

Future-Proof Solutions for Improving Urban Life through Enhanced Public Service Delivery

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Abstract

Aiming at improving urban life through more sustainable integrated solutions, will certainly deliver quality-of-life benefits. Disruptive projects in cities are always a good opportunity to bring novel work models and know-how and develop it into business as usual for future use. The paper focuses on the issue of reducing the negative effects of rehabilitation projects requiring worksites usually located on main roads or sidewalks, by addressing the concept of dig once policies, thus changing from a rigid acting mode, to a more open, shared approach involving efficient partnerships.

Addressing the virtual enterprise experiential practice for better inter-institutional cooperation may be the key for creating the premises of new and smarter work model for infrastructure projects.

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1. Introduction

Developing our cities into intelligent and sustainable environments is one of the biggest challenges of our time. More than 50% of the world's population lives in cities and is expected to rise to almost 70% by 2050.

Urbanization has accelerated lately and brought serious challenges that increased exponentially, in line with people's aspiration towards a comfortable life style: mobility issues, waste management problems, increase in energy consumption and related pollution, limitation in open and available spaces as a

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result of urban infrastructure works. Therefore, decision makers must face the great challenge of ensuring the sustainability of cities and creating more livable urban spaces.

This phenomenon cannot be approached by the existing models anymore. As we are entering a new decade, cities have to change vision and become more intelligent and, especially, more creative in order to address the growing challenges.

Worldwide and in most of the urban development strategies, the SMART component rapidly evolved from 'should' to 'must' as there was a growing awareness on rapid, wise and efficient action in order to face the fast evolving environment. Smart cities are already reality, therefore smart, innovative and citizen-oriented solutions are the normal of these days.

The smart city concept became an expression widely used for cities with an intelligent infrastructure. There cannot be one single city that may claim it is intelligent as a whole, yet developing intelligent infrastructures, such as sustainable lighting, transport, water and waste management, electricity and heat, air quality, combined with ICT (Information and Communication Technology) is an excellent opportunity for cities to improve their citizens' quality of life. After all, this is all about when referring to a smart city: a commitment to improving the life of its inhabitants whilst ensuring sustainability of its actions towards achieving this scope.

As entrepreneurs understood that developing strategies that relate to the information technology entrepreneurial ecosystems and take into account technological progress as one of the main drivers for economic growth (Roja & Nastase, 2014), so too should local administrations and public service providers should consider such approaches for improving everyday life for its citizens. Furthermore, developing the public services and raising their overall performance has been shown to increase the competitiveness of a region or country (Ioniță, et al., 2009).

Businesses, companies, citizens and technology can all be more, by creating strong interconnections, both from the point of view of the digital technologies and from the institutional collaboration perspective. Smart technologies and solutions create new resources to generate a faster and more informed decision-making process which allows for a quick and confident management procedure in relation to a better usage of urban infrastructure.

The optimum way for a smart city does not lie in more infrastructure, but in intelligent and simplified solutions issued with great concern towards how money is spent (especially, public money), how much time is allocated, which is the economic and social impact, so as to be able to avoid a lack of perspective and to build healthy vision on how to simplify things in order to obtain rapid and efficient results with minimum socio-economic impact. Well managed urbanization techniques generate successful urban development and planning.

2. Creativity and cooperation in the smart city is what makes a city really smart

A city needs creative and innovative minds/workforce in order to renew, even reinvent, traditional ways of doing things. We are coming now to understand that people want to live someplace that indeed has a sense of place. Interaction is the very fabric of a community that encourages engagement, collaboration and makes a community a livable place.

When a city begins to organize itself to be a smart city or renews itself for the creative economy, everyone with a stake in the area, should be at the table. To face the multidimensional urban reality, it has become necessary to find common and adapted means to conceive the city and the urban infrastructure development.

Thus, the smart city invites people from creative and digital economy, local authorities, concerned public or private institutions, users, urban planners to think holistically and to imagine and create ways of approaching the challenges and aligning strategies to achieve common goals.

Having in view the above mentioned, this article's main objective is to demonstrate that collaboration is the key to a smarter city, so it must be the front of mind for the entire ecosystem. This means that, where possible, a joint approach of several city's infrastructures can help create truly actionable intelligence and a cost effective and life improving experience.

In a city, like Bucharest, a metropolis with the largest concentration of people and businesses, where density (together with its own set of problems) prevails, it is essential to identify sustainable ways of improving efficiency of city services in such a way as to make efficient use of every square meter of the city's scarce land, which means that the city planners and all the stakeholders must act in a way that does not make the city feel cramped and unlivable. The city's social life is strongly related to the urban space, so public services and utilities need to avoid to become unadapted to the rhythm of the urban expansion.

The image of heavily trafficked arteries closed for different repairs, for road infrastructure modernization, rehabilitation of district heating pipes, sewers interventions or cable/wire grounding that take place simultaneously or successively involving ever repeating traffic congestion, high operational costs, lot of time allocation and a high level of city's residents discomfort, is raising profound concerns while looking for the appropriate road to build an inclusive, resilient, smart and sustainable city and community.

A big structural and social problem in Bucharest is having to break the asphalt surface and execute excavation techniques that heavily impact mobility (road traffic, pedestrian access), life quality (noise, dust, vibrations) and even underground utility facilities in the vicinity of the intended work. An even bigger structural and social problem is having to break the asphalt and execute excavation techniques several times, in the same place, by different public utilities or private companies having different scopes of work based on the specificity of their business activity.

Moreover, underlying Bucharest vision to become a smart and connected city, broadband infrastructure starts to be increasingly viewed as a utility like gas, electricity or water. Fiber optic cables which are ideally suited to accommodate today's smart city's applications, need to be buried underground, so excavation works are also implied in this case.

The impact upon the city's quality of life is huge: financially, socially, environmentally and from the time spending perspective.

In this context, the traditional approach is no longer appropriate. A courageous new way of thinking is needed in order to achieve the goal of any sustainable urban policy and improve the existence of this city's companies and citizens as we address the future of this community. As we are future focused, the decisions need to be made beyond what works today. Becoming a successful smart city is not simply about data or other new technologies – it's in fact about creating an environment where technology and different infrastructures can be united in a way that benefits citizens.

3. Providing better quality of urban life through Dig Smart Policies

Growing urbanization trends, together with a greater environmental awareness, are transforming cities into game changers in the sustainability game (Cruz & Sarmiento, 2017) but rebuilding aging infrastructure is one of the biggest expenses a municipality may hold. As with heavily populated, high density cities, this becomes increasingly harder considering the social impact of construction sites, usually blocking already crowded roads. Because of this, most local governments try to delay as much as possible, mostly due to political reasons, big infrastructure projects. Such is the case for many European Cities, in particular in Romania. In this particular case, one of the most aging infrastructure commonly found in most countries that used to be part of the communist block in Eastern Europe is the District Heating Networks. Under the centrally planned economy, DH systems provided subsidized energy services to large parts of the population using standardized designs and building materials, while serving as an infrastructural base for the expansion of prefabricated panel housing estates (Poputoaia, 2010). In the case of Bucharest, most of the main thermic energy transport network is 40 years old and some 2,600 tons of hot water are lost in the ground every hour during the cold season ((Danish Board of District Heating, 2020). A first step in rehabilitating this huge network will be done in a European funded project that will allow the replacement of 210 km of main transport network, out of the total of approximately 900 km.

This type of great infrastructure projects as the one presented above, are a great disruptor in the everyday lives of citizens. Most of such networks are buried under main roads that are already suffering from overcrowding and traffic problems, as with most big cities. Unfortunately, there is no way around some construction sites when digging for the main trenches, taking out the old pipes and

installing the new ones. This not only costs time and money, but also creates great dissatisfaction among citizens.

There is one silver lining though, through some innovative and forecast planning, cities can become SMARTER and more resilient through this kind of grand infrastructure projects, by linking more infrastructures in one place.

The concept discussed here is called “dig once policies” that refer to “governments installing conduit whenever there is underground construction in the public right of way – whether that construction is for installing new utility equipment, repairs or road work (Fiber for the home Council Americas, 2019). ”Dig Once Policies”, sometimes referred to as ”Dig Smart Policies”, usually address solely the issue of the broadband cables to be introduced into every trench when an infrastructure project is proposed. In the context of this paper, we shall take it a bit further and use the “Dig Smart Policy” as a concept of defining the use of one infrastructure project that digs up trenches for one network to be used for all other interested network operators to install new cables, pipes, sensors and other infrastructure elements in the same trench or work at already existing ones.

In the context of ever smarter cities, urban planning tends to become a driving force. As such, developing a model to reduce digging and the destruction of newly and recently paved roads or sidewalks, that come with increased citizens discomfort and environmental impact, becomes a must for creating better and more resilient cities.

If, at a municipality level, more interested parties can be found that would benefit from the underground works of say the project presented above, through the uncovering of more than 100 km of trenches (even though not all of them will be uncovered), large amounts of future digging may be prevented. In terms of costs, if more operators can get their infrastructure projects in line with an existing one through a dig smart policy, the advantages come from (Columbia Telecommunications Corporation, 2017):

- Labor and material, through reduced crew mobilization expenses and larger bulk material purchases;
- Trenching or boring, when coordination enables lower-cost methods or allows multiple entities to share a common trench or bore for their independent purposes;
- Traffic control and safety personnel, particularly when constructing along roadways that require lane closures;
- Engineering and surveys associated with locating existing utilities and specifying the placement of new facilities;
- Engineering and surveys associated with environmental impact studies and approvals;
- Restoration to the PROW or roadway, particularly in conjunction with roadway improvements.

If such incentives, as cost reductions, are not enough for third parties to accept the idea of digging once for the betterment of cities, some coercive actions can be considered by the municipality like prohibition of overhead cables in the city or enforcement clauses that prevent re-excavation within a certain amount of

time in the same area, this leaving other network operators with the inability to conduct repairs or modernizations to their pipes, cables, sensors etc.

Studying the USA approaches to dig smart policies, two such approaches can be found (Fiber for the home Council Americas, 2019):

- Voluntary Joint Trenching, which requires entities that have received approval to excavate in public rights-of-way to formulate construction plans, and schedule construction, with other service providers that are interested in installing or maintaining equipment in public rights-of-way, all in a voluntary manner.
- Mandatory joint trenching, which requires all potential excavators to install their infrastructure in the same trench at the same time. All parties then split the costs of the excavation.³¹ A mandatory joint trenching law would require that all excavators determine a “lead.” That lead excavator would then approach the city to receive a “joint trench” permit on behalf of all the service providers installing underground infrastructure in the excavation.

Even if same trench use for underground infrastructure cannot be implemented in some cases, there is still the discussion of using the same work site for maintenance works on different underground infrastructures, so that traffic congestion is kept to a minimum, considering that digging for underground infrastructure maintenance aggravates already congested cities (Gunjal, 1996).

Implementing this kind of public policies will automatically force public service providers, as well as the public administration to have a more strategic approach when dealing with planning future works, especially for large infrastructure projects that involve EU funds, which in turn helps with the new public management reform (Hințea, et al., 2015).

If such an approach is to be implemented at a municipal level, following the programming of intervention projects on different infrastructures, and programming same trench, dig once policies, or same work site interventions needs to be a continuous joint effort of all interested parties, from municipal administrations to infrastructure operators. Such joint efforts could be managed through a “virtual enterprise”.

4. Virtual enterprises, a new way of managing joint efforts in an integrated approach

The complexity and dimensions of such an initiative require the participation of several public and private entities that can ensure the success and smooth functioning. All this necessary installation and maintenance work of the various urban service infrastructures require coordination, sharing of resources, plans and information. In general, the classic procurement system of a city is slow and complicated, being often reduced to the classic situation “problem-solution” at the lowest possible cost. In this case, state institutions look at companies as mere suppliers of products or services rather than development partners. This leads to a certain type of restrictive relationship between partners, often reduced only to the financial aspect. This is happening all over the world, including in the U.S. "And in

cities with highly prescriptive processes that favor incumbent vendors, the onerous process of proposal submission may deter young companies that have bright ideas, new technologies, and effective solutions from approaching government at all (Davey, et al., 2019)".

It is necessary to change this type of buyer-supplier partnership and replace it with another model, which allows the reunion of the efforts of several entities after a common program to achieve the objectives set in a fast time, with minimal effort, stimulating the creativity of those involved.

One such model is the virtual enterprise. What is a virtual enterprise? "A virtual enterprise (VE) is based on the ability to create temporary cooperation and realize the value of a business opportunity that partners cannot (or can, but to a lesser extent) capture on their own" (Katzy & Schultz, 1998). "Virtual enterprise (VE) is a temporary alliance of enterprises that come together to share their qualifications, skills and resources to better respond to business opportunities, and whose cooperation is supported by computer networks" (Camarinha-Matos & Afsarmanesh, 2003).

Perhaps a more comprehensive name for this model is that of virtual organization, given that this model comprises a network of organizations that share resources and skills to achieve their mission / goal but not limited to an alliance of enterprises (Camarinha-Matos & Afsarmanesh, 1999). In fact, L.M. Camarinha gives as an example of a virtual organization "a virtual municipality, associating via a computer network, all the organizations of a municipality (eg city hall, municipal water distribution services, internal revenue services, public leisure facilities, cadaster services, etc.)" (Camarinha-Matos & Afsarmanesh, 1999)

Proof that such a model is a solution in the current socio-economic context is demonstrated by the European Union's interest in recent decades in establishing a viable theoretical foundation and in supporting the initiatives of virtual enterprises created in the European space. Several European Union projects in the Framework Programs for Research and Technological Development are focusing on virtual enterprises: The current FP8 program, which continues the tradition, also called HORIZON 2020 that will be continued by HORIZON EUROPE.

Notably, the Ecollead program set guidelines in terms of business process for VO Breeding Environments (VBEs) and Virtual Organizations (VOs) management based-on ECOLEAD Project Results (Romero & Maolina, 2009).

5. Study Case

5.1 Destructive project in Bucharest - a possible catalyst for better policies

In the case of Bucharest, most of the centralized heating network is older than 30 years, and one of the biggest challenges faced by the current administration is the rehabilitation of this system, so that it becomes efficient to a certain degree. This created the premise for a large scale infrastructure project, amounting to 300

million euros in replacing 210 km of pipelines, most of which is buried underneath main roads throughout the city.

Given the large amount of network operators that share a common interest in periodically doing maintenance work, replacements or new investments in assets that are usually dug underneath the same roads, the timing is perfect for creating the proper local policies for digging and creating joint work sites.

Such common joint work sites are economically viable given the shared digging and work-site preparation costs. The social advantages are given by eliminating the citizens displeasure in having to deal with multiple work sites spread throughout the year. Considering the social impact of every work site, it can be discussed that there is even a marketing opportunity in this matter, given the fact that seeing less and less work-sites, each having the responsible operator visible for the citizens, each company will benefit from the lesser displeasement of the local population, compared to the present day scenarios.

The main identified operators that would benefit greatly from such dig once policies in Bucharest are as follows:

Table 1. Entities that would have an economic and social benefit

<i>Public entity governing the public service</i>	<i>Operator/Company</i>	<i>Field of work</i>	<i>Expected benefits</i>
BUCHAREST CITY HALL	COMPANIA MUNICIPALĂ TERMOENERGETICĂ BUCUREȘTI S.A.	District heating network operator	Shared digging, worksite preparation and road rehabilitation costs.
	APA NOVA BUCUREȘTI S.A.	Water Management Operator	Better company image through less discomfort to the citizens, given the decreased work sites.
	S.C. DISTRIGAZ SUD REȚELE S.R.L.	Local Gas Supplier	
	NETCITY TELECOM SRL	Local Fiber network administrator	
	COMPANIA MUNICIPALĂ DE ILUMINAT PUBLIC BUCUREȘTI S.A.	Public Lighting Operator	

<i>Public entity governing the public service</i>	<i>Operator/Company</i>	<i>Field of work</i>	<i>Expected benefits</i>
BUCHAREST DISTRICT CITY HALLS	COMPANIA MUNICIPALĂ STRĂZI, PODURI ȘI PASAJE S.A.	Local Road Administrator	Less rehabilitation works given the decreased strain on public roads Better company image through less discomfort to the citizens, given the decreased work sites.
	PUBLIC DOMAIN ADMINISTRATIONS	Most works regarding the public domain in terms of maintenance and rehabilitation, with the exception of main streets and parks administered by the main city hall	Shared digging, worksite preparation and road rehabilitation costs. Less damaged public domain through less interventions on the roads and sidewalks
	E DISTRIBUTIE MUNTENIA SA	Electric energy distribution operator	Shared digging, worksite preparation and road rehabilitation costs. Better company image through less discomfort to the citizens, given the decreased work sites.

Source: Authors

From an economic point of view, to have an example of how shared digging would benefit each party, the costs of several main steps common to all underground infrastructure works were analyzed.

From the data received from the company “Energetica Servicii S.A”, the municipality owned company that does most of the rehabilitation work for the district heating network, medium costs are as follows:

Table 2. Medium costs in Bucharest for several steps that can be share by more operators when doing underground works

<i>Common stage in every underground work</i>	<i>Medium cost*</i>
Work-site preparation	17.000 Euro
Digging	12.000 Euro
Return to the initial state	14.000 Euro

Source: Data adapted by authors

Even though the data received refer to one work site, they express the medium cost to change 1 km of pipeline for district heating. Costs of other type of infrastructures may differ slightly.

One of the remaining problems in such joint efforts for shared digging is related to the legal provision that usually does not allow for such shared payments for one work site to some extent. Until the policies and legal provisions for easy access to shared work sites and shared expenses as described above, one of the best approaches to implement such work models is through a virtual enterprise.

5.2 Public Investments through a virtual enterprise in Bucharest

For a more accurate description of how a virtual enterprise could work in the case of Bucharest, we have represented in figure 1 a scheme of organization and operation that establishes the roles of the participants in the VE according to the model proposed by Camarinha (Camarinha-Matos & Afsarmanesh, 1999).

In this case, an enterprise may play different roles within a virtual enterprise during the various phases of its life cycle. In other words, several kinds of actors can be found in and around a virtual organization, acting as: the VE Coordinator, VE member, Data / Service provider, etc.”

VE Coordinator. The VE Coordinator will be the regulator component of the VE related activities. The coordinator is either a node specialized in coordination and added to the VE-network, or its role can be played by an already existing VE- member.

Among others, the VE Coordinator may be responsible for the following tasks:

- Register new enterprises in the network
- Provide assistance to the new enterprise to install and configure the supporting infrastructure
- Maintain the VE-network directory information
- Reconfigure the VE, if necessary, and distribute news about the network evolution
- Might serve as a “witness” for those enterprises that require a third-party support in their negotiation with other enterprises
- Supervise and coordinate different enterprise activities towards the common VE goals.
- Supervise and assist enterprises with VE-dissolution.

Member Enterprise. Enterprises with different skills participating in a VE constitute the Member Enterprise nodes. The main functions performed by a member enterprise include:

- Handle the first contact made by a customer (user);
- Establish contact and secure interaction with other nodes;
- Perform its share of activities within the global VE business process, according to the assigned workload / responsibilities (defined in its contracts);
- Manage its local information visibility rights in order to protect both its own interests and the interest of the VE;
- Share and exchange the information (and materials) required for cooperation and production scheduling on particular orders with other member nodes.”

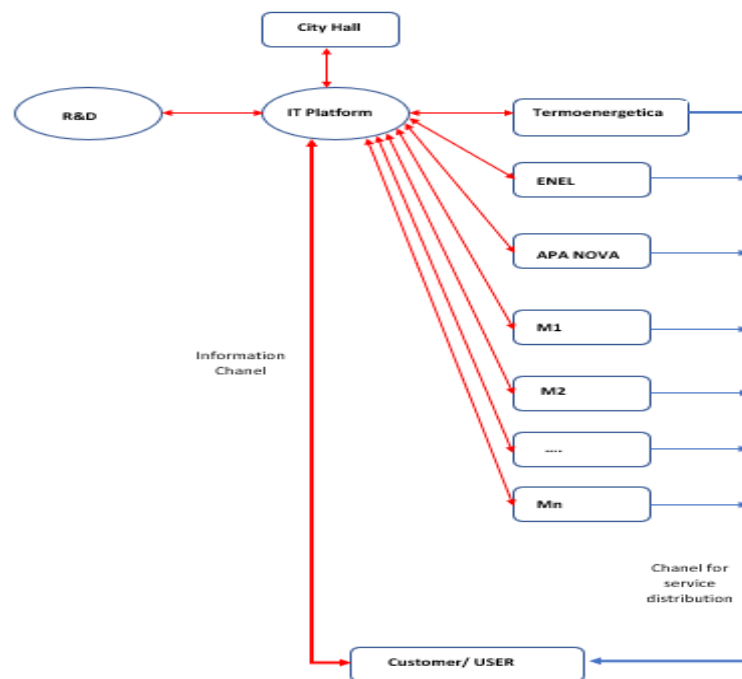


Figure 1. Graphic representation of a VE and it`s members
Source: author`s design

In our scheme, Bucharest City Hall has the role of EV coordinator, M1-Mn have the role of members, R&D is a member that has the role of managing and bringing the necessary improvements for the proper functioning of the IT support platform. Within the scheme, with blue color it is marked the service channel through which the inhabitants of the city are served, with red - the information channel connected with the public, VE members and the IT platform.

In our VE architecture we can find a VE coordinator-Bucharest City Hall, a long list of possible VE members (heat and hot water supplier, electricity supplier, gas supplier, water supplier, communications provider, fiber optic supplier, traffic monitor, medium monitor, etc.), an IT platform that is managed by a member responsible for R&D IT platform. Members are interconnected through information channels and provide to end users through a common service channel. Common management and maintenance of service channel decrease costs for every member.

Through the creation of such an informational channel through the VE, shared works can be planned, coordinated and managed through one entity.

6. Conclusions

A smart city is not only about information and communication technologies. It is also about smarter transportation and accessibility, efficient water and waste management and upgraded ways of providing light and heat to the citizens. Above all these, it is about communication and close cooperation for the benefit of its inhabitants and businesses. As approached in the paper, it is ideal for a city that strives for SMARTness to try and develop new work approaches that have less negative impact on citizen's everyday lives. Figuring out a way to have fewer work sites and all the road and sidewalk problems that follow, should be in the focus of every local government.

Dig once policies, virtual enterprises and everyday institutional cooperation may sound like a novelty for many cities, especially in East Europe, but they should all turn from best practices to business as usual if we are to create the SMART cities that we all dream about.

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