Social Media in Smart Cities: an Exploratory Research in Mexican Municipalities

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Abstract
Social media tools have been the main tool in many municipal portals. Municipalities have used Twitter and Facebook platforms to improve communication and speed services provisions as an initial step to become a smart city. The purpose of this research is to explore such goals in eight Mexican municipalities of the Central State of Mexico. Through a mixed research - qualitative and quantitative - data collection of the KLOUT score and interviews of community managers, we explored this social media approach and the link with the smart city impact. We found that most municipalities are using these tools without a strategy or plan to become a smart city. Some of them - Tlalnepanta and Metepec - have an important strategy and the main goal of using technology is to improve their citizen relationship and inside process.

1. Introduction
Research of social media in municipalities has been relegated; despite the enormous potential of this platforms to enhance citizen relationship. Up to date, most research has been done on local or federal governments [1], [3], but recent research is focusing more in smart cities rather than at a municipal level [4], [6]. This new research trend has been discussed in recent years. What makes a city smart? What functions or elements can be considered to decide if a city is smarter?

Much research regarding this definition has been done [6], [7]. Some researchers consider that in order to understand this area we have to conceive and integrate a framework [7] and not a single idea that relates to technology implementations [8]. An area to be discussed regarding smart cities’ advancement is the inclusion of social technologies to increase communication and improve relationship with citizens [5]. The inclusion of social media technologies is another approach to be researched in detail when following this path of research [9], [10].

The purpose of this research is to explore social media inclusion in smart cities. We chose the municipalities of the central Mexican State to understand this process using a mixed method: a qualitative and quantitative approach in order to develop an integrative and comprehensive study of this trend.

This paper will be structured as follows. This first is an introductory section followed by a literature review section that shows conceptual trends and some background of this topic; a third section which describes the methodology of the research design; a fourth section that describes our main findings; a fifth section of discussion and the final section will address our conclusions and recommendations for this kind of research.

2. Literature Review
Research on cities and the use of technology to implement services and promote governments online has been done for some time [11], [13]. Most of them are related to the idea of one-stop online services and the diffusion of government activities.

The use of technology for municipal diffusion of government activities started with the research of Weare et. al [14] searching over 454 California websites. This is one of the first researches with this perspective, in which cities are conceived as data providers through the use of Internet. The e-MuniS is a project for information sharing and best practices for the implementation of online services along municipalities [15].

Research of the use of computer technology and information systems in cities started on Poland when the analysis of 15 Polish cities revealed important trends for the federal government [16]. Ahn’s research
Survey studies about the use of Internet technology in cities are also held by Holden et al. [22] in the U.S. and Bochicchio [23] who found some interesting needs in Italian cities – front office procedures, normative and bureaucratic procedures. The Romanian study of 165 cities is another contribution in this field [24] in order to understand the “intelligent citizen” and the urban perspective. The Arab study of six Arab capital cities with official municipal Web sites revealed some inoperable features for these countries and lack of interactivity and services.

Corpus Christi in Texas focused on citizen interaction with online government transformation research over e-services for citizen [25]. This could be considered as an early stage of interactive social media platforms use. Agostino’s research [26], over 119 Italian municipalities, is related to the engagement of using social media tools. Bonsón’s research [19] studies citizen trust in governments, transparency levels and engagement.

Another study of the Los Angeles county related technology with citizen services [28]. In the UK, the change of concept introduced e-citizen into the CRM formula, different from the traditional perspective of citizen as a client [29]. The Ontario case that used data to predict and increase citizen contact is a complementary perspective of the use of technology that started supporting a relationship between citizens and government [30].

An example of the use of social media for municipal public administration is the Italian IRIS online platform where citizens can report urban maintenance problems and expect an answer from the government. This adaptation of local bureaucracy using technology was implemented in Venice [31].

We can find another contribution in England where social media was used by government officials to understand and transparent government actions [3]. Also, in order to understand the problem of transparency and social media in municipalities there is a research of Swedish municipalities where authors state the difficulties to align transparency with the process and the fast updating of social media [32]. Another contribution to understand the use of social media, transparency and accountability is proposed by Bonsón [27] whose research introduced the idea of e-participation and social media.

Another path of research on municipal use of technology is the use of mobile technology. Arlington’s city app which is a clear example of this, was launch before the super bowl to provide government information and help visitors [33]. This conception leads to understand the city as a platform of interaction more than just services [34], [35]. Research from Gil Garcia [36] for the case of Mexico City, integrating the technology program Angel Network, goes in the same direction.

We can extract three main trends from this review regarding social media and municipalities. The first trend is to understand the impact of technology through products, surveys and obtained results. The second trend is the main use of social media platforms to communicate with citizens and spread government goals. The third trend is the use of mobile technologies through apps which enables government and citizens to increase their communication and relationship. This research is focused on the second trend, in which we analyze social media tools on government action.

3. Method

Our research design is conceived on qualitative and quantitative methodologies in order to obtain a clearer view of our object of study – social media in municipalities. For the purpose of our research a mixed method is ideal to understand the approach of social media from different perspectives [37], [38]. This section will explain both stages.

3.1. Quantitative Research

The sample consisted of thirty municipalities that helped statistically for the findings and final conclusions. In order to analyze the social media data, we used Klout as a main variable combined with other statistical numbers of 30 municipalities such as: inhabitants; households with computers; households with Internet access; cellphone access and school years. All data was obtained from the official government registry ministry INEGI [43].

According to Edwards and his team, Klout “is a system-generated tool for measuring influence. In other words, it is a potential rating system that can be used as a measure of credibility. Klout is computed based on a user’s ability to drive action in social networks” [39]. Klout’s score has three components: true reach (how many people are a user influence), amplification (how much the user influences them), and network impact (the influence of the user’s network). The social networks that influence a user's Klout Score are Twitter, Facebook, Google+, LinkedIn, Instagram and Klout itself [40].

3.2. Qualitative Research
We selected eight study cases based on interviews for the qualitative analysis. We characterized issues about software for measuring social media, organizational impact, personnel involved in social media tasks and social media strategy and later we made a collective analysis in order to find four variables of the studied object [41].

Our research instrument has five variables: information, queries or consultations; inclusion, collaboration and empowerment based on Mergel’s research for the public administration model [42]. Our sample initially considered 11 municipalities but only eight accepted to provide the interview (see Table 1).

<table>
<thead>
<tr>
<th>County</th>
<th>Follower</th>
<th>Twitter</th>
<th>Facebook</th>
</tr>
</thead>
<tbody>
<tr>
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<td>8</td>
<td>4241</td>
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<td>1275</td>
<td>3025</td>
</tr>
<tr>
<td>Cuatitlán</td>
<td>3303</td>
<td>1552</td>
<td>2395</td>
</tr>
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<td>Ecatepec</td>
<td>10996</td>
<td>2808</td>
<td>21054</td>
</tr>
<tr>
<td>Huixquilucan</td>
<td>1713</td>
<td>159</td>
<td>5796</td>
</tr>
<tr>
<td>Metepec</td>
<td>4509</td>
<td>503</td>
<td>2874</td>
</tr>
<tr>
<td>Naucalpan</td>
<td>8448</td>
<td>8086</td>
<td>6011</td>
</tr>
<tr>
<td>Nezahualcóyotl</td>
<td>4573</td>
<td>50</td>
<td>10346</td>
</tr>
<tr>
<td>Tlalnepantla</td>
<td>5761</td>
<td>655</td>
<td>4401</td>
</tr>
</tbody>
</table>

Table 1. Municipalities’ sample for qualitative research

3.3. Background, Mexico’s use of Internet

Internet use has grown quickly in recent years in Mexico. According to the latest study of AMIPCI [43], there are 45.1 million Internet users in the country. The 30% of Internet in Mexico is in the range of 25 to 44 years, a young – mature sector. During 2013 the daily average time connection for Mexican surfers was 5 hours and one minute.

INEGI [44] reported that in terms of connectivity 9.5 million Mexican households have Internet access which represents 30.7% of the total in Mexico meaning an increase of 20.6% compared to 2012 (a very significant increase). There are 11.1 million households equipped with computers in Mexico. This represents 35.8% of households in the country, an increase of 13.3% in relation to last year; finally 65% have cell phones.

The study of the World Internet Project (WIP) [45], a national survey carried out with two thousand interviews, with a confidence interval of 95%, indicated that there are 59.2 million Internet users in Mexico. Among the analyzed activities in this study: 91% of users access social networks. There was an increase of 70% compared to 2011. In 2011, 97% of users reviewed their email compared to 2013 were the figure declined as only 85% of people reviewed the use of social networks.

The Mexican Internet Association (AMIPCI) revealed in its ninth study regarding Internet habits of users in Mexico (2013) that Mexicans sending and receiving e-mail was the first activity online with 87%. In the second position, with 84% was for searching information. The third position with 82% was for accessing social networks. The main entertainment activity is the use of social networks, where 9 out of 10 Mexican use it, representing a 93% daily.

4. Findings

Our findings are organized into qualitative and quantitative sections. The combination of them resulted in interesting achievements.

4.1. Qualitative Findings

Our research instrument has four variables: information, queries or consultations; inclusion, collaboration and empowerment based on Mergel’s research for the public administration model [42]. We organized our findings following these ideas.

4.1.1. Information. Most of the interviewed counties have the ability to provide information using their Twitter and Facebook accounts. According to the interviewers citizens use these platforms for placing questions related to public services. Three examples are relevant. The county of Coacalco suspended the system of water supply for a couple of days. Information and questions were provided using Twitter. A second example was the use of Facebook and Twitter in the county of Metepec to collect food and beverages to help in with a natural disaster, a hurricane that affected the states of Guerrero and Veracruz in 2012. The county of Huixquilucan used these tools for the diffusion of several festivals achieving a high impact.

"People started sending retweets about the collection for Acapulco. One lady, Sara Cortez from Cuatitlán Izcalli published: ‘very good you are doing so. How can I help?’ And we answered: ‘just collect food, beverages for people in the disaster areas’. The lady started promoting among her neighbors and collected a lot of things. She requested a hearing from the major and was received. The major thanked her for all the help for the government’s initiative (Metepec’s interview)."

4.1.2. Queries or Consultation. However the most recurrent use of social media tools is through petitions
and complains from citizens. Nezahualcóyotl and Naucalpan created a program named "citizen’s management" to gather and track complaints, petitions and services collected directly from social media platforms. Using this system they created a ticket, provided feedback and reported the goals of the service.

The second example are Nezahualcóyotl, Coacalco and Metepec that received information from social media platforms, giving instructions to solve petitions but there was no task compliance tracking. Finally, the rest of the interviewers mentioned that they collected information but there were systematically no tracking. Another interesting example took place in Nezahualcóyotl where neighbors asked for their policemen cellphone number or patrol number using Twitter or Facebook.

4.1.3. Inclusion. The best example for inclusion is provided by Naucalpan which performed virtual hearings with the mayor using Twitcam. Coacalco is planning to use the same strategy but with the addition of agency directors or responsible for public services. Tlahuapan uses YouTube channels to stream the sessions of the city council. An interviewer from Coacalco expressed:

"Young people are the most active; they suggested a football field using some free areas.... We invited them to get an appointment and solve their petitions off line".

4.1.4. Collaboration. The use of social media tools for promoting collaboration among citizens and public officials is a promising trend. This is what most interviewers revealed. It is important to point out that the use of these tools is mostly to promote cultural activities rather than political ones. The "zombies’ parade" in November was mainly organized online by citizens from Nezahualcóyotl and petitions regarding security and organization were held using social media platforms.

The Quimera, a cultural festival organized by the county of Metepec, asked for cultural projects and initiatives using online social media. They received 57 proposals for different activities for the festival. Also, in this county they submitted streets’ names and circulation changes using Twitter and Facebook with a great participation and success from citizens.

"We are looking for this relationship to become meaningful. With our new strategy we look forward to creating a connection with citizens. It is important that citizens understand our worries about their concerns and needs. We are really interested in their problems and we will track their petitions and claims until they receive an answer.

4.1.5. Empowerment. We did not find any element that would lead us to the creation of empowerment using social media tools. Most of the municipalities are using these tools only for information purposes and for collecting claims or needs; not for providing co-productions or any relationship with citizens. The closest idea was a participatory budget practice that the Tlahuapanla municipality implemented using their website that allowed citizens’ participation on budget decisions. An extract from Tlahuapanla’ interview:

“For the participatory budget, we launch a hashtag #makeithappen. We asked citizens using Twitter what kind of things they needed in their neighborhoods. We provided a workshop to teach citizens how to elaborate a proposal. Our municipality created a special account of 100 million pesos just for his project in 2014”.

Another part of the interview was related to technical and organizational issues: involved personnel, software use for measuring impact, organizational structure and changes and general strategy. Our main findings are summarized in Tables 2 and 3.

<table>
<thead>
<tr>
<th>Software</th>
<th>Atizapán</th>
<th>Coacalco</th>
<th>Ecatepec</th>
<th>Huixquilucan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mentions that they only use the tools that Facebook provides</td>
<td>They only use the tools that social networks offer for free</td>
<td>Mentions that they measure its growth by using graphics</td>
<td>No answer to this question</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization</th>
<th>2-3 people in charge. Speaker Office is the owner of the social media</th>
<th>They have a special social networking area which controls other dependences</th>
<th>Electronic Government area.</th>
<th>“The structure of the official website is precisely in charge of an area called e-government&quot;</th>
</tr>
</thead>
</table>

| Personnel | Each department has its own social network | Each one of the managed areas has its social networking link | Each department has its own social network | Each department has its own social network |
Strategy
Generates “likes” on Facebook and maintains conversation in the social media platforms

Tracking of complains or information needs from citizens and integrates a team group for solving them

Organizes citizens’ petitions and demands through social media tools and directs them to the correct government agency

Table 2. Summary of findings - qualitative research

From these technical topics, we can extract three main ideas. The first one is that most of the interviewed municipalities have a lack of strategy for social media. With the exception of Tlalnepantla and Nezahualcóyotl, the rest of the municipalities are just using the social media for information purposes and to collect claims and doubts.

<table>
<thead>
<tr>
<th>Metepec</th>
<th>Naucalpan</th>
<th>Nezahualcóyotl</th>
<th>Tlalnepantla</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>Use of free software to measure impact, but do not specify which one</td>
<td>Social Bro, HootSuite, Facebook</td>
<td>Use of undetermined software to measure “likes”</td>
</tr>
<tr>
<td>Organization</td>
<td>Speaker and communications area</td>
<td>All department s are in charge their own Twitter account. Only Facebook is a general account which concentrate s all information</td>
<td>Multimedi a Departme nt</td>
</tr>
</tbody>
</table>

Table 3. Summary of findings - qualitative research

The second idea is that most of the interviews revealed not sufficient personnel involved in social media tasks. Most of them share this task with other administrative ones from their normal jobs. With the clear exception of Tlalnepantla, that holds a specific agency assigned to social media tasks and organizes the work of the rest of the agencies that have a social media tool, the rest of the municipalities have an important lack of personnel.

The third idea is the organizational problems revealed in the interviews. The first problem is that the social media are usually subordinated to the department of the speaker’s office – communication area – but does not dependent from the CIO or the IT department of the municipalities. This way, the area does not regulate or organize information for press releases with a proper strategy for social media.

A second problem is that some municipalities like Metepec, Nezahualcóyotl and Tlalnepantla allow every agency to have a Twitter or Facebook account with the problem of information dissemination and lack of quality controls for the information releases of social media. This could be a problem in the long term that
needs to be discussed. It is important to consider for the future if the carry on with this kind of practices or if they get just a single official account.

4.2. Quantitative Findings

Our research based on quantitative data is supported by two kinds of analysis: a descriptive analysis and a correlated analysis, both of them are described as follows:

4.2.1. Descriptive analysis. The descriptive analysis is based on the Klout data collection. We started collecting data in 2014 when interviews of the qualitative research were already conducted. However, some of the municipalities do not have this measurement yet. Besides, some of them still do not have a Twitter account. Nevertheless we collected a sample of 30 municipalities that are described in Table 4.

The first thing to mention is that interviewed municipalities (see Section 4.1) have a remarkable use of social media tools. For example, the case of Metepec that started with a Klout of 52 in April 2014 had an important increase in just a few weeks reaching 57. Two municipalities are also interesting because they are stable in their measurements. If we observe the cases of Ecatepec and Naucalpan, they only increased or decreased one point. This behavior is apparently normal for the rest of the municipalities.

<table>
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<tbody>
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<td>58</td>
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<td>n.d.</td>
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<td>n.d.</td>
<td>n.d.</td>
<td>43</td>
</tr>
<tr>
<td>Santo Tomas</td>
<td>n.d.</td>
<td>n.d.</td>
<td>n.d.</td>
<td>51</td>
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</tbody>
</table>

Table 4. Klout values for municipalities, 2014

Klout values are just a reference to understand the impact of social media tools: Facebook, Twitter and Google+. It’s important to notice that these tools are constantly changing through the activities of the account. Clear examples are the municipalities that have a clear activity trend on their accounts with a ranking higher than 40 points. Other municipalities have a rank below 40 points and the last collected rank was only of 26. Ixtlahuaca established that the use of this tool is just emerging and beginning to consolidate. And a large number of municipalities do not have a Klout account.

4.2.2. Correlation Analysis. The correlation analysis considers other values such as literacy and Internet access additionally to the Klout analysis referred to in the former section. We applied a correlation test of the quantitative data sample with a significance level of 0.01 (Table 5). We found a high relation between large populated municipalities (1) with housing (3), housing with Internet (5) and the use of cellular phones (6) (see Table 5).

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
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<td>.508**</td>
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<td>2</td>
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<td>.752**</td>
<td>.560**</td>
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<td>.590**</td>
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<td>5</td>
<td></td>
<td>.851**</td>
<td>.309</td>
<td>.547**</td>
<td>.499**</td>
<td>.376*</td>
</tr>
</tbody>
</table>

** Significance at 0.01 (bilateral)
This relationship is consistent with other studies where large populations have a better access to Internet, computers and for instance social media tools. It is important to consider this kind of awareness regarding social media for participation purposes and policy making in the future. It is also noted, that municipalities with a smaller number of inhabitants and Internet access have reduced interest for social media tools and this must be another future research.

Furthermore meddle age (2) is highly related to housing using computers (4) and Internet (5) and a high level of scholarity (7). This finding can be related with income and job opportunities.

Finally, a strong relation between housing using computers (4) and Internet (5) was found. Also, a strong relation between housing with Internet (5) and the use of cellular phones (6) was detected.

This way we can conclude that families using technology in big cities use computers, Internet and cellular phones. This is the trend in smart cities where the academic level of citizens does not have an important role.

5. Discussion

A smart city must use social media as the main tool to improve communication with citizens, create collaboration and promote empowerment between citizens and public officials. The use of information technologies is an irreversible trend nowadays. Data retrieved from 30 municipalities in the State of Mexico shows the initial steps of this trend. Most municipalities have been using these platforms in recent months. Some are starting to have success; some others just understand the use of these technologies and the way they adapt to their bureaucratic labor. However, at least three main trends have been identified for smart cities as a result of this combined research: 1. Major impulse promoting social media; 2. The need of metrics to assess goals and objectives; 3. Organization and strategy combined to reach people.

1. A major impulse of the use of social media has become more common as we can state from several interviews. We have the success cases of Metepec, Naucalpan, Tlalnepantla and Nezahualcóyotl. Normally the have their own Twitter accounts, separated from the accounts of the municipality. The understanding of technology and its appropriate use will become transcendent for the success of the social media strategy on municipalities. The example of the major of Tlalnepantla, who sent a tweet with a photo of his pay check, is a first attempt of open government and transparency using this platform.

2. Metrics and social media.- Tlalnepantla, Metepec and Naucalpan clearly mentioned software for measuring impact on social media. This lack of interest to measure success or errors on social media administration must be a clear concern of how to use this kind of tools and the relevant impact that it implies for citizens. But problems attached to the use of these tools have to be carefully considered. The example of the Nezahualcóyotl anniversary last April is relevant. When this municipality started asking citizens if they wanted them to bring an important rock group – Caifanes – for the anniversary celebration, the numbers of tweets went up suddenly in such a way that the Federal Government had to interfere stopping the event or ceasing the Twitter account because of allegedly danger and social disturbance.

3. Organization and strategy for municipalities. Most of the smart cities on literature reviews use social media to provide information [16], [21] and very few to interact with citizens for services or just for evaluation [19], [25], [28], [29]. Results from the collection of data from Klout and our interviewees identify that internal organization are important to transform communication with citizens and public officials. It is also relevant to have a clear strategy in mind to engage citizens and create interactions. The most active municipalities, Metepec and Tlalnepantla, have a more defined strategy and maintain and increase their numbers on Klout rankings.

This map of social media impact over some municipalities in Mexico allows us to determine such important trends to be considered in further studies. Nevertheless there are a lot of other important topics to be researched in the near future along with all the changes in technology.

6. Conclusions

An important trend for the research of the smart cities field is to understand the use of technology for communicating among citizens, public officials and agencies. The purpose of this research is to understand how municipalities are using social media. In order to achieve this purpose we made a qualitative and quantitative research. We focused our research on websites, as the starting point for interaction with citizens on the smart cities field.

We identify three lessons from the qualitative research: lack of strategy, short personnel for social media tasks and organizational troubles. Over these lessons we suggest three main trends to solve them and so, they may be used as pillars for smart cities implementation in social media tools. We expect this

* Significance at 0.05 (bilateral)

Table 5. Quantitative Data Sample Correlation Test

This relationship is consistent with other studies where large populations have a better access to Internet, computers and for instance social media tools. It is important to consider this kind of awareness regarding social media for participation purposes and policy making in the future. It is also noted, that municipalities with a smaller number of inhabitants and Internet access have reduced interest for social media tools and this must be another future research.

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effort will help municipal governments to become smart cities and improve their relationships with citizens.

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