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# Intelligent Communication and Patterning in Smart Cities

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## Abstract

What makes a city great and smart has puzzled many, and millions are fascinated by metropolises and interested in the effects and phenotypes of urbanization. More than ever before, citizens are demanding smart cities, which are in progress and have co-evolved and shaped us, the citizens, the country, the economy, and the world, reciprocally over many centuries. This chapter highlights the past and future roles of communication and pattern formation in the local cluster of the developing smart city and “assistive technologies” and catalyzes that were and will be needed to transform a city via better cluster management, urban planning, coordination, citizen enablement, integration, and citizen feedback into a better functioning, convenient, and intelligent place for all of us including disabled, ill, young, or aged persons. With some explicatory analogy, the “metacity” is becoming a new living entity that is either more or less disabled and needs “smart enablement,” new solutions that solve old bottlenecks, as the city is as enabled as its citizens that need some aids. Hence, smart cities are on the agenda in most countries, and fair opportunity, city functioning, smart communication, and smart pattern formation play pivotal roles in the unmatched urban enablement of all citizens and, concomitantly, the enablement of the “metacity” entity. Smart cities thus hold the key to stimulate the economy, to create the pattern of great places for all, to meet our Maslow’s pyramid of needs also on the city level, and without leaving anyone of us behind.

**Keywords:** communication, assistive, technology, pattern formation, smart, cities, city, disabled, enablement, form-follows-function, patterning, cluster, management, urban

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## 1. Introduction

Cities can be defined and understood as developing clusters with spatial localization and a heterogeneous but cohesive density function of human sojourn probability, demand and supply, culture, and the respective architecture and infrastructure, and city systems. Our cities have developed over a long time and they still evolve into modern-day “smart cities,” as onset and the ongoing trend since centuries, which can be best understood if one reveals their historical development and evolution over time worldwide. An understanding of past developments, the demand and wish to improve our cities, creativity, and economic interests are among the major driving forces that will frequently propose and demand smarter cities including “new assistive technologies” for all smart citizens including disabled persons. Improvements can be best achieved by learning from unbiased evaluations of previous developments, empirical and apodictic facts, performances within contexts, and circumstances. We do not only need to know and understand what really matters to create intelligent cities, we also must ask the question what “smart cities” really are or should be—a common goal of human endeavor. Eventually, we all live in city that will have some goals.

On the roadmap toward smart cities, there are many streets and crossroads where form follows function but everything is a function including esthetics and aid. We want a city to function, we want a city to be a nice, good, clean, great, comfortable, and a compatible place to live with all basic amenities and even more, if possible, in a step-by-step approach undertaken in the right order and priority for a citizen with general or specific Maslow’s pyramid-like demands and requirements and for everyone in the city as a whole. We want to integrate into the one-species biocenosis of a city that takes care of the multispecies biocenosis in a biomedical way via health care system supply.

Whenever a smart city integrates us we become smart, rise, and grow beyond ourselves. Without enablement and integration into the smart city, we are all disabled—all of us. The smart city is designed to extend us by providing us with everything we need to work and live and for our pursuit of happiness and at least our basic human rights. In the developed and developing world, urgent city demands can vary at very different stages and many segments. What makes a city great, what makes it smart, and what attracts and enables their citizens the most? What is needed to unleash the entire potential of a city and its citizens and to diversify and upgrade its functions? The best strategy is to help the weakest link in the chain, the weakest infrastructure, the weakest citizens, the most urgent requirements [1].

To say it with Aristoteles, the whole of a smart city is more than its smart city components.

This synergistic effect is known to be the key driver of the urban economic and cultural engine, only if all economic dimensions are met, only if all drivers of growth are supplied, and improving the bottlenecks first, than gross domestic product (GDP) and wealth and functional key performance indicator (KPIs) will soar [1]. The whole is more than its sum as the important

elements network together and make a city great and smart and an economic cluster of co-dependencies, and as a result, all bottlenecks must be improved and advanced as the major take-home message of the math behind it [1]. By enabling all citizens, disabled and unemployed ones, they will be a part of new growth. If one of the key component is missing, it would cause a bottleneck to be understood as the weakest link in a chain [1]. Solving this bottleneck for all citizens [1] means to pull the city and its citizens upward into a more productive, intelligent, wealthy, healthy, qualitative, cultural living without forgetting about anyone of its citizens by integrating all [1]. A further advancement of city entrepreneurship takes dimensions of intrapreneuring into account [1].

As important as it is for a country to unleash the power of intrapreneurs [1] and to close all bottlenecks, to be attractive for investors and to stimulate qualitative and quantitative economic growth [1], as important it becomes for a city to be an economic, functioning, great, and sustainable place. All individual and all common goals must be better aligned, channeled, and met. Every urban planning can be thought top-down and bottom-up, centralized or decentralized, and private or public, and “the big things” are only standing strong in a well-founded detail solution and highly interact with “the small things.” Small mirrors big, and big mirrors small, in a city like in a country, and this reciprocal patterning could distantly remind on a fractal-like pattern (**Figure 1**) – to better remember this urbanistic effect. It seems to be a fundamental principle in all cities, countries, and governing in general due to the reason that everything is interconnected, and also cities shape us, and we shape the cities.

If we are enabled in the cities, then the cities become enabled too. As form follows function, all forms will strive toward a functional form, but as function also follows form, for example in art, design, and esthetics, all functions will also strive for a form function, and now both can happen at the same time to a different extent smart cities should be aware of. These patterns often have an anthropocentric reason and are centered on human demands, communication, intelligence, cycles of evaluation, planning, and implementation, steadily forming demand and supply functions, and the requirement to meet the challenges of an ongoing urbanization.



**Figure 1.** City evolution in fractal-like patterns or rethinking the reoccurring themes. For example, in megacities, there are often patterns of subcities and towns with one metropolis; art, design, architecture, culture, and how things are done influence each other on all layers. The small things that are relevant for all citizens make the city’s big things, and vice versa.

Communication and patterning, aiming at smart city goals and the enablement of all citizens, comprising responsiveness, planning, and implementing, are some major pillars that might summarize and can help direct the cities into human-friendly places of good living and working. Cities are not only places of mass enablement that bear economies of scale and scope but also difficulties and new challenges of size and magnitude. To solve social problems or the needs of disabled persons in a developing megacity, it can bear much intricacy and requires a city masterplan that is more powerful if done for everyone.

To resolve all citizens' issues, one must always start at the individual urbanite and integrate and coordinate the required actions and smart city planology for all townsmen and even more than that, for all potential visitors and even for people that will only get an opinion about the city – smart cities are big in our mind. Money, wealth, and luxury are not everything that makes a city smart and big, there are also affordable ways to do so and it is worthwhile to try a real mastery to find top alternatives.

Communication is the beginning of solution finding, planology, and patterning a smart city. The economy and society turns into an uncontrolled network of co-dependencies and leave the free market and normal government [2] and the city become a part of the rising network economy, and competitive advantage becomes more and more defined by smartness, information, and technology [2]. But smartness can be good or bad for people if there is no common goal. For example, smart consultancies have destroyed the global job markets via billion dollar HR consulting that hinders the smart workforce to find an entry position. Good smartness would be to allow intelligent workforce to get an entry position vice versa. Thus, we need smart cities with good goals: it would be surely good to integrate everyone.

The information age [2] has quantitatively ended patriarchalism in the western world [2] and has led to advancement of females over males via betterment of females in job sectors. This has fully destroyed the lives and careers of many male citizens, and concomitantly science and the common sense in the society is not functioning any longer. The city is the arena of this interplay between female femo-fascistic and male job stealing organized crime networks. Hence, there would be no good development without smart city goals that would happen naturally in such unopposed information and organized crime network societies [2]. Consequentially, smart city movement is the only good integrative idea to move forward as they intend to help everyone living in the city irrespective of the gender or employment. A key idea is enablement of all citizens via integration and assistive technologies that are a help. New cutting-edge technologies can help to assure mobility, interactivity, information, jobs, a more convenient supply and a better understanding of demand via assistive technologies. Such citizen-centered solutions can empower and enable disabled and nondisabled persons.

Assistive technologies can be defined in the widest sense to enable citizens that deal with a lack of mobility in the city, lack of instructions and information, lack of any specific need that the city should, and can take care of using technology to thrive humane city evolution, and assistive technologies can be defined in a narrow sense to help disabled persons. Both definitions are used here because enablement is important for basically all citizens and it will never be helpful if we are divided and conquered on every topic—all citizens are one.



This book chapter deals with catalysts, enablement, and principles of evolving smart cities and assistive technologies and that we can learn from developments over time. It will also discuss some major drivers, general goals, and key game-changers of “smart cities.” Myriads of dichotomous influences, let it be historic or present, materialistic or intangible, accumulative or ephemeral, arbitrary and planned, rational and creative, considerate or impulsive, conservative or progressive, liberal or conventional, with capitalistic or social focus, have altogether, and many more, parametrically and incidentally shaped the cluster of the city in many patterns of central or decentral, private, and public decisions. The right theoretical frameworks are still missing and without them smart city evolution will not work. Hence, this work must give a general understanding of smart city and enablement and makes the assistive technologies case examples of the smart city goal theory and evolution.

We are just about to begin to better understand, reveal, and track all city and cluster patterns scientifically, statistically, spatiotemporally, logically, and we still need to find the right read-outs and KPIs to measure the ongoing smart city success, e.g., from year to year. We are still at the beginning to control smart city evolution, and smart cities have already formed coincidentally due to the obvious requirements of the cities and by trial and error, but sometimes also by good planning and foresight for all citizens. City planning has gone a long way like all of the city technologies, both the inventions and their implementation. The smart city planning must also protect citizens from bad and evil networking and must enable transparent and good networking to direct the evolution of the information age [2].

In ancient Egypt, in the Roman empire, the Greek polis, ancient Chinese cities, or in some big western capital cities, the idea of top-down planning, centralization, purpose function, and order was part of planology and urban management. This has yielded nice overall city structures, city architecture was keeping the big picture and impression in mind, and both aesthetical and functional aspects were sometimes considered more rigorously, especially in capitals or important cities for the emperors or leaders. Today’s modern-day cities are more decentralized, market-like, with residential, industrial, scientific, governmental, recreational, and many more designated areas for building. This new bottom-up freedom has yielded great developments, but there are upsides and downsides to both models of urban planning. Dialectically, it might be advisable to search for the best of both worlds and to assure right contexts, frameworks, and conditions of deciders, to assure a free but also well-planned city.

For instance, a recent experiment with people who had never studied town planning before were asked to design like city architects the regular city areas and streets, which resulted in the same pattern we see everywhere in our cities. This might show that cities could lack behind in advancing or planning the city in a more aesthetical and accessible way for all citizens.

Consequentially, we see positive and negative developments of this decentralization and both must be questioning it when needed and celebrate it when needed too. Still many city issues and challenges of today will only be resolved by centralized planning and top-down design. Everything that the market would not achieve must be achieved differently; “assistive technologies” for example, often need governmental, state, and city support—but not always.

We need to research to gain a better understanding how to achieve intelligent smart cities in a cost-effective and most suitable manner. Generally spoken, decentralization can work

fine whenever a special and personalized particulate private interest had to be met. But this decentralization has not worked out for common societal goals due to a lack of incentives.

Particulate interests seem not to have been able to sustainably team up in a marketplace to build a smart city for all of its inhabitants and citizens, while the city fathers also believed in “the market” for centuries. Examples are health care, assistive technologies, education, infrastructure, and many more. These prerequisites must be actively enabled in smart cities whenever the market does not meet the needs of all citizens, or if the market cannot be channeled or does not get any smarter or better over time.

Our cities still lack intelligent communication, and communication solutions are still at their very beginning despite the digitalization, the internet, and the “mobile phone area” of the world. Taxes and governmental funding are key drivers and needed to build infrastructure, hospitals, transportation, halls, theaters, parks, bridges and tunnels, airports and seaports, to enable city vitality, to enable city growth, to enable investors, to enable functionalities, and to enable all citizens including disabled citizens with both mobile and nonmobile assistances. Smart city communication is still in its infancy, like mobiles, and more serious helpful apps.

If you want your city to function, you must enable your citizens to do all their functions. Enablement is a common welfare goal that was not reached by an invisible hand or market so far. Although the “invisible hand” is known to channel private economic egotisms into economic activity that manifold supplies the society—it is also a system and machine to manifest social inequality and oppression and also did not serve any higher common goals, like welfare, healthcare, social justice, fairness, equalization, and protection of citizens irrespective of gender, race, disability, or any individualism. Adam Smith did also never intend what neo market radicals have made out of it. All he was saying is that the capital market organization provides incentives to make egotisms indirectly work toward a common goal of overall supply and that there were not only bad things and downsides of capitalism [3]. This misunderstanding has caused suboptimal pattern formation around the globe until today. The right decision about public and private in all cases is the solution.

For instance, which markets should solve all the problems of all disabled persons? There are not enough incentives to solve all of the market failures that we see today, and the market lacks centralized solutions for common goals if needed. So the governments, states, and cities have had to step in with laws, regulations, and governmental funding. Until today, cities, towns, states, and countries have not sustainably solved common goal questions, and there is hope that new “assistive technologies”—in the widest sense for all people and questions—might help in these endeavors, like public transportation, ICT, or infrastructure.

Thus, if we start aiming to solve citizen problems, enablement comes into play for both disabled and abled persons. Enablement using technologies is thus a key defining feature of modern smart cities, no matter how we are disabled or hampered to do something we need to do. By making public transportation compatible with wheelchairs, it can save costs that individuals or the public have to bear for alternatives and give back some normality in life. Vehicles and cities can be better designed for wheelchair paths or blind persons. One can thereby learn from the solutions for disabled persons to provide solutions for all citizens.

Since centuries, cities develop into smarter places, but it will still take a long time until they are all there. This development can be best understood as a process in time. Not only new

inventions, socioeconomic, cultural, political, and technological developments, but also health care, migration, defense, employment opportunities, industrial diversification, financial and service sector development, arts and architecture, and much more has all impacted smart city urbanization and city cluster aggregation. New assistive technologies are game changers for citizens, both disabled or not, and will help to enable citizens in smarter cities.

## 2. Smart cities

What is a smart city, what are smart cities? Today, there are still no universally accepted definitions. Many have heard the terminology, but are not familiar with what it really means or have precise definition. Worldwide and also per country, the definitions vary much and it is interesting and worth doing to have a closer look at recent definitions:

The government of India, for example, has created an important “Smart Cities Mission” with a wish list of infrastructure and services and with universal core set of the basic requirements that holds true for all cities: (I) adequate water supply, (II) assured electricity supply, (III) Sanitation, incl. Solid waste management, (IV) efficient urban mobility and public transport, (V) affordable housing, especially for the poor, (VI) robust IT connectivity and digitalization, (VII) good governance, especially e-governance, and citizen participation, (VIII) sustainable development, (IX) safety and security of citizens, and (X) health and education [4]. Smart cities can act like a lighthouse to other aspiring smart cities, and one can learn from one another to speed up developments, and smart cities become part of an international network of cities that could help each other. The conceptualization varies toward more advanced needs in more developed cities and countries that often have solved fundamental issues some time ago, but also advanced and developed cities have not done everything right and must learn from their mistakes. Developing cities can benefit from this city learning and can try to do the specific right things for them immediately. Maslow’s pyramid or hierarchy of needs provides a good general understanding. It is not just a psychological phenomenon or explicatory model of the psyche, individual needs but also a real-world challenge for all people and all cities and their needs. Maslow’s pyramid of needs holds true for the city, the country, all citizens, and also disabled citizens.

As a result, the phases of smart city evolution could be ordered in a fashion related to Maslow’s pyramid of needs and requirements (see **Figure 2**). The UK Government’s BIS (Department of Business Innovation and Skills) “considers smart cities a process rather than a static outcome, in which increased citizen engagement, hard infrastructure, social capital, and digital technologies make cities more livable, resilient, and better able to respond to challenges” [5]. The British Standards Institute (BSI) defines the term as “the effective integration of physical, digital, and human systems in the built environment to deliver sustainable, prosperous, and inclusive future for its citizens” [5, 6]. Recently, the United Nations Economic Commissions for Europe (UNECE) has started a United Smart Cities program that is sharing the same key areas comprising urban mobility, sustainable housing, clean energy, waste management, and information and communication technology (ICT) [7, 8] and fulfills as a mission the SMART criteria of specific, measurable, achievable, results-focused, and time-bound goals [9]. And there are many more missions like these ones, but much nebulosity exists over what a smart city is, globally. When we think about smart city evolution, it has already gone a long way,





**Figure 2.** Maslow's pyramid in analogy to the evolutionary phases of smart cities.

a very long and complex journey, not fully perceivable in all billions of details, and yet there is still much to come to reach to goal of a smart city, as it seems to be a never-ending process. Would it not be nice to have free public transportation in a free smart city? Would it not be nice to have a compatible site for disabled persons with wheelchairs? Would it not be nice that the city has a solution to all our problems and is responsive to what we want to know or what we want? Utopic, idealistic or even realistic—the future will show, but there is already strong evidence that the attractiveness increases in smart cities also for investors, for tourists, and growth with all benefits the city and the citizens.

Whenever we use the terminology of evolution, a selection from diversity, survival of the fittest, we often end in misunderstandings and wrong comparisons. But cities do evolve but differently, like the economy, the country, the sciences, engineering, or IT [7], but this cultural type of evolution is clearly different, and it follows very different rules, still it is an evolutionary principle at work, with a different type of DNA, entities, selection, incentives, and diversity. If we have to distantly compare city evolution to biological evolution, we might think of the transition from isolated single cells to multicellular organisms that adhere and have started a division of a labor and a specialization in the common cluster and reproducible vehicle with a genotype and phenotype. Multicellular organisms, the metazoan, had an increasingly competitive advantage, this way spread all over the world, found and developed in their also changing niches. We the “*metacitizens*” are the biological component of the city that evolved biologically and culturally, while the city evolves differently and shapes our niches.

When people settled down and towns grew to cities, a division of citizen labor took place: architectonically, functionally, and on many different levels, so that we could think of cities in the same way, as forming multicompartmental, multifunctional *metacitizen* lifeforms that

cluster and slightly integrate in metacities, which also appear like lifeforms, new collective entities that wire together via infrastructure, streets, internet and ICT, governing, and more. At the same time, smart cities will co-evolve the forefront of the internet [7] as nerve system.

But this development into multicellular organisms created many new requirements and challenges for both biology and urbanization. An organism or city that is growing naturally or due to the influx of immigration, new residents must have new structures, body plans, and procedures. Among the new needs are those listed in the smart city missions and in Maslow's pyramid of requirements (**Figure 2**) mentioned earlier: transportation, energy, health, education, ICT [7, 8], economy, governance, research, social and technology assistance and help and aid for sick, aged, young and disabled persons, and much more. This might correspond to the need of a transporting blood and vessel infrastructure system, heart, brain, internal organs, skeleton, muscles, several senses, digestive system, blueprints, specializations, and mechanisms, which make the big thing work. The immune system helps fighting pathogens like the police and fire departments, and regeneration is also in place. We should not overstress the comparison, but when we are thinking about *smart city* definitions, it might be important to include a distant analogy to evolution. In the light of such comparisons, one could view or define *smart cities* as locally evolving cohabitation clusters with the division of functionalities that develop economies of scale and scope and thereby become intelligent entities with own goals and strategies and relevant engines of the economy, culture, science, and country, social policy, and for human development. All of this depends on communication, integration, coordination, in the first place or phase, while responsiveness, patterning, and implementation are the part of the second phase.

The more city townsmen are integrated and enabled the better. *Metacitizens*, *metacitizens*, or *metabürger* are members of the evolving city or town and state or country. Such inevitable democratic *metacitizens* for smart cities evolve by sharing common goals of a fair and sustainable civic society with help and integration for all. Smart cities evolve over centuries and “widest sense assistive technologies” are key driver, e.g., sewerages (see **Table 1**).

Time	Smart City Goal	Cultures and Countries
5000 B.C.	Single Sewerages, First Toilets	Tribes
3000 B.C.	System of Sewerages	Sumerians
2000 B.C.	Sewerages, Aqueducts	Greeks
1000 B.C.	Uphill Water Supply	Persians
600 B.C.	Sewerages, Aqueducts, Indoor Water	City of Rome
500-1500 A.D.	Medieval Period	Slowdown of Smart City Development
1500-1700 A.D., 1700-1800 A.D.	Renaissance, Age of Enlightenment	Revival of Smart Cities; Europe, UK, USA
1700 A.D.	Sewerages, Aqueducts, Water Supply	France, England, etc.
1800 A.D.	Sewerages, Aqueducts, Water Supply	Paris (new standard setting)
1840 - 1890 A.D.	Sewerages, Aqueducts, Water Supply	New York, London (standard setting)
1900 A.D.	Sewerages, Aqueducts, Water Supply	Became Standard in European Cities

**Table 1.** The invention of sewerage is 8000 years old but reached Euro cities 7900 years later.

How well are city development and technology evolution really doing if an invention like sewerage, in fact, took up to 7900 years to be fully implemented as a working standard? How well is human cultural and smart city evolution really doing? What is it that holds us back? What slows human city development, planning, and implementation, and hampers the human civilization so much? What are we doing for all that research and innovation if it takes another thousands of years before the most logical and needed things find their way? Where does the implementation delay stem from? How to speed up the help the citizens need?

Maybe the answer can be found in the circumstances of the long medieval period in which much of the previous knowledge and know-how of the ancient and antique cultures was lost or not implemented for all, including most of their inventions. Lack of communication, education, and communication systems like universities, schools, a free or functioning press or information collection and distribution system, lack of libraries, books, and knowledge and information dissemination technologies, but also censorship, and a strict obedience to all hierarchies might have repressed a faster evolution toward smart cities. Key inventions were already made but not implemented. The Renaissance and *Age of Enlightenment* have speed-up smart city evolution again by reviving previous ideas including sewerages (see **Table 1**), knowledge, technologies, art, and humanism, which were essential for integration of citizens in this important ascent. This has changed perceptions of the city, it has reduced its feces, odor, all around the clock in many corners of most streets, and has simultaneously improved the health situation of millions of people by reanimating assistive technologies of leverage aqueducts and pressured water supply, that limited the deadly cholera epidemics.

We can assume that assistive technologies—in the widest and in the narrow sense—are still delayed and lacking until today, and we can also learn from the past that effective communication and implementation patterning are needed to improve smart city comfort, inclusiveness, and development and to unleash the help for all of the citizens including disabled persons. After the *enlightenment area*, the city also became more enlightened, more intelligent, and steadily gave rise to more intelligent and educated citizens that frequently shared some common goals, which became an important building block of today's smart cities (that might be at risk again) as the pattern reoccurs from small to big and vice versa, like also happens in a fractal (see **Figure 1**). The more the city grows, from hundreds to thousands, to millions, the more externalities and issues are concentrated in space, which is causing imaginal smart city inhibitors that repress city evolution, which is causing a major *metacity* issue that requires more infrastructure, supply, order, technology, and more.

Without such “assistive technologies,” all the citizens become somehow disabled in their functions and one need to enable them again: for example, if commute distance per citizen increases, while parking spots and cars have reached a steady-state or saturation phase, public transportation needs to be extended, advanced, and a full coverage will be important. Another example is unemployed persons in the city that are disabled in their professions by a big lack of good or adequate employment opportunities in most of all countries today. Enablement of citizens, especially of those who need help, disabled or not, is a key solution. Further examples are if modern life impairs family formation and there are more and more lonely persons and singles in cities, or poor and needy people, lack of money impairs them.



Smart city evolution has much been driven by the enablement, empowerment, and by fair enhancement of citizens. Fairness and adequate enablement seem to be a dimension of economics [1] and also of the city: intrapreneur in the firms and economy is comparable to metacitizens in the metacity. City-driven enablement of all citizens in this context always means the enablement of all citizens that need the assistance to perform their functions and meet reasonable expectations, key demands, and wishes. Hereby, city planning can learn a lot from helping disabled citizens: this offers many lessons to be learned for all citizens. The barriers that disabled people become challenges to overcome with ideas, planning, assistive technologies, city strategies, and the same hold true for all citizens that face any sort of issue and barrier to anything in the pyramid of needs.

The city, resembling a living entity, not only becomes apparent by growing wires, tubes, sewerage, water supply, headquarters, streets, public transportation, energy, supply and waste systems, functional specializations, and interfaces for interaction—but also by the group and mass behavior and behavioral patterns of its citizens and via communication. The individual behavior determines the group behavior, and vice versa the group behavior is taken over by the individual; this makes independent thinking important or everything can go wrong, only if communication and patterning allow smart inputs it works.

Once you build a plant or home you become linked to the city systems. Would not it be nice if the city is compatible with all of us and has already thought about the interfaces and aids? Now how the city patterns depend on centralized and decentralized pattern formation and there are many city patterns to study and publicly reported to citizens today (**Figure 2**). Would not it be nice to have such mappings also for a disabled person? For example, imagine you could simply check on a map if there would be a problem to go there by wheelchair. New assistive technologies of today for disabled and all citizens will often need a central and quality controlled mapping and database and public information management systems.

How are we designing the city is a function of many activities that are either interdependent, private or public, centralized or decentralized, normed and standardized or free to the owner and basically managed by the city or not? These entire sets of the accumulated decision, historic and new, regulations and investments, and more variables, define the city patterns together with the recent economic, cultural, domestic and global trends and sentiments. Importantly, these city patterns are becoming recorded and monitored more systematically over time, and some cities make them publicly available like the City of New York's (**Figure 2**) NYC Open data that everyone may study further [10] of its key office of strategic planning. This creates a cycle of communication and patterning but mostly city fathers are the drivers. The patterning of the city happens always, planned or not, and size and historic decision pose some additional challenges but also great things become possible in smart cities, unique in the country and can get important even worldwide. Access to information is an assistive technology for all citizens, enabled or not, and eligibility and transparency are always helpful to smarten your city and to enable citizens. Accessibility is an important thing to have for all citizens and one thus also needs "Enablement of Assistive Technologies." The first example is again the wheelchair path or captions for people with sensory disabilities, but there is much more to do to enable technologies for disabled and all further citizens too.



**Figure 3.** Concept of the metacity, the metacitizen, and bridges of enablement thinking. Bridges of enablement for disabled citizens and others to enable them to participate. The bridge of enablement is needed for all metacitizens in the metacity to best integrate their potentials.

To illustrate pictures, we need many bridges of enablement to integrate the metacitizen into the metacity (see **Figure 3**). It shall become a city where everyone takes care of citizens and the city and each other, basically a city for citizens, a friendly entity that integrates and that gives us a chance in life and the supply, the information, aid, and comfort that we need. But economic, sociocultural, scientific and urbanization steadily also raise new challenges of eligibility, accessibility, integration, transparency of information, fairness, and assistance.

What can the city and government do to help disabled citizens and what can citizens do to help the city? To channel such endeavors incentives and assistive platforms of participation, integration and coordination are needed. IT platforms will be the basis of the service economy for smart cities that can shape the horizon of city governance [11, 12]. This leads to the question, what can the city do for both disabled and not disabled citizens, in general, to be kept in mind. In both cases, the question arises from the standpoint how can we bridge the gap to citizens to fully enable them and what gaps are to be closed. We need to research the gaps and find innovative ways to close them. Assistive technologies and models can catalyze bridges over these gaps. A new mindset of how to enable citizens would lead to many new breakthrough innovations. So what halts human development and smart city development? It is often also the lack of exactly these bridges of enablement (**Figure 3**) and the lack of communication and patterning that leads to an understanding that implements new important findings. So how can we improve this situation in the future? We need to build elusive bridges of enablement again that take care of all citizens, no matter if disabled or not, as nobody should



be left behind in a modern world like this where; we are all dependent on each other and in cities like these. How can we reach such goals? We must generate the economic and political momentum to lever smart city goals and developments. For smart cities, an economic and political momentum can be gained to sustainably lever the smart city goals and developments as an inclusion-of-all-citizens policy. This is very feasible, if all newly generated money may only enter the economy in a monetary transmission that benefits the smart country or smart city goals [13]. Recently, the growth of the monetary aggregates (M1, M2, M3) equals a big part of the money that the government is losing, and could be invested into smart goals [13]. By generating firms that generate value-adding jobs in the city, state, and country to always keep jobs in access in order to “avoid social hostility for citizens” including disabled ones. The internet of things and smart environments, if done in the right platforms [11], could create jobs and supply, e-inclusion, and assistive devices [14].

Catalysis of bridges of enablement between the metacitizen and the metacity is needed all along the pyramid of needs (**Figure 2**)—starting from the bottom to meet all basic needs to the top, while especially taking care of critical bottlenecks generally bottom-up, there are some exceptions. This simple strategy still inquire for very big effort, especially in cities in developing countries that can be accelerated and catalyzed by the lessons and methods learned, and aid in assistance in the planning and implementing from some of the more advanced cities.

**Figures 2** and **4** also indicate that smart city management requires smart communication systems and feedback patterning cycle that starts with information gathering to match all demand with suitable supply including infrastructure and assistive technologies. The cities develop into smart cities via positive interactions and values for their citizens. These interactions are mainly physical and technical: ground, electricity, water, waste, and so on. The next big step in smart city development could be based on “intelligent city interfaces” and intelligent platforms that help to make citizens function and unleash their capacities.

Only if there is feedback, signaling, and responsiveness mechanisms between the living metacitizen and the living metacity, it will become a friendly metaentity that we want and it will be possible to better coordinate and integrate the two, which happens reciprocally in



**Figure 4.** City patterns on city maps of New York City (from NYC.gov).

interactively. One feasible way to do this remains to be the internet that will be shaped by the smart city developments [7], as the world is reaching a high coverage and infrastructure for a service economy, and ICT is given [11] like computers and smartphones and a more comprehensive assistive internet of things [14]. We are already linked to the worldwide web, but smart and trustworthy assistive city apps are still missing as most private internet platforms are not quality assured and there is a big misuse of data and asymmetric information on most private sites. Should all go public? For example, there is not one trustworthy dating site worldwide that is not cheating by fooling and stealing the citizens to rob good-looking candidate for conspiracy network mating and alike. There is not much fairness-checked internet services [11, 7, 11] for all, and the remaining lack of helpful professional assistive technology apps that intend to make the life easier for disabled or other citizens, mainly fake and false information, and a lack of quality of IT and services [11]. Free and fair ICT sites and assistive technology hubs thus must be generated and always quality assured by an independent agency to assure information symmetry and a fair-play open environment for supply and demand for all citizens. Maybe everything important in life must be quality assured by a governmental agency, as there is simply much misuse of information and ICT procedures. Not only dating sites, not only assistive technology databases, basically everything, starting from platforms of offerings, meetings, housing, healthcare, assistance and mappings for disabled, and much more. Maybe, we can learn the following from smart cities and assistive technologies: we need platforms of enablement [11], quality-assured marketplaces where products and services can compete fairly with each other and where you find whatever you need; if the private market does not deliver, then there will be a city or public offering. Moreover, using such internet platforms [11, 14], it will also be possible to advance them via feedback and platform learning while quality is assured independently.

What about if every citizen had an interaction cockpit with the city like in a Borg spaceship? This could assure ideal demand and supply [11, 7, 11] in the IT network economy [2], but fairness must be fully assured—that is not happening so far by today. That might be still too early but a very first interactive interface in the internet would be possible to do all important things with the city and country, like taxes, bureaucracy, and all from your home computer, no need to find your way through the city or to find a good time for that, no need to take holidays to see an administrative office during opening hours, etc. This assistive ICT and platform technology [11] could help all citizens and especially disabled persons. It is catalytic to look for overlapping things that synergize—and provide special help for all. Every metacitizen could obtain a one-for-all login and password for the metacity, metastate, and metacountry. One-for-all would be one of the slogans of the metacitizen, as nobody should be left behind as part of the common smart city goals. Public-ran website of the government would be provided [11] to offer citizens to freely interact, exchange, and trade in a mutually beneficial way. IT care must be taken, or privacy and individual will never ever be protected.

This website can be designed as an assistive technology that could be used for many things by all citizens including disabled persons, as listed in **Table 2**. Using a web-based interface, it would become possible to personalize the smart city help for its citizens. It could be used to gather the demand information from all citizens in order to adjust the supply function of the smart city. Such information can be used or misused. Assuming that this information

Smart City Web Interface	Topic	Detail
Polls	What do citizens think about politica orcity questions?	realtime, anonymous, weekly, monthly
Election	Online voting; mor interest in topics	anonymous, yearly (or more often)
Parties	Which party stands in for what? Who verifies?	unbiased political information (neutral)
Interests	What are the preferences of citizens?	what should the city invest in? (Stats)
News, Stats, Facts, Info	The latest city news and city information	official world, country, state, city news
Tax	Automated taxation (no need to file any longer)	no need to file your taxes any longer
Aids or Disabled	Assistive technologies (apps, information, ICT), aids	smart city services, aid, and information
Segmentation	Citizens of known segements can be better served	personalized/Customized Support and Help
Transparency	City, State & Country finance and performance	what did the city do about it?
Jobs, Occupational Topics	Sustainable career paths assured for all citizens	who wants a job should get one.
Health and Assistance	Hospitals, physician, experts, nearest help?	a network of health care system support
Police, Fire, Agencies	Crime, fire, evacuation, scam, any threats?	whatever it is - citizens need to get the help
Feedback	Citizens can give valuable feedback - but how?	feedback for the city is needed to optimize it!
Education	Schools, universities, institutes, publishing Platforms	all schools/universities should be fine and free
Recreation	What recreations would you prefeere locally?	parks, sports, groceries, clubs, fitness
Singles or Families, Hobbies	Non-scam infos about events for singles or families?	kindergardens, quality familiy and dating sites
Music, Events & More	Which events or things would you like in your city?	music, events, talks, congresses
Data safety and anonymity	Who prevents that assymetric information is misused?	independent agencies must assure data safety
Housing, product/services	One site and shop for everything, comparable platforms?	if private market does not deliver then the city does

**Table 2.** Innovation of smart city interfaces with the citizens (secure web-based platform); assistive technologies can also be ICT and data based and might need public infrastructures like the GPS-system or independent agencies that deliver ICT hubs and assure data quality.

would not be used against the citizens but only for them, it could offer great potential to super-advanced smart city evolution by meeting the demands of integrated *metacitizens* faster.

Taking the case of assistance for disabled citizens again: the smart city web interface would allow collecting all information to integrate and coordinate all efforts to help and assist disabled citizens by interviewing them directly what they really need and by providing them the information and help in a customized fashion. In this customized ways, all metacitizens could be provided with what they need. For instance, everybody needs health care, needs to find a city job, needs to get to work somehow, has hobbies, family, or wants to have further aid and information. Everything could be done on one website with many subsites and hyperlinks. Whatever citizens might urgently need should be available to them to make them feel good at home. Feedback allows officials to research all potential issues. Especially disabled persons, unemployed, aged and poor persons could be helped this way with financial aids, assistive technologies, online education and market-relevant training.

Web interfaces generally offer great opportunities as assistive technologies for all citizens including disabled persons who regularly use a computer. There are many assistive technologies available today for disabled persons that could be one day linked to the internet to get more assistance and help like translations, instructions, or augmented reality and more and more interaction sites and regulations would become possible. All together they help to evolve smart cities with enablement for all people including disabled citizens.

**Table 3** given an overview of major assistive technologies for disabled persons. The federal governments worldwide have often recognized the importance of assistive technologies and have founded new regulations for their implementation, especially in the last 10–20 years.

Assistive Technologies	Modified from NIH/NICHHD and other sites
mobility aids	wheelchairs, scooters, walkers, canes, crutches, prosthetic devices, orthotic devices
hearing aids	all types of hearing aid technologies, assistive listening, captions, amplifiers
cognitive assistance	computer, electrical assistive devices, computer based instructions, assisted procedures
software and hardware	screen readers, screen enlargement applicaitons, for mobility and sensory impariment
assistive computer interfaces	special keybords, special pronters, special screens for sensory impairment
education assistances	book holder, page turner, adapted pencil grips; education for special value adding jobs
closed captioning	enablement for people with hearing disabilities
accessibility, remove barriers	barriers can be removed to enable wheelchairs and mobility of disabled persons
high tech assitances	light weight high performance wheel chairs (for sport); electric aids,robotics, robot aids
adaptive switches	to perform simple tasks, precursors of robotic aids
diverse assitive aids	to perform regular works in houtholds and at work (cooking, dressing, grooming, etc.)
visual aids	large prints, electronic read (book on tape), talking computer software, tactile assistance
positioning	healthy body position; sport; positioning in wheelchair, at home, school or at work
alternative communication	different forms of communication using the other senses

**Table 3.** Assistive technologies (slightly modified from NIH/NICHHD [16]).

For example, the Individuals with Disabilities Education Act (IDEA, 1997, 2004) states that assistive technologies must be provided for any child if the device is approved to increase, maintain, or improve functional capabilities, assessed by a special service team. All of these assistive devices [15–17], as all health care, help the best if people in need are fully served.

Once again smart city development can learn a major lesson from all of these approaches to help people and children with functional disabilities and from customized appliances. Finding bridges of enablement is also a key for all other citizens in need of help or a job. The lessons tell us that we must provide full help if we can and we must do the same to people without a disability that might be impaired or nonenabled in other ways. Connect the citizens to the city system means that everyone needs fair bargain and a fair and livable chance in life. What if we announce a right or fairness and plain level field for all citizens, or a right to be also integrated into the networks that govern the job markets? No networking should be allowed that only benefits some networkers, everyone must be treated fair and equal, where are the fair chances in universities, schools, or as an applicant and on the job?

Whatever problem we might have with evil exclusive networking, lack of inclusiveness and integration, issues with accessibility to the city, to jobs, to information and data, basically whatever problem or issue it might be, we could agree that it must be reported somewhere. Someone should take care of this but nobody is usually responsible for anything today. However, a smart city could allocate responsibility and would research every new case in order to know how to solve it in all future—if citizens ask for x that solution y is provided.

The assistive technology web interface (Table 2) would allow such a reporting and would also integrate all assistive technologies in the narrow sense (Table 3) in advanced ICT forms.

All reported customer citizens, a disabled person or even patient problems would professionally research in order to learn which procedures work fine and which solutions are still elusive. A Smart City is a learning organization of a city and needs a learning ICT platform



[11] and infrastructure and responsiveness to all citizens. Screening and a final solution must be given, which can be short term for the citizen, or long-term for the city, as some things will take some time, cannot be done overnight, while previous solutions are instantaneous. Only feedback can help to solve the silent challenges that are million-fold dormant in our societies as nobody has really registered them. But it is of importance to reveal and resolve all silent issues—best early on.

The smart city is more than the sum of its citizens—and the citizens are more than just its parts. Together they form the metacity entity that wants to thrive and evolve some more, the metacity wants to interconnect like nerve cells in the brain and the division of labor makes it possible that everyone can try to give what he or she can do. But the city needs more plans and actions to enable all citizens without conflicts of interests. What if we could do what we can do best? This would benefit smart cities. Still, most of us are hindered to do exactly that.

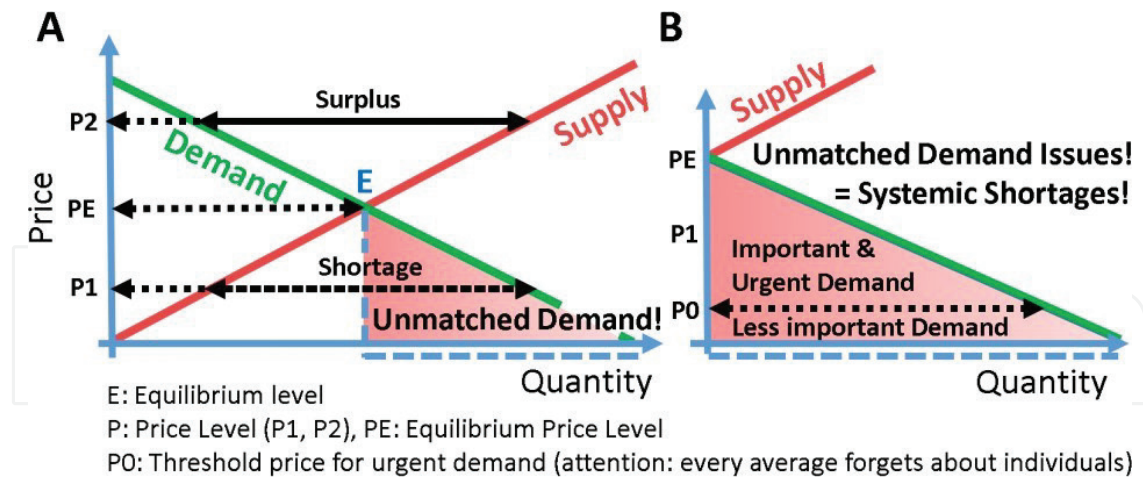
Smart cities could strive for an enablement of skills by providing platforms [11] and hubs for all sorts of professions: artists, musicians, scientists, writers, engineers, entrepreneurs, innovators, sports, and disabled persons, and much more. This would attract many new talents into the city and can benefit the economy if done right. A smart city should bear a niche and real chance for everyone—a way to make it—and thereby attracts special people that will be beneficial for the city in the long-run, in direct or indirect new ways. Smart cities empower their metacitizens, strengthen the community, bridge all barriers that a citizen faces to have a good life, enable the disabled and enable the blocked citizens, they allow smart feedback to achieve smart city goals and solve social problems. Smart cities are unique places that want to be general great compatible places that also want to be very special too.

Smart cities will further evolve via wide sense and narrow sense assistive technologies, and communication via web interfaces, which could lead to totally new patterning outcomes in cities, if the city fathers, majors, and decision makers will become responsive to citizen input. Citizens will have to trust the new communication technologies and interfaces with the government and city, which will create the need for quality assurance of such ICT systems [11]. Agencies should assure its unbiasedness, neutrality, independence, and a real privacy protection for more fairness as information based decisions patterns all cities [11].

If these important smart city goals will be reached depends on many things, including the historic fatalities, which are still striking today—e.g., a real privacy protection is still elusive.

What else could delay smart city evolution? There is also a flaw in the capitalistic system for common goals and standards. Moreover, the markets have a built-in issue to equilibrate in a semishortage (see **Figure 5**). Subsequently, this shortage situation for less affluent citizens can get better but not always. Shortages for less affluent and poor citizens pose a major barrier to city evolution due to the reasons that there is also urgent and important demand. Economics has forgotten or downplayed the role of equilibrated markets for less affluent people, which is an inherent market failure for all of those who cannot afford what every they importantly need. The utility that would be provided would be very high, let us assume much more than the remaining cost to become affordable: an economics of human inclusion.





**Figure 5.** Economical flaws regularly cause shortages that hinder smart city development. Econometrical model, figure legend: (A) at equilibrium prices, demand matches supply only for a percentage of the overall demand. The remaining demand is not served at the given prices, which causes shortages for all demand that can only afford to pay sub-equilibrium prices ( $<PE$ ). IN this example only the majority of all demand (e.g., 75%) is served but a significant proportion of demand is not met not met (e.g., 25%). But do you want 25% of your citizens to be without something they urgently need like water, electricity, health care, jobs, etc.? (B) No, 100% of all important and urgent demand must be served also below the equilibrium level. If demand follows the curve of few rich and many poor people than the unmatched demand will be the biggest part of it. Unmatched demand happened along the entire pyramid of needs in both the developing and developed world and spreads on the individual level even more. (B) illustrates the starting problem of supply before the prices would fall. Early supply is too expensive at low quantities which hampers economies of scale and scope. Catalysts are needed to bridge bottlenecks to vitalize the economy by matching key demand.

Catalysis	Catalysts of Smart City Development	Description of Role on Smart City Evolution
Which Catalysis	Communication & Patterning	Finding out what citizens and businesses really need; smart idea and solution finding
Which Catalysis	Bottleneck Identification	Identify major bottlenecks that hinder in cascades subsequent smart city development
How to Catalyze	Economies of Scale, Scope, Time	Can lower the price level -> better coverage of demand and important demand
How to Catalyze	Productivity; Synergies; Technology	Can lower the price level -> better coverage of demand and important demand
How to Catalyze	Smart Subsidiarities, Smart Taxation	Strategically eliminating bottlenecks that hinder wealth/growth
How to Catalyze	Investment in Smart City	Strategically providing attractiveness for citizens and businesses
How to Catalyze	Creation of Non-Business Platforms	Fair opportunity in research, music, art, writing, engineering, architecture, etc.
How to Catalyze	Health Care incl. Aid for Disabled	Health careinfrastructure, hospitals, assistive technologies, affordable health care
How to Catalyze	Solution for Market Failures	Public enterprises, public financing of projects, public aid for citizen needs, technologies
How to Catalyze	Smart entrepreneurship, start-ups	Lower the market-entry barriers for value-adding start-ups (business activation energy)
How to Catalyze	Smart Employment opportunities	Create enough and diverse jobs for all; enable transferable and sustainable career paths
How to Catalyze	Assistive Technologies	Create awareness and scope; develop in tandem for disabled and non-disabled persons

**Table 4.** Catalysts for smart city development including assistive technologies.

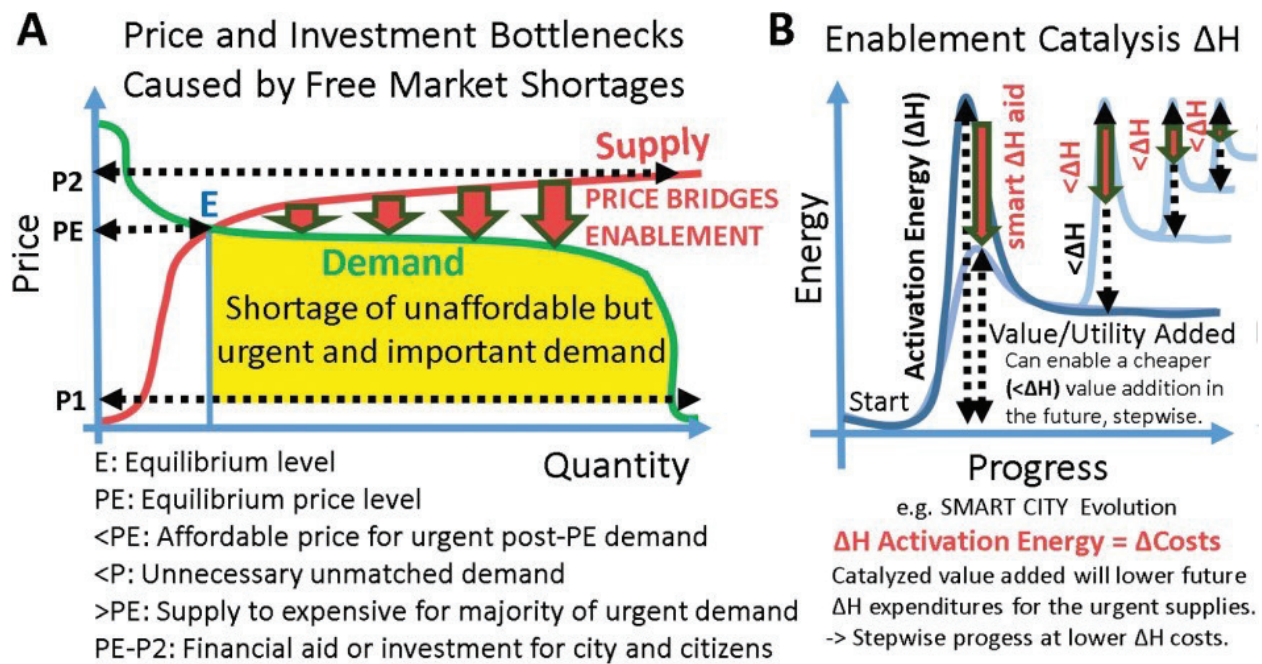
Here, a smart city can provide financial help to eliminate shortages of important demand due to unaffordable prices. Whenever demand meets supply an equilibrium price (PE) is believed to be found in the prevailing microeconomic theory [17]. This price (PE), however, will always cause an initial shortage at some quantity. Especially if important or urgent demand is not affordable this can cause bottlenecks for the population; and assistive technologies are also one of the examples, but also food, housing, healthcare, medicine, ICT, infrastructure, and more. When it comes to urgent and very important demand this can cause major blockades for all citizens and halts smart city development; like the sewerage that was maybe too expensive

early on, which has caused terrible situations over centuries and millennia and ill citizens. Hence, catalytic switching events are needed (see **Table 4**) to give the starting help the market might need, or the city must manage it, e.g., infrastructure.

One might argue that prices could fall in the future but this does not always happen and the people need urgent or important demand immediately, like water, electricity, jobs, or health. As a result, Smart City cluster management must take care of all of these bottlenecks of “important citizen demand” where supply does not meet demand as it should. Hence, it would be important for macroeconomics and microeconomics to think about the level of.

coverage when it comes to important demand and important supply. What is the percentage of people who will get what they urgently need at a market equilibrium? Often not 100%.

When it comes to important demands and urgent needs, one should strive for 100% of coverage and supply as one cannot wait until the prices will fall, maybe, one day? It can be life-saving, it can be an enablement, it can be food or water, infrastructure, medicine, jobs,



**Figure 6.** Shortages due to unaffordable supply for the important and urgent demand. (A) Urgent and important demand is a bottleneck for the city, economy, family, or for the individual. At equilibrium level, only a tiny fraction of this important and urgent demand is satisfied. In an economy with only a few rich and many poor people, as given, frequently most of the demand is not matched by supply even under ideal market conditions and even at equilibrium level (see yellow area). A price subsidization or public investment or tax-cut can make the supply available to all and how they are in urgent need of it. Important demand can be very many things, and many are already covered by public expenditures like infrastructure e.g., for smart cities, like financial aid for people with health problems or disabilities, universities, research, water, pollution and waste management, sustainability, social aids or jobs. (B) Progress via enablement is trying to find smart ways to catalyze value added to solve all major bottlenecks—starting with the most urgent ones—which results in new ladders of enablement of faster and cheaper progress ( $<\Delta H' < \Delta H'' < \Delta H^n$ ). Such aid becomes required if the markets fail due to market failure an equilibrium, due to other market failures like poverty, monopolies, not enough jobs or too little income. Like in a chemical reaction, progress can be accelerated via smart synergistic catalytic aids that also build on each other.

assistant technologies, and it can be basically everything that the market would underserve. In a networked economy of today, in which consultancies mange all prices and HRs for firms, it becomes implausible that a price might fall soon or that most urgent demands will be met.

“Implementation delay” is one of the hallmarks of smart city and smart economies of today, with centuries of delay in major technologies like the sewerage system, fair insurance, public transportation, and jobs for all without cheating on unemployment numbers. Today’s unemployed statistics tend to be systemically embellished, which hinders communication and pattern formation in the country, state, and city, because everybody tends to have the wrong numbers, and politics might use them as the population and media are responsive to the euphemized data. Patterning and communication require correct information. Smart city development needs good decision making and is advanced by smart catalysis (**Figure 6**). Shortages due to unaffordable prices can be bridged via strategic temporary subsidiaries or public corporations and institutes that deliver such services [11] and products at affordable prices (**Figure 6**). The costs of solving a fundamental bottleneck will be a good investment that saves future costs and might benefit the city and economy, and enables cheaper investments in the future, as subsequent bottlenecks are reduced and all build on each other. Patterning catalysts can be grouped into catalytic goals setting and implementation. A list of some common themes is given in **Table 4**. First of all, bottlenecks are solvable via ideal “catalytic investment cascades” to be identified for continuous improvement [1].

Communication and patterning are like planning and implementation (**Table 4**) and will lead to new assistive technologies for all people and specifically for disabled citizens. Some of the key questions that arise in the evolving citizen-city-country communication system are summarized in **Table 5**. Assistive IT network systems could take care of all of our needs.

Finally, assistive technologies and any city aids can be achieved in a centralized public or decentralized private manner and it is very important to find the right choice or balance. In **Table 6**, there is a brief summary given of decentralized and centralized urban patterning, of the more decentralized mobile assistive technologies, the more centralized local assistive technologies, and eventually, an outlook is given about some novelties in this exciting area. Assistive technologies are a very interesting and an outstanding high-tech field of many futuristic cutting-edge novelties that are fascinating not only to technology fans and experts. Assisting the disabled can

Assistive Technologies	Communication	Smart City Pattern
Mobility Aids	Help on demand for all	Higher compatibility with mobility aids, help on demand
Hearing Aids	Help on demand for all	City screens for all people to provide captions with information
Cognitive Assistance	Instructions for all	Streamflow efficient and effective procedures that make sense
Software and Hardware	Interfaces for everything	Enable feedback, interactive environments, safety, transparency
Job Opportunity Pattern	Identify all job potentials	Provide customized jobs for all citizens incl. disabled persons
Health Care System Pattern	Personalized medicine	Personalized health care, learning health care system with TQM
Architecture Pattern	Form follows function follows form	For all citizens including disabled aids (ramps, elevators, screens)
Report an Incident	tell the city what is missing	Smart cities have to learn from every case to stay smart
Solution finding	Which solution is conflict free?	Smart City and Smart Country strive for good solutions for all

**Table 5.** Communication and patterning for all citizens: technology assistance for disabled citizens can help all citizens, like screens, instructions, designed processes, aids, and more.



Decentralized Urban Patterning	Centralized Urban Patterning
Private households and businesses; potential trend setters	Public institution and public businesses, inclusive planology
Private architecture, private industry; potential city interactions	City planning, overall city architecture and blue print patterns
Principle of self-determination; potential interfaces with city	Principle of subsidiarization and hierarchical responsible planning
Private spaces: private patterns; potential interfaces with city	Inclusive common spaces for families, sigles, young, old; for all
Rich could contribute to city goals; potential joint ventures	Bigger industries and big businesses could cooperate with city goals
Smart housing options for all citizens; affordable living	Assure enough houses at affordable prices; affordable living
Emergency training; citizen engagement; smart city goals	Emergency services; civic inclusiveness, integration, responsiveness
Decentralized: Mobile Assistive Technologies	Centralized: Local Assistive Technologies
All assistive technologies to carry around	Accessible urban planning, architecture, digital assistances
Difficulty of urgent demand of unaffordable assistive technologies	Financial aids for local and mobil assistive technologies
Assistive Technology Novelties	Assistive Technology Novelties
Novelties: artificial intelligence, robotics, higher interactivity	Novelties: artificial intelligence, robotics, higher interactivity
Smart phone maps for everything e.g. accessible city routes	Online services that provide the information for free
Many optional activities for lonely people, singles, and families	Assured/approved safety, independence and quality of options
Interactive civic and citizen information, segment of one	Assured data saftey; good use of information to provide services
Smart phone apps: navigation, information, help, connect	Apps for everything that a citizen might need in life that really help
Augmented reality; world translation in a preceivable way	Augmented reality hubs and software maintenance
Face, head, body,hand tracking/interpreting devices	Face, body, hand tracking communication system
Free rights and free lawyers for all citizens, uncoupling from money	Regulations for all citizens and assuring that they are all met

Table 6. The big topics of centralization and decentralization, a scientific not political theme.

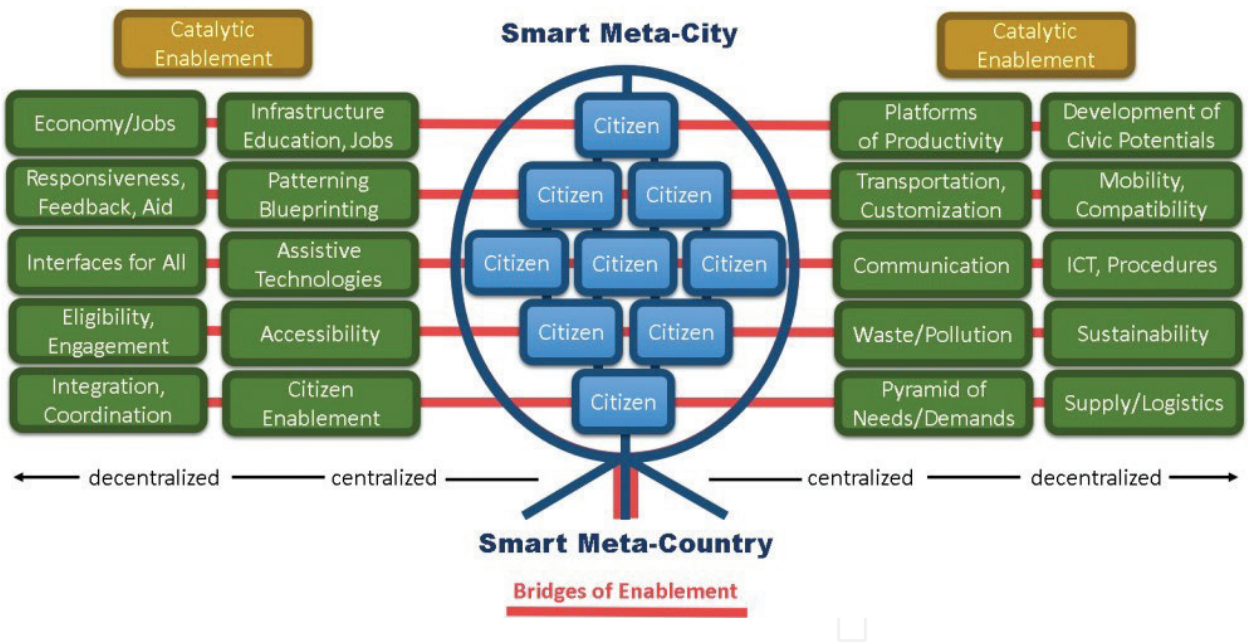


Figure 7. Summary of the smart metacity: catalytic enablement to solve all bottlenecks.

be like a seed that will grow into the enablement of all by extending our senses, our mobility, services, and assisting us in every function that we have in life - like an urban tree of enablement. They are a key driver of technological progress in robotics, artificial intelligence, cognitive assistance, mobile appliances, augmented reality, virtual reality, human-machine interfaces, cyborg technology, communication technology, image-based interpreting algorithm, and so much more. Assistive technologies will lead in the future to advances in robotics, advances in

artificial intelligence, and advances in their interactivity with all sorts of assistive technologies for disabled persons and assistive technologies for all remaining citizens too.

Robotic implants and automated prosthesis are thinkable like entire helping robots, machine-human interface technologies, and early cyborg technology that might be further advanced and could help disabled people to have a more normal and independent life. Smartphones will be performing medical and assistive functions, information, instructions, assistance, robotic control, will control additional devices and instruments or robotics, and more if necessary. Astronaut missions have led to additional inventions and assistive technologies will likewise do. **Figure 7** gives a general overview of smart city evolution: the role of breakthrough catalytic enablement, bridges of enablement, interactivity, interconnectivity, enablement of all citizens, assistive technology, smart metacities with metacitizens, and roles of centralization.

### 3. Conclusions

Smart city development builds bridges of enablement for all of its citizens, matches their overall and individual demands, and enables assistive technologies and key communication among the citizens, the city, and government that responsively resonates and patterns the future city. Learning smart cities increasingly makes use of assistive technologies in the widest sense and narrow sense to enable all of their citizens. Catalysts of smart city development are needed whenever the free market does not provide a satisfactory solution on time to catalyze various aids or to reach higher stages. Assistive technologies will drive innovation in the field of robotics, artificial intelligence, digitalization, transportation, and also cyborg technologies and advances in many other fields like smartphone technologies.

Maslow's pyramid of citizens needs will stay the main orientation for smart cities and all citizens including the needs disabled, aged, young, unemployed, troubled, or poor persons. New ICT and web technologies can assure a faster and more informed progress toward more functioning, comprehensive, assistive, healthy and nice city patterns, better reciprocal communication and more autonomy and independence of all, and the collective of citizens. If done right and if the new level of personal information is not misused against citizens, such assistive ICT technologies [7] could boost smart city evolution by better coordinating and integrating all of the efforts and by finding a smarter way in which supply fully matches demand and assuring everyone gets the assistive technology help needed. By improving our help for people with disability, cities and countries can also learn how to improve the lives of all citizens by finding the right bridges of enablement and assistive technologies for everyone everywhere and by assuring sustainable career paths and good city lives for all. An "ongoing" but not trivial future work and important case study is the advancement of what is called "e-governance" [12, 18] by the new IT and ICT fields of "e-inclusion" [19]. Assistive technologies are high-tech drivers for many new innovations that create jobs, and smart cities and assistive technologies can best grow in a socially



sustainable environment with a good communication and understanding of all decisive circumstances—so we should incentivize more efforts on common grounds to unleash our smart potentials and dreams.

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