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DIGITAL INCLUSION PROCESS IN BRAZIL AND ITS SOCIAL TRANSFORMATION IMPACTS

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ABSTRACT

Definition and implantation of national policies to reduce digital exclusion involve organizational, social and management aspects. In Brazil, in view of socioeconomic, cultural, geographical, and demographical differences, implanting such policies means bringing into focus scenarios that compromise problems already discussed in the published literature with respect to Information Systems in Developing Countries. This paper presents the necessity to implant national policies of exception to expand projects of digital inclusion in regions with unique features such as Amazon. It also discusses present scenarios in implanting such projects in the region focusing on the challenges to be faced with respect to infrastructure, human resources, national and regional policies as well as strategies to manage such programs. Some metrics are presented to analyze Social Networks to generate indices or parameters with focus on analyzing social context of the actors. The methodology described is an alternative to evaluate and accompany digital inclusion programs.

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INTRODUCTION

Internet has boosted Information and Communication Technologies (ICT) as an important and recent milestone in business sectors. ICT has been influencing several spheres of the society in terms of their roles as individuals, organizations, society, etc. Consequently, ICT affect the parameters of development and are a part of an irreversible revolution of the society, business activities and government actions. ICT can help companies, spread around with different branches in different regions, to integrate their economic activities benefitting growth in both production sectors and global distribution. Extending production and business to new areas or less developed economic zones is also a plus when employing ICT.

Depending on the size of the companies, they definitely have an edge with respect to competition. The downside of this is that such large companies have leverage when dealing with developing countries, which have no other option but investing, sometimes heavily, in updating their technologies to innovate and be competitive. Studies, in particular within academic institutions, are under progress to identify social implications of ICT in the developing nations. Moreover, academics have been trying to set new approaches to define a methodology for such studies and this has become a hot topic in Information Systems as well as in multidisciplinary topics. An important aspect of this is to accept that technological innovation and its effects on the society within the developing countries are intimately related with their socioeconomic policies (Avgerou, 2008).

Experiences of innovation in peripheral and ultra-peripheral regions (within a country) clearly demonstrated employing policies of exception (Fortuna, 2009) recognizing and understanding regional realities and therefore maintaining a serious focus on developing such regions to achieve significant socioeconomic standards. The concept of ultra-peripheral region comes from European Union, but fits quite well into the Brazilian scenario when considering, for example, the Amazon region to which specific policies must be considered. In Heeks (2008), several favorable arguments on adopting ICT in developing nations are discussed: At the macro level, Heeks argues that life is becoming increasingly digital, not only in more advanced nations. At the micro level it can be observed that poor communities already sometimes prefer ICT over alternatives to spend the little money available. Within the perspective of research, there are several vantage points for ICT initiatives in the developing countries as the intended project and the reality are quite distant (Heeks, 2002). Therefore, studies focused in these countries become a valuable source of information in order to verify or validate theories of technical and economical growth that force socioeconomic policies or major reforms in that direction (Avgerou, 2008).

On the other hand, ICT ideas have been criticized as they are very much related to developing a country based just on ability to compete (Heeks and Kenny, 2002; Avgerou, 2003; Ciborra, 2005; Avgerou, 2008; Al-Jaghoub and Westrup, 2009; Romijn and Caniëls, 2011; Díaz Andrade and Urquhart, 2012). The argument of these authors is that technological innovation alone is not sufficient to improve the socioeconomic conditions of a country, although it may boost the potential for opportunities. In other words, technological innovation can be considered as a phenomenon that goes beyond technical boundaries and takes to socio-technical analysis. This is due to the fact that innovation is directly inserted in a social context.
In spite of this debate, there is a consensus that access to ICT is a must in economical development, social justice, improve in education and cultural enlightenment. Besides, eGov initiatives integrate ICT in government actions to improve quality of their services, responsibilities and efficiencies (Gupta et al., 2008; Matheus et al., 2010). It is in this context projects of telecenter and means to train instructors are inserted to enable digital inclusion. Most of these projects involve government and local institutions to enforce the applicability of ICT to improve the performance of public sectors, distribute health care and education with an emphasis on democratic participation of the community. So, research challenges pop up. For example, how can Information Systems technology be employed taking into consideration different cultural aspects of community of a specific region within a country? It means technologies may have to be tailored to suit specific communities so that they can be motivated and be prepared to naturally accept digital inclusion.

Objectives and Organization of the Paper

The objectives of the paper are:

- Present scenarios for implanting telecenters and training of instructors to enable digital inclusion in Brazil. The scenarios are discussed observing the problems already known in adopting Information Systems in Developing countries: scalability, sustainability, innovation and appropriation of the technology;
- Discuss access to information, as a universal right and consequent needs to implement specific/local policies of exception to achieve large-scale projects of technological innovation in regions with unique features such as the Amazon. It is essential to criticize approaches that discriminate regions in the sense that decisions taken in urban centers may not attend the demands of the remote centers and in particular without the community participation;
- Present how to employ metrics of SNA (Social Network Analysis) to generate indicators or parameters to analyze the social context of their actors. The methodology is presented as an alternative to evaluate and accompany programs of digital inclusion.

In order to achieve the above mentioned objectives, the paper is organized as follows: Section 2 introduces ISDC (Information Systems in Developing Countries) and providing emphasis on Brazil in Section 3. In Section 4, we define "telecenters" point out some challenges to their implementation and their role in training digital inclusion agents. Some scenarios to implement telecenters in Brazil based on ISDC perspective are discussed in Section 5. Section 6 is dedicated to focus on access to information as a universal right and the necessity to rethink of how specific or local/regional needs are considered to define public policies of digital inclusion. Section 7 relates how our research has evolved from preliminary previous work by extending the use of SNA to different levels: macro (organizational) and micro (actors within telecenters). Final considerations and remarks are presented in Section 8.

ICTs and Development

Published work on ISDC refer to: strategic importance of ICT so that companies can be more competitive (La Rovere, 1996; Avgerou, 1998; Indjikian and Siegel, 2005; Commander et al., 2011, Wrescha and Fraserb, 2012); e-commerce, e-business and new business models (Kapurubandara et al., 2004; Ray, 2011; Lawrence and Tar, 2010); e-gov and improving performance of government institutions (Basu, 2004; Khan et al., 2011; Sharma et al., 2012); systems and software development (Bagchi and Paik, 2001; Pscheidt, 2012); provision of health services (Jayasuriya, 1993; Oak, 2007) and education (Hepp, 2003; Nilsson and Nilsson, 2012); democratic participation (PNUD, 2001; Miah et al., 2009). Avgerou (2008) discusses that two areas within the published literature are distinct: one related to ICT as a strategic source to economic growth and the other related to how ICT can contribute to improve institutions and services such as health, education and governance. Considering economic growth, papers from Avgerou and Walsham (2000) and several others, criticize a direct correlation among ICT, economic growth and improving social conditions. Their argument is based on the idea that ICT (know how and practices) is usually transferred from the developed nations. On the other hand, with respect of how ICT may contribute to improving institutions and social services within developing nations, literature assumes that ICT can make a difference (Basu, 2004; Khan et al, 2011; Sharma et al., 2012) and enforce changes in public policies (Díaz Andrade and Urquhart, 2012). In the developing countries, a research stream known as ICT4D (Information and Communication Technologies for Development) can be considered as a spotlight as it refers to the international and socioeconomic development focusing on human rights to

develop the society. If the government plays a major role in social networks, then using IS and technology or hesitating in using them may have relevant implications, socially speaking (Avgerou, 2008). Besides, development of a society of information is directly influenced by: laws, use of national or adequate to international standards, infrastructure and use of existing resources by governing bodies and innovation policies. In Chile, for example, industrial sector has a significant support from CORFO's InvestChile founded by National Innovation Council (Investchile, 2011). The idea is to attract foreign investments in technology and provides necessary support to foreign companies that plan to start in the country. Several incentives, for training and infrastructure, are given as well as aiding in feasibility studies. In Israel, Start-up Nation program coordinates efforts to ensure sustainability creating consortium of companies and academic institutions to develop competitive technologies (Senor and Singer, 2009). South Korea developed and implemented national policies to stimulate economy on IT sectors that should transform the socioeconomic structure focusing on sustainable development, social inclusion and economic growth (Mian, 2011). In Singapore, a government body, the National Research Foundation, stimulates innovation combining academia, business companies and government (Chua, 2007). In India, government is the main actor for innovation and entrepreneurialism by offering tax exemption to technological sectors that ensures competitiveness in costs, commercial missions in strategic markets to map opportunities and bilateral agreements with the main consumer marketing of Indian IT products (Sarma and Krishna, 2010). And, in Brazil, strategic program in Software and IT services defines goals for 2012-2015 considering (Brasil, 2012): (i) economic and social development; (ii) international placement; (iii) innovation and entrepreneurialism; (iv) scientific and technological production; and (v) innovation and competitive edge.

Brazilian Scenario

If technological innovation is, in fact, considered as a strategy to economic growth in Brazil, it is necessary to also observe its interaction with research, technological drift and learning. So, although companies are the force behind the increase in productivity by improving and implementing advanced technologies, it is essential that government has to be a part of this change. Government can play a major role in stimulating actions towards science, technology and higher education. In Brazil, the expenses with the public sector, directly or indirectly, are more than 40% of the present resources (Brazil, 2012). Therefore, any efforts to reduce this figure have a significant impact and even better if this process moves on to other sectors of industry, commerce and services. Public sectors are still behind in employing ICT when compared to other countries and this fact enables positive perspectives based on technological innovation yielding new flexible organizational models with reasonable operational costs. With more innovation-based agile organizational structures, it is possible to offer better services to the citizens with lower costs as well as being competitive in international markets. Otherwise, Brazilian government will not be able to cope up with efficiency in delivering quality services to its population without forgetting the fact that it might be able to compete equally with other markets. So, it is essential that government takes actions to be a main and a strategic actor towards innovation process.

On the other hand, when ICTs are considered as a contribution to improve social services within a country, government efforts may not be effective due to the fact that a significant part of the population has no access to computers, to Internet, and even abilities for such use. Added to this issue, there is another major drawback of illiteracy. For instance, in 2011, 42% living in urban areas and 75% in rural areas never accessed Internet (IBGE, 2012). So, digital exclusion has become a topic of interest not only to collect data and statistical measures with respect to access and profiles, but also to evaluate projects and policies of digital inclusion.

In order to face such challenges, Brazil has some ongoing projects of implanting telecommunication infrastructure, digital inclusion and governance (http://www.mc.gov.br/inclusao-digital/acoes-e-programas).

Some of the highlights are:

- National Program of Broadband – the objective is to expand the infrastructure and telecommunication services, promoting access by the population and seeking better costs, coverage and quality;
- Digital Cities Program – implant infrastructure for network connection as well as interconnecting systems among government bodies to improve management and access of government services to the citizens;
- Telecenter Programs – implant and train agents for digital inclusion within communities and Centers for Recovering Computers to promote recovering equipment at their own localities, such as, telecenters and schools to appropriate technologies by those responsible for management and administration;
- "A Computer per Student" Project – promotes digital inclusion with proper educational incentives to provide and use, in full time, an educational laptop for each student;
- Digital Networks of Citizenship Program – favor integration of digital inclusion policies with social policies, thus creating a national network of public bodies to train the use of ICT and qualify people to use Internet in public spaces with a free access.

There are other local initiatives, such as IGOV (http://igovsp.net/sp/) and AcessaSP (http://www.acessasp.sp.gov.br) in the State[1] of São Paulo and Navegapará (www.navegapara.pa.gov.br) to install digital cities in Pará State in the Amazon region. Both NavegaPará and Acessa SP are involved in implanting public spaces to access ICT and IGOV is focused on actions on electronic governance. The research discussed in this paper has emphasis on NavegaPará as it deals with regions of difficult access. The idea in the latter is to provide free connection in telecenters, schools and public spots as well as to train agents for digital inclusion. Investments in different program in Brazil enabled the country to raise 2 positions during the last survey by Division for Public Administration and Development Management (http://www.unpan.org/dpepa.asp) of United Nations Public Administration Programme. This survey considers the efforts by the public sector to adopt ICT to improve knowledge and dissemination of information to

[1] In Brazil, states are autonomous units (self-governance, self legislation and self revenues) with governments and constitution. The so called "Member-States" of Federal Republic of Brazil are divided into municipalities which are the smallest autonomous units of the Federation.

benefit the population. In spite of this, investments are still speculative as the proposals are based on predictions of benefits in a long run and the physical capability of the technologies without taking into account the necessary efforts and barriers to implement them. There is a lack of appropriate systems to gather information, methodologies to implement processes and measure results as well as other indicators considering geographical, social, environmental and cultural specificities of each locality or region.

Telecenters

High indices of digital exclusion represent a problem to increase the democratic participation. In Brazil, for instance, due to its immense territorial dimensions several rural communities remain isolated from any global information and the government actions do not reach such localities. Internet has a low penetration and some regions, such as Amazon occupying 60% of the country, are entirely different with respect to access and scenarios when compared to urban areas. In the Island of Marajó, largest fluvio-maritime island of the globe with 40,100 km^2, there are towns[2] that are 5 days apart by boat. Latin American countries have been investing to create and use technological centers or telecenters to motivate communities to access ITC with low or no cost. In Brazil the concept of telecenters is very much related with public and community spaces that promote public and free access to ITC with several computers with Internet access. These spaces are also used to offer courses and other activities. Challenges to install telecenters and training of agents for digital inclusion Programs to install telecenters in Brazil usually are part of public sector and local organizations. There are others, very few, that are initiatives from other institutions. Brazilian government is not measuring efforts towards policies of digital inclusion by not only providing more equipment but also to train local agents to disseminate the necessary knowledge to operate such equipment. According to Mori (2011), policies from the government must consider 4 elements: physical, digital, human and social resources. For the Brazilian case, we could identify some challenges for each one of these elements. Physical resources refer to delivery, installation, telecommunication connection and adequate physical and technological infrastructures. However, if there are no skilled professionals to maintain such resources, telecenters may remain inactive for days or months. Therefore, physical resources have a strong correlation with training of personnel so that they acquire skills to deal with specific tasks.

Human resources is related to educating citizens in different levels of technologies, including digital literacy or digital fluency as well as involving specific means to employ ICTs based on local reality. Human resources, considered as one of the most complex aspects of public policies due to appropriation, locally and socially, of the telecenter space, involve hiring agents of digital inclusion, basic and continuous qualifications. By creating human resources, daily and routine technical problems of the telecenters should be solved locally. Digital resources refer to digital content, including software installation and updates. In case of development, installation and use of digital resources, challenges are those that are common while installing Information Systems (IS): user's role in the specification and design to understand what is really needed; adequate interface; coherent functionalities according to local needs; tests with those from the local community; feedback of the process of specified functionalities based on the usage. IS must be modeled in such a way to support training of digital inclusion agents in order to develop and maintain public policies. Other aspects that should be considered in the modeling process are: telecenter administration, production of parameters to evaluate the training so that management may take decisions, local community participation in decisions instead of considering decisions from communities from urban centers. Social resources deal with communities, institutions and the society that supports access to ICT. Examples are local organizations and programs that promote social awareness. Major challenges, here, are how to articulate and convince public sectors to invest in telecenters with respect to its installation and management. Different localities present different realities and these must be considered when analyzing the parameters in evaluating the progress of telecenters.

In order to avoid being criticized for fragmenting actions of digital inclusion, the Brazilian Government defined some targets to extend and consolidate public policies for this purpose. In this context, one of the strategies was to expand and consolidate setting up telecenters in all the regions of the country. This strategy has highlighted problems that we identified and classified into categories well known in ISDC (Information Systems in Developing Countries). Our discussions focus on demands to build techniques, systems and methods of analysis to foster, dynamically, decision making to correct the directions already in progress as well as future actions.

Scenarios to set up telecenters – a perspective based on known research problems in ISDC

Failure is a very familiar term in IS due to: unfinished projects, no results, users dissatisfaction, etc. Research, on failures in IS projects in developing countries, lacks of data but there are evidences to infer that such failures have higher rates than in developed nations (Avgerou, 2008; Pscheidt, 2012). This concern soars when considering pressures on innovation, investment costs and "desperate" need to match more developed economies. According to Braa et al. (2004), weaker skills to deal with IS contribute to this issue. Unfortunately lessons are not learned from errors, besides there is a lack of capital for investment and qualified professionals (Heeks, 2002). In the developing countries, endemic problems do not enable concluding technological innovations and moreover expected outcomes are unreachable (Avgerou, 2008). It is not possible to list all the possible failures while setting up telecenters. However, most of them are correlated with organizational problems, system development (implementation, monitoring and management) and management. The following sub-sections discuss some scenarios in view of known research problems in ISDC such as failures in: scalability, sustainability, innovation and appropriation of technology.

Scalability

Avgerou (2008) discusses that, developing countries, in spite of some success in setting up pilot projects, face scalability issues when trying to enlarge the pilot versions. Until 2009, most of the concluded or ongoing digital inclusion programs setting up telecenters were conducted by different entities dealing with small scale projects. With a goal to integrate such actions, the Brazilian Government created Telecentros.BR program (http://www.governoeletronico.gov. br/acoes-e-

projetos/ inclusao-digit al/telecentros-br). This program is public and its target is to offer both equipment and training to agents. The role of these agents is to not only to disseminate the knowledge but also to make the knowledge more democratic to several segments of the population. This program also includes access to culture as well as entertainment. The program's challenge is technology, producing skills, political support and its local adaptation.

In order to understand the resources of Telecentros.BR, Figure 1 illustrates a general view of its processes.

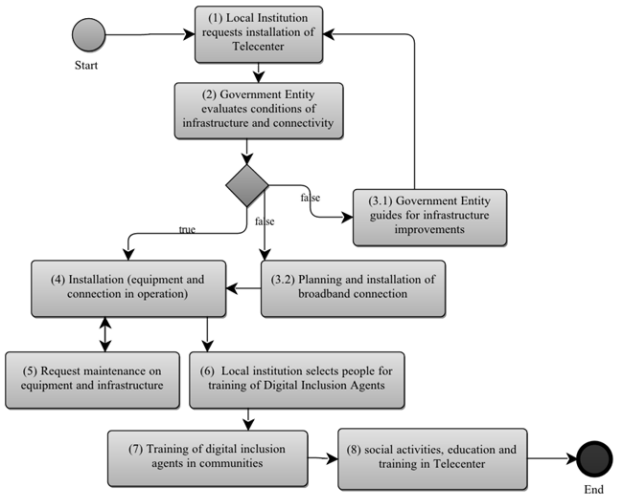

Fig 1. An Overview of Telecentros.BR Program

In order to set up a telecenter, a local institution[2] participates with a proposal to a public call (1). The proposal should include detailed information on space and existing physical installations. There is an evaluation (2) of the infrastructure conditions and network connection facilities. If there is no sufficient infrastructure, the institution is notified to set up such infrastructure (3.1). In case of lack of network connection facilities, the Government becomes responsible to provide such facilities (3.2). Only after all the conditions are met, the necessary equipment is delivered with the sole responsibility of the institution to install them so that a telecenter is set up (4). Once a telecenter is operational, eventually machines may break or there may be inadequate furniture. Whenever a problem is simple, the local set up must be able to deal with it. If not, a government sector that is responsible for solving it comes into picture (5). Digital inclusion agents that are to be trained must be recruited from surrounding areas of the telecenter (6). They are trained by regional centers, whose selection is also based on a public call (7). The local institution, through its agents, may offer courses, conduct social, educational and entertainment activities to the community (8). The illustration in Figure 1, in spite of its clarity in showing the involved processes of Telecentros.BR, there are some problems with respect to scalability and design. Delivery and maintenance of the machines, for example, to remote locations with difficult access (riverside dwellers) in Amazon is an issue. In the town of Pacajá (with a population of 41000 and 600 km from Belém, capital city of Pará State), it took months for the machines to be delivered. The delay occurred due to: (i) climatic conditions; (ii) problems with transport; and (iii) heft of the machines by pirates[3]. There is another issue of concern with respect to the country's present telecommunication infra-structure. Several requests of setting up telecenters are from regions without connectivity and may take ages to reply to such demands. Moreover, even with connectivity, some regions lack of qualified personnel to install equipment, necessary software, etc. Added to this is the lack of proper organization and lack of local political support. Brazilian Ministry of Communications estimate that around 50% of the sponsored telecenters are not operational (+Telecentros, 2012). And there are cases that even when a telecenter can be set, it is not a trivial task to attract local community members to participate in the training process. Such challenges, in several localities, haven't been sorted out and thus jeopardizing the targets that were set. The initial target, until December 2012, to set up 8083 telecenters (Falavigna, 2011), managed to just set 1193. This was clear during the 11th Workshop of Digital Inclusion in which, managers, monitors, members of the society representing 21 States participated. The participants made a Youtube video (http://www.youtube.com/watch?v=Pqbg8Oxb-T8) and a letter (OID, 2012) to the President Excellency Dilma Rousseff with a formal complaint. Based on this, another collateral damage has occurred by training only 4299 agents instead of 15000.
Even after a telecenter is set, there is a concern with the target community. A very reduced frequency has a direct impact on the expected indices on the use of Internet. Some pilot projects were successful but without any major impact on the indices and moreover such projects are not able to disseminate their operations in a proper way.

Sustainability

There is no unique definition, but the term sustainability refers to maintaining something already functioning in a self-sustainable and self-sufficient manner without the need of external support (Kimaro and Nhampossa, 2005). The concept is to sustain, survive, or give rise to a process, an organism or a resource (Loukola and Kyllönen, 2005) with some key issues: (a) what to sustain; (b) why sustain? and (c) how to maintain. However, it is not easy to evaluate sustainability as there are no enough data. For example, there is no information on how telecenters operate after it was inaugurated. How they sustain and how much they are used. In fact, telecenters are social spaces that include people, social and cultural activities. So, it is not a trivial issue of what is to be supported and not even *why* and *how*, as they are just not physical space, a connection or installed software that are to be maintained. Telecenters also involve activities that promote cultural, social, educational events. Our analysis identified three vectors: environmental, social and economical.

In the category of environmental sustainability, CDI Telecenter (http://www.cdi.org.br/) has become instrumental in guiding, donating and discarding electronic equipment. It also plays a major role on environmental education. RCL Network (http://moradiaecidadania.org.br), in the case of social category, is a NGO integrating a network of institutions that act on social vulnerabilities. It provided skills, in the area of IT, to more than 50,000. Ivinhema telecenter stands out in the economical category. It is located in the Center-West region and deals with fostering skills and income generation to young people and adults.

[2] A local institution can be an association of fishermen, riverside dwellers, native Indians, quilombola community, social entity of human rights, or any other with legal attributions.

[3] Thieves along Amazon rivers are also known as "pirates".

It plays an important role in the development of the region around its location by producing knowledge with social, economic, cultural and political development. Financial resources for telecenters are also in order and are parte of debates in defining public policies for digital inclusion. Considering that telecenters are public spaces, there is a stream that opts for the equipment and other resources to be financed by the community as a condition to sustainability. However, such ideas are not always feasible especially when dealing with localities that are poor and quite remote such as the Amazon region. In our analysis, in order to positively benefit the indices of digital inclusion, it becomes imperative for a compromise in sharing the investments. Naturally most of these investments must come from public sectors and there must be a pre-defined arrangement that agrees on these public-community responsibilities. So, the public sector must finance, at least, a significant part of the resources and telecenters must be integrated with the community activities to enable competence to use and maintain them.

Innovation and Appropriation of Technology

Innovation may be distinguished in three different ways (Pscheidt, 2012): (i) benefitting needy communities; when innovation comes from out of these communities, these are the places where it is applied; (ii) benefitting needy communities; when innovation takes place along with the involved community members; and (iii) innovation by the community by itself. The last item has appeared lately after new technologies became accessible to communities with less resources. In Brazil, the very first telecenter projects were planned and deployed by individuals and entities in the major urban centers but to be set up in needy communities, either isolated or not. Such projects had advantages of incorporating external experiences but left a gap between the project and the reality as it did not involve commitment of telecenters' users. For example, Navegar Amazônia project (http://www.cidade.usp.br/?p=93), conceived by University of São Paulo, used a boat with a lab with computers and digital media. The crew included technicians with cultural knowledge with the objective of integrating, disseminating and fostering digital inclusion in Amazon region islands. It also tried to foster economical return to the communities by commercializing some applications for cell phones. Some examples of applications were ringtones similar to sounds of the forest, pictures of Amazon cultures as wallpapers, etc. As it was a boat, the equipment belonged to the boat and it didn't stay permanently, technology appropriation by riverside dwellers wasn't considered.

Avgerou (2008) discusses that it is not a good practice planning innovation projects without the community participation. As an example, in a training program offered to digital inclusion agents by Telecentros.BR, some challenges had to be faced: (i) in an indigenous tribe, the selected person did not have permission, by his chief, to use e-mail services; (ii) program expects 6 hours of service by the agent in a telecenter; however, the riverside dwellers used to close the center after 4 hours as they had long distances to travel to get back to their homes. Nevertheless, we find examples of innovative projects planned by the communities and from the local practices. The projects could take off due to cheaper access to technologies and increase in investments by government to set up telecenters.

There is another factor, which is the increasing importance of activists in the region. Thus, innovation by local users has become somewhat common facilitating adaptation of technologies e new ways to their use within the context of the communities. In Amazon, two projects may be mentioned as examples of innovation:

Puraqué (http://www.puraque.org.br), conceived by a third sector organization. It is located in Amazonia and activist of free software receiving funds from public sector. It is a project that acts in setting up and consolidating telecenters in riverside and quilombolas communities. These communities use a currency, known as Muiraquitã, based on concepts of digital culture, meta-recycling, solid residues recycling and solidarity economy. The currency may be obtained from collecting solid residues and it can be used to obtain products and services that range from training programs to recycled computers; Saúde Alegria (http://www.saudeealegria.org.br) also conceived by a third sector organization. Also located in Amazonia, it acts on extraction communities of rivers Amazon, Tapajós and Arapiuns. It benefits around 29 thousand people. The project supports participative and integration processes, defined by the population, for developing the communities. It has doctors, agronomy professionals and educators from diverse areas. The project promotes actions for digital culture, health, production and handling agroforestry, income generation, education, arts, culture and e-participation.

Access to Information as a Universal Right and Social Transformation

Access to information is a fundamental right of life in democratic societies. Based on the principles established in the Universal Human Rights Declaration as well as Millennium Objectives, right to free access of information by means of ICT must be assured on an equal basis to all citizens being major actors in a globalized society. Besides, a global commitment to transparency of the governance can be achieved by ICT, from which, it may be possible to point out abuses of corruption, for example. There are several factors that lead to digital exclusion. The fact is, in Brazil, there are several communities with no access to ICT. They are outcast from the globalized economy and do not belong to information society. Democracy alone is not enough to foster digital inclusion. There is a necessity to promote social welfare with focus on education, health, and security. These must become a top priority or else social inequality increases (Sorj, 2003). So, there must be efforts to tackle such issues and ICT may be an appropriate means to minimize them. European Union adopted some measures to a sustainable development in the ultra-peripheral regions stressing the use of ICT (Fortuna, 2009). One of such regions is French Guiana, north of South America, considered International Amazon. This discussion provides a scope to adopt public policies to such regions with some unique features. So, the policies and programs promoted by the government are to be criticized, as they do not consider different cultural and regional issues of this vast country. Any indicators or parameters of evaluation become useless if such differences are not taken into consideration. Therefore, it is our understanding that ensuring access to information requires conditions for social appropriation rather than ensuring the financial survival of the telecenters. We consider important and instrumental including cultural diversity, access to citizenship, to political democracy, education, employments, income to evaluate programs and public policies of inclusion.

Such factors can provide insights to understand the dynamics and specific difficulties of different areas of the country. However, evaluation of telecenters that were set up is not trivial when considering all these aspects that were mentioned and very few publications are available (Avgerou, 2010). An arrangement involving public institutions and community to set up Telecenters in Amazon: Navegapará case As an example of initiatives of setting up Telecenters, Navegapará (www.navegapara.pa.gov.br) was, in fact, an innovation based on fiber optics network that involved scientific institutions and the distributor of electricity Eletronorte company (http://www.eln.gov.br). The company handed over 1800 km of fiber optics, which associated with radio signal, enabled a hybrid solution to attend specific demands of the Amazon region. The project started in 2007 with an objective of, until 2008, setting up, in the State of Pará in the Amazon region, 186 telecenters and connecting 600 schools to the network. This program is part of actions to develop the region and it is a response criticizing how the regional development, historically, was treated. The main exports of the State of Pará are mineral products (iron, bauxite, manganese, limestone, gold), agriculture and livestock. There are not any manufactured products from these sectors, i.e., just the raw minerals are exported. The result is an economy with low standards in income, weak generation of jobs and very low indicators of educational development.

Telecenters are expected inspire local entrepreneurism but unfortunately this is not a reality in almost all the centers in Brazil. Their operation depends on public policies of investments that are based on pre-arranged agreements between the community and local institutions that are to be benefitted. Such benefits include the de facto setting up of the telecenter as well as resources to promote activities. In our study, Navegapará has innovation scenarios as a local initiative from public policies with a pre-arranged agreement. This program reached a significant scale and it has a positive impact on the region, setting up 180 telecenters (http://www.infocentros.pa.gov.br). The agreed arrangement supported setting up telecenters under the local institution management, such as NGOs, fishermen associations, native indian tribes, *quilombolas* and other relevant local institutions, *Puraque* (Section 5.3). In order to extend the activities in the telecenters, Navegapará promoted, with open calls, motivated promoting workshops and social activities, such as cultural and educational projects. Besides, courses to train digital inclusion agents were also offered. Institutions with different expertise (planning, organization, action and penetration within the communities), that were part of this agreement, resulted in different scenarios of utilization of the centers. By analyzing each of such scenarios enables a better understanding of local reality. Besides, it is important to understand the relevant role each institution plays in the appropriation, in community participation and definition of policies to promote innovation and development.

Social Networks based approach

Avgerou (2008) pointed out a new field of IS to be explored within the context of ISDC, but considering aspects of possible resistance to ideas of innovation. The discussion leads to constructing analytical capability to explain technological innovation without discarding the social context. We also have the impression that evaluation models should consider socio-economic and cultural aspects of the involved society. So, when considering training of digital inclusion agents in Telecentros.BR Program, Social Network Analysis (SNA) approach has shown as a potential candidate to observe different levels: macro or organizational, in which a network is built based on social relationships among the actors; micro, where the actors exert a main role with their own characteristics and context. As the training was based on distance education and using online social networks, we applied SNA metrics to extract general indicators of participation e commitments, observed from the perspective of the networks being created among its different actors (Brito et al., 2013). Based on this experience, we focused our research to observe social, technological, cultural and political problems well known in ISDC and also present while setting up telecenters in Brazil (Section 5). As a result, new analyses were conducted on specific scenarios (Section 7.1), considering the context of the individuals, i.e, actor level.

Participation in Social Networks in Training Programs to Digital Inclusion Agents In Telecentros.BR Program, Moodle platform (http://www.moodle.org) has been employed to train digital inclusion agents. The platform is supported by mailing lists, Wiki, Blogs, social networking sites and content sharing. The Moodle learning environment (http://ead.telecentros.mc.gov.br/) uses resources and activities that explore forums, blogs and browsing online content. In a distance learning environment, instant message tool was available for spontaneous use by the participants. This fact justified the interest in extracting indicators of commitment and relationships of the participants. A database registered with 22 months of training was used. More than 4,300 agents were involved. Metrics, described in the following Section, were used on the database.

SNA Metrics

A social network is often developed and built by daily and continuous communication between people, which includes different types of relationships among individuals or groups (Jin et al., 2007). This network is based on two sets (Batagelj and Mrvar, 2008): the vertices (nodes) that represent the selected units and a set of edges (links) that represent ties between vertices. Each edge has two vertices as end points; if they are equal, a loop is characterized. Vertices and edges thus form a graph, which may be directed. Additional data on the vertices or edges are generally known as properties (or attributes) (Batagelj and Mrvar, 2008). In this paper, the nodes of the graph are the training agents. Each node (actor) has attributes, including *name*, *age*, *address*, *telecenter and local institution*. The network is thus defined as a graph and set of data (attributes) associated with it. The objective is for the agents to develop abilities on social participation, sharing problems and solutions (at the actor level). For this, two main metrics have been identified: centrality and prestige. Centrality deals with how the actor is related to the social networks, i.e., if this value is high then he or she is well positioned in the network. Therefore, prestige is also considered as a metric to analyze social networks to identify the influence of content production and publication of the agents. The *degree centrality* metric focuses on the visibility of the node in the network, i.e., the most central node is one that has the greatest degree (Wasserman and Faust, 1994). For Wasserman and Faust (1994), this metric identifies nodes that are in direct contact with many other nodes and thus occupy a central place in the network. Moreover, a less central node indicates that the actor occupies a peripheral position in the network. The metric

degree centrality can be defined using the number of edges of a node, i.e., the *degree centrality* for an actor is given by $C_D(n_i) = d(n_i)$. Centrality indices for directed relations generally focus on choices made, while prestige indices generally examine choices received, both directly and indirectly. Two centrality indices are easily applied to directed relationships (*degree centrality* and *closeness centrality*), while the mediation centrality indicator, because of its reliance on non-directed graphs and geodesic distances, is not. For actor prestige, we consider *degree prestige,* i.e., the simplest actor-level measure of prestige, the *indegree*, denoted $d_I(n_i)$. The idea is that actors who are prestigious tend to receive many nominations or choices (Faust and Wasserman, 1992**).**

Scenarios of Participating Agents in Digital Inclusion Training

Analysis focusing on learning platform based directly on access log revealed interesting sources to extract information. In this context, we can mention the tool that deals with messaging developed in the Moodle platform (http://ead.telecentros.mc.gov.br/). As there was a large volume of exchanged messages, the first step was to observe the network structure that emerged from spontaneous exchange of messages among the participants. The main motivation for this is the focus on the training program: besides capacitating the participants as agents of digital inclusion in the telecenters, the program must also promote activities to encourage participating in open social networks, where the participants can share the daily problems that show up and look for possible solutions. Therefore, it is of interest to the managers to analyze the social network of the participants, characterized by spontaneous message exchange, excluding interactions originated from the tutoring activity. This approach enables the observation of the potential of peer-to-peer interaction. Using the centrality and prestige metrics, it is thus possible to quantitatively analyze these relationships. Table 1 presents *degree prestige* and *degree centrality* extracted to visualize the networks.

Table 1. *Centrality* and *prestige* indices of the Telecentros.BR Network

Metrics	Agents
Degree centrality (average)*	134.90
Degree centrality (lowest)*	1
Degree centrality (highest)*	31611
Degree centrality (average)	0.06
Degree centrality (lowest)	0
Degree centrality (highest)	15.34
Degree Prestige (average)	0.06
Degree Prestige (lowest)	0
Degree Prestige (highest)	22.02

* value not standardized

During the training process, participants develop projects involving communities around the telecenters. Interactions among participants are very much encouraged to promote ability development to map problems and articulate solutions in telecenters to enhance the use of resources and increase community participation. As the networks are visualized as a graph and given the volume of messages exchanged among participants, it is necessary to use a computational tool. So, visualizations have been achieved by Pajek (Batagelj and Mrvar, 2012). In Figure 2, the attribute *degree centrality* is the one that determines the size of vertices (nodes) in the network.

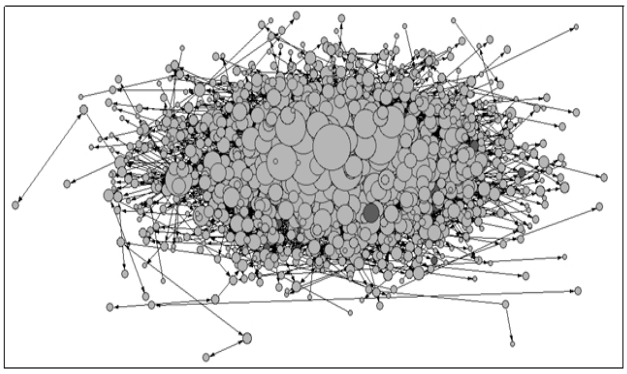

Fig. 2. Network of relationships among participants (size of the vertices according to *degree centrality*)

After applying the metrics and visualizing the network, we focused on the agents with higher values of *degree centrality* and *degree prestige*. Based on the experiments (Brito et al., 2013), 4 ranges for the calculated indices were determined (Table 2 and Table 3). To analyze agents with highest *degree centrality*, we considered just the top range (29.6%), with 1273 persons. There is still some discrepancy in the values, but in our preliminary analysis pointed out that only 20% showed significant indices of *degree centrality*. The sample was limited to 207.

Table 2. Value Ranges of Degree Centrality

Range	Agents
[4.854E-4 to 9.7090E-4)	14.7%
[9.7090E-4 to 0.0048544)	28.6%
[0.0048544 to 0.0174757)	27.1%
[0.0174757 to 15.3451456)	29.6%

Table 3. Value Ranges of Degree Prestige

Range	Agents
[0 to 9.7090E-4)	4.9%
[9. 7090E-4 to 0.0058252)	28.8%
[0. 0058252 to 0.0203883)	25.9%
[0. 0203883 to 1.807767)	40.4%

The same process was applied on *degree prestige*, i.e., considering just the top range (40.4%), 1737 individuals with a sample of 216. Combining both the lists and removing the repeated ones, the final list was with 292 individuals (Table 4 shows a reduced list, with the first ones). As a preliminary trial, this experiment was quite useful to identify tutors to act in new training courses. It also served as a strategy to understand interactions in a large-scale digital inclusion training programs to those who invest in Telecentros.BR. Moreover, social networks analysis combined with Bayesian networks enabled correlating and measuring, probabilistically, the effects of participation in the tools of interactions and use of resources and proposed activities in distance training environment (Silva et al., 2013). It can be considered as an additional facility for analysis to both pedagogical specialists and program coordinators. Each vertex (node or individual), within the social network of agents, has attributes associated with it. It is possible, from these attributes, to map a region, a local institute and telecenters where agents are located. In our case, it was possible to identify telecenters under the supervision of local institutes that historically played a major role in that region and therefore, it has potential to promote social actions with the community around the telecenter.

Table 4. Indicators of *Prestige* and *Centrality*

	Country region	Degree Centrality	All Degree normalized	Degree Prestige	Degree normalized
1	Southeast	31446	15,26	22677	22,01
2	Southeast	31611	15,34	8827	8,57
3	Northeast	3544	1,72	1862	1,80
4	Midwest	3608	1,75	1717	1,66
5	Northeast	3872	1,88	1441	1,40
6	Northeast	1396	0,67	1256	1,22
7	Northeast	2369	1,15	1251	1,21
8	Northeast	2258	1,09	1250	1,21
9	Northeast	1666	0,80	1188	1,15
10	Northeast	2878	1,39	754	0,73
11	Northeast	1211	0,58	678	0,66
12	Southeast	1557	0,75	570	0,55
13	Northeast	747	0,36	527	0,51
14	Northeast	2515	1,22	476	0,46
15	Northeast	1622	0,78	453	0,44
16	Northeast	846	0,41	422	0,41
17	Northeast	572	0,28	420	0,40
18	Northeast	551	0,26	410	0,40
19	Southeast	596	0,29	400	0,39
20	Northeast	613	0,30	373	0,36
21	Northeast	432	0,20	355	0,34
22	Northeast	838	0,40	343	0,33
23	Southeast	587	0,28	336	0,32
24	Northeast	507	0,24	307	0,30
25	Northeast	369	0,18	297	0,29
26	North	867	0,42	78	0,07
27	Northeast	846	0,41	422	0,41
28	Northeast	756	0,36	188	0,18
29	Northeast	686	0,33	187	0,18
30	Southeast	670	0,32	155	0,15
31	Northeast	635	0,31	251	0,24
32	Northeast	599	0,29	157	0,15

On the other hand, we observed a reduced list of such agents in North in spite of their association with institutions with long history of social service. Some hypotheses cropped up: telecommunication infrastructure problems, no socio-cultural identification with the program, some issues on devising a political-pedagogical aspect of the program, personal problems among others. They have to be more thoroughly considered to improve the system to acquire more information not only on the digital inclusion agents but also on the communities around the telecenters. Employing SNA to evaluate the operation of telecenters is new in Brazil. It can be considered as a promising technique to develop methodologies to measure the process of technological innovation in the context of telecenters. Such analysis deals with problems in different levels, i.e., network level, involved actors level, etc.

Final Remarks

Being the subject, setting up telecenters, multiple challenges associated to different types of facilities may be mapped. Once they are somehow managed, there are still some problems that persist and are inherent to processes of technological innovation. This goes deeper when considering developing countries, as, unfortunately, there is a bridge to span between those that plan and those that should receive the benefits. Such a bridge becomes longer considering vast countries with different cultural, geographical and demographic diversities. This is a case of Brazil where there are continental distances between its extremities and there is an impact on the ability of institutions to articulate with public sectors to set up telecenters as well as to define public policies of digital inclusion. In Brazil, only 5% of the population accesses Internet via telecenters (IBGE, 2012). Most of those involved that define government initiatives do not agree that, for this percentage of the population, it might not be necessary to justify huge investments to set up telecenters and train digital inclusion agents. Recently, Chaudhuri (2012) argued that policies to speed up disseminating ICT just by introducing computers and Internet fail and even in a best scenario are ineffective. However, regardless of indicators of accessing Internet, when innovation impacts and its consequent social transformation are observed, investments must be seriously considered, at least to some localities. It is in this scenario, a question is raised: is it possible to measure and evaluate, using same criteria, the impact of innovation by setting up and using telecenters in these different regions? Answer to this depends on understanding local contexts in which 42% (living in urban areas) and 75% (living in rural areas) never had any access to Internet in Brazil until 2011, considering different socio-economic, cultural and political aspects of each region. Digital inclusion programs, in Brazil, depend intensively on local communities and this means that it is necessary to invest in techniques, measuring and evaluation methods that consider local contexts and skills of partner public institutions in the process of innovation and appropriation of ICT.

This again leads to investing in research and in systems that acquire information with feedback to planning actions and implementation and maintenance of telecenters. In this respect, the work discussed here has been limited as more thorough analyses could have been conducted if processes to acquire information on users of telecenters were improved. This is in agreement with what Avgerou (2010) pointed out: it is instrumental to conduct studies on the institutions and political actors so that technological potential and economical models can be translated into industries, information infrastructure and more empowered societies. Therefore, our research “wakes” government organizations to adopt new approaches to plan, execute, evaluate and follow digital inclusion programs. Indicators that do not take into account local context may

result into actions that are significant and investments and efforts might be wasted. This is a multidisciplinary nature of effort and it is must be treated as such by bringing together experts from multiple areas of expertise. Our understanding is that SNA can promote advances in research that looks into how communities may appropriate and develop fluency in using ICT in all social spheres. This is because SNA not only considers data and indicators of access but also attributes of individuals, their communities and local institutions.

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