communication technologies are in control of creating new territories of so called "cyberspaces", i.e. "a world in the wires" (Shields in Kitchin, 1998: 385) and new social spaces "that lack the formal qualities of geographic spaces" (Kitchin, 1998: 386). Networked spaces are constituted by "mobile network of people and nomadic technologies that operate in noncontiguous physical spaces" (de Souza e Silva, 2006: 272).

Although it has been often suggested in deterministic discourses, there are no clear evidences that the emergence of these alternative virtual spaces signifies "the end of physical space" (Castells, 2010b: 2738), "the end of geography" (O'Brien in Conventz & Thierstein, 2015: 131) and "the death of distance" (Cairncross in Conventz & Thierstein, 2015: 131). It appears more probable that the physical and virtual setting will continue complementing rather than substituting each other: "Sometimes we will use networks to avoid going to places. But sometimes we will go to places to network." (Mitchell in Castells, 2001: 238).

The results emerging from the fieldwork in NUMA and HOLM confirm previously stated assumptions. When asked about the nature of the work and the reason for settling the activities in particular places, the respondents highlighted the importance of "professional community" and a shared space as "a physical social network". Respondents appeared as greatly appreciating what Castells named "milieu" (2010b: 2741), i.e. a micro networks located in certain places. In words of one interviewee, "being present there" and maintaining regular and frequent contact makes things happen faster and easier than relying exclusively on one medium or channel for networking. Thus, Moriset's argument (2013: 3) appears valuable in this case. In his view, *explicit knowledge* (e.g. verbalized and written information, data and files) can be exchanged and traded at distance through digital platforms, but the production and exchange of *tacit knowledge* (contextualized, action-oriented, "know-how" knowledge) include social and cultural components that can be

achieved only through in-person meeting in selected places. Also, the idea of “exporting” NUMA concepts in locations outside Paris is not based solely upon the mission of inserting trademark in other countries but also about “creating a global innovation network and making exchanges easier” (Ferran, 2015).

Face-to-face meetings remain crucial for several purposes. On the one side, it is suggested that the key innovation and decision-making processes require building trust between actors, face-to-face meetings and consequently - a shared space (Castells, 2010b: 2741). This trend can be clearly seen in the case of HOLM platform built upon the idea of making the meeting place accessible for national and international partners. Thus the moto “Mobility meets logistics” (HOLM, 2015: 7) can be interpreted literally: the building is located in the area of Airport City in order to maximize opportunities for face-to-face meetings of mobile professionals, if necessary, even making the use of the connecting time between two flights. In a time when companies can source goods, technology and information from around the world, often with the click of a mouse, HOLM merges the idea of airport lobby and research centre and assigns a different relevance to a physical setting.

On the other side, face-to-face interactions in coworking places such as NUMA are regarded as “serendipity accelerators” (Moriset, 2013: 1). Shared spaces that provide opportunity for meeting and collaboration are greatly appreciated by freelance professionals. Several participants in the walking session in NUMA, introduced themselves exactly as “selfemployed creative entrepreneurs” looking for a place “to break isolation” and “cultivate professional contacts with other coworkers” in a real and not only virtual domain. Taken all together, diverse contemporary working structures embrace both physical and virtual work environments and practices.

Finally, for framing the discussion about material and virtual realms, the paper suggests that transformative effect of the technology will continue to redefine the content of materiality. Generally, the experience of materiality is to a large extent a cultural construction, shaped by machines used on everyday basis and their specific requirements (Picon, 2012: 107). Digital devices shape the motility of the daily routine and are the key component of blurring

the borders between physical and virtual realms. It is possible to argue that material reality today progressively takes the form of virtual using the aesthetics, vocabulary and communication pattern from digital technology. Place arrangements are manufactured by processes of digital thinking adopting representative forms that are “smooth and intersecting, polished and translucent, thin and diagrammatic” (Vidler, 2000: vii).

Therefore when dealing with issues of contemporary materiality the crucial considerations are not only materials and their use but the way they relate to the world they constitute.

Conclusion

"Every society - and hence every mode of production(...) - produces a space, its own space."

(Lefebvre, 1991:31)

As societies are produced and transformed, new spatial configurations emerge as a complex act of assembling social practices, financing models, technological styles and built forms. The main purpose of this work was to examine the link between techno-economic and spatial transformations, more precisely, to assess the role that knowledge and technology-intensive services, with their particular requirements and practices, play in development and transformation of building types.

The research began by questioning the ingredients of the present-day economic activities. While stating the link between techno-economic transformation of society and the evolution of built environment, the paper set out the goal to examine the resultant patterns of these relations. To do that, the paper examined two small-scale knowledge-clusters (entrepreneurship lab NUMA in Paris and research platform HOLM in Frankfurt) that give the account of the emergent environments where representative patterns of collaboration and innovation take place.

The relevance of the work lies in the fact that it brought into dialogue discourses, research methods and scales. It developed the theoretical framework for tracing spatial implications

on micro issues in urban planning, architecture and selected building types. The work postulated the concept of transdisciplinarity in order to enable thinking about building types as a system of spatial relations. Moreover, it discussed sets of attributes of the specific building types while embedding them into broader economic and social context.

Taken all together, the research confirms the hypothesis that relations of production occur in a space and provides evidences that knowledge economy has clear spatial implications. The research has shown that knowledge work is equally dependent upon physical and virtual networks and that the importance of physical space is not fading in the contemporary economic activity. Setting the interaction on the ground and establishing shared space for collaboration and innovation is seen as a decisive element of the conception stage of the new production space. Unprecedented combination of flexibility, decentralisation and networking that characterize contemporary mode of production requires particular organizational form and as the paper argues, settling knowledge-based activities within building type that is both the medium and the outcome of the interactions it organises.

Additionally, building type is analysed as an exact physical space that supports social activities enhanced by new technologies. Indeed, it is the transformative power of information and communication technologies that has permitted concepts of location and activities to be “networked” together. From the point of view of this paper, relational thinking in terms of connecting objects and processes is central to understanding contemporary spatial reshaping. Therefore, following research findings and recommendations will reflect this two-faced set of considerations.

The first finding emerging from this study is that knowledge and technology-intensive services organised in a form of small-scale clusters have a considerable capacity to link technological, urban and social innovation. On the one side, benefits of establishing knowledge cluster formats are already acknowledged from the business perspective. On the other side, finding the way to enable local knowledge systems to capitalize on their own legacy and skills without establishing parallel systems in situ that sustain intrinsic ideologies remains the crucial challenge.

Returning to the question of dominant production model, it is important to acknowledge Castells's predictions (in Graham & Marvin, 2001: 15) about global economy that “will penetrate all countries, all territories, all cultures, all communication flows, and all financial networks, relentlessly scanning the planet for new opportunities of profit-making”. As such, it will not be an egalitarian but highly selective process “linking valuable segments and discarding used up, or irrelevant, locales and people”. Seen through the lenses of the phenomenon analysed here, the paper suggests that the status that small scale knowledge clusters acquire will have the capacity to further shape “splintering” or “integrating” experience of the environment.

Research findings support strong recommendations that small-scale knowledge clusters should take advantage of their organisational hybridity and flexible programming while nurturing specific kind of relations: relations of bonds. From the practical point, having an incentive to be immersed in the local context as a member of advanced entrepreneurial ecosystem appears as important as having an incentive to approach the system from the outside as a citizen or a guest. Knowledge- and technology-intensive services have the capacity to connect to the neighbourhood, district and region acting as a fuel for the local entrepreneurial systems and urban life. Consequently, there is plenty of room for employing knowledge as the activity perspective in the local development as well as for recombining skills from different parts of the value chain in order to create innovation.

The second finding to emerge from this study implies the tendency of engineering space and new building types as a service. For the entrepreneurial- and engineering-minds space is a category of information that needs to be organized. The logic of digital technology operating as a set of reversible operations that modify organisations simply by rearranging the components is transposed straight into organisation of a space. Examined building types are shaped through the acquisition of data about human behaviour, patterns of work, needs and preferences. Design is applied as a catalyst to shape the future uses and identify new possibilities.

In the past years, the discourse on space has become a common terrain for tech- companies, policy makers, entrepreneurs and engineers. They all refer themselves to a vision of building types that would be better designed, managed and organised thanks to the intensive use of

digital technologies. “Technological solutionism” (Morozov, 2013) comes to light as a method of dealing with space induced by technological and economic pragmatism.

Further research is required to evaluate the relevance of evidence-based design, planning and programming of building types as well as the effects of techno-social engineering of space. It is an ongoing challenge to put in place scientific responses and design tools that would evaluate the interplay between advocacy of knowledge- and technology-intensive services and practical reality of building types.

Although existing in incomplete and partial forms, spatial expressions of knowledge economy embody the model for future development.

Small-scale knowledge clusters as discussed here represent emblematic conceptualization of the contemporary building types that are not built using the geometric logic of constructing and reconstructing, but that are assembled of heterogeneous networks of people and practices. They are open systems capable of absorbing new attributes, actors and roles without sacrificing the flexibility of the system. Hybrid architectural programmes, forms and building identity - they are indicators of profound changes taking place as a consequence of techno-economic transformations.

As much of the activities shift from classically assigned single-purpose spaces to integrative spaces, building types appear ready to generate variations. Typological investigation indicates that it can be expected that new combinations will occur to accommodate and express new conditions and purposes and that clarity of building typologies will be further challenged. Without any doubt, technological trends, business models and design novelties will continue to clash and resolve in the built environment.

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