The IGLUS way:
a conceptual framework for governing urban systems

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In this article, I will briefly present the "IGLUS way". IGLUS stands for "Innovative Governance of Large Urban Systems" and is a global action-research and action-learning program aimed at urban executives, so as to help them to better govern – i.e., plan, operate, maintain, and renew – their metropolitan infrastructures, notably also thanks to the Information and Communication Technologies (ICTs; digitalization).[2]

IGLUS is grounded in an intellectually sound and a methodologically systematic conceptualization of the governance challenges of large urban infrastructure systems, their performance, as well as pragmatic recommendations how to address these challenges. This paper is therefore subdivided into the following sections: (2) the conceptualization of urban infrastructure systems as well as of the challenges they face, (3) the definition of performance of urban infrastructure systems, (4) the conceptualization of urban system governance, as well as (5) the identification of the role digitalization plays in all this. But before doing that, let me briefly develop the argument why we even talk about large urban systems, their challenges, their performance and their governance.

Why Large Urban Systems?

At the heart of IGLUS lays a political science consideration: at IGLUS, we think that Nation-States are no longer the relevant geographical entities for dealing with today's global and local challenges – rather, metropolitan areas are. Let me explain: with the (peace) treaty of Westphalia (1648) a new and unprecedented political order emerged in Europe, defining the more or less peaceful co-existence among sovereign Nation-States. Thanks to European colonization this concept of sovereign Nation-States spread throughout the world, a concept that defines the world order ever since. With the French Revolution (1789) Nation-States started to involve the citizens into their governance (to various extent) and with the Industrial Revolution, since the late 19th century, Nation-States moreover became actively involved in the (industrial) development of their sovereign territories. Up to today, Nation-States define the way – each on its own territory – how collective problems are solved and how public and also private affairs, including most of the local affairs, are governed.

Such State-centric governance has been extremely successful when it comes to economic and social development, even though such development remains uneven across and within Nation-States. Still, without nation-State involvement, no country and no society would have reached the level of industrial development achieved today. And this is precisely where IGLUS sets in: while the Nation-State and Nation-State-based governance (involving local authorities to various but

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rather lesser degrees) has been a success in terms of development, it is not at all clear whether such Nation-State-centric governance will be appropriate when it comes to dealing with the very consequences of such development. And these consequences are numerous, such as the exhaustion of the industrial development model and ensuing economic crises, climate change and pollution, growing social inequities, population growth, migration, and many others more (see below). In short, we at IGLUS think that while nation-States have been instrumental and have served (well) as the relevant units for industrial development, they constitute inappropriate geographical units when it comes to dealing with the consequences of this very development. In short, new more relevant geographical units will have to be defined – and corresponding governance mechanisms will have to be engineered (see below) – so as to deal with these very consequences. This will necessarily involve a much more pragmatic, problem-solving approach, and, as I like to think, collective learning approach (Finger and Asun, 2001). The philosophy and the very goal of IGLUS is precisely to explore such a collective problem solving-approach so as to help the new relevant entities – which we at IGLUS think are the metropolitan areas – govern the challenges they already do and increasingly will have to face.

(Large) urban (infrastructure) systems and their challenges

At the heart of (answering) these challenges are the urban – or rather the metropolitan – infrastructure systems. At IGLUS, we distinguish between "primary" and "secondary" urban infrastructures, yet we focus only on the primary ones, as they are foundational for secondary ones, as well as for all other economic, social and cultural activities. Primary infrastructures are energy, transport (for persons and goods), telecommunications, water (drinking water and wastewater), housing, waste, and what we call green infrastructures (urban parks, urban trees and other vegetation). Secondary infrastructures could be health care, education or cultural infrastructures (museums, etc.). Neither the economy, nor society can function without them.

At least these primary infrastructures are of systemic nature, i.e., they can only functions as integrated systems and as such constitute complex and dynamic socio-technical systems (Pasmore and Sherwood, 1978). As systems, they are characterized by non-linearity, emergence and adaptation (Thurner, S., Hanel, R. and P. Klimek, 2018). As complex and dynamic socio-technical systems, they also display particular economic characteristics, such as path dependency, sunk costs, externalities (including public services characteristics), network effects, tipping, etc. (Finger, 2019). But infrastructures are not static; rather, they follow a life-cycle, as they have to be planned, built, operated, maintained, rehabilitated and renewed. At times, they decay. Finally, all these primary infrastructures, at least in a dense urban context, are strongly inter-related and dependent upon one another – e.g., transport, housing and water depend on energy, transport depends on housing and vice versa, green infrastructures depend on water, etc. – and it can therefore be argued that metropolitan areas constitute by themselves complex and dynamic socio-technical systems (Batty, 2013).

While their systemic and interdependent nature is in itself a challenge, urban and especially metropolitan infrastructure systems are, in addition, challenged by a series of outside factors. Let me briefly discuss the seven most important factors which are challenging urban infrastructures separately and of course differently depending upon the stage they are at in their life-cycle:

- Financing challenges are about raising the money necessary especially for building and rehabilitating the urban infrastructures from public (local, national, supranational) and private sources, sometimes in the form of public-private partnerships (PPPs). Such challenges concern in particular housing, but also transport, energy and green infrastructures.

- Economic challenges, instead, are about paying for the operations and sometimes also for the rehabilitation of the infrastructures, typically from user fees, access charges, public subsidies or often from a combination of both. Such economic challenges can also pertain to so-called Public Service Obligation (PSO) contracts, whereby private operators and public authorities share revenue risks within the context of a PPP.

- Technological challenges typically pertain to new technologies replacing or more often having to be integrated into legacy technologies or even into entire entire technological systems. This is particularly the case in infrastructures whose technologies are rapidly evolving, such as telecommunications and more recently transport and energy. Yet, such challenges result mostly from the financial implications of replacing or upgrading legacy systems (see above financing and economic challenges).

- Demand challenges typically pertain rapid urbanization due to an influx of new inhabitants. Consequently, urban infrastructures need to be developed, extended and upgraded, often within a short time-period. In the short term this raises problems of infrastructure capacity and breakdowns and in the medium- and long-term issues of financing (see above). In some cities, challenges of urban decline have been observed, leading to problems of overcapacity and ensuing economic challenges, i.e., challenges of paying for and operating over-dimensioned infrastructures. Such demand (and decline) challenges concern all infrastructures.

- Social challenges pertain to inequity in accessibility, affordability, quality and types of infrastructure services within a city according to income, social class, geographical location, but can also include inequities according to race, gender and ethnicity. Such social challenges are typically more persistent in the case of water, wastewater, waste, transport and green infrastructures and can, if acute, result in social unrest and in any case will lead to political interference into infrastructure governance.

- Ecological challenges pertain to both climate change and pollution. Climate change, or to be more precise global warming, challenges in particular the water, the housing, the energy and the green infrastructures, whereas pollution challenges the water, the wastewater, the waste, the green and very importantly the various transport infrastructures. Demand challenges often exacerbate ecological challenges, whereas the latter often exacerbate social challenges.

- Jurisdictional challenges pertain to the fact that most, if not all metropolitan infrastructure systems typically cut across different jurisdiction, i.e., city district, city, metropolitan and even national jurisdictions. This is typically the case of energy and water systems (urban energy and urban water are mostly source from outside the city), as well as of transport

systems, which rarely cover the entire metropolitan area in the same way. This is mostly a governance issue, as we will see below, with direct (negative) implications for the economic, the financing and social challenges.

Table No.1 summarizes these seven challenges as applied to the different infrastructure systems taken separately. It unfortunately does not represent how these different challenges reinforce each other, such as in the case of urban heatwaves leading to higher energy consumption which in turn exacerbates the urban heat island effect, as well as the pressure on green and water infrastructures.

Table No.1: urban infrastructure systems and their challenges

Challenges / Infrastructure Systems	Financing	Economic	Tecnological	Demand	Social	Ecological	Jurisdictional
Energy	√	√	√	√	√	√	
Transport	√	√	√	√	√	√	√
Water	√	√		√	√	√	√
Waste		√	√	√	√	√	√
Housing	√		√	√	√	√	
Telecom			√				
Green	√			√	√	√	

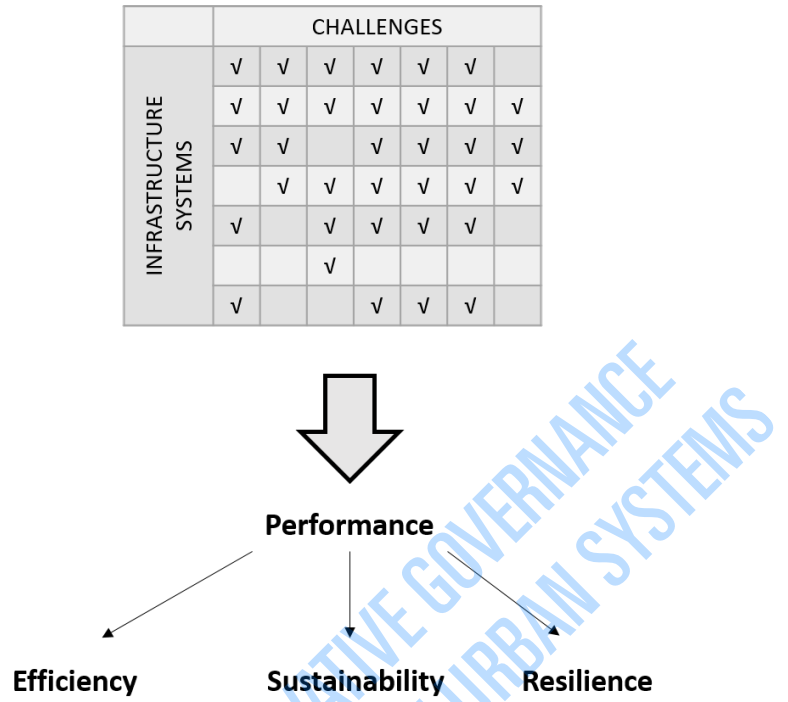
Source: author

The way these seven challenges are addressed – both in each of the seven infrastructure systems separately but also in their systemic relationship with one another – will determine how well these systems and the metropolitan system as a whole will be performing. We will thus now turn to the conceptualization of the performance of large urban systems. Later on, we will also show how such performance relates to the attractiveness of metropolitan areas.

Performance

Indeed, metropolitan infrastructures are no goal in themselves; rather they are foundational for urban economic wellbeing and social life. The better they perform, either in themselves or as an integrated metropolitan infrastructure system, i.e., the better the above seven challenges are addressed either separately and, more importantly, in their relationship with one another, the better the overall performance. In this section, I will therefore now show how we at IGLUS are conceptualizing such performance, as illustrated by figure No.1.

Figure No.1: the link between (addressing) infrastructure challenges and performance



Source: author

At IGLUS we have come to the conclusion that performance of urban infrastructure systems is to be categorized into the following three dimensions, namely efficiency, sustainability and resilience. While these are mainly buzzwords, they are still the best available concepts and define three clearly distinct dimensions of performance.

- Efficiency is about resources use, whereby resources are both financial and natural (soil, energy, airspace, water). Efficiency is also about operations. Obviously, urban infrastructure systems should perform as efficiently as possible and generate the highest possible output per input unit. This efficiency logic can be applied to each infrastructure system separately: an urban metro system should be efficient in itself and so should an urban mass transit (commuter train system). But it would be better if both were optimized together, and it would be even better if the entire mobility chain, together with the energy transport consumes were optimized as an integrated system. As we will see below, digitalization is certainly a key means for making urban system more efficient, and this, and only this as I will argue, is what "Smart Cities" are all about.

- Sustainability is about the relationship between the different urban infrastructure systems and their ecological, social and economic (financial) environment, i.e., urban infrastructures should be ecologically (to the extent possible), socially and financially sustainable. But it is even more important that entire urban infrastructure system as a

whole is sustainable: for example, it makes no sense that motor vehicles become electric, yet electricity is produced by fossil fuels.

- Resilience is about resistance and recovery from external shocks: for example, urban infrastructure systems need to able to cope with heatwaves, floods, earthquakes or terrorist attacks on the drinking water system. Not only would they need to cope, but moreover would they have to learn how to cope better the next time another external shock comes around.

There are synergies and tradeoffs between these three performance dimensions: obviously, more efficient urban infrastructure systems are also more sustainable, even though they will not automatically be sustainable in absolute terms if they are fully optimized. Furthermore, more sustainable systems are probably more resilient, but fully optimized systems are less resilient in turn. This means that performance choices have to be made, and such choices are resulting from the urban infrastructure systems' governance, to which I will now turn.

Governance

Governance is about addressing the challenges of complex dynamic and large urban systems so as to achieve performance. It is also about the processes by which performance objectives are identified and ultimately decided. The intellectual foundation of our approach is rooted in new institutional economics, which basically considers governance to be the process and the outcome of coordinating among actors (Williamson, 2000).

When it comes to governing large urban systems, the number of actors which have to coordinate among themselves are many; we call this horizontal coordination. Actors moreover can be found at various governance levels which then leads to the need for what we call vertical coordination. Typical actors capable to address the above identified challenges of large urban systems are as follows:

- Public authorities can be found at various levels, starting from the most basic one: these can be city district authorities, followed by city authorities, metropolitan authorities (if they exist), national authorities (which always also play a role in urban governance) and, in the case of Europe, also supra-national authorities. Public authorities can be of varied nature, such as political actors (elected or not), administrative actors, regulators and courts, the latter two typically being found only at the national level. Public authorities tend to be involved in planning and decision-making, rather than in operations, but this is not a general rule.

- Private actors (firms), in turn, are typically rather involved in operations at intra-urban, urban, metropolitan, national or global levels. At times, private actors can also play a role in planning, such is in the case of private think tanks or foundations, as well as in advise, such as in the case of consulting firms.

- But many important actors of urban systems are neither purely public, nor purely private, and can therefore be called hybrid. This is typically the case of public enterprises, which

can be purely urban (called "utilities"), sometimes regional and of course national, in which case they are called "State-Owned Enterprises" (SOEs). Sometimes these are even joint ventures between public and private enterprises. One of the interesting features of the governance of large urban systems (as opposed to the national level) is precisely the existence of many types and forms of such hybrid actors.

- Civil society actors (which can be formally organized or not, in which case they rather take the form of social movements) can be found at various levels of governance, namely most typically at very local (district) or at national or global levels. At these latter levels, they rather take the form of Non-Governmental Organizations (NGOs)

All these actors should, but very often will not, coordinate among themselves so as to address urban challenges. They also have to coordinate across levels (and with actors at different levels), but again, very often they will not. This is, on the one hand, because actors have interests and thus coordination can and will lead to conflict (the sociological dimension of coordination) and, on the other hand, because coordination, especially when involving conflict, is costly (the economic dimension of coordination). Consequently, outcomes – be it plans, decisions or operations – are always suboptimal.

New institutional economics posits that there exist three ways of coordination, namely markets ("competition"), hierarchy ("command-and-control") and network ("self-organization"), i.e., neither market nor hierarchy. While this distinction is somewhat applicable at national and global levels, coordination at the urban and metropolitan level is most often a combination of all three. In other words, urban and metropolitan coordination takes the form of very sophisticated ways of coordinating among all these types of actors, often from different governance levels. What is particularly important here are the attributes or rather the powers of the different actors involved in the coordination process. One can distinguish here between positional or legal powers (and attributes, i.e., certain actors having the power to decide on certain matters), reputational or charismatic power, power resulting from expertise as well as power resulting from access to financial resources.

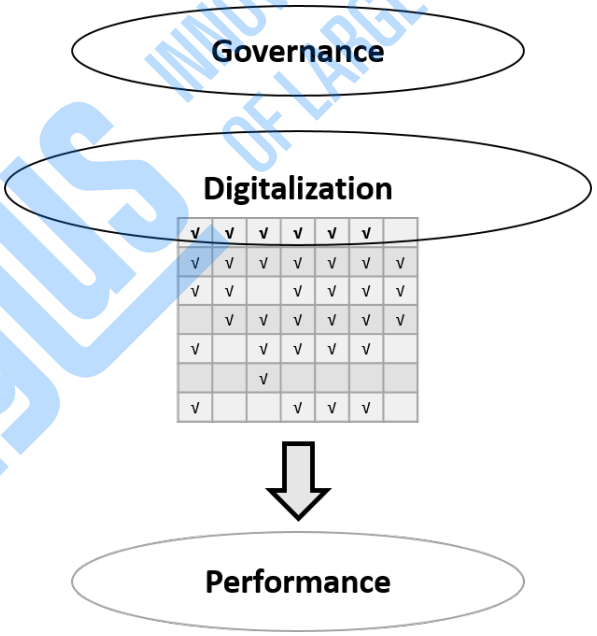
And this is precisely where digitalization comes in, as digitalization's main feature is the lowering of coordination costs and thus the changing of the power relationships among the actors involved in coordination.

Governance, digitalization and performance

The most recent urban discursive innovation is without doubt the "Smart City" concept (Finger and Razaghi, 2017). And indeed, neither the concept, nor the broader topic nor, to a certain extent, the reality of Smart City can be ignored any longer when discussing urban governance. In this section, I would like to go behind and beyond the hype of "Smart Cities" as mainly promoted by vendors as well as by some cities which have fallen for them. I would like to show that there is, indeed, something to Smart Cities, though not necessarily what strikes the untrained eye. In order to understand what Smart Cities could and ultimately will be about, one must first understand what digitalization is and does.

Let us first talk about the hardware dimension, i.e., the one promoted by most of the smart city vendors: sensors, RFID tags, cell phone signals, cameras, etc. generate data from about every source about almost anything. Data will be gathered in some sort of data platform, but do not necessarily be stored in that platform, as long as they are accessible in real time. What is much more important is data analysis thanks to ever more sophisticated artificial intelligence algorithms. Basically, what such analysis does is to automatically coordinate previously uncoordinated elements of the (urban) systems. In other words, analysis of digitalized data – in short "digitalization" – substantially lowers the costs of coordination, either by coordinating automatically, such as matching lenders and renters of rooms in the case of Airbnb, or bringing together riders and drivers in the case of UBER. As a consequence, the hotel or the taxi markets become more efficient. And this is what Smart Cities are all about: substantial efficiency gains as a result of more or less automatic coordination of previously badly or even uncoordinated actors. For example, various transport operators can be better coordinated so as to offer more seamless mobility solutions, perhaps even combined with smarter, i.e., more efficient energy sources. In other words, digitalization, when applied to urban systems, can and will undoubtedly lead to more efficient cities and, because of that, also to a little bit more sustainable cities. The same digitalization, if properly governed, might well also lead to more resilient cities (e.g., early warning systems thanks to real-time data and predictive operations). Figure No.2 illustrates this link between governance, digitalization and performance graphically:

Figure No.2: the governance, digitalization, performance nexus



Source: author

But there is more to digitalization in and of urban systems, namely the phenomenon we can call "platformization", as it has already become known in some industries (see: Finger and Montero, 2017). Digital platforms such as UBER and Airbnb, besides increasing efficiency, also redefine the taxi and the hotel industry, appropriate value-added, and now serve as the new intermediary

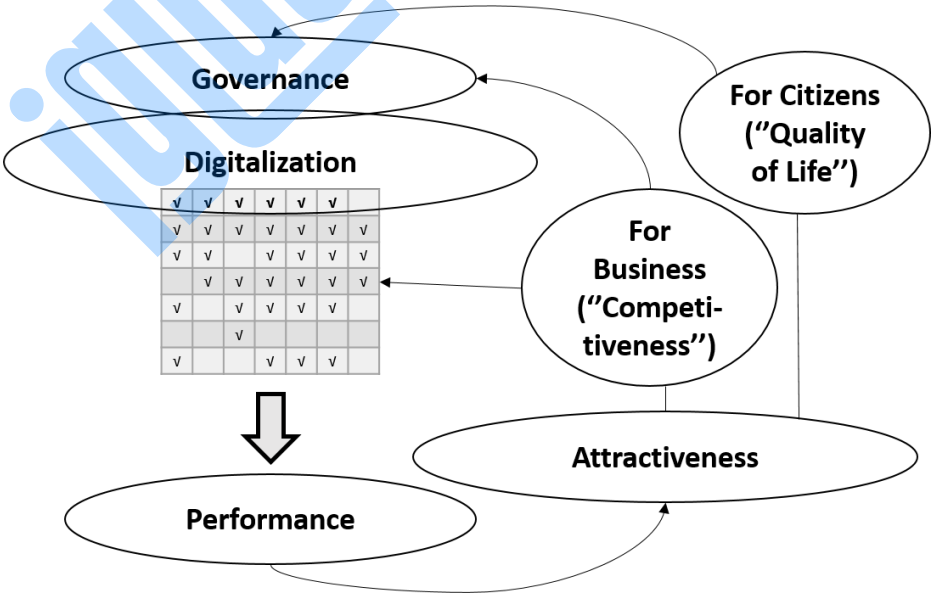
with the customer. A similar evolution could be envisioned for entire cities, where by new urban platforms in between city governace and urban infrastructures, a phenomenon that has been called "city as platform".

However, it would be desirable that data are not left to purely commercial analysis, but rather are governed in the common interest by the various urban actors, some sort of "public interest digital urban platform". For example, algorithms analyzing urban data, instead of seeking to optimize efficiency and profits, could be programmed to optimize community action, consumption reduction, self-help solutions, and many other collective problem-solving objectives, leading not only to more efficient, but also to more sustainable and ultimately to more attractive cities or metropolitan areas. This, however, would require, first, to create digital platforms at urban – instead of at global, as is currently the case – levels, something which has become called "City-as-a-Platform" or, as I would suggest more appropriately, "City-as-a-Service" (CaaS), by analogy to "Mobility-as-a-Services" (MaaS). It would furthermore require the corresponding data to be analyzed and exploited by algorithms working or "optimizing" for the common good or the public interest. This in turn would require a type of governance of the CaaS platforms that involves all the relevant actors concerned by solving the challenges of today's urban systems. In other words, CaaS platforms, as well as the urban systems whose performance these platforms are serving, will have to be governed to the benefit of all the actors involved; otherwise they will simply become yet another layer complexifying and further sub-optimizing governance and performance.

Linking it all together

In lieu of conclusion, let me link it all together or, rather, "close the loop". Figure No.3 illustrates the link we posit between governance, digitalization (City-as-a-Service) addressing the challenges of large urban systems, their performance … and back.

Figure No.3.: closing the loop



Source: author

Indeed, even the "performance" of large urban systems cannot be a goal itself. Rather, performing urban systems are ultimately there to serve the metropolitan area's inhabitants and businesses (which in turn create jobs and produce goods and services for inhabitants). If urban systems and their challenges are governed for efficiency, sustainability and resilience, metropolitan areas will become more attractive for peoples who will appreciate a better quality of life. Better-governed, i.e., more efficient, more sustainable and more resilient metropolitan areas will also attract better businesses, again to the benefit of the citizens. And a more active involvement of citizens and businesses, and thus a better governance of these urban systems will hopefully be the outcome.

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