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Specialist Centre on PPP in Smart and Sustainable Cities

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PPP FOR CITIES CASE STUDIES

BARCELONA GIX: IT NETWORK INTEGRATION (SPAIN)

Jordi Salvador, Joan Enric Ricart,
Francesc Trillas & Miquel Rodríguez Planas

With the collaboration of Ajuntament de Barcelona

April 2017

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The Specialist Centre on PPPs in Smart and Sustainable Cities (**PPP for Cities**) is a research, innovation and advisory center that aims to provide public administrations throughout the world with support in the organization, management and development of projects involving collaboration between the public and private sectors in the smart cities arena.

It is also a partnership platform between companies and administrations from all over the world where they can further explore the dynamics of public-private partnerships, create guides to good practices and standards and design solutions to the issues facing cities.

The center is led by IESE Business School and is part of the United Nations' International Centre of Excellence on PPPs program. It has the support and sponsorship of Barcelona City Hall and other public administrations and private companies.

The authors would like to acknowledge the collaboration of Cellnex in this project

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Highlights

The IT infrastructure and networks owned by Barcelona City Council (active[a] and passive[b] networks) were managed separately under different external contracts. This resulted in an inefficient, complex and costly management system for the Barcelona IT services. Barcelona City Council decided to use a public-private partnership (PPP) framework to accelerate the process of integration, expansion and evolution of the IT network while obtaining a better, safer, and customized IT service. The PPP involved bundling separate activities, which was expected to generate efficiencies, and receiving financing for investment in new equipment from the private firm. Additionally, the private operator would bring to the project experience and technological know-how about network management. The new single contract to manage the municipal infrastructure and IT networks comprehensively was known by the name Barcelona Gestió Integrada de les Xarxes Municipals (Barcelona GIX: literally, "Barcelona Integrated Management of Municipal Networks"). The project introduced an innovative business model in which the concessionaire would provide corporate services to the city council while the council would allow the firm to use the spare capacity of the infrastructure, owned by the municipality, to commercialize network capacity among operators in the wholesale market.

This network-sharing model between public and private agents would help reduce the council's IT network-operating costs through a yearly payment and the generation of new revenue streams.

In short, the partnership would allow Barcelona City Council to have a new-generation infrastructure to support the technological development (5G, the Internet of Things, connected cars, etc.) associated with a smart and sustainable city and to enable future telco network deployments.

Location: Barcelona, Spain

[a] Active networks involve commuting and routing equipment.

[b] Passive networks involve poles, fiber-optic cables, and boxes that will be transferred to the operator.

Characteristics of the PPP contract

Type of project: Brownfield[a]
Size: Active and passive IT networks of Barcelona City Council (fiber optics and Wi-Fi[b])
Delivery mode: Finance, operate, manage and transfer (FOMT)[c]
PPP estimated value:[d] €10,675,225 (€8,822,500 net)
Estimated maximum value of the contract:[e] €14,902,000 net (8 + 2 years)
Award amount: €9,150,625 (€7,562,500 net) (guarantee of 5% of the net amount within the following 10 days needed)
Initial required private investment: €3.62 million net in the new municipal network (nova xarxa municipal or NXM) plus €475,000 net for Wi-Fi renovation in three years
Contract announced: August 2, 2013
Contract awarded: January 23, 2014
Contract signed: February 24, 2014
Start of operation: March 1, 2014
End of contract: February 28, 2022
Payment method: Mixed payment system in which the city council pays the cost of operating the IT service (maximum €945,000 yearly initially + network capacity increase) while the private concessionaire pays for the initial investment in new equipment (NXM and Wi-Fi) and a yearly fee (€219,560 net) for use of the infrastructure that will be rented to IT operators in the wholesale market
Duration: 8 + 2 years after contract has been signed
Contracting authorities: Municipal Institute of Information Technology (IMI) of Barcelona City Council (http://ajuntament.barcelona.cat/imi/en)
Companies advising the IMI: Aggaros (www.aggaros.com) and Nae (http://nae.es)

[a] The IT network already existed. The project consisted of renewing it.

[b] See Exhibit A. Wi-Fi Map.

[c] The contract also included small construction works (soft construction).

[d] Initial bid value.

[e] The maximum value of the contract including two additional years.

Bid-winning company

Bid-winning company: Tradia Telecom S.A. (100% owned by Cellnex, www.cellnextelecom.com/en)
Main equipment provider: Cisco

1. Background of the Project

In 1994, Barcelona City Council, in order to improve the IT services provided to corporate departments, decided to connect its offices around the city with its own IT infrastructure.

At that time, the council owned five different IT networks, divided into active and passive networks:

- Municipal corporate network of the Municipal Institute of Information Technology (abbreviated IMI in Catalan) (fiber optics, electronic network and management systems). Serving around 200 city council buildings.
- Urban mobility control network (fiber optics, electronic network and management systems). Includes traffic lights, cameras, etc.
- Dark fiber[1] network of the 22@ district.[2] Used by corporate services and wholesale operators in that specific district of the city. Managed initially by the municipal firm 22@Barcelona S.A., until that company ceased operating in 2012, and then transferred to the IMI.
- Telecontrol network for urban tunnels. Used to control urban tunnels (fiber optics, electronic network and management systems) and highways in the city.
- Wi-Fi network. Used both for corporate services and to provide services to residents through the free network Barcelona Wi-Fi[3] (fiber optics, electronic network – routers and Wi-Fi access points, both internal and external – and management systems). There was an additional use – a premium service offered through operators – that worked only at a pilot level.

Six different companies managed the municipal networks before the integration:

- Contract for maintenance of the corporate fiber-optic system operated by the IMI. Estimated value: €35,000 per year
- Contract for maintenance of the 22@ district fiber-optic system operated by the firm 22@Barcelona S.A. Estimated value: €40,000 per year
- Contract for maintenance of the traffic fiber-optic system operated by the mobility department. Estimated value: €60,000 per year
- Contract for electronic maintenance of the corporate network operated by the IMI, included in a general maintenance contract for all of the electronic maintenance (WAN and LAN). Estimated value: €40,000 per year
- Contract for maintenance of the radio link operated by the IMI. Estimated value: €20,000 per year
- Contract for engineering and operation of the municipal fiber-optic network managed by the IMI. Estimated value: €20,000 per year

The value of two more contracts should be added to the previous six, if a cost comparison is desired between the Barcelona GIX contract and the previous set of contracts. First, there is the maintenance of the electronic traffic system, not managed directly by the IMI, which had an estimated cost of €30,000 per year. Second, there is a contract for operating and managing the Barcelona Wi-Fi service and access point networks, which had an estimated cost of €600,000 annually. The eight contracts amounted to €845,000 annually.[4]

In July 2011, Barcelona City Council made the transformation of Barcelona into one of the world's leading smart cities one of its priorities. To achieve this, the city's IT infrastructure and networks had to be adapted to the standards required to implement smart city projects and devices. To improve the city's connectivity it was necessary not only to improve how the existing network functioned but also to spread the range and increase the number of devices and small sensors in public areas, such as bus shelters and traffic lights.

The IMI, the agency in charge of the city council's IT infrastructure and networks, asked potentially

[1] Optical fiber system that has been installed but is not in use. Due to the high cost of the civil engineering works required to install the cables, it makes sense to install additional capacity in case it will be needed in the future.

[2] *22@* is the innovation district in Barcelona. It was created in 2000 to attract companies focused on RDI, universities and research centers. For further information, see *22@ Barcelona 2000-2015: Barcelona's innovation district*. Ajuntament de Barcelona (*22@Barcelona 2000-2015: Barcelona's Innovation District*, Barcelona City Council), https://www.slideshare.net/barcelonactiva/22-barcelona-20002015-barcelonas-innovation-district

[3] Barcelona Wi-Fi is a Barcelona City Council service that enables people to connect to the Internet through Wi-Fi access points, or hot spots, located in various municipal amenities and public access points. Through the Barcelona Wi-Fi service, the council aims to encourage citizens to access the Internet and make it easier for residents to incorporate this technology into their everyday lives. It has 590 hot spots.

[4] That said, it is important to highlight that the costs of the old and new contracts are not directly comparable because of the upgrading of the services and equipment that came with the new PPP contract. Nevertheless, section 6 of this document includes estimated costs.

interested companies for new business models for the city's IT infrastructure (a method known as a competitive dialogue procurement procedure[5]). The new design had to include different investments and operational scenarios. The IMI received support from the advisory firms Aggaros and Nae to define the most suitable business plan for the city's IT network. After the design was completed, the tender process was opened.

At the time of the contract auction, the IMI was managing the fiber-optic network in the 22@ district, after the municipal company 22@Barcelona S.A., which managed the network previously, ceased operating. However, it was not the task of the IMI, as a public institution, to manage the IT infrastructure. It is for that reason that the IMI also included the management of this network in the new contract.

The Barcelona GIX project's goals were:

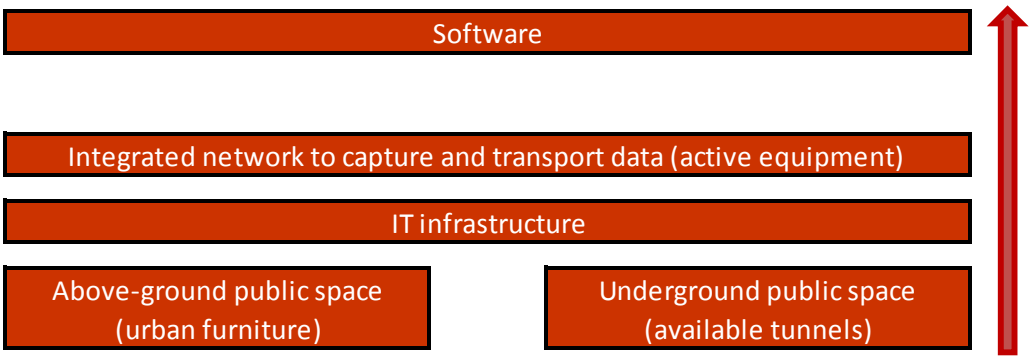
- Integrating the different municipality networks
- The creation of new network governance by a private concessionaire
- Sharing and monetizing fiber optics
- Cost reduction and efficiency in operations and maintenance
- Increased security according to the requirements of the municipal services
- Flexibility for the service design
- Technological development
- Increasing the network's capacity to incorporate more devices and thus achieve a reliable and resilient network on which to build the future smart city

The city council decided to integrate the management of the active and passive networks to optimize investment, avoid management overlapping, and ease supervision. Additionally integration would allow technological efficiency gains to be achieved by sharing the bandwidth among all organizations within the city council.

The integration should allow for the interoperability of systems to manage the city in a smart way and take complete advantage of the increasing number of sensors available in the city that provide information in real time about what is happening in the city.

The integrated management approach and technological development would allow enough capacity to be achieved for innovations associated with smart cities to be adopted. (See Figure 1.)

Figure 1. Added-value chain of a smart city



Source: Ajuntament de Barcelona (Barcelona City Council) (2014). *Mesura de govern – Pla director de les TIC: Desplegament d'Infraestructures "smart" a l'espai públic (PDTIC)*, p. 4.

[5] E. Engel, R.D. Fischer, and A. Galetovic (2014). *The Economics of Public-Private Partnerships: A Basic Guide*. Cambridge University Press; A. Estache and A. Imi (2011). *The Economics of Public Infrastructure Procurement in Developing Countries: Theory and Evidence*. Centre for Economic Policy Research.

The scope of the active and passive networks owned by the city council was, at the time of the bid, as follows:

- Nodes of the urban mobility control network: 740
- Nodes of the municipal corporate network: 36 (should increase to 198 nodes with the new municipal network)
- Citizen Wi-Fi network hot spots: 253 (free Internet services for the city's people)
- Urban Wi-Fi: 469 (corporate services; 190 of them also offer service to Barcelona Wi-Fi)
- Corporate fiber-optic network: 250 km
- Urban mobility control network and urban tunnel telecontrol network: 200 km
- Dark fiber network of the 22@ district: 60 km
- Urban tunnel telecontrol network items of equipment: 5
- Radio links (considering both sides as a single link): 9

Due to the complexity, scope and heterogeneity of the networks, the measurements could vary. For the passive fiber-optic equipment, the concessionaire would have to accept the variability completely. Regarding the active equipment, the minimum variability that the operating company should accept would be 10% of the previously detailed equipment.

The bid-winning company had two months to carry out due diligence of the network after receiving the infrastructure to amend the data provided. At the end of the contract, the city council is to pay for any additional equipment in excess of the percentage established in the contract.

The city council decided to use a PPP framework to implement the project. There were several benefits to using a PPP framework, according to the IMI:

- Modernization of the council's IT network within a short time (avoiding tedious administrative burdens)
- Bundling of different tasks, potentially generating efficiency gains
- Obtaining private financing for the new equipment in the context of a lack of economic capacity to finance such projects due to the weak public administration budget[6]
- Allowing for the monetization of the network's spare capacity through operators in the wholesale markets
- Transfer to the private company of risks associated with operating and managing the IT network

2. Tender Process

The city council invited future bidding companies to participate in the design of the IT infrastructure (the new municipal network or NXM), according to council requirements. The two companies that decided to take part in the design were Tradia Telecom S.A. and Unitecnic, each using its experience to contribute to the network design.[7] Once the infrastructure had been designed, the IMI called for tenders to upgrade, integrate, operate and manage the IT infrastructure under a PPP scheme. The bid-winning firm would bear the integration, financial and operating risk of the project. As compensation, in addition to payment for the operation, the firm would be able to commercialize the spare capacity of the existing network (owned by the city council) in the wholesale market.

The IMI expected to attract bidders with enough financial strength to finance (based on expected future revenues) the high investment cost required by the contract with no financial tension (€3.62 million in three years). These companies were mainly firms operating neutral networks such as Xarxa Oberta de Catalunya (www.xarxaoberta.cat).

The previous providers of the services were different small firms that lacked the financial strength to finance the new equipment and human resources to carry out the project while remaining solvent. It is for that reason that none of them bid for the contract. The old contractors were mainly SMEs dedicated to integrating systems and they had no experience in the commercial operation of networks. Some of the IMI's former providers, however, ended up providing services to the bid winner thanks to the in-depth knowledge of the network they had acquired in the previous years.

The only two bidding companies were the ones that took part in the project design, Tradia Telecom S.A. (owned by the public listed firm Cellnex) and Unitecnic (owned by Mediapro).

[6] According to Eurostat's *Manual on Government Deficit and Debt: Implementation of ESA 2010*, as a basic rule, "the PPP assets are classified in the partner's balance sheet and not on government balance sheet" if certain conditions are met (Luxembourg: Publications Office of the European Union, 2014, p. 309, http://ec.europa.eu/eurostat/documents/3859598/5937189/KS-GQ-14-010-EN.PDF/).

[7] The future network management company had to have the profile of a neutral operator, something that limited the number of bidders.

Table 1. Qualified bidders

Bidders	Company or consortium	Country
Bidder 1	Tradia Telecom S.A.	Spain
Bidder 2	Unitecnic (Mediapro)	Spain

Source: Díaz, T. (2013) 'Diez firmas tecnológicas pujan por los servicios TIC de Barcelona', *Expansión October 16th, p. 3* (Catalunya).

The tenders were assessed according to the economic proposal and technical evaluation of each of the firms. The contract was awarded to the bid that better fulfilled the criteria defined in the contract. Because of the previous discussion between the contracting authority and the bidders regarding the most suitable design of the network, there were no major differences in the technical design of the two firms' projects.

Tradia Telecom S.A. had previous experience in providing IT networks to several operators in Spain. In 2014, when the contract was awarded, the company was part of the publicly traded company Abertis, which had an EBIDTA of €3.12 billion (Abertis off loaded the telecoms branch of the firm, Cellnex, through an initial public offering on May 7th, 2015).

Since 2010, Unitecnic had been managing Xarxa Oberta de Catalunya, a concession of the Center of Telecommunications and IT Technologies (CTTI, http://ctti.gencat.cat/ca/inici) of the government of Catalonia (Generalitat de Catalunya), to provide the Catalan regional government with a neutral IT network of bandwidth to connect 745 government buildings.[8] Unitecnic is part of Mediapro, a leading European media and content firm with an EBITDA of €129 million in 2015.

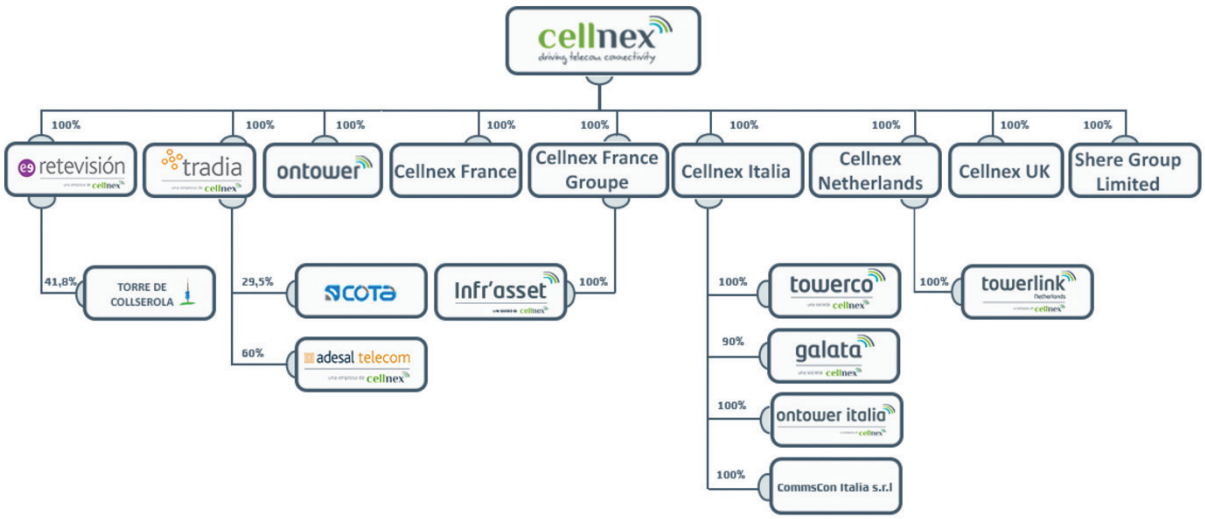
The contract was awarded to Tradia Telecom S.A.,[9] with a bid of €9,150,625.

According to the tender conditions, any subsequent contract modification would require the approval of the contracting committee.[10]

3. Internal Project Characteristics

3.1. Bid-Winning Firm: TRADIA TELECOM S.A.

Figure 2. Cellnex structure



Source: "Who We Are," Cellnex, https://www.cellnextelecom.com/en/who-we-are, last accessed May 2017.

[8] In the Xarxa Oberta de Catalunya contract, the Government of Catalonia forced any operator with contracts with the regional government to use this IT infrastructure, ultimately paying the neutral operator. This condition would be important when evaluating the result of the Barcelona GIX project. Due to the lack of enforcement and a vacuum in the legal system, the bid-winning firm could not secure the expected benefits defined in the contract because some operators opted to extend their existing network instead of buying services from the concessionaire of the fiber-optic infrastructure in the 22@ district.

[9] See Exhibit B. Evaluation of Proposals.

[10] See Exhibit C. Contracting Committee.

Tradia Telecom S.A., previously Difusió Digital Societat de Telecomunicacions (DDST), was originally owned by Catalonia's regional government. Tradia Telecom S.A. was dedicated to carrying and transmitting IT signals. The firm was a leader in setting up digital terrestrial television (DTT) signals. It was privatized in 2000, being acquired by Acesa Telecom S.A., part of the Acesa Group (currently Abertis), a leading operator of toll roads and IT infrastructure.

Tradia Telecom S.A. is now fully owned by Cellnex (controlled at that time by Abertis with 34% of shares) and is in charge of IT network management in the firm. Cellnex[11] is a publicly traded company that owns 13,578 sites. It has a presence in the United Kingdom, Italy, The Netherlands, France and Spain and had an EBITDA of €235 million[12] in 2015. Cellnex had €57,920,810 in capital, the main shareholder being Abertis (www.abertis.com/en) with 34% of the capital, followed by Blackrock (5.911%), Fundació Bancària "la Caixa" (5.000%), and Threadneedle Asset Management (4.902%).

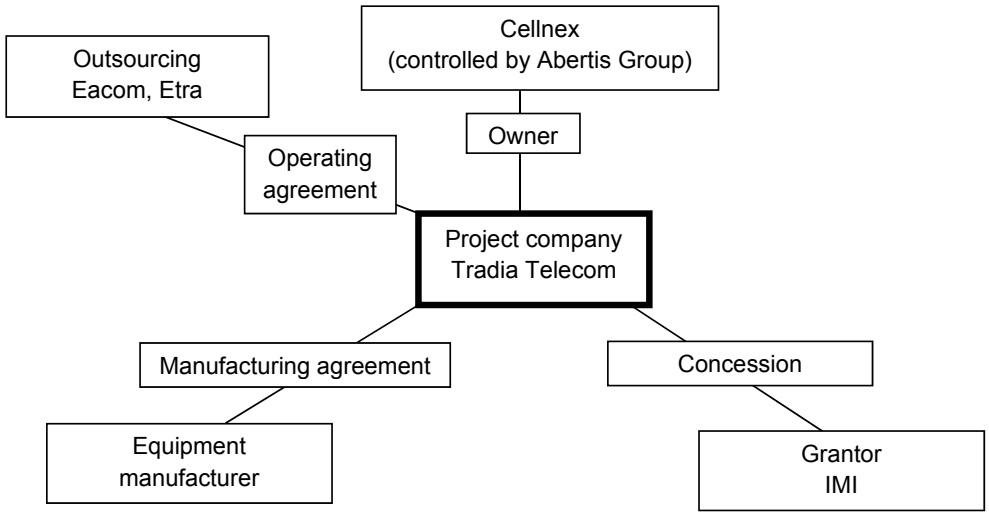
The tasks assigned to Tradia Telecom S.A. in the Barcelona GIX project were:

- Operation and management of the integrated network (accept, operate, manage, expand, integrate and return the integrated network)
- Providing all the new equipment required to integrate the network, to be managed jointly
- Technological development of the network (involving an investment of €3.6 million plus €475,000 net for Wi-Fi renovation in three years)
- Providing corporate services to the city council and expanding them when needed
- Providing services to third parties (22@, Wi-Fi and wholesale): renting out the dark fiber network in the 22@ district and providing the Barcelona WiFi service with the same terms

3.2. Project Structure

PPP projects are often associated with the creation of special purpose vehicles (SPV) to isolate the project

Figure 3. Project structure



Note: For simplicity, the project structure mentions only the firms most relevant to the project.

Source: Prepared by the authors.

[11] Cellnex went public on May 7, 2015, when it started trading on the Madrid stock market. The toll-road company Abertis Infraestructuras sold a 66% stake in Cellnex.

[12] See Exhibit D. Financial Information.

risks from firms' balance sheets. Normally, these kinds of projects are financed using nonrecourse project financing. However, in this particular case and due to the relatively small amount of the contract compared with the firm's total assets, no SPV was created.

Figure 3 shows the structure of the project in which Tradia Telecom S.A., the firm awarded the contract, occupies a central role. The company is 100% owned by Cellnex, which is controlled by the Abertis Group.

The contracting authority was the IMI, the institute in charge of IT provision for the city council. The IMI awarded the concession agreement and was politically responsible for the service.

The companies providing outsourcing services for Tradia Telecom in the management of the network included Eacom (www.eacomsa.com) and Etra. The main provider of equipment was the firm Cisco (www.cisco.com).

3.3. Finance and Funding

One of the characteristics the competing firms had to show to be awarded the contract was enough financial strength to put in the required investment.

According to the contract, the bid-winning company would be paid to operate the network (€945,000 a year plus any increased network costs that were the result of city council demands) but it would have to invest €3.62 million in the new multiprotocol label switching (MPLS) corporate network and €475,000 to renew the Wi-Fi network within the first three years.

In addition, the concessionaire would have to pay the city council €219,560 a year from the concessionaire for the commercial use of the network's spare capacity.

By signing the contract, the IMI committed itself to paying to the bid-winning firm a fixed amount for a period of eight years plus another two years for the IT services provided. That was actually an off-balance-sheet liability for the administration, shifting the cost of renewal of the network to future administrations.

3.4. PPP Payment Method

A mixed payment system was used.

- According to the original contract, the IMI would pay the operator an annual fee to operate and manage the network. The amount set out in the contract was €945,000 a year (€1,150,000 a year including VAT) plus an annual amount that increased depending on how much the network increased. In addition, the company was paid around €90,000 in 2015 for operating and managing the network enlargement. The contract did not consider payment increases due to price inflation.
- Tradia Telecom S.A. would pay the IMI €219,560 a year for the right to use the infrastructure and to sell it to third parties.
- Tradia Telecom S.A. would pay 5% of the revenues it received from third parties.

The two parties also discussed the possibility of starting in new business areas such as the operation of small cells installed in urban furniture to improve the network in areas with high usage levels such as beaches and other tourist areas. In that case, Tradia Telecom S.A. would receive 30% of the revenues from the IT operator providing the service to the end costumers, while the city council would receive the other 70%. The project remained at the pilot level.

The bid submitted by Tradia Telecom S.A. included the expected internal rate of return (IRR) of the project for the company. For a 10-year period (eight years plus two more) the total IRR was expected to be 11.3%, with 8.2% from municipal services and 13.6% from services provided to other operators. Three months after the contract went into effect, the Spanish parliament passed a law liberalizing the infrastructure[13] that ended up affecting the project IRR initially forecasted by the company.

3.5. Risk and Risk Mitigation

As in any PPP project, a proper risk assessment was a critical factor for ensuring the success of the service. The academic literature[14] often says that the risk should be transferred to the party that can deal with it better. Optimal risk transfer in PPP contracts requires, however, an understanding of the interests that agents might have at stake and consequently which incentives each of the parties have to carry out the project.

The two agents involved in the contract were the grantor, IMI, and Tradia Telecom S.A.

[13] Law 9/2014 of May 9: General Law on Telecommunications.

[14] Contract theory studies how economic actors deal with contractual arrangements, generally in the presence of asymmetric information. This theory states that the risk should be allocated to the party that can control the source of the risk or the party that is better able to absorb the risk in cases of high risk aversion (Engel, Fischer and Galetovic, 2014).

Table 2. Risk transfer

Risk category	Allocation
Land and space	IMI
Design	IMI/Tradia Telecom S.A.
(Soft) construction	Tradia Telecom S.A.
Financing	Tradia Telecom S.A.
Inflation	Tradia Telecom S.A.
Demand	Tradia Telecom S.A.
Operations	Tradia Telecom S.A.
Supply of equipment	Tradia Telecom S.A.
Political	IMI

Land and space risk. The IMI bore the risk for the land and space used by the IT infrastructure. Any issue involving land would be under IMI's responsibility. Also relevant was the fact that it was a brownfield project that consisted of renewing and updating the existing infrastructure rather than constructing new infrastructure.

Design risk. The IMI bore the network design risk, but the firms that participated in the tender jointly worked on the design. The bid-winning firm implemented the project according to IMI design requirements. The partial bundling of design, equipment installation (construction) and operations could led to efficiency gains resulting from a reduction in cost maintenance, as argued by PPP theory, because the firm internalizes the operating cost (Hart, 2003).[15]

(Soft) construction risk. In this particular case, the tasks included the receipt and integration of the infrastructure and small construction works to install new equipment and fiber-optic cables. Tradia Telecom S.A. had to receive the existing complex and heterogeneous IT network from the city council and make an inventory of it to check that the information in the contract corresponded to what was actually there. That risk fell to the concessionaire. Regarding the installation of the equipment, in some cases the firm outsourced the process and risk to third-party contractors.

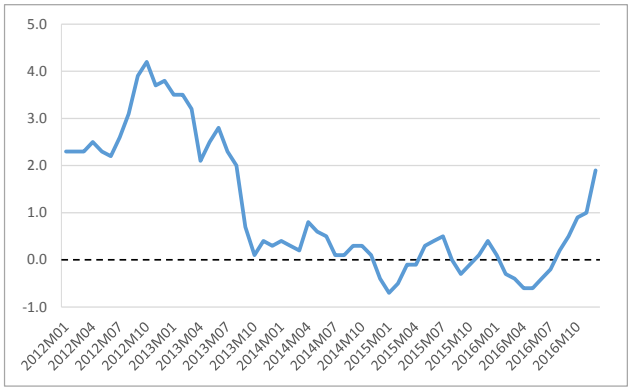
Tradia Telecom S.A. also assumed the **risk of the new equipment installation and maintenance** even though the city council owned the equipment. Any problem resulting from equipment malfunctioning was part of the company's responsibility.

[15] Oliver D. Hart (2003) "Incomplete Contracts and Public Ownership: Remarks, and an Application to Public-Private Partnerships." *The Economic Journal* 113 (486): C69–C76.

Financing risk. The risk of financing the new equipment was borne by Tradia Telecom S.A. However, the company only faced a moderate financial risk as it was supported by the financial strength of Abertis (or Cellnex, from May 2015), the group into which the firm was integrated.

Inflation risk. The bid-winning firm bore the inflation risk as there were no updating clauses for the prices paid by the city council to the concessionaire for the whole period. Nevertheless, the levels of price growth have been historically low up to very recently compared with data of the early 2000s.

Figure 4. Inflation in Barcelona province (year on year)



Source: Instituto nacional de estadística, http://www.ine.es/FichasWeb/RegProvincias.do?codMapa=9, last accessed April 2017.

Demand risk. While the payment to Tradia Telecom S.A. for the network operations was based on availability, the risk for demand from third parties was borne by Tradia Telecom S.A. The company paid €219,560 annually to the IMI to sell the network's spare capacity in the wholesale market to third parties.

Operational risk. The operation and maintenance risk was borne in full by Tradia Telecom S.A. The firm was responsible for the proper functioning of the city council's IT network, to provide services not only to corporate offices but to the whole city.

Supply of equipment. Tradia Telecom S.A. was responsible for supplying equipment. The equipment had to comply with the specifications established in the contract. The main provider of infrastructure was Cisco.

Political risk. The city council was responsible for the proper provision of IT services to its own departments and to the city's people, users of city council services.

3.6. Governance

With a long-term contract in which there are several agents involved, project governance is one of the keys to its success. During the lifetime of the project, unexpected events may force the parties involved to agree on issues that were not considered initially. It is for this reason that contracts are said to be incomplete (Grossman and Hart, 1986).[16]

This section is devoted to evaluating the mechanisms established in the contract, such as institutional design to govern the contract and avoid opportunistic behavior by any of the parties. Disputes, doubts and potential renegotiations can arise regarding issues that were covered insufficiently in the initial contract. Then the institutional architecture (the number and function of administrative units, and the role and selection of the different agents involved) is crucial to guarantee good contractual choices and good contract enforcement and monitoring.

Disputes or conflicts may arise from unexpected situations, such as the one mentioned before when the Spanish parliament passed the new telecommunications law[17] liberalizing the use of infrastructure and increasing competition in the fiber-optic business.

The conflict resolution mechanisms between the contracting authority and concessionaire were defined in section 15 of the contract's technical specifications. The model includes different committees for areas such as strategy, tactics and operations:

- Executive committee – contracts and strategy. This committee is the highest executive authority and is in charge of contract enforcement. It is under the contracting authority, which is in charge of contract modifications. The decisions approved by the executive committee must be acted on by the concessionaire. The committee's main tasks are:
  - ✓ Informing the contracting authority of any decisions that would imply modifications to the contract, so requiring the authority's approval
  - ✓ Confirming the proposed strategic recommendations
  - ✓ Guaranteeing the contract's execution
  - ✓ Solving disputes over the contract's execution
  - ✓ Agreeing and validating changes to essential services and agreed modifications in the service-level agreements (SLAs) once they have been proposed by the follow-up committee
  - ✓ Defining and modifying the principles of the contract's execution
  - ✓ Following up contract quality indicators
- Follow-up committee – tactical

This committee's main tasks are:

- ✓ Supervision of the overall achievement of the service and quality standards
- ✓ Setting in place an appropriate control mechanism for the proper supervision of the contract's execution
- ✓ Verifying the utilization and development of the most suitable types of technology for each case
- ✓ Following up bid prices and invoices from the concessionaire, in accordance with the contract, as well as penalties
- ✓ Verifying compliance with data confidentiality and security requirements
- ✓ Approving modifications to nonfundamental SLAs and controlling the introduction of the agreed modifications
- ✓ Scaling up fundamental modifications of the SLAs to the executive committee
- ✓ Following up the main indicators in the areas of enlargement, operations, and services
- ✓ Following up incidents and solutions, and the operation and economic impact of these

- Operational committees: network increases, operations and maintenance, services committee

Operational committees' duties involve the supervision of the daily work carrying out the services, and solving any problems with these services. These committees were to be composed of members of the city council and the concessionaire.

[16] Sanford J. Grossman and Oliver D. Hart (1986). "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration." *Journal of Political Economy 94: 691–719.*

[17] Law 9/2014 of May 9: General Law on Telecommunications.

The concessionaire was to assign the following members to the previously mentioned committees:

- Project director
- Head of the network enlargement
- Head of operations
- Head of operations for services provided to the administration and wholesale services

The city council was to assign a counterpart of its own for each of these concessionaire representatives.

The contract includes a detailed list of all the information that the concessionaire has to provide to the IMI on a regular basis about the functioning of the IT service.

The main problem with the project arose when Tradia Telecom could not develop the fiber-optic rental business in the 22@ district as initially expected due to increased competition. That reduced the chances for Tradia Telecom S.A. to sell the fiber-optic network capacity it was managing. So far, the two parties have discussed the issue but they have not made a decision, probably because the event is so recent. Consequently no modification has been made to the contract yet.

4. External Project Characteristics

4.1. Economic Conditions

Barcelona was hit hard by the Great Recession, as were many other cities in southern Europe, particularly from 2009. Despite the unstable economic conditions, Barcelona managed to attract an increasing number of tourists, which partially compensated for the weak performance of the domestic economy.

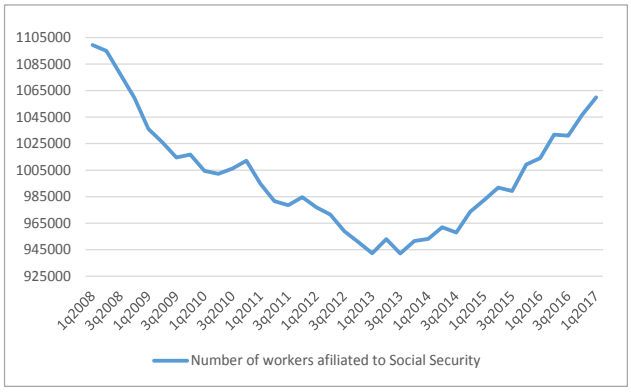
Firms' and residents' weak economic activity negatively affected the city council's finances by reducing the local tax intake.

In Figure 5, it can be observed how the number of visitors to the city has followed an upward trend despite a slowdown in 2012. This resulted in an increase in jobs generated in the city's tourist sector and an increase in tax revenues for the city. The positive tourist numbers data contrast with the downward trend in the number of people affiliated to Barcelona city's Social Security system, hitting a low point in the third quarter of 2013.

Figure 5. Number of tourists

Source: Prepared by the authors based on data from Ajuntament de Barcelona, http://ajuntament.barcelona.cat/barcelonaeconomia/ca/turisme-fires-i-congressos/activitat-turistica/turistes-i-pernoctacions-als-hotels-de-barcelona, last accessed April 2017.

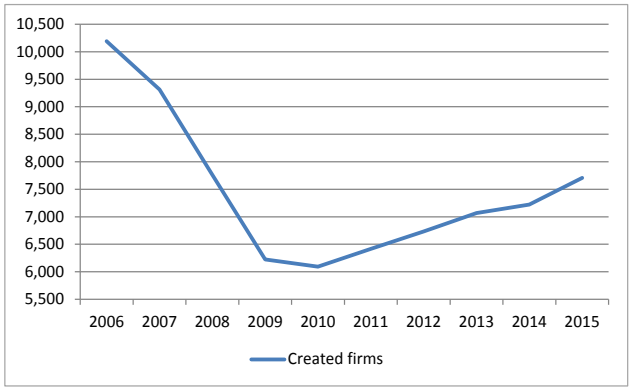
Figure 6. Workers affiliated to Social Security in the city



Source: Prepared by the authors based on data from Institut d'Estadística de Catalunya, http://www.idescat.cat/pub/?id=afic&n=8270&geo=com:13, last accessed April 2017.

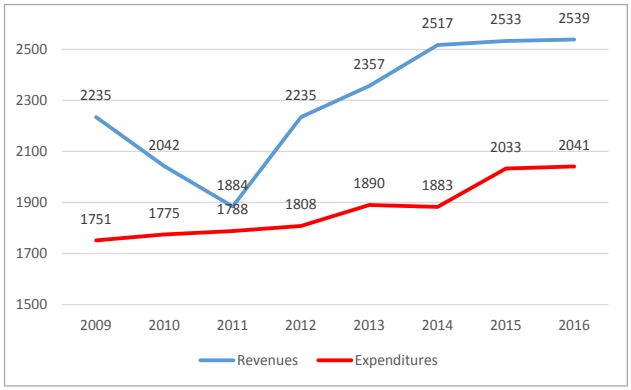
Good news was not evenly spread over the whole economy in Barcelona, as Figure 7 depicts. Sectors other than tourism also suffered the consequences of the financial and real estate shock that the Spanish economy experienced. Finally, Figure 8 shows the decrease in Barcelona City Council revenues up to 2011, although these were higher than the expenditure in the period shown.

Figure 7. Firms created in Barcelona



Source: Prepared by the authors based on data from the Departament d'Estadística, http://www.bcn.cat/estadistica/catala/dades/anuari/cap11/C1101010.htm, last accessed April 2017.

Figure 8. The city council's current revenues and expenditure



Source: Ajuntament de Barcelona, http://ajuntament.barcelona.cat/premsa/2017/03/01/barcelona-proposa-destinar-el-superavit-a-reforcar-la-liquiditat-municipal-i-a-inversions-financerament-sostenibles/, last accessed April 2017.

4.2. Legal/Legislative Conditions

The contract was signed in accordance with the regulation for public-sector contracts and the general administrative clauses of Barcelona City Council.

The tender deal was set out as a special contract according to article 19.1 b) of Royal Decree/Law 3/2011, of November 14, by Which the Consolidated Text of the Public-Sector Contract Law Is Adopted.

The Spanish parliament passed Law 9/2014 of May 9: General Law on Telecommunications, liberalizing the use of infrastructure, three months after the beginning of the contract.

4.3. Political Conditions

The contract was awarded on January 23, 2014, and operations started on March 1, 2014, under a city government led by the CiU (Convergence and Union: a centrist liberal nationalist alliance).

More than one year later, the election of May 24, 2015, led to a change of city government. The new government of the left-wing platform Barcelona en Comú (Barcelona in Common) merely supervised the execution of the contract to ensure it was implemented according to the contract standards. The change of government had no effect on the contract performance due to the stable institutional framework existing in Spain.

The strong institutions and existing rule of law in the country allowed for a smooth government transition.

5. Impact of the Project

5.1. Administration

With Barcelona GIX, the city council benefited from an improvement in the IT infrastructure, not only to provide better service to corporate service providers or residents but to carry out the technological improvement needed to develop a smart and sustainable city[18] and enable future telco network deployments. With a PPP framework being used, the technological improvement came with the investment of the private firm, Tradia Telecom S.A., so the budget-constrained public sector did not have to go through tedious bureaucratic procedures.

Barcelona GIX project allowed the municipality to reduce IT network maintenance costs, and it resulted in up-front investment by the private firm, better IT infrastructure, and easier network control, and eventually generated income in favor of the city council from the payment for using the spare capacity.

The technical benefits expected from the IT network integration were:

- Improved efficiency in the use of the existing network
- Achieving the required quality in network interconnectivity to develop smart city projects
- Easier management of the network and reduced operational costs
- Homogeneous service to all city council departments

[18] C. Carrasco et al. (2015). "Barcelona: A Roman Village Becoming a Smart City." IESE, SM1625E, 07/2015.

- Total control over networks
- Cost optimization
- Simple and homogeneous cost control
- Greater security, adjusted to the specific requirements of municipal services
- Total flexibility to design and adjust infrastructure size for new services
- Making it easier to increase the number of services

According to the IMI, the technical benefits of the new municipal network using multiprotocol label switching (MPLS) compared with the old ones are:

- The possibility of providing Barcelona Wi-Fi in any part of the city council's buildings
- The possibility of providing internal Wi-Fi in any access point of the outdoor network
- The possibility of providing a completely independent network in all the spots where the fiber-optic system is extended, which in turn makes it possible to create new connectivities for new projects in municipal enterprises and nonmunicipal enterprises looking for interconnection points
- The possibility of migrating data using LAN extensions through the level 3 MPLS network
- Connectivity at 10G of six edge points with the two main core points and with node redundancy
- Double link with fiber for each router where service is provided
- The possibility of installing a routing element in the points and buildings currently working with level 2 and consequently limiting the network broadcast traffic
- Improved performance and timing for equipment capacity and for the implementation of a faster technology than router IP

In terms of cost, comparing the new and old contracts is not straightforward due to the lack of quantitative data on the new network capacity and the improvements to how the Barcelona IT network functions.

That said, an estimated yearly cost comparative between two contracts is provided in the less favorable scenario for the city council. (The improvement in network capacity is not accounted for and the investment in equipment in the first contract is not considered either.) Even in this extremely conservative scenario with no technical improvement in the network, the additional cost of the new contract can be estimated at around only €7,000 a year, as detailed in the table below.

Table 3. Cost difference for the administration*

ESTIMATED YEARLY COST			
	Previous contract	**Barcelona GIX**	
Maintenance of the corporate fiber-optic system	35.000	18.2000	Fiber-optic O&M
Maintenance of the 22@ district fiber-optic system	40.000	206.000	O&M of active equipment
Maintenance of the fiber-optic traffic	60.000	400.000	Wi-Fi O&M (independent of hot spots)
Electronic maintenance of the corporate network	40.000	16.000	O&M of radio links
Maintenance of radio link	20.000		Management of roof access
Engineering and operation of the municipal fiber-optic network	20.000	201.280	Other
Maintenance of the electronic traffic system	30.000	-259.081	Payments to the contracting authority for use of spare network capacity
O&M of the Barcelona Wi-Fi service	600.000	106.200	Increase in network capacity
TOTAL operations	**845.000**	**852.399**	**TOTAL operations**
Cost difference	**7.399**		

* Data for the previous contract are based on information provided by the IMI. Data for the Barcelona GIX contract are based on estimates by the IMI for the fifth year for costs related to operations and management (O&M).

The benefits for the public administration would have been greater if the project had developed as expected originally (before the approval of the General Law on Telecommunications that liberalized the use of infrastructures.)

Barcelona GIX had the following fiber-optic and Wi-Fi hot-spots network and users according to the IMI 2015 report:

Table 4. Fiber-optic and Wi-Fi (GIX) figures

	2011	2012	2013	2014	2015
Buildings with fiber optic (municipal)	187	205	213	226	236
Fiber optic (km)	262.844	264.399	n.a.	n.a.	569.852
Wi-Fi hotspots	392	403	409	673	860
Number of Wi-Fi users	459.677	491.463	818.343	1.289.820	1.724.851
Maximum number of monthly Wi-Fi users	49.955	49.953	90.886	156.811	220.091
Month with the maximum number of Wi-Fi users	October	December	August	October	August
Number of districts with more that 2 Wi-Fi spots	43	45	46	53	33

Source: IMI 2015 annual report, http://ajuntament.barcelona.cat/imi/sites/default/files/memoria_2015_v22.pdf, last accessed April 2017.

It can be observed that, from 2011 to 2015, the number of municipal buildings with fiber optics increased by 26.2%, while the number of kilometers of fiber optics more than doubled (up 116.8%), as did the number of Wi-Fi hot spots (up 119.39%).

The most recent changes in the Wi-Fi network, according to the IMI 2015 report, were:

- Improved security with the requirement to sign in using email
- Introduction of new firewalls
- Integration with the TMB bus network and establishment in metro stations
- Pilot programs to test devices using solar energy
- Introduction of Wi-Fi in cultural centers
- Total of 746 access points, in 69 districts, with an average of 100,000 monthly users

Thanks to the integrated IT network (Barcelona GIX), the city council now enjoys the following:

- Availability of a strategic element for the technological development of municipal services: traffic, garbage disposal, gardens and city lighting
- Sustainable IT model at a limited cost to the council
- Capacity to monetize spare IT infrastructure capacity
- Availability of a tool whereby different agents can cooperate to define the city strategy: technology providers, integrators, operators, etc.

5.2. Residents

The benefits for residents were twofold. First, improvements in the network led to better services in the city council offices. Second, the expansion of the Wi-Fi service in the city resulted in better connectivity to the network. In 2015 the number of Wi-Fi hot spots had increased to 860. The new contract goes into much more detail about monitoring the IT services, so the quality of service provided to citizens improved.

The Wi-Fi service has an average of 100,000 monthly users with 250,000 connections. There were 1.8 million total connections in 2016, with an accumulated 6,173,320 connections and 290 million visited webpages. Five metro stations have 35 hot spots and five buses have a Wi-Fi service.

Moreover, the amount paid for this was only part of the actual infrastructure cost due to the financing method used.

Finally, residents will benefit from all the innovations that will use Barcelona GIX in the framework of a smart and sustainable city.

5.3. Concessionaire

Tradia Telecom S.A. had the opportunity to:

- Manage the infrastructure of the city of Barcelona, where the firm has its headquarters
- Operate and manage a contract in conditions of limited uncertainty
- Rent IT infrastructure with the goal of finding new clients in the wholesale market
- Profit from business deriving from the Barcelona GIX concession
- Participate in the development of the smart city project in Barcelona, one of the world's leading cities in this field

Profits from the contract were, however, partially limited by changes to national regulation that affected business conditions in contracts sponsored by local administrations (at the lower administrative level). The existing multi-level adminitrative framework may change the initial conditions under which the contract was signed. This represented an important lesson learned when it came to developing further and improving this innovative business model in other areas.

Overall and considering all the elements, Tradia Telecom S.A. was satisfied with the project, according to some of the firm's executives.

6. Assessment

6.1. PPP Methodology

This PPP is the result of a contract between Barcelona City Council and a private operator, Tradia Telecom S.A. (originally a subsidiary of the infrastructure firm Abertis), to expand and integrate the municipal administration's information technology network and related municipal services, including a Wi-Fi hot spot network. The project design was the result of a competitive dialogue between the public administration and the same two private operators that submitted bids in the final tender. The contract between the city council and the winning bidder had a duration of eight to 10 years, and it started to be implemented in 2014.

The private operator committed itself to financing the upgrade investment in exchange for receiving availability payments and the right to sell spare capacity to telecommunications operators.

In principle, this contract fits in with the principles of incentive theory as applied to PPPs because the project aims to bundle a number of activities that were isolated previously. In this way, the operator may take into account the impact of its decisions in one activity segment on other segments, thereby achieving economies of scope[19] and better control of the lifetime costs.

Another strength of the project is that, despite the short experience of it so far, it has already survived a significant political change. The PPP was designed by a center-right government, which lost the election in the second year of the contract and was replaced by a left-wing government that has respected the terms of the deal.

The main challenge of the project so far has been the operator's difficulty in trying to sell spare capacity, a difficulty that could be a consequence of regulatory changes, according to the private firm. Although the private operator was supposed to bear the demand risk, there is the possibility that it can claim that the demand has not materialized not for commercial reasons but because of regulatory decisions that were not anticipated in the original contract.

The city council decided to use a PPP framework to implement the project for the following reasons (the purported benefits are accompanied by an assessment of the argument):

- To modernize the city council's IT network within a short period of time (avoiding a tedious administrative burden). It is possible that having only one private contractor for an integrated project speeds up its development in an administration as complex as that of a big city. However, tedious administrative burdens are part of the protection that citizens have to safeguard their interests and to prevent opportunistic behavior by decision makers.
- To obtain private financing for all of the new equipment in the context of a lack of economic capacity to finance such processes due to the public administration's budget weakness. It is questionable that the financial difficulties of the time affected only the city council and not the private operators working on the same project. It can possibly be argued, though, that fiscal rules imposed by higher levels of government created accounting incentives to postpone the liabilities to which local governments commit themselves in a PPP.

[19] Economies of scope mean it is cheaper to produce a different range of products together than to produce each one of them separately.

- To allow for the monetization of the network's spare capacity. The operator will then receive new sources of income from renting out the unused infrastructure to operators in the wholesale markets and potentially from the installation of small cells. Although it seems that this monetization is not materializing as initially expected, there are no reasons why the same degree of monetization, through selling spare capacity, could not be achieved by the city council itself, given that it has experience in commercial activities in the local public sector (a zoo, an amusement park, museums, etc.).
- To transfer to the private company the risk associated with operating and managing the IT network. This is a good reason to organize this project as a PPP, especially when it integrates tasks that previously were developed independently.

The bundling of several previously separate IT projects was used to achieve a more homogeneous quality and better control of overall costs. The contract was also meant to boost Barcelona's strategic objective of promoting itself as a smart city.

A limitation of the process leading to this PPP is that there were only two bidders due to the strict requirements regarding the firm's profile (mainly neutral operators.)[20] (The same two companies participated in the design process in a competitive dialogue.)

Although only two years have elapsed out of the contract's total duration of eight years, some aspects show that sometimes it is risky to have long-term contracts in sectors that evolve so rapidly (and that are subject to regulation by levels of government not involved in the contract).

Overall, the PPP project is a sensible one that would probably have benefited from more competition at the bidding stage and clearer recognition of the uncertainties deriving from regulation and technological development.

[20] This analysis is developed further in the following section.

Table 5. PPP methodology

PPP METHODOLOGY	BARCELONA GIX	
	EXISTING	DETAILS
1. Procurement method & bidding process		
1.1. Value-for-money analysis or cost-benefit analysis	Yes	Aggaros and Nae
1.2. Real Competition for the contract	No	Two bidders
1.3. Tender evaluation committee	Yes	Internal member
2. Contractual issues & incentives		
2.1. Bundling	Yes	FOMT
2.2. Quality verifiable	Yes	IT service interruptions
2.3. Externalities	Yes	Positives
2.4. Duration		8 + 2 years
3. Risk, finance & payments		
3.1. (Soft) Construction & operation risk	Transferred	
3.2. Demand risk	Partially transferred	
3.3. Policy & macroeconomic risk	Partially transferred	Spare capacity sales and adjustments for inflation
3.4. Payment mechanism	Mixed payment. Public sector pays for operations, and private firm pays for investment	
3.5. Special Purpose Vehicle (SPV)	No	
4. Governance		
4.1. Transparency	Yes	Well-defined governance system
4.2. Participatory decision-making process	No	Bidding companies participated in design process, but not residents
4.3. External monitoring	No	
4.4. Legal framework	Yes	Consolidated Text of the Public-Sector Contract Law
4.5. Distribution of tasks	Contracting	IMI
	Monitoring compliance	IMI
	Renegotiation	IMI
	Regulation	Spanish government
	Operation & quality	IMI and Tradia Telecom S.A.
5. Construction process		
5.1. Cost overrun	No	
5.2. Delayed deadlines	No	
6. Potential Benefits		
6.1. Possible price certainty	Yes	
6.2. Transfer of responsabilities to privates sector	Partially	Spare network capacity
6.3. Scope & Incentives for innovation	Yes	Wi-FI access points, new urban infrastructure, IoT networks, small cells, connected cars
6.4. Savings in public payments	Yes	Improved services
6.5. Life-cycle approach	Yes	
6.6. Incentive to finish on time	Yes	

Source: Prepared by the authors.

6.2. United Nations Sustainable Development Goals

The project was also aligned with some of the United Nations Sustainable Development Goals:

Table 6. Alignment with U.N. goals

	BARCELONA GIX	
SUSTAINABLE DEVELOPMENT GOALS	GREAT IMPACT	MODERATE IMPACT
1. No poverty		
2. Zero hunger		
3. Good health & well-being		
4. Quality education		✓
5. Gender equality		
6. Clean water & sanitation		
7. Affordable & clean energy		
8. Decent work & economic growth		✓
9. Industry, innovation & infrastructure	✓	
10. Reduced inequalities		✓
11. Sustainable cities & communities		✓
12. Responsible consumption & production		
13. Climate action		
14. Life below water		
15. Life on land		
16. Peace, justice & strong institutions		
17. Partnership for the goals	✓	

Source: Prepared by the authors.

There is a goal that has clearly been achieved thanks to the project – goal 9: industry, innovation and infrastructure. Barcelona GIX allows for the IT network to be improved and, as a result, its users can enjoy a better service. This has a second implication – the capacity to encourage the creation of more IT companies and the improvement of innovation processes.

Additionally, goal 17 (partnership for the goals) is also clearly reached. In this case, the use of a standard PPP makes clear that this project fosters partnerships between public authorities and private firms to improve services to citizens.

Besides these directly affected goals, there are other Sustainable Development Goals that can be considered as having been improved by this project although to a lesser degree. This is the case with goal 4 (quality education), goal 8 (decent work and economic growth), goal 10 (reduced inequalities) and goal 11 (sustainable cities and communities).

In the case of goals 4 and 8, the impact is similar as it is clear that the improved IT infrastructure promoted by the city council in the 22@ district has created more opportunities for residents to access content. In addition, it has become easier for entrepreneurs and private firms to access the digital economy and launch their products and services in the digital market.

Goal 10 and, in part, goal 8 (decent work and economic growth) are affected because making IT more accessible to the public by improving the IT infrastructure can reduce what is called the digital divide[21] if properly targeted. As pointed out by Strover (2014):

> "As more bandwidth-intensive applications evolve, and if services continue to charge by speed tiers, we are once again facing the prospect of another type of digital divide, one in which higher income households afford high speed mobile services and lower income households are left with less capable services; rural areas likely will be the last in line for the best wireless service."[22]

Finally, goal 11 has also been reached, as improving social and economic progress is a way of making cities and communities more sustainable.

6.3. City Strategy

Perhaps the most interesting characteristic of this collaboration is its consistency with the smart city strategy at the time of the tender and contract design. In fact, the most important motivation for this solution is to prepare the city infrastructure for the development of the 2011 smart city strategy. Barcelona's smart city strategy anticipated the need for a more integrated infrastructure to support sensors and connections. The tender, contract design and even the governance structure of this PPP were developed in line with this strategy.

Shortly after the contract was signed, there was a new election and a change of local government. Barcelona's new government decided to reconsider the smart city strategy. While of course the future cannot be predicted, there should be enough consensus on the city strategy for it to be less affected by any political changes in government.

Another interesting characteristic of the PPP is the development of a new business model that includes the possibility of financing the project by selling extra capacity to third parties. This is an innovative formula, again very much in line with the strategy as it allows for greater scale and modernization while holding down costs. The overall result is a much more efficient and broader network at essentially the same cost as the fragmented, much smaller-scale and less modern network in place before the new contract.

Again, unexpected events may disturb such a nice plan. In this case, the competitive maneuver of some operators using a new regulatory framework makes it very difficult to put into effect the potential business initially incorporated in the contract. While it is difficult of course to anticipate competitive and irregular maneuvers, it seems more relevant in this case to highlight the difficulties involved in making progress with new business models in regulatory environments that involve different levels of government and therefore cannot be controlled enough by local governments alone. This makes it difficult to deal with the regulatory risk in the contract.

One aspect to highlight in this case is the difficulty of attracting a large number of bidders mainly due to the requirements demanded of the concessionaire, including that it had to be a neutral network operator.

In addition, the link with the city strategy means that those partners that are already committed to the city have a greater interest, so other players are clearly going to underbid. For committed partners, the relationship and future business as well as the association with Barcelona's smart city strategy are much more important than the internal rate of return for this particular project. As a consequence, not only can the small number of bidders be explained but one can assume that it is not a concern as even just two committed players are enough to make the bidding very competitive.

Finally, the governance established for this project seems sensible and appropriate. It remains to be seen how capable both sides of the contract will be at dealing with unexpected events and avoiding opportunistic behavior.

[21] M. Hilbert (2014). "Technological Information Inequality as an Incessantly Moving Target: The Redistribution of Information and Communication Capacities Between 1986 and 2010." *Journal of the Association for Information Science and Technology* 65(4): 821–835.

[22] S. Strover (2014). "The US Digital Divide: A Call for a New Philosophy." *Critical Studies in Media Communication* 31(2): June 2014.

7. Conclusions

Barcelona GIX, the project aimed at unifying the management of the IT infrastructure and network, was set up with the following goals:

- Limiting the net cost of operating and managing the IT infrastructure, while maintaining a commitment to providing services to residents and the local administration
- Creating a new business model that would allow the spare capacity of the municipal network and street furniture to be monetized
- Achieving greater savings than the current amounts by fostering the intensive use of the municipal infrastructure
- Increasing the number and type of services that the network is able to support
- Increasing the capacity and range of the IT network so it can transport the necessary connectivity services to any area of the city where there is a municipal need
- Encouraging the constant renewal of technology so that the most advanced technological solutions are available at any given time

Barcelona GIX allowed the provision of IT services to be increased, making it possible to:

- Add new city council buildings to the service
- Provide Wi-Fi to more areas of the city
- Support the smart city and mobility service strategies

The use of a PPP not only allowed the decision-making process and implementation to be accelerated but also enabled the use of an innovative system to pay for the technological improvement by using the network's spare capacity. The concessionaire could sell the council-owned network's spare capacity to operators to partially finance the cost of the equipment investment and IT operation.

The first years of the contract have shown some room for improvement of the PPP (from a business model point of view), as follows:

- Legal coordination between different levels of government could be better
- Increased flexibility is needed to add new business models to the original contract (such as small cells in urban furniture). This would have generated revenues for both agents – the city council and Tradia Telecom S.A.
- It is difficulty to monetize the Wi-Fi network when there is already a free WiFi service provided by the municipality (with a 256 kbps speed limit)

Despite these small drawbacks, the contract has clear conflict resolution mechanisms designed to resolve such difficulties. Both parties are satisfied with the evolution of the PPP project, which has achieved its main objectives and can be considered a success.

Exhibit 1. Evaluation of Proposals

Objective criteria

CRITERION	SECTION	DESCRIPTION	MAX. POINTS	TRADIA	UNITECNIC
1		**Operational model and evolution of the Barcelona Wi-Fi service**	**15**	**11**	**13.5**
	1.1	Operational model	6	4	5.5
	1.2	Improvements added to the indicator report	4	4	3
	1.3	Improvements added to the service report	3	2	3
	1.4	Improvements added to the device report	2	1	2
2		**Technical solutions for expanding the new municipal network**	**15**	**4.5**	**7**
	2.1	Design proposals	4	0	1
	2.2	Proposals for technical improvements to the equipment	3	1.5	2
	2.3	Ease of integration of management systems	4	0	0
	2.4	Level of support of the active equipment	2	1	2
	2.5	Ease of migration	2	2	2
3		**Migration schedule and start-up of the contract**	**10**	**7**	**7**
4		**Follow-up plan and contract control and quality management**	**10**	**4**	**4**
5		**Operational plan**	**10**	**6.5**	**6**
6		**Business plan**	**8**	**4.5**	**7**
	6.1	Details	2	0	1
	6.2	Analysis of potential demand	3	1.5	3
	6.3	Commitment of third parties	2	2	2
	6.4	Suitability of costs and investment allocation mechanism	1	1	1
7		**Profitability plan**	**7**	**7**	**7**
8		**Relationship with Mobile World Congress**	**5**	**4**	**5**
	8.1	Commitment of the firm to play an active role in the city's competition centers	1	1	1
	8.2	Commitment to play an active role in projects associated with the competition centers	2	2	2
	8.3	Commitment to develop social projects in the context of the M4All project for children with disabilities	2	1	2
9		**Expanding the new municipal network**	**5**	**2**	**3**
10		**Service portfolio**	**5**	**5**	**5**
		TOTAL	**90**	**55.5**	**64.5**

Source: Document provided by IMI.

Exhibit 1. (Continued)

Valuations using formulas

CRITERION	MAXIMUM	VALUATION	TRADIA PROPOSAL	UNITECNIC PROPOSAL	TRADIA SCORECNIC	UNITECNIC PROPOSAL
Expansion of the new municipal network	32	Increase in the number of access points that the bidder commits itself to provide, install and operate in the network above the minimum of 170 points	128	128	32.00	32.00
Reduction in the annual fee for providing corporate services	20	Proposed reduction (%) by the bidder with respect to the total budget of the tender	0	7.5	18.50	20.00
Values of the parameters C1 and C2 associated with the payment for deploying new municipal nodes	15	Parameter C1 (%)	0	0	15.00	11.00
		Parameter C2 (%)	0	10		
Discount promised by the bidder in the final infrastructure transfer amount	15	Reduction (%) over the final transfer value proposed by the bidder	100	20	15.00	3.00
Improvement of the annual availability fee that the bidder would have to pay the city council for using its infrastructure and renting it to the wholesale market	10	Value of the proposed availability fee (≥219,560), specified in the PPT	219,560	237,124.8	9.26	10.00
Value of the parameter Ci corresponding to percentage of income from services provided to third parties that will be paid to the city council on an annual basis	8	Parameter Ci in the PPT	5	3	8.00	4.80
Improvement of the deployment plan's schedule	5	Improvement of the deployment (months) of the new municipal network proposed by the bidder with respect to the maximum period specified in the PPT (36 months)	18	18	2.50	2.50
Variability percentage that the bidder will commit itself to accept with respect to the number of items of active equipment to transfer at the start of the contract	5	Variability of items of active equipment proposed by the bidder with respect to the minimum variability required (10%)	100	100	5.00	5.00
	110				**105.26**	**88.30**
OBJECTIVE CRITERIA	**90**				**55.5**	**64.5**
TOTAL					**160.76**	**152.80**

Source: Document provided by IMI.

The two tables above show the points awarded to each of the bidders. Tradia Telecom S.A. got a higher overall score because it scored more highly in the valuation criteria using formulas (particularly in those elements associated with economic values), even though it got fewer points in the objective criteria.

Exhibit 2. Contracting Committee

President: President of the IMI
Members:
1. Secretary-general of Barcelona City Council
2. Auditor-general of Barcelona City Council
3. CEO of the IMI
4. Director of the IMI's strategy and innovation department
5. Head of the IMI's finance department
6. The IMI's smart cities and telecommunications director
7. The IMI's head of the project

Source: Information provided by IMI.

Exhibit 3. Financial Information

€M	2014	2015
Broadcast infrastructure	250	225
Telecom site rental	107	303
Network services and others	79	85
Total revenues	**436**	**613**
Operating expenses	-258	-378
Adjusted EBITDA	178	235
Nonrecurring items	0	-18
Depreciation and amortization	-91	-154
EBIT	87	63
Net interest and others	-9	-27
Corporate income tax	-18	13
Noncontrolling interests	0	-1
Net profit attributable to the parent	60	48

€M	2014	2015
Assets		
Noncurrent assets	950	1.808
Trade and other receivables	191	168
Cash	91	51
Current assets	282	219
Total assets	1.232	2.027

€M	2014	2015
Equity and liabilities		
Share capital	58	58
Share premium	339	339
Noncontrolling interests	5	83
Share capital and attributable reserves	401	480
Reserves and minority interests	100	58
Shareholders' equity	501	538
Borrowings and bonds	418	970
Other liabilities	89	320
Noncurrent liabilities	506	1.290
Borrowings	4	8
Trade and other payables	221	191
Current liabilities	224	199
Total equity and liabilities	1.232	2.027

Source: Data provided by IMI.

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