Complexity and Digitalisation of Cities - Challenges for Urban Planning and Design

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COMPLEXITY AND DIGITALIZATION OF CITIES
CHALLENGES FOR URBAN PLANNING AND DESIGN

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Preword

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In recent decades, theories of complex adaptive systems have gradually started to enlighten the dynamic mechanisms lying behind many previously “mysterious” phenomena in the late modern Metapolis, a nonlinear, self-organizing city of flows in a constant flux. Complexity as a very explanatory set of theories has been able to expand our understanding beyond the illusionary linear progress of tradition monocentric cities. Along with computational development, theories of complex systems also provide methods to evaluate, measure and simulate complex non-linear mechanisms previously out of our reach, and building the ‘complexity planning praxis’ with baby steps.

However, we are now facing another related challenge of the accelerated digitalization of society, the consequences of which are yet to be seen. What we know for sure is that the complexity and unpredictability of urban life, ways we use and (re-)define the city, and the corporeal -built- manifestations of new urban life will change drastically. We are becoming more and more networked through social media and successively smarter gizmos; responding increasingly faster to the variety of transient attractions in the city, and (unintentionally) impacting the shifting of gravities of activities across

the regions in more surprising ways than ever. Small events may become trends overnight, just to be forgotten next week for the sake of others. Or cumulating input may emphasize the signals enabling big actors grow huge, swallowing small ones on their way to success, to vanish again… Along with myriads of applications we are becoming more and more capable of not only following and producing emphasizing signals, but also intentionally collecting, analyzing, processing and even producing data. These coupled spatio-virtual phenomena take place simultaneously in the "real" corporeal space, and in virtual world – apparently as real as the physical realm.

Our understanding of these interlinkages and generally the impact of digitalization in cities is still in its infancy. Apparently, virtual networks are complex adaptive systems as well, sharing similar features with systems in nature and in social/human systems. However, despite that complex theories of cities are also providing a robust framework for understanding these new digital phenomena –complex network theory, scaling, emergence, self-organization of information – it is likely that the dynamics of these very complicated, computerized socio-spatial systems go beyond "classical" theories. Consequently, more empirical evidence is needed, first, to learn from the systems' dynamics in a complexity framework, secondly, to reflect back from reality to complexity to build more fine-tuned theories of complex adaptive socio-virtual cities, and finally, to construct mental models and other sophisticated methods to steer the processes in which myriads of individuals mold the city.

Autonomous progress and digital tools

The following selected papers were presented in the 13th AESOP Complexity and Planning Thematic Group Meeting “Complexity and Digitalisation of Cities - Challenges for Urban Planning and Design” arranged in 15th-16th January 2015, in Tampere, Finland. In their papers, the authors explore how a variety of aspects of digitalization of society impact the city. First three papers of Al-Sayed and Deni, Baslik et al. and Saleh et al. contemplate the bottom up perspective of processes related to digitalization, such as the ways people use the city in virtual-physical interface or emergence of new temporary and (semi)permanent structures of digitalization eventually enslaving the system. Digital tools appear in these papers as methods enabling new patterns through changing behavior, for tracking them, or for simulating the bottom up urban dynamics.

The impact of social media and Web 2.0 on socioeconomic behaviour in the physical space in focus in the paper of **Kinda Al-Sayed and Suleiman Deni** titled “Virtual communities and patterns of social interactions in ‘Tech City’”. These affects are explored in space using space syntax theory, with a reflection of these physical characteristics to the social network (twitter) configurations in the case study of ‘Tech City’, London. Correlation between street network characteristics and the virtual and socioeconomic attributes of start-ups is scrutinized, and the findings indicate a correspondence between virtual network centrality and centrality in the street network, along with other patterns such as those in the individual dynamics of start-up firms especially in regard to relocation mechanisms of the businesses.

Mohamed Saleh, Gert De Roo and Katharina Gugerell explore in their paper “Unfolding the Story: Informal Communities Thriving by Self-Organization throughout the Egyptian Revolution” the massive transitions in the society as a result of social movements emerging within the interplay of virtual and physical worlds. In these processes, more or less temporary patterns emerge in a self-organizing and co-evolutionary manner, shaping new type of coupled, virtual/physical, self-regulatory public sphere. Potential forms of governance under these complex, self-managed circumstances are discussed, along with assumed novel roles of planning concentrating on identity instead of functionality, and necessarily considering interdependent informality and creativity of citizens.

In their paper “A simulation based upon land ownership pattern: the case of Istanbul” **Seher Başlik, Ercüment Ayazli and Mehmet Rıfat Akbulut** explore urban, bottom up emerging growth patterns of cities. The aim of the research is to discover a solution for the unpredictable and unsustainable urban growth, focusing in the case study area of Istanbul. A dynamic cellular automaton based simulation model is presented for predicting urban growth through transformations in land ownership and land use pattern. Land ownership pattern is considered as the major input for urban growth and in this study the primary variable, along with distance, land use and size of the area. The model dynamics is based on the dynamic plot division indicating growth, using applied “game-of-life”-rules, assuming the cell finally “dies” as it reaches the minimum size (200sqm).

Digitalization, governing and control

The latter three papers of Devisch et al., Unalan and Kuecker explore how ICT and digital tools provide new means to control, steer or self-govern the city. These approaches raise the question of the role of the top down level - either as an emergent pattern of participatory activities, or as a normative structure – stressing the fact that also this level should respect the systems' complexity. However, it appears that many applications do not, emphasizing also the necessity for a critical debate.

The paper of **Oswald Devisch, Jeremiah Diephuis, Katharina Gugerell, Martin Berger, Martina Jauschneg, Theodora Constantinescu and Cristina Ampatzidou** is titled "Game mechanics for civic participation in digitized cities". The authors make an argument that society is dualistic in nature with its goals: on one hand, it possesses a need to involve people more in its decision-making processes (top down view). On the other hand (bottom up perspective), is an increasing strive towards sophisticated co-creative methods of more emancipative participation, highlighting new aspects such as interpretation, reflection, and contextualization, that is, civic learning. Gaming, also supporting vertical and lateral trust, is considered as a good platform for this. In this paper, several game mechanics relevant to civic learning are described and discussed.

In her paper "Digitalization of cities from semiotic co-evolutionary perspective**"** **Dilek Unalan** explores how high speed digital communication systems create new spatial logics and urban patterns, and thus impacts urban spaces, communities and urban planning.

She introduces a co-evolutionary perspective in digitalization, which enables the emergence of new signifiers and meanings within the system. These create permanent transitions in cities through socio-cultural selection pressure. Unalan uses this theory as a lens through which she explore the level of influence of digitization in urban space, community and planning practices in Istanbul, revealing that ICT applications can transform urban space, but they can also emphasize socio-economic and cultural differences in urban communities. She points out that digitalization as such do not guarantee more democratic or just operation of the city, unless participants are treated as citizens instead of clients.

Similar critical issues are elaborated thoroughly in the critical essay "New Songdo City: A Case Study in Complexity Thinking and Ubiquitous Urban Design" by **Glen David Kuecker.** He considers this new urban form to be characterized by deployments of computer technologies and analytics that optimistically promise enhanced efficiencies within the urban metabolism, and overcome variety of humanistic and natural crises from climate change to economic and ecological degradation. However, Kuecker skeptically considers that these highly digitalized, utopian smart and ubiquitous cities are just a continuum of the Modern design system. They are aiming at increasing efficiency and consolidating the top down paradigm, which collides seriously with resilience/CAS theories and makes it harder to build adaptive capacity to recover from the crises inevitable in any complex system. Smart cities avoid the complexity of "natural" cities, and lack the necessary features for panarchic dynamic renewal. Kuckers remains very critical whether they provide a solution, if the bottom up "intelligence" of the citizens is missing.

VIRTUAL COMMUNITIES AND PATTERNS OF SOCIAL INTERACTIONS IN 'TECH CITY'

Kinda AL-SAYED and Suleiman DENI

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ABSTRACT

The impact of social media and Web 2.0 on socioeconomic behaviour in the physical space of the built environment had recently become a matter of intense debate in social sciences and human geography. This paper examines the relationship between the configurations of urban space from the perspective of 'space syntax' theory by Hillier and Hanson (1984) and the configurations of social networks in Twitter, whilst focusing on the technology start-up cluster in 'Tech City' London. Where there has been arguments made for a strong correlation between twitter ties in businesses and physical distance, this research is focused on the borough scale aiming to outline a relationship between the configurations of streets and the virtual and socioeconomic attributes of start-up businesses. The paper reports a moderate relationship between indices of centrality in twitter network

and its correspondent measure in street networks. In addition, the research yields global and temporal patterns of relationships with land uses and land values. The paper concludes by reflecting on how the configurations of twitter Tech-City community are present in the physical medium, where short and long links define the local and global part-whole relationship between Tech-City and other communities.

1. INTRODUCTION

The impact of social media and Web 2.0 on socioeconomic behaviour in the physical space of the built environment had recently become a matter of intense debate in social sciences and human geography. This paper examines the relationship between the configurations of urban space from the perspective of 'space syntax' theory by Hillier and Hanson (1984) and the configurations of social networks in Twitter, whilst focusing on the technology start-up cluster in 'Tech City' London. Where there has been arguments made for a strong correlation between twitter ties in businesses and physical distance, this research is focused on the borough scale aiming to outline a relationship between the configurations of streets and the virtual and socioeconomic attributes of start-up businesses. The paper reports a moderate relationship between indices of centrality in twitter network and its correspondent measure in street networks. In addition, the research yields global and temporal patterns of relationships with land uses and land values. The paper concludes by reflecting on how the configurations of twitter Tech-City community are present in the physical medium, where short and long links define the local and global part-whole relationship between Tech-City and other communities.

2. LITERATURE REVIEW

2.1 Twitter as a Social Networking Service

Since 2007, Twitter and Facebook have been the most successful social networks, in the UK it was estimated that the total number of users was 15 million for Twitter in September 2013, and 31 million for Facebook in December 2013[1].

Twitter is a social networking utility that limits posts to 140 characters for each message. An example on a Tweet user interface is displayed in Figure 1. Tweets may contain a mention, which links the tweet to a specific user, and a hashtag, which links tweets to specific pages with the same hashtag title. In Twitter, users can follow each other's pages. It is characterized by its wide accessibility through different means (see Figure 2).

Figure 1- A typical tweet in Twitter: 1. Hashtag 2. Mention 5. Link (WTWH Marketing Lab, 2012)

[1] *Source: www.rosemcgrory.co.uk [last accessed August 2014]*

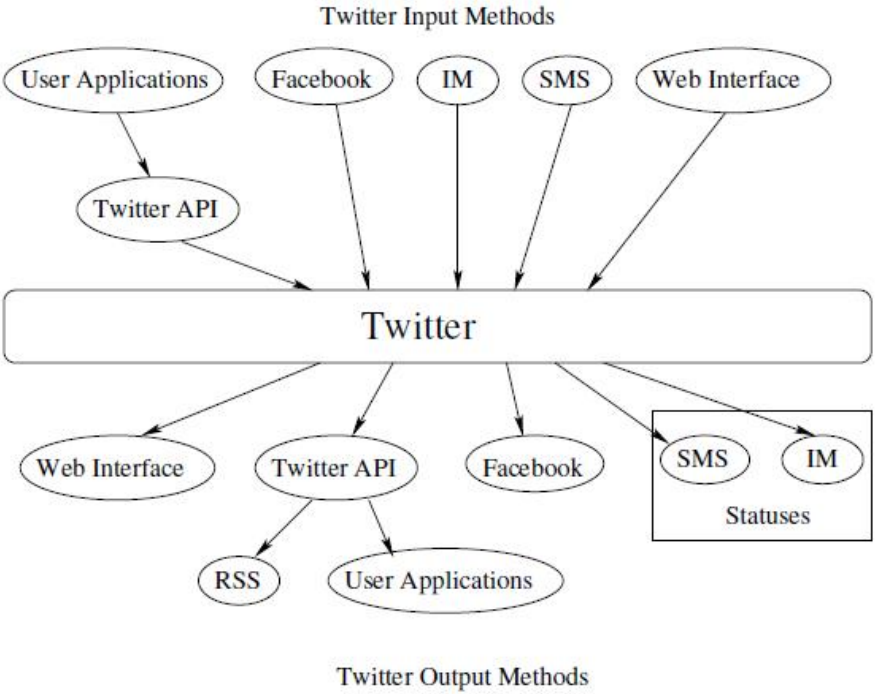


Figure 2 - Twitter Input and Output Methods Arlitt et al. (2008)

2.2 Interactions in Physical and Virtual Spaces

Researchers, including Atkinson (1998) and Morgan (2001), have seen what can be called 'the death of space' or 'the death of geography', as termed by Cairncross (2001), which points to the death of space with the advent of social technology. Cyberspace had been theorized, predominantly, as a 'space of flows' (Castells, 1996) and as in (Urry, 2007), part of a mobilities paradigm.

According to Castells (1996), the new millennium is articulated as an age of 'globalisation', wherein technology breaks the geographic boundaries and isolation of the developing countries. Castells (1996) introduced the term 'space of flows', where social practices dominate and shape a networked society. The space of flows can be categorized into three layers: the first contains a network of electronic exchanges; the second is made of nodes and hubs; and the third refers to the spatial organization of the dominant managerial elites (who direct the functions of the virtual space).

Urry (2007) introduced the mobility paradigm in an attempt to conceptualize 'movement-driven social science' (Urry, 2007: 18), focusing on the movement of people, objects, information and ideas of contemporary society. Urry's research introduced five mobility[2] paradigms, each constituting circulating entities between spaces, these paradigms were centred on moving entities and their effects in society. He has projected the value of places on their meaning and their affordances, but has not shown any awareness of the presence of street networks and the differences between neighbourhood configurations.

Castells' (1996) account of space is based on the concept that ancient societies were limited in their interactions to their own geographic zones, and had attempted to justify this conception through discussion of the gap in the development of technologies between China and the West. This is debatable, as there have been interactions between different cultures in the past; this misconception was referred to by Hillier and Netto (2002) as the 'myth of historical

[2] *These paradigms are: corporeal travel of people, physical movement of objects, imaginative travel, communicative travel, and virtual travel*

spatiality'. Moreover, it was suggested by Urry (2002: 16) that 'there are wide possibilities of virtual proximities simulating physical presence, especially with regards to proximities around objects and events'.

In the search for a theoretical overlap between social theories of physical and virtual space, Weissenborn's (2010) thesis had built on the body of work in Bill Hillier's space syntax theory (Hillier and Hanson, 1984; Hillier, 1996) through extracting concepts that could be integrated in a framework to be compared to the work on virtual space and society of Yochai Benkler (2002, 2006). Weissenborn (2010) found common ground between the two forms of space in 'morphic languages'[3]; specifically the notion of logical space[4] (Weissenborn, 2010: 55). However, in the virtual space morphic language corresponds to ' feasibility spaces' (Benkler, 2006), which through change unfold socio-cultural production, organization and communications, thereby creating a 'networked information environment'' (Weissenborn, 2010: 55).

2.3 Studies on Virtual Activity and Physical Presence in Societies

Social network sites are good sources for collecting data about networks' and users' behaviours. In one of the early analyses of the structure of followers and followees in Twitter (Huberman et al., 2008) which includes a sample of 309,740 users, it was shown that the number of followers or followees (see Figure 3) does not always

[3] *Morphic language in space syntax (Hillier and Hanson, 1984: 48) is defined as 'any set of entities that are ordered into different arrangements by a syntax as to constitute social knowables'*

[4] *Logical space can be defined as 'a discontinuous world of expressive forms, signs and symbols which we occupy cognitively' (Hillier, 1996: 305).*

indicate the number of friends; however, the number of posts increases directly with the number of close users (see Figure 4).

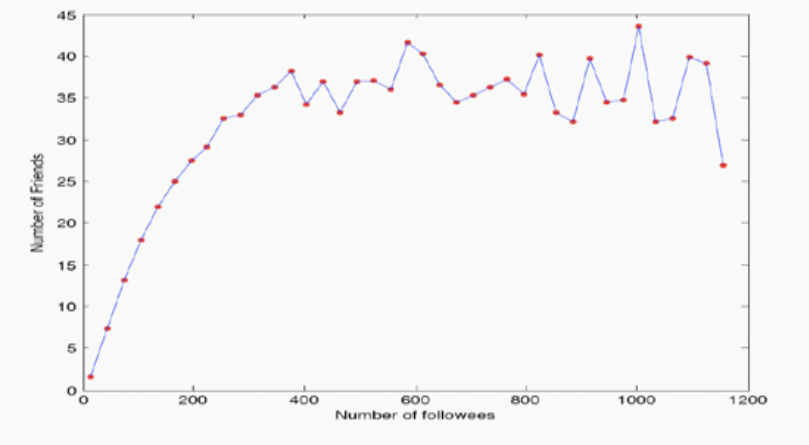


Figure 3 - Number of Friends against Number of followees (Huberman et al., 2008)

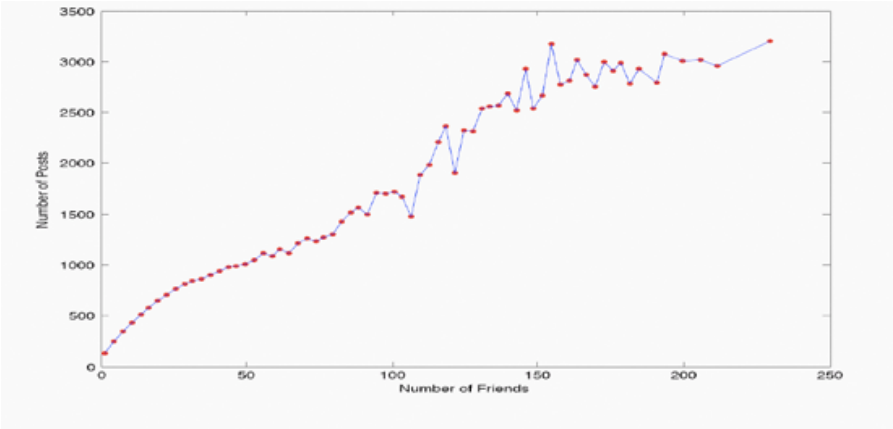


Figure 4 - Number of Posts against Number of Friends (Huberman et al., 2008)

There have been several studies examining user activities in the online and the offline life. One of the most prominent of these, (Cranshaw et al., 2010) compared the social setting of spaces, users' physical movement and their Twitter activities. It was found that the users' visit locations and regularity are better predictors of their social ties, i.e. their online friends. Based on a measure called entropy[5] as the main variable, it was found that if the users were observed with others in high entropy area (places with a high probability of encounters) those they encountered were less likely to be their friends in the social networks. In another experiment (Garcia-Gavilanes, Mejova and Quercia, 2014), it was shown that the business connections between different world cities in Twitter were biased by the inverse relation with geographical distance, with a correlation of r = 0.68.

In summary, there are several strands of research characterizing Twitter's user activity, explaining the variables (physical distance, language and coexistence) that influence the structure and intensity of social ties. Yet, to the authors' knowledge, there has been little research on social networks at street or district level taking into account urban space configuration and Twitter structure activity. Most recent research has been focused on taking relatively large clusters, which could possibly be explained by the popularity, density and the frequency of interest in online social network sites in the research areas.

[5] *As defined in Cranshaw et al. (2010) is the ratio of the number of space inhabitants against the study sample users*

3. METHODOLOGY

This section demonstrates the case study and the research methodology. The methodology used is based on datasets of two selected samples from the virtual space (twitter metrics) and the physical space (urban data and spatial configuration), then the data is visualised and analysed through qualitative and quantitative approaches.

3.1 Case Study

As a case study, Tech City is one of the densest clusters in London and has a strong reputation in the technology industry worldwide as the birth place of some of the key businesses on the Web (see Figure 5), including Last.fm and TweetDeck. Old Street and Shoreditch areas were the homes of a creative cluster in London accommodating galleries, dense with clubs and bars, architects, publishers and designers (Foord, 2013). The study area is highlighted in figure 6.

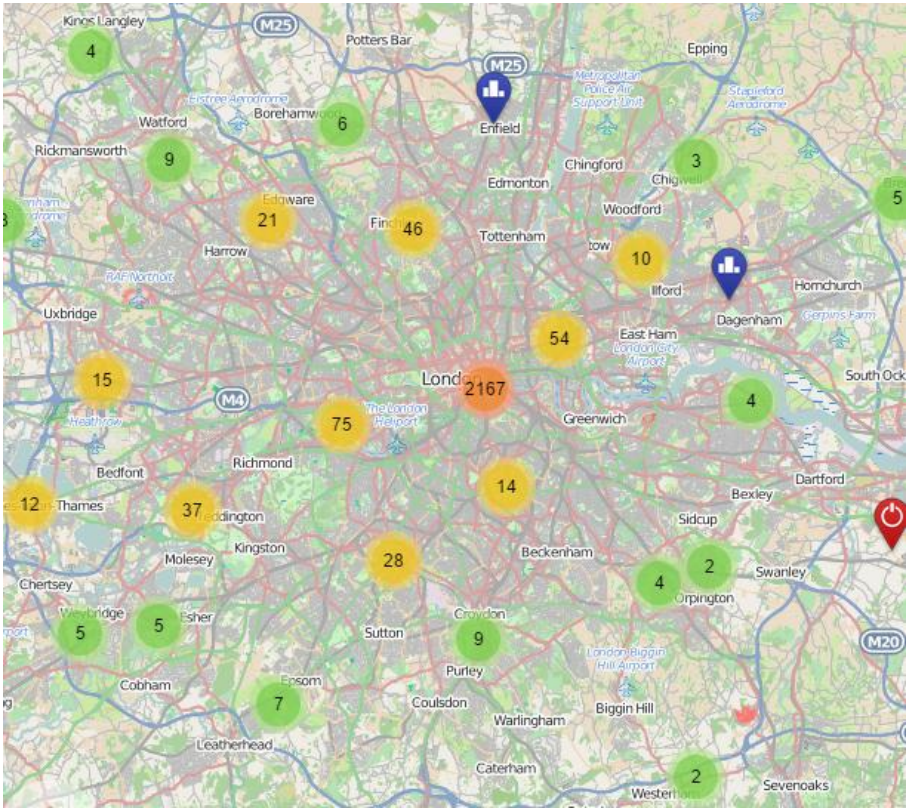


Figure 5 - London Map and the Study Zone Highligthed Orange (Techbritain.com, 2014)

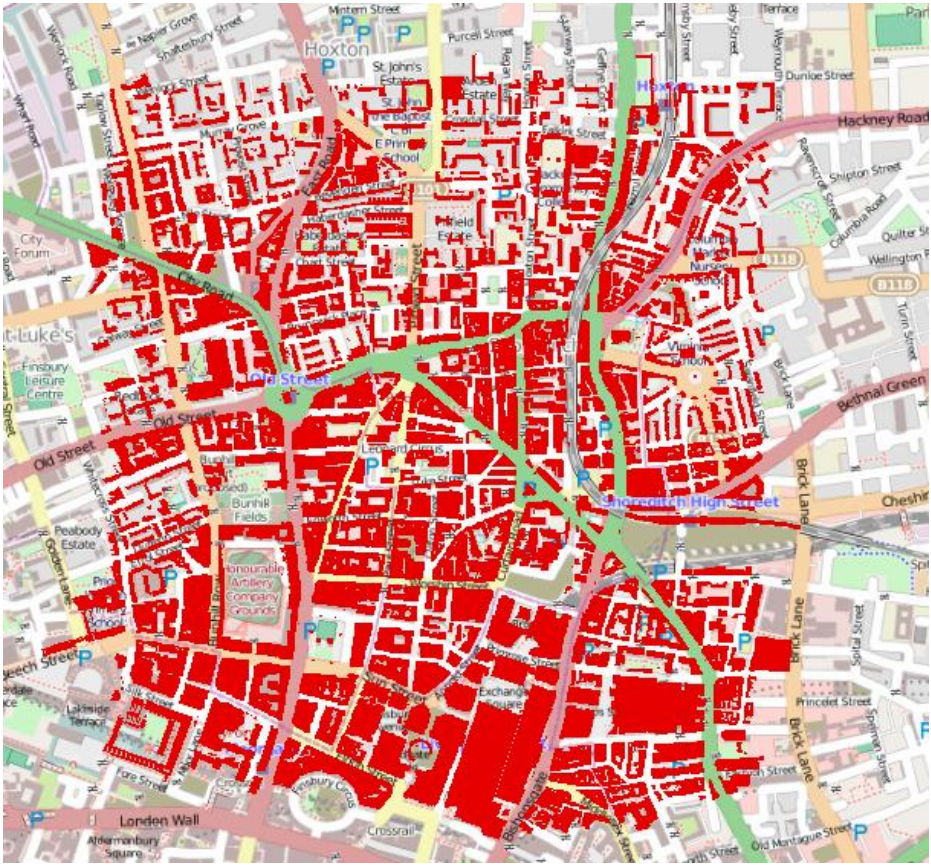


Figure 6 - The study area highlighted red.

The land use distribution and density vary in the study area. In the southern section there is a higher density of commercial properties, while residential properties dominate the northern section. However, most of the high rent areas are in the southern section, and prices decrease towards the north and slightly decrease towards the east.

As can be seen, the price increase has heavily affected the densest commercial cluster in the study area (see Figure 7); the average property price south of Old Street roundabout reaches an average of more than £664,000 pounds.

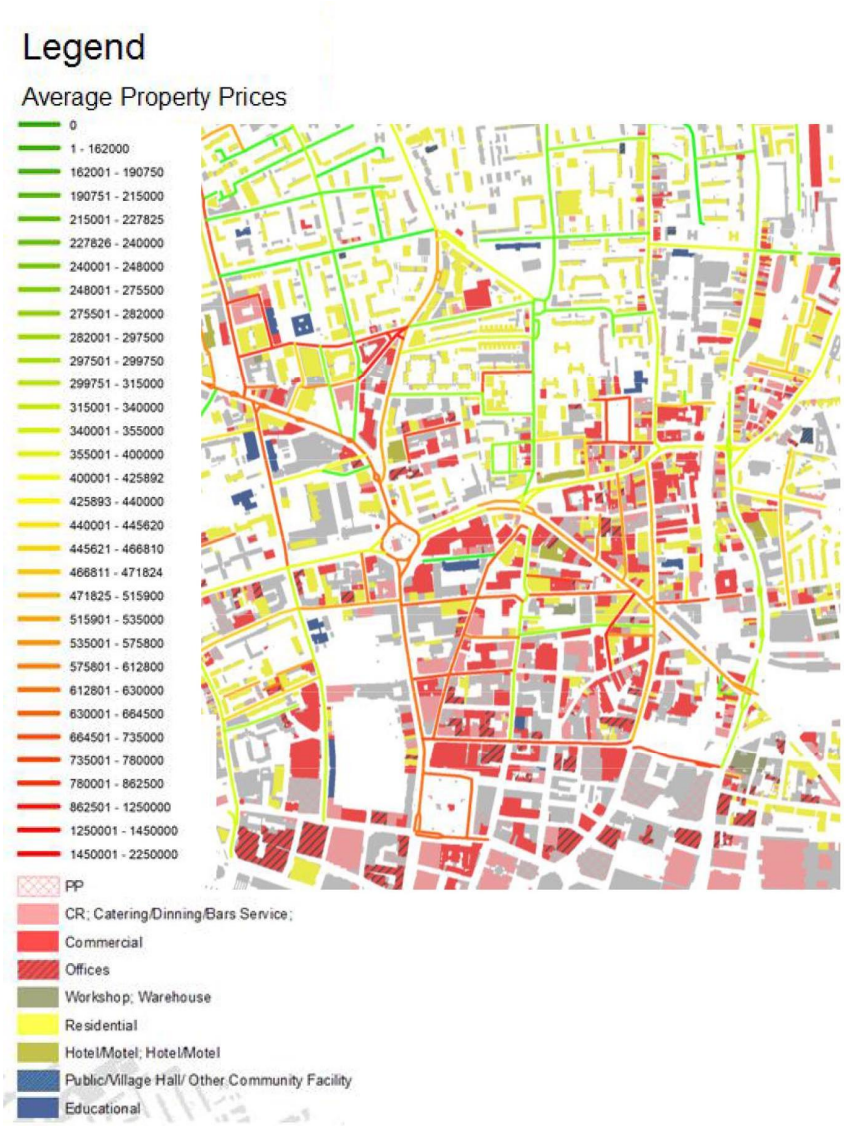


Figure 7 – Study Area Land Use and Average Property Values Map

3.2 Growth Environments and Tech City (Cluster Literature and Tech City Potentials)

As was identified by Daniel Isenberg in his article on starting an entrepreneurial revolution, which may seem to be the objective of Tech City, it was said:

> *"Governments around the world are recognizing that entrepreneurships can transform their economies. But most of their efforts to spark venture creation are wasted on trying to achieve the impossible-creating another Silicon Valley."*
>
> (Isenberg, 2010:1)

According to Isenberg (2010), the face of entrepreneurship around the world has changed forever, and new influential start-ups are originating from unexpected locations. As quoted above, the power a start-up can add to the economy has been realized by many governments worldwide. As an example, his reference to Estonia's Skype as a start-up, and the Finnish game 'Angry Birds', which was acquired by larger companies for millions. Due to the emergence of these companies from unexpected locations, it was said that there is no formula for success in the entrepreneurial economy, 'only a practical road map' which is based on the factors in figure 8.

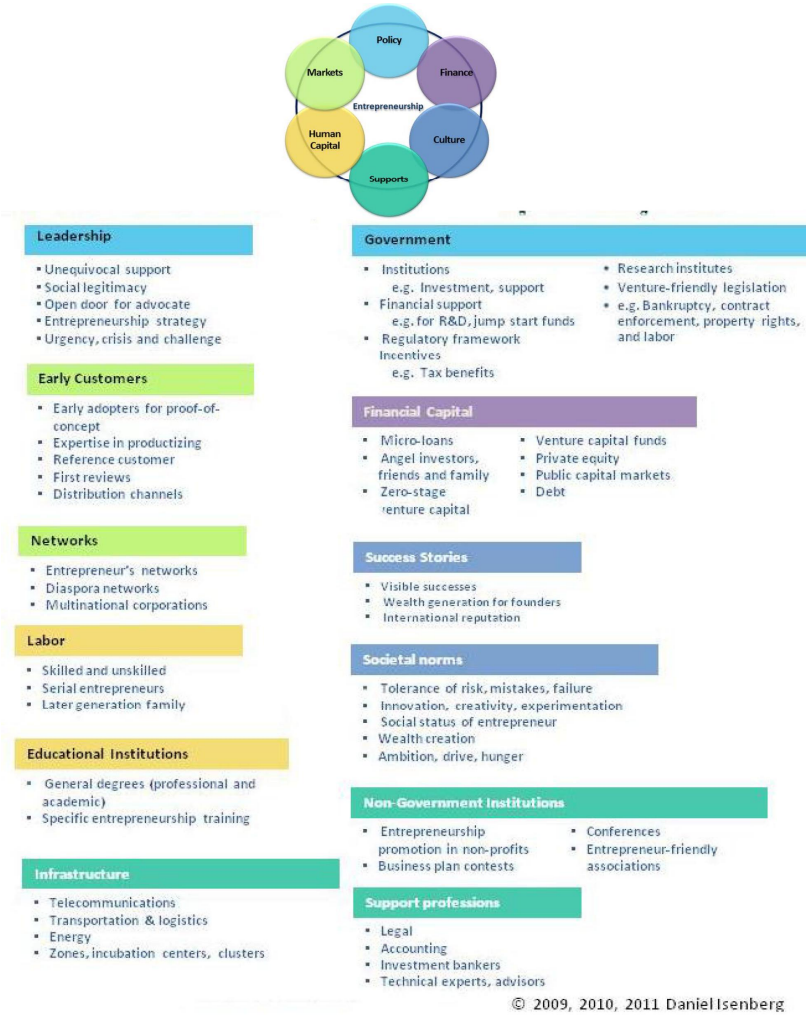


Figure 8- Domains of the Entrepreneurship Ecosystem (Edited) (Forbes, 2011)

Figure 8- Domains of the Entrepreneurship Ecosystem (Edited) (Forbes, 2011)

3.2 The Sampling Process and Companies Data

The largest accessible dataset of technology companies in the study area is techcitymap.com (see Appendix), where there is a list of companies with their Twitter accounts, their physical locations, and local Twitter metrics within the community. The target was to create a sample of a possible ecosystem within the specific study area. Starting from Tech City Map dataset, a list of 1472 companies with their Twitter metrics was used as a starting platform to select the 50 companies, which were then followed and cross-checked with other similar directories (see Figures, 9, 10, 11).

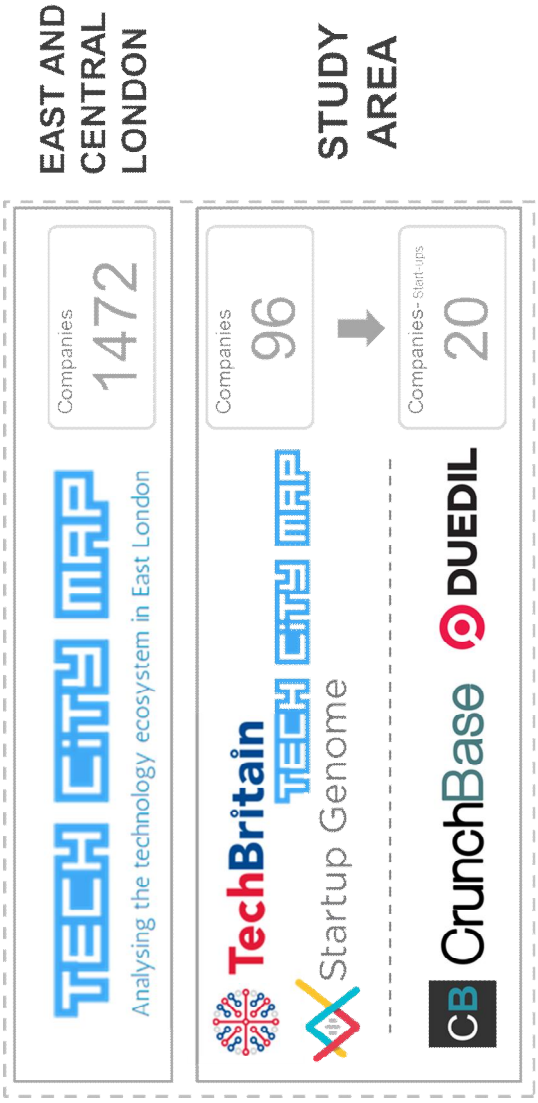


Figure 9- Source of Data and Samples

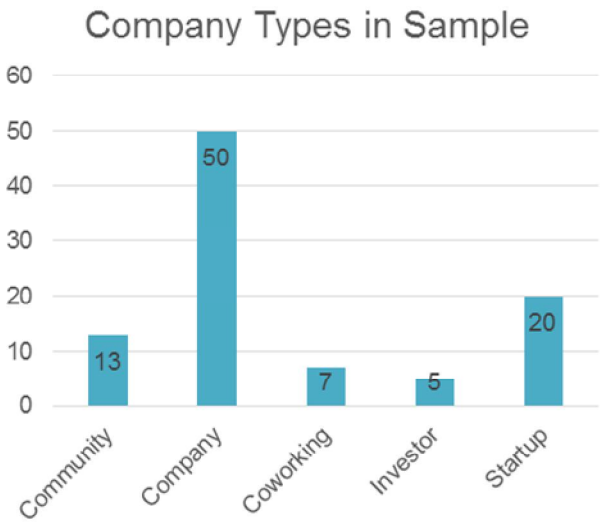
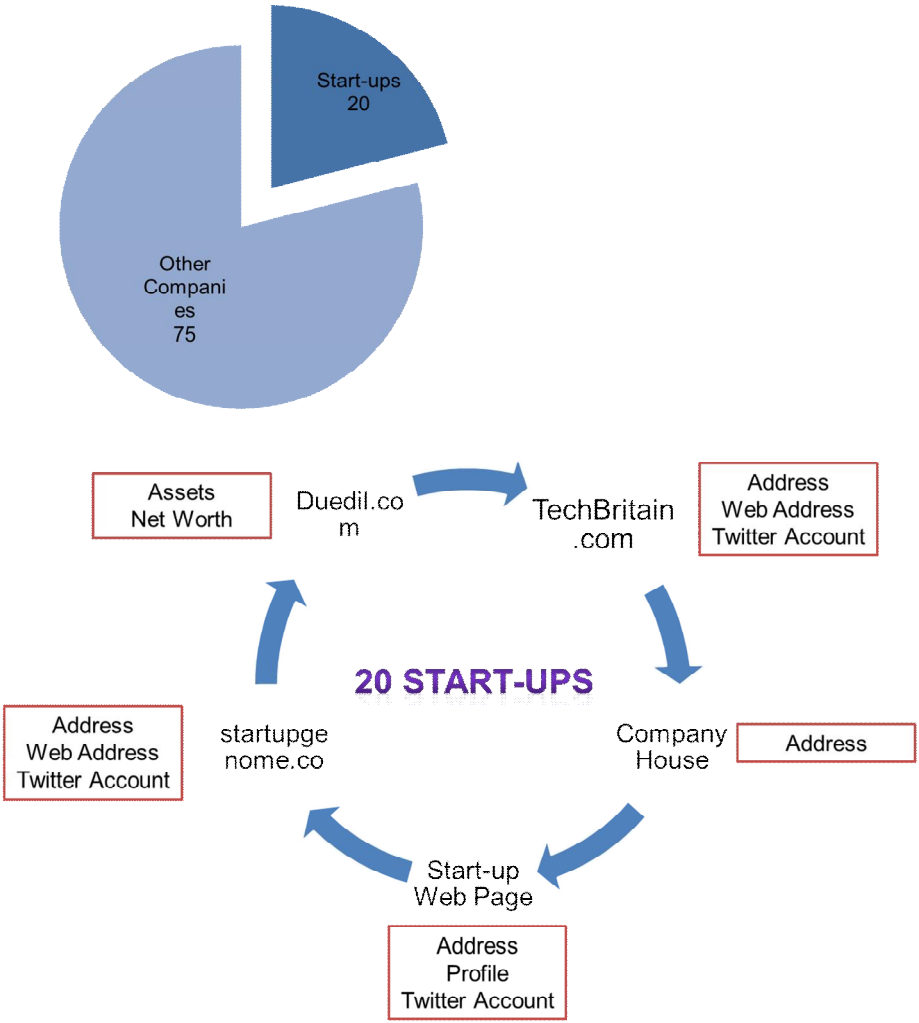


Figure 10 – The Company types in the Study Area Sample



(Figure 11 (part A). Data Building and Verification Processes)

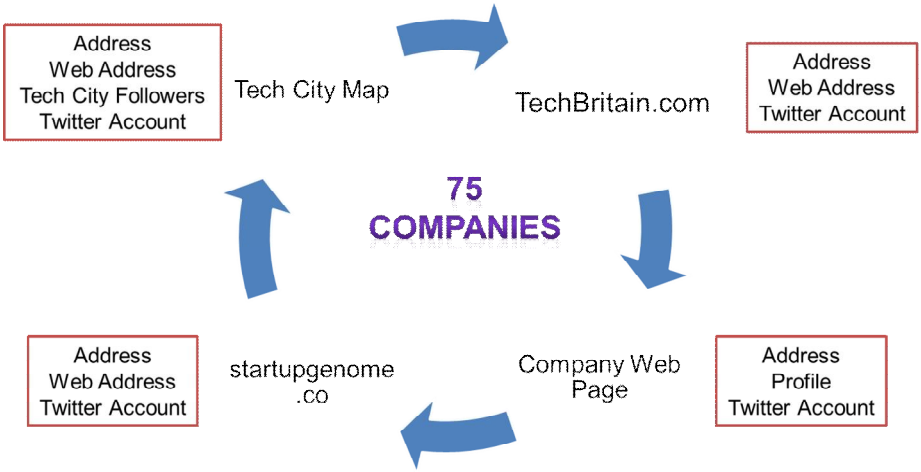


Figure 12 (part B). Data Building and Verification Processes

3.3 Twitter Relationships Visualization and Analysis Methodology

A list has been created of Twitter accounts of all the 1,472 companies in Tech City, with Twitter profiles data, using SocialBro.com[6] Web services, which includes the number of followers, followees and Twitter activity rate. A second more detailed dataset has been created of specific clusters in the study area, with its own Twitter

[6] *SocialBro is a popular social management website with a wide range of features and analytical reports.*

network data using the NodeXL[7] Excel plugin, to determine Twitter relationships and calculate the Twitter local networks metrics (i.e. as in-degree, out-degree, degree, betweenness centrality and closeness centrality).

After creating the dataset of the local Twitter network (figure 12), the variables were analysed and visualized for further analysis using Gephi and GIS software or JMP (see the Appendix for more details). The final analysis is to go through the specific Twitter account activity using an online analysis service 'Twittonomy', providing a deeper analysis of individual users. This analysis lists the top ten users mentioned and replying, whilst also highlighting popular tweets and popular hashtags.

3.4 Urban Data and Spatial Configurations

The base layer urban data (i.e. postcodes, land-use and street name) for the study area was extracted from Ordnance Survey (OS) and AddressBase Plus services to ArcGIS compatible sets. The average property value data (in 4 years frame) was collected from the Land Registry website and then these datasets were linked through street names in the study area. A street was taken as an indicator of the street property value.

Through a dedicated set of tools, (UCL Depthmap)[8], the configurational values for each spatial element of an architectural or

[7] *NodeXL is a free and open-source social network analysis and visualization plug-in for Microsoft Excel 2007, 2010 and 2013 with social network data mining functionalities (nodexl.codeplex.com) (see Appendix).*

[8] see Appendix

urban layout was computed. Space syntax offers different types of network-based models to represent space in a layout. One of these representations is the axial map. An axial map is the set of fewest and longest lines of sight that cover accessible space in a layout. A segment map is another type dual network representation, where each street inter-junctions is treated as a node and each intersection between two segments is a link.

To apply space syntax analysis on the case study, an axial map of 5km radius was extracted from the Space Syntax's 'London axial map'[9]. UCL Depthmap was used to run segment analysis. Data was then extracted to ArcGIS and linked to the street names, so it can be compared to other variables.

Configuration measures are related to social behaviour, and in this paper two key measures will be used: firstly integration, which is defined as the depth of each line/segment within the whole spatial network (which indicates to movement direct accessibility) (Hillier and Hanson, 1984:108); secondly choice, which can be defined as the likelihood of a line/segment for through movement potentials. The shortest paths in a network will have the highest through movement potentials and the highest choice values (Klarqvist, 1993). These definitions apply to topological measures of network distance. Angular measures of graph distance use some angular weighting to outline semi-continuous lines. The two main measures of angular segment analysis are angular weighted graph betweenness (choice), and angular weighted graph closeness (integration). These two indices were recently normalised to reduce the effect of network size; normalised angular choice (NACH), normalised angular integration

[9] Source of data: Space syntax Ltd.

(NAIN). The normalisation followed a recently invented method that weighs the effort made by shortening journeys by the cost of segregation in the spatial network (Hillier et al, 2012). Angular indices were proven to be powerful at capturing vehicular and pedestrian movement potentials as well as at highlighting catchment areas for active economic centres (Hillier et al, 2012).

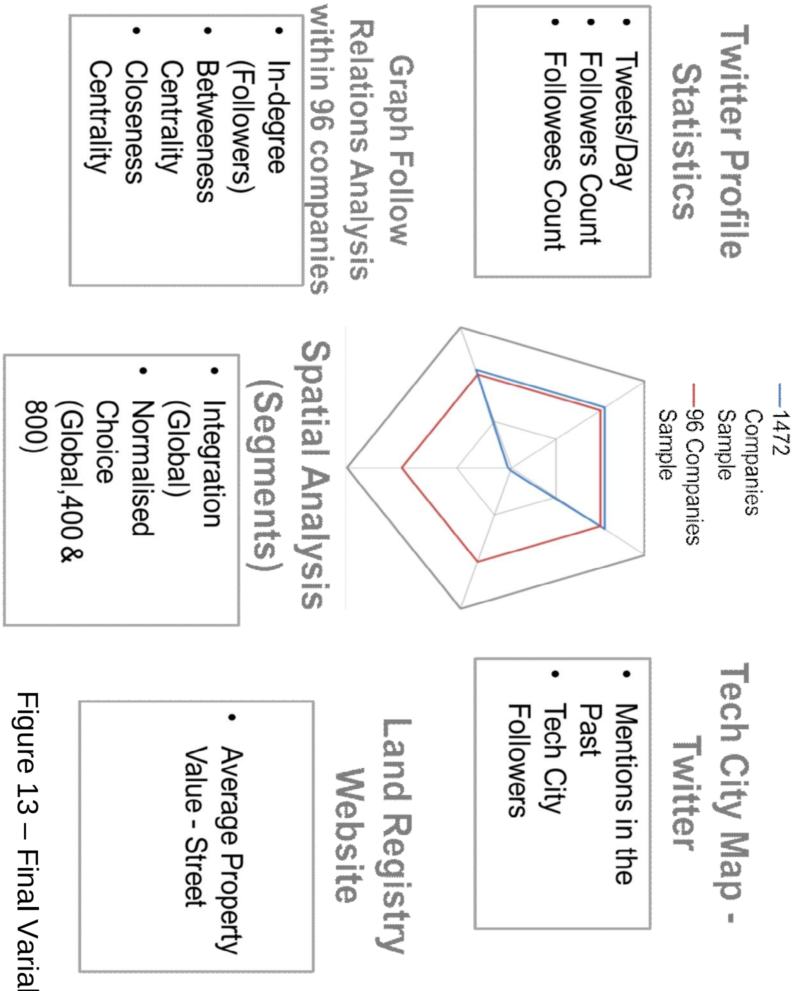


Figure 13 – Final Variables

3.5 Testing Process

After building the datasets (Figure 12), propositions are tested on the basis of quantitative and qualitative approaches. The datasets are first exported into JMP software to analyse the quantitative relationships between different variables. Twitter relationship patterns are then mapped and overlaid on the urban data for qualitative analysis. The analysis process is briefly illustrated in figure 13.

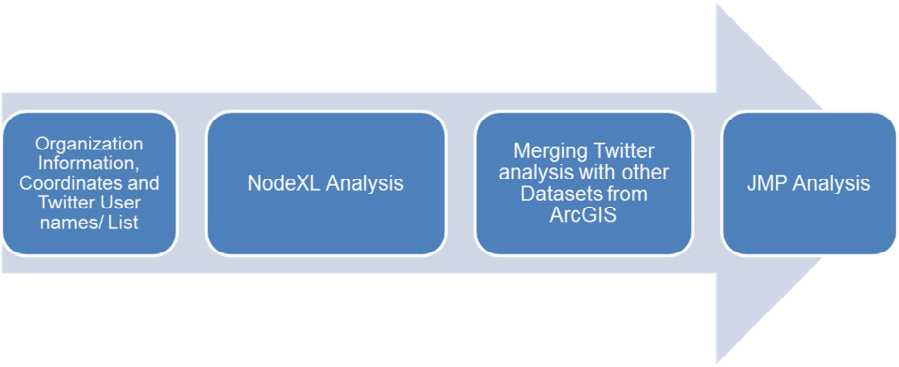


Figure 14 - A simple diagram of the analysis process

3.6 Analysis and Results

This includes the regression linear relationships analysis of the Twitter data of the first sample of 20 start-ups, and space syntax values using R-square values of the different variables, via JMP and Excel (check Appendix for further details).

Rsquare Values	Integration N	Nach N	Nach 400	Nach 800	Assets 2013
Tweets per day	0.052847	0.034384	0.050514	0.047771	0.001067
Followers	0.070679	0	0.004421	0.001915	0.259211
In-degree	0.12001	0.418976	0.516485	0.465311	0.069812
Closeness Centrality	0.000247	0.100549	0.129977	0.133776	0.157749
Betweenness Centrality	0.02881	0.016934	0.021461	0.022332	0.030705
Assets 2013	0.004235	0.010065	0.011984	0.020075	

Table 1 – Start-ups Spatial configurations and Twitter Analysis[10]

Rsquare Value	Integration N	Nach n	Nach 400	nach 800	followers	techcityfollowers
Tweets per day	0.000875	0.00468	0.007622	0.009154	0.092124	0.005333
TechCity Followers	0.028184	0.01292	0.004783	0.006154	0.08263	
Followers	0.000106	0.00712	0.017452	0.012768		0.08263
Indegree	0.000024	0.03226	0.046171	0.039765	0.014997	0.538067
techcity focus	0.025703	0.01085	0.002524	0.006992	0.006901	0.000076
Betweenenes Centrality	0.001096	0.00491	0.009352	0.009266	0.003824	0.479831
Closeness Centrality	0.004141	0.00016	0.001928	0.001275	0.014532	0.231193

Table 2 – 96 companies sample Spatial configurations and Twitter Analysis

Rsquare Values	Tweets Per Day	TechCity Followers	Followers	InDegree
Tweets per day				
TechCity Followers	0.040121			
Followers	0.034089	0.073673		
Indegree	0.048717	0.524823	0.012554	

Table 3 – Tech City Scale (1472 companies) sample Analysis

Regression Analysis

On the start-ups scale there is a weak relationship between space syntax values and economic performance, number of followers, and

[10] *This study included 20 start-ups, and was limited to 17 out of 20 observations, as three start-ups one had zero choice value and zero degree; one had relocated outside the study area and the other did not have a line within the segment map.*

Twitter Tech City's local configuration (See Tables 1-3). However, there is a moderate negative relationship between the number of local Tech City followers (In-degree) and normalized angular choice values peaking at 400 metre radius (see Figure 14). This shows that Tech City users in lower choice (through movement measure) areas have more followers from the sample. This means start-ups are more likely to choose areas with lower choice values within the street network.
Tech City Map, based on graph modelling as in the previous example, is added to this map but in this case there are 96 parties overall, including start-ups.

Examining Tech City followers from techcitymap.com (see Tables 2 and 3), there is a higher correlation between the sample community followers and Tech City followers than there is between Tech City followers and the global scale followers.

On one hand this means that users who were of interest to the sample are more likely to be of interest to other technology start-ups within the larger Tech City. On the other hand, this could show that in Tech City, Twitter users have far more users with broader interests outside the geographical area of Tech City.

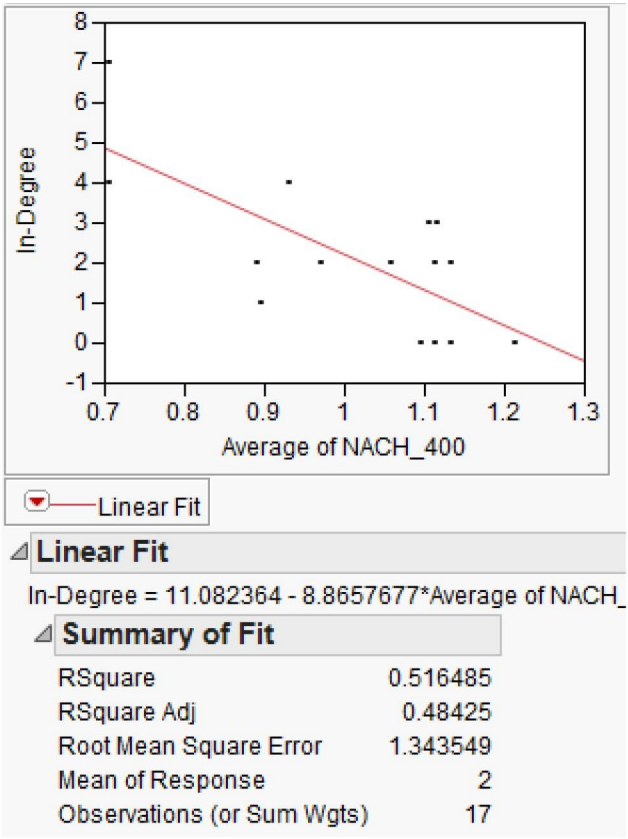
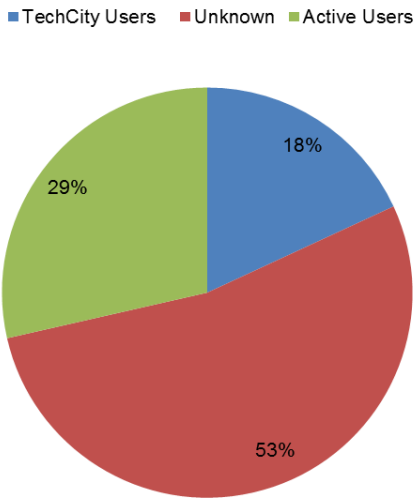


Figure 15 – Analysis of Start-up followers and NACH(r400)

Analysing mutual Followees

On analysing the number of followers of all 20 start-ups, the study area's central users can be found. After creating 20 sets of the start-ups' followee[11] lists, most of the top five common users were very active accounts with more than 100,000 followers. One exception is the username of an editor and TechCrunch's cofounder (Mike Butcher), who could be synonymous with TechCrunch but based in London. Within the set of users who had five or more mutual start-up users, about 29% were active users and at least 18% were Tech City users (see Figure 15). After examination of the data, Tech City users can be seen to have more mutual Tech City local followers and fewer Twitter global followers. After sorting Twitter users in order of the ratio of mutual start-ups' followers and total followers' count, six out of the first ten results were from Tech City London (see Figure 16).



[11] *Followees refer to those who are followed.*

Figure 16 – Twitter distribution of the most followed users

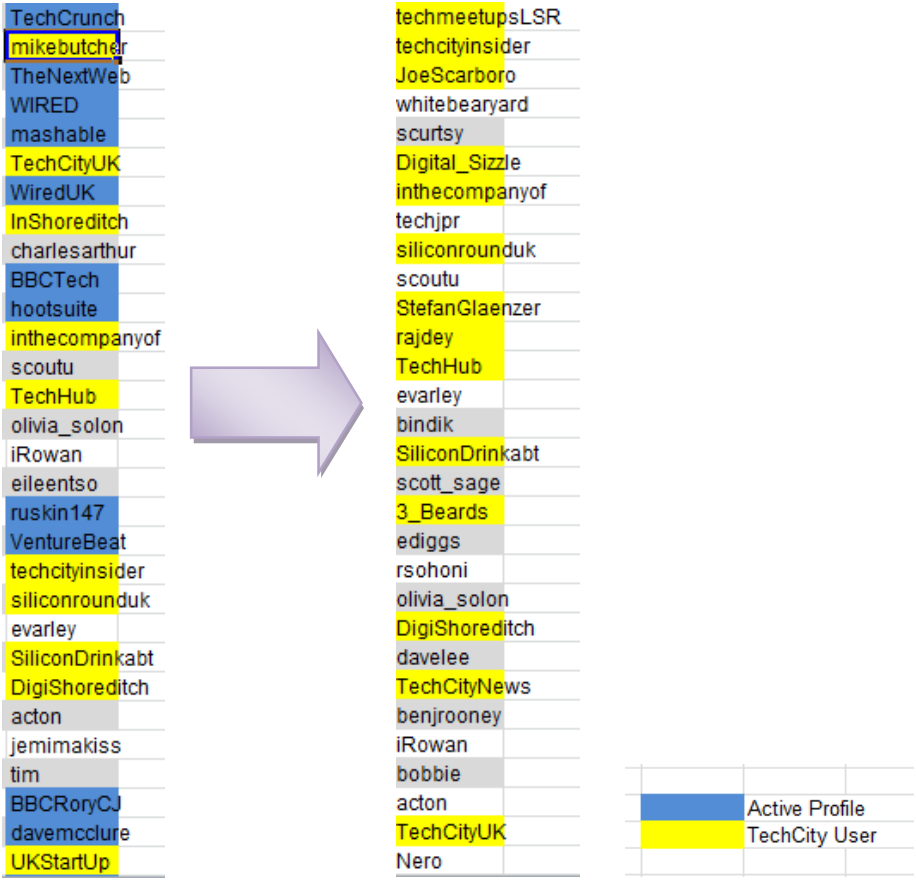
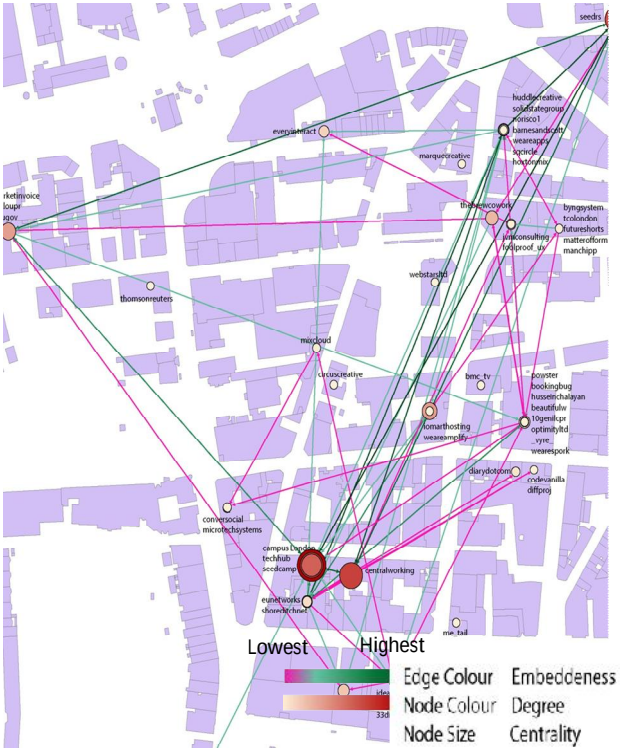


Figure 17 – Arranging Twitter list of all the start-ups from highest mutual followees to highest start-ups to followers ratio (all the followees have more than five mutual followers).

Tech City Start-ups' Dynamics

Some earlier findings in this paper highlight patterns in the static behaviour of start-up businesses in relation to their physical location and status in the twitter community. The analysis suggested that most technology start-ups are located in streets which have relatively low accessibility rates (low choice and low integration values) in comparison to companies and IT services offices (figure 17 and 18).



[2] (Figure 18, part A)

[12] *Embeddedness: "of an edge in a network to be the number of common neighbors the two endpoints have." (Easley and Kleinberg, 2010)*

Figure 19 (part B) – The first part shows Twitter Network Analysis on a large sample of users' relations compared to the second showing Office types and Accessibility (Spatial Integration) Values within the study area

The centrality of twitter networks of the sample start-ups and companies does not correlate with spatial centrality. As can be seen in figure 17, it can be said that centrality in the virtual network is more likely to be in areas where there is a high density of start-ups and venues than spatially integrated streets, yet there is a low to medium correlation which will be discussed further in this paper. Furthermore, community and event organisers tend to have many followers within Tech City companies and start-ups sample (figure 18).

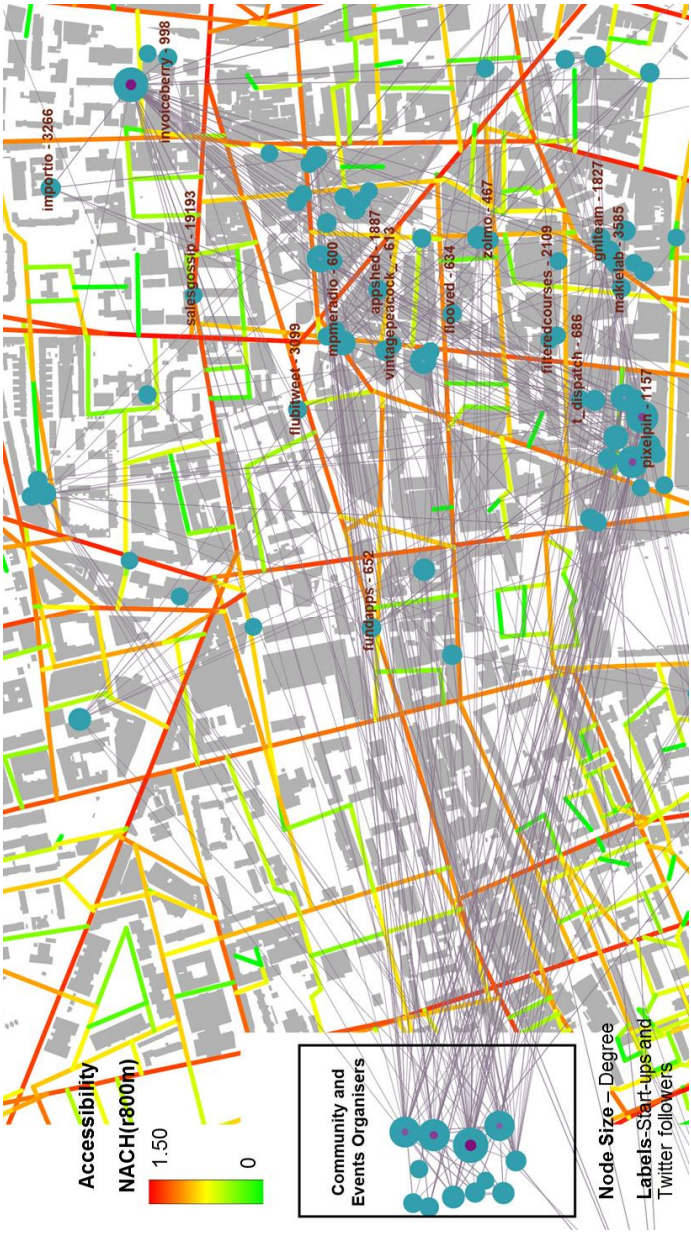


Figure 20 – NACH (r800m) Normalised Choice accessibility and the sampled Start-ups in the study area, the unlabelled nodes are workspaces and Tech companies

To reflect on the temporal dimension of their organisation in physical and virtual space, there is a need to trace their individual dynamics, hence we observe the behaviour of six start-ups in Tech City.

The analysis in (figure 19) suggests that after a period of their formation, five of the start-ups had moved to an area with higher choice value, although isolated from the rest of the clusters. Two start-ups, however, had moved to more expensive properties. We Are Apps Ltd had gone to more expensive property due to the company's interest in settling in a commercial shopping area (Soho) in order to be close to as many brands as possible, whereas in the case of Invoiceberry the start-up's move was towards a London metropolitan university accelerator space (Invoiceberry.com, 2011).

Further analysis of the six start-ups' interests, through hashtags and the favourite tweets ,as analysed by Twittonomy.com (2014), reveals that most of the hashtags used are centred on the product, offers and features only. For example, PixelPin was relatively better connected with local Tech City news and event organizers, which could be due to its repetitive appearance in the local media as a successful Tech City start-up. This case study has shown that the business type and status play an important role in the dynamics of Tech City start-ups, as well as land value and choice measures.

Company Name	Change in Integration N	Change in NACH 800	Change in NACH 400	Change in Street Property Value	Direction from main cluster
Import.io	-6%	24%	24%	-78%	Outwards
PixelPin	-20%	62%	59%	-23%	Inwards
We Are Apps	-2%	3%	1%	44%	Outwards
Filtered Courses	7%	27%	33%	-59%	Inwards
Invoiceberry	-50%	12%	13%	46%	-
Move Guides	33.48%	24%	34%	-37%	-

Company Name	Twitter Followers	Tech City Follower	Sample Followers	Tweets Per Day
Import.io	3266	5(0.15%)	2(0.06%)	4.79
PixelPin	1157	3(0.26%)	7(0.61%)	2.38
We Are Apps	304	8(2.63%)	0	0.97
Filtered Courses	2109	0	0	1.44
Invoiceberry	998	-	2	3.1
Move Guides	1611	-	2	4.85

Figure 21 – Six Start-ups' Dynamics Analysis

4. DISCUSSION

One of the key findings of this study of start-ups is the analysis of the relationships in physical life via the mutual followees study in the first section of the analysis; it shows that community and event organizer's accounts, where the community of Tech City is realized as a whole in the physical space, were also central in this study (see Figure 20). However, in the search for a relationship between the spatial configuration and position in the start-up focused sample of 96 users, a moderate negative correlation of r = 0.51 was found between normalized choice values and the number of the sample followers (20 start-up within a 96 users sample). The result may suggest that the ability to grow businesses in the virtual space enabled start-ups to choose segregated physical locations within the spatial structure of their locality, as these locations were cheaper to rent.

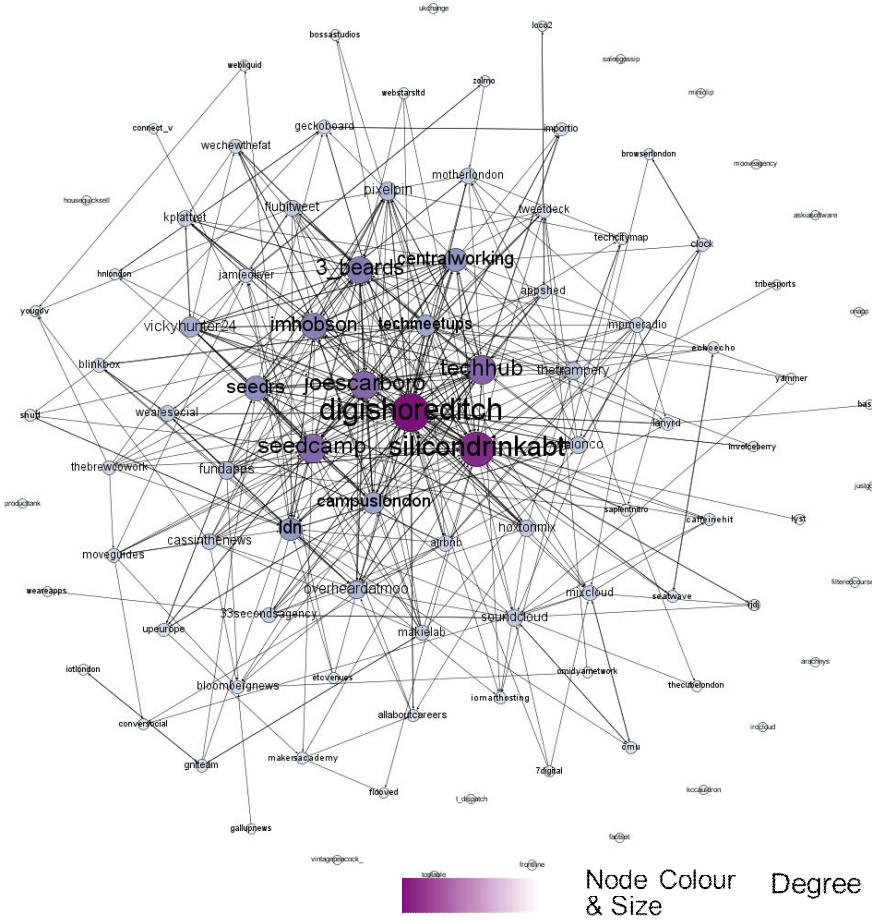


Figure 22 – The Study Sample (96 users) social network analysis (Fruchterman–Reingold Layout[13])

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[13] As defined by wiki.gephi.org (2014) 'The Fruchterman-Reingold Algorithm is a force-directed layout algorithm. The idea of a force directed layout algorithm is to consider a force between any two nodes. In this

The spatiality of the twitter community was not particularly strong. In general, there was a low degree of focus of the start-up accounts on neighbouring users in Tech City. The same finding was reflected again in the analysis of six users, which had shown a low focus in the sample and Tech City accounts list which was less than 2%.

Another limitation is the fact that most Tech City start-ups have limited financial resources, and the presence of other natively established businesses competing for similar office space forced many start-ups to relocate towards the cluster edges. Start-ups are limited to membership co-working spaces and existing warehouse style offices, which again restricts them to specific points within the overall study area. Secondly, as was shown earlier in the work of Huberman et al. (2008), the involvement of users in Twitter varies according to the level of Twitter engagement of their friends. In this case, it can be said that start-ups whose customers are from the Twitter public, as in the case of import.io, and sales conversations tend to be more focused and more active in the social network, thus the critical factor in determining the social network activity remaining under the engagement of parties of interest (such as customers, investors and community central figures), their business type and progress.

On tracing common followers in an attempt to find central figures in the study area, the common followees can be categorized into two categories according to their focus, whether it is in global or Tech City scale. The first group had international technology news blogs from different themes around technology, and the second constituted of

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algorithm, the nodes are represented by steel rings and the edges are springs between them'.

Tech City specific news, local Tech City community and Tech City's event's key figures. The difference between the first and the second group is in the ratio of followees to followers, which is high in the first and low in the second. This ratio distribution can be explained as a typical local to global online popularity contrast. Start-ups rarely follow other start-ups (see Figure 21). Follow relationships are formulated by desirable media content. Therefore, if the Tech City virtual community had to exist it would be centred around Tech City news accounts, community groups, key investors, events organizers and would more likely to follow each other.

The results from the final analysis of the six accounts show that most of the tweets which originated from them are promoting their progress and products; this was, as can be assumed, the main objective of the Twitter accounts. In analysing the relocation pattern of the six start-ups, the destinations had remarkably lower property values and the change of spatial configuration (choice and integration) was increasing.

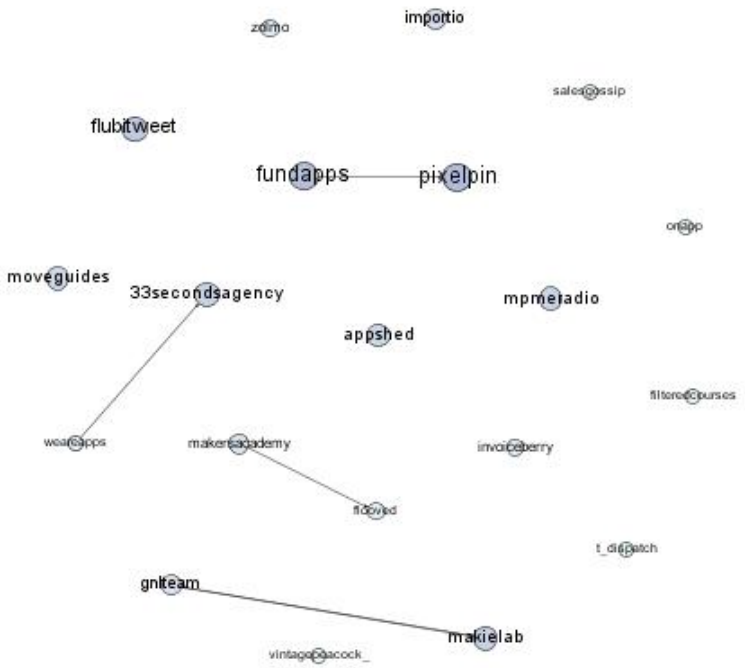

Figure 23 – Start-ups Follow Network

Previous research on the relationship between physical space and virtual space has had positive results. It was shown that virtual space is affected by physical distance, travel frequencies and language (Garcia-Gavilanes et al., 2014; Gruzd, 2011; Cranshaw, 2010). However, in the scale of the study area cluster, moderate to no correlations had been found between the spatial configurations, Twitter configuration, activity and start-ups' economic assets. Start-up

companies can be seen as individual, with distinct interests, but unified by common interests or goals.

One of the most controversial views on the social space was Castells' (1996) description of the virtual space as a 'space of flows' and his explanation of the virtual space as a new platform for trans-spatial relationships between societies which had not existed before (earlier societies were spatial and confined to their own borders – denoted a 'space of places'). The virtual space can be defined as a space of flows, but according to Castells the space of flows and the space of places do not intersect with each other, but rather create two parallel worlds. The findings of this present research confirm part of Castell's view, regarding the fluid characteristics of virtual space. However, our results disprove the claim that society's interaction in physical space and virtual space represent two parallel worlds, since we found that being central in virtual space does correspond with being central in physical space.

Theoretically, the way these two worlds intersect and link between users is manifested in how the individual socializes in urban areas. As pointed out in the Introduction, both virtual space and physical space might be decoded and encoded into a morphic language. Weissenborn (2010) showed that description retrieval is one of the most important components in morphic languages, which explains the way humans 'intuitively grasp' (Hillier and Hanson, 1984: 48) their position in artificial systems (as in cities and the Web clusters). Description retrieval is the mechanism by which Twitter users connect their standing in physical life to their life in the virtual world, bringing their interests and the reflection of physical interactions into the virtual space.

As described by Hillier and Netto (2002), in urbanized settlements the institutional space is the main sphere of each society and this space formulates the relationships of the individual through creating and controlling adequately large organizations for specific purposes. This definition of society in an urban space (as a reflexive society) is more consistent with the findings of this research. In the virtual space, individuals with common followees that have matching purposes or interests (as in the institution) tend to see the same contents and thus bring about a mutual information base which could equally influence these users. However, unlike that space there is no limit to the size of followers of an organization's page or the number of organizations in the virtual space; the only limitation is in the number of pages a user can fully track, depending on the time spent in Twitter and the activity of the followees, which leads some users to limit them. Therefore, as in the urban space, conceptual and spatial relationships can be carried into Twitter and can be spotted in the follow structure.

Framing the case under "aggregate complexity" (Mason, 2001:409), start-ups can be seen as part of a larger complex system a "whole" which is constituted of linked components inside the city. One of the objectives of Tech City was to build a Tech City community through creating a more flexible environment for self-organisation through creating a high co-presence of like-minded individuals from start-ups to established technology companies. This includes having a complex internal social structure where an individual can be a part of start-up workspace, a regular café visitor, active with start-up event organisers or a part of local club. However, according to the urban observations done earlier in the research, most of the non-member pedestrian activity was in the area that is central in twitter network analysis (Campus London building). Campus London accommodates two public floors which includes a café and meeting venues themed for

start-ups. There is a small share of the public space for start-ups in the study area; also most of the offices were parts of membership workspaces or rent spaces. In conclusion, it can be said that there is a spatial limitation which limits the chances for emerging relations and collaborations among the individuals who share the study area (particularly start-ups) in public and urban spaces.

Limitations

A major limitation was a result of Twitter's Search API which limits the number of requests and time frame of the data. This research would have benefited from studying a followers growth chart and the analysis of the growth of tweets over time before and after relocation. Secondly, although there were more than four directories; there was no consistency between them. The data quality of each was tested and the categorization in Tech Britain was used in this study.

Conclusion

This paper investigated a hypothetical relationship between configurations of urban space and the social network in Twitter, whilst also taking account of economic indicators that outline the performance of TechCity start-up businesses and property prices in the London boroughs where they cluster. The aim of this paper is two folds; to outline a global static pattern in how centrality in the Twitter network coincides with central and accessible spaces in the urban space, and outline a pattern in the individual dynamics of start-ups focusing in particular on the circumstances underlying the relocation of their businesses.

When looking at the global picture, we analysed Twitter networks separately and established their relationship with the configurations of street spaces property prices and land uses. After taking a sample of 96 users in Tech City, it was found that most of the start-ups within

the sample follow similar global influential pages as well as local community centres. Very few start-ups follow other start-ups in Tech City, and the follow relations in the start-up sample were mainly from, and centred on, community users. This can be explained by Twitter's fluid nature, being focused on the contents and encompassing primarily the company's operational interests, global interest and, finally, local interests including connections; however, the last could be visible to communities, as there is one community in the cluster, but less likely to appear in a random dispersed sample of 20 start-ups with 76 other active users. In spite of this, there is a moderate correlation of R-square = 0.51 between higher follow rates of start-ups in the sample and lower values of normalized choice. The relationship between start-ups locations and property prices is very weak for the sample under study.

When focusing on the temporal dimension of start-ups mobility, we found that -when relocating- start-ups would strategically choose to be closer to shortest paths, and often targets lower rent areas in the new locations. This is particularly evident for those with higher popularity and status in the virtual space – Twitter network. It is important to highlight here that this finding only holds for the six case studies that are investigated here.

As was indicated by Urry (2007), the mobility paradigms are actively circulating entities, including communicative and imaginative travel where there is a referential meaning added. The presence of the users on Twitter, as part of virtual travel, could be influenced by any of the circulating entities, such as movement of products or corporeal co-presence. The same conceptual society that is highly active had been visible from Twitter relations. On adapting the theoretical framework of Hillier and Hanson (1984) to explain the virtual space in

Tech City, Twitter proved to be a medium for conceptual relationships. These conceptual relationships were less likely to transfer into the physical sphere and manifest into spatial relationships. In addition, the number of restrictions on start-up choice of location within the cluster and Twitter's intricate interconnections made it difficult to distinguish a significant correspondence between activities in physical and virtual spaces. It is important to mention here that this result is only valid for the small sample that was analysed in this paper, and might therefore be vulnerable to the effect of outliers. In order to generalise our findings, there is a need to test our propositions on a larger case study, and perhaps compare our case to similar phenomena in different geographic locations.

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Appendix A

Glossary

ArcGIS - is a platform for designing and managing solutions through the application of geographic knowledge.

Betweenness Centrality – "is an indicator of a node's centrality in a network. It is equal to the number of shortest paths from all vertices to all others that pass through that node". (Wikipedia, 2014)

Choice – is a spatial configuration measure of the through movement in a space. A space with higher choice value has a higher concentration of shortest paths through the whole network. (Hillier and Hanson, 1984).

Closeness Centrality – "is an important concept in social net- work analysis. In a graph representing a social network, closeness centrality measures how close a vertex is to all other vertices in the graph." (Okamoto, Chen and Li, 2008).

Community - A community as defined by Turner (1986:84) is "the implicit law of wholeness arising out of relations between totalities" Turner had addressed an individual as a totality which cannot be a part of another totality.

Company House – is the official register of British companies, which includes director names, registered

address, change of registered address and change of directors history. Moreover, more statements can be bought online.

CrunchBase – a global database of technology companies and start-ups, which is run by TechCrunch.

DueDil – is a company dataset based on Company House data, which provide information about company's yearly statements, directors and registered addresses.

Embeddness- "of an edge in a network to be the number of common neighbors the two endpoints have." (Easley and Kleinberg, 2010)

Edges – is the line which connects on point in the graph to another.

Fruchterman–Reingold Layout - The Fruchterman-Reingold Algorithm is a force-directed algorithm, which sorts the nodes according to the force of their connections (Wiki.gephi.org, 2014).

Gephi– is graph visualization software which was created by students from University of Technology of Compiegne in France and the first release was July 2008. It has a dynamic and flexible interface where users can explore and interact visually with complex network visualizations. Gephi has wide library of styles, clustering algorithms and plug-ins. Its features include navigation, filtering and sorting network data through data tables. Gephi imports files from more than ten formats (including GEXF, GDF, GML and

GraphML) and it operates in Linux, Mac OS X and Windows.

Intergration – is a spatial configuration measure of to movement in a space. A space with higher integration value is the easiest to get to (access). (Hillier and Hanson, 1984).

JMP- is a statistical software which is characterized by its graphical interface.

Nodes or Vertex – is the main units in which the graph is made.

NodeXL– (Network Overviewer for Discovery and Exploration in Excel)is network analysis and visualization software which was created by Marc Smith's team and the first release was in July 2008 (nodexl.codeplex.com/wikipage/history) and the project is run by the "Social Media Research Foundation" (NodeXl, 2014). It stores the social network data in an editable excel sheets (Vertices, Nodes, Groups..etc)(Bonsignore et al., 2009). NodeXL has it is own library of network metrics calculations (such as degree, centrality and others) and a graph visualization feature (ibid). As many open source software, the data import and export feature from other network analysis software is superior and flexible; as NodeXL can work with GraphML, Pajek, UCINet and matrix formats (NodeXL, 2014).

Start-up – the tradition definition of a start-up is a company which is less than 3 years old. This definition does not apply to all start-ups. Another definition as reported from Adora Cheung in a Frobes article "Startup is a state of mind. It's when people join your company and are still making the explicit decision to forgo stability in exchange for the promise of tremendous growth and the excitement of making immediate impact." (Robehmed, 2013).

Twitter API– is a Twitter application programming interface (i.e. an interface on application mainly to edit and extract data).

- **Twitter Search API:** looks backwards for different queries (Hashtags, usernames or mentions) from the history of tweets roughly up to a week old. 1000 tweets to retrieved in one minute or two with a limit every 15 minutes. Requires less structure.

- **Twitter Streaming API:** Collects forward real-time stream data, requires time and structure background yet it is good for constructing bigger dataset and has a limit on the tweet rate delivery.

Twittonomy– Specialized Social Media analytics website with built-in. Extracts a list of the last 3200 tweets per user in an excel file or a pdf sheet. Filters and analyses tweets by date range. Analysis includes tweet frequency graphs in dates and hours, mentions pie charts of active mentions, popular hashtags, tweets and replies.

Virtual Community - 'social aggregations that emerge from the net when enough people carry on those public discussions long enough, with sufficient human feeling, to form webs of personal relationships in cyberspace' (Rheingold, 1993).

UNFOLDING THE STORY: INFORMAL COMMUNITIES THRIVING BY SELF-ORGANIZATION THROUGHOUT THE EGYPTIAN REVOLUTION

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ABSTRACT

In this paper, we will attempt to unfold the role of informality in the social, political and spatial transformations associated with the recent Egyptian emancipatory movements. In that respect, we will explore the interdependency between informality and creativity within communities of Cairo. We are mainly concerned with informality as a collective political platform constituted of a spontaneous coming together at critical moments. This consequence has a strong relationship with new entities that came to action in social movements lately. These entities are the interplay between a physical world represented in symbolic public spaces, and a virtual world represented in the social media and online tools. This interplay

resulted in spontaneous patterns and networks that have emerged from the bottom-up in a self-organized fashion. Along the process of this emergence, the collectives have gone through several phases of transition, through which they formed a group of creative social rules of behaviour to regulate their collective actions in critical moments. This behaviour was happening in a dynamic process of co-evolution between the physical and the virtual, shaping a new type of public sphere, which eventually resulted in a temporal stability out of a condition of revolution or chaos. This process in a later phase developed from the initial condition of self-organization to a form of self-regulated and self-managed environment. We suggest that this environment was nothing but an institutionalized outcome which was based mainly on the physical-virtual interplay. Considering this outcome we explore potential forms of governance in a world to come: A world that is highly dynamic, highly complex and rather anonymous. We assume these associate with new roles of spatial planning, with a shift in focus from functionality to identity. If our assumption is correct it will affect the planner's position within a co-evolving urban-virtual environment.

Keywords: Creativity, Future Governance, Self-organization, Social Movements, Social Media

1. INTRODUCTION

> *"if the river's fall is steep, the direction of flow is clearly defined (stable); but when the fall levels out, the river's situation becomes unstable – with the river hesitating, as it were, as to which direction to take. It*

> *then takes very little to determine the further progress of the river. Like a river, a city can also find itself in a vulnerable situation and invite creativity."*
>
> (Buttimer, 1983)

Since the year of 2011, major metropolitan cities in the Middle East and North Africa are witnessing unpredicted political, social and spatial changes. By the beginning of 2011, uprisings in these cities have escalated to revolutions of the so called, Arab Spring. In particular, our interest goes to the inspiration taken from the Egyptian revolution. When the revolution appeared in the streets, the first goal was to reclaim the public space in order to pursue freedom and social justice (El-Husseiny and Kesseiba, 2012; Castells, 2012). These events led to overthrowing a totalitarian regime, or in other words, ending a long nested dictatorship. This was carefully maintained and supported by global powers to prevent a possible radical Islamism (Ali, 2014). With that regard, we ask why the change happened at that time and not before?. There must be a new agent in the network that triggered or mobilized these changes. Castells (2012) undertook this by analysing the difference between 2008 and 2011 uprisings in Egypt. Almost the same initial movement failed to gain momentum in 2008, unlike three years later when it finally made a fundamental change.

Before the revolution reached the streets, there was a dynamic and non-linear process of events in a virtual world consisted of social media and digital tools. Gerbaudo (2012) went far to describe that as a tweeted revolution made by the Facebook Youth by drawing from previous literature about the Egyptian revolution. This phenomena

has extrapolated globally afterwards in other countries like Spain, Iceland, USA and Ukraine (Castells, 2012; Gerbaudo, 2012). Like a butterfly flapping its wings somewhere else, in different contexts the same networks have been able to adapt and co-exist (De Roo, 2012). In retro respect, the paper argues that this emerging digital age, or rather the digital revolution (Mitchell, 2003), has given the informal collectives new opportunities for empowerment. These opportunities were opened up by the use of social media, along with interacting with the public space. This resulted in spontaneous spatial patterns in a discontinuous manner, allowing creativity and novelty to occur at the moments of scale breaks within such patterns, which are far from stability: Moments of Revolt occurrences (Holling and Gunderson, 2002; Allen and Holling, 2010). In other words, we argue that the informal collectives' emergence was a consequence of processes of self-regulation, self-management and self-organization. Thus, we are discussing this process as a co-evolving socio-ecological system, surfacing in an urban-virtual environment. The paper is incorporating the case of Egypt's revolution within a Framing theoretical approach (Allmendinger, 2009), overarching theories of emergence complexity, self-organization and actor network approach (Portugali, 2012; De Roo, 2012; Latour, 1987; Luhmann, 1986). On that account, we assume this approach could further the ongoing argument on future governance and the roles of spatial planning.

1.1 Background

To understand these recent social and political transformations, it is helpful to historicize things first. Throughout this paper, we will take the example of Egypt, as we will build the story chronologically to explore the impact of social media and public spaces during and after

the revolution. Thus, a brief perspective is needed to discern Egypt's political and technological development. To start with, Egypt has long been the driving force for political, economic, religious and social development in the Arab World (Attia, 2011). In a way, it has been considered as an arbiter of peace and a model of moderation and diversity in its region, in terms of religion, heritage and culture (Shokry, cited in Attia, 2011). Such a divergence of identities is often considered by planning scholars as a pre-condition for creative behavior in communities going under a stage of instability (Hospers, 2003; Healy, 2008; Landry, 2008). The Egyptian population is young, with an average age of 24 years (Danju et al, 2012). At the end of 2010, an estimated 80 percent of Egyptians had a cell phone. About a quarter of household computers had access to the Internet as of 2009. But this was mostly excluded to the youth layer between 20 and 35 years in metropolitan cities such as Cairo and Alexandria. With regard to the social media, after launching the Arabic version of Facebook in 2009, about 5 million users were actively engaging in this network by the beginning of the 2011 uprisings (Castells, 2012; Gerbaudo, 2012). This youth generation managed to create a vibrant social media and steadily increasing citizen engagement on the Internet (Danju et al, 2012). This has allowed the Internet savvy individuals to virtually share information and ideas, creating a hybrid space of collectiveness and self-learning (Baraki, 2012; Keser et al, 2011).

New social media such as YouTube, Twitter, and Facebook, along with other means of virtual interaction, played an important role in communicating, coordinating and mobilizing the massive collective actions 'revolution' in Egypt (Kneissel, 2011; Ghannam, 2011; Cattle, 2011). It is also important to mention that the events of the Arab revolution have been one of the first occasions for social media to

stimulate fundamental changes. As we speak, this complex medium is increasingly expanding globally as a catalyst for grass-roots social movements. Due to the recent impacts of social media tools and networks on political changes, there is not much research that has been dedicated to them (Attia et al., 2011). The consensus on how to measure the effectiveness of social networking has not been fully understood yet (Hartman, cited in Attia, 2011). Pelling and White (2009), added that the psychosocial variables that cause people to use social networking holds great uncertainty. Nevertheless the areas in which social media mobilizes individuals and collectives are starting to be defined (Warren et al., 2013). It could be expressed as the use of specific types of websites focusing on creation and growth of online social networks which allow users to communicate in a virtual space (Coyle and Vaugh, 2008). We mean the virtual in a Deleuzian way, as in his eyes the virtual shouldn't be essentialized to be something less than real (DeLanda, 2002). He thinks of it as a new land of opportunities, able to drive an out-of-the-box thinking when facing challenges in our reality. This sense of newness is nothing but a creative capacity (De Roo et al, 2012). Coyle and Vaugh (2008) have conducted quantitative research to discover that these virtual tools compared to other forms of communication are exploding around individuals' abilities to be creative and expressive. Hence, this virtual-urban environment comes with a considerable amount of uncertainties. Besides, this environment has shown lately its capacity to produce large events through the interactions between its parts (networks, actors and connections), which is the core reason of a system to be described as self-organized. Moreover, we argue that the virtual and physical actors in this environment are extremely dynamic and affecting each other development over the time. This phenomenon of intertwined entities is more likely to be thriving through co-evolution. This environment has been able also to show a

great deal of adaptivity to co-exist in different contexts and cascade similar outcomes. This could be seen in the global-local impact and how social movements in different countries were learning from each other in a parallel time. Since this environment has the capacity to co-evolve, adapt and self-organize when exist in different contexts, it holds the key features of complexity. All of these non-linear behaviours are usually associated with the occurrence of change in an unpredictable and rather surprising manner when a system reaches a sort of a critical point. In our case, this point happened as a consequence of the desperate need of the informal collectives to act creatively in the spatial and virtual public spaces in order to overcome fear and oppression. Thus, we argue that creativity is the main driver for this system to self-produce and self-organize new structures and functions over time.

1.2 What is at stake?

As we discussed above, the issue of using the public space and online media in collective actions is to be considered very recent, but you can already fill a library with articles and books addressing it from many perspectives. Some scholars have based their study on merely observations in order to describe what was happening and how the collectives were using these tools to express their voices (Gerbaudo, 2012; Cattle, 2011; Attia, 2011). Others have taken the issue a bit further by deducing caveats and recommendations by linking it specific theories, with the purpose of extending some existing debates in different disciplines. It has been used for example by social theorists to develop the concept of self-identity (Pelling & White, 2009). Since the politicians were one of the most important stakeholders in this debate, they didn't stay passive about it. Thus, they researchers in this field have been very interested in the political

power of social media and its impact on the future policy making (Shirky, 2008). Other general approaches such as utopianism or futurism, technological determinism, postmodernism, and feminist critiques have also tackled the impact of this digital era on our contemporary communities. However, they seemed to offer limited or preliminary understandings when they studied this issue from their specific or separate perspectives (Mitchell, 2007; Kitchin, 1998).

With regard to planning, there have been several attempts to incorporate the use of these two worlds into the concepts of participative planning and the communicative turn (Baraki, 2011). Castells (2008; 2012) tried to use this relationship between physical and virtual communities, inorder to build a new conceptual understanding on his notion of the networked society and self-communication. Moreover, this issue has aroused several contributions to the approaches of e-governance and e-planning (Lodigiani, 2014; Brabham, 2009). Thus, we are trying to join this argument by discovering the new opportunities for spatial planning that could be discerned from this issue. We suggest a new approach to revisit the story of the Egyptian revolution in wider context, not from a merely political, social or technological approach, but we chose to tackle it as a complex scene between people, governments, physical patterns, and virtual networks. That is to gain a more conceptual understanding on how the informal collectives were changing the notion of public sphere, through their constant novel behaviour. So far, such a spontaneous behaviour couldn't be fully understood by the formal forms of governance. The purpose of this understanding is to open up a new milieu of adaptive governance which could fill some institutional voids between the formal and informal.

1.3 Main Question & Objective

After presenting the main drives for this paper, we can state that our main question is following: How can we add to planning practice by learning from the emergence of informality during the Egyptian revolution? In particular, what are the potentials that lie within this process that could allow planning to move towards more adaptive forms of governance in world to come?

It's the ultimate purpose of this paper to stimulate debate on the interdependency between informality and creativity within communities. By informality we refer to the informal collectives who were the main actor in the Egyptian revolution, and the spatial patterns that emerged in the public space because of these collectives. By creativity we mean the novel behaviour that was the developed along the emergence of collectives beyond the traditional pathways. We will then relate this emergence to a dual tension that goes from stability to a sort of chaos as the extreme opposite: Revolution occurrence. This will be constituted through unfolding the story in order to dig deeper into the process itself rather than the observable context and outcomes. In that sense, the reason for addressing creativity is to pick on the new added layer that retains the balance between the aforementioned extremes. The assumed layer is caused by the extension of public space to include virtual tools such as social media in the context of these communities. From the theoretical perspective, through integrating theories of self-organization and transition with the process of the Egyptian revolution, we attempt to explore how this virtual-physical interplay has resulted in changing the conceptual understanding of public space. Thus, we seek to explore this new form of shared space by tracing down the underlying process that led to it. This will be

addressed from a non-linear perspective in order to understand how and why this transformation in the public space came about.

1.4 Methodology

This paper is mainly based on joining an argumentative debate with the purpose of discerning meanings behind facts and metaphors surrounding our case. Thus we are using qualitative methodology, so as to address the topic based on the non-linear rationale which incorporates theories of complexity, self-organization, transition and co-evolution. Such theories that take great attention to change and dynamic networks are better studied and understood from a qualitative approach (De Roo, 2012; Portugali, 2012). In-depth ethnographies were conducted with 12 participants in the form of semi-structured interviews. The selection of the participants were based on including legitimate actors who were committed to the movement since the start and till the time this paper is being written such as activists, journalists, academics and initiatives founders. The participants were from a wide variety of ideological groups. Through these interviews, we tried to touch upon the internal dynamics of the initial social movement, and the patterns that have been formed as a consequence of such a spontaneous coming together.

Thus, we built the argument following four steps. First of all, we link the story of the Egyptian revolution to theories of self-organization, transition and co-evolution (De Roo, 2012; Allmendinger, 2009, Rotmans & Loorbach, 2009). We are addressing this through aligning the facts and events of the story to the ingredients and features of such theories. Second, we relate this theoretical framework to the

interdependency between informality and creativity. This interdependency will be unpacked by analysing the context and outcome of the story in the micro and macro levels (Coleman, 1998). That is why the qualitative approach was chosen, as it could offer a more holistic analysis to the emergence of informal collectives before and after the revolution. Then, we will discuss the new media's impact on the public sphere. The third step is to discover potential forms of governance in a world to come, and its associated new roles of spatial planning. This will be done by studying state-of-the-art implementations, with regard to the emergence of social media, informal collectives and public space. Then we present a multi-layer spectrum manifesting this relationship in a wider context. We suggest this spectrum to support our qualitative approach, as it represent an approach to formulate our understanding on the meanings behind the facts.

2. Theoretical Framework

This paper explores the possible use of theories of self-organization, transition and co-evolution, in order to generate a theoretical framework capable of addressing this case study from different lens. Embracing these theories is seen as a reasonable starting point for explaining the relationship of social media, informal collectives and public space. This explanation draws from issues such as open networks, dynamic behaviour, constant novelty and social and spatial change. Thus, these theories could provide a better understanding of the hypothesized spectrum that goes from stability to revolution by building on the framing theory approach, so as tointerrelate practical aspects such as institutional design and metaphysical aspects such as creativity and behaviour (Alexander & Faludi, 1996; cited in Allmendinger, 2009). In general, this paper takes the post-

structuralism approach to study the interrelationships and networks between involved actors (Allmendinger, 2009), then embraces an idealistic way of thinking as a gateway to explore the 'becoming' of governance and planning in co-evolving urban-virtual environment (De Roo et al., 2012). This idealistic thinking doesn't contradict with the post-structuralist and framing theory positions, but it rather support their objective of gaining more holistic knowledge on the becoming and away from the transcendence notions (Hillier, 2005). Thus, with these positions, we seek to stimulate a debate throughout this paper in order to pose a number of problems and opportunities for spatial and institutional design.

Then, as mentioned above, in this paper we chose to sail under the flag of post-structuralism. That is because one of the main characteristics of post-structuralism that it touch upon the connectivity between the social and spatial. Also this approach argues that places are always open and in a continuous flux with other places and spaces in time (Allmendinger, 2009). In terms of the social, it covers collaborative and communicative planning (Murdoch, 2006). With regard to informality, Ananya Roy (2005) argued that planning from that perspective might result in the 'unplanned' or the informal. Similar to that, Holston (1995; cited in Allmendinger 2009) imposed on this socio-spatial relation. He attempted to discover in which ways planning can better engage with and stimulate the variety of ways in which the 'social' influence and react to the rules of the state, especially the diverse communities that exist at the edges of the state, in an abstract manner 'the informal communities'. Allmendinger (2009) define this in terms of post-structuralism as a spontaneous order of society. Self-organization processes in these communities lies particularly within spontaneous impulses. Thus, by taking the post-structuralist position, we can dig deeper into the void between

the formal planning and the spontaneous nature of the patterns and networks that emerged because of the informal communities along the Egyptian revolution. Thus, we perceive the reality of this emergence as a continuous process of transformation and change, which derived us to understand its events from a non-linear perspective, so as to cope with it further phases. However, we aren't arguing that building a theoretical framework on this process will allow us to gain more certainty, but rather carving out future places and governance that can flow with processes that created these spontaneous patterns and networks (Harvey, 1996).

In short, we are addressing the relationship of social media, informal collectives and public space in a wider context, on a spectrum that goes from stability to revolution. This will be discussed as a self-organized process, which in return brings with it many uncertainties about the public sphere and governance in a world to come. A world that could include conditions in which traditional governance doesn't count as optimal or appreciable fit anymore. Thus, we associate it with the notion of more adaptive forms of governance that can cope or manage this relationship,which is going under a rapid and constant change. Finally, we try to contribute to the planning debate by seeking to discover what could be the planner's roles within such a co-evolving urban-virtual environment.

3. Informal Collectives and Patterns Formation

As mentioned above, in this paper we argue for utilising a non-linear thinking in studying the interdependency between informality and

creativity in self-organized communities. In this part, we try to understand how this self-organized behaviour happened in the Egyptian revolution, through touching upon the emergence process of informal collective along the revolution time trajectory. To start with, we need to refer to our understanding of self-organization, through which we will unpack the story. Self-organization as a system could be defined as an aggregation of individual actors and actions in micro level which spontaneously form an organized pattern in a higher scale (macro level) (Heylighen, 2010; Portugali, 2000). This understanding will allow us to discern the emergence of informal collectives, as emergence is nothing but the effect that is generated from the interaction of elements within the system in a spontaneous manner (Portugali, 2012). In our case, this emergence happen at a critical point within the system, as the interaction between parts has cascaded a large event or a revolution. However, such large events don't happen on a daily bases, they usually happen in very specific conditions. But in our case, the condition wasn't merely because of local inner forces in the Egyptian context. We argue that this critical condition was just initiated during the Arab Spring uprisings, but lately it has spread out in a global level, cascading similar outcomes in very different contexts such as Turkey, Spain or Ukraine (Castells, 2012; Gerbaudo, 2012). We suggest that this condition was a consequence of the new intertwined public space between the physical and the virtual.

Thus, by reflecting more on the case study, we impose that the main actor are informal collectives thriving by a mix of processes of self-regulation, self-management and self-organization. We noticed that this appears in the form of spontaneous spatial patterns in the public space. These processes are then assumed to transform into new possibilities in an evolutionary manner (DeLanda, 2002). By that we

think about the 'becoming' of these processes through tackle them as spatio-temporal dynamics rather than static public spaces (De Roo, 2010). Taylor (2003) described this, from Foucault and Kant perspective, as dynamic processes not directed by a specific actor; rather it is the consequence of interactions between different actors and networks. In our case, those different actors are the informal communities and collectives who deploy their creativity by using public space and social media. This creates emerging networks that is more likely to stay in a constant process of discontinuous change in structure and function, which could result in different frameworks for participation over time (De Roo, 2012). We assume that this emergence thrives by a mix of processes of self-regulation, self-management and self-organization, with informal actors stimulating these processes (De Roo, 2012). This resembles what derived us to consider them the non-linear rationale in approaching the story.

Thus, through the following parts, first we try to unfold the social and spatial transformations that happened in the metropolitan cities of Egypt such as Cairo and Alexandria. We approach the story from the relational perspective of post-structuralism, in order to discover the relationships between the interacting actors and networks (micro) and the emerged patterns in their context (macro). We chose an approach from social and behavioural sciences that could serve our objective. This approach is adapted from Coleman's boat that has been used to study similar processes with regard to revolutions and social movements (Coleman, 1998). Second, we theorize the time trajectory of the story using the phase transition theory to understand the different levels of development that were occurring along the emergence of informal collectives in Egyptian cities. This could allow us to link different tipping points and thresholds to their output. This will be translated later on to the institutional capacity that lies with the

process of emergence, which we relate strongly to the theory of self-organization.

3.1 Unfolding a Moment of Revolution

Through this paper, we are trying to construct a wider context that includes the emergence of the social media, informal collectives and public place. While doing so, we seek to the answer the question of how the virtual tools will co-evolve towards a dynamic medium, in which informal collectives can engage their creativity. If that would ever happen, then which governance forms could be tailored enough to cope with this world to come? We suggest studying this emergence by understanding it as a self-organized process. Such a process is highly concerned with the interaction between the parts in the macro level in order to cascade impacts on the macro level. Thus, drawing from social science theories, we study the relationship between macro-factors (context and outcome) of the case in Egyptian cities, and the micro factors that underlie their causal relation (choice and behaviour). The concept of Colman's Boat is therefore used to unfold this relationship (see Figure 1). The main objective of this model is to study the 'relationship between macro-factors (improved social conditions, occurrence of revolution) and the micro factors that underlie their causal relation (frustration, aggression)' (Mayntz, 2004; Coleman, 1998). The model can also be applied to processes of change in a given social structure or institution. Micro1 stands for individual reactions to situational givens determined by Macro1, Micro2 for the behaviour thus induced (Little, 1993; cited in Mayntz, 2004). This model is then reasonable to be used in order to explain

issues of fundamental socio-technical changes, such as those in discussion.

First, the context that we are dealing with was a country had been under a nearly constant state of emergency since 1967 till 2008, allowing the government to squash protests, censor the media, and detain citizens for long periods of time without formal charge (El-Husseiny and Kesseiba, 2012). Then citizens are now empowered with social media tools to force the system, particularly the government, to listen to what they care about and to demand respect (Kirkpatrick, 2011; cited in Warren et al., 2014), which is according to Coleman (1998) pictured as an improved social condition. Afterwards, the outcome was obviously an occurrence of revolution. This has appeared in the emergence of informal collectives through social media and the desire of these collectives to be identified with and to make a statement at a public place. In beginning, this process was proceeding in a spontaneous manner without particular intentions to form any patterns. Then after the collectives constituted a form of togetherness both in the physical and online public spaces (Castells, 2012), they developed the outcome of their initial emergence into a second phase. In this phase, they reshaped these public spaces in terms of function and typology (Attia, 2011). They have reshaped the public space based on new social agreements or conventions, with the purpose of imposing an idealistic image of unity with diversity in terms of differences in ideology, religion or political view. Lévy (2005) described this phase as collective intelligence, a 'form of universally distributed intelligence, constantly enhanced, coordinated in real time, and resulting in the effective mobilization of skills'. Surowiecki (2004; cited in Brabham, 2009) researcher several case studies to discover that 'under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them. He

presented this concept in his book The Wisdom of Crowds. We relate this behaviour to an advanced level of self-organization towards self-management.

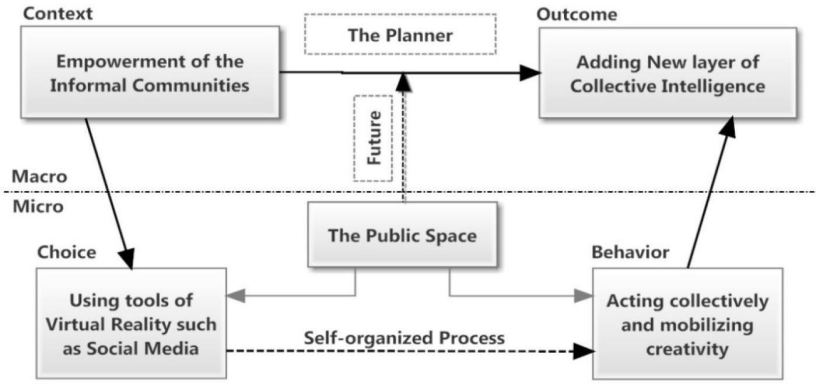

Figure 1: Discerning the emergence of informal collectives in micro scale and their impact on the macro level (Adapted from; Coleman, 1998; Mayntz, 2004)

On the micro level, the choice can be related to the availability of resources and actors' efficacy in using them effectively are essential, which draw back from resource mobilization theory and social movements (Jenkins, 1983). In addition to resources like a motivated citizenry and the availability of transportation to gather in mass, a significant resource for the Egyptian revolution that was utilized effectively was social media (El-Tantawy and Wiest, 2011). Della Porta and Mosca (2005) add that internet-based communication

technologies provide an important additional resource for social movements implemented by “resource poor” actors, offering a means for mass communication that may have previously been restricted by financial, temporal, or spatial constraints. Christensen and Christensen (2013) have related these limitations to the concept of “ephemeral communicative space”. This concept refers to patterns emerges spontaneously as extensions of pre-existing communicative space, in our case this happened in the critical case of revolution. This could be linked more explained more deeply through the idea of self-organized criticality (Heylighen, 2010). Accordingly, the resulted behavior was the act collectively and mobilizing creativity through the use of social media and public space. In this process, there were signs of producing a sense of self-regulation in the ways the collectives were managing their occupied public space, and the ways they were self-learning to use the online public space for their better good. Finally, through this analysis, we attempt to answer, why this change at that time? One of the obvious reasons is that it was a result of the youth excess and the spread of new information technology such as Internet, e-mail, Facebook, YouTube and Twitter (Baraki, 2012). Currently, frustrated youth are increasingly moving to exploit these new resources to empower themselves (Al-Zubaidi, 2011, cited in Danju et al., 2013). This process is relative to our choice to consider concept such as self-organization, through its constant generation of new possibilities in an evolutionary manner. The new rules of behaviour that emerge in this process support our assumption about its future development with regard to self-management and self-regulation. This could be associated with new roles of spatial planning, with a shift in focus from functionality to identity.

Now we give a more clear reflection of this conceptual understanding and how it was appearing in reality during the Egyptian uprisings in 2011. In particular, we chose the most popular place to the international media, which is Tahrir Square. This symbolic public space was the first place in which the Cairene communities have gathered in order to transform their collective actions through social media into the physical world (Attia, 2011). First of all, choosing this place in particular wasn't to gather in massive way wasn't planned from the beginning, and it is worth mentioning that this place in particular hasn't been used before in any previous huge uprising. But when the collectives found themselves gaining numbers there, they discovered that it was the perfect choice. The square was surprisingly centred geographically in this metropolitan city, and it has the perfect location for their statement, with most of the government important buildings just around the corner (Castells, 2012). Thus, in the matter of three days, this social movement has spontaneously transformed from being a minor online initiative towards a parallel capital ruled by informal collectives, and away from Mubarak's police government (Ghannam, 2011). We use the term 'capital' is used as a metaphor for what has emerged out of the initial self-organized condition. The place has been reshaped by the collectives both in functionally and structurally. In terms of structure, this vast square has been divided into different places according to social agreements and conventions. This was because the collectives needed to create vibrant activities (functions), to impose their statements (Attia, 2011). These activities were including protecting themselves against violence, cleaning the place, leisure, basic needs, and most important keeping themselves informed about what was happening outside in order to stay connected with the online public space. The latter was important as it was one the main factors that helped the collectives to organize their actions and continue the self-learning process (Castells, 2012).

3.2 Theorizing the Story

The purpose of this study is to deduce dynamics from the case, which resulted in a fundamental change from stability to revolution; a concept that we will build in the form of a spectrum, as a step forward in making use of understandings. These dynamics are assumed to be mainly stimulated by processes of self-regulation, self-management and self-organization. Thus, we support our choice to consider self-organization theory, by correlating it with key features of transition theory due to its emphasise on the impact of critical moments and thresholds in a dynamic system (Durlauf, 2005; cited in Van Wazmael, 2012). The transition theory defines change as non-linear movements or leaps from one stable level to another (De Roo, 2012; Rotmans & Loorbach, 2009). This could be intertwined with the fact that this changing system has the potential to co-evolve during a process of transition. With co-evolution, the system undergoing the transition might fundamentally transform in terms of its structure and function (De Roo, 2012). This appears in some cases in the form of large-scale changes such as crises or massive social movements like revolutions (Coaffee and Murakami Wood, 2009).

Moreover, we combine the transition theory with self-organization in order to allocate two different phases of self-organized system which are drawing from the work of Heylighen (2010). First the initial condition which is most likely to be emerging spontaneously without the impact of any external forces. Although this phase sounds very basic, but it is a very critical phase with regard to the becoming of the system, as this spontaneous phase could lead to two results, it can either deviate into a chaotic state, or it can develop with a tendency to increase effectiveness, the latter is the case through which system tend move to the second phase of self-organization. This second

phase thrives through self-learning by trial and error in order to overcome local or external obstacles, until it reach to an acceleration level of the system. This acceleration happens when the interaction between actors produces new rules of behaviour that stands as short cuts by deploying lessons from the trial and error process. When the system develops this capacity to accelerate and adapt, it would be no longer suitable to be defined as a solely self-organized system, it could be rather considered as self-managed or self-regulated. This is because themanaging rules or regulations have been sorted out along the process in the form of the new rules of behaviour, and were not pre-defined in advance.

By imposing on the context of the Egyptian revolution, in the initial condition, sudden change has occurred spontaneously in a relational way to previous events and governmental practices as discusses before, or as extensions of pre-existing communicative space (Christensen & Christensen, 2013). According to theory of multiple streams of Kingdon (2001), this new behaviour has emerged when the informal collectives seized windows of opportunity to couple a problem stream with a political stream through revolution. In terms of phase transition, this was in the take-off phase of transition curve, in which the process of change causes the system's condition to shift from the stabilized state (Loorbach, 2007). In our case, this was the moment in which informal communities stated to outrage in order to break through the over-controlled system by the formal government. We relate this outcome to the initial phase of self-organization, which is the state of revolution on our hypothesized spectrum (see Figure 2). In this state, there was an increasing potentiality by the informal collective to increase the effectiveness of their initial spontaneous emergence (Castells, 2012).

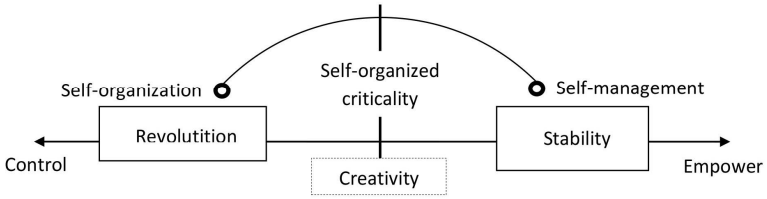

Figure 2: The condition in which the creative capacity could exist in the midway between stability to revolution, which could be associated with transformation from of self-organization to self-management.

Then, in the acceleration phase, structural changes happened in a visible way, in the form of spatial and virtual patterns. We considered this to be the start of the aforementioned second phase of self-organized process, in which these informal communities created their own rules of behaviour in the virtual and physical public spaces, which constituted a sort of self-managed environment. This was in order to develop their collective actions to stabilization in the future; we assume that the use of creativity has led to new form of public space (see Figure 2). By quoting form the Metaverse Roadmap (2007), this was a sort of a co-evolving process towards a social virtual world combined with the physical or the tangible world. On our assumed spectrum, this is on the other extreme against control-led technologies. However, in the case of Egypt, the revolution called for social justice, the poor population mostly blame poor conditions to the

revolution and always urge for stability that they believe would improve their living conditions (El-Husseiny and Kesseiba, 2012). Therefore, it has become a must to learn from the previous positive impact of social media, in order to develop them in a way that could support informal communities to continue using their creativity, which can lead again to their aspiration for stability.

3.3 Opportunities for Institutional Design

Van Assche (2007) referred that "every social system constructs its own space, according to its own rules of self-organization". When this position faces communication within networks in our case, they act as autopoietic systems, while producing and reproducing their basic entities including functions and structures (Luhmann, 1986). This could be fragmented into individual agents connected by networks, and agents interact dynamically while exchanging information. Additionally, it is important when addressing such institutional networks, to consider that they are increasingly 'light'. As Knorr Cetina (2005) indicated them as informal, non-rational, non-bureaucratic and lightly-regulated, thus capable of being flexible and adaptive toward different contexts. This supports our argument to correlate them with self-organization. As they often appear in temporal dimensions, and flows of entities and practices (Knorr Cetina, 2005). This is realized in our storyline when Egyptian formal government tried to dismiss demonstrations by creating an Internet blackout. However, the youth continued to demonstrate and protest and their numbers have increased. Egyptians managed to have their voices be heard through advanced technical workarounds and old

traditional technologies, including word-of-mouth and phones (Muscara, 2011).

Moreover, one approach that seems to be correspondent with our relational and post-structuralist positions, which is the perspective of relational complexity. Monno (2012), refer to this approach as one of the interesting ways to shape the quality of places democratically to deal with the diverse identities of society. This could end up with new imaginative and creative institutions able to avoid oppression and exclusion. Healy (2008) perceived this type of institutions with regard to public sphere, as a consequence of a twofold reason. On the one hand, they could be constructed as nodes of social encounter in a fluid and dynamic manner in the absence of state, which could be defined as a self-organized process. On the other hand, formal governance could be also fostering their spontaneous emergence through creatively transforming their productive capacities into planning policies and strategic plans. This might sound too ideal or virtual in the sense of the unseen in present, if we combine it with the Habermasian theory of public space (Habermas, 1991). However, through our analysis to the new emerging public space, we argue that it could be starting to bring this virtual image to reality. This has appeared on the horizon, through the adaptive nature to transform from self-organization to a form of self-governance. Swyngedouw (2005), promoted this idea as an important issue for planning, the idea of forming adaptive forms of governance/government associated with the emergence of such relational social creativity. Therefore, we see promising institutional opportunities in this convergence between the physical and virtual in the public space, as it could lead the way towards sustainable future bridging institutions between the formal and informal. This sustainability would therefore relay basically on the adaptive and creative nature of such institutions.

In order to envision the nature of these future institutions, based on our post-structuralist and framing theory approach, we propose a spectrum able to formulate our understanding on making use of the self-organization within informal communities. This has could result in discovering adaptive forms of governance which could cope or manage this self-organization capacity, as discussed above, we suggested that this capacity was enabled through a new type of public space, which was co-evolving between the urban and virtual spaces. Thus, here we are trying to further the idea that has introduced in (Figure 2), which was an attempt to relate turning from revolution to stability with the two phases of self-organization. Moreover, we are building this proposed spectrum between two conditions based on the lessons that we deduced from the emergence of collectiveness along the Egyptian revolution. This duality could explore the emergence of social media, informal collectives and public place in a wider context. On one hand, the first condition on this spectrum is the case in which informal communities self-organize to set their own politics separately and in the absence of state (revolution or pre-policy). This could be the result of the obsession of control and functional objectivity. On the other hand, the second condition is the case in which the formal institutions have adaptive capacity to experiment with the informal, by leaving a space for informality to deploy creativity and act within the gaps of rules in order to fill the void between the formal and informal.

As such, we argue that creativity has the capacity to fill a gap in knowledge on the future of virtuality, through bridging these two extremes. This highlights the importance of considering the area in between: An area of co-evolution. That is to say, putting the mechanism of association-creativity in the centre of spatial planning practice might be a window of opportunity to cope with the becoming of a co-evolving urban-virtual environment (Shirky, 2009; De Roo et al., 2012). This association-creativity is suggested to accommodate the convergence of identities in a common ground and a new of form public space and political practices. This may result in the formation of a co-evolving mode of governance for more participatory planning and inclusive urban governance. This mode could sustain the balance between self-organization and stability. This relates strongly to concept of post-policy or governance-beyond-the-state.

4. Conclusion and Discussion

Castells (2012), in one of his important conclusions on studying the networked society, he argued that revolutions are always betrayed, but they usually don't go in vain. They simultaneously produce new relationships and networks in their contexts (see also, Coleman, 1998). This eventually may influence their future reality (planning to bridge the virtual and real, following Deleuze and Zizek). Such social transformations often behave like nature systems as they evolve with an unstable environment, thriving by adaptive processes of sudden revolting and slow accumulated change (Holling et al, 2002). This behaviour could be in a series of global domino's effect of revolutions. In each context (country), the agents were almost the same, but distinguished local interactions were emerging according to different

identities, showing a great deal of flexibility. Thus, the phenomenon of self-organization was appropriate to describe the new structures that emerged out of these interactions (Teisman et al, 2009). That is to say, we argue that adaptivity could be the missing link towards creating resilient public spaces in a world to come, by shifting the focus to identity-based planning and governance.

Based on the story behind this theoretical framework, the world has witnessed lately that the medium of collectiveness has expanded one that is global and rather multi-level fusion of virtual and urban public space (Shirky, 2008). This was shown by the large number of social movements happening in different contexts: From the Middle East to Iceland; From Tahrir square in Egypt to the Indignados in Spain (Castells, 2012; Gerbaudo, 2012). In a nutshell, the paper eventually seeks to fill a gap in knowledge about the impact of virtuality on governance and spatial planning; A gap between the formal and informal actors in metropolitan cities going under change. Hence, we structured a multi-disciplinary reasoning by drawing from social theories, behavioural science and system thinking (Coleman, 1998; Pelling and White, 2009, Holling et al, 2002).

Furthermore, we correlate this theoretical grounding to the development of thinking of virtual engagement with planning. Then we presented recent implementations of digital media based planning and governance within different contexts such as, Finland, The Netherlands and USA. Shirky (2008), before the whole chain of revolutions and social movements, envisioned that if the formal governance bodies didn't respond to the new dynamics of social media by offering alternative governance modes, social movements "the informal" will continue to fill the gap. He continues, but the informal doesn't have yet the institutional capacity to do it. So far, the

informal collectives have been able only to disturb the system, causing a high level of instability. They seek take responsibility of their future cities, and they often symbolize in the statement of occupying the public space, which they see as a place for expressing their identity. Recently, this self-identity seeking has appeared strongly due to the catalyst of social media tools (Pelling and White, 2009). However, from the early signs, the co-evolution of the Internet and networksociety might eventually replace the formal, if people took it more seriously (Shirky, 2008; Castells, 2012). Thus, we argue that a new lens is necessary for spatial planning to connect the missing link: A link lies within the possible inability of formal governance to cope with the future evolution of social media and virtual public space.

In front of the increasing growth and complexity of our cities, the challenge is to understand how we can use digital media technologies and principles from online culture to design liveable cities and to engage citizen with issues at stake in their cities (de Lange, 2011). Therefore, the idealistic approach has been embraced as a gateway to position the creative communities on the scale of complexity, as it has the potential of considering the becoming and therefore it is built on the idea of association-creativity (De Roo et al, 2012). This associative capacity to imagine the future is also a key factor in the complex adaptive systems which will be applied later in the empirical part. This is essential because, “as spatial planners, for example – to imagine a future worth aiming for (idealism). This imagining capacity, however, touches upon a mechanism that supports our associating capacities, that is, creativity” (De Roo et al., 2012). This thinking is an attempt to capture the real city within, as Portugali (2000) mentioned in his book Self-organization and the city. He manifested that in concepts such as Cognitive city and Humanistic city. Thus, we assume, through the presented spectrum, that the evolution of the

digital era could result in future cities like villages from the past, which are happy places made by and for people.

The intended contribution by this paper was to create new lens through which the informality can be linked to creativity. We addressed that by highlighting the capacity of the newly emerging virtual tools to stimulate fundamental changes in the unstable context of Egypt. Also, we presented the ability of the same tools to generate a creative vibrant environment in other stable contexts (countries). Therefore, we argued that the virtual could create future hybrid systems that embrace diversity and identity at their core. We argue that these new systems hold the capacity to bring together the formal and informal in a resilient future. With the literature review, we tried to strengthen our assumption that planning is about to enter a new landscape of possibilities. It could face the need for new roles in order to manage the co-evolving urban-virtual environment. But, still there are many challenges facing our assumptions. One of these challenges is the lack of understanding of those processes and their "rules of engagement" (Norris, 2001). This leaves the opportunity to discover the role of the informal communities in influencing political and spatial change through the medium of virtual tools, together with formal bodies within flexible and robust forms of governance.

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A SIMULATION BASED UPON LAND OWNERSHIP PATTERN: THE CASE OF ISTANBUL

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ABSTRACT

A sustainable way of urban living is not yet realized. One of major problems of today in global scale is fast growing cities which exploit and consume natural resources around beyond any measure just for growing for the sake of growing in several cases by neglecting ecological and economical sustainability. Unintegrated housing areas hosting different social class and income levels around metropolitan areas are triggering social discrimination and conflicts. Beyond superficial observations, permanent solutions fort his complex problems is only possible by reliable researches. In practice, many estimations based upon observations are far of reflecting real dynamics of growth. However, a major investment or an urban project which is located according to a single criterion may easily affects growth directions and trends of a city negatively.

The paper is based on an ongoing research project in a fast growing suburb of İstanbul. Population of case study area is increased almost 17 % between 2008 and 2011. The major goal and target of the project is to develop a dynamic simulation model of cellular automata to predict urban growth through transformations in land ownership

and land use pattern for the years of 2025 and 2050 by dynamics of land plots and land ownership. Land ownership pattern is one of major inputs to affect urban growth and is adopted here as the primary variable along others such as distance, land use and size of the area for to understand dynamics like physical size, speed of growth, growth direction.

I. INTRODUCTION

At the beginning of in his well known book of "Cities and Complexity" Michael Batty first attempts to define what the theory is dealing: "What is the city of today ?" and asks a basic question:

> "*If you were to ask the population at large to define a city, most would respond with an image much more akin to what a medieval or industrial city looked like than anything that resembles the urban world of the early twenty-first century in which we live*"
>
> (Batty; 2005: 16).

Then he provides us a vision of a global city of today via a journey on the highway around New York which looks like totally different than common imagination:

> "*The reality is very different. Drive east from New York's Kennedy Airport along Long Island, and for more than one hundred miles, the landscape is dominated by high speed roads, along which are strung mile after mile of shopping centers, interspersed with low-density residential and commercial development, owing little, it*

> *would seem, to the global city at its western end that still appears to provide the economic rationale for his urban sprawl. The same is true almost any direction one cares to travel away from New York City*."
>
> (Batty; 2005: 16).

Michael Batty's description of views along the roads to New York is like an anti-thesis of Kevin Lynch, Donal Appleyard and John Myer's work and book of "The View from the Road" of some forty years earlier in which provides panoramas of what industrial cities used to be and used to look (Appleyard et al. 1964, 1971). At the eve of 21st century urban panoramas and visions particularly in cities who take part in global network are on the way to radically change and become more and more complex in city making and urban living. New paradigms and approaches highly needed to comprehend this new urban realities as criticized by some scholars;

> *"…monocentric models as it is called, has provided the basis for most attempts at explaining urban spatial structure over the last 150 years; yet it is now clearly inadequate, at these casual observations show…for the most part, what we observe in terms of cities is evidence of such equilibria…new theories of the city must give at least equalweight to questions of dynamics as to spatial form*"
>
> (Batty; 2005: 19).

Some systems are highly complex. From the point of view of systems approach from macro to micro scale, with all multitude of political, social, economic and spatial subsystems, with all countless process of inputs, outputs and feedbacks and with all boundless and infinite number of interactions among them, cities are open and dynamic systems of endless complexity. Cities and phenomena such as urban growth, physical transformation of an urban space, traffic flows etc. are often viewed and cited in the literature as one of best examples of artificial complex chaotic systems since they offer little clues to make precise forecasting. Cities are complex and chaotic in system's behaviour. Even an uneducated eye can see the complexity and can describe a chaotic situation like a traffic jam in an urban scene. However, this needs more proofs than mere observations. Complexity is related with a given situation while chaos is only visible in a process through time; in other words only a behavioural pattern can be defined as "chaotic". Any system such as a mechanical system, an animal population, flow of a liquid, a biological organism, a storm in atmosphere or economy which are apparently unstable, unforecastable or uncontrollable, should be under the influence of many elements independent of each other or under the random influence of external factors (Ruelle,1994).

As argued, rapid suburbanization of cities at the periphery represents the spatially most extensive indicator of growth and is one of three interrelated problems of contemporary urban growth (Batty; 2005:386). However, urban sprawl may qualitatively differ from one case (i.e. country, region) to another as dynamics and impacts (rate of urbanization, planning legislation etc.) change. This diversity is particularly valid for cities of urbanized and urbanizing countries. Population increase and spontaneous, rapid and unplanned urban sprawl is one of significant characteristics of urbanizing metropolitans.

One of basic questions in field of forecasting urban growth is that how far growth of a city can be predictable in terms of physical direction and size? This is one of major subject matter and the aim of this work is not to decrypt why and how a rural land transform into an urban land but to reveal where the next development may and will takes place and to define general characteristics of land plots which are vulnerable for this transition.

The work is based on an ongoing research project in a fast growing suburb of İstanbul, the district of Sancaktepe, on relations of large agricultural terrains and the way and speed of urbanization and modelisation of this process by Cellular Automata (CA). The major aim and target of the project is to discuss and develop a method to measure and predict urban growth via dynamic simulation model of cellular automata on transformations in physical pattern of land plots. There is a general consensus in scientific circles that complex system models are not supposed to be predictive (Allen; 2012:XIII; 1997; Haken; 2006). However, it is also argued that complex physical systems can be predictable and even decidable at some level of description due to some simplifications (İsraeli and Goldenfeld; 2006). The research project is based on the claim that behaviours of basic elements of a system determine general situations and change in a system as a whole. Then, when it comes to a complex system such as urban sprawl, to focus on the scale of basic components of an urban system than to broad generalizations is more convenient and useful to understand the nature and dynamics of the system and to make more accurate predictions. Therefore, a complex urban system such as urban sprawl can be more precisely predictable through follow up of physical change in land ownership pattern in urban fringe areas. In addition, the research project in which this work is derived is also an attempt to prove the limits of predictability through this

method. This is the main hypothesis of the research project and this work.

Population increase, change in physical spread of built up areas and land use pattern through time are some of conventional methods to measure urban growth. However, urban growth has several symptoms and can be monitored and measured by various methods and parameters. Physical change in land plots is a reliable way to monitor and measure urban growth particularly in case of rapid urbanization. Land ownership pattern is one of major inputs to affect urban growth and urban sprawl is adopted here as the primary variable for to understand dynamics like physical size, speed of growth, growth direction. Data of building/land plot are suitable tools to deal with dynamics of an urban system since they provide all necessary requirements such as

- repeating events with relatively in short time arrays,
- considerable amount of accurate datas enough big to follow trends in through time. (Akbulut, Başlık; 2013).

Here, change in size and geometry of agricultural lands is used to trace size and speed of urban growth since, changes and differences in physical pattern of land plots such as split of lands into new pieces and changes in shape and geometry of land plots is one of signs of urban growth and can be considered and interpreted as it did here as a consequence of urbanization as well as a parameter to make forecasts and to measure speed of it. This is the way, urbanization is dealt here.

2. CASE STUDY AREA

Urbanization particularly around major urban areas like İstanbul is largely realized by “gecekondu” (squatter) mostly between 1940s to 1990s on the base of shared property which is a common reality and practice in Turkey in spontaneous built up areas prior to an urban plan. Transformation of agricultural lands into built up areas is firstly did by purchase of the land by various holders according an unofficial land division. Then, this shared property is officially recognized and legalized by an urban plan. Therefore, process of transformation is accomplished and agricultural terrain is turned into an urban land. Here, size of lands matters. Agricultural lands on hills and slopes are more suitable for marketing and commercialization to build on since they are mostly enough big for to divide them into land plots of reasonable sizes (i.e. mostly 200-500 m²). The spatial way of local urban spread confirms this observation and hypothesis. Therefore, urbanized lands displays a tendency to spread from large agricultural terrains around and at vicinity of existing villages (Özaydın et al.; 2010).

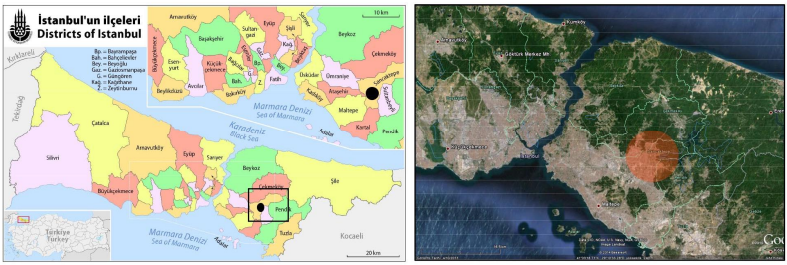


Figure 1: Location of district of Sancaktepe at the east of İstanbul metropolitan area (Google, 2014).

The Sancaktepe is one of new districts of İstanbul established only in 2008 and located at the Asian side of Metropolitan Area (Figure 1). It covers an area of 61,9 km² with a population of 304.400 in 2013. Since 1970s Sancaktepe with its neighbouring areas is experiencing a galloping population increase and rapid urbanization. Population of case study area is increased almost 17 % between 2008 and 2011.

Sancaktepe District where the case study area is located is a dense urbanized area of almost last two decades surrounded by important ecological natural resources. Case study area is within Samandıra neighbourhood and limited with urban areas of similar character developed in recent decades in north and south and with public forests in east and south and water basin protection area of one of Istanbul's principal water reserves in east (Figure 4).

Figure 2: 1982 aerial image of the case study area in its vicinity (Greater İstanbul Municipality)

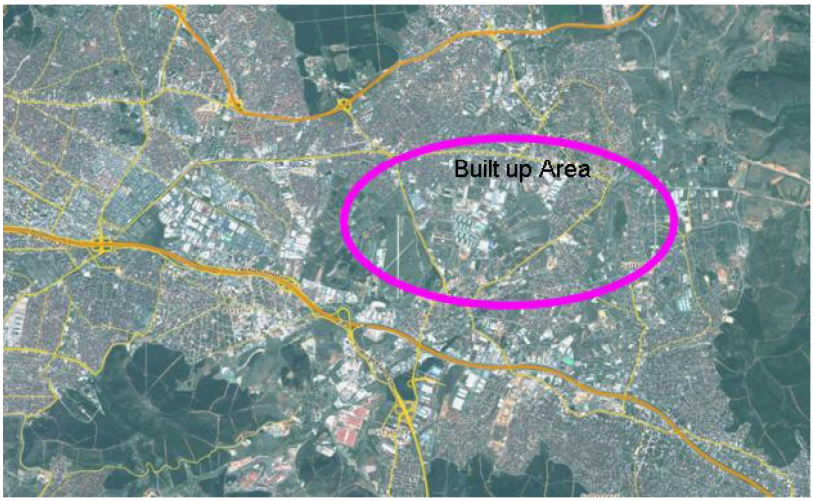


Figure 3: 2014 satellite image of the case study area in its vicinity (Greater İstanbul Municipality)

However, the Samandıra neighbourhood which the case area is within its in boundaries was one of oldest villages around. Due to rapid urbanization, the village is turned into a township then, an independent municipality and finally into an urbanized district of greater metropolitan area, from rural to urban in the last fifty years (figure 2, 3). The case study area was an almost distant hamlet with only a handful of land plots in 1950s. However, six decades later, the same area is now a dense, busy urban district at the outskirts of İstanbul metropolitan area. Population of Samandıra village was 351 in 98 houses in 1938. Population reached 4974 between 1970 and 1975 with a slow increase. However, this slow trend will radically be changed after 1980s with a galloping urbanization and population will

reach 61.852 in 1990 and almost doubles itself with 112.653 in 2007. The squatting or illegal and unplanned constructions (locally "gecekondu") is first flourished in second half of 1940s on shared (multi proprietor) and public owned lands in and close vicinity of İstanbul. Squatting reached the Samandıra village of case study area in 1970s and first gecekondus constructed on agricultural terrains. Physical pattern of land ownership is a lot changed following this and large agricultural terrains are divided into smaller land plots. First maps of land register of the area date of 1956. Whereas first urban planning activities for the region only begun in 1996 and still not finalized. Data related with land plots for different years are as follows:

Table 1: Qualitative Distribution of Land Plots in Case Study Area

	1960	1990	2000	2014
Total # of land plots	219	1466	3539	3521
Minimum size of land plot (m^2)	887,12	100,33	23,38	23,38
Maximum size of land plot (m^2)	395.495,87	274.430,69	182.796,62	182.796,62
Most common size of land plots (m^2)	37 plots between 110.000-120.000	Between 200-300	Between 200-300	Between 200-300

Although earliest set of data of case study area goes back to 1960, physical change in land plots is simulated with CA in two periods between years 1990, 2000 and 2014. Total number of land plots, minimum and maximum and most common size of land plots are shown in the Table 1 and distribution of most common size of land plots is shown in Graph 1.

The period between 1960 and 1990 was a period of relative stagnation where fewer significant movements of urbanisation and land division is encountered. First serious sign of urbanisation emerges around 1990 and the process continues towards Millenium

and beyond. Increasing number of land plots due to land divisions as the result of new buildings and fastening urbanisation is the evidence of this phenomenon.

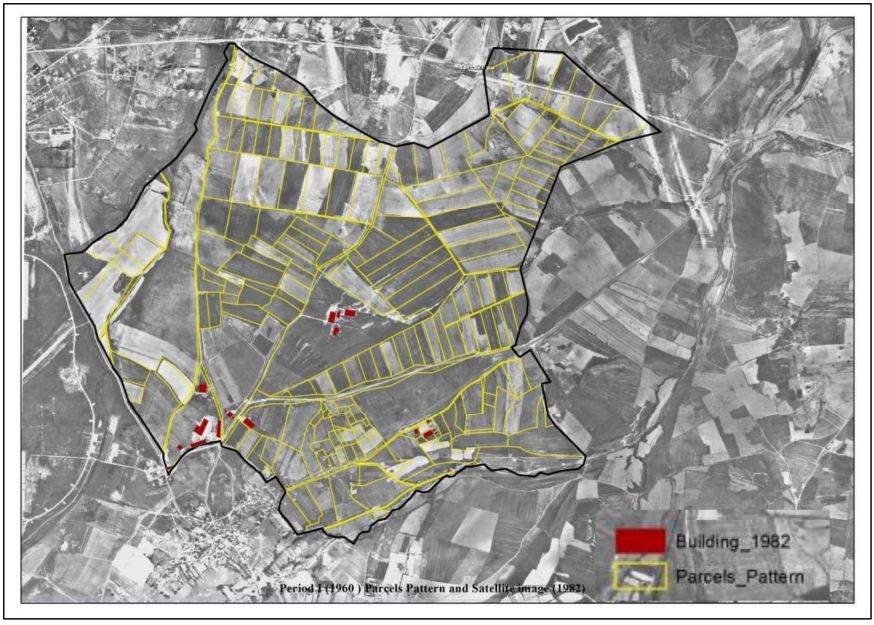
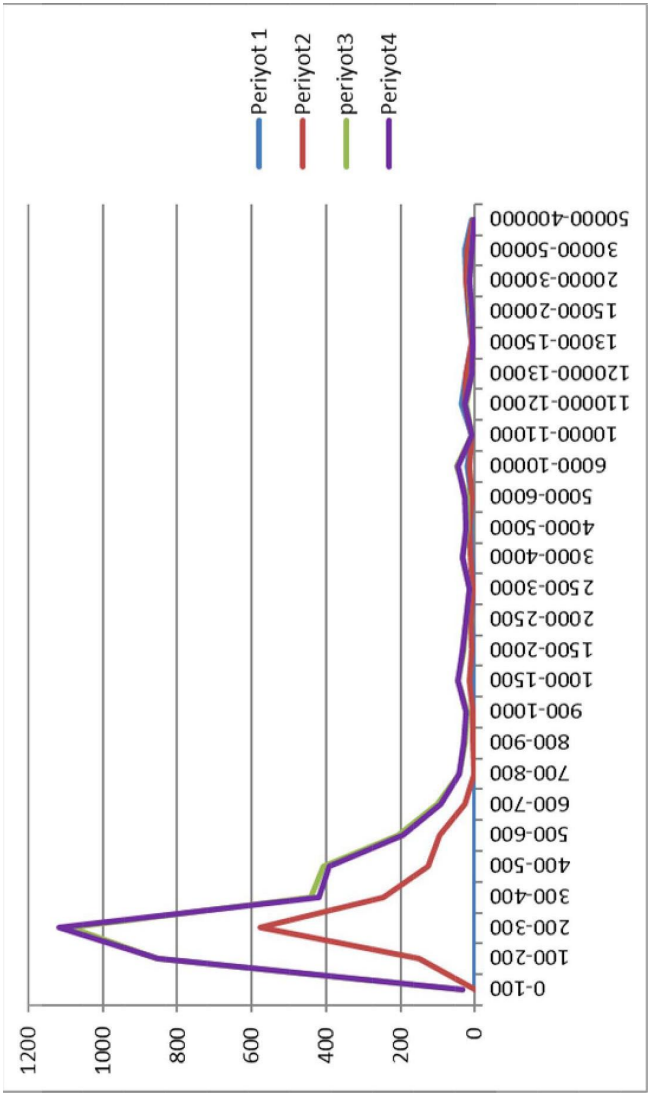


Figure 4: Pattern of land plots in Period I (1960) from aerial image of 1982.

Figure 5: Case study area in its close vicinity (2014) and a recent picture of case study area showing urbanized small size land plots in background with some vacant lands in transition (foreground).

Graph 1: Distribution of Most Common Size of Land Plots According to Years



From 1960 to 1990 number of land plots is increased almost 6,7 times and 2,41 times from 1990 to 2000. However this trend is reversed in following period with a rate of almost 1%. This is due to unification of some land plots. This also gives an important clue about land division process aspect of urbanization. Land plots are divided into smaller pieces until they reache an optimum size. This is mostly an average size between 200-300 m² for Sancaktepe case study area. However, whether small size land plots are suitable for individual houses, but not for use which require large size lands such as industry or land development. Therefore the fragmentation period of previous large agricultural lands through urbanization is then replaced locally here and there by unification where new developments require as the scale of urbanization changes.

Figure 6 show the process of land division and urban spread for years of 1960, 1990, 2000 and 2014 consecutively. Figure 5, clearly illustrates increasing number of land plots through time and locations where urbanizations took place and where small size land plots are reunified to make large divisions. Figure 7, illustrates the way large lands are divided into small pieces through time for periods of 1960-1970, 1970-1980, 1980-1990, 1990-2000 and 2000-2014 and how urbanization process spread on the terrain. Figure 7 is also the visual outcome of CA simulation where red areas correspond living cells where land division process progress and black areas to dead ones where this process is accomplished.

Division of land into reasonable size of plots is a common practice in Turkish urban growth and planning system. Urban planning system and planning legislation in Turkey favors urban development by individual land plots of size mostly around 500 m². During long

decades of low level of capital accumulation and income, urban development through medium size land plots is undoubtedly contributed a lot to land developers and land owners with limited financial resources. This practice was also valid for squatter (gecekondu) type unplanned urban areas and urban growth as in the case of Sancaktepe which is illustrated here. But in this case, size of land plots are generally smaller (mostly 200-400 m²). Therefore, the essence of urban growth in Turkey is division of lands into common size of plots. This may be done via an urban plan or an entrepreneur's land division of a large terrain without an urban plan. Anyway the final result will be similar to each other.

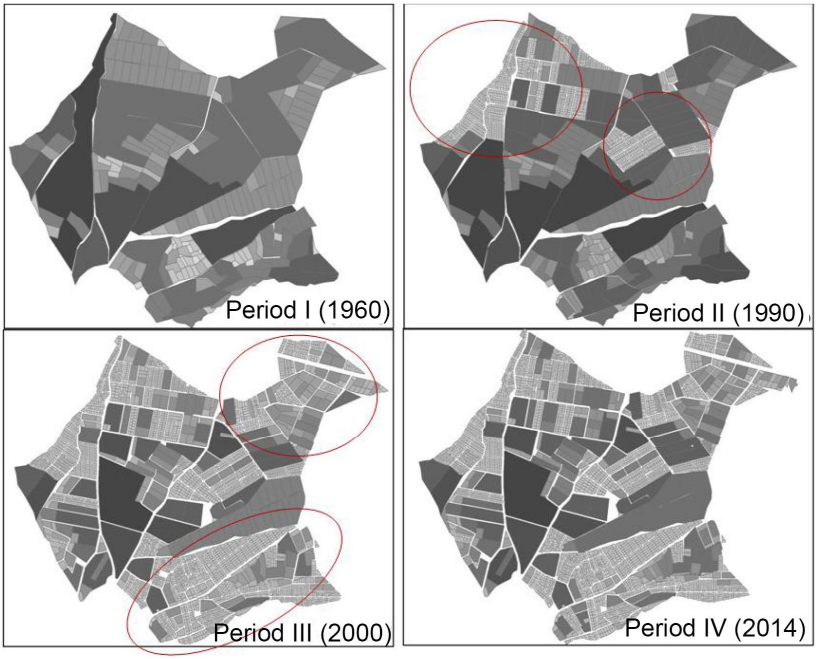


Figure 6: Increase and locations of land plots in time through land division

Land register maps on which land plots are clearly shown are regularly used in CA model. Land register maps of 1956 are obtained from local district municipalities and are joined in digital format. Renewned land register maps due to urban planning applications of 1990, 2000 and 2014 also obtained from the same sources and different coordinates are adjusted thus, every map are harmonized with each other. Changes in each and every land plot in case study area from 1956 onwards are gathered from land register archives and are marked on maps. Therefore, necessary detailled informations such as motives, when and how terrains are divided and to how many blocks and land plots they transformed into are obtained from archive sources. Double check of vector and alphanumeric datas and comparison of changes in land ownership pattern according to different periods are made on aerial and satellite images of 1982, 1996 and 2014.

3. CELLULAR AUTOMATA (CA): A BRIEF

Generally, nonlinear relations among elements of complex systems and feedback loop give birth to unstable unforecastabilities whether the scale. In order to follow up “appearances” within it, the urban system should be analyzed from the smallest element to the whole and the model should absolutely include every scale for a correct CA design. As proved in physics and in chaos theory, basic structural elements play an important role in determining general characteristics of a system as a whole (Haken; 2006:6). Monitoring an urban system just as a whole may be illusive since it does not include or ignore what happens at the scale of its basic elements. Behavioural characteristics of a system may be best understood on the level of its

basic elements and buildings and/or land plots are highly suitable to understand an urban dynamic as a system (Akbulut; 2004; Akbulut, Başlık; 2011). Hence, buildings or land plots should be considered as the smallest urban element like a cell of an organism. According to Batty's definition the smallest unit of a city is the "cell" for physical space and "agents" (humans) for social units. The smallest units display a transformation from bottom to the top or, from local to universal in other words. The behaviour pattern in local level of the smallest unit, defined as agent will result of appearances in global scale. Cellular Automata is one of convenient models for this structure. In fact, CA is also an agent based model since cells play the role of agents (Batty; 2009:57). Cellular Automata (CA), at this point, helps us to understand dynamic behaviours of complex systems and predict future actions since it is an appropriate tool for behavioural fundaments of complex systems. As a powerful model able to measure spatial transformation due to influential grand projects and investments on urban structure, Cellular Automata, provides an important contribution to urban and regional planning for observing and understanding behaviours of complex urban systems, to predict urban growth. However, CA is also criticized for tending to be indicative rather than predictive particularly in predicting urban growth (Batty; 2009:57).

Although, CA was in use in analysis of complex systems in many disciplines since 1970s, it was only introduced a decade later in 1980 in urban and regional planning. It is claimed that this delay is mostly due to retarded awareness of geographers and urban planners in perception, comprehension, research and analysis of human agglomerations and regional structures within the concept of systems theory (Benenson; Torrens; 2004:72). CA was also unfamiliar at the beginning to geographers and urban planners' conventional spatial

analysis methods on the spatial base of defined regions or territories (zones). Whereas, the “cell” is the base unit of CA in modelling whether a life cycle or a city. Use of CA in urban and regional researches is particularly gained a common ground following spread of geographical information systems (GIS) and adoption of the method of definition of datas in grid pattern of cells. In general use, territories determined by administrative boundries or service areas is replaced by pixels and grid attributed datas (Batty; 2007:16). Raster analysis techniques, remote sensing images and digital land use maps in GIS provides a natural base for CA. Even, CA modules in some GIS software highly simplified analysis of land use transformation, future predictions and urban simulations.

Human agglomerations are generally considered, conceptualized and associated with different forms. The modernist approach of city as a machine is maybe the most familiar one. Another common conceptualization of city is to consider it as an organism. Emergence, namely the birth, expansion, the grow up, transformations, the maturation or mutation and even abandonment and disappear namely, death all display an organism’s life cycles in a city’s life and dynamics or different phases, a city undergoes may be associated to life cycles of an organism. Spatial sprawl of a city may then be interpreted as proliferation of cells, growth in numbers. This is obviously not for the sake of a pleasant mind game or just to make some similarities. Thinking of a city like an organism is a groundbreaking contribution to our knowledge base and understanding about cities. Contribution and innovative approach to some resident urban problems such as prediction of urban growth and spatial transformation is maybe the primary benefit from CA.

The matrix of cells, each of which cover an equal area such as an acre, a hectare, a square-kilometer, a square-meter etc. is the main essence of CA and through observation and analysis of behaviour of cells like an organism, spatial growth, urban sprawl, macroform, functional and land use change and transformation of a city become more predictable. In addition to matrix of cells, a CA model, only contains a few parameters namely, a state, input, transition rule, neighbour and time. A state is the probability of what a cell may be in a condition of two options only like open-closed, 1-0, action-inertia, road-railroad or it may refer to an information of situation among land use alternatives like trade, housing, industry etc. Any cell organizes itself according to state of neighbouring cells and the input is the information a cell receives from outside. Rules are determinant sentences to define a behaviour pattern according to a received information from outside. Rules are in accordance with the time of a cell in a given situation and define the next state of a cell according to received information from outside. Neighbouring is one of most important parameters of a CA. Definition of neighbouring cells may vary according to aim, spatial characteristics and time.

Transition rule is another important factor in working principles of a Cellular Automata and this make it works and effective. Here, rules may be conditional statements with “if, then” declarations and can contain mathematical expressions and functions. Transition rules should be applicable to each cell, in every situation and all times (Torrens; 2000).

Working principles of Cellular Automata may look simple but, many different situations should be considered in complex urban systems according to every single local characteristics. CA space of cell or working unit in other words represents inhomogeneous pieces of a

city since every pieces of a city which corresponds to cells has also different spatial and physical particularities such as topography, land use, accessibility, distance to a center etc.

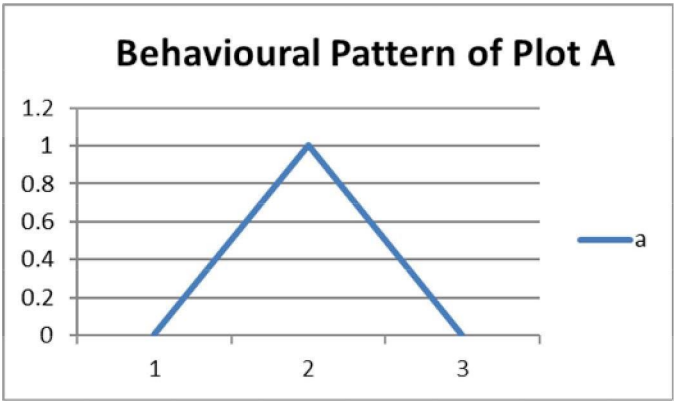
4. THE METHOD: CELLULAR AUTOMATA AND LAND DIVISION PATTERN

As previously indicated, a reliable way to monitor physical urban growth is physical change of land plots as allotment of large properties into smaller ones. This is particularly an efficient method in case of rapid urbanization for example in squatter areas. The conventional process goes as occupation of once large estates mostly state properties or unattempted lands by squatters and division of agricultural terrains into smaller lands plots by holders. Decrease of land sizes continues until an optimum land area is reached. Therefore a continuum in land divisions can also be interpreted as a continuity in urban growth. The process will be terminated as far as all usable lands are divided into an optimum land size. In Turkey and in Istanbul this is in many case an interval between 200 m² and 500 m².

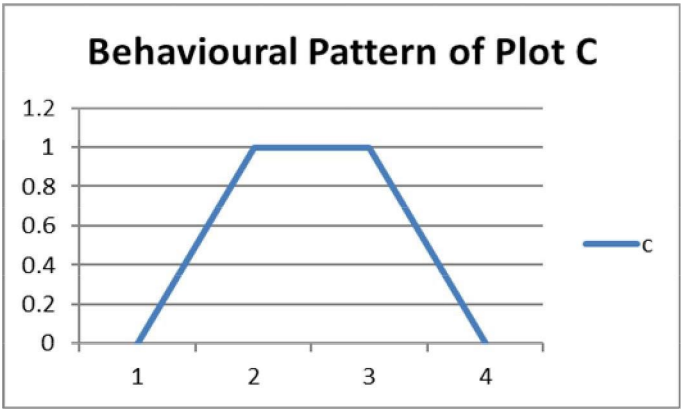
Hence, the first and the basic rule of transition of cellular automata emerges as “any cell lives until it is divided into new smaller ones”. And this continues as far as it reaches an indivisible size. Then the cell is dead. Urban growth process is terminated. Transition rules are based or inspired from Conway’s “Game of Life” simulation and only outcomes are illustrated here. The fundament of cellular automata model in this work is physical pattern of land plots. Land plot is adopted as the smallest basic element of the model and rules are

generated according to observations of growth or shrinkage in physical size of land plots. Generally, a division of a property into smaller pieces marks the beginning of physical transformation for a given land plot and precursor of a construction activity is soon. Qualitative transformation of an agricultural terrain to a multitude of smaller land plots for construction also marks the re-commercialisation and reassessment of a land. In the case of split of a land into smaller pieces, firstly begins with two or three land plots. And each new piece are re-divided in itself in following period until they reach an optimum size. In some cases some pieces stayed stable without any more division. First split is the first impulse of transformation. A land may enter into a state of stability without any change or may continue to be divided into new ones in following periods. Division also means a new function for a land. Hereby, in the case of physical and functional transformation of a land, buildings will be increased on it which will eventually be resulted with mutation of an agricultural land into an urban one. Consequently, division of a land which also means a change in physical size of a land plot, should be considered as the primary stimulus and determinant of the process of build up.

In most CA models to deal with urban growth, built-up areas, topography, land use, accessibility, natural and artificial obstacles for urban sprawl such as forest, natural reserve and preservation areas, military zones etc. are adopted as primary determinants of models. But, all this parameters are not included in the CA model presented here. Physical transformation in land plots is adopted as the unique parameter in this model.



Graph 2: Behaviour of plot A in three different period.



Graph 3: Behaviour of plot C in three different period.

Two fundamental behaviour patterns are determined through analysis of changes in land plots in the course of rule setting and making of CA model. In 1956, 219 land plots in case study area reached 3521 in 2014 through division or in other words geometrical transformation of some lands. In following t+1 period this transformation sprawled other land plots. But, in t+2 period, amount of transformed land plots tend to close initial position by decreasing. During following t+3 period, geometric transformation is encountered only in a few land plots. While, geometric transformation discontinued in some land plots after first period, keeps going in second period in some others. For example, some of land plots which started to be changed in t period, still continue to behave the same way in t+1 period, while some others which emerged for the first time in t+1 period continue to be changed in t+2 with a similar behaviour. Finally, there are two fundamental behaviours of land plots. Physical transformation starts and terminates or, reaches a stable position or inertia following a continuous period.

CA simulation is made via land register maps as mentioned before and registries of land register archives. Analysis begins in 1956 since earliest land register maps available of the case study area date this year. Land plots in case study area are examined in ten years period of 1960-1970, 1970-1980, 1980-1990, 1990-2000 and 2000-2014 in order to determine physically changed land plots marked on the map (Figure 9).

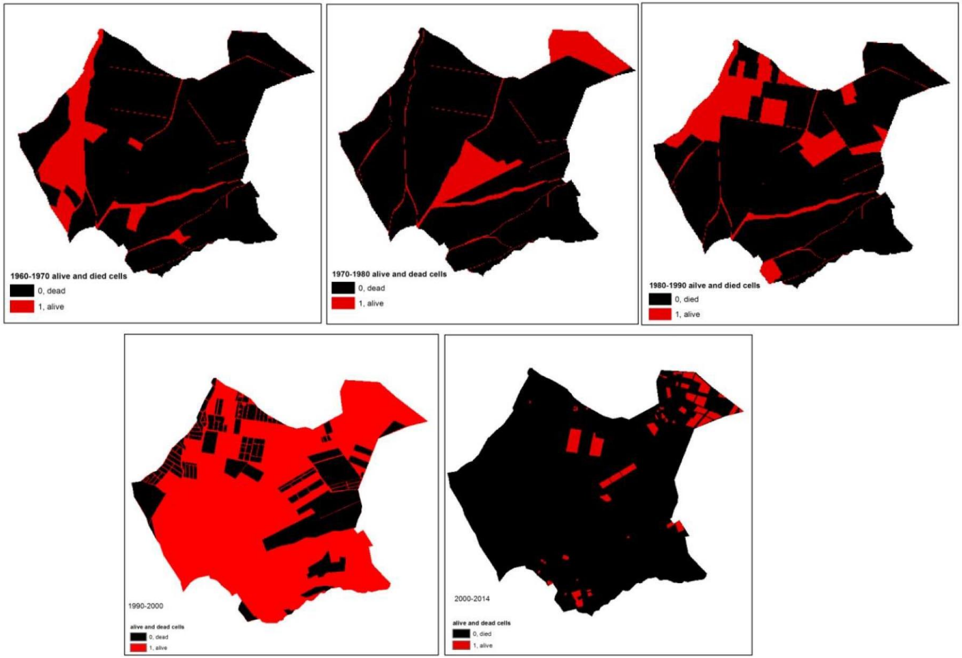


Figure 7: Maps showing physically changed land plots between 1956 and 2014. Areas in red represent "living cells" where division of land plots continues and blacks are "deads" ones where this process is accomplished

The first land plot which is divided in 1960-1970 period is located at the west of case study area and has an area of 36.4 ha. Division of this land begun in 1965 and continued until early 2000. During first ten years period only 5 plot are divided and their sizes are spatially reduced. In following 1970-1980 period, 9 plots are divided into smaller ones and biggest among them has an area of 22,38 ha. while others with a size of 2 or 3 ha. Significant new building activities at plots at the north and west of case study area and new land divisions at north are due to a new principal road are visible in analysis of divided land plots between 1960-1980 via aerial image of 1982 (Figure 8). In 1982, case study area has dominantly agricultural character and agricultural terrains around the village of Samandıra at the south of case study area is very significant.

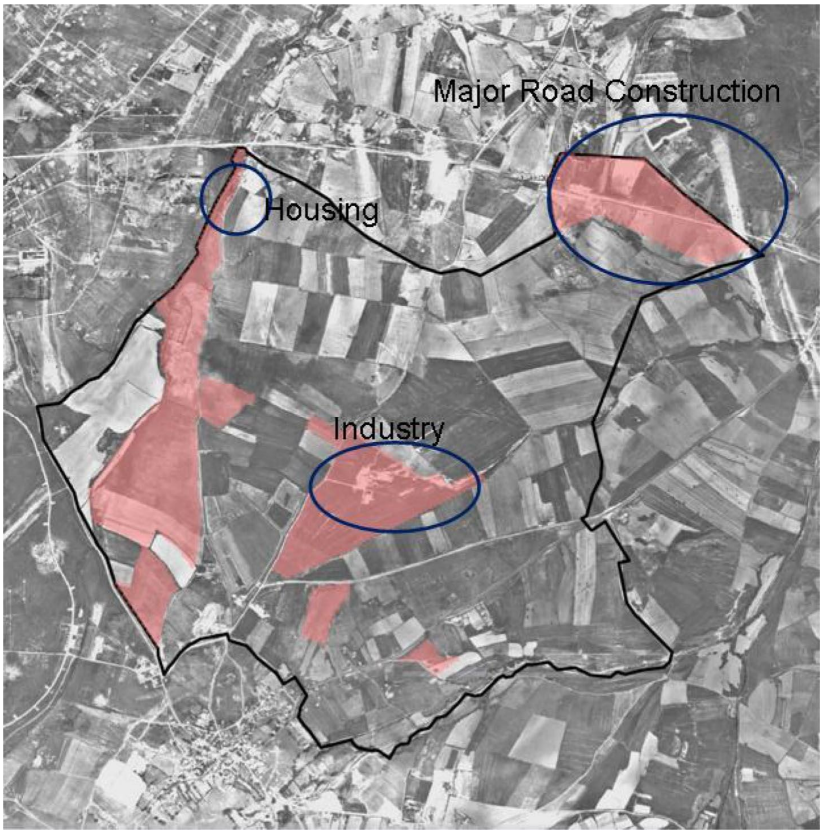


Figure 8: Some new land uses and divided lands between 1960-1980 as shown in red on 1982 aerial image.

An industrial building is built in 1971 as one of earliest in case study area, upon a piece of three new plots formed by the division of a large land of 22,38 ha. In 1972, a new principal road at north divided 8 plots and some of them are expropriated and lost their agricultural

character. May be limited in numbers but, these few changes should also be considered as forerunners of mass transformation of agricultural terrains at case study area.

Between 1980 and 1990, 27 plots are decreased in size in northwest in addition to change in land use towards housing estates. The period of 1990-2000 represents a breakthrough in terms of increasing land division is an incomparable way with three previous decades. Almost all land plots are divided in this period with a few exceptions. Size of plots is generally reduced to an average of 200-300m² and even some of them is only 23 m² of size. A total of 2341 land plots are changed between 1990 and 2000 in size with a change in land use also. Housing, industry, stock yards and an infrastructure of electricity are new uses and even undivided lands before are now turned into empty or green areas as they lost their agricultural character. Urban implementation plan of early 1990 also fastened new constructions in the zone with increasing housing.

From 2000 to 2014, 141 land plots are changed physically but this time to form larger plots by unification in a reverse way. A new urban implementation plan became effective in 2008. Commerce, social infrastructure, green areas with housing as the dominant use and a technical infrastructure of electricity are located within case study area in this plan. Industry, stock yards and warehouses are curiously disappeared and converted into some prestigious housing areas with disappearing empty lands and agricultural terrains. Therefore, process of dissolution of an urban fringe into metropolitan and clearence of agricultural terrains and activities to open-up new territories for urban sprawl is accomplished here.

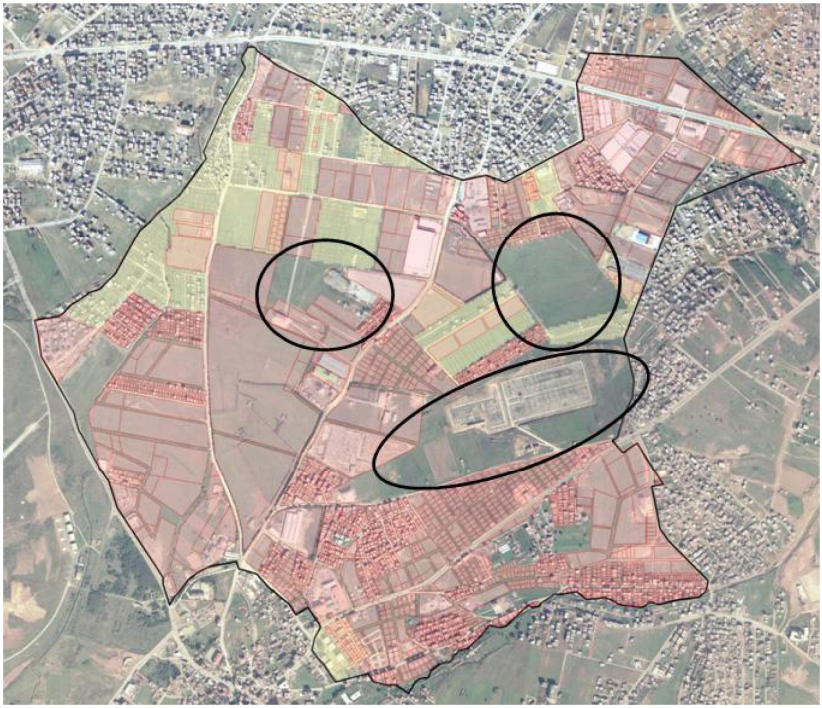


Figure 9: Physically changed land plots (shown in colours) with some unchanged land plots on 2002 satellite image.

5. CONCLUSION

Differing from many CA models predicting urban growth, the one used here is designed to deal whether a physical change exists in any land plot instead of to examine presence of buildings on lands

and works according to the rule that urban growth is closely related with physical division of land plots. Here, plot sizes matter. As large a land plot, as more as it can be divided and through a multitude of periods it can be stay alive to orientate growth. Therefore, land plots with changing size are defined alive at the beginning and stay alive as long as they can be divided into new pieces of land. As this indicates, transition rules is based here on "Game of Life".

From 1956 to 2014 some of large lands are never divided into smaller ones (Figure 9). The stability or resistance to physical change of these lands while other lands around were changing is probably due to ownership or land uses which remain irresponsive to change. For example, an infrastructure which occupies one of largest plots in the area remained untouched on its terrain all through decades.

Figure 10: Changed land plots from 1956 to 2014 according to how many times they changed.

However, this relative stability in some areas should not be generalized to the whole or to the research area. Open and dynamic systems are not stable in nature. At the case study, stability is only observed at the level of individual land plots. Some land plots stayed

unchanged in size and geometry all through periods while some others reached a state of stability or inertia after a series of changes. However, if characteristic irregularities of a system can resist small fluctuations then this is a stable system. A system should normally be accepted stable while unpredictability dominates the system in small scale (Gleick; 2000:50).

From 1956 to 2014, research evidences clearly indicate that there is a close connection between physical change of land plots and urban sprawl and divided or unified plots represent the initial pace of build up process. A multi spot urban sprawl by bouncing is monitored within case study area between 1956-1990. The physical change in case study area begun in 1965 with division of a 36,4 ha land and this land keeps to be divided continuously into smaller pieces all through the five periods. Usually, a priority of division into smaller pieces may be attributed to larger lands with a rational approach. However, this is not the case in this study. Relatively, more smaller lands in size are begun to be divided earlier. This is what is called “emergence” in CA (Figure 10) which means appearence of a new state corresponding a transition rule in CA.

Change in population, physical spread of built up areas and land use pattern through time are some of conventional methods to measure urban growth. However, urban growth can be observed and can be measured by various methods and parameters via its symptoms. But, the process of urban land development is so complicated and ill-defined that it is impossible to propose a universal law that would control the process in different places (Wu;2002:796). This may lead us to a radical axiom such as there is no a comprehensive universal method applicable to forecast urban sprawl anywhere. However, as the case illustrated here, some methods may be generalized and may

have global validity. Physical change in land plots is a reliable way to monitor and measure urban growth particularly in case of rapid urbanization. In countries and cities where rapid urbanization is a continuous phenomenon, physical change of land plots particularly agricultural terrains in urban fringes is a dependable tool to monitor, to understand and to estimate size and speed of urban sprawl in quantitative as well as in qualitative way.

The research which this paper is based is an attempt to estimate urban growth or urban sprawl through physical changes in geometry of land plots in a case study area in a rapid urbanizing region of İstanbul metropolitan area along the last sixty years with a CA model. Research evidences which some of them are presented and discussed here are verifying close connection between size of land plots and speed and direction of urban sprawl.

The CA model which is designed for this purpose here has a different characteristic. CA models to deal with urban growth have a general tendency to process according a multitude of parameters such as built-up areas, topography, land use, accessibility, natural and artificial constraints and restrictions for urban growth sprawl. But, only physical transformation in land plots is took as the unique parameter in the CA model presented here.

Finally as to conclude, major outcomes of this case study are as follows:

- Physical change in geometry of land plots is a reliable way to monitor, to measure as well as to make estimations about urban growth and physical sprawl particularly in urban fringes.

- There is a close connection between division of lands into smaller land plots and urbanization and it is highly promising to follow large lands in urban fringe areas to predict probable future urban sprawl.

- Large agricultural terrains particularly for cereals are more vulnerable to be divided into smaller pieces for future buildings.

- A large land can continue to be divided into smaller plots until they reach an average size which is 200-300 m² at the case study area and 200-600 m² mostly for İstanbul. This land size is highly suitable for development with limited resources whether by land owner or small size developer.

- In the case of interest of big investors and developers, small size land plots tend to be unified to make larger plots suitable for large size development.

- CA is a highly suitable tool to deal with urban growth in the past, present and at future since it simplifies and reduces complexities to a more comprehensible level.

- The proposed CA model is to monitor and to predict future urban development according to land sizes through digital means and techniques

- The CA model proposed here is very efficient for the analysis of the past but currently has some shortcomings to predict future developments since it is a monoparameter model which runs on the basis of land sizes.

- To include more parameter in the CA model is not always a preferable solution since many multi parameter mainstream urban CA models fall within limits of simplified, non-complex regular planning procedures as they copy and imitate them in their transition rules. Particularly in conditions of rapid and spontaneous urbanization without a prior urban plan or limited local plans, planning procedures may represent a “fake regularity” illusion.

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GLOSSARY

Gecekondu: Literaly “1anded by the night”. Local name of spontaneous and illegally built squatter houses in Turkey. Gecekondus first appeared around major urban centres in late 1930s and the phenomenon is largely ended up in 1990s.

Land ownership pattern: Land ownership pattern is used here as a general terminology to define division of lands and their physical aspects such as geometry of land plots and their sizes according to ownerships. Therefore, it represents a geometric pattern of land division according to land registry. Terminology as used here did not make any reference to type of land holder.

Land plot: A separate piece of land registered in the name of a holder in land registry. In Turkish land and planning legislation land plots qualitatively differ prior and post planning particularly in size and geometry. Land plot is adopted here, as the basic physical component (i.e. agent) of urban system to forecast urban sprawl.

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GAME MECHANICS FOR CIVIC PARTICIPATION IN DIGITIZED CITIES

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ABSTRACT

The digitization of society not only made it possible for authorities to involve citizens in policy making - via social media, real-time monitoring, etc. -, but at the same time increased the demand from these citizens for more direct participation. Both authorities and citizens see participation as an instrument to reach a well-defined objective. In the case of a municipality, for instance, this may be generating public support for a new policy or the avoidance of juridical complaints and thus the shortening of a building process. This instrumental approach to participation is miles away from its true objective, namely to emancipate people, irrespective of personal ambitions (Arnstein, 1969). Emancipation requires that acts of civic participation are accompanied by processes of interpretation,

reflection, and contextualization, or, in short, by civic learning. Gordon & Baldwin-Philippi (2014) discuss two requirements for civic learning: namely critical reflection and lateral trust. Critical reflection refers to the ability to map key actors, to analyse key dynamics, to understand the concerns of involved actors, etc. Lateral trust refers to the trust between citizens and/or local community groups. This is opposed to vertical trust, which refers to the trust of citizens in (local) authorities. The two authors argue that games are excellent platforms to support civic learning, under such conditions.

A difficulty in this respect is that developing a good game is time-consuming and thus costly. Considering that civic learning is a long-term process, typically addressing a multitude of issues and involving multiple audiences, it is clear that such a process requires a series of games, making it virtually impossible for one organization to cope with. The paper therefore proposes to no longer reason in terms of complete games, but rather in terms of game mechanics. These are methods to steer the interaction of players within and with the game world (Sicart, 2008). Think of rules and actions supporting actions such as searching, collecting, bargaining, cooperating, creating, etc. The challenge is then no longer to develop a full game addressing a given spatial issue, but rather to develop re-usable mini-games addressing single features of civic learning. These mini-games can then be combined into a 'full' game as the participatory process evolves.

The purpose of this paper is to list and describe a number of game mechanics relevant to civic learning and to touch upon a series of challenges related to the 'organic' use of such mechanics along a participatory process.

Keywords: Civic learning; guided self-organization; collective efficacy; game mechanics, dynamics and aesthetics

1. INTRODUCTION: GAMES FACILITATE CIVIC PARTICIPATION

1.1. An increasing demand for civic self-organization

Countries all over Europe are increasingly witnessing situations in which citizens are asking for a more direct form of civic participation, ranging from demands for more information, over requests for the active involvement in decision-making procedures, to complete self-governance. At the same time, a growing number of governments are putting civic participation at the center of their policy objectives, striving for more transparency, the coproduction of public projects, and even the empowerment of lay citizens and communities to self-organize and take up (part of) the decision power (see a/o Van der Steen et al., 2013). Illustrative, in this respect, are initiatives such as the 'Big Society' in the U.K. and the 'Participation Society' in the Netherlands.

Urban planning has, since the sixties, been experimenting with how to support this call for 'civic self-organization', resulting in paradigms such as advocacy planning, trans-active planning, collaborative planning and communicative planning (Feindt & Nentwig, 2005) which are stated in various European spatial policies as central objectives (i.e. European Spatial Development Perspective – ESDP, Cities of tomorrow, European Landscape Convention, Brundtland Report

1987, UNCED -Agenda 21). These attempts did lead to a more horizontal relation between citizens and spatial policy makers (a/o Hagedorn, 2002; Mitchell, 2005; Pares & March, 2013), but at the same time revealed a number of challenges, like how to equally motivate citizens, organizations and institutions to engage in participatory processes, how to sustain this engagement, how to integrate underrepresented actor groups or overcome unequal resource distribution, how to tackle misunderstandings related to differences in expertise, and so on (e.g. Arnstein, 1969; Healey, 1997; Pares & March, 2013).

These challenges make that, in practice, the two-way demand –from both citizens and authorities- for civic self-organization often ends in disappointment. Certainly when self-organization is understood as a system that "*acquires a spatial, temporal, or functional structure without specific interference from the outside*" (Haken, 2006). Unequal power relations among the involved citizens or between the involved citizens and authorities, make that the more powerful participants can enforce their practices or procedures on the less powerful ones and, as such, hinder global patterns to spontaneously emerge from local interactions. And even in those rare occasion that self-organization does take place, the result is not automatically that positive, for instance, creating negative externalities for the larger environment of which the self-organizing system is part. Helbing (2014) speaks in this respect of 'selfish self-organization', and illustrates his point by referring to congestion patterns at road intersections. Simulations of these patterns suggest that local optimization (i.e. cars self-organizing) only generates good results below a certain traffic volume, but ends in queues long before the maximum capacity utilization of the intersection is reached.

1.2. Guided self-organization

In order to address the above challenge of supporting true civic self-organization and, at the same time, avoid negative externalities, scholars in complexity thinking are increasingly pointing at the phenomenon of 'guided self-organization' (e.g. Prokopenko, 2010; Helbing, 2012). The main idea is to guide the process (dynamics) of self-organization, achieving a specific increase in structure or function within a system. "This guidance may be provided by limiting the scope or extent of the self-organizing structures/functions, or specifying the rate of the internal dynamics, or simply selecting a subset of all possible trajectories that the dynamics may take" (Prokopenko, 2010, p.287). Heylighen (2013a) stresses that guided self-organization is not about imposing a trajectory but about stimulating the system components to move in the right direction. Such stimulation requires feedback, either in the form of rewards or inhibits. This feedback can either be introduced by an external actor, or by the system components itself. A second way of guiding a system is by controlling the boundary conditions, introducing 'scaffolds' that make the right moves easy and make the wrong moves difficult, while at the same time leaving enough space for exploration.

The process of guided self-organization has been observed within the context of biological systems (Polani, 2009) and has been applied to transportation and production systems (Helbing, 2014). Given our challenge to support civic self-organization, the question is how to guide social systems. An interesting concept, in this regard, is that of 'mobilization systems' introduced by Heylighen et al. (2013b). They

begin their argument with the observation that the digitalization of cities has led to the emergence of internet communities collaboratively developing content that can be freely consulted – and often edited- by anyone. The authors stress that these communities produce very useful - and typically high-quality - applications and information, without any direct communication between the contributors. In other words, these communities self-organize. What makes this even more remarkable is that in most cases there is no financial compensation or legal organization. These communities often consist purely of volunteers contributing on an informal basis to a common project. Heylighen et al. (2013b) are not focusing on the motivations for why people engage in these communities, but on the underlying structures supporting the functioning of these communities. In short, the aim of the authors is to try and understand the feedback mechanisms and scaffolds that guide the self-organizing internet communities in generating qualitative output. This aim makes the article very relevant to our objective to support civic self-organization.

Heylighen et al. (2013b, p.2) begin their investigation by referring to these feedback mechanisms and scaffolds as mobilization systems which they define as "a socio-technological system that motivates and coordinates people to work towards a given objective—thus efficiently rallying their efforts". With socio-technical systems, they refer to all ICT techniques which have – over the last decade or two – been labeled as "persuasive technologies", "collaborative technologies", "user experience", and "gamification". These technologies all have in common that they can be used to guide actions without imposing a trajectory. In order to derive the general principles behind mobilization systems, the authors first investigate how these technologies are able to stimulate or motivate individuals to act 'effectively' (i.e. committed

and focused), pointing, among others, at the importance of clear goals, feedback and challenges. In a second part, the authors investigate how the technologies succeed in coordinating the actions of these individuals so that they help rather than hinder each other, to collectively achieve an optimal result. Here they point, among others, at the importance of alignment. They conclude their paper stressing that "effective mobilization systems will both incite individuals and coordinate communities" (p.15).

1.3. Mini games for guided self-organization

The objective of this paper is to explore the use of mobilization technology to support guided civic self-organization within the context of urban planning. Within this overall objective, the paper particularly explores the use of games as mobilization devices. The commercialization of mobile communication devices and sensing technologies (such as GPS, air quality meters, hart rate monitors, etc.) has precipitated an explosion in the use of games, both for entertainment, educational and commercial purposes, to the extent that scholars have started to talk about the gamification of society, with games infiltrating nearly every aspect of our daily lives (Kapp, 2012). Also urban planners are increasingly exploring the use of games. For an overview of recent examples, see a/o Wachowicz, 2002; Borries et al., 2006; and Poplin, 2011. What this overview makes clear is that experiments with games are either led by urban planners or by game developers, but rarely by multidisciplinary teams in which both are present. The consequence is that these experiments either do not really result in games (in the sense that they have rules and goals, and are fun to play), or do not really support spatial decision-making processes.

Developing a good game is time-consuming and thus costly. Considering that civic self-organization requires the involvement of multiple audiences, typically addressing a multitude of issues over longer periods of time, it is clear that 'guiding' such a process calls for a series of games, making it virtually impossible for one organization to cope with. This paper therefore proposes to no longer reason in terms of complete games, but rather in terms of generic mini-games addressing particular challenges/objectives of civic self-organization. These mini-games can then be combined into a 'full' game in order to align the actions of all actors involved.
The paper starts by introducing the MDA-framework, a method to understand and design games. The next section re-interprets a civic participation process as a number of challenges. Each challenge is then translated into design goals for a series of 'mobilizing mini-games'. The fourth section proposes three mini-game concepts addressing a selection of these design goals. The fifth section suggests how these concepts could work as real games by augmenting them with additional elements utilized in games for other contexts. The final section draws some conclusions regarding the use of games to guide civic self-organization processes.

2. Mechanics, Dynamics and Aesthetics

The point of departure of the MDA framework (standing for Mechanics, Dynamics, and Aesthetics) is that the consumption of games is relatively unpredictable (Hunicke et al., 2004). The string of events that occur during gameplay and the outcome of those events are unknown at the time the game is being designed. The MDA framework is a formalization of this string of events, approaching games as a series of interaction '*rules*' that generate a '*system*' of

actions, which trigger (fun) '*behavior*' among the players. Or, translated into the terminology of game-designers, games are '*mechanics*' that generate '*dynamics'*, which trigger '*aesthetics*'.
Mechanics are the clockwork of the game, consisting a/o of the various actions, roles and control mechanisms afforded to the players. Together with the games content (narrative, levels, assets and so on), the mechanics generate or support all gameplay dynamics. Dynamics refer to the observable behavior of the players, such as competing or cooperating, hiding or sharing information, forming or ending of alliances, and so on. Aesthetics are what the player experiences when playing the game. These experiences are generally summarized as 'fun', and can include sensation, challenge, fellowship, submission, and so on.
Hunicke et al. (2004) describe these three components as "lenses" for looking at games. "*From the designers perspective, the mechanics give rise to dynamic system behavior, which in turn leads to particular aesthetic experiences. From the players perspective, aesthetics set the tone, which is born out in observable dynamics and eventually, operable mechanics*" (p.2). Switching between these lenses then helps understanding games and, as such, helps to get a grip on the unpredictable consumption of games. The designer begins by tweaking one part of the mechanics to then observe the changes in dynamics and aesthetics. He then tweaks another part and observes again, until he understands the role of all game components.
The framework not only helps to understand, but also to tune games; for instance, to avoid a particular gameplay dynamic, or to amplify a particular playing experience. Again, the designer simply has to go through an iterative process of tweaking and observing. Approached as such, the framework even helps to develop completely new games supporting particular design goals (Hunicke et al., 2004). The

designer begins with outlining the aesthetics that the players should experience. These make up the design goals. The second step is to imagine the dynamics that support these goals. Once these are drawn up, the designer composes a range of mechanics which could potentially trigger these dynamics. Then the iterative process of tuning and analyzing begins, until the mechanics generate the desired player experiences.

Note that such an iterative design process requires precise design goals, in order to assess the impact of changes in the game mechanics. These design goals could either be desired player experiences (as mentioned earlier), but also particular playing dynamics (such as cooperation or reflection). With 'precise' we mean that the design goals should be operationalized in such a way that they can be observed, documented and analyzed qualitatively or quantitatively. The next section will define such 'operational' design goals related to our objective of developing a game supporting civic participation.

3. Design goals: civic learning and collective efficacy

On the basis of an analysis of formal participatory initiatives in the United States, Gordon & Baldwin-Philippi (2014) conclude that institutional forms of capacity building, such as taking part in town hall meetings or in public design charrettes, may represent acts of civic participation, but hardly ever lead to durable (i.e. long-term and structural) civic engagement because there is limited learning involved. They propose to particularly focus on the process of civic learning within civic participation. They illustrate their point with the argument that: "*Voting in an online poll about the future of the city might represent an act of civic participation, but civic learning*

happens when the participant tells a friend or neighbor about the poll, when participants write about it, argue about it, or debate it at a public gathering" (p. 760). Dahlgren (2009) characterizes civic learning as 'interactive practices' – as opposed to isolated events – that "*include how [mediated information] is received, discussed, made sense of, re-interpreted, circulated among, and utilized by publics*" (p. 74). It is a process of learning about social, political and economic reality of the community (Schaffer, Squire, Halverson and Gee 2005). Gordon & Baldwin-Philippi (2014) argue that civic learning requires, on the one hand, collective reflection, and on the other hand, trust building. With collective reflection they refer to a process during which a community of people reflects collectively upon their acts of civic participation and contextualizes these acts to understand the end view of that moment of participation, a/o mapping the involved actors, analyzing the generated dynamics, comparing formulated concerns, and assessing envisioned futures. Such an intense process of collective reflection, the authors claim, requires trust. Firstly among the community members, that there is power in their individual opinions, that others are paying attention, that others will support their proposal, that others will (also) come with productive input or take future action, and so on. Secondly, between the community and (local) authorities, that their proposals will be taken seriously and acted upon. Gordon & Baldwin-Philippi (2014) refer to the first type as lateral trust, and the second as vertical trust. They end their argumentation with stating that civic learning – supported by collective reflection and trust building – is a precondition for association building, *"simultaneously providing a context within which citizens believe in the importance of their actions and creating associations among individuals and between publics that have the potential for future productive use*" (p. 778). Note that association

building is, in this context, synonymous with civic self-organization and is, in this paper, considered to be a precondition for durable civic engagement.

Interesting in this respect is the concept of collective efficacy, referring to the capacity of a group to realize collective, as opposed to forced, goals (Sampson et al., 1997). Note again that collective efficacy can be considered to be in family with civic self-organization. As with civic learning, collective efficacy depends on two types of trust. The first type, mutual (or lateral) trust, refers to the belief in one's own capacities and in the capacities of others. Kleinhans and Bolt (2010) stress that this trust is not so much about actual capacities, but primarily about the perception of capacities. They argue that this perception increases the better people know one another. The second type of trust is referred to as the willingness to intervene for the common good. Sampson et al. (1997, p. 919) point out that "*just as individuals vary in their capacity for efficacious action, so too do neighborhoods vary in their capacity to achieve common goals*". Again, this type of trust has to do with perception, on the one hand regarding the effectiveness of the proposed actions, on the other hand, regarding external factors, such as support from (local) authorities. Seen as such, willingness to intervene is related to the concept of vertical trust. Kleinhans and Bolt (2010) argue that the willingness to intervene increases with the size of the network that the community can rely on.

In summary, the concepts of civic learning and collective efficacy – and thus civic self-organization- can be operationalized as collective reflection, (perception of) lateral trust and (perception of) vertical trust (or willingness to intervene). What follows is an attempt to translate these concepts into design goals:

Aesthetics related to collective reflection:

- to make people experience that they share concerns, values and norms
- to make people experience that they play a role in these concerns
- to make people experience that they also can have different perspectives on the same concerns
- to make people experience that they can anyway come to shared objectives

Aesthetics related to lateral trust:

- to make people experience that they share capacities and roles
- to make people experience that it is also good to have different capacities and roles
- to make people experience pleasure in reaching a common objective
- to make people experience appreciation for taking initiative

Aesthetics related to vertical trust:

- to make people experience reward in involving external actors

4. Three mini-game concepts

With these design goals in mind, three mini-game prototypes were designed as exploratory activities for groups of four to eight participants. Alternatively, the games could either feature multiple groups, each playing separate instances, or be scaled up to work with a greater number of players. To accommodate for different playing preferences and contexts, three entirely separate approaches were chosen: a card-based game, a map/boardgame and a digital game.

Although each of the game prototypes focuses on different aspects of the identified design goals, all of the games share a number of similar features:

1. Each game is designed for a co-located context, i.e. players interact within the same physical space,
2. All games foster communication between individual players,
3. The games aim to establish trust between players and promote the ideals of collective efficacy.

A brief description of each game prototype is given followed by a brief analysis of its proposed benefits in respect to the design goals.

4.1. Game Concept 1: Floating City

The first game concept, *Floating City*, is a card-based activity loosely based on established metaphorical games such as “Speedboat” and “Speed Plane” described by Gray et al. (2010). Such games are routinely used to help groups quickly identify major problems with a product or service without getting too caught up with the negativity typically associated with voicing complaints.

In *Floating City*, the respective town, city or neighborhood of the players serves as the focus for collective reflection activities. In this game world, cities (or neighborhoods) of the future are elevated into the air like floating castles to have a better access to resources (i.e. the sun) and better views of the world below. However, each city needs to be tethered so that it does not float away due to wind or other adverse conditions. The weight of pressing urban problems also influences the height cities can attain, and the higher a city flies, the better the quality of life.

In the first round, players are presented with a graphical representation of their floating city and given cards of two separate colors (e.g. brown and yellow) and asked to write down the strengths (brown cards) and problem areas (yellow cards) of their city or neighborhood. For the problem cards, players also need to estimate the "weight" of the respective problem (in tons, kilograms, etc.). The cards are then collected and then examined together by the group (with a moderator). Only strengths that were identified by at least two players are then added as tethers to the graphical representation of their city. Problems are grouped together so that they are (fairly) equally distributed based on their weight on the surface of the floating city (so that it should not tip and the tethers will hold).
In the second round, all players receive an additional card of an additional color (e.g. green). After selecting one of the established problems that they are most concerned about, each player proposes an idea to lessen its metaphorical "weight". The new cards are then reviewed in the group and each player gives their estimate to how much "weight" each of the proposals would relieve. The average of those answers is taken and the weight of the city is recalculated. This process could be repeated for multiple steps, but the goal is to calculate the weight difference between the initial and final phases of the game so that players can quantify the results of their brainstorming.

Benefits: The proposed game structures the brainstorming process and provides democratic mechanisms for sharing and evaluating the ideas of others. It promotes reflection as an individual and as a group and reinforces the identification of shared beliefs.

4.2. Game Concept 2: Are You Gonna Go My Way?

The second game concept, *Are You Gonna Go My Way?,* utilizes a map of the respective community, town or neighborhood for a turn-based boardgame-like activity. Players are each given a marker or pen in a different color and instructed to draw their three most traveled routes in the area (from starting to end point). If other players use part of an already established route, they should draw their line next to the existing one so the colors are still clearly identifiable.
The game uses a total of three six-sided dice (each with a different color). During each turn, one of the players rolls two dice (e.g. red and black) separately. The number of each die is important, but nevertheless secondary; the location of each die on the map is primary (if a die lands outside of the board, it needs to be rolled again). Once the dice have been rolled, the player is asked to name some desired (preferably buyable) item (e.g. pizza, beer, book). The location of the black die is the starting point for the round; the red die is the destination. The rest of the players need to confer and determine how they can procure the desired item in the most direct manner from the established starting point all the way to the destination point. To do this, players must use one of their existing routes, but only one route per player can be used in a round. Players are encouraged to use their knowledge of the area to decide which location (i.e. store) would be the closest to pick up the desired item. If there is a gap between player routes, then a “taxi” has to be taken from one route to another. The cost of the taxi is decided by rolling the third die. The added values of the two initial dice represent the total amount of money (e.g. dollars) the player is willing to pay for the desired item. The goal is for players to limit their use of the taxi and to ideally save as much money as possible to deliver the item. Each “dollar” saved is distributed equally amongst the players. Once an

item has been delivered, the next player is up and can decide what he or she desires in the game, and so on until each player has had a turn.

Benefits: The game facilitates the sharing of knowledge about existing infrastructures (e.g. location of shops or other procurement opportunities such as in informal economies) and helps to establish lateral trust within the group.

4.3. Game Concept 3: Crowded Streets

Crowded Streets is a digital game and utilizes a setup with a floor-based projection and a laser tracking system as described by Hochleitner, et al (2013) so that players can actually walk “on” or over their virtual environment. Each round starts with a basic version of a small town or neighborhood projected onto the floor. Players can select different “city components” from categories such as “energy”, “education”, “industry”, etc. simply by walking to the respective area (see figure 1) and then moving the selected component to the desired location. Town needs and/or emergencies are generated randomly (similar to games like SimCity) so that players also need to react to them. The population of the town also grows over time based on the existing infrastructure. A second category of players, made up of audience members (ideally experienced stakeholders), can upgrade existing structures based on the taxes generated by the current population. This is done by using any mobile device, either with a browser or e-mail client, to denote the monetary value of the upgrade and the component’s ID. The goal of the game is to collaboratively build and maintain the fast-paced growth of the town for a defined period of time.

Benefits: The game allows each player to experience taking initiative and yet still be part of a collaborative process. It also enables the involvement of outside actors and ideally both rewards players for their contributions (via external upgrades to the structures they built) and fosters their capacity for vertical trust. Additionally, it serves as an initial explorative activity to discuss common urban development issues that are represented in the town's underlying infrastructure model.

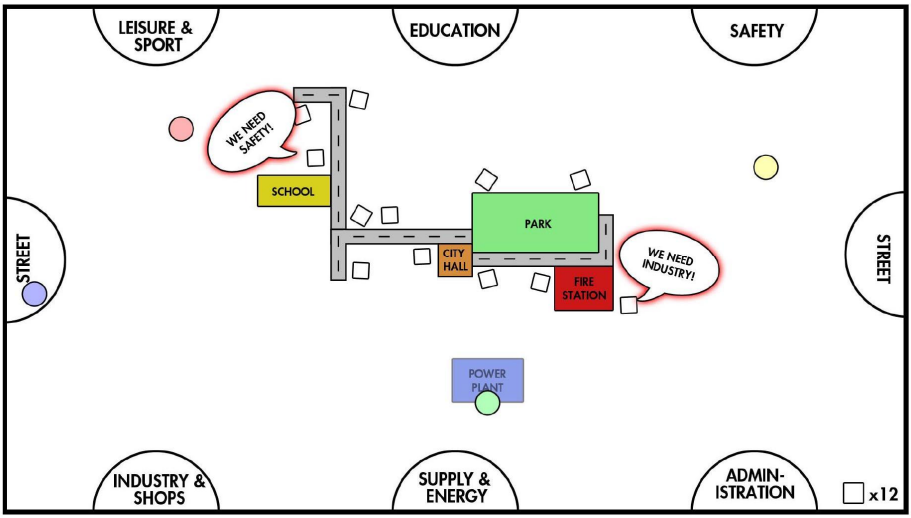

Figure 1: A graphical mock-up of Crowded Streets, a co-located multiplayer digital game. Players (represented by colored circles) can select and place town components simply by physically moving to different areas on the floor projection.

Although each of the three mini-games proposed here were developed with the MDA framework in mind and reflect the design goals defined by the tenets of civic learning and collective efficacy, they are still quite limited from a game-design perspective. The next section will address some of these shortcomings and the potential for such approaches to become full-fledged games.

5. Towards actual mobilizing games

Games are designed experiences, but they are usually designed for an audience with specific player preferences (e.g. strategy, role-playing, etc.), a clearly defined narrative and/or setting, and are intended to be played either repeatedly or for an extended amount of time (in some cases, literally hundreds of hours). Using traditional game approaches as mobilization devices poses a number of challenges, as audiences can vary and the time for such activities is usually quite limited. Ideally, games used in such contexts should either be generic enough to be applicable to more than one situation or easily adaptable so that they can be custom tailored to each environment. Nevertheless, to truly harness the potential of game-based approaches, particular focus needs to be placed on the factors that contribute to the enjoyable experience attributed to them. Squire (2011) identifies a number of essential elements for the design of a captivating game experience which he applies to games in educational contexts. Two of these elements appear particularly applicable to the (further) development of mini-games like those proposed in the previous section into actual games in their own right.

Overlapping of goals: The proposed mini-games (and many other so-called games utilized in similar contexts) all feature a very limited

number of goals to reach, and thus, offer few or no conflicting decisions for players to make. Although this simplicity makes the games easier to learn and play, it significantly limits the potential to replay them or for players to simply get caught up in the exploration of a multitude of possibilities. However, adding goals and/or mechanics can quickly change the dynamics of the game and perhaps even hamper the desired effects of the experience. For example, adding the possibility for the floating city to completely sink or even crash may motivate players to participate more quickly, but it can easily discourage a high level of quality of their contributions and may even goad some players into actively sinking their city just to explore that option.

Orchestration of time: Game mechanics are typically implemented in ways that make use of multiple and varied (but corresponding) time structures so that players always have something interesting to do or think about. This is a particular weakness of some board games, as they are usually turn-based, and sometimes only offer a passive experience when it is another player's turn. This is not to say, however, that every minute of gameplay should require decisions to be made; watching, waiting and considering can also be very active endeavors. In fact, adding a feature that can potentially increase waiting time, such as making the taxi cab option dependent on rolling an odd or even number can potentially promote the challenge and fun of a game like *Are You Gonna Go My Way?*

In addition to considerations regarding the experience of gameplay, there are two other significant caveats for the use or development of actual games to guide civic self-organization processes. The first is related to the framing of the game and its level of abstraction

(Mitgutsch et al, 2012). Games always employ some level of abstraction, for their underlying models, rules and representations. As such, they offer a limited relevance to real-world situations. This is, in and of itself, not necessarily a major drawback; abstract models are used to explain concepts in every discipline from economics to physics. However, coupled with the second caveat, the issue of transfer, it does present some difficulty in having lasting effects on participants. SimCity may do a very good job of illustrating some of the challenges city planners may be confronted with (on an abstract level), but playing the game often and or at a high level will not necessarily increase my willingness to be more actively involved in making my hometown a better place. As Wagner et al. (2013) experienced with their involvement with the serious game *Ludwig*, achieving a measurable transfer of knowledge, skills or behavioral change requires multiple iterations, and in a best-case scenario, a teacher or trainer who mediates gameplay and post-play discussion.

6. Conclusions

Games are, by nature, participatory devices: the player creates his/her own gameplay experience by observing and reacting to the dynamics, or combined mechanics, of the game system that was conceived by the game designer. Games also offer extraordinary potential for helping individuals to understand and become more involved in self-organizing processes. They can provide clear rules, goals and a motivational structure for participation and effectively illustrate the flow of processes using (abstract) interactive models. Using games in a co-located setting also provides the benefit of interpersonal communication, allowing and/or forcing participants to verbalize and therefore more profoundly concern themselves with

their own opinions, beliefs and ideas, as well as those from others. In sum, games are clearly mobilization systems supporting guided self-organization. To create games that can specifically guide civic self-organization processes, particular attention needs to be paid to meeting specific design goals that focus on establishing commonality and trust between participants. The use of a game or multiple games for promoting guided civic self-organization may only be part of the answer, but it is a promising technique for exploratory phases and can be employed in successive iterations, provided that such games offer multiple goals and mechanisms that continually activate player interaction. In fact, the game design/development process itself could potentially become part of the larger participatory process, with observation and inquiry of the gameplay –and thus the iterative process of tuning the game- becoming part of the (meta)game itself.

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DIGITALIZATION OF CITIES FROM SEMIOTIC COEVOLUTIONARY PERSPECTIVE

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ABSTRACT

Emerging high speed digital communications create a new logic governing the mix and distribution of living and work spaces, thereby cause transformation of urban patterns. This study aims to understand the extent to which digitization impacts urban spaces, communities and urban planning. It uses the semiotic coevolutionary perspective to examine digitization impacts, and to discuss possible future paths for urban form in the digital era. From this perspective, new signifiers and meanings emerged by digitization create social and cultural selection pressures that are paving the way for permanent changes in the urban context. A case analysis from Istanbul stimulates thinking about the extent to which digitization impacts urban space, community and planning practices in Istanbul. The case findings reveal that ICT applications can transform urban

space but also can deepen dual city phenomenon in terms of social and cultural differences, and economic inequalities in the urban communities.

Keywords: Digitization, smart city, dual city, semiotic coevolution, sociocultural selection

I. INTRODUCTION

This paper aims to understand the extent to which digitization impacts urban space, community and urban planning. To do so, it examines the past and current transformations in urban spaces and considers digitization as an emerging era that may bring both new opportunities and downsides. It also intends to stimulate thinking on the possible future paths for urban spatial planning and the role of planners with regard to new digital telecommunications.

For better understanding interactions in a new emerging era, it adopts the semiotic coevolution perspective which places importance on the role of sociocultural selection pressures, new signifiers and new meanings generated by new signifiers in regime transitions. This perspective has explanatory power for the joint effects produced by complex dynamics and multiple networks in the urban context. By using the semiotic coevolutionary perspective, this study examines the impacts of fast-developing changes due to the digital revolution on urban space and community life.

In the final part, it provides a case example from Istanbul that illustrates impacts of a smart city application on the physical city and community life in an urban context. New signifiers, new meanings, sociocultural selection pressures and changes by the application of a smart city project are examined from the semiotic coevolution perspective so as to understand the impacts of an ICT application on the urban space and its community.

2 COEVOLUTIONARY APPROACHES IN CULTURE STUDIES

In recent cultural studies, there are increasingly more cultural-ecological models to interpret observed patterns in society–nature coevolution. Waring and Richerson (2011) employ mathematical models of cultural evolution that extends the formal characteristics of population genetics into the cultural realm, positioning cultural traits and various routines of social learning as dominant transmission processes. They point out that some cultural phenomena are not adaptive, while others are even maladaptive in terms of biological evolution. To demonstrate the explanatory power and feasibility of such models, Waring and Richerson (2011) develop a simple model of a biological species that is affected by a habitat modification practice.

Sieferle (2011) proposes that coevolution between natural ecosystems and human societies is mediated by human culture as an autopoietic system. An important implication of this conceptualization is to acknowledge that the autopoietic reach of culture is endangered although limited by adaptive boundaries where the physical population serving as material information carrier for culture. Therefore, a cultural system that is neutral or even maladaptive vis-à-

vis the survival chances of the human population can emerge and propagate. Another implication is that nature and culture cannot interact directly, because nature's elements only interact physically, via flows of material and energy, while culture's elements only interact symbolically, via flows of information**.** Hence, nature and culture cannot possibly coevolve in any direct sense. The human population constitutes an interface with the effect of transforming cultural programs into physical effects, but also of providing culture with signals gained from the physical environment. In this conceptualization of society–nature coevolution, Sieferle (2011: 322) addresses three elements (nonhuman nature, the human population and culture), and the autopoietic character of culture as a recursive system of communication needs to be fully recognized in order to avoid both natural and cultural reductionism. In this coevolutionary theory, culture is considered as an autopoietic system, and it is aimed at the unity of "persons" in a physical-biological sense and "culture" in a symbolic sense.

Weisz (2011) seeks synergetic potentials between Luhmann's social systems theory and social metabolism to develop a socio-ecological conceptualization of society–nature coevolution. In seeking this, she calls for a fundamental shift in analytical focus from populations to communication systems. Weisz argues that the greatest sustainability challenge we face is transitioning from industrial metabolism and to this end the concept of society–nature coevolution should prove very useful. In Weisz's work, an elaborated concept of coevolution hinges on a more precise and sociologically more meaningful concept of cultural evolution and understanding how cultural evolution is linked to the environment.

Weisz and Clark (2011) identify two types of systems that are capable of evolution: biological systems and communication systems. They argue that human populations evolve with their cultural systems and other non-human populations coevolve with human populations and culture. However, Fischer-Kowalski and Weisz (2005) stress that the term society-nature coevolution is not totally consistent since in socio-ecological understanding, the society cannot be equated with a communication system, nor is all of nature evolving.

3 SEMIOTIC COEVOLUTION

Cousins (2014) proposes a natural selection process that account for learning. In his proposal, natural selection works for a species not only in relation to its environment but also within the species, 'in other words, a learned and/or cultural feature brings about a genetic support also takes place as a natural selection' (Kohler, 2014:193). Cousins (2014) presents a semiotic coevolution of mind and culture that is supported by the concept of niche construction: by constructing a man-made niche, human provided themselves with new selection pressures. Cousins's proposal of semiotic coevolution stresses that the first humans played an active role in their own evolution by constructing a particular niche, a man-made niche, early humans set themselves within a new environment, as we broadly call it in biology, an environment they now have to adapt to. Introducing the concept of sociocultural selection, Cousins asserts that selection for survival is no longer just a matter of physical strength or fitness as considered in the classical view of selection in biology, but it is also cultural, social, and semiotic.

Early tool use and communicative activity itself spurred cognitive and cortial development, by changing the environment to which early hominins had to adapt. Enhanced cognitive abilities, in turn, led to more advanced tools and social activities, giving rise to an evolutionary 'feedback loop' between culture and mind.

He considers human as an agent of his own species evolution through the design of a niche without having full control on the outcome (Kohler 2014). The new concept of niche construction counts on various types of pressures under which selection can take place, including for instance the social structure of a community, or the use and function of language within that community.

The niche construction approach (to the coevolution of mind and culture) acknowledges behavioral solutions and opens the way to an understanding of how learning guides natural selection by altering the selection pressures themselves. The niche construction approach identifies the capacity for cultural learning, rather than specific learned behaviors and claims that the choices, activities, or innovations of organisms generate feedback in the form of altered selection pressures and genetic change in future generations of those organisms (Lewontin, 1982; Laland et al., 2000; Laland and Sterelny, 2006).

Cousins's proposal of semiotic coevolution gives particular emphasis on the social and cultural selection pressures and stresses that sociocultural and organic selection pressures can come from a self-constructed niche. Cousins (2012) states that symbolic reference itself is an adaptive trait designed to construe cultural entities according to prior needs and goals, thus to produce meaning conducive to the achievement of these goals. The basis of

conventional perception and behavior depends on the extent of members of a cultural community share similar processes of reference and cultural signifiers remain stable in what they signify. When needs and goals change, however, the process of symbolic reference generates new meanings -new pointing to relations between signifier and signified- in such a way as to make those signifiers useful to addressing the need. The result is descent with modification- a change in the collective construal of a cultural entity, and thus a change in the entity itself.

4. URBAN PLANNING AND DIGITIZATION FROM THE SEMIOTIC PERSPECTIVE

Cousins' (2014) semiotic approach to coevolution offers considerable insights for the analysis of coevolutionary processes in which spatial planning changes emerge in parallel with the socio-economic/socio-ecological regime transitions. Sociocultural selection pressures and new signifiers presented by Cousin's proposal help explain the likely changes in spatial planning by digitalization era.

In the transition period form agrarian into the industrialization era, there has been fundamental changes in relationships between human society and natural environment. Industrialization process, dates back no more than 300 years, has been characterized by 'large scale, machine-assisted production of goods and services by a concentrated, usually urban labour force' (Krausmann et al., 2008:187). In this process, there has been a continuous increase in labour productivity and energy efficiency as well as industrial growth output resulting in continuous economic growth by treating

information as a kind of knowledge valuable for a particular practice, in most cases, for production. In socio ecological terms, industrialization has fundamentally changed the human domination of the Earth's ecosystems (McNeill, 2000 in Krausmann et al., 2008:187) and led to colonization of terrestrial ecosystems (Fischer-Kowalski and Haberl 1997, Haberl et al. 2001, Krausmann and Haberl 2002). Industrialization process is signified by technological change, spatial concentration, declining economic significance of the agricultural sector, material wealth and social change.

Since 1980s, the industrial society has been in a transition process towards post-industrial society with the highest evolution of capitalism. The post-industrial process is signified by service sector, declining economic significance of the manufacturing sector commodities as oppose to products, goods, corporate liberalism and technocratic modern society that is able to subvert social consciousness through powers of manipulation rather than powers of coercion. With the transition to post-industrialized society, information has been regarded as a self-sufficient value, independent of its applicability in the manufacturing process. From the 1980s onward, neoliberalisation and globalisation have become hegemonic and changed the key institutions involved in social reproduction (Robertson, 2007).

In line with the changes by the mobilisation of neo-liberal ideas societies and social relations, new spatial planning practices have emerged to fit the political reality characterized by globalisation and neoliberalism. In the 1990s, by the increasing pressure of neoliberalisation on existing planning frameworks and practices, spatial planning processes have failed to live up to its progressive planning aims (Cerreta et al., 2010; Haughton et al., 2010; Olesen,

2011). In post-industrialisation process, planning practices has tried to see the world through webs, flows and networks in what Davoudi and Strange (2009) refer to as 'fuzzy maps' (Olesen, 2014, p.38). A new relational perspective has been supported by these fuzzy maps. From the relational perspective, space is understood as socially and culturally produced, thereby multiple ways are opened up for understanding an urban area (Amin and Thrift, 2002; Healey 2007).

Since 2000s, the extensive use of digital and network technology has pushed society from the post-industrial era to digitization. In digital and information era, digits are becoming an extensive global phenomenon and force (Bao and Xiang, 2006:41). Digitization process is signified by digits, knowledge economy, declining economic significance of the goods, universal communication, technological innovation, ICT apps, information networks and information society.

Development of the information, knowledge and network society and ICTs have influences on the structures of cities and regions and spatial development and planning practices. For many authorities around the world, there is now a common goal which is further development of information society and ICTs. In this regard, ICTs are needed to be taken into account in all future spatial planning processes (Talvitie, 2004).

Today's lazy references to the death of distance, the end of space and the virtualization of everything intensify uncertainty with regard to urban planning. Situations of uncertainty call for new forms of planning that in a sense are fluid (Nyseth, 2012). Too much fluidity means losing control, and giving up the ambition of steering (Nyseth, 2012). Fluid conditions may also marginalize civil society, giving too

much power to private investors (p.41). Therefore, spatial planning in the information era is defined as a difficult task of managing fluidity (Nyseth, 2012).

The ICT has highly diversified impacts on planning as the main driving force of the development of information, knowledge and network society. ICTs trigger spatial changes that are always both an opportunity and a threat. Telecommunication infrastructure and service standard of an area are the most crucial elements for the future of all regions and community activities. In most cases, the telecommunications infrastructure and ICT services are built and operated by private companies while the development of traditional traffic networks has normally been a public responsibility. Wireless communication systems may provide new possibilities, but their availability and cost will not be equal in all areas. This may result in the 'dual city' phenomenon, i.e. when a city becomes divided both socially and spatially into different areas.

Dual city phenomenon can also be addressed for other different areas. Knowledge and skilled people are becoming the most important factors of the new economic development. The new economic trends may serve to deepen social and cultural differences in cities. Dangers of growing inequalities in large cities and the metropolitan areas are warned by many planning researcher (see Castells, 2007; Hall, 2002; Kotkin, 2006**)**. Not only metropolitan areas, small cities and communities may also have inequalities caused by the new development trends.

New sociocultural selection pressures and new signifiers are likely to emerge in the adaptation process to digitalization and informatization. Spatial planning cannot be free of the influence of these pressures

and signifiers. New georeferenced data, geospatial technologies, GIScience, remote sensing, mobile computing, computer assisted design, vizualisation, virtual reality system design, web-based mapping programs and other geospatial new possibilities as the subsets of developing technologies will be widely used in spatial planning. Conceptualization and programming for virtual reality representations and web 'mashups' that bring real time data from multiple sources are intellectually demanding and difficult tasks (Batty, 2005, Longley and Battey 2003 in LeGates et al., 2009:766). Such planning tasks require skilled planners as specialized experts who are able to use more sophisticated technologies to produce advanced spatial analysis and maps.

In the digitalization era, geospatial technologies represent a fundamental change in spatial planning. The use of geospatial technology seems to be the main tool for decision-making. For the solution of planning problems, it has to be incorporated to the spatial thinking concepts. In that sense, the extent of spatial planning adaptation to complex digitalization processes relies on the success of geospatial technologies to reflect the fundamental spatial concepts and to improve spatial thinking.

5. DIGITIZATION AND URBAN LIFE IN ISTANBUL: IMPLEMENTATION OF THE CITYSDK PROJECT

The progress of Istanbul in the digitization domain has been relatively slow. Local servers have had the option to be host under the .ist extension, slightly departing from the country's .tr by 2013. The municipal authority has already been in operation to notify the IT

centers of some local municipalities for urgent or everyday citizens' needs by the support of the private sector's iPhone and Android apps. There are ongoing pilot real life Living Lab projects in Istanbul which target water and wastewater applications as financially viable solutions with significant reuse of resources, smart grid applications and local generation of electricity, applications for buildings and retrofits for households in the city. One of these pilot projects is the CitySDK (Smart City Service Development Kit and Its Application Pilots) project which was a pan-European project aimed at creating an open source service developer toolkit for Smart Cities. Smart Mobility, Smart Tourism and Smart Participation were the selected services in which applications for Istanbul as well as the other partner cities would be created.

The CitySDK project started with a kick-off meeting in Brussels on the 16th and 17th February, 2012 and planned to be lasting for 30 months. This project was funded by ICT Policy Support Programme (ICT PSP) as part of the Competitiveness and Innovation Framework Programme (CIP) by the European Community. The CitySDK consortium comprised of 23 partners in 9 European States and the project was led by Forum Virium Helsinki. Istanbul Metropolitan Municipality and TAGES (a private sector company), representing Istanbul, were among the project partners.

The project idea arose from the challenges faced in transferring of Smart City applications from one city to another city. While transferring the applications, there is a lack of unified backend technologies, lack of innovative end-user services, and no unified markets beyond single cities. In this respect, the main objective of the project was to create a smart city application ecosystem through large-scale demand-driven city pilots. The project had two steps to

achieve its main objective; first one was to create an open service developer toolkit, and the second one was to engage a vast number of developers by various means to the use of this toolkit. The CitySDK users would be the Municipality ICT Department, private developers, SMEs and the end-users (citizens).

By the implementation of the CitySDK project in Istanbul, the new components from the PTA (Personal Travel Assistant) and CitySDK including Mobile PTA Application as well as open interfaces for 3rd party developers were added to the existing web-based Istanbul Metropolitan Municipality Travel Plan System. For the engagement of new 3rd party developers to the open interface, SME training workshops, 'AppsChallenges' developer competitions and business seminars were organized (http://www.tages.biz).

Although the CitySDK project was applied to create a user-centred, open-innovation ecosystem, it has been a technical oriented living lab project. Smart participation applications of the CitySDK project have not dealt with social and cultural issues. Enhancement of participation by the affected citizens, taking social and cultural differences into account and paying attention to economic inequalities among the users have not been implied by the project objectives. The user groups addressed in the project were only participants with technical knowledge and skills. The end-users have been far from reflecting the variety of the society as they were perceived as users rather than citizens.

6. CONCLUSION

This paper has aimed to understand the extent to which digitization impacts urban space, community and urban planning. The semiotic coevolution perspective that places importance on the role of sociocultural selection pressures, new signifiers and new meanings generated by new signifiers in regime transitions has offered insights to achieve the study's aim. The impacts of digitization, knowledge economy, declining economic significance of the goods, universal communication, technological innovation, ICT apps, information networks and information society have been questioned in urban space and community.

Analysis of the CitySDK (Smart City Service Development Kit and Its Application Pilots) project, one of the smart city projects implemented in Istanbul, has illustrated the extent to which digitization impact urban context with regard to its space, community and planning. This analysis has revealed that the CitySDK project has been a technology oriented living lab. The project has been far from being a social oriented living lab addressing social considerations. Participant groups of the project have been identified as users rather than citizens. Social and economic inequalities in Istanbul have not been addressed by the project. Hence, this project has been an example of how digitization can only create technological pressures rather than sociocultural pressures that could lead to permanent changes in the urban space and community.

As in the CitySDK project, participants have also been required with technical knowledge and skills to be involved in many other smart city applications. In that sense, dual city phenomenon may become deeper in terms of social and cultural differences, and economic inequalities in urban communities while development of the information, knowledge and ICTs inextricably influence urban space

in the emerging new digital era. From this regard, the extent to which digitization impacts urban life relies on the success of new technologies and applications to reflect the fundamental spatial concepts such as empowerment, participation and co-creation.

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NEW SONGDO CITY: A CASE STUDY IN COMPLEXITY THINKING AND UBIQUITOUS URBAN DESIGN

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ABSTRACT

A new urban form has emerged amid the perfect storm of global crises: climate change, energy transition, demographic shifts (growth, aging, and urbanization), food and water insecurity, pandemics, economic stress, and ecological degradation. Known as "smart cities" or "ubiquitous cities," this urban form is characterized by deployments of computer technologies and analytics that promise enhanced efficiencies within the urban metabolism. This paper presents South Korea's New Songdo City as a case study in ubiquitous urban design by asking if it constitutes an opportunity within the perfect storm for an emergent, resilient urbanism. A key player in building New Songdo City is Cisco Systems. The project is an important strategic transition for Cisco Systems as its move from internet "plumbing" (routers) to whole systems design. An emergent property within global capitalism, ubiquitous urban design is a driving force in reproducing markets, technology, and investment. The emergent property, however, is nested within Gale International's (the developer) top-down, Haussmann-like approach to urban planning. It has a high modernist, linear approach to urban design that attempts to impose order on the oscillating environment of global crises. Core to the resulting tension between bottom-up and top-down approaches, is how ubiquitous design increases efficiency within modernity's late conservation phase, and how it drives the system into a deeper state of overshoot that threatens to tip into a hard collapse. As we build more of these cities, we need to question if they are the proper strategy for weathering the perfect storm

Introduction: The Bridge to the Future

Among the great lines of social science inquiry is the process of becoming that rests at the core of humanity's reproduction. Every moment we experience the predictable yet unstable flow of regeneration, a process of local to global micro and macro systems interacting to constitute anew the world we live in. Within the flow resides the potential for emergence where random interactions within the sub-parts of a complex system find repetition that result in the formation previously unknown patterns. With further repetition emerging patterns form rule-sets that constitute the production of new systems. Commentators like Steven Johnson (2001) and Malcolm Gladwell (2002) teach us that emergent properties are hard to discern, and often do not become knowable to us until after the fact of their formation. Given the complexity of a globalized world, one experiencing unprecedented stresses and turbulence within its key systems, we face the challenge of knowing when something new and important is transitioning from the world of noise (the random un-patterned interaction of system parts) to the process of becoming, what complexity theorist Mark Taylor (2001) describes as the process of "in"- "formation." The time scale of the process of becoming is part of the discernment challenge. In some cases, the tipping point is sudden and brings radical change, while in others a Braudelian wave of long duration best defines the process of becoming. Of course, part of the line of inquiry concerns the question of if rapidly emergent properties are actually the product of the long duration, as suggested by E. P. Thompson's (1965) notion of the "Great Arch," in which bourgeois sentimentality came into being through multiple, mini-revolutions spanning a century.

Walking along almost vacant streets designed for large, urban automobile traffic, one comes to the edge of New Songdo City, an "instant city" that the City of Incheon, in the Republic of South Korea, built from scratch. A six-story tall building with a silver apron of mixed glass and metal stands on the edge of the urban form facing both the newly constructed urban form and an expanse of land, reclaimed from the sea by the mega-development project. The structure's design consists of oddly juxtaposed straight lines with long curves and seemingly random stairways, patios, and entrances that make one wonder if the building best resembles Picasso's Cubism rather than an example of the "smart city" planning of the city's developer, a Boston, but now New York City, based firm, Gale International. Entering "Tomorrow City," as the developers, in an embarrassingly over-eager attempt to brand their creation as a "bridge to the future" (Kuecker 2013), have named the building, one finds a fascinating collage of built spaces designed to showcase the cutting edge gadgets of 21st century technology, the so-called "internet of things" that some see as representing an emergent property that will generate a new complex adaptive system both utopian for the human condition and savior to a looming planetary collapse. Tomorrow City occupies 47,000 square meters (505,900 square feet), that contain the U-Transit Center, U-City Vision Center, U-Mall, and U-Square; all spaces of demonstration, for the smart city's ubiquitous urban design.

Figure 1: New Songdo City's "Tomorrow City"

After visiting Tomorrow City, one might understand why so many observers resort to superlatives in their attempts at capturing what New Songdo City represents. Halpern, LeCavalier, Calvillo, Pietsch, in their essay, "Test-Bed Urbanism," pronounce, boldly, "Songdo is, arguably, the most extreme instantiation of a far more prevalent and genuinely ubiquitous faith in the place of big data and interactive feedback to monitor and sustain daily life" (290). In the *Foreign Policy* special 2010 issue, "Metropolis Now," Parag Khanna (2010, 128), a Senior Fellow at the New America Foundation, wrote, "Songdo might well be the most prominent signal that we can—and perhaps must—alter the design of life." Greg Lindsay (2010), a business journalist and promoter of John Kasarda's areotropolis

urban design (Kasarda and Lindsay 2011), boldly states, "New Songdo is the most ambitious instant city since Brasília 50 years ago." Interviewing author J.C. Hallman, *Salon* on-line magazine explained (Rogers 2010), "New Songdo is the most ambitious of the six examples in J.C. Hallman's 'In Utopia,' his new book about modern-day utopian projects. Fascinated by the decline in utopian thinking over the past century, and inspired by his own suburban upbringing, Hallman wanted to look at far-fetched ideas that are pushing the boundaries of our social imagination — and, to varying extents, succeeding."

A new urban form has emerged amid the perfect storm of global crises: climate change, energy transition, demographic shifts (growth, aging, and urbanization), food and water insecurity, pandemics, economic stress, and ecological degradation (Kuecker 2007). Known as "smart cities," or "ubiquitous cities," this urban form is characterized by computer technologies that promise enhanced efficiencies within the urban metabolism. This paper presents New Songdo City as a case study in ubiquitous design by asking if it constitutes an opportunity within the perfect storm for an emergent, resilient urbanism. The essay utilizes complexity thinking to explore smart cities as emergent properties, which is the central organizing concept for the essay. To better understand the relationship between the smart city, emergence, and maladaptation, the essay also integrates critical theory with complexity thinking, which contributes to the growing critical urbanism literature on the topic of smart cities. The essay commences with a discussion of smart cities and their relationship with capitalist reproduction. Building from this analysis, the essay next considers New Sondgo City within complexity thinking, and develops the emergent properties analysis of smart cities. The following section considers the "true believer's" epistemic, which is

juxtaposed to a discussion of smart cities and the "right to the city" in the final section. Together these sections argue that smart cities represent a maladaptation to the perfect storm, a form of emergence that will sustain a death spiral of systemic overshoot. Additionally, the essay argues that the pursuit of smart city prevents alternative forms of emergence that enhance human resilience in an era of deep crises.

Internet of Things, Smart Cities, and the Reproduction of Capital

Smart cities find their origins in the emergence of the "internet of things" made possible by the continued waves of information technology revolutions of the past 30 years. In particular, the explosive development of "smart phone" technology and its global adaptation, made it possible for the vast array of electronic appliances and gadgets connected to the world wide web to be controlled by one device. International Data Corporation (IDC) (Clarke 2013, 4) estimates that about 1% of connectable devices are currently connected to the internet. By 2020 the number of connectable items will reach a staggering 212 billion "things." Further, they estimate that by 2017 earth will have 3.5 billion people connected to the internet, and 64% will be by mobile connections. "People and connected things will generate massive amounts of data, an estimated 40 trillion gigabytes, that will have a significant impact on daily life," explains the IDC study (Clarke 2013, 4). "The internet of things will enable faster response times to medical or public safety emergencies and save lives, it will improve the quality of citizen life by providing direct and personal services from the government, and it will uncover new information about how our cities work, thus enabling city leaders to use resources more efficiently and save money while providing superior services" (Clarke 2013, 4). As indicated by IDC,

the internet of things provides near endless opportunities for companies, such as Cisco Systems, a sponsor of the IDC study, to mine vast amounts of data.

Over the next 25 years, modernizing and expanding the water, electricity, and transportation systems of the cities of the world will require approximately $40 trillion, which is equivalent to the 2006 market capitalization of all shares held in all stock markets in the world (Doshi, Schulman, and Gabaldon 2007). Urban analytics promises to be a central player in the market, so much so, Kamel Boulos and Al-Shorbaji (2014, 23), state "The topic of 'smart cities' is among the hottest emerging research and business themes of the 21st century." They note that University College London (UCL) launched two new master degree programs in Smart Cities in 2014. They cite Cisco Systems CEO John Chambers keynote address at the 2014 Consumer Electronics Show in Las Vegas, where he valued the public and private sector of the internet of things at $19 billion for the following decade (Kamel Boulos and Al-Shorbaji 2014, 23). They (Kamel Boulos and Al-Shorbaji 2014, 23) state that the Cisco CEO explained that "hyperconnected cities could… transform the retail industry through smart shopping carts and virtual concierges, reduce city energy costs for streetlights, revolutionise city waste management through connected garbage bins, and change the way cities handle parking through a real-time parking finder communicating with connected parking spots." Anthony Townsend's *Smart Cities* (2013, 31), the leading book on the topic, confirms these findings; he estimated the smart city share of the $40 trillion market to be $100 billion.

The way companies like Cisco Systems and urban agencies like the City of Incheon are using the innovation of the internet of things to

constitute new patterns within the urban form appears to be yielding a new urban rule-set. Yet, as an emergent property, the newness of something like New Songdo City is marked by a lack of discursive traction for what to call the new urban form. As Taylor (2001) suggests, an urban form like New Songdo City has left the stage of being "noise" and appears to be "in" – "formation." A 2011 report published by OVUM (Green 2011, 6), an information technology consultancy, for example, states, "The idea of the smart city or community has a center but no clearly defined boundary. There is not even a general agreed terminology, with 'smart city', 'intelligent city', 'wired city', 'senseable city,' and 'smart and connected community' all used to describe similar concepts." The report states, "While no one owns any of these terms, some tend to be associated with particular vendors or linked to particular approaches." OVUM uses Cisco Systems as an example, stating, "Cisco prefers the term 'smart and connected communities' to 'smart cities', and tends to use this term to indicate an orientation towards behavior-centric implementations." The report (Green 2011, 6) asserts, "A common trend is the need to complement existing disciplines of physical urban planning with a new discipline of digital planning so that cities will have their own digital master plans."

The research consultancy Forrester (Bélissent 2010, 3) defines the smart city as a "city that uses information and communications technologies to make the critical infrastructure components and services of a city — administration, education, healthcare, public safety, real estate, transportation, and utilities— more aware, interactive, and efficient." The report (Bélissent 2010, 3) develops the definition by stating, "This new approach to urban governance is enabled by the next macro cycle of information technology innovation, which Forrester labels 'Smart Computing.'" It uses "real-time

awareness and data analytics to support better decision-making. Each system that makes up a city's infrastructure can be made smarter by enabling real-time interaction — either human or machine — to facilitate decision-making based on the data produced. In the system of systems that is a city, the potential for efficiency grows as more systems interconnect and interact. Computing technology transforms a city's core systems, enabling them to capture, analyze, and act on the data they produce. As a result, a smart city can optimize the use of and return from finite resources." Forrester (Bélissent 2010, 28) defines "smart computing' as a "new generation of integrated hardware, software, and network technologies that provide IT systems with real-time awareness of the real world and advanced analytics to help people make more intelligent decisions about alternatives and actions that will optimize business processes and business balance-sheet results."

As an emergent property within neoliberal globalization, ubiquitous urban design is a driving force in reproducing markets, technology, and investment. The driving force, arguably, is one of the more important frontiers for new markets necessary for capitalism to continue to escape from its periodic surplus capital crises. As the world's largest privately financed development project (Townsend 2013, 25), New Songdo City represents an important case study for understanding smart cities in capitalist reproduction. Halpern, LeCavalier, Calvillo, Pietsch (2013, 287) argue, "Cisco's turn to urban development and to the production of smart city models and prototypes is an exercise in creating markets for the very hardware on which the company was founded." They (2013, 282) explain how Cisco Systems is "looking for new sources of revenue and hope to

'monetize' the attentive capacity of Songdo's inhabitants. Their hope is to use this latent reserve of data gathered on users to produce services that can be paid for through advertising, electronic education, physical treatment, home telemedicine, or any number of other speculative products vying for a share of this new market. For Cisco—like Facebook, Google, and other companies that attempt to link user behavior at the interface with consumer behavior in order to monetize their vast data sets—data are the currency of this new realm, a realm envisioned as an interface for inserting and extending the sensorium." Robert Hollands (2013, 6), echoing Mark Swilling's (2011) argument about how "green urbanism" is the newest form for the commodification of the urban infrastructure, suggests that while it "might be argued that environmental sustainability is in itself progressive, it might also be suggested that it can be used to disguise another significant and growing force behind smart cities. And that is a combination of aggressive marketing strategies and huge profits to be made by major corporate ICT firms, engineering, property development and construction companies." Hollands (2013, 6) cites consultancy reports that estimate annual smart city markets ranging between $20 and $40 billion by 2020. From this perspective, the smart city is reduced to a marketing ploy that sells the techno-utopian fantasy of a quality of life purged of the dystopian threat of adding 2 billion people to the urban form (Provost 2012).

Why Now? Locating New Songdo City within the Perfect Storm

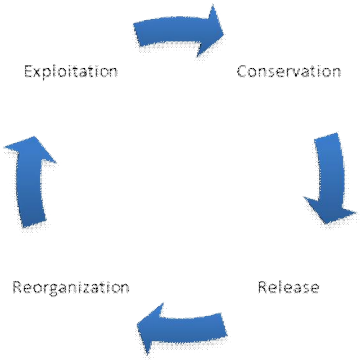
A 2013 white paper sponsored by Cisco Systems and issued by International Data Corporation (Clarke 2013, 1), a global provider of market intelligence, advisory services, and events for the information technology, telecommunications and consumer technology markets, states that "Smart City development is a question of *when* not *if*, a

question of how not what. Why? Because we live in a world experiencing economic turmoil, climate change, aging populations, and rapid urbanization. But we also live in the midst of tremendous technological innovations that have the potential to address the issues that challenge every city." The IDC report invites consideration of a basic question: to what extent should we understand the emergence of smart cities like New Songdo City as the product of capitalist profit seeking through market innovation, and to what extent do we need to approach this new urban form as the consequence of the "perfect storm" (Kuecker 2014 originally published in 2007) of crises within the macro, global system? Or, do we consider the capitalist market explanation to be one of the factors in the perfect storm, whereby New Songdo City represents a symptom of the deeper structural crises of the 21st century. These questions invite us to locate New Songdo City within our current historical moment, an analysis that invites us to consider the early decades of the 21st century to be a departure from the modern world system, one driven by modernity's systemic collapse (Kuecker and Hall 2011). By this argument, we build the smart city, this new urban form, because we are leaving the modern era and are entering an era of turbulence, a factor of systemic oscillation that is tipping into processes of disordering and widespread loss of complexity. New Songdo City, by this argument, is the product of 21st century panarchy.

The idea of "panarchy" comes from the work of an ecologist, "Buzz" Holling (Holling and Gunderson 2002). It proposes a four phase cycle for complex adaptive systems, such as a forests, animals, or economies. The phases, demonstrated in Diagram One, consist of reorganization (when the system is disordered), exploitation (when emergence happens), conservation (when emergence becomes the

dominant rule-set that is pursued for relentless efficiency), and release (when the system passes from overshoot to a disordering of the system, or collapse). As a complex adaptive system, modernity is either: [1] in its late conservation phase, a time of extreme overshoot, and oscillating between reproduction and collapse; [2] at a tipping between conservation and release phases; or [3] it is in the preliminary stages of the release phase. As locating the current historical moment is of great importance to our analysis, this essay maintains that we have entered the release phase, the initial movement toward a radical disordering and simplification of the system. Yet, modernity's grasp remains firm, as we desperately attempt to prevent collapse by keeping the system within the conservation phase. Smart Cities are one manifestation of this desperate attempt to keep the system ordered. Given the complexity cycle, panarchy also maintains that a macro, global system consists of nested sub-systems, each of them global. These include systems like climate, energy, food, population, economy, and ecology. Panarchy maintains that each of the subsystems have reached their release phase tipping point, what Richard Heinberg (2010) calls "peak everything." At this moment the marco, global system experiences synchronous failure, which tips the system to the release phase where the system moves to disorder and simplification.

Diagram One: Complex Adaptive System Cycle



Source: Adapted from Gunderson and Holling, 2002: 34.

Urban design with the smart city at its core represents a significant misreading by planners about the state of the global system. They have a "sustainability" mind set that assumes the system is in overshoot, whereby urbanization is currently past a threshold of sustainability, defined as a scenario in which present forms of societal organization result in an extreme disequilibrium between sources and sinks, whereby the disequilibrium compromises present and future capacities for reproduction (for sources and sinks, see Meadows 2008). Consultancy reports on smart cities frame their analysis with the overshoot scenario and the need for sustainability. McKinsey and Company (Elfrink 2012), for example, frames the sustainability challenge around peak demographics: "Our rapidly urbanizing world faces an enormous demographic imbalance. Over the next few decades, Europe, and to some extent the United States and China, will be aging and shrinking, even as India, Africa, and the Middle East see their populations expanding. At the same time, we still have three

billion people in the world who have no access to water, electricity, health care, and education. And we are moving from a global population of seven billion to nine billion." The McKinsey report emphasizes, "Clearly cities are the key to whether we successfully meet this massive transition challenge and achieve growth that is both sustainable and inclusive. And the critical enabler is going to be technology." Forrester Research, Inc. (Bélissent 2010, 2) shares the demographic frame, and shows its impact in driving peak everything within key sub-systems within the urban metabolism: "More people means competition for limited resources and eventual scarcity. Demand for water and energy illustrates these pressures. In 1990, 20 countries faced water scarcity — up from only seven in 1955. By 2025, an additional 10 countries — and by 2050, another four — will face water scarcity, accounting for a total of 18% of the world's population. Another 24% will experience water stress or shortage. Combined, that's almost half the world's population — with most in developing countries. The demand for energy use is also growing more rapidly in developing countries. The Organisation for Economic Cooperation and Development (OECD) estimates that energy consumption will increase by 84% in non-OECD countries, compared with a 14% increase in energy use among the 33 OECD countries. The two largest uses of energy consumption are industry and transportation, both of which are expected to increase more rapidly in non-OECD countries." Leading design firms, such as Arup International, join this perspective. Their September 2010 report, "Smart Cities: Transforming the 21st Century Via the Creative Use of Technology," (4) states: "The challenges of climate change, population growth, demographic change, urbanisation and resource depletion mean that the world's great cities need to adapt to survive and thrive over the coming decades. Slashing greenhouse gas

emissions to prevent catastrophic climate change while maintaining or increasing quality of life could be a costly and difficult process. There is an increasing interest, therefore, in the role that information and communications technologies could play in transforming existing power-hungry metropolises into low-carbon cities of the future. But, as yet, few cities have fully grasped the possibility of becoming a 'smart city'"

Smart cities are an adaptive response to the perfect storm, where planners assume the system of modernity can be saved by scaling back the system from its extreme overshoot and landing it in a steady state of system equilibrium. Positive feedback loops within the global complex system, however, send signals to urban planners and developers that they should relentlessly pursue efficiency within the capitalist rule-set, while constructing significant economic, political, social, and cultural signals that prevent it from embracing policies and actions that would cause system stabilizing negative feedback loops. By this analysis, a smart city like New Songdo City, especially due to the strong market forces driving innovators like Cisco Systems, constitute a positive feedback loop that will drive the modern system deeper, faster, and harder into its release phase. Lacking a system operating by negative feedback loops, cities, along with the rest of the global community, will drive itself into a hard, species threatening collapse. Smart Cities constitute mal- adaption to the perfect storm, and are far from the "eco-city" urban form advocated by visionaries like Richard Register (2006) or the fundamental paradigm shift envisioned by Donella Meadows, Joregn Randers, and Dennis Meadows, in their *Limits to Growth* (2004) call for a "sustainability revolution."

One way to think about emergent properties in complex adaptive systems is to consider the evolution of transportation from horse to railroad. For centuries the dominant means of terrestrial transportation was the horse. Horse transport defined time-space relationships in both absolute and relative/abstract forms (on time-space relations, see Gregory 1994). Central to time and space, horse transport was constitutive to society, and was common sense for how the world operated, especially within the practice of everyday life. The horse was the typewriter and telephone before the computer and internet. A transportation revolution happened in the early 19th century with the "iron horse" or "railroad." It caused a radical reworking of relative/abstract space, that compressed time-space in ways not seen for millennium. It was the 19th century's internet revolution, and it was a fundamental force shaping modernity. To get to the railroad, a process of innovation took place, such as the one represented in Picture Two, which is an engineer's design for what he imagined to be what we now know to be the railroad. It required assembling existing technologies, such as steel rails, gears, wheels, and the steam engine. Putting the pieces together, however, also required an epistemological shift, one that displaced the horse centered paradigm of transportation, with a new way of thinking, being, seeing, and acting of the railroad age. At the tipping point, the new parts are in play, but the old way of thinking, the "horse sense" that says "if it is transportation, it must have the horse," is still dominant, and prevents the tipping to the new paradigm from happening. The horse, however, absurd, had to be central to the new form of transportation, because if you were doing transportation, the horse had to be involved. The horse, on the conveyor belt, on the railroad track constitutes a metaphor for paradigm shift, cultural hegemony, and the larger process of societal transformation.

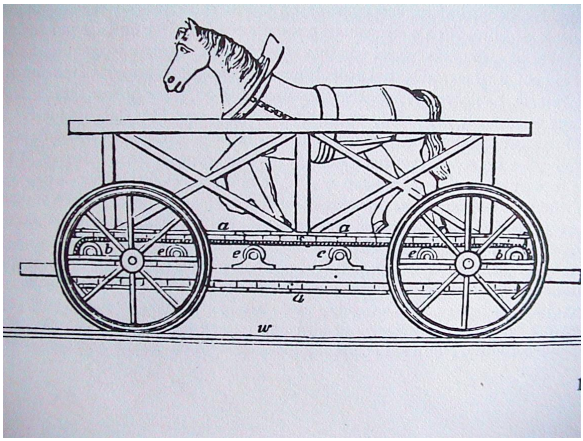


Figure 2. *Engineer plan for railroad, circa 1829.*

New Songdo City, then, is the horse on the conveyor belt on the railroad track. As with the transition to the railroad, today's smart city remains in a process of experimentation, testing, and exploring (Townsend 2013). The final form is unknown, and the complete transformation in thinking, the epistemological shift away from "horse thinking" has not yet taken place. Townsend (2013) maintains tha how that shift will happen remains an open question, as well as when, or even if it will happen in a timely fashion.

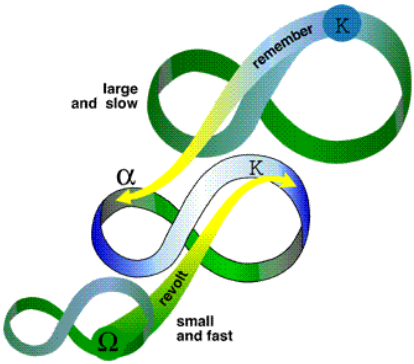
One insight into how the smart city transition might happen comes from consideration of Dennis Kingsley and John Urry's (2009) *After the Car*. In this book the authors use complexity thinking to analyze

the historical emergence of the car system. They illustrate how it became central to the larger macro, global system of 20th century modernity, and make the case for how the system integrates the physical metabolism of energy and material consumption with human systems of production and consumption in forming a rule-set that constitutes one of the deepest cultural paradigms of late modernity. More significant for thinking about smart cities is their argument that a new car system is in the process of emergence. They maintain that relatively random components of the macro global system are forming new patterns that are showing signs of a new rule-set that will soon set the foundation for a new system that will launch the next wave of transport revolution. They illustrate how new fuel systems, new materials, smart vehicles, digitalization, de-privatization, new transport policies, new living practices, and disruptive innovation are coming together to tip the modern mode of car transportation into something radically new and different. If we tip past the point of modernity's car based transport system, the resulting emergent property will fundamentally re-define our ways of being, seeing, thinking, and acting, and will constitute the basis for the sustainability revolution called for by Meadows, Randers, and Meadows. Google's development of the driverless car, soon to be on the road in California, suggests that the tipping point has arrived (Muller 2013). Yet, that "if" is a very big "if."

Kingsley and Urry's post-car system highlight another perspective to the panarchy concept, one that sheds more light on the challenges of understanding what may happen to the macro, global system at its critical threshold where panarchy finds the late conservation phase's extreme overshoot resulting in modernity's tipping into a post-modern release phase. They show that the system's emergent properties, even in the relative rigidity of the late conservation, where the system

is locked into a death spiral of the relentless pursuit of efficiency within the rule-set, can persist as a complex adaptive system by evolving within the modern rule-set to a newer, higher stage of systemic reproduction that avoids collapse while transitioning into a new system. Presumably this new system state would pass through the critical threshold, avoid entering the release phase, and tip into a new reality, one that would be radically distinct from the previous system of modernity. This emergent process of evolution would also constitute a post-modern proposition, but it would not entail collapse.

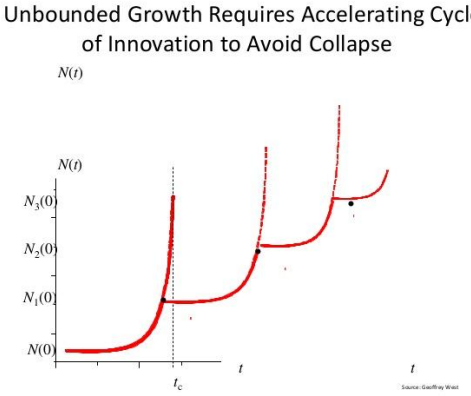
Diagram Two: Emergence as panarchy



The evolutionary perspective is advocated by Geoffrey West, a physicist at the Santa Fe Institute, one of the leading think tanks for complexity studies. In his Ted Global 2011 presentation, "The Surprising Math of Cities and Corporations," seen by over 1.2 million viewers, West explains how cities can prevent a "limits to growth" collapse by innovation. "What we do is, as we grow and we approach

the collapse, a major innovation takes place and we start over again, and we start over again as we approach the next one, and so on," according to West (2011, 14:50).

Diagram Three: West's unbounded growth as a possible path of emergence.



West, however, recognizes that while innovation driven unbounded growth can avoid collapse, it still faces deep predicaments. "So there's this continuous cycle of innovation," West states, "that is necessary in order to sustain growth and avoid collapse. The catch, however, to this is that you have to innovate faster and faster and faster. So the image is that we're not only on a treadmill that's going faster, but we have to change the treadmill faster and faster. We have to accelerate on a continuous basis" (West 2011, 14:50). This "catch" is no minor thing, as it returns us to the limits of growth, and strongly suggests that smart cities remain firmly bounded by the laws of thermodynamics that warn us against devising open loop systems that require perpetual growth. The catch negates the more optimistic interpretation of New Songdo City put forward by Townsend (2013,

28), which endorses the "bridge to the future" concept. He sees New Songdo City as planting the seeds for future smart city successes. The catch, points to a consistent problem within modernity first recognized by William Stanely Jevons, in his 1865 *The Coal Question*. Jevons argued that technology driven gains in efficiency that intend to conserve resources paradoxically result in increased consumption (Hallett 2013). Likewise, Thomas Homer-Dixon, invites us to see the limitations of innovation as solutions to crises in complex adaptive systems. In his *Ingenuity Gap*, Homer-Dixon (2002) illustrates that when we innovate to solve problems caused by the complex systems we create, we make the system even more complex. A positive feedback loop of problem, innovative solution, enhanced complexity becomes part of the late conservation phase rule-set, a factor that drives the system to extreme overshoot, while making it more rigid and decreasing its resilience, especially its ability to emerge into a new system. While we can see the innovative solutions to system problems as constituting an emergent property similar to West's vision of collapse escaping systemic evolution, Homer-Dixon argues that eventually the system will become so complex and the problems, the "unknown unknowns" it throws at us will scale beyond our capacity to successfully adapt. As West argues, eventually, we will not be able to bridge the ingenuity gap fast enough to escape collapse.

Discerning if New Songdo City is a factor of the ingenuity gap, the efficiency trap, or both, is largely a question of interpretation. Yet, those options tell us that as an emergent property, New Songdo City and the smart city form of urbanism is an innovation that reproduces the modern system, keeping it within a positive feedback loop of extreme overshoot that will eventually tip into collapse as against an emergence that crosses thresholds into a new system without

collapsing. New Songdo City is not the bridge to the future that its creators represent it to be. Instead it is a collasal example of maladaptation, an errant form of emergence that wastes billions of dollars and vast amounts of social capital on building the wrong urban form at a critical moment in human history.

Steven Johnson's (2001) analysis of emergence makes the case that it is a process of self-organized becoming that happens without a master plan, leadership, or design. He uses the example of ant colonies, and the "myth" of the queen sending orders to the worker ants that make the colony function. Instead of this pacemaker, the ant colony self-organizes from the collective behavior of the colony, a process that manifests a capacity for adaptation that approaches learning. For Johnson, there is no pacemaker in emergence; it is a bottom-up rather than top-down process. Many observers negatively critique smart cities, especially New Songdo City, for being a top-down pacemaker. Dan Hill (2013), for example, refers to the smart cities as the "urban intelligence industrial complex" led by the likes of Cisco Systems, IBM, Siemens. Hill, echoing Townsend's (2013) analysis, juxtaposes the top-down urbanism of current smart cities like New Songdo City with the bottom-up vision of "smart engaged citizens." He asks, "is there a tension between the emergent urbanism of social media and the centralising tendencies of urban control systems?" Hill has in mind the people centered smart urbanism developed by Adam Greenfield, especially his Urbanscale project (http://urbanscale.org), and as articulated in his *Against the Smart City* (2013). They take from Richard Sennett's damning 2012 assessment, "a city is not a machine; as in Masdar and Songdo, this version of the city can deaden and stupefy the people who live in its all-efficient embrace. We want cities that work well enough, but are open to the shifts, uncertainties, and mess which are real life." The

critique of top-down urbanism engages the ghost of the epic battle between Jane Jacobs and Robert Mosses over the future of New York City's essence. The debate between serendipity and planning reaches back to the authoritarian modernist planning of Haussmann's redesign of Paris (Harvey 2006), as well as the high modernism of Lúcio Costa and Oscan Niemeyer's design for Brasilia (Holston 1989) and Le Corbusier's five points of architecture. The top-down vs. bottom-up tension with smart cities also suggests the dystopian potential of high modernism as explained by James Scott in his *Seeing Like a State* (1998). Steven Poole (2014), writing for *The Guardian*, explores the utopian vs. dystopian tension in our understanding of the smart city, and concludes that their top-down propensity will eventually destroy democracy.

The True Believers

The top-down vs. bottom-up debate over smart cities is acknowledged within the consultancy community. OVUM (Green 2011, 8), for example, explains, "Another tension that runs through the various initiatives is the differences between the top-down and bottom-up approaches to digital urban renewal." In their perspective, "the respective distinction between the top-down and bottom-up models is a 'tight' approach, which involves monitoring, instrumentation, and centralized control, and a 'loose' approach, which focuses on enablement, community involvement, and behavioral change. The paradigm for a top-down approach is a tightly managed enterprise resource planning system for the entire city, including its distributed physical assets. The paradigm for a bottom-up model is an open source platform that supports instead of prescribes the creation of modular and diverse applications and extensions by third parties."

Smart City defenders, such as Rick Robinson, an executive architect at IBM specializing in smart cities, and whose Urban Technologist Blog (http://theurbantechnologist.com) advances ideas for making the smart city idea work, vigorously argue against the naysaying dystopian thesis. Simply stated, he argues that "No-one wants top-down, technology-driven cities. They'd be dumb, not smart." Robinson asserts, "In all of my contacts across the world, in technology, government and urban design, I don't know anyone who thinks it would be 'smart' for cities to be run wholly by technological systems; who believes that digital data can provide 'perfect knowledge' about city systems; or who thinks that cities built and run entirely by deterministic plans driven from the top down would be healthy, vibrant places to live (or indeed are possible at all)." Robinson attempts to reframe the top-down vs. bottom-up smart city tension by avoiding its either-or dichotomy by seeing them as complimentary processes. "From the governance of cities, to the policies that affect investment, to the oversight, administration and operation of city infrastructures," Robsinson states, "these processes work top-down; and in order for us to rely on "bottom-up" creativity improving cities for all of their citizens, we must adapt and improve them to better support that creativity." Robinson thinks Jacobs and Mosses can ride off together into the smart city sunset.

When meeting with Gale International executives in their New York City office in May 2013, I gained insights to the "true believer's" mentality carried by smart city advocates. When CEO Stan Gale sold off company assets to help finance the project, the Gale International team had gone "all in" on the project. When I asked about low occupancy rates, media reports of a lethargic city life, and their top-down design approach, the executives spoke directly about the cultural dynamics of urban formation. They discussed how the plans

can be made, the buildings built, and the infrastructure placed, all with the intent of creating a "smart" and "sustainable" city. Yet, they framed New Songdo City's future as resting within the Jane Jacobs (1992/1961) urban frame, one that recognizes the street level as against the master planner's drawing board. They embraced the idea that the city will be made by its inhabitants, the culture they bring, and the intangible interactions of their collective lives. Their observations suggest the idea of emergent properties, but their desire for a bottom-up, street level city culture conflicts with Gale International's dual propensity for top-down master planning and its attempt to copy iconic architecture and landscapes from the great cities. For the master plan, Gale contracted the global architectural firm, Kohn, Pedersen, and Fox, which generated the blue prints for the instant city. Together, they created the simulacrum landscape of iconic structures and places copying from New York City's Central Park, the Sydney Opera House (see Picture Three), and even the canals of Venice. Emergence, as Johnson (2001) explains, is an organic process, a patterning from random interactions that does not have a pacemaker planning and overseeing the process of becoming. With Gale International, Kohn Pedersen and Fox, Cisco System's, New Songdo City clearly has pacemakers. Built from scratch – except for the ecosystem it landfilled-- the city came into being direct from the design table, without any inhabitants to generate a bottom-up, self-organized process of urban becoming. This top-down smart urbanism significantly limits the self-organizing, serendipitous capacity of the urban form from escaping the death spiral of modernity's extreme overshoot.

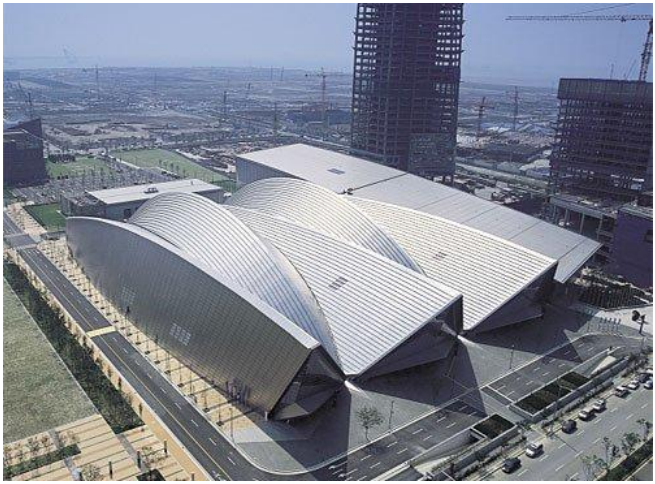


Figure 3.Kohn, Pedersen, Fox' Convensia, a simulacrum of the Sydney Opera House

Obedient to the laws of thermodynamics, a collapsing system experiences loss of complexity and a move from order to disorder. To prevent the collapse, human agents within the extant system expend energy through their interventions to keep the system ordered. Complexity thinkers like Joseph Tainter (1988) and Homer-Dixon (2006) argue that the system will experience diminishing returns, as more and more resources are poured into sustaining a system that would otherwise become disordered. This sustaining gesture rests at the core of the smart city epistemic, one deeply rooted in a Cartesian mindset that views the non-human world as a machine, where nature can be controlled by reason (Best and Kellner 1997). This epistemic reduces nature to an instrument or tool for human purposes. The instrumentalist view of nature sees the world

in a linear fashion in that it attempts to reduce the randomness, spontaneity, disorder, and chaos of a non-linear universe to knowable universals, civilizational myths disguised as truths that make human dominion over nature not only possible but a necessary facet of the human condition (Quinn 1999). With global crises bringing our oscillating system to the edge of chaos, Gale International's New Songdo City is the product of the Cartesian epistemic, an attempt blind to the desperation of the gesture to restore order to modernity's collapse.

Emergence and the Right to the City

Emergence is important because it is the core of resilience, a resource in great demand if we are to avoid a hard collapse of the macro, global system. The source of resilience is the commons, especially the social, political, economic, and cultural relations relations built by humans. The late conservation phase, however, brings us to a relentless pursuit of efficiency within the economic rule-set, neoliberal globalization. For the past 40 years, neoliberal globalization at ever great speeds and depths has penetrated all scales and spaces of the commons, leaving a social fabric torn to shreds precisely at the moment that it is most needed, and leaving us dependent upon capitalism to save us from the crises it had created. As Naomi Klein's *The Shock Doctrine* (2008, also see Keucheyan 2014) informs, capital thrives on the profit making potential of crises. As neoliberalism continues to transition capitalism to its green iteration (Swilling 2011), the commons continues to be privatized, as clearly illustrated by the case of New Songdo City, an instance of an urban form constituted as privately held public space. As Hollands (2013, 3) states, "The problem in urban sociology generally is there appears to be a distinct lack of an alternative to the neo-liberal city, smart or otherwise." Looking for the urban equivalent of the Zapatista

movement, the ways that "other knowledges" can generate alternative urban forms suggests how smart cities like New Songdo City block their emergence. Arguably, spaces like slums is one such zone of liberation, as well as squatter communities, such as the Frente Popular Pancho Villa ("Los Panchos") autonomous *comunidad popular* in Mexico City's Acapatzingo barrio (Zibechi 2014), or Torre David in Caracas (see Picture Four), where impoverished city dwellers occupied an skyscraper-office complex abandoned after being two-thirds constructed due to a the developer's bankruptcy, and transformed it into a vertical squatter community (Baan 2013).

Figure 4. Torre David in Caracas.

Responding to the crisis of post-war capitalism and its detrimental impact on Parisian urban form, and anticipating 1968, Henri LeFebvre (2003) argued for the "right to the city." LeFebvre's formulation provides deeper insight to emergence, as the "right to the city" is the urban dwellers right to transform the city and to be transformed by the city (Harvey 2012; and Merrifield 2013). Boosters of the smart city

embrace the techno-utopian potential human transformation and consequent systemic emergence toward the enlightenment's continued perfection of the human condition. The dystopian view understands smart cities to be a denial to the right to the city. Them New Sondgo City portends a new era of splintered urbanism (Graham 2001; and Swilling 2011), a global apartheid of gated smart cities protecting a global elite in what Hodson and Marvin (2010) call "bounded urbanism" from the global slum (Davis 2007). Hollands (2013, 11) argues that "smart city initiatives stop" the "right to use technology." Instead, he advocates for "the right to shape the city using human initiative *and* technology for social purposes to make our cities better and more sustainable." Hollands' analysis is echoed by Townsend's (2013) call for a bottom-up approach of smart technology citizens using the internet of things to constitute a new civil society.

Conclusion

In complexity thinking, systems abide to the laws of thermodynamics. Entropy tells us that any system's propensity is toward disorder. Cities, as Edward Glaeser (2012) reminds us are humanity's "greatest invention," a remarkable way to bring order to the complexity of human agency. When systems reach the critical threshold of their tipping point, emergence becomes critically important in determining the potential outcomes of the tipping. This essay considered smart cities, such as New Songdo City, as constituting the newest wave of Glaeser's greatest invention, by charting three potential emergent outcomes. The first path maintains that smart cities are an emergent property that fails to prevent systemic collapse, largely due to their lack of resilience caused by their neoliberal assault on the commons. The second path of panarchy finds smart cities as tipping the system into an entirely new system. In this scenario, the new system comes into formation without the midwife of collapse. The third path

maintains that as a “unbounded growth” emergent property, smart cities keep us in sustained, extreme overshoot, where New Songdo City represents the relentless pursuit of efficiency within the late conservation phase’s capitalist rule-set.

As urbanization increasingly becomes a pressing issue within the 21st century’s perfect storm, the question of the smart city’s relationship to emergence speaks directly to one of the bigger debates in urban studies. One side maintains cities are the location of 21st century resilience and they key for weathering the perfect storm, while the other sees the urban form as exacerbating modernity’s systemic collapse. The smart city undoubtedly will play an important role in determining if cities are our savior or curse. New Songdo City suggests early bets on the curse may prove the winner.

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