Prospecting the Appropriation of Digital TV in a Brazilian Project

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A good practice for developers of new technology, which has great influence on the life of interested users (as in the case of the Digital TV), would be to inform them about the benefits of the technology and the challenges for its appropriation. Usually the focus of works that investigate the appropriation of Digital TV has been on avoiding the non-acceptance from users based on usability and accessibility concerns. This work presents other risks related to non-acceptance, influenced by the way the technology will be owned, by the infrastructure of the city and by the life style of the population. Human and contextual factors help to overcome the non-acceptance of users and give rise to some recommendations useful for the developers of this technology to mitigate such risks.

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General Terms: Design, Experimentation, Human Factors
Additional Key Words and Phrases: Technology Acceptance, community-oriented TV

1. INTRODUCTION

The deployment of a new technology requires developers to have background knowledge of the users’ needs inclined towards this technology. These professionals apply various practices, such as identifying what users expect and analyzing the viability of such expectations. User expectation refers to the founded hope towards supposed rights, probabilities or promises [Holanda, 1999] that can influence the way he/she will interact with the technology. Many times an individual has no hope left when his/her experiences are marked by repeated failures. However, often these practices do not happen because the professionals do not believe that the expectations of some users are representative of a community. Bodker and Buur [2002] affirm that it is not recommended to focus on the needs of a particular community, but rather to regard inputs from users as a source of inspiration for better describing the products.

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In this work, such inputs refer to characteristic expectations of a sample of users, residents of a small Brazilian municipality, which were used as reference for an awareness process of the acceptance of Digital TV. Initially, it was thought that the inputs from users—representatives of a small group—would only serve as a source of inspiration to better design products. However, the participation of users revealed a series of human and contextual factors involving the community as a whole.

The analysis of the expectations of these users regarding the acceptance of the Digital TV System described in this article was influenced by human and contextual factors: the knowledge level of users of the proposed technology; friendship, trust and solidarity among people of the community; involvement and support from local authorities; and the quality of the interaction established with the researchers, among others. Such factors have been useful to help the authors in understanding the risks that would lead to the unsuccessful appropriation of the technology (that is, the non-use and/or non-acceptance thereof by the involved users). From this understanding, the authors could verify which solutions are taken by analyzing two different viewpoints:

1. The viewpoint of the users; it was verified that people apply their own solution and social strategies if they have problems accessing the system and if they have a behavior of (partially) satisfied judgment when using the system;
2. The viewpoint of the stakeholders, who are relevant professionals involved in the Digital TV system proposal, responsible mainly for the deployment of the services and the infrastructure required. It was verified that the agents (such as organizations in which the stakeholders work) are applying existing subsidies or developing their own methodological strategies as solutions, in order to provide users with an interactive Digital TV with usability and accessibility.

Our aim in this paper is to show how the target users would be prepared to accept a new technology by analyzing the risks that they face and the strategy they applied to mitigate such risks. The results have guided our research to investigate the solutions adopted by the agents. An organizational semiotic tool was applied both to classify the identified risks and to investigate the agent solutions.

This article is organized as follows: contextualization of this research, preliminary elicitation of risks that may compromise the acceptance of the technology, description of the identified human, technical and contextual factors from the users’ viewpoint, and description of the methodological and infra-structure factors from the stakeholders’ viewpoint. In our previous work [Furtado et al., 2008] only the users’ viewpoint was addressed.
2. BACKGROUND

2.1 DIGITAL TV IN BRAZIL

Television is a powerful medium in Brazil, considering its reach and social influence on the whole society. According to a survey conducted in 2007, 98% of Brazilian people have TV in their households, but only 24% have computers and 17% have access to the Internet [CGI.BR, 2007]; therefore, bringing interactivity to TV is an excellent way to promote both digital and social inclusion. After some efforts involving the Federal Government and several research groups to define the Brazilian Digital TV System (SBTVD), the system was launched in December, 2007, in Sao Paulo and is based on the Japanese standard. Since then, eight more cities —most of them state capitals—now have digital broadcast TV. The established deadline to access this technology in all Brazilian municipalities is 2016. There are difficulties for the spread of this technology deployment, such as: it requires the preparation by broadcasters of national Digital TV for transmission, as well as by viewers for purchasing converters following the Brazilian Middleware, called GINGA [2007], which must be integrated to the Japanese transmission standard. Updating the high definition image transmission is being prioritized by all digital broadcasters and there is still no return channel working to support interactivity. The value chain of the SBTVD involves agents related to different organizations (such as software development companies, broadcasters, etc.) who have a set of responsibilities to deploy the system. This chain will only be actually outlined with the definition of business configuration, regulation and coordination when the coverage is much wider and with all the possibilities of interaction deployed.

Considering this fact, the government has difficulty analyzing the appropriation and deployment of this technology, mainly when it needs to have a vision of each context in which this technology may be inserted. Consequently the government has difficulty in making decisions of investment (such as regarding STB funding, digital TV coverage, interactivity solution for return channel, etc.). Analyzing only technical solutions for technical challenges could be a grave error. People who live in small municipalities are used to finding solutions that go beyond existing technical resources in order to overcome their infrastructure difficulties, for instance. Thus, the first research question is: How can the efforts to be developed by agents as a whole help to minimize problems related to the deployment of a new technology and the appropriation thereof by a specific community? Another substantial question is: How can the relationship among citizens of such community make the technology appropriation easier? The government is very optimistic about the acceptance of this technology because of the following reasons: Brazilian users’
behavior (the culture of TV—people talk about TV programs) and their need for information (regarding learning, health, government applications of social relevance). A more realistic view of the Digital TV appropriation scenario warrants investigation in order to understand the effectiveness of the SBTVD for different user profiles. Particularly, another research question should be addressed: How did the Brazilian risks affect local communities? To answer the questions posed above, we will present a risk management study within a European Union-funded project. Then we will show that managing the potential risks at the beginning of the project would improve the chances for appropriation of the technology.

2.2. CONTEXT OF THE SAMBA PROJECT IN BRAZIL

The experiments that guided the analysis in this article are part of a research project aimed at developing applications for Digital TV, called System for Advanced Interactive Digital Television and Mobile Services in Brazil—SAMBA [2007], which started in January 2007 and will take place until February 2009. SAMBA aims to create a computational environment that allows citizens to have access to contents produced by the population through the TV. These citizens are residing in the city of Barreirinhas, a small municipality (47,728 inhabitants) in the state of Maranhão [IBGE, 2002]. The town has a high illiteracy rate (about 40% of adults). Only 33.3% of the population live in urban areas and most of them have no access to basic sanitation, resulting in one of the lowest Human Development Indices¹ (HDI) in Brazil, see Table I [Ministry of Health, 2007]. People in our scenario spend a lot of time watching television: 16% of the users watch TV more than 5 hours per day; 66% watch between 2 to 5 h/day, and only 18% watch less than 2h/day. For a clear comparison about the penetration of TV within this target population, one can take the example of Italy, where 73% of the population watch TV less than 2h/day, and not every day [Furtado et al., 2007].

| Table I. Barreirinhas and Brazilian indicators |
|-----------------|-----------------|-----------------|
| Indicators      | Barreirinhas    | Brazil          |
| Elder people    | 6,76%           | 8,49%           |
| Illiteracy (>15 y/o) | 40,93%    | 13,63%          |
| Urbanization    | 33,30%          | 81,25%          |
| Basic sanitation| 0,30%           | 69,52%          |
| HDI             | 0,552           | 0,800           |

¹ A measure of life expectancy, literacy, education, and standard of living for countries worldwide.

The Set-Top Box (STB) adopted in the project, called SAMBOX, is compatible with the European middleware MHP (Multimedia Home Platform). A STB is a device connected to the television set that, among other things, can convert digital signals into
analog signals. The SAMBOX allows the sending and receiving of data through a return channel, established via a PLC (Power Line Communication) network [Opera 2007].

The reader may be asking whether this system being financed will be compatible with the SBTVD. Before answering, two aspects are worth mentioning: the time required to deploy the SBTVD for the whole country, and the benefits that this project can bring to the research on Digital TV in Brazil. As previously mentioned the deadline to access this technology in small municipalities—as in the case of this study—is 2016. In the SAMBA project, the transmission starts in 2009. Concerning the benefits obtained with the results of this project, we can say that the SAMBA environment developed to access content through Digital TV may be compatible with the SBTVD. It is based on compatible characteristics, such as the adoption of JAVA-TV of the HAVi standard [HAVi, 2001] and GEM (Globally Executable MHP) specifications [ETSI, 2003], which are common to both the Japanese and European standards. Another benefit to contribute to the quality of the SBTVD is related to the fact that SAMBA is being built considering the socio-cultural diversity of users, their difficulties in using this new technology, and their strategies to overcome such difficulties.

In summary, accepting that the appropriation of a new technology is dependent on human and contextual factors; the hypothesis made the authors investigate the following questions: What risks do people face to own this technology? How can the relationship among people in local communities decrease risks for the coverage of this technology? In the following sections, we present two experiments that guided us in answering these questions.

3. METHOD
The researchers (some of whom are authors of this article) have worked closely in two experiments with the residents of the town (the interested users) to guarantee a good level of satisfaction of the services. Then, the team worked with the stakeholders by applying a questionnaire as a form of direct collection of data related to their role in the project. Below, we will describe the method applied in both experiments with the users and the method applied with the stakeholders.

3.1. APPROACHING THE USERS
The team performed two experiments in the municipality in January 2007 and October 2007, using—as a meeting place with participants—an institution that acted as a gateway during the initial contact with the population.
3.1.1. First experiment
The main goal of the team was to know the needs and expectations of the participants of the study via Digital TV. Therefore, with instruments (questionnaires and prototypes of TV applications) and techniques (interviews and focal groups), it was possible to elicit data to define services that are most appropriate for that community [Vasconcelos et al., 2007]. The study involved participants with different ages, education levels, socio-economic conditions and professional groups. The researchers applied 117 questionnaires, with occasional interviews at the participants’ residences or workplaces (see Figures 1a and 1b).

Then, 26 participants used some TV applications in various situations (e.g., voting, communication). The results were analyzed in a quantitative and qualitative manner [Furtado et al., 2007]. The quantitative analysis referred to the presentation of statistics on socio-demographic data (such as: number of residences that have TV, Internet access, etc.) [Vasconcelos, 2007]. The qualitative analysis enabled the definition of the needs of users in the town of Barreirinhas, which were: to communicate, to obtain information, to participate in educational programs, and to have more alternatives for leisure. Such needs were related to the limitations of the town on the basis of factors such as: restrictions on access to the Internet, few secondary schools, and few options of entertainment offered to the community. After this experiment, the stakeholders defined the TV service concept, as well as the applications to be developed. A service is a benefit that enables a target audience to live better by satisfying their needs when interacting with a particular set of applications. The SAMBA system is composed of the following applications: T-vote, T-photo gallery, T-info, T-RSS, and T-SMS. The first two applications support services of participation and collaboration among users through the TV. The next two applications support services for obtaining information created by the secondary users or coming directly from Internet pages. Using the last application, users make non-free calls to landline and mobile phones by using the TV.

With this information, the team developed several interaction scenarios about how TV services would address the elicited needs of users. The team produced a video of these interaction scenarios illustrating prospective users interacting with the new technology.
3.1.2. Second experiment

Aiming to validate the results obtained of the first study and to discover new users’ characteristics and expectations, the team conducted a second meeting and performed five workshops with thirty participants, fifteen male and fifteen female. New users were included, but still maintained diversity. In each workshop, after an explanation of the workshop goals, the users had the opportunity to use an existing Digital TV application [Piccolo and Baranauskas, 2008]. This moment also occurred in the first experiment, but this time the team prioritized group activities (i.e., the participants helped each other as they interacted with the application using a remote control) (see Figure 2a). Then, the team presented the video with the possible solutions of interaction that SAMBA could offer. To improve the understanding about what it was possible to do, the screens (still as low-fidelity prototypes) were inserted in the video. Figure 2b illustrates the participants watching a video of a professor that prepares his classes to be viewed by students through the TV. It presents a screen with fields to be filled out by the professor about class slides.

Each workshop finished with a moment for considerations about the study, choosing the acceptance factor of the new technology to be deployed in the municipality as a target point of the study. The subjective analysis to be described in the fourth section involves the authors’ perception about this factor for the participants involved in the study.

According this experiment results, stakeholders planned to testbed the following content: Information about business, education, tourism, sports, and health campaigns illustrated with pictures and some text. Some contents will be elaborated by local organizations; others can be elaborated by users who have participated in the meetings. Below, the stakeholders involved in this project are presented.

3.2. APPROACHING THE STAKEHOLDERS

Stakeholder representatives of the SAMBA value chain are researchers and developers from eight countries (half of the representatives are European and half are Brazilian) responsible for the deployment of TV services, plus two local organizations in contact
with the target users. Table II describes the relevant stakeholders, the associated agents, and their responsibilities.

Table II. Description of the main SAMBA stakeholders

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Agents</th>
<th>Responsibilities</th>
</tr>
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<tbody>
<tr>
<td>Application developer</td>
<td>Software development companies at Finland (AXEL), Germany (FHC/FOCUS) and Southeast Brazilian research institute (PUSP)</td>
<td>Develop applications that offer the services, including the content creation application and develop the architecture to treat the return channel via PLC.</td>
</tr>
<tr>
<td>Interaction design professional</td>
<td>Software developer company at Italy (CreateNET) and Northeast Brazilian research institute (Unifor)</td>
<td>Observe users experiences and design user interface applications adequate to the context of use.</td>
</tr>
<tr>
<td>TV content producer</td>
<td>Local organizations, (as SEBRAE), community (secondary users) and Brazilian Broadcaster (TV Mirante)</td>
<td>Develop interactive content in relevant community-oriented domains.</td>
</tr>
<tr>
<td>Data storage company, operator and broadcaster</td>
<td>Local Brazilian Broadcaster (TV Mirante)</td>
<td>Store the content generated with the system, and pack the content and application together to broadcast them to the TV.</td>
</tr>
<tr>
<td>Enabler of PLC return channel</td>
<td>Brazilian association of telecommunications (APTEL)</td>
<td>Offer services with personalized information through the PLC interactivity channel.</td>
</tr>
<tr>
<td>STB developer</td>
<td>Digital TV innovation center at Italy (Digilab)</td>
<td>Provide a low-cost STB compliant with envisioned solution (PLC-modem, iDTV standards, etc.)</td>
</tr>
<tr>
<td>Telecom infrastructure installer</td>
<td>Telecommunications Brazilian provider (i.e. CEMAR local organization)</td>
<td>Technical responsible for the system operation on the final user location and for the PLC network installation</td>
</tr>
</tbody>
</table>

Our perception about the users’ non-acceptance of the technology (which will be described in the next section) motivated us to get the stakeholders’ opinion about what would affect the success of the project. We wanted to understand what concrete solutions stakeholders were focused on to address certain critical factors of acceptance (herein called risks). The term “concrete solutions” is used because, according to the project schedule, all of the TV applications should have been implemented and the PLC network deployed. We constructed this understanding with the stakeholders who participated in the meeting that took place in this municipality in October 2008. The data was obtained from a questionnaire that was elaborated by following three steps:

1. Identification of agent(s) that could treat the identified risks. The agents described in Table II were associated to one or more risks according to their responsibilities.
2. Definition of the questions. For that, we first looked for factors that have some implications on solving the risks. For instance, for agents that could address risks related to community, we would like to know what international norms and standards were being applied. See Table III.

Table III. Association of the Risks to Stakeholders

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application developer</td>
<td>Standard format based language or specification (as Java, XML, GEM) for the applications.</td>
</tr>
<tr>
<td>Designer</td>
<td>Specification of the users’ context of use; International norms and standards; user profiles, W3C Guidelines to offer accessible TV applications; specification of the user interface (style sheets, virtual keyboard, closed caption) customization (text size, colors).</td>
</tr>
<tr>
<td>TV content producer</td>
<td>Commitments between the local agents (the secondary users) and the primary users. Motivational policies; Usefulness of the created content.</td>
</tr>
<tr>
<td>TV broadcaster</td>
<td>Contracts or agreements that regulate the project. Laws and conventions to offer accessible TV programs and applications; Technical subsidies as LIBRAS (Brazilian Sign Language) window.</td>
</tr>
<tr>
<td>Enabler of PLC return channel interactivity</td>
<td>Coverage area. Contracts or agreements that regulate the project. Completeens of the estimated infrastructure work. Delivery of personalized information.</td>
</tr>
<tr>
<td>STB developer</td>
<td>International norms and standards; Adaptations. Laws, standards and conventions to build TV set.</td>
</tr>
<tr>
<td>Telecom infrastructure installer</td>
<td>Coverage area. Rules to delivery the TV set equipments. Management of the changes.</td>
</tr>
</tbody>
</table>

Then we took the work of Piccolo [2008] into account, in which many questions associated to Digital TV agents in general were described. We also included some new questions particular to the SAMBA context. Blank spaces were reserved for stakeholders to write in their answers.

3. Selection of the relevant stakeholders to answer the questions. We defined six different questionnaires—written in Portuguese or English according to the stakeholders’ nationality—being applied with eight stakeholders as follows: two (2) application developers, two (2) designers, one (1) STB developer, one (1) Telecom infrastructure installer, one (1) interactivity enabler, and one (1) TV broadcaster.
4. RESULTS: IDENTIFICATION AND ORGANIZATION OF RISKS

The level of user satisfaction called the attention of the researchers to analyze some possibilities that could jeopardize the appropriation of interactive Digital TV in the community. The notion of risk refers to possible problems that might cause obstructions to the normal flow in the performance of any plan.

The researchers identified human and social aspects, such as friendship, trust and solidarity among people of the community, as crucial factors for the project to attain success in the context of this technology usage. This identification was made based on the observations and comments of participants during the experiments. These aspects are represented in layers of the “semiotic onion” [Liu, 2000], a tool used to identify and organize the risks that could influence user satisfaction towards the appropriation of Digital TV. This tool was chosen because several types of signs (such as technical, human, and social) that compose an information system and/or influence its quality of use can be represented in different and interlinked layers. The innermost layer concerns the assurance of the quality in use (operational) of a system (e.g. TV). Towards the extremities are the layers more related to the capability of TV agents (including the definitions of system transmission) and of communities (including lifestyle of final users, involvement of the local organizations) to deploy and to use the technology. Considering this structure, the identified risks and aspects relevant to this research context were placed in three layers, as illustrated in Figure 3.

Fig 3. Organization of risks and aspects in the semiotic onion

The technical level comprises technical aspects of the project, such as devices used to transmit and use the system and the infra-structure of the city. The identified risk was the Coverage Area of the Digital TV system, influenced by the number of households and people’s behavior to share the STBs. The formal level refers to possible or existing contracts or agreements that regulate the project and the technology benefits. The identified risk, called Interoperability, was influenced mainly by the following social aspect: users’ perception of the benefits of “being the first users” considering the future.
The technical level is under the influence of both formal and informal levels and, at the same time, it impacts these levels. At the informal level, we found risks influenced by the following aspects: fear provoked by works that were similar and previous to the ongoing research; and profile of the population (such as friendship, collaboration). The identified risks were: Sustainability, Adaptability and Commitment. Organizational aspects that may lead to management risks (such as lack of planning for an integrated set of governmental actions) were not considered in this work, because the main focus was on the relationship among citizens and their lifestyle.

The risks will be described below and, based on the comments of the participants, we were induced to suppose levels between satisfied, partially satisfied, and dissatisfied.

The Coverage Area risk refers to the limitation of scope of Digital TV. Fifty SAMBOX units will be distributed free of charge in places located on streets where the PLC is currently installed. Despite the efforts of the Telecom installers towards the expansion of this scope, many homes of the participants will not receive the STB because they are outside the area benefited by the scope of power distribution. To address this risk, the team requested the participants to make a list of street addresses of the possible benefited houses in which they could have easy access to watch TV. The list quickly had several addresses. When we asked the reason why there were so many possibilities, they said: “The house of Joe (a resident who will be benefited) is always open. Anyone can come in...”. Another important factor, as proved during the application of the questionnaire (N=117, 68%), people usually watch TV in groups—with friends or family. Despite the fact that the people knew each other and demonstrated the feeling of cooperation, we observed, at many moments, the desire of all participants to have a SAMBOX in their homes. The observed behaviors signaled a risk that led users to a behavior of partially satisfied.

The Interoperability risk refers to the fact that the SAMBA digital TV is different from the Brazilian digital TV. In the specific case of this research, when the TV broadcaster transmits the content via broadcast, all the content needs to be understood by the STB installed in the households. When the STB is Brazilian, the applications developed for the SAMBOX that are compatible with the GEM functions should not be re-written. However, some adjustments (such as: having to purchase another STB in the future) may be required. We stress the fact that the community has not given importance to this for several reasons: i) the delay of this municipality to be benefited by the SBTVD deployment program; ii) the fact that the municipality was elected to be the first Brazilian municipality to use Digital TV with interactivity was a reason of pride for everyone; and
iii) the gratuity of the system during the period of the project. These reasons are evidenced in the following quotes: “It doesn’t matter; this study has already brought good results for our children considering the future.” “We’re proud and interested to disclose Barreirinhas to the world.” “[...] Better yet, the fact that it’s free [Digital TV].” Such acceptance behaviors, in the view of the researchers, point to strong evidence of user satisfaction related to the appropriation of the new technology.

The Sustainability risk refers to the participants’ feelings toward the disassembly of the structure after finishing the project. Two years ago, an electrical structure was installed in the municipality in order to allow the installation of Internet in schools. There was a pilot project, where many people were directly and indirectly involved. But the project was not self-sustaining: the computers were destined for another purpose, the installations to support cabling were removed, and the technicians involved did not provide any justifications to the community. The team informed the participants that they still did not know what will happen with the PLC network and TV sets when the project is over. Given this possibility, the behavior of the users with respect to this risk was ranked as not satisfied. This classification is based on fear of testimonies related to the discontinuity of the project.

The Adaptability risk refers to Digital TV not being adapted to the profile of the population. The educational level is one of the most relevant factors to jeopardize the use of a technology by users who have little familiarity with the technology, mainly: to enter texts using a remote control, to read long texts on the TV screen, etc. For this research, in order to have a better understanding of this risk, we analyzed users interacting with Digital TV applications in situations of simulation. They are willing to interact, when followed by one or more people that can slowly demonstrate the steps. Their manifested behaviors, which might also have been motivated by the interesting possibilities of interaction with the technology, led users to say that they were willing to overcome difficulties. Therefore, this risk was considered as partially satisfied.

Finally, the Commitment risk refers to the constant change of users participating in the studies. In the second experiment, which took place ten months after the first one, we contacted the same participants again. However, some unexpected situations prevented the participation of all of them: change in residence, transfer from the workplace, lack of telephone, work-related travel. Although the change of users participating in the studies is common in users’ field studies, in this particular project it compromises the progress of the work of researchers, who have to define the places where the SAMBOX will be installed. As some actions need to be taken in function of the selected users, and as they
are always moving, the team identified this risk as inconvenient, resulting in a behavior of partially satisfied.

The next section will present how SAMBA stakeholders and target users face the risks of such technology.

5. FACING RISKS

5.1. The users’ viewpoints

Though data analyses, it was possible to establish associations between the behavior of users and their acceptance towards Digital TV. We therefore established human and contextual factors that were grouped as follows.

First there are factors that influence the acceptance of the new technology and will help to overcome the risks, such as: (i) Trust in the project, which was influenced by the fact of being funded by the European Community and by the credibility of the work performed; (ii) Feeling of friendship and collaboration among the population and their pride in being from Barreirinhas; (iii) Access to more information, especially for adolescents who have to commute in order to seek technical training and education in other municipalities; (iv) Benefits for collectivity through the use of various functions of Digital TV and for their children in a future perspective, where the people responsible for the children and teenagers envision a better life for them; and (v) Gratuity of the project, bringing Digital TV to public spaces and to several households.

There are also factors that partially influenced the non-acceptance and may be worked to overcome the risks, such as: (i) Lack of regularity of participants in the meetings with the research team because of difficulties in communication, change of address, transfer to other cities; (ii) Non-comprehension of the use of the technology, but the availability and cooperation of other people, who were more skilful with the technology; and (iii) Limited scope of Digital TV in the municipality, thus restricting access for a large part of the community.

Finally, the factors that influenced non-acceptance are the following: (i) Disbelief with regard to the continuity of the project, because of events prior thereto, was characterized as a factor that influenced some of the contacted people to avoid getting involved with the study, thus immediately refusing to participate in the first phase; and (ii) Lack of time of some of the merchants, not demonstrating interest in being available nor to make their places of business available.

Next, several factors were revealed when analyzing the stakeholders’ answers to the questionnaires regarding the risks.

5.2. The stakeholders’ viewpoints
The factors revealed by data collected from the stakeholders were classified into infrastructural and methodological terms. In terms of infrastructure, they refer to building an infrastructure that will improve the users’ experience. In terms of methodology, the factors refer to both what to do and how to carry out a project in order to assure user satisfaction. The methodological factors address requirements of specific project management. Therefore, only when describing the infrastructure solutions adopted in the studied town will we highlight the adopted solutions in the Brazilian scenario in order to evaluate the generality of the findings. The main infrastructure factors are the following:

**Support to extend the connectivity options.** For the Coverage Area risk, solutions can be found by extending the access options. According to the engineer of the municipality (the telecom installer), two public places were chosen for the installation of SAMBOX, namely: Sebrae (Center for Support to Small Businesses) and the Municipal Department of Education. Another adopted solution was to allow using applications in mobile scenarios. Thus, the users will have two-way communication resources through the return channel using both the PLC network in the case of land-line, and the GPRS or WiMax networks in the case of wireless. The transmission of data through the WiMax network is being tested in Sao Paulo. Related to GPRS network (having Internet access using a cell phone network), many operators provide cell phone users with a wide coverage area for this technology in the whole country. In Barreirinhas there is only one operator;

**Possible adaptation to the Brazilian Standard.** Despite the fact that users do not consider the Interoperability risk as discouraging to adopt the technology, we investigated with the application developers how difficult it would be to make future adaptations to use the currently developed applications in the Brazilian system. “Applications for the STB are designed for STB with MHP. So they are based on MHP Standards,” said an application developer, and “STB standards (such as GEM/MHP) tend to be slightly incompatible in details and profiles. While not having to rewrite applications would be desirable, it’s no big problem to make adaptations, since the Brazilian middleware could interpret Java applications and their XML format,” said another application developer. To make SAMBA applications run in the Brazilian system, it is necessary to use the Ginga Java free version. Sun Microsystems released this version in December 2008; by now it is only available for developers who take the courses offered by Ginga developers;

**Contracts that regulate the PLC network are still being defined.** SAMBA has not yet achieved a formal level in its specifications. Take the example of the use of PLC technology, which is not yet common in Brazil and where legislation to offer interactivity channels has not yet been defined. The interactivity enabler said that there is a public
tender process at the National Agency of Telecommunications (Anatel) related to the proposal for regulations that will guide the provision of broadband via the electric network. The result of contributions should accelerate the definition of the regulation. Since this fact is still in the definition stage, it somewhat complicates the mitigation of the Sustainability risk;

**More flexibility to interaction.** It was noticed that the Adaptability risk has been addressed by several stakeholders, such as the designers, the application developers and the interactivity enabler. They have sought mobile solutions to provide various types of content and to give more flexibility for interactivity. For instance, because the STB must be low-cost, it is not possible to have streaming video via the return channel. Thus, in mobile scenarios, the users will get video. In Brazil, it is already possible to watch TV on cell phones. However this is a mobile TV that needs just an antenna on the handset. There is no need to have deployed the SBTVD. In addition, during users’ field studies [Furtado et al., 2007], great familiarity of participants in interacting through SMS was observed. For this reason, the skypeTV application was implemented to support TV users to send SMS messages to mobile users;

**Management of SAMBOX’s address in the households.** Concerning the Commitment risk, the choice for a benefited user (or family) to obtain the SAMBOX followed by the removal thereof during the period of service use may bring inconveniences to stakeholders to evaluate the quality of services through the PLC network. The addresses of the SAMBOX units must be registered and updated. The engineer of the municipality said that they would manage a list of delivery of the equipment and receive a letter signed by the benefited user committing himself/herself to take proper care of the equipment and to contribute to the project. He also stated that in the event they do not uphold the promise, his team can go easily to their homes and take back the equipment, stating that people let his team in and out of their homes whenever they need. This proposal for mitigation of such risk cannot be applied in the entire country; people from larger cities are more reserved regarding their privacy.

In methodological terms, as the risks of Coverage Area and Interoperability concern technical and formal issues, the solutions were identified only to address the informal risks, as described below.

For the Sustainability risk, the local organizations that have influence on the society and that are concerned with the well-being of the community are providing stakeholders with possible solutions. For instance, the local broadcaster is sending journalistic reports on the news of the project to the radio, TV and the web portal of the news network. “This
news and the project’s early results, such as the installed infrastructure and the developed applications, have attracted the interest of local authorities,” says the Telecom infrastructure installer. This fact was confirmed by the response of the Brazilian designer (the mediator at the meetings with users) who says she has been approached by a local organization to draft a project requesting resources from the Brazilian government to provide continuity to this project.

Regarding the Adaptability risk, it is important to have support for interaction. The Italian designer believes the SAMBA applications will be easy to use, because there is conformity in the applied standards (for navigation, to start an application). In addition, there are some possibilities of customization (text size, colors). The Brazilian designer believes most in the manifested behaviors of the participants that are based on a community-oriented lifestyle, instead of an individualistic one [Furtado et al., 2007]. This is the reason they are preparing a strategy for expert users to motivate non-expert users to interact with the SAMBA applications (for instance, to read and enter texts).

For the Commitment risk, the Brazilian stakeholders are applying several participative techniques focused on users’ present and future daily lives. This means they are working close to the secondary users in order to find ways to motivate people to interact with the system. Particularly, some factors obtained from the questionnaires were the following: i) Generation of useful contents for small groups. One application developer said: “at the moment we’re thinking more about small groups (like school classes, groups of friends) who will create content that is appropriate for that group, and we hope to have lots of such small user groups (with overlaps) rather than one big group;” and ii) Adoption of inaugural strategies. The TV broadcaster is preparing a strategy to inform users how important their participation has been to the process of defining the system.

This section showed how human, technical and cultural aspects may be mapped into specific strategies useful to mitigate risks from the users’ viewpoint, and how methodological and infrastructural aspects can also be helpful for the stakeholders’ actions.

5.3. DISCUSSION

The main implications of our findings regarding the identification, classification, association and mitigation of risks are summarized as follows:

**Focus on human and social aspects rather than stakeholder targets.** Comparing this risk analysis with a traditional project risk management, the main difference is that this one is mainly based on the users’ viewpoint instead of also considering the stakeholders’
targets and responsibilities. For example: the TV broadcaster’s main concern considered in this analysis was not an increase in audience, just as the manufacturer’s main concern was not increasing the set-top box venue;

**Implication of the semiotic onion for facing the risks.** Stakeholders were associated to one or more identified risks by taking into account their responsibilities in the project and possible factors that had some implications on solving the risks. This association was not difficult work, because the risks were previously classified according to the semiotic tool illustrated in Figure 3. For instance, stakeholders responsible for factors related to aspects placed in a certain layer were associated mainly with facing risks regarding these factors (although not exclusively);

**Implication of a Brazilian risk in SAMBA and Brazilian scenarios.** The Ginga middleware specification is composed of Java API to support the interactivity developed with JavaTV applications. The limitations in having the Ginga Java free version write Java applications may be considered a Brazilian risk. In the SAMBA scenario, this may make it more difficult to adapt the system. So, solutions of using JavaTV to mitigate the Interoperability risk depend firstly on the Brazilian solutions to support this language. In the Brazilian scenario, the Ginga STB developers must pay the license to each STB produced by increasing the price. A high-cost STB compliant with Ginga solution would cause negative impacts on the promotion of educational programs in local communities, for instance. Low income populations, who generally present the highest illiteracy rate, may not have access to these kinds of interactive programs through digital TV;

**Opportunities for mitigating a Brazilian risk in SAMBA and Brazilian scenarios.** While the SAMBA stakeholders will use the system installed (antenna, transmitter, server) in the town and the transmission services of a public broadcaster (a SAMBA stakeholder) to run the applications, the reality in the Brazilian scenario is different. There is a consensus among Brazilian agents that application developers should not wait for public broadcasters to transmit their developed applications. Public broadcasters are not interested in promoting digital inclusion if they have to divide their audience, for instance, by transmitting interactive TV applications with educational contents to several channels. As opportunities, application developers should look for: i) STB developers who are interested in having several contents (mainly commercial contents) as case studies of STB utilities and; ii) cable TV companies, who are already promoting interactions with TV applications (however they use American or European standards, not Ginga).

6. RELATED WORKS
We looked for multi-national driven projects that address the deployment of a new technology in communities. Beacon (2008) is a research project on Digital TV also carried out with the support of the European Commission. It will develop innovative T-Learning services in the city of Sao Paulo, Brazil. They defined the educational methodology and prototypes for T-Learning from questionnaires and interviews. Citizenmedia (2008) is also a multi-national project on Digital TV. It defined the proposed applications and the target users’ profile mainly by using cards during the meetings with participants of the study. In BREWER et al., [2005] there is a description of the inappropriate infrastructure of the target town and solutions to introduce the technology in this context. In all these works, user field studies were conducted. None of them discussed the specific characteristics of the community in which the technology is going to be deployed, thus providing a number of lessons to be learnt for similar future projects.

Related to works using the SBTVD and/or producing something to improve it, our research brought some initiatives but with no results involving real experiments focusing on the users’ behavior and interest in using interactive TV at home and producing their own contents. Other works—as is the case of Brazilian works [Piccolo et al., 2007] and [Furtado et al., 2005]—have demonstrated initiatives to develop Digital TV applications focusing on usability and accessibility by suggesting to provide users with, for instance, opportunities to personalize such applications, increasing font size, changing colors, providing alternatives to write and read, etc. Other works have presented studies about the purchasing power of Brazilians to acquire this technology [Holanda et al., 2006].

7. CONCLUSION

Digital TV has been characterized as a very important resource for digital inclusion in which the involved population lacks information resources, and where television is one of few means of communication. In this article, we focused on analyzing the expectations of target users inclined towards this technology. When analyzing the ways in which the relationship among such users could make the technology appropriation easier, the observed users’ behaviors revealed some human and social aspects, which signaled risks that make users become satisfied, partially satisfied and dissatisfied.

Regarding the generality of the findings presented herein, we want to emphasize that the risks of Sustainability, Adaptability and Commitment can be the same for any Brazilian municipality with similar characteristics, such as: limited infrastructure, mainly in small municipalities; the citizens have had previous non-successful experiences with projects for deployment of new technology; and the citizens lack familiarity with the
technology being proposed and do not see any reason to overcome their difficulties. The Interoperability risk is specific of convergent technologies, such as Digital TV, and is being deeply studied by the aforementioned European Union-funded project. Finally, the Coverage Area risk is common in isolated communities. This is the case of Brazilian projects for the creation of a digital village, because only a few streets are connected via the power distribution system. Future work should involve a comparative study that could be made by applying this project in other Brazilian cities in order to discover the matches and mismatches of users’ cultural aspects and to validate the generality of the findings presented herein.

In this paper, several factors related to motivation and technical issues, among others, were identified and analyzed based on the manner whereby stakeholders and users expect to mitigate such risks. The results lead to a systemic solution encompassing both users’ and stakeholders’ perspectives, which can inform solutions for the Brazilian scenario. Furthermore, we analyzed that Brazilian risks (such as the lack of support to interactivity existing in the current technology, lack of interest of public broadcasters) may affect local communities. Several educational and social programs geared toward the low-income population may not happen as the government expects. In this study, we perceived that there is a worse situation: when the involved individuals lose hope caused by their experiences of repeated failures.

We believe that seeking alternatives both to optimize the infrastructure existing in a community and to enrich the social interactions of such community will increase the chances that people have to increasingly appropriate their lives and capabilities. It is important to do what small communities seem to do in general: to shift from individual-based to group-based projects, in order to treat the phenomenon of social and digital exclusion as dynamic. We also believe that the preliminary findings of this work are useful to other international technological projects, suggesting ways of dealing with cross-cultural issues. They are also particularly useful for the SAMBA European project as means for knowing the expectation of the community and for adequately dealing with the potential frustrations thereof.

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