Cidade Inteligente e Inteligência de Dados
Análise do aplicativo NOA Cidadão da Prefeitura Municipal de Salvador

Smart City and Data Intelligence
Analysis of Salvador's City Hall NOA Cidadão application

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Resumo: *Este artigo analisa a inteligência de dados desenvolvida pelo NOA Cidadão, aplicativo da Transalvador/Prefeitura Municipal de Salvador (PMS), no projeto "Salvador 360". A partir de uma perspectiva neomaterialista (FOX; ALLDRED, 2017), realizamos: a) análise da interface; b) análise de conteúdo dos documentos oficiais e comunicações públicas; e, c) análise de reação dos usuários na plataforma Google Play Store com o auxílio da ferramenta Appbot. Conclui-se que o aplicativo mobiliza uma abrangente rede, articulando dados, processos, instituições, agentes e equipamentos. Concluímos apontando que o aplicativo NOA Cidadão é um dispositivo-rede que depende tanto da disposição do usuário em fornecer dados quanto de outras instituições e dos servidores da Transalvador para funcionar como um aplicativo inteligente.*
Palavras-chave: *cidade inteligente; dados; Salvador 360; NOA Cidadão.*

Abstract: *This article analyzes the data intelligence developed by NOA Cidadão, an application by Transalvador/Municipal Council of Salvador (PMS), in the "Salvador 360" project. From a neomaterialist perspective (FOX; ALLDRED, 2017) we performed: a) An interface analysis; b) A content analysis of*

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official documents and public communications; and c) An user reaction analysis on Google Play Store using the Appbot tool. We argue that the application mobilizes a comprehensive network, articulating data, processes, institutions, agents and equipment. We conclude by pointing out that the NOA Cidadão application is a network device that depends both on the user's willingness to provide data, as well as on other institutions and Transalvador servers to work as a smart app.

Keywords: *Smart City; Data; Salvador 360; NOA Citizen*

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Introduction

This paper analyzes the NOA Cidadão app by Transalvador[3] and the City Hall of Salvador (the fourth biggest capital in Brazil4), which is part of the Smart City axis of the "Salvador 360"5 project through the Assisted Operations Center (NOA). Seeking to optimize internal communication with the city's regulating bodies and everyday needs, the City Hall of Salvador developed "Salvador 360" to stimulate the economic growth and de-bureaucratization of the metropolis. The NOA Cidadão integrates the Smart City axis of the "Salvador 360" app portfolio.

NOA is the infrastructure installed at the headquarters of Transalvador, responsible for processing data generated by the equipment and systems that monitor the traffic in Salvador. Through NOA Cidadão, the city hall aims to amplify the capacity of identifying problems in public places through users' notifications. By allowing citizens to communicate directly with Transalvador, the app works as a device for identifying issues in streets and public places (irregular parking, broken vehicles, road problems, damaged traffic signs, among others).

This paper presents the results of research that analyzes the NOA Cidadão app to answer the following questions: What kind of data intelligence does NOA Cidadão produce? How does the network which the app integrates operate? What lessons can we take from this answer for the analysis of smart city projects? To do so, we used a "neo-materialist" methodology under development at Lab404 (Facom/UFBA), executing the following steps: 1. Assembling the app's actor-network diagram (Figure 1); 2. interface analysis. 3. content analysis of official documents and public communication; and 4. analysis of users' reaction on the Google Play Store platforms with the support of the Appbot tool.

3   Transalvador is a municipal institution of the City Hall of Salvador, which has the goal of managing the municipality's traffic and public parking lots.
4   Available at: https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-no-ticias/releases/31461-ibge-divulga-estimativa-da-populacao-dos-municipios-para-2021.   Accessed on 10 November 2021.
5   About "Salvador 360," see: http://360.salvador.ba.gov.br/?fbclid=IwAR3A5m5n-Uig9ICILW_Q-2B7E-jwWnRsckEc8oaZz6qJHwRVtLol2zp08pTI.

About Data Intelligence and Smart Cities

The NOA Cidadão is part of a smart city Project, the "Salvador 360" of the City Hall of Salvador. The term "smart" in this work means the abbreviation of Self-Monitoring Analysis and Technology Report proposed by Rothbertg (2005). That is, we are highlighting mechanisms of data monitoring, analysis, and visualization through computer technologies to produce action models in specific systems. Smart technology (HILDEBRANDT, 2020) can be measured by its capacity for agency and data-driven response to respond to context.

These technologies generate a kind of "ambient digital intelligence" in which sensitive objects and spaces are responsive to the presence of people and other objects (GREENFIELD, 2006). Therefore, smart city projects use data to produce procedural smartness that can vary in the level of independence and agency of their processes. How does this intelligence effectively work? What are its impacts? These projects have many bureaucratic, technocratic, and vigilant biases and problems.

Generally, smart cities are projects that massively use these technologies aiming to equip public management and citizens with digital information and systems that can facilitate urban life. The thesis is that a city guided by data can explore and extract value and meaning from sets of information captured by devices that feel and respond to the environment in an adaptive mode to solve, in an efficient and sustainable way, diverse urban problems such as mobility, infrastructure, pollution, or management (KITCHIN et al., 2017).

Many cities around the world look to implement projects that integrally or partially use information and communication technologies as well as data analysis to support citizens and managers and thus establish anticipatory governance. For this, cities rely on a massive dataset used in predictive policing to assess the likely future in advance. There is no consensual concept of what a smart city is (VANOLO, 2014; HUSAR et al., 2017; FIGUEIREDO et al., 2020; HAQUE, 2012; BATTY et al., 2012; HILL, 2013; BAYKURT, 2020). According to Lemos (2017, p. 80):

Smart cities are projects currently in vogue in many countries which have as basis ideological discourses for promoting the use of information and communication technologies by companies and governments to improve the management of cities and citizens' lives. The goal is to foster economic growth, innovation, expand forms of environmental sustainability with the more efficient use of urban public resources and citizen participation. Smart city projects are covered by a narrative that mixes corporate innovation, technocratic discourses, and political aspirations for modernization. At the basis of this narrative is the intensive use of big data, the internet of things, and cloud computing.

What type of intelligence does the NOA Cidadão app of the smart cities project of the City Hall of Salvador mobilize?

Neo-materialist Methodology

The methodology for the analysis of apps was based on the pragmatic and neo-materialist approach (LEMOS, 2020). We seek to investigate the research object by understanding its material dimensions and as an object-network from a pragmatic dimension inspired by neo-materialist theories (FOX; ALLDRED, 2017), the actor-network theory, and Latour's (2012) anthropology of the moderns. This approach allows us to verify the concept of intelligence that emerges from the NOA Cidadão app through interfaces, documents, and forms of action.

The methodology of Lab404 starts from the premise that objects are multiple and reveal controversies in relationships with other objects. For example, one could study the NOA Cidadão app to detect data privacy and security problems. However, we are concerned here with understanding which data intelligence is at stake, seen as the app is part of a "smart city" project. Intelligence is frequently associated with processing, response, and interferences created by data analysis, as discussed in the previous section. Here, we argue intelligence is always dependent on a broader network (LATOUR, 2012).

To test this hypothesis, we analyze the app in an immanent way and in its relations. The methodology requires us first to identify the "**mode**,"

that is, the precise location of the problem, the place where the controversy is situated, and the question of interest. In our case, it is the production of "smart" through the NOA Cidadão app.

From the adopted position (the "smart" problem), we need to locate which elements are producing mediations in this mode. We call that constituting the inventory of mediators, which participate by influencing actions, making others do. The "**inventory**" identifies all actors involved and how they express themselves (interfaces, documents, patents, action forms…), describing the network (humans and non-humans) concerned in the issue under discussion. Inventorying actors means looking to understand the forms of mediation, that is, transduction movements that allow us to understand what actors pragmatically produce as action (in the case of users, institutions involved, information system…).

The third phase, "**transduction**," precisely describes these agencies, understanding how they are produced, their meanings, and their strengths. This phase aims, therefore, to open black boxes (unpacking), identifying what things do, what they are made of, and what they make do. The last step is to present the construction of an integrated vision of the controversy through "**reaggregation**." This step proposes a new "black boxing" as the provisional result (which will be a concrete material element of new mediation produced on the object by the research itself), being a propositional dimension with a view to understanding the collective affectation in the redefinition of the problem.

Once we had defined the mode (the controversy around data intelligence in smart city projects), we assembled the inventory with all participating actors (humans, institutions, interfaces, documents, official communications) and how they express themselves, mapping forms of mediation, searching to understand actions, meanings, and strengths this agency produces. Finally, we reaggregated the problem, articulating a new formulation of the data intelligence problem in "smart city" projects through the case of the NOA Cidadão app.

NOA Cidadão actor-network diagram

From the actor-network, we can visualize the action network built around the NOA Cidadão app by the City Hall of Salvador to enable traffic incident reports and provide data for its management. The aim is to build plans to mitigate accidents on public roads and provide more traffic fluidity in the city. The app more prominently integrates with two institutions: the Office of the Superintendence (GASUE) and Transalvador. Therefore, Transalvador, NOA Cidadão, users, the Control of Zoonosis (CCZ), the Civil Defense of Salvador, the Fire Department, the Mobile Emergency Care Service (SAMU), and the Municipal Public Order Department (SEMOP) are intertwined in an interdependent way, as the diagram below shows (Figure 1).

Data provided by users are captured in the app and sent to the Assisted Operations Center (NOA), which opens an inquiry at Transalvador's Office of the Superintendence. The app refers data to Transalvador's internal sector, which assesses the severity and urgency of reports and forwards them, if pertinent, to the agent closest to the occurrence. As soon as the information is in progress or the problem is solved, Transalvador agents inform the situation of the incident to the internal sector, which then forwards the status to NOA Cidadão. This way, the user gets feedback for their report. The Office of the Superintendence uses stored data in NOA's database concerning every notification to produce statistics and reports with the intention of assisting the creation of public policies.

Figure 1 – NOA Cidadão as an object-network
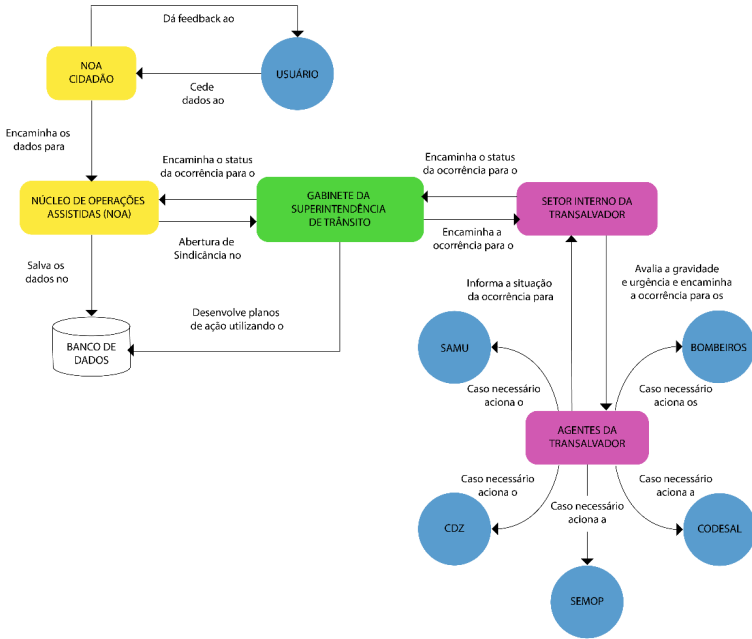
Source: Elaborated by the authors

The diagram shows the flow of data, infrastructures, institutions, and people, indicating the system's intelligence depends on the integration of this network's diverse elements. The app, therefore, is a part of this network and not the place of the system's intelligence since that one is distributed and demands the participation of the entire network, starting with the citizen's information input. The app needs users' collaboration, inserting data that initiates the notification process, returning in the end as feedback or in the moment of the incident, but is equally dependent on the good functioning of other instances involved. Data intelligence is limited to notification information, and it is unclear if the Operations Center uses these aggregated data to generate other types of action besides statistics reports. Good functioning depends, therefore, of diverse agents along the network and does not sustain itself only in the datafication process (data collection and processing).

NOA Cidadão's Interface

The analysis of the app's interface was built in the order in which functions, buttons, and information are presented to users, looking to identify how the idea of intelligence is outlined immanently on the app. Each screen was analyzed as a group to assess functionalities. NOA Cidadão possesses more than 50 thousand installations on Google Play Store, and its last update was in August 2020.

NOA Cidadão works through users' direct claims in nine categories (Figure 2) of incidents in public places and forty-three specific types of distributed incidents (Figure 3). To register the notification, the user must typify the incident based on predefined categories, locate the accident's address through the GPS or manually, and comment if they find it relevant. The only data in the registration that are not mandatory are the address's complement and photo.

The app limits fields of information input to collect data that are of interest to the organization and its agents for sharing information with other institutions. The activity takes place in four areas: a) Accident; b) Infractions; c) Infrastructure; and d) Warning. Figure 3 identifies how each type of incident is typified by the app and the respective institutions referred. However, we do not know how Transalvador organizes and activates its team to respond to reported cases and communication mechanisms between institutions.
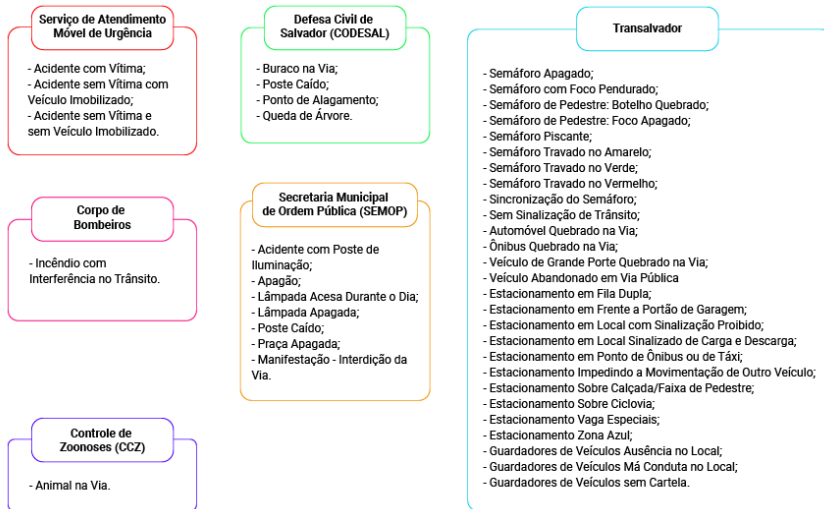
Figure 2 – Notification Screen

Source: NOA Cidadão Google Play (2020)

The types of data registered for each accident enable to locate infor-mation distributed to different authorities with the purpose of diagnosing the general situation of the event and identifying the actions and instru-ments that may help in solving problems on public roads. In the specific notifications for the Mobile Emergency Care Service (SAMU) present-ed in Figure 3, Transalvador can recognize the gravity of an accident and the need to initiate SAMU's service to aid victims.

Figure 3 – Chart of authorities and notification forwards

Serviço de Atendimento Móvel de Urgência
- Acidente com Vítima;
- Acidente sem Vítima com Veículo Imobilizado;
- Acidente sem Vítima e sem Veículo Imobilizado.

Defesa Civil de Salvador (CODESAL)
- Buraco na Via;
- Poste Caído;
- Ponto de Alagamento;
- Queda de Árvore.

Transalvador
- Semáforo Apagado;
- Semáforo com Foco Pendurado;
- Semáforo de Pedestre: Botelho Quebrado;
- Semáforo de Pedestre: Foco Apagado;
- Semáforo Piscante;
- Semáforo Travado no Amarelo;
- Semáforo Travado no Verde;
- Semáforo Travado no Vermelho;
- Sincronização do Semáforo;
- Sem Sinalização de Trânsito;
- Automóvel Quebrado na Via;
- Ônibus Quebrado na Via;
- Veículo de Grande Porte Quebrado na Via;
- Veículo Abandonado em Via Pública
- Estacionamento em Fila Dupla;
- Estacionamento em Frente a Portão de Garagem;
- Estacionamento em Local com Sinalização Proibido;
- Estacionamento em Local Sinalizado de Carga e Descarga;
- Estacionamento em Ponto de Ônibus ou de Táxi;
- Estacionamento Impedindo a Movimentação de Outro Veículo;
- Estacionamento Sobre Calçada/Faixa de Pedestre;
- Estacionamento Sobre Ciclovia;
- Estacionamento Vaga Especiais;
- Estacionamento Zona Azul;
- Guardadores de Veículos Ausência no Local;
- Guardadores de Veículos Má Conduta no Local;
- Guardadores de Veículos sem Cartela.

Corpo de Bombeiros
- Incêndio com Interferência no Trânsito.

Secretaria Municipal de Ordem Pública (SEMOP)
- Acidente com Poste de Iluminação;
- Apagão;
- Lâmpada Acesa Durante o Dia;
- Lâmpada Apagada;
- Poste Caído;
- Praça Apagada;
- Manifestação - Interdição da Via.

Controle de Zoonoses (CCZ)
- Animal na Via.

Source: Elaborated by the authors

Figure 4 screens show a test we did on the feedback system of the NOA Cidadão app. We generated two notifications, one in the "Traffic signs with a problem" and another in the category "Irregular parking." Only the first notification was solved (though the app did not update the request's status). Regarding the second, the NOA Cidadão app informs the incident was finished because there was no possibility of assistance due to deterrent conditions. However, these conditions were not clarified.

The NOA Cidadão feedback system informs the status of the notification, which may change depending on Transalvador's resolution. General information on the notification's status appears in the answer space if the reported traffic problem could not be solved. Users may not track Transalvador's steps in the resolution of the problem nor send questions about the ongoing incident if they have any or want to object to the authority's procedure.

Figure 4 **–** Information screens of notifications made

Source: NOA Cidadão Google Play (2020)

Official Documents of the NOA Cidadão

We analyzed official documents and public communications of the institutions responsible for the NOA Cidadão app: FAQ, releases (N=25); interviews or official statements to newspapers Correio da Bahia (N=3) and A Tarde (N=2), videos (N=2), social media posts on Facebook (N=24) and Instagram (N=31); Management Report Fiscal Year 2016-2013; Transalvador Report 2013-2018; portfolio of the "Salvador 360" initiative; presentation in the Seminar of Assessment of the National

Policy for Reducing Morbidity and Mortality by Accidents and Violence of the Transalvador Superintendent; Map of Transalvador Internal Control Processes; and Map of Transalvador Road Safety Processes. It is important to note that the official documents found are generic and make few specific references to NOA Cidadão. The app does not have "Privacy Policy" and "Terms of Use" documents, preventing a complete analysis of the network's functioning.

Based on the app's official documents and public communications from the institutions involved, NOA Cidadão appears as part of a larger project to implement new smart devices in the City Hall of Salvador. The goal is to collect data through the app to enable smarter action planning, better mobility quality in the city, and the improvement of the public institution. The app can thus help to modernize public management and services and meet the needs of both the municipality and the citizens through digital data captured in the use of the networked device.

Official documents and public communications portray NOA Cidadão as a collaborative project that involves citizen participation. Incoming notifications are sorted by priority of assistance, and those considered more severe, such as accidents or situations that can cause trouble to the traffic flow, are solved more quickly. If a team cannot go immediately, the incident is saved in the NOA database, and agents are directed to the place later.

Besides emergency actions, specific operations happen at points with the highest incidence of notifications. The notification is an important factor for the public institution to carry out operations. The typification of the reports delimits data collection to guide Transalvador's action in incidents registered by the user, considering the urgency and the management needs of public agents. Employees of the Office of the Superintendence of Traffic analyze the incident's gravity and forward it to Transalvador agents that manage its equipment (vehicles, breathalyzer) and to supporting public institutions – Zoonosis Control (CCZ), Civil Defense of Salvador (CODESAL), Fire Department, Mobile

Emergency Care Service (SAMU), and the Municipal Department of Public Order (SEMOP) – that assist in the control of incidents.

User reactions on Google Play Store

We used the Appbot tool[6] to carry out the analysis of user reactions. We collected a total of 325 user comments on the Google Play Store on January 13 and 14, 2021. The goal was to learn the perceptions of users on the app and on the management of problems. Comments collected from the Google Play Store expressed spontaneous impressions about the app. Reviews are mostly negative, as Figure 5 shows, resulting in an average of 2.5 stars in the store rating.

Figure 5 – User reactions to NOA Cidadão on Google Play Store
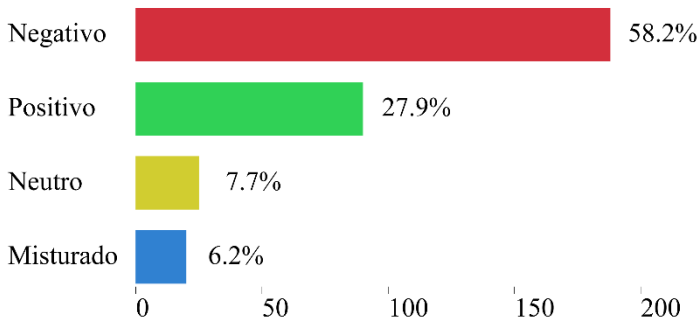
Source: Elaborated by the authors

These negative comments (58.2%, N=188) are related to the device's poor functioning (25%, N=51) and problems in the system for geolocating incidents (8%, N=15). Some users state that, after updating the app, the function for consulting fines stopped working (8%, N=16). With the latest app update, people who do have Mercosul license plates (3%, N=9) can no longer keep track of fines on the app. Some reviews refer to Transalvador's work (6%, N=18) and the institution's ability to solve the problems reported by the app, revealing how the system's intelligence

6   Available at: https://appbot.co. Accessed on January 13, 2021.

is linked to an action network. Positive comments (N=90) are broad compliments (69%, N=62) about the importance of the City Hall of Salvador's initiative (3%, N=3), its public utility, and acknowledgements to the former mayor's management (2%, N=2) and changes made on the app's interface, such as making it more intuitive (2%, N=2).

Some comments raise questions about Transalvador's responsiveness through the app (10%, N= 32). There are reports of user requests left unanswered or that have been considered resolved, leaving users with no response. NOA Cidadão does not aim to be a forum for public debate but a space for direct information about urban issues specifically related to transportation and mobility in the city. Without getting feedback on their notification, citizen engagement seems harmed. Transalvador consults citizens indirectly, asking them to inform problems, but does not have an active attitude in giving feedback about the service's progress or the solution of notified problems. The lack of feedback or a cryptic one can confuse users, especially in systems that depend on emergency actions.

Conclusion

NOA Cidadão works through citizens' predisposition to inform incidents to the public institution's command center. The app's construction rests on citizens' experiences with problematic situations in the road space of the capital of Bahia. Its intelligence is based on data input and citizen participation, referring to data processing and the articulation between diverse municipal authorities. That points to the need to understand "smart" not just as data in computer systems but as articulation strategies between diverse stakeholders.

The app is an object network connecting processed digital data on mobility with the articulation of authorities in the municipal organization. Through users' participation and collaboration informing incidents, the public institution identifies places and types of problems that it must prioritize. This action depends on the existence of communication channels with other institutions to articulate employees and

equipment meant to assist incidents filtered by the command center of the Assisted Operations Center (NOA). As a device-network, NOA Cidadão only works if it articulates data collection and institutions.

In its ensemble, interface, software, and data, the app is just the tip of a broad network that has its effectiveness in the functioning of all the agents involved. Therefore, the neo-materialist investigation of NOA Cidadão, developed through the analysis of its interface, official documents' content, public communications, and user reactions in the app store, allows us to state that its smartness emerges from a network that depends on good reactions from all: users, the app, institutions, and Transalvador agents.

NOA Cidadão combines automated digital systems (app, database) with analog systems (agents, vehicles). That shows that a smart city is not a city of independent data but a device that needs the support of other actors in the process. The app is a fundamental point in this network since it is where the system receives digital data input. However, the app cannot work alone and is not enough to solve identified problems.

There are problems with the app's feedback to users. In the analysis of user reactions in the Google Play Store, comments report malfunctioning problems, incidents that had no follow-up, and delay in Transalvador's response. The app depends on users' actions but does not let them track the progress of their notifications, thus risking losing citizens' interest. In this sense, feedback should be taken more seriously, developing mechanisms that allow users to monitor the incident's solution. There are also interface problems since we identified a lack of mechanisms to speed up communication with other institutions in emergency situations and more efficient ways to identify and hold accountable users who make false notifications.

The content of official documents and public communications indicates that NOA Cidadão allows the expansion of the municipality's capacity to identify problems in public places. The City Hall looks to produce a codified space (KITCHIN, R.; DODGE, M., 2010) that facilitates the monitoring of the functioning conditions of public roads

through the vigilant participation of citizens. Therefore, the device's intelligence is, as in many processes of digital technology use in urban space, a vigilance intelligence distributed between users, command centers, and Transalvador agents. Data are fundamental for the functioning of public policies that may assist in the redistribution of resources and the speed of public agents' actions. However, public power returns little information to app users. The vigilance cycle must improve to provide elements that allow informants to "watch over" the actions of instances involved.

NOA Cidadão materializes itself through action protocols – sending digital data, calling agents closest to incidents, sending accident alerts – carried out by command organizations and implies a specific type of citizen participation. Intelligence is mobilized in a wide network in a process articulating data, the assignment of decisions between the app, the Office of the Superintendence of Traffic, Transalvador's internal sector and agents, and actual actions in urban space.

This way, NOA Cidadão attaches itself to Salvador's smart city project. The app is not an autonomous device and depends on both users' willingness to provide data and the employees of the Office of the Superintendence of Traffic and Transalvador's internal and external agents who filter and respond to incidents. The intelligence is broad and networked. But we do not know if a richer and more integrated form of data intelligence is being made or if it is just a computerized ombudsman that does not use data to generate new actions (for example, types of notifications per geolocation allow one to learn about specific situations in certain neighborhoods, which can lead to precise and "smarter" actions).

In a new research stage, to learn details about how the data is processed, stored, and transformed into action plans, we aim to interview the app's developers and managers, identify every contact point of the device, and explore its practical implications for the municipality's mobility. We will carry out a survey with users to understand how they use NOA Cidadão and their perceptions about the initiative after using the app.

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