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Liveable urban forms: planning, self-organisation, and a third way (Isobenefit urbanism)

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Urban development combines the forces of dispersal and agglomeration, often facilitated by free market forces, and this results in different patterns and self-organised ways, with both positive and negative outputs. Globally, over 6 billion people will live in cities by 2050, and this would require at least an additional 1.2 million km^2 land to be built on. This huge expansion of the urban population and area requires construction at scale that avoids current urban problems such as urban heat island effects, carbon emissions, pollution, congestion, urban sprawl and excessive hard surfacing, while maintaining the physical and mental quality of life. Two basic approaches would be to let market forces freely shape our new urban areas or to impose a strong planning framework. This paper introduces a third way, Isobenefit urbanism that takes advantage of the two basic approaches to urban development. Isobenefit urbanism is a relatively recent urban development approach to shaping urban form, through an examination of centralities and localisation by a code whose implementation results in Isobenefit cities where one can walk to reach the closest centrality (where theatres, restaurant, schools, offices, promenades, shops...are located) and the closest access to green land regardless where one lives, and regardless the size of the city.

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Introduction: why a different urban model?

More than half the global population now lives in cities, and this will increase to nearly 80% by 2050; this means that there will be over 6 billion people living in cities, and the land occupied by cities will increase by 1.2 million km^2 (2030[1]). Rather than just thinking of cities as efficient spaces in which to "pack" as many people at high densities, we must develop concepts of liveability and place that can allow for individual welfare and collective diversity. This means providing the necessary supporting infrastructure (e.g. housing, water, electricity, connectivity) and a high level of environmental quality to address problems of pollution, safety, mental health and physical stress. Such an approach does not mean a "blueprint" for city development, but it accepts that different cultures, histories, and priorities all contribute to the uniqueness of place and the importance of diversity.

Some of these issues can be translated into monetary terms. For example, urban sprawl and mono-functional structures cost $1 Trillion yearly in the US[2]; urban mental illness, compared to rural mental illness, cost $1 Trillion per year (D'Acci, 2020); cars yearly produce 1.3 Million deaths and 20–50 Million injuries; and road accidents cost 3% of GDP in many countries[3]. Cities are also a major and increasing user of resources: cities globally consume 75% of energy and materials; generate 80% of greenhouse gases[4]; city air pollution is responsible for 1.8 Million premature deaths annually (Southerland et al., 2022); traffic occupies 60% of public space[5] in some cities; and, ultimately, cities are not the happiest place for most of the global population (D'Acci, 2021).

But it is not a simple task to change existing cities, and in many cases this would be undesirable. However, we do have the opportunity to think in innovative ways when considering the huge growth in the urban population over the next 30 years. A large part of the 2.2 billion new dwellers estimated to be living in cities by 2050 will be accommodated in ex-novo cities or new urban expansions[6], therefore, literally built from scratch. This means there is a unique opportunity as well as a responsibility to alleviate the issues generated from the current approaches to urban development and to present alternative planned self-organised urban forms for liveable cities.

Cities, planning and thinking

Modern urban planning has developed over the last 150 years as a response to the social and economic problems created by the growth of cities and the means to accommodate the huge growth in population and migration (Glaeser, 2011; Hall, 2014). Since that time, urban planning has continuously struggled for its own identity as it interacts with all aspects of society, principally the market forces that were transforming the city from its traditional monocentric structure into a more complex entity. Subsequently, the central city declined as cities spread, with the associated movement of people and activities to the suburbs. Various problems, such as housing and the homeless, the unemployed and the underclass, and the construction of new infrastructure and urban renewal, have repeatedly been central concerns of planning (Fainstein, 2010). More recently, the central city has become attractive again, as cultural opportunities, regeneration, agglomeration economies and a desire for more sustainable living have all become more central concerns (Phelps, 2015).

City planning and social science approaches have provided the framework for an understanding and analysis of the city, often supplemented by innovative design, such as through the New Towns Movement and the Radiant City in Europe to the Garden Cities and Broadacre City in the US (Hall, 2014). There was a golden period of planned cities and neighbourhoods throughout the twentieth century. City planning is also different from many other disciplines as the methods and processes are eclectic, often being borrowed from other disciplines. Similarly, there was a strong desire for action, not just knowledge.

More recently, the environment and concerns over the use of finite planetary resources have become a new focus for land use and urban policy. This is not the slum environment of the nineteenth century which sought to provide housing, clean water and sewage for the burgeoning industrial cities, but a new concern over the quality of the environment. People and business were leaving the city as the perceived quality of life has deteriorated, and as modern lifestyles and activities no longer require such close proximity of homes, workplaces and other activities but more open and green spaces (Gehl, 2010).

The city is thus a source of concern. From the viewpoint of urban economists, the city is involved in a permanent struggle between economies of scale and scope (localisation advantages, economies of density, etc.) and agglomeration diseconomies (congestion, pollution, criminality, etc.) (Glaeser, 2011). As a result, the city is faced with a new dynamic where compact ways of living and working are contrasted with the desirability for deconcentrated patterns of living and working (e.g., urban sprawl, the edge city) (Garreau, 1991). For the urban planner, there may still be the desire for a well-functioning city where all the necessary supporting services and facilities are accessible and within close proximity, but this has to be balanced against the other requirements for the provision of public services, such as housing access, open space, education and health facilities, clean air, a safe environment and reduced levels of inequality in society (Burdett and Rode, 2018).

The debates over sustainable development have renewed the critical role that the city must play in the twenty-first century as it provides the most sustainable form of urban development, as well as providing the centre for economic activity and the place where most people will live. The most appropriate means to make the built environment compatible with the wider natural environment is to seek to provide facilities and services in close proximity to where people live, preferably within walking or cycling distance or by a short journey on public transport (Meadowcroft et al., 2019). This is the principal means by which a high-quality urban environment can be created, which has low levels of pollution and congestion and maintains quality through secure, safe and attractive local environments. Many existing medium and large cities already have a high-quality urban environment (e.g. many historical cities) and these places should continue to prosper, and at the same time, new urban forms need to be built, taking advantage of the agglomerations of smaller urban centres linked by high-quality public transport.

Planned versus spontaneous urban morphogenesis

Urban morphogenesis studies (Barke, 1990; Conzen, 1988; Dovey et al., 2020; Liu et al., 2016; Serra et al., 2017; Whitehand et al., 1999) and urban utopias [Brown, 2009; Castán Broto, 2020; D'Acci, 2019; Gold, 1984; Pinder, 2015) are becoming more relevant than ever as a response to the exceptional scale and speed of world population growth and urbanisation, and to current urban issues noted above. Two approaches are typically used: planning and spontaneity. At one extreme, a *One Size Fits All* approach to planning is often seen as the major failure of paternalistic policies. By forgetting cultural, anthropological and geographical contingencies and underestimating people's actual behaviour, a paternalistic approach might result in undesirable outputs, missing the policy's goals. Conversely, at the other extreme of spontaneity, a pure libertarian *Laissez Faire* approach could miss long-term and collective costs and benefits. Furthermore, the adequate multidisciplinary knowledge needed to measure such costs and benefits would not be present, and there may even be a lack of awareness about them.

A Third Way would be a libertarian paternalistic approach that would embrace both approaches allowing freedom of individual choices, self-organised patterns and randomness while incorporating benevolent, scientifically educated guidance. Comprehensive planning ideals are difficult to achieve solely by planning approaches (Altshuler, 1965), but even harder if there is no planning at all. Recently, the potentialities for self-organised processes shaping urban forms are a subject of great interest in planning approaches (Moroni et al., 2020; Marshall, 2009; Alfasi and Portugali, 2007; Bertaud, 2018; Boonstra and Boelens, 2011; Boonstra and Boelens, 2011; Fainstein, 2000), with some suggesting an ideal level of beauty in cities being achieved somehow in the middle ground between design and chaos (Cozzolino, 2021).

With the advent of cars and the possibility of reaching far-away locations, everything has changed, and free market forces have induced current urban forms such as urban sprawl, with the associated monofunctional endless peripheries and the continuous paving of green land. We can think about two spontaneous forces: dispersal and agglomeration (Henderson et al., 2001; Mori, 2020).

The agglomeration forces typically involve

1. increasing returns to agglomeration such as knowledge spillovers (learning from neighbours);
2. positive externalities in labour market (e.g. locations with already skilled workers);
3. firms' benefits from locations close to demand or with transport networks to reach markets.

These forces operate at different scales: at a 'macro' level, where they are forming cities themselves, including their size and regional location; at a 'micro' level, where they are localising centralities (e.g. central business districts), functions and densities within them. A spatial coordination of agglomerations among services and activities (firms, amenities, functions, etc.) happens mostly spontaneously via inter-service demand externalities that arise from shared consumers. Larger cities might spontaneously emerge where a greater number of services (e.g. firms and related workers-consumers) co-locate to share clients, as well as where larger, more specialised firms that are more sensitive to increasing returns and located in agglomerations in a few and further apart cities.

The dispersion forces typically involve

1. negative externalities (covering objective factors such as congestion, pollution, crime, greenless environment; and subjective factors such as a stressful lifestyle);
2. supply of immobile sources (e.g. lands and buildings, whose prices typically rise hugely in central locations as a consequence of their fixed nature and high demand for positional advantages);
3. geographically dispersed demand (dispersed residents means dispersed labour and consumers, resulting in greater distances transported for goods and services: namely, dispersed labour and consumers to be reached, and distances to be reduced, both motivating firms to locate themselves in such dispersed places).

The first two are local forces, limited to within the city; the third is a global force, dependent on interregional factors.

If we add a lock-in effect, better known as path dependency, once the locational process starts (for small initial geographical differences or random events), a natural consequence of this self-organised balance among dispersion and agglomeration forces is the emergence of astonishing regularities in settlements location pattern ((dynamic) central place theory) and their sizes (power laws distribution). It is important to note that such regularities emerge from self-organised processes in which each actor or agent (entrepreneurs, dwellers, developers, workers, etc.) spontaneously—without being induced or forced by any planning—balance the above dispersion-agglomeration forces which are *endogenous* rather than *exogenous* (or historical) factors (Mori, 2020).

The classical urban economic theory—Malthus, von Thünen, Christaller, Losh, Alonso, Muth, Mills—is based on this *spontaneous* trade-off between accessibility and space, which defines the theoretical nucleus of the urban economy, which has continued to grow through the use of more complex models (Fujita et al., 2001; Glaeser, 2008). In choosing locations, firms aim to maximise profit and households to maximise utility.

We should not forget other types of forces: political, cultural, utopian, technological, historical and environmental, some of them directly or indirectly involving planning. Inside this self-organised spontaneous frame, planning is seen as an external perturbation to the 'natural' development of cities. If we think of a city as the physical manifestation of *one* specific historical path, among many, driven by the free market's invisible hand, which aims at finding the overall optimal output, we can reflect on the fact that several futures are possible in the past. Most of such possible futures can still be the result of the free market (spontaneous forces) achievement of optimal balances. Other futures can be the result of planning, not achievable by spontaneous forces alone.

A Third way: isobenefit urban morphogenesis

Isobenefit urbanism (D'Acci, 2013, 2014, 2019)—defined as equal benefits across urban spaces covering walkable workplaces, amenities, nature, services—is a libertarian paternalistic approach to planning. It is a morphogenetic code designed to promote a walking city where one can reach green space, shops, amenities, services and places of work within a 1-mile distance from the home. Isobenefit urbanism provides an explicit set of self-planning mechanisms within a given land use distribution. It does so by leaving free the actual urban development and growth to follow spontaneous and random—or locally/collectively desired—patterns of functional locations and of density across the urban planimetry, driven by market forces and/or *genius loci*, as well as city size and their locations spontaneously following the above-mentioned agglomeration-dispersion forces. The possible outputs are numerous, though all satisfying the Isobenefit design objective function. The urban morphological patterns produced by evenly mixing urban and natural land reduce urban heat island effects, flooding and particulate pollution. By increasing walkability and a walkable daily life, it implies a carless urban society with related advantages in terms of reduced air and noise pollution, commuting time, space-saving, aesthetics, and ultimately physical and psychological well-being.

There are four basic rules for the Isobenefit urbanism code[7]:

1. Each citizen reaches within roughly 1 mile: (a) workplaces, daily needs and a centrality; (b) a green area;
2. a) buildings are 'close' to each other for at least 1 continuous sq. km.; (b) green areas are continuously interconnected.

Centralities are intended as multifunctional places where one to find a variety of services, amenities, and functions (e.g. shops, restaurants, libraries, workplaces, universities, theatres, promenade, vibrant streets, history, etc.). They are interconnected via sky-trains, underground[8] and cycle paths.

Regarding point 2b, the green intended is ranging from urban parks to agricultural (with public paths) land and wild forests. These green cells are physically interconnected, while the built cells physically interconnected and/or by land-free public

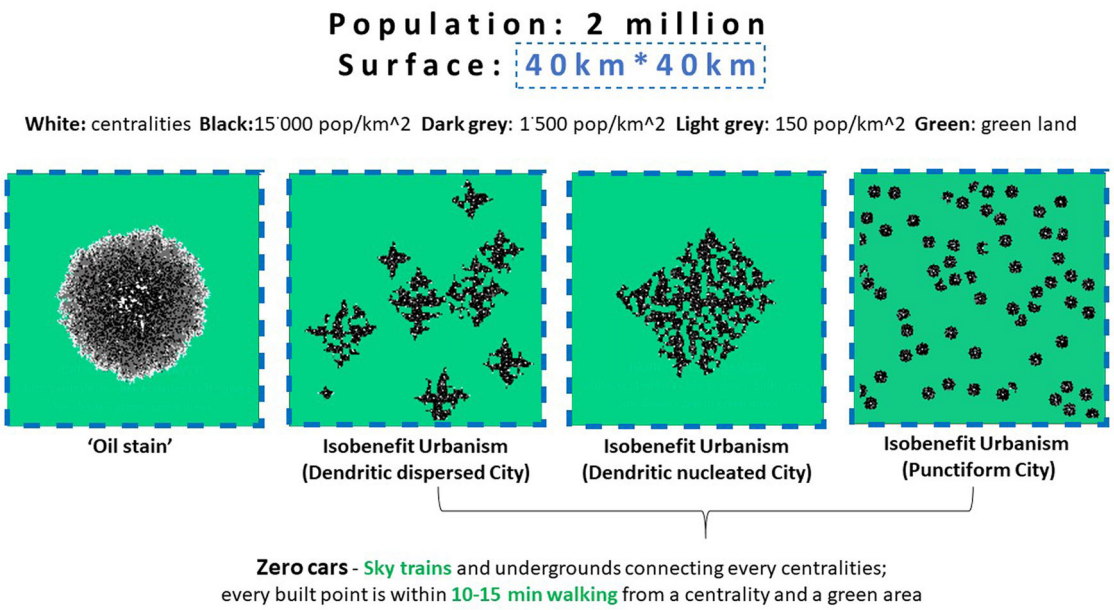

Fig. 1 Isobenefit digital twins. Oil stain versus Isobenefit urban developments.

transport lines such as sky trains and underground. The urban cells can have three states: green, built and centrality, whose size can be decided by the modeller and eventual sub-states defining different levels of densities of the built cells.

Density[9] is not a priority for this morphogenesis approach, but proximity is. We can have an Isobenefit village, town, city or megacity. It does not matter the scale and the built density; what matters is the walkability, or walkability + public transport, from any built cell to the closest green, services, amenities, work places and centralities, and the interconnectivity by public transport between each centrality. This would mean that one can reach any point of the entire built settlement by walking and public transport in a direct and quick way.

Economically speaking, this regional pattern of isobenefit settlements would allow isobenefit villages and isobenefit small towns to easily reach bigger isobenefit cities to enjoy the services they miss. In fact, isobenefit settlements are connected among each other (as well as with industrial areas, which in isobenefit planning are located outside the settlements) via sky trains, underground, hyperloops, reachable by walking from whatever locations.

The issue of employment would need to be treated in more detail. Some operations—industrial, but also quaternary, require large facilities employing thousands and may also benefit from close agglomeration (e.g. financial). The scale of these operations would, e.g., generate large commuting flows, which the isobenefit form is otherwise designed to minimise. The isobenefit model, as presented, is implicitly one that accommodates mostly residential and local tertiary activity, however, it embraces the realistic scenario of having people living in a place and working in faraway places, such as in case of industrial activities or these requiring large physical agglomeration. In such cases, these workplaces are located outside the cities and reached by tubes/sky-trains from any centralities; meaning by walking + public transport from any residential point. When the required agglomeration can also be non-physical, synergies are achieved horizontally via club-type networks: small branches of the same companies, firms, industries, services, etc., spread and interlinked across centralities rather than physically close and packed within the same (bigger) centrality or location.

Figure 1 shows an example of a 2 million population settlement in a typical oil-stain urban development versus the counterpart isobenefit versions.

The business as usual urban growth means that the built area expands as 'an oil stain', and distances are increasingly incrementally from built cells and their closest green and centrality cells over time. In its Isobenefit counterpart, such distances stay constant (roughly less than half km on average and 1 km maximum), regardless of whether it carries on growing toward 1000, 100,000, or 1,000,000 inhabitants (Fig. 3 in D'Acci, 2019, Figs. 4–6 in D'Acci and Voto, 2023).

Having green land "inside" the entire built area generates beneficial effects such as physical and mental health, urban heat island effects, water infiltration and flooding mitigation, pollutant sequestration and biodiversity. While having all locations accessible by walking and public transport, private car ownership would be pointless. Assuming that the electricity used for public transport (sky trains, underground and urban tapis-roulant) comes from renewable sources, and by ensuring that all the inter-intra cities movements are by walking + public transport, one can quantify the environmental and economic benefits originated from this type of urban morphogenesis code.

Walking cities proposals

Figure 2 summarises chronologically walking city proposals.

Most of them proposed to have at walkable distances: services, working places, local gardens and public transport.

The novelties of Isobenefit urbanism are mostly five:

1. having everywhere at a walkable distance *centralities* (*actual* "city centers" and Central Business Districts (CBDs) not just spread their contents (work places, services, amenities, etc.) in a walkable distance;
2. having all the above centralities interconnected among themselves (ideally by sky trains and undergrounds);
3. having everywhere at a walkable distance *large continuous* green areas;
4. the ease of increasing the urban size by simply adding and linking walkable units (see the vertical temporal line at the top of Fig. 3 in D'Acci (2019). It is a roughly linear addition of transportation costs (mainly related to the extended sky-train/tubes connecting centralities of the added walkable units), which would be well supported by the *super*linear (i.e. *more* than linearly proportional) addition of urban

Year (author)	Term	Concept (*walking* city/neighbourhood)	Source
1898 (Ebenezer Howard)	Garden City	A cluster of garden cities linked by road and rail, orbiting a central city in a polycentric dominant core model. Each garden city is a multifunctional town of cottages, mixing services, residences, work places and amenities all reachable within less than **1 mile**.	Howard (1898)
1929 (Clarence Perry)	Neighbourhood unit	Within **¼ mile** pedestrian unit, one reaches shops, schools, parks, community institutions, rapid transit and arterial streets.	Perry (1929)
1961 (Jane Jacobs)		Dense mixed-use walkable areas	Jacobs (1961)
1966 (many)	New Urbanism	"[...] planned for a jobs/housing balance [...]" "Many activities of daily living should occur **within walking** distance"	CNU (1966): The Charter for the New Urbanism (principle 5 and 12)
1970's -1980's (Leon Krier)	Urban quarter	10-minute or **quarter-mile** walk neighbourhood within which residents can do their daily activities (dwelling, working, leisure)	Krier (1984)
1980's (Andres Duany and many)	Traditional Neighborhood Development	"Mixed uses [..] retail shops, schools, and workplaces; A mixed-use community core within **one quarter mile** of all residents [...] access to mass transit"	Duany et al. (1980's) in Rohe 2009
1980's (Peter Calthorpe)	Transit-oriented development/The Pedestrian Pocket	Compact mixed-use areas **within walking** distance from high capacity rapid transit/with housing, offices, retails, day care, recreation and parks	Kelbaugh (1989), Calthorpe (1993)
1980's (the Urban Villages Group)	Urban Villages	**Walkable**, transit-oriented, **mixed-use** neighborhoods with housing and jobs	Urban Villages Group (1980's)
2012 (Portland City Council)	20-minute complete neighborhoods	"**Walkable access** to schools, parks, a grocery store and transit"	Portland City Council (2012)
2012 (Kent Larson)	Compact Urban Cells	"provide most of what people wants **within 20 minute walk** [...] and connect all with mass transit"	Larson (2012)
2013 (Luca S. D'Acci)	Isobenefit Urbanism	each point can reach continuous natural areas, job locations, centralities, shops, amenities (recreational, medical, cultural), usual daily activities by **15/30 minute walking or** within 15 minute **biking** "**daily activities by walking or at maximum biking** [...] to reach places of work, shops, amenities (recreational, medical, cultural. . .), and **centralities** from our habitations [...]" (2013) "The time [...] to reach the ordinary daily points [...] (work, buying food, recreational time, education, a **green** area [...]) should not be higher than a **reasonable time (T*)** which is around 30 minutes walking/10-**15 minutes** biking" (2014) "**15 minutes** walking" (2019)	D'Acci (2013, 2014, 2019)
2014 (Bus Industry Confederation, et al. Australian Gov)	30-minute city	"most of peoples day to day work, educational, shopping or recreational activities should be located within **30 minutes walking, cycling or public commuting** from their homes"	Albanese (2014)
2016 (Shanghai Administration)	15-minute walkable neighbourhood	"Within **15-minute walking** distance the provision of healthcare, education, library, Leisure [...]"	Weng et al. (2019)
[2016]/2020 (Carlos Moreno)	15-minute city	"all residents are able to access their **daily needs** (work, housing, food, health, education, and culture and leisure) within the distance of a **15-minute walk or bike** ride"	https://obelaward.org/winner/cities

Fig. 2 Walking cities.

GDP usually happening when cities get bigger, and even more in isobenefit cities as their congestion costs are not existent, or very limited;

5. Isobenefit urbanism provides an easy algorithm that could be flexibly combined with the use of Artificial Intelligence and planners-local contingency aims; it can also provide real-time digital *isobenefit twin* cities by simulating the numerous possible isobenefit *counterparts*.

Beside spreading centralities (CBDs and highly mixed-use areas) at a walkable distance from everywhere within the city, Isobenefit urbanism provides a new paradigm that attempts to relate the built environment to green spaces through the concept of proximity. An Isobenefit City is a city within the wood-forest-parks, and it proposes a dramatically new relation between city and nature, whose implications and paradigm shift range from local to metropolitan-territorial scale. It proposes a proximate and sharp physical link between the built environment and green areas.

Each of the *walking units* of Isobenefit urbanism and provides a centrality, and each centrality is interconnected to the others via sky-trains and underground, making the whole a single city (enjoying economies of agglomeration and scaling advantages) but at the same time keeping the walking access to most daily points and green spaces. All points are easily reachable from distant locations thanks to the interconnectedness of walking + skytrains, and this avoids some diseconomies of agglomeration while reaching population-thresholds to make centralities economically viable, and it creates a hyper-connected archipelago of walking units rather than enclaved walking-ghettos. Isobenefit urbanism (if applied to a city or megacity) does not *restrict* into local community life, and it doesn't *spatially confine* daily life but extends it. If one chooses to live in a megacity or a city, it might also be because she *doesn't* want a community lifestyle.

Whether each walking unit is physically adjacent to its proximate ones (linear-city, annulus-city, dendritic-city) or not (punctiform-city), it doesn't matter as they are interlinked via skytrains and underground. If the densities/typology of these units are villages, towns or cities alike, the overall net would form a mega-village, mega-town or mega-city where synergy is not vertically achieved through a web-type network based on complementarily of the 1-mile unit's centralities; but horizontally via club-type networks. Specifically, this is achieved via branches of the same companies, universities, services spread across centralities rather than having a (big) centrality just for universities, another just for banks, another just for medical services, and so on.

What would it take to create an Isobenefit city?

The unplanned ("libertarian")/planned ("paternalistic") dichotomy is a fundamental one for understanding urban morphogenesis—but also for generating it. Real cities always fall somewhere between these two extremes; and policy regimes, intentionally or not, typically attempt to nudge them toward one pole or the other. Actual attempts to build what are hoped to be ideal cities—for example, new capitals like Brasilia—usually begin as completely planned and designed structures. But since they must actually function as economic and socio-cultural entities, they soon begin to rearrange themselves, both internally and especially by spontaneously generating unplanned additions outside the area of planning control. They thus evolve to become more like cities that are the result of organic growth. In fact, almost all urban areas are the result of a plethora of planning actions at various scales carried out in the absence of any large-scale comprehensive coordination, either spatially or over time. As a result, almost all urban areas tend to have a similar structure as measured by several characteristic fractal dimensions (White et al., 2015), even though each is unique in its particular collection of idiosyncratic local neighbourhoods. In the end, therefore, it seems that even cities that were planned to be, in some sense, Utopian eventually end up being much like all the others.

The Isobenefit city is certainly a Utopian city, even though it is a combination of paternalistic and libertarian policies. The planning ensures that all residents benefit from quick access to both natural areas and central services by fragmenting the developed area to a degree that never happens in real urban areas while requiring that each fragment have some combination of residences, services, and employment activities. The many possible forms of fragmentation, often fractal, are generated by the Isobenefit urbanism software, which is similar to simulation software (White et al., 2015) that successfully generates the various forms of actual cities. This might suggest that the fragmented form of the Isobenefit city could arise spontaneously, just as the fractal forms of real cities do, but that is not the case. Laissez faire policies, even when augmented with planning, never lead to such an outcome, while attempts at completely planned cities also end up, after several generations, resembling typical urban areas, albeit with a remnant Utopian city as an artefact at the core. Thus the crucial issue is this: how could an Isobenefit city be brought into existence?

To realise an actual Isobenefit city, it would be necessary to specify the actual layout of the built form and the green areas separating them in advance and then strictly protect that urban template. Protection of the green areas would need to be much stronger than zoning, which is almost never very permanent (e.g. Alfasi et al., 2012); green areas would have to have a status more like that of a park and would probably have to be publicly owned in order to insure that they were protected over the long term. But since the template of the urban form (the combination of built and green areas) must be completely specified on the ground in advance, how will that form be determined? Here the Isobenefit urbanism software could be useful. If it were modified so that the cell space was non-homogeneous (as in some other cellular models, e.g. White et al., 2015), the forms generated would reflect the influence and constraints of the actual environment—topography, hydrography, vegetation, and other relevant characteristics; they would therefore be in harmony with the natural environment. One of the forms generated could then be selected and implemented legally on the ground.

If the Isobenefit city were not simply an extension of an existing urban area (and implicitly it isn't), a second foundational planning act would be necessary to initiate actual development: an initial economic base would need to be provided. Here the new capital city example is relevant: establishing government operations immediately provides employment and thus generates a demand for housing and services. Another example of a possible initial activity would be the foundation of a new university, as in the case of Louvain-la-Neuve in Belgium. Once the economic base is established, growth can proceed normally with the spontaneous establishment of new industries, businesses, and organisations, as well as the housing necessary for the growing population associated with them, all within the pre-defined template of built and green spaces.

The subsequent, continuing growth of the city can be largely unplanned ("libertarian") because it occurs within the constraint of the Isobenefit urban template. That gives scope for variety and innovation of architectural forms, activity mix, and social diversity.

Conclusion

We introduced a general discussion about the synergy and friction between planned and spontaneous approaches to urban development. Isobenefit urbanism provides an example of a relatively recent planning approach that also allows a certain spontaneity. It can also be seen as part of the *x*-minutes cities family, currently much debated[10]. Within this framework, the main novelty which Isobenefit urbanism offers is a particular concern over the relationship between natural land and built land, as these two components directly shape the physical form of Isobenefit cities. A second novelty is the roughly evenly (in terms of walking distances) dispersal of centralities throughout the city planimetry. Other urban models (listed in Fig. 2) suggest a walkable distance from certain daily activities, but they do not mention natural lands, centralities and the flexibilities of different urban forms.

These Isobenefit urbanism concepts are translated into a code which is changeable according to one's design criteria, and these parameters can be tested to provide visual inputs to the

debates over alternatives. The code can be implemented into a GIS (D'Acci and Voto, 2023; UCL Bartlett School of Planning, 2023) so that real case studies can be investigated[11]. The primary aim of this paper is to stimulate a debate among academics, professionals and governmental institutions about the tension between planned and spontaneous approaches to urban development and then to propose the Isobenefit urbanism approach as a new way of thinking about and modelling our urban built form, at all scales.

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Notes

1 Source: World Bank https://www.worldbank.org/en/topic/urbandevelopment/overview
2 Source: London School of Economics https://blogs.lse.ac.uk/usappblog/2015/06/01/urban-sprawl-costs-the-american-economy-more-than-1-trillion-annually-smart-growth-policies-may-be-the-answer/
3 Source: World Health Organization https://www.who.int/news-room/fact-sheets/detail/road-traffic-injuries Note this is a national figure, not and urban figure - the WEF calculates 42% of these are in urban areas, but this only covers 56 countries
4 *Source*: World Economic Forum https://www.weforum.org/agenda/2022/04/global-urbanization-material-consumption/, https://unhabitat.org/topic/urban-energy
5 Source: Public Space website https://www.publicspace.org/multimedia/-/post/future-of-the-urban-public-space
6 This is calculated as follows: Global pop 2023 = 7.9B, of which 56% are urban = 4.4B. Global pop 2050 = 9.7B, of which 68% are urban = 6.6B. Difference = 2.2B. All figures from UN.
7 Simulations, dynamic visualisations and realistic visions are available at www.urem.eu/isobenefit, and quantified in D'Acci and Voto (2023)
8 Underground schemes are expensive—surface schemes are cheaper—note also that sky trains are more expensive than street-level schemes, but they have some attractions and can be automated.
9 Here for density levels, we mean the range of density between single-family houses with small gardens and skyscraper flats. Namely, isobenefit urbanism does not necessarily indicate high density (e.g. Fig.1) but also villages of single-family houses with their own little gardens.
10 https://www.weforum.org/agenda/2022/03/15-minute-city-stickiness
11 Further developments are currently being tested at the University College London under a UCL Grand Challenges Small Grant. https://github-pages.ucl.ac.uk/BSP-isobenefit-urbanism/ https://www.ucl.ac.uk/bartlett/planning/research-projects/2022/mar/future-urban-growth-lab

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The authors declare no competing interests.

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Additional information

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