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## **Public Service Innovation: Solid Waste Sector from the Perspective of Clean Development Mechanism Landfill Projects**

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### **Abstract**

This paper is devoted to public services innovation in the municipal solid waste sector. It analyses the implementation of Clean Development Mechanism (CDM) projects in the Bandeirantes and São João landfills in the municipality of São Paulo, Brazil. The study is based on the concept of Public-Private Innovation Networks in services (ServPPINs). Using the ServPPIN concept it was possible to identify competence gaps affecting the stakeholders involved in these CDM projects. We focus in particular on those organisational and relational competence gaps that are likely to weaken innovation feasibility in services related to solid waste. In fact, innovation is closely linked to the development of new competences among service providers and users. For the most part, these will arise out of changes in interactions between actors - given that the projects in question include the coordination of various actors (public, private, and citizen).

**Keywords: ServPPIN; public service innovation; clean development mechanism; landfill.**

### **1. Introduction**

The Kyoto Protocol was adopted in 1997 at the Third Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC) and came into force in 2005. This Protocol established that countries included in Annex I were to reduce their greenhouse gas (GHG) emissions by at least 5% between 2008 and 2012, in relation to 1990 emission levels. At the United Nations Climate Conference COP-18, held in Doha, Qatar, in December 2012, it was confirmed that the Kyoto Protocol would continue until 2020 (UNFCCC, 2013).

In order to assist Annex I countries to comply with their GHG emission reduction targets, the Protocol established the Clean Development Mechanism (CDM), which entails the implementation of project activities in emerging and developing countries, resulting in Certified Emission Reductions (CERs), which can be bought by Annex I countries.

CDMs encompass activities for reducing GHG emissions by establishing projects across a wide range of sectors, including landfill sites. These projects have excellent potential for GHG reduction given that, due to the municipal solid waste management model adopted in

countries like Brazil, which is characterized by the disposal of its waste via intensive use of landfills, and other disposal methods in the ground (controlled landfills, and open dumpsites) with common practice allowing gas to escape directly from landfills to the atmosphere via a methane drainage pipe.

Methane is a greenhouse gas, the global warming potential of which is 25 times higher than that of carbon dioxide. According to the United States Environmental Protection Agency (EPA), it is estimated that methane emissions from landfills comprise about 6% to 13% of total global emissions of methane (Rubio-Romero, 2013).

It is worth noting that the CDM concept encompasses both global issues linked to climate change and the promotion of development in the local context (Brazil, 1997). In this way, beyond the objective of assisting Annex I countries to fulfill their goals of GHG emission reduction (in line with article 12 of the Kyoto Protocol) these projects must also assist in promoting sustainable development in the host countries in which they are held (Fernández et al, 2012; Fernández et al, 2014; Ventura et al, 2012).

The importance of civil society's effective participation throughout the approval process of a CDM project cannot be overstated. Another crucial point is that project proponents should send letters of invitation to all project stakeholders, taking into consideration the following agents in the case of Brazil: local authorities and chamber of deputies for all municipalities involved, municipal and state environmental departments; Brazilian NGOs and social movement forums, community associations both directly and indirectly associated with project activities, as well as both State and Federal Public Prosecution offices.

Within this general context, this paper aims to discuss the challenges raised by the promotion of public services innovation in the municipal solid waste sector. We focus on the implementation of CDM landfill projects in the municipality of São Paulo, Brazil. The theoretical background of the analysis is the concept of Public-Private Innovation Networks in Services (ServPPINs), highlighting the important role for service innovation played by public and private organisations working in collaboration.

Rather than being implemented with the explicit goal of promoting service innovation, the CDM landfill projects aim to reduce greenhouse gas (GHG) emissions, in line with the Kyoto Protocol. However, these projects must also promote local sustainable development in host countries (by creating local co-benefits) and this can also lead to innovation dynamics.

In this paper, we focus on competences development based on interactions and relationships between the stakeholders involved in CDM landfill projects, highlighting the importance of network construction and opportunities for achieving local co-benefits from this.

Discussion of the development of organisational and relational competences for public services innovation is apt, since most studies on this subject are still technology-biased (Schmidt and Rammer, 2007; Mothe and Nguyen, 2010). Therefore, for better comprehension of public services innovation, it is necessary to examine other aspects, going beyond technological factors.

Innovation studies concentrate on the private sector. The literature generally neglects or underestimates the role of public sector in the innovation process (Djellal et al., 2013, Windrum; García-Goñi, 2008). The public sector is often portrayed as a facilitator of

innovation activities, merely drafting the legal framework. However, there is a growing literature pointing out a more active role played by the public sector in innovation (both its own innovation and that of other sectors) (Gallouj and Weinstein, 1997; Mulgan and Albury, 2003; Hartley, 2005; Halvorsen et al. 2005; Koch and Hauknes, 2005; Windrum and García-Goñi, 2008; Potts and Kastle, 2010; Fuglsang, 2010; Sundbo, 2011; Djellal and Gallouj, 2013; Djellal et al. 2013).

The public sector is extremely heterogeneous. Although public services are often provided by public organisations, other provision modes have recently emerged. Public services can be provided by public actors, private actors, or both (Di Meglio, 2013; Weber and Heller-Schuh, 2013). In the case of the municipal solid waste sector and the implementation of carbon market projects within landfills, innovation opportunities are strongly related to the interactions and relationships built by stakeholders at the different levels at which they are involved.

The paper is structured in four sections. Following the introduction, section 2 discusses the ServPPIN concept focusing on the importance of relational and organisational competences for service innovation. Section 3 is devoted to the presentation of the empirical cases, focusing on the competences that should be developed by each stakeholder involved in the selected CDM landfill projects. Our conclusions are set out in section 4.

## **2. The ServPPIN Concept: a Multi-agent Framework for Innovation in Services**

The purpose of this section is to discuss the concept of Public-Private Innovation Network in Services (ServPPIN), highlighting the roles played by public and private actors, and the interaction processes between them, in order to promote innovation – both technological and non-technological. The subsection 2.1 aims to show the main features as well as the differences between ServPPINs and traditional Public-Private Partnerships (PPPs). Finally, the subsection 2.2 aims to present the relational and organisational barriers within a multi-agent context.

### **2.1 Public-Private Innovation Networks in a Service Context**

Innovation networks and systems have been the subject of an extensive literature in economics, sociology and management (Callon, 1992; Edquist, 1997; Lundvall, 1992; Nelson, 1993 among others). In the same vein, more recently, there has been a growing literature on Public-Private Partnerships (PPPs). Although these are not necessarily devoted to innovation (being mainly set up to produce infrastructure and/or services), PPPs can also be used as mechanisms for the production of innovations. One of the factors encouraging interest in examining Public-Private Innovation Networks is the growing recognition of the important role played by public sector organisations in the innovation process. The innovation network concept is biased towards manufacturing and technology. It has only recently been applied to innovation in services - which is surprising, given the interactional nature of service activities.

A network is the establishment of relationships based on trust (Fuglsang, 2013), on reputation, and on mutual dependency between selected partners. The concept of the innovation network (in the traditional sense) suffers from a certain number of shortcomings, namely: a technology bias (with largely predominance of tangible technological innovation),

a manufacturing bias (linked to the previous one), and a market bias (centrality of the private actors in the innovation dynamics). This means, to make it short, that innovation networks are mainly focused on technological innovation produced by the collaboration of private actors in the manufacturing sector.

The ServPPIN concept provides a way of overcoming these various biases (Djellal and Gallouj 2013; Gallouj, Rubacalba and Windrum, 2013; Gopakumar, 2014; Labarthe et al. 2013). It goes beyond the technologicistic view of innovation. It adopts a broader perspective, incorporating non-technological aspects of innovation (table 1), including organisational innovation, ad hoc innovation, social innovation, and bricolage innovation, i.e. innovation through non-programmed activities, trial-and-error processes and adaptation to random events (Fuglsang, 2010).

IN	ServPPIN
Visible innovations (technological)	Visible (technological) and Invisible (technological and non- technological) innovations
Simple innovation	Simple and complex innovation
Predictable innovation	Predictable and unpredictable innovation

**Table 1. Main differences: Innovation Network (IN) and ServPPIN**

Source. The authors, based on Djellal and Gallouj (2013).

Besides, the ServPPIN contributes to opening up the traditional innovation network concept to new actors: all market services, as well as third-sector organisations (NGOs, associations etc.). It extends potential forms of participation for certain actors, for example, the involvement of civil society in the decision-making and consultation processes. This is particularly the case with regard to the role civil society plays in the ServPPIN context – helping to translate social preferences which are not merely reflected by market prices (Fuglsang, 2013) – where there is a need to empower the public and users to foster a successful cooperation.

Public administrations are thus no longer restricted to playing a support role in the innovation process. They may be active participants in that process, particularly insofar as their own activity is concerned (Rubalcaba, 2006).

ServPPINs are also networks of collaborative partnerships between public and private organisations, but they are more comprehensive open and flexible than traditional PPPs, which entail relations between actors that are more closed, with predefined functions, rules and formal procedures (particularly contracts) that can bureaucratize the process, and limit the potential for innovation. The high number, and diversity, of participants in a ServPPIN can lead to a complex and intensive process of interaction in which a large amount of heterogeneous information and knowledge (tacit and non-tacit) are likely to be exchanged, since plenty of channels are opened for interaction.

According to Bučar et al. (2013), ServPPINs can be understood as a place for social interaction and the construction of social relations aimed at innovation. Nevertheless, of all case studies based in ServPPIN concept, several were not explicitly oriented towards the innovation target. For example, in some hospital case studies the main objective was to

reduce costs in the use of technologies (Farias and Almeida, 2014; Schartinger, 2013; Windrum, 2013;). Similarly, the CDM landfill projects we examined were implemented in order to reduce GHG emissions, rather than with the explicit goal of promoting service innovation. In fact, the technology and innovation outcomes appear to be additional results of the local co-benefits generation.

In other words, interesting changes and innovations are likely to arise out of such networks - which can then be retrospectively labeled 'innovation networks'. Taking into account non-technological, incremental and non-programmed innovations (ad hoc, bricolage, rapid application etc.) it is also possible to consider even those networks which are not explicitly (or immediately) oriented towards innovation to be ServPPINs. This is one difference between ServPPINs and traditional innovation networks (IN) (Table 1).

It should be noted that in ServPPINs, interaction between the public and private sectors occupies a central position. This interaction is favourable to the various parties involved, and not just in monetary terms. In this sense, from a perspective based on the notion of network, ServPPINs are a means of deepening studies related to public services innovation - an innovation field that is yet to be explored in depth (Brandão and Bruno-Faria, 2013; Djellal and Gallouj, 2013; Gallouj et al., 2013).

The ServPPIN concept is particularly relevant as a theoretical basis for our research since it allows us to take into account the relational and organisational competences, as well as the goals, of the various stakeholders involved – and these are important elements of service innovation (Djellal and Gallouj, 2013; Labarthe et al. 2013; Lima and Vargas, 2012; Weber and Heller-Schuh, 2013).

One of the essential characteristics of the service supply is the inseparability of the productive process from its results. The output of a service cannot be dissociated from its process. Therefore, in such activities (characterized by the interaction between customer/user and service provider) the service interface component should be taken into account, as well as the human or technical competences necessary to service provision.

Organisational processes and innovation management are important issues in service innovation (Kahn and Hounwanou, 2008; Gallouj and Weinstein, 1997; Lima and Vargas, 2012), since, in services, innovation processes are rarely carried out in a particular R&D or innovation department. In other words, organisational structure and competences play an important role in the processes of innovation in services (Hertog et al., 2010; Lima and Vargas, 2012; Djellal et al., 2013; Gallouj et al., 2013). However it should be noted that even in manufacturing industries, organisational factors are often singled out as mechanisms that block innovation (Sundbo, 2011). These factors include: poor targeting of resources; motivation and decisions; inadequate employee competences or weak company culture; an inefficient communication system, and lack of technology or knowledge. Public and private actors must be able to cooperate in order to share risks and mobilize resources and complementary competences devoted to non-technological as well as to technical innovations.

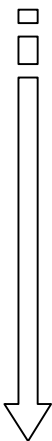
This cooperation is especially important for traditional public services such as the solid waste sector, which (in this context) require new structures - in terms of approaches, strategies, solutions – in order to adapt to the rapid and complex changes induced by new environmental policies.

Mainly because of their important institutional and regulatory role, public institutions are decisive in the success and sustainability of ServPPINs (Djellal et al, 2013; Weber and Heller-Schuh, 2013; Windrum, 2013).

Thus, the emergence of an open and collaborative culture is crucial to the development of such a network. Organisational boundaries need to be opened up to facilitate the collaboration and integration of various competences and (sometimes divergent) goals.

## 2.2 ServPPIN: Relational and Organisational Barriers Within a Multi-Agent Relationship Context

The typology of ServPPINs is based on the specificities of the innovation implemented. The criteria used for this typology are: the nature of the innovation (tangible/ intangible); its degree of simplicity; its origin (adoption/ production) and its planned or unplanned nature. Four types of ServPPINs are identified. These are, in increasing order of complexity: 1) simple ServPPINs set up to adopt a technology; 2) simple ServPPINs set up to produce technological innovation; 3) simple ServPPINs set up to produce non-technological innovation; 4) complex or architectural ServPPINs that engage in various types of innovation. These ServPPIN types are also related to traditional service innovation perspectives<sup>1</sup>: assimilative (or technologicistic), demarcative (or service-oriented), and integrative, as set out in the Figure 1.

Complexity Degree	approach	ServPPIN type	
			Goals
	Assimilative (Technologist)	1) Simple ServPPIN set up to adopt a technology	Public and private agents cooperate to adopt planned and simple technological innovation developed in the manufacturing sector
		2) Simple ServPPIN set up to produce technological innovation	The production of planned and simple technological innovation is the main goal for cooperation between public and private agents
	Demarcative (service-oriented)	3) Simple ServPPIN set up to produce non-technological innovation	Public and private agents cooperate, in particular, to produce simple and unplanned non-technological innovation
	Integrative	4) ServPPIN set up to adopt/produce complex or architectural innovation	Considered the most complex ServPPIN type, since it can cover various modes of innovation

**Figure 1. ServPPINs types related to service innovation approaches and goals.**

Source: Data based on Djellal and Gallouj (2013).

<sup>1</sup> 1) The assimilative (or technologicistic) perspective: analyses innovation in service under the same perspective of innovation in manufacturing industries, taking into account, largely, technological innovations. 2) The demarcative (or service-oriented) perspective: analyses innovation in service focusing on services' specificities, taking into account, largely, non-technological innovations. 3) The integrative perspective: intends to provide the same analytical framework to analyse manufacturing industries and services industries, taking into account technological and non-technological innovations.

It turns out that innovation dynamics within an architectural ServPPIN are the result of complex and non-complex processes of interactions between various actors having heterogeneous competences and goals (Djellal and Gallouj, 2013), whereas the various stakeholder goals influence the adoption and/or production of innovations. The complex nature of this type of ServPPIN describes the multiple forms of innovation that it includes and, consequently, the various competences and goals to be considered.

Within the integrative service innovation approach, Gallouj and Weinstein (1997) suggested a characteristics-based model which define any product/ service as a system that combine tangible or intangible technologies and competences (belonging to the service provider and/or the service user) in order to produce service characteristics.

The characteristics-based model highlights the importance of interface and interaction among agents participating in the service relationship. Although Gallouj and Weinstein (1997) emphasise the importance of organisational and relational competences, they do not ignore the important role of technical knowledge, which is also part of the service supply.

More recently, through the ServPPIN concept, Di Meglio (2013), Gallouj et al (2013) and Langergaard and Scheuer (2009), emphasizes the importance of multiple links and feedbacks (interfaces) between public and private sector, and also with users (in our case, representatives of associations from the communities surrounding landfills) and policy makers for service innovation. As pointed out by Djellal and Gallouj (2013):

ServPPINs are multi-agent service relationship systems. The actors involved in interaction have to deal with the ill-defined nature of their respective products, their non-stockability, a diversity of systems of interaction, the multiplicity of possibly competing value systems and the fact that their products are located in different spatial and temporal scales. ServPPINs introduce the traditional research questions of service economics into network-based analyses of innovation. (Djellal and Gallouj, 2013 p. 30. highlighted by the authors).

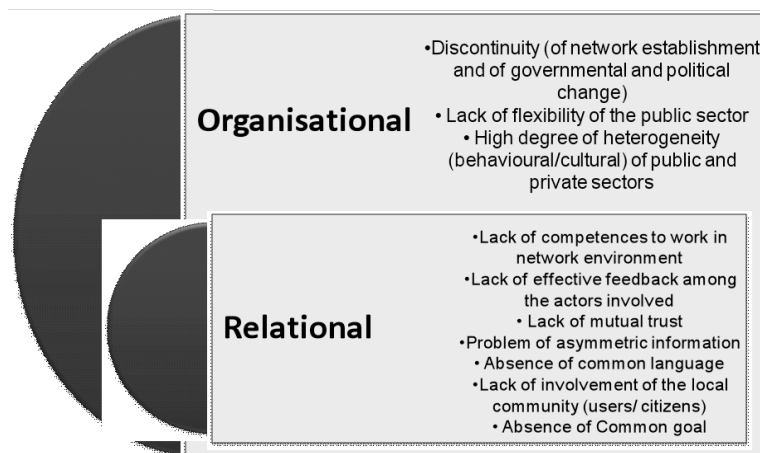
In this manner, the ServPPIN set up to adopt/produce complex or architectural innovation fits appropriately for analyzing public service innovation, once, according to Bugge et al (2010) and Bloch and Bugge (2013) the multi-faceted and heterogeneous nature of the public sector is a result of the multiple interfaces which characterize public organisations: 1) interface with the private sector; 2) interface between the public sector and citizens, and 3) internal interfaces within the public sector (between government levels and between different areas of activity).

These various interfaces, which illustrate the heterogeneity of the public sector (Brandão and Bruno-Faria, 2013), and also the permeability between organizations (private, public, and third sector) (Gallouj et al, 2013), can be useful in understanding the logic of public service innovation.

Focusing on relational and organisational aspects to innovation in a multi-agent public service relationship context, Figure 2 provides a list of limitations/barriers. It is observed that although is tenuous the distinction between organisational and relational innovations, we decided to analyze this issue separately, as a subgroup within the organisational innovation. The organisational and relational distinction is justified through the focus of this study, emphasizing that the opportunities for innovation are strongly linked to interactions and relationships built by stakeholders related to the CDM projects.



In brief, according to Figure 2, the organisational aspects to innovation in a multi-agent context are more related to cultural and behavioural heterogeneity between public and private sectors as well as the lack of flexibility of the public sector. The relational aspects are more linked to poor relationships between the actors, with the necessity to develop competences to work in a network context, diminishing asymmetric information problems and increasing transparency, mutual trust, and common language.



**Figure 2. Barriers to innovation in public services in a multi-agent public service relationship context.**

Source: The authors, based on Di Meglio (2013); Djellal et al (2013); Gallouj et al (2013); Weber and Heller-Schuh (2013); Windrum and García-Goñi (2008).

From the perspective of several authors, such as Fleury and Fleury (2001) and Zarifian (2001), individual competences are essential for a service provider carries out its activities in an appropriate manner. In this manner, the relational skills are more linked to individual skills, in which individuals develop competences to act. Within this context, the service users also play an important role: presenting feedback on their needs, desires and preferences, and for that, they also need to develop specific skills (Lima and Vargas, 2012).

The analysis of relational and organisational barriers under this context allows us to identify the competence gaps that need to be remedied in order to promote public services innovation (in this case, the municipal solid waste sector through landfill CDM projects) as shown in next section.

### **3. Empirical results: The Case of Two Brazilian Landfill CDM Projects**

51 of the 330 Brazilian CDM projects are developed on landfills - 23 of which are located in the State of São Paulo (UNEP RISOe, December, 2014). The landfills selected for our empirical research are the Bandeirantes and São João landfills, both located in the municipality of São Paulo, a city of great complexity in terms of the role played by local government management.

From 1979 to 2007 these landfills received almost all of the municipal solid waste collected in São Paulo - Brazil's most populous city, with around 11 million inhabitants - and the country's largest generator of municipal solid waste. In addition, 50% of CER (Certified

Emission Reduction) revenues are allocated to the municipal City Hall, specifically for the Environment and Sustainable Development Fund (FEMA) which is administered by the Municipal Department for the Environment.

The data on the CDM landfill projects was obtained through documentary research in Monitoring Reports (MR) and Project Design Documents (PDD), between 2003 and 2010. The United Nations Environment Programme (UNEP Risoe) database was also consulted: this provides monthly updates on CER status, generation, purchasers, and the Designated Operational Entity (DOE) responsible for CDM landfill project validation. Another data source used was the CDM registry (UNFCCC) - the online platform for CDM project registration.

Data was also collected through semi-structured interviews organised into six categories (environmental quality monitoring, gas emissions monitoring, closing of the landfill, access to CDM projects, relationships between stakeholders, and the contribution of CDM project resources to the management of solid waste). These interviews were conducted with both public and private sectors, and with service users, in the second semester of 2011.

Application of the ServPPINs framework made it possible to map and systematize the competence gaps of the stakeholders involved in the Bandeirantes and São João CDM landfill projects – and in particular, the competence gaps relating to interactions between stakeholders, making innovation feasible and improving the quality of solid waste services supply in the city of São Paulo. Using the ServPPIN concept, the analysis assists in the identification of important elements for innovation promotion in public services, and highlights the relational and organisational aspects.

It is observed that it is common practice in CDM landfill projects to have several parties involved in the landfill gas (LFG) recovery activities: concession-holders responsible for managing the landfill, for capturing LFG, Municipal Departments, and representatives of associations from the communities surrounding the landfills. The challenge is thus to elucidate the goals of each of these, as well as the competence gaps that need to be remedied in order to promote public services innovation. According to Di Meglio (2013), collective action is essential to ensuring the adequate supply of public goods and services.

In this sense, focusing on CDM project implementation - which demands publication of the activities and civil society participation-service users also have an important role to play within the context analysed. In other words, there is a need to develop interaction between private, public and third sector organisations, aimed at restructuring the municipal solid waste sector. It will then be pertinent – given that these projects involve the interaction of different actors - to discern these aspects in the analysis of GHG reduction projects in the solid waste sector.

### **3.1 Characterization of the Landfills, and Identification of Stakeholder**

Table 2 provides the main characteristics of Bandeirantes and São João landfills, regarding to the year of beginning landfill operation and year of landfill closure; the amount of waste received per day; the project registration date on CDM Registry; average of carbon credits (tCO<sub>2e</sub>) generated per year; concession-holders responsible to develop different activities regarding to landfill management and biogas recovery.

<b>Characteristic</b>	<b>Bandeirantes</b>	<b>São João</b>
Year of beginning landfill operation / closure	1979 / 2007	1992 / 2009
Tons of waste / day	4,000 to 5,000	6,000
Project registration date on CDM Registry	Feb 20, 2006	Jul 02, 2006
1st Crediting Period	Dec 03 - Dec 10	May 07 - May 14
Average tCO <sub>2</sub> e / year*	1 million tCO <sub>2</sub> e	800,000 tCO <sub>2</sub> e
Power plant: Installed capacity	20 MW	25 MW
Concession-holders	Concession-holder responsible for landfill management; and concession-holder responsible for biogas recovery	Concession-holder responsible for landfill management; and concession-holder responsible for biogas recovery
Municipal waste received over years of operation (tons)	37,226,873	26,153,980
CER price/ ton	2012	€ 3,3
	2007	€ 16,2

**Table 2. Characterization of the Bandeirantes and São João Landfills**

Source: The authors, based on PMSP (2012); UNFCCC (2005a); UNFCCC (2005b) \*this data is based on the preliminary modelled/ projected emission reductions from the PDD.

Application of the ServPPIN concept to the context studied has enabled systematization of the agents identified as stakeholders involved in the Bandeirantes and São João landfill CDM projects as well as the differences in preferences between the various stakeholders involved in the development of CDM projects in landfills (Table 3). The agents are separated in: public, private and user sectors, and each agent, with their own preferences.

<b>Sector</b>	<b>Agents</b>	<b>Agents Preferences</b>
Public	Municipal Services Department; and Municipal Department of Green Areas and the Environment	Best practices in solid waste management; Stabilization of GHG emissions; Carbon credits generation
Private	The concession-holder responsible for landfill management; and the concession-holder responsible for biogas recovery and power generation	Landfill management based on accomplishment of technical parameters; Biogas capture to generate energy and carbon credits
Users	Representatives of associations from the communities surrounding Bandeirantes and São João landfills	To reduce or to avoid negative externalities generated by landfills; more environmentally benign service; less pollution; quality of life; risk reduction

**Table 3. Agents involved in the Bandeirantes and São João CDM landfill projects and their preferences**

In the next section, we discuss the competence gaps and public service innovation opportunities emerging from the interface/interaction between the various stakeholders identified (public, private and user).

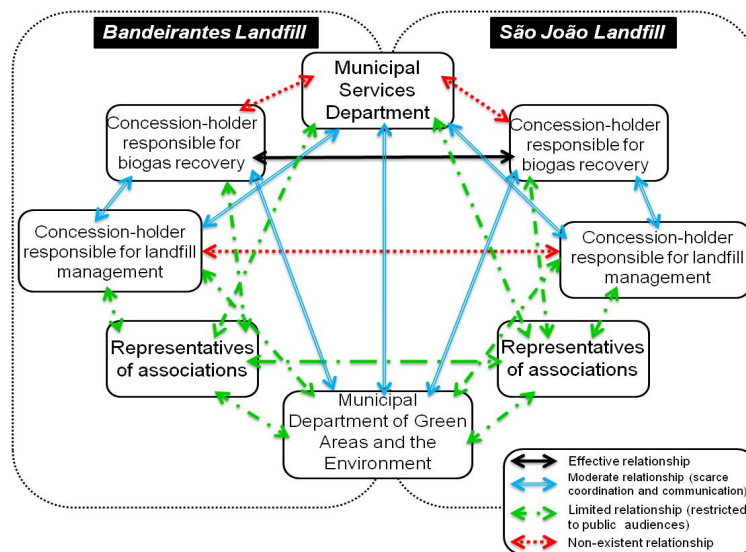
### 3.2 Competence Gaps and Public Service Innovation Opportunities

The analysis of the CDM landfill projects from the ServPPIN (using inter-stakeholder interface/interaction) shows that the promotion of innovation is limited by a wide range of factors (Table 4).

Interface/ Interaction between...	Key points identified
a)... representatives of associations from the communities surrounding the landfills and municipal departments and private concession-holders	- the need to develop a common language - the need to publicize activities related to CDM projects - the need to open up a communication channel
b)... concession-holders: private concession holder managing the landfills and private concession holders responsible for LFG recovery and power generation	- coordination issues between concession-holders at the landfills
c)... municipal departments and representatives of associations from the communities surrounding the landfills	- problems of access to revenue from the sale of Certified Emission Reductions
d)... municipal departments and private concession-holders managing the landfills	- lack of communication - lack of characterization of the municipal waste - absence of empirical data on local climate and humidity conditions
e)... municipal departments and the private concession holders responsible for LFG recovery and power generation	- absence of local regulatory standards for fugitive gas monitoring, as well as regarding the establishment of criteria for the surface waterproofing system that enables LFG recovery - ongoing implementation of legal requirements regarding the solid waste inventory in the municipality

**Table 4. Limitations on inter-stakeholder interface/ interaction.** Source: The authors.

These limitations are also associated with the interface/ interaction level between agents. Largely, the interactions are restricted to public audiences related to CDM projects (Figure 3).



**Figure 3. Interface/ interaction level between agents.** Source: The authors.

There is a need to develop competences in order to meet the above-mentioned gaps (Table 4 and Figure 3), specifically with regard to the following points: 1) understanding of complementarities between actors; 2) flexibility; 3) coordination; 4) training and 5) communication.

*a) Interaction between the representatives of associations from the communities surrounding the landfills and municipal departments and private concession-holders*

Regarding the relational aspect, communication between the representatives of associations from the communities surrounding the landfills and the other agents was identified as a core competence to be promoted. One challenge was to improve channels for the presentation of information about the objectives, and technical parameters to be met - in landfill management as well as in the development of CDM projects.

Two key points were identified as limiting and obstructing the process of innovation: lack of a common language and the need for the public sector and the private sector to publicize<sup>2</sup> the activities related to CDM projects. In other words, the establishment of an effective communication channel with the surrounding communities is required.

Without a common language, surrounding communities may remain unaware of any possible benefits arising out of project implementation. Furthermore, the establishment of a common language can improve exposure of the different interests at stake. Publicizing activities related to CDM projects and implementing an effective communication channel would improve discussions, negotiations and disclosure to the various stakeholders via public consultations and dialogue mechanisms.

In terms of organisation, in the projects studied those competences aimed at establishing new organisational models need to be better exploited. This is particularly important for models supporting the role that civil society/service users and the third sector could play in order to promote improvements to public services. In this sense, third sector organisations can be important protagonists in ServPPINs, particularly with regard to social innovations.

*b) Interaction among private concession-holders: both those managing landfills and those responsible for LFG recovery and power generation*

In terms of the relational aspect, the empirical investigation highlights the importance of the development of competences aimed at improving interaction between private concession-holders in landfills: those who are responsible for managing landfill areas and those who are responsible for LFG recovery and power generation. Once again, the difficulty of organising competences for the purposes of cooperation and communication was acknowledged.

With regard to the organisational aspect, the empirical investigation identifies a gap in competences for working in a network (lack of complementary competences, lack of ability to make use of a partner's competence).

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<sup>2</sup> The São Paulo Municipal Accounting Annual Reports (2008 and 2009) shows that no plan was published showing how revenue would be employed - which relates to the disclosure of plans, programmes and projects developed with the resources of the Environment and Sustainable Development Fund (FEMA) which is administered by the Municipal Department for the Environment Fund that receives 50% of the CER (certified emission reduction) revenue deriving from these projects.

Private companies could better interact by seeking to solve everyday problems, aggregating their knowledge of events occurring in a variety of situations in landfills - for example the problems of impermeability, or of capturing biogas.

Relational performance development would also improve landfill closure processes (for example, in relation to the material used for the landfill cover layer; maintenance of the landfill plant cover; damage to the biogas drains caused by the pruning of vegetation; cases of breakdowns to the LFG recovery system). In addition, other CDM projects in this sector may benefit from the replication of these learning processes.

*c) Interaction among municipal departments and representatives of associations from the communities surrounding the landfills*

With regard to the relational aspect, the communication issue was once again identified as a core competence to be promoted. It is thus necessary to develop the competences of the associations (from the communities surrounding the landfills) to discuss technical indicators about landfill operation and closure plans, as well as other alternatives for final disposal of waste. There is a need on the part of technicians at the municipal departments to ensure that data communicated about CDM projects can be easily understood by the communities surrounding the landfills.

With regard to the organisational aspect, it should be noted that access to CER resources occurs through public tenders. However, sub-districts need to develop competences in order to be able to publicize good quality projects and thus access revenue from the sale of carbon credits.

Monitoring and management of budgetary compliance with the Special Fund for the Environment and Sustainable Development (FEMA) (the Municipal Fund of the Municipal Secretariat for the Environment, which receives the CER revenues) requires the development of competences for financial management of these revenues, as well as staff training aimed at improving management of these various revenue streams.

The São Paulo Municipal Annual Accounting Reports confirm that FEMA's 2008 and 2009 revenues from the carbon credits of the Bandeirantes and São João CDM landfills projects were applied in programmes and projects. However, according to the data analysed, it was observed that only a small amount of the resources from the auctions of the Bandeirantes and São João projects was employed, as a proportion of the updated budget (24.21% in 2008 and 12% in 2009).

In addition, the need to develop competences was noted, with a view to developing actions directed at environmental education and the inclusion of informal rubbish collection linked to landfill CDM projects, so as to provide opportunities for improving the services linked to landfill operations.

*d) Interaction between municipal departments and the private concession-holders managing landfills*

With regard to the relational aspect, the investigation highlights the feedback gap among the actors involved; a serious lack of communication was identified. It is fundamental that clear communication channels be established between private and municipal organisations working on CDM projects.

One practical example is the issue of fugitive gas emission and gas monitoring. If technical personnel, within both public and private sectors, were to enjoy more effective communication, sharing and communicating sampling results, the control of fugitive gas emissions could be improved, increasing the efficiency of the gas capture system.

The lack of empirical data relating to the characterization of municipal waste also harms development of landfill GHG emission reduction projects, since this diagnosis allows the recognition of types of materials contained in the waste, facilitating a realistic estimate of the amount of LFG to be generated. This means that the project proponents avoid being surprised by outlined values of CER generation that are too different from those calculated at the phase of project design.

Residues characterization could also provide a diagnosis that would support a recycling market analysis seeking to understand the actual levels of demand and supply in terms of materials. This would contribute to an increase in the useful life of landfills.

With regard to the organisational aspect, the gap linked to networking competences is highlighted. This is likely to result from the (behavioural/ cultural) heterogeneity of the public and private sectors. More open organisational boundaries are therefore necessary in order to facilitate collaboration as well as the integration of various competences and goals.

*e) Interaction between municipal departments and the private concession-holders responsible for LFG recovery and power generation*

Once again, with regard to the relational aspect, the investigation identifies a feedback gap among the actors involved, especially concerning the lack of data characterization of municipal waste. Characterization data should describe the type and quantity of municipal waste generated locally, defining the amount of organic waste produced, thus facilitating a realistic estimate of the amount of LFG to be generated. The availability of such data could better align the methodology to the reality of the landfill, making calculations more precise.

Data offered by the IPCC (1996 and 2006) is generally used. The difficulty is that this information is based on average values for medium and low-income economies, which may be inconclusive and merely extrapolated to arrive at average values for a country of continental dimension, such as Brazil.

Regarding the organisational aspect, besides the networking competences gap, a further gap is highlighted relating to the absence of local regulatory standards for fugitive gas monitoring. The concession-holders apply the standard developed by the EPA (Environmental Protection Agency) even though this is not designed for local conditions in Brazilian landfills. The development of competences based on the establishment of a standard suited to local conditions would improve the efficiency of the biogas capture system.

#### **4. Conclusion**

The Public-Private Innovation Network in Services (ServPPINs) can be useful in establishing new approaches to public, private and user interactions, based on the identification of competences and preferences, existent or to be developed. The analysis of the Clean Development Mechanism (CDM) landfill projects studied using the ServPPINs perspective (i.e. through interface/interaction between stakeholders) shows that a wide range of factors

limits and affects the promotion of innovation - mainly in terms of relational and organisational aspects, highlighting the lack of involvement of citizens/service users and the lack of synergy between public and private sectors.

There is need to develop competences in order to meet the above-mentioned gaps, generally with regard to the following points: 1) understanding of complementarities between actors; 2) flexibility; 3) coordination; 4) training and 5) communication.

Although CDM landfill projects are implemented with the purpose of reducing GHG emission, rather than with the explicit goal of promoting service innovation in the project host countries, technology and innovation issues are aspects of local co-benefits generation, which have to be managed.

ServPPINs are useful insofar as they provide a theoretical framework for addressing contexts that are marked by multiple agents, and the role of competences and goals in promoting public services innovation.

The carbon market's potential for promoting improvements in municipal solid waste management by using CDM projects in landfill sites and resources from certified emission reductions need to be better understood.

Both public and private proponents must interact and plan how the Bandeirantes and São João CDM projects can be turned into an effective tool for local sustainable development - taking into account the surrounding communities' participation. The public sector could have a prominent coordinating role in this sense, favouring the promotion of improvements to services.

Opportunities for innovation relating to the final disposal of solid waste in the Bandeirantes and São João landfills are associated with the establishment of a new organisational structure, guided by the inclusion and participation of the various stakeholders identified in the research - who are already engaged in implementation of the CDM projects.

Innovation is dependent on the development of new competences by service providers and service users. These competences will mainly arise out of changes in interactions between these agents (public, private, and citizen) in the relational and organisational aspects. Such innovations will also arise out of changes in the environmental aspect, since in addition to monitoring of the technical parameters required for general operation of landfill sites in landfills which implement CDM projects - auditing is also carried out by the Designated Operational Entities (DOE), which are responsible for validation of these projects.

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