Archinomics
Towards a Sustainable World City System

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Abstract

To achieve an effective model of sustainability, cities should no longer be developed as isolated entities, devoid of external influences. Instead, a 'network' model of sustainability is proposed, which requires advanced knowledge of both a city's internal urban properties and its external socio-economic linkages to other cities - where we will focus on city-firm connectivity. Within a rapidly globalizing world, corporate relations between cities are increasingly important to the development of urban and regional functions and the subsequent production of space. A city's performance is therefore dependent on its relative structural and functional position within the world-city-network, and where this interdependence reflects its level of sustainability. In the first chapter, the relationship between the overcoming of scarcity and the development of city-firm networks is discussed. Based on a spatio-temporal 'network' model, the second chapter defines sustainability as an evolving 'normative' conception that has developed over many centuries, suspended between the processes of globalization and urbanization. In the third chapter an empirical analysis reveals initial, tentative understandings of city-firm networks at various spatial scales, where in the last chapter, correlations between city-firm connectivity and urban indicators are shown.

1 Scarcity and city-firm networks

Ever since the Industrial Revolution, technological and social innovations have been paramount to global economic development, supplying and creating new forms of demand. Shifting scarcity has led to a type of progression, suspended between the processes of globalization and urbanization, and has led to an increasingly unequal distribution of technology, capital and labor. A new form of society has been manufactured which requires a paradigmatic shift in how we perceive and engage with the world[6]. Pivotal to this will be the re-conception of sustainability and appropriate policies and interventions. Within this paradigm urban planning and architecture can evolve and be relieved of their current deadlock[7]. Today, cities form increasingly interdependent systems in which societal and environmental prospects and predicaments are evident. Therefore cities should be developed as integral components of an emergent world-city-network. A contested 'networked space' that is increasingly limited in scope and resources. Within this evolutionary context the city's transition can be observed[8] reflecting the ancient struggle between economic production and societal wellbeing[9]. Here, a 'circular causality' exists between firms, cities, and their networks, where a city's performance is a measure between its business relations and the wellbeing of its people. A city therefore must develop itself according to its relative

6 Beck, Ulrich (1992)

7 Saskia Sassen addresses the meanings and roles of architecture as still being 'centred in older traditions of permanence' which are 'irrevocably destabilized in cities marked by digital networks, acceleration, massive infrastructures, and growing estrangement'. Architecture, in her opinion, needs to confront the 'massiveness of the urban experience'. Sassen, challenges architects to go 'beyond the notions of high-tech architecture, virtual spaces, simulacra, theme parks, and the materialities of power'.

8 An example at the beginning of the Industrial Revolution would be architect Ledoux's ideal city model 'Chaux' (1804) versus economic geographer Von Thünen's economic city model 'The Isolated State' (1826). Or similarly today a parallel could be drawn between certain works of OMA e.g. the 'Prada store networks' and Peter Taylor's 'World City Network'.

9 It seems that Manfredo Tafuri's prediction, in *Progetto e Utopia*, (1973), that the architect's belief in creating a better society would eventually be swamped by 'capitalism', has become a hard fact.

position within the network. Today little is known about city-firm relationships and their environmental impact. An understanding of corporate 'network footprints' and how these coincide with urban development becomes exceedingly important, where sustainability is defined as the interrelationship between interscalar city-firm networks and social, economic, and environmental indicators within cities. From this conception architecture could gain a higher significance[10]. By integrating economic and architectonic knowledge, architects may become effective intermediaries between market and territorial interests. Judging today's generally inadequate urban developments[11], proliferating junk-space[12], socio-environmental discrepancies, and the degradation of the design professions[13] - it appears that a 'bigger picture' and 'grander narrative' is more needed than ever before[14].

2 Sustainability and city-firm networks

Since the Industrial Revolution city-firm networks flourished, progressing towards our current phase of globalization and where the concept of sustainability reforms around phases of economic recession[15] such as in the 1930s and 1970s[16]. Today we are descending into a new recession, again requiring a redefinition of sustainability. In the provided scheme (figure 1), it is argued that *sustainability* is a 'normative' concept, developing over time, and intertwined between the processes of *globalization* (societal integration) and *urbanization* (spatial integration). These processes have incrementally generated an increase of *complexity* (social, economic and environmental impact), primarily driven by profit maximization and capital accumulation. At the heart of the scheme, we find *scarcity*, in which demand and supply are progressively overcome and regenerated by *network formation* and *knowledge formation*, both suspended between the processes of *globalization* and *urbanization*. Globalization consists of *societal innovation* and *economic innovation*. Urbanization consists of *infrastructural innovation* and *urban innovation*. Furthermore, scarcity coincides with jumps in scale, in which complexity, in the form of societal and environmental problems, is firmly embedded. In turn, uncertainty fuels socio-economic innovation[17] and is perpetually challenged by corporate and political forces. Sustainability, as a normative action, seeks continuous optimizations between *market* and *territorial* values[18].

10 'Yet a concern for architecture has never been free from a degree of suspicion. Doubts have been raised about the subject's seriousness, its moral worth and its cost….Endowed with a power that is unreliable as it often is inexpressible, architecture will always compete poorly with utilitarian demands for humanity's resources', Alain de Botton, 2006.

11 Considering that almost half the use of fossil fuels is used in making and running buildings and the urban and rural textures that connect them, the major challenge to the architectural professions is to suggest ways of reducing humanity's adverse impact on the planet while improving the quality of human life, Harvard Design Magazine, 2004.

12 This may lead us to counter the relative lack of reflective architecture in our profession today and the consequential production of what architect Rem Koolhaas calls 'junkspace' or what Luis Fernandez-Galiano calls the 'horizontal Babel', Foster, Harvard Design Magazine, 2004.

13 In a series of lectures given at the Columbia University, by Rem Koolhaas, Mark Wigley and Ole Bouman, 2005, it was outlined that 'in the current paradigm, architecture has reached its limits and must seek new forms of collaboration and modes of expression'. According to Rem Koolhaas, architecture is 'constantly losing ground and becoming increasingly unimportant'.

14 'The weakness of traditional grand narratives is not that they were too big, but that they were not big enough….and what purpose would intellectual thought have if it were not continuously subjected to chaos', Peter Sloterdijk,, 2004.

15 S-shaped economic cycles discovered by the Russian economist Nikolai Kondratiev (1892 – 1938). Each cycle is boosted by a new core innovation - K1 by water mechanization (1800); K2 by steam mechanization (1850); K3 by electric power (1900); K4 by Fordist mass-production (1950); and K5 by ICT (2000).

16 It is around these moments that new theory and interventions are conceived such as the Club of Rome (1968); the UN Conference on the Human Environment (1972); and the Bruntland Report (1987); and reactionaries like Patrick Geddes, Christopher Alexander, and Jane Jacobs.

17 'Necessity is the mother of invention', Plato.

18 Examples of sustainability jumps in spatial scale are Charles Chadwick's small-scale district interventions during the first economic cycle; for the second cycle, Haussmann's metropolitan interventions; for cycle three, Howard's regional Garden City plans; for cycle four Wright's national Broadacre plans; and for the fifth cycle the international plans of the Club of Rome. Towards the sixth cycle a sustainability conception for the world city network is required.

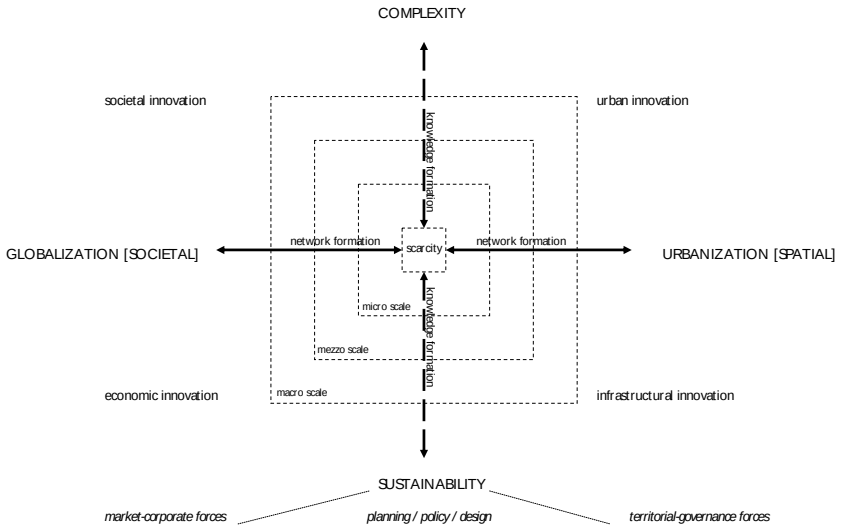


Figure 1: Sustainability model

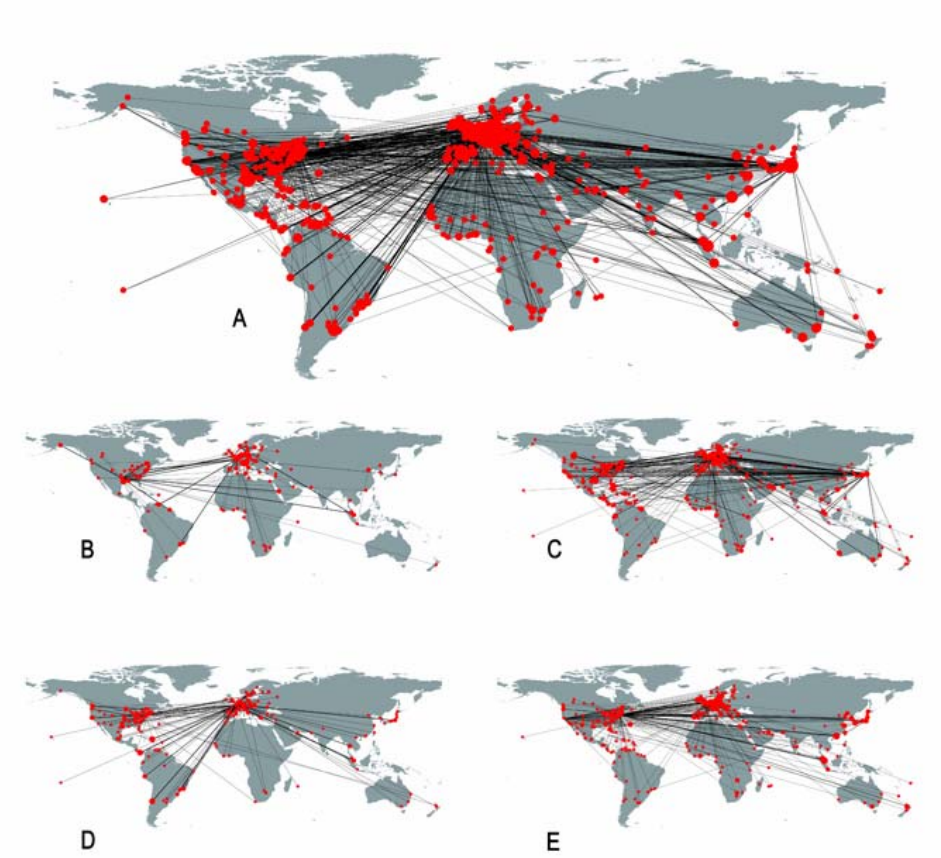
3 Multinationals and interscalar city-firm networks

This research investigates sustainability as a corollary between city-firm networks and urban indicators. For example, due to its higher connectivity, New York has higher sustainability levels than Rotterdam. From city-firm connectivity we can determine the overall structure of networks, the extent, distribution and economic functions of linkages between cities; the economic functions of and between cities; and competitivity and collaboration levels. Correlating these results with the indicators e.g. city-GDP or education levels, we can gain insight into sustainability. From this, exploitation and tradeoffs between cities or firms can be determined. We can also determine which functional improvements need to be made within or between cities. In this research, *multinational corporations* are seen as pivotal to the production of cities[19]. Therefore the intra-firm networks, economic sectors[20], and city locations of top multinationals and their affiliates, at various scales were collected for analysis.

Networks at the macro scale

Here city-firm connectivity (map 1) reveals the global network of our world, where 60% of the connections are in information, marking a difference to previous phases of globalization. Three core economic regions are seen, where variations in economic modes define core, semi-peripheral and peripheral relations[21]. The more globally connected these regions are, the stronger their regional connectivity, indicating that the world is not flattening[22], but polarizing. Although cheaper transportation and IT networks elude a 'shrinking' world, 'real distance' still matters.

19 The top two hundred multinationals in 1999 accounted for almost one third of world GDP and of the world's 100 largest economies (multinationals plus countries), 40% are multinationals, controlling 70% of world trade, The World Bank 2000.
20 The economic sectors, in ascending order of value are basic materials, manufacturing, trade, producer services (services that support the manufacturing industry), and consumer services (services that focus on urban populations).
21 This simultaneous 'fragmentation and integration' process, relates to the rise in business links and destinations within and between regions - fuelled by new transportation and communication technologies, and the profit maximizing redistribution of basic material, manufacturing and services industries (see maps).
22 Thomas Friedman, 2005.



Map 1: Global city-firm networks

A = total connections

B = basic materials connection

C = manufacturing connection

D = trade connections

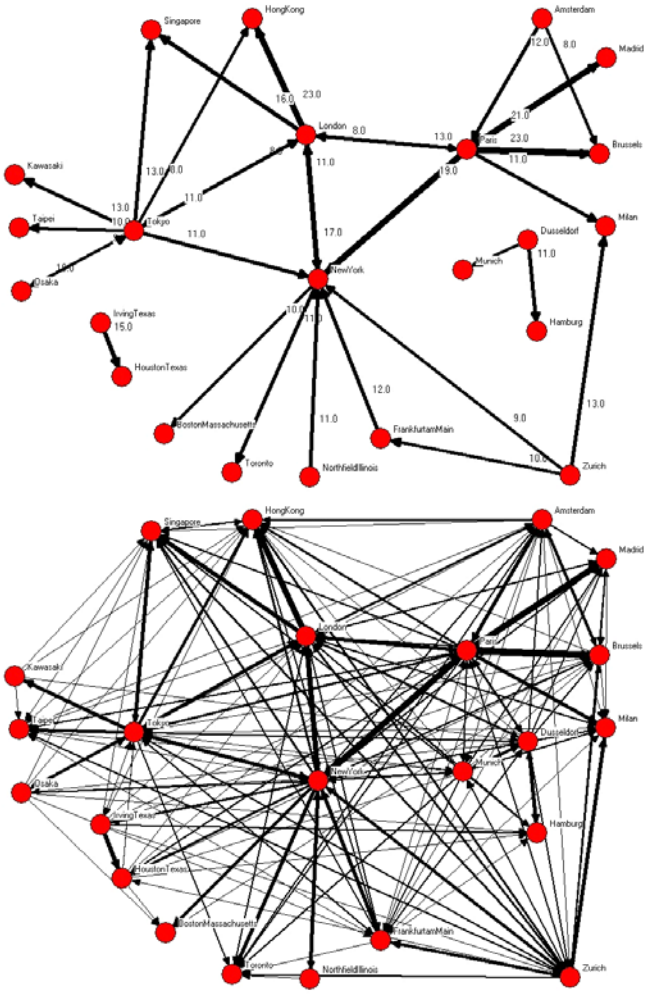
E = producer services connections

Here the top ranks (tables 1 and 2) are occupied by New York, Paris, Tokyo and London, accounting for one-third of global corporate activity. The aggregate connectivity of the Randstad cities does not match them! New York is most connected[23] and Houston's strength underlines our dependence on oil. In a network analysis (graph 1) core and semi-periphery relationships can be seen, with the global 'quadrad' at the centre (top). The star-shape of these nodes indicates their strong vertical, hierarchic relationships, where these cities serve as control centers of the global economy[24]. A strong correlation (figure 2) exists between connectivity and aggregate distances, indicating the relationship between a city's connectivity and its spatial reach, where it is obvious that most cities operate at a lower scale. New York, Paris, Tokyo and London, hold extremely disproportionate shares of connections, mirroring global inequality. We see (table 1 and 2) that New York's strongest connections are to Atlanta, Paris, Zurich and Tokyo - primarily in information, which represents 80% of its total linkages. In a global context, The Hague and

23 A position once occupied by London in the 19th century and Amsterdam in the 18th century, and where it is likely that Tokyo will become the centre of the 21st century world economy.

24 From these nodes semi-peripheral cities branch out. The arrow shows direction of dependency - where for instance London has 23 links to Hong Kong. Regional sub-networks are also seen e.g. between Irving and Houston. Further on (below), we see the propagation of incrementally weaker network relations. These have more horizontal type characteristics, and are controlled from above.

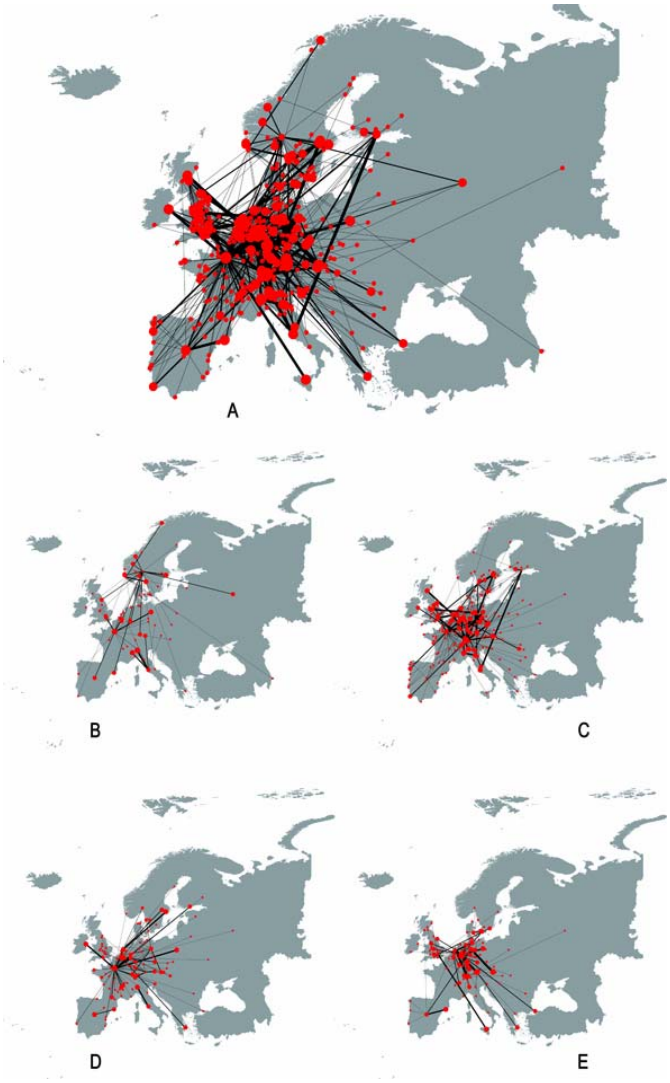
Amsterdam rank as secondary cities, where Amsterdam predominates in information, and The Hague in goods - due to its strong connections to Houston. Rotterdam's connectivity reveals a tertiary type city and its strengths are with New York, London, Amsterdam and Munich, especially in manufacturing, and not trade as one would imagine. Its strength in trade relates to lower spatial scales.



Graph 1: UCINET 'centrality' analysis of city-firm networks

Networks at the meso scale

The biggest share of EU connectivity (map 2) is in information with strongest cities being Paris, London, Zurich, Munich and Amsterdam. NW Europe is the EU's core economic region, and the consistent 'blue banana' from London to Rome, has dissolved into a nebulous web of cities. Paris is Europe's primate city, followed by London, Zurich, Amsterdam and Madrid (table 1 and 2). Here, connectivity to non-EU cities declines, indicating the EU's strong supraregional interdependency. Paris's strongest links are with New York, Santiago and Brussels, and its dominant sector is trade. Amsterdam's strengths are with San Jose, Brussels, Chicago and Atlanta, and its primary sector is consumer services. At this scale, Rotterdam's importance increases.



Map 2: European city-firm networks

A = total connections

B = basic materials connections

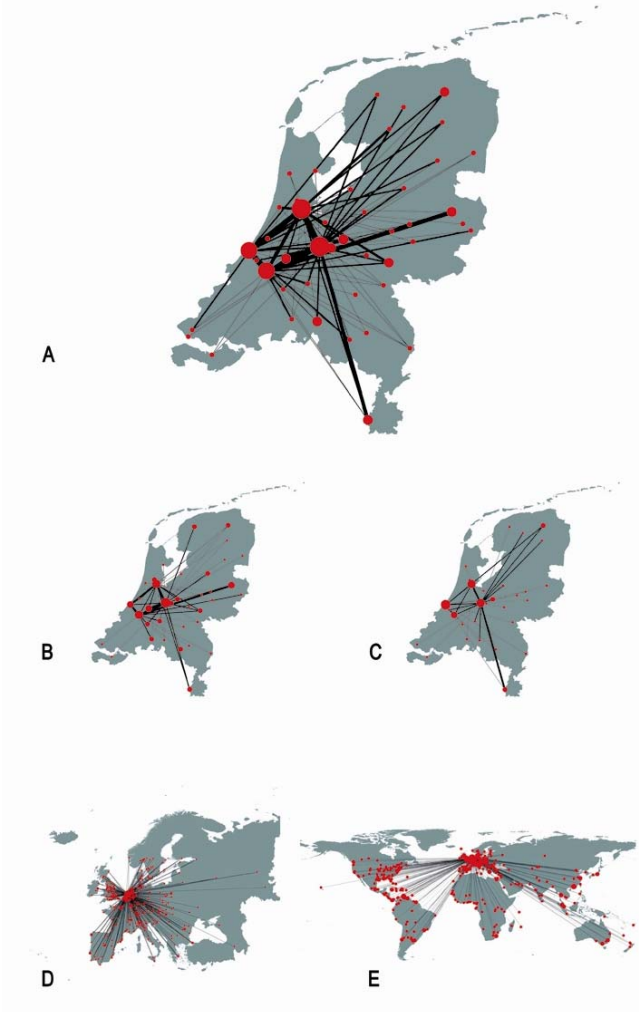
C = manufacturing connections

D = trade connections

E = producer services connections

Networks at the micro scale

The Randstad's sectoral share is 60% in information and 40% in goods. Its strongest sectors are respectively, consumer services, manufacturing, trade, producer services, and lastly basic materials. The Randstad cities share 37% of all connections between themselves and the strongest external connection is to London. Looking at the connectivity of individual Randstad cities, we see that 70% of these city's business relations are outbound, stipulating the importance of understanding higher scale relations. The Randstad's network footprint on Europe and the world is shown (map 3). Amsterdam is most connected to Paris in terms of goods, but to London in terms of information linkages. In the case of Rotterdam, its strongest goods link is to London, and in information to The Hague. If we look at connectivity within the Randstad, we see that Amsterdam claims the highest share of inner-city connections, followed by Rotterdam, The Hague, and Utrecht. Looking at Rotterdam's top firms (map 4) we see that only 30% of the firms are directly related to port industry, while 70% are city related. It is questionable, whether Rotterdam is a port city. Furthermore, we find approximately 78% of firms cluster within the city centre and 22% in the port.



Map 3: Randstad city-firm networks

A = total connections

B = manufacturing connections

C = producer services connections

D = Randstad's footprint in Europe

E = Randstad's footprint in the world

Map 4: Rotterdam's top 1000 business agglomerations

Black = port related firms

Red = city related firms

4 Networks versus urban indicators

Comparing connectivity to total populations in EU cities, we get a correlation[25] of 0.7, and selecting the population 'employed', the coefficient rises to 0.9 - meaning that the more connected a city is, the higher the percentage of economically active citizens. Furthermore, those employed in the information sector score better than those in the goods sector. Depending on the ranking and economic profiles of cities, policies should be developed to stimulate regional or global entrepreneurship. Investigating connectivity and education levels, we see that basic education levels score 0.6, while advanced education scores 0.9, indicating the dependency of our information society on advanced education – and that governments should seriously invest in this. Furthermore, employees in IT hardware score merely 0.4, while those in IT services score 0.8. Looking at multinationals per city, versus city-GDP, a high correlation of 0.9 is achieved; showing their contribution to overall economic output. A correlation between connectivity and air-passenger arrivals shows a score of 0.9, possibly indicating that the more corporate linkages a city has, the more business travels there will be.

Presently the research is in a preliminary phase and for now only a rough sketch of our networked world can be shown. In this, the disproportionate structure of city-firm networks is evident, challenging our understanding of even-distribution, equality and future sustainability. It has been shown that in our globalizing world, city-firm networks play an important role in the production and performance of our cities. By knowing the empirical relationship between a city's internal and external properties, tradeoffs and insights into the programming and designing of social, economic and environmental functions can be addressed. Eventually this type of knowledge can be vital to local, regional and global development, where the interrelationship between these scales becomes clearer. Per scale, the interdependencies between cities and their action radius can be determined - and based on connectivity and economic-profiles, cities can be classified into similar and dissimilar types. From this, competitors and collaborators can be distinguished and future specializations determined. A city can unveil the structure and hierarchy of its city-firm relationships, which can lead to smart investment strategies within itself or its partner cities. From this a city can better speculate which future socio-economic functions are needed and where they should be located, which in turn translates into urban programs, and consequently urban designs and architectures. By defining appropriate functions and sensible localities, at different scales, and integrating these into imaginative structures, global, regional and local sustainability can gradually be improved, in a paradigm where the spatial science and design disciplines converge.

25 A correlation of above 0.7 indicates a very significant relationship between the variables, where 1.0 would be the maximum.

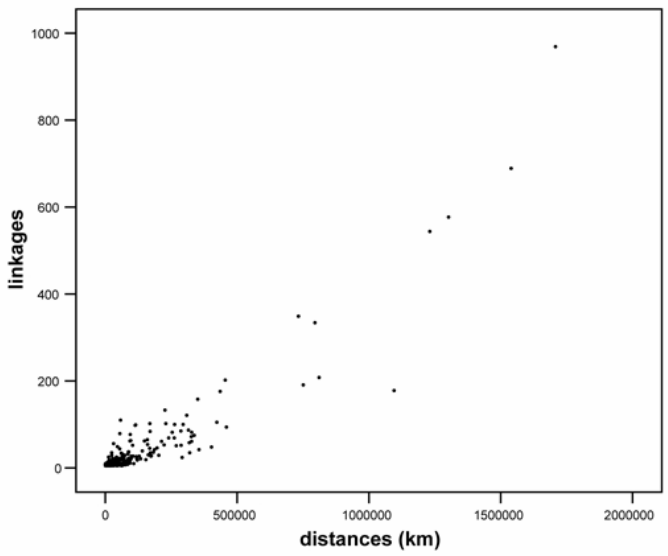


Figure 2: Total city-firm linkages versus total distances

TOP 30 CITY-FIRM CONNECTIVITY AT DIFFERENT SCALES

RANK	GLOBAL CITY	LINKS	%	EUROPE CITY	LINKS	%	RANDSTAD CITY	LINKS	%	AMSTERDAM CITY	LINKS	%	ROTTERDAM CITY	LINKS	%	THE HAGUE CITY	LINKS	%	UTRECHT CITY	LINKS	%
1	New York	969	9,3	Paris	882	10,0	Amsterdam	909	11,3	Amsterdam	505	23,8	Rotterdam	475	26,2	The Hague	563	34,4	Utrecht	620	25,1
2	Paris	689	6,6	London	743	8,4	Utrecht	704	8,8	Paris	119	5,6	London	234	12,9	London	131	8,0	Amsterdam	352	14,3
3	Tokyo	577	5,6	Zurich	466	5,3	The Hague	695	8,6	London	111	5,2	The Hague	78	4,3	Dover	83	5,1	Willemstad	202	8,2
4	London	544	5,2	Munchen	311	3,5	Rotterdam	660	8,2	Brussels	52	2,5	Paris	55	3,0	Houston	47	2,9	Brussels	185	7,5
5	Zurich	349	3,4	Amsterdam	288	3,3	London	573	7,1	Milan	52	2,5	Utrecht	35	1,9	Groningen	34	2,1	Rotterdam	138	5,6
6	Munich	334	3,2	Madrid	270	3,1	Paris	267	3,3	Luxembourg	48	2,3	Singapore	34	1,9	Paris	32	2,0	Luxembourg	105	4,3
7	The Hague	208	2,0	The Hague	265	3,0	Willemstad	259	3,2	Dublin	46	2,2	Dublin	32	1,8	Amsterdam	31	1,9	London	97	3,9
8	Dusseldorf	202	1,9	Dusseldorf	190	2,1	Brussels	252	3,1	Barcelona	42	2,0	Durban	30	1,7	Santiago	27	1,6	Paris	61	2,5
9	Vevey	191	1,8	Vevey	187	2,1	Luxembourg	170	2,1	New York	42	2,0	Santiago	30	1,7	Hamilton	24	1,5	Dublin	40	1,6
10	Palo Alto	178	1,7	New York	163	1,8	Dublin	128	1,6	Santiago	42	2,0	Willemstad	29	1,6	Melbourne	24	1,5	The Hague	38	1,5
11	Houston	176	1,7	Basel	145	1,6	Singapore	104	1,3	Singapore	40	1,9	Barcelona	26	1,4	Rotterdam	22	1,3	Madrid	32	1,3
12	Amsterdam	158	1,5	Brussels	129	1,5	Santiago	102	1,3	Sydney	37	1,7	Hamburg	22	1,2	Utrecht	22	1,3	Maastricht	25	1,0
13	Madrid	133	1,3	Barcelona	126	1,4	Milan	95	1,2	Tokyo	36	1,7	Milan	22	1,2	Victoria	21	1,3	New York	23	0,9
14	Stuttgart	121	1,2	Stuttgart	122	1,4	Madrid	93	1,2	Madrid	31	1,5	Amsterdam	21	1,2	Edinburgh	19	1,2	Miami	22	0,9
15	Brussels	110	1,1	Santiago	117	1,3	Barcelona	90	1,1	Caen	28	1,3	George Town	20	1,1	Singapore	18	1,1	Zug	21	0,9
16	Singapore	105	1,0	Utrecht	115	1,3	New York	87	1,1	Utrecht	27	1,3	Mexico City	20	1,1	Baltimore	17	1,0	Barcelona	20	0,8
17	Barcelona	102	1,0	Wolfsburg	97	1,1	Dover	84	1,0	Lisbon	25	1,2	Brisbane	18	1,0	Calgary	16	1,0	Douglas	18	0,7
18	Utrecht	102	1,0	Goteborg	95	1,1	Groningen	68	0,8	Rotterdam	25	1,2	Madrid	18	1,0	Willemstad	13	0,8	Groningen	18	0,7
19	Kowloon	100	1,0	Ludwigshafer	95	1,1	Houston	57	0,7	Florence	22	1,0	Geneva	17	0,9	Madrid	12	0,7	George Town	16	0,6
20	Omaha	100	1,0	Frankfurt	94	1,1	Tokyo	57	0,7	Mexico City	21	1,0	Bucharest	16	0,9	New York	12	0,7	Nassau	16	0,6
21	Trieste	99	1,0	Trieste	91	1,0	Hamburg	55	0,7	Budapest	19	0,9	Arnhem	14	0,8	Buenos Aires	11	0,7	Leeuwarden	13	0,5
22	Wolfsburg	98	0,9	Milan	88	1,0	Hamilton	54	0,7	Sao Paulo	19	0,9	Colombo	14	0,8	Hamburg	11	0,7	Singapore	12	0,5
23	Ludwigshafe	94	0,9	Houston	86	1,0	Sydney	52	0,6	Hamburg	18	0,8	Istanbul	14	0,8	Milan	11	0,7	Arnhem	10	0,4
24	Frankfurt	87	0,8	Vienna	85	1,0	Lisbon	50	0,6	Berlin	17	0,8	Lisbon	14	0,8	Dublin	10	0,6	Hamilton	10	0,4
25	Fairfield	85	0,8	Kowloon	82	0,9	Mexico City	49	0,6	Cairo	17	0,8	Nairobi	14	0,8	Los Angeles	10	0,6	Lisbon	10	0,4
26	Dublin	84	0,8	Courbevoie	81	0,9	Maastricht	43	0,5	Athens	16	0,8	Groningen	12	0,7	Budapest	9	0,5	Mainz	10	0,4
27	Irving	82	0,8	Singapore	77	0,9	Budapest	42	0,5	The Hague	16	0,8	Zug	12	0,7	Kuala Lumpu	9	0,5	Milan	10	0,4
28	Osaka	82	0,8	Tokyo	77	0,9	Vienna	39	0,5	Vienna	16	0,8	Bangkok	11	0,6	Lagos	9	0,5	Southampton	10	0,4
29	Milan	79	0,8	Espoo	74	0,8	Zug	39	0,5	Bangkok	15	0,7	Kuala Lumpur	11	0,6	Leeuwarden	9	0,5	Dusseldorf	9	0,4
30	Atlanta	77	0,7	Dublin	70	0,8	George Town	37	0,5	Shanghai	15	0,7	Lagos	11	0,6	Athens	8	0,5	Geneva	9	0,4
20													New York	10	0,6						
22													Tokyo	7	0,4	Tokyo	7	0,4			
24																			Tokyo	7	0,3
52				Rotterdam	22	0,2															
65	Rotterdam	20	0,2																		
		N = 10368			N = 8840			N = 8040			N = 2121			N = 1810			N = 1639			N = 2470	

Table 1: Connectivity ranking at different spatial scales

STRONGEST LINKS TO OTHER CITIES **STRONGEST SECTORS**

GLOBAL CONNECTIVITY

	Rank 1	links	Rank 2	links	Rank 3	links	Rank 4	links	Rank 5	links	BM	M	T	PS	CS	G	I
New York	New York	139	Atlanta	36	Paris	32	Zurich	24	Tokyo	21	0	223	99	372	275	223	746
Paris	Paris	50	Brussels	37	New York	32	Santiago	24	Madrid	21	86	54	197	207	145	140	549
Tokyo	Tokyo	100	New York	21	San Jose	18	Singapore	15	London	14	4	252	60	232	29	256	321
London	London	40	Kowloon	30	Singapore	15	New York	12	Chicago	11	10	232	5	213	84	242	302
Amsterdam	Amsterdam	9	Brussels	9	Atlanta	6	Santiago	6	London	5	2	9	4	8	135	11	147
Rotterdam	New York	6	London	4	Munich	3	Amsterdam	1	Cincinnati	1	0	12	0	4	4	12	8
The Hague	Houston	46	Groningen	6	Calgary	6	San Juan	6	Melbourne	3	0	203	3	0	2	203	5
Utrecht	Brussels	15	Amsterdam	7	Luxembourg	7	Willemsatd	7	London	4	0	2	1	2	97	2	100

EUROPEAN CONNECTIVITY

	Rank 1	links	Rank 2	links	Rank 3	links	Rank 4	links	Rank 5	links	BM	M	T	PS	CS	G	I
New York	Paris	56	Zurich	33	London	16	Frankfurt	15	Munchen	14	0	21	29	32	81	21	142
Paris	Paris	88	New York	56	Santiago	33	Brussels	30	Madrid	25	62	171	447	37	208	233	692
Tokyo	London	13	Paris	9	Dusseldorf	7	Munchen	6	Zurich	5	4	36	7	13	17	40	37
London	London	59	Kowloon	33	Paris	23	Dublin	20	Singapore	17	8	276	37	274	148	284	459
Amsterdam	Amsterdam	14	San Jose	12	Brussels	11	Chicago	11	Atlanta	8	2	4	27	46	209	6	282
Rotterdam	London	6	Munchen	3	Duisberg	2	Amsterdam	2	Chicago	1	0	8	0	10	4	8	14
The Hague	Houston	46	Baltimore	8	The Hague	7	Calgary	6	Groningen	6	1	213	3	1	47	214	51
Utrecht	Brussels	15	Luxembourg	8	Amsterdam	7	Willemstad	7	Utrecht	6	0	2	1	13	99	2	113

DUTCH CITIES CONNECTIVITY

		links		links		links		links		links	BM	M	T	PS	CS	G	I
New York	Randstad	87	Amsterdam	42	Rotterdam	10	The Hague	12	Utrecht	23	0	29	0	10	26	29	36
Paris	Randstad	267	Amsterdam	119	Rotterdam	55	The Hague	32	Utrecht	61	9	88	22	59	89	97	170
Tokyo	Randstad	57	Amsterdam	36	Rotterdam	7	The Hague	7	Utrecht	7	5	24	7	14	7	29	28
London	Randstad	573	Amsterdam	111	Rotterdam	234	The Hague	131	Utrecht	97	88	239	111	70	143	327	324
Amsterdam	Randstad	909	Amsterdam	505	Rotterdam	21	The Hague	31	Utrecht	352	10	125	91	79	604	135	774
Rotterdam	Randstad	660	Amsterdam	25	Rotterdam	475	The Hague	22	Utrecht	138	3	225	240	46	137	228	423
The Hague	Randstad	695	Amsterdam	16	Rotterdam	78	The Hague	563	Utrecht	38	101	36	0	211	237	137	448
Utrecht	Randstad	704	Amsterdam	27	Rotterdam	35	The Hague	22	Utrecht	620	0	252	83	64	305	252	452

BM = basic material
M = manufacturing
T = trade
PS = producer services
CS = consumer services
G = goods
I = information

Table 2: Strongest city links and economic sectors

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