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How to Find Open Data? Creation of Cavuca, a Search Platform for Municipalities' Open Data Search

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Complete Research

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Abstract

This paper discusses the Open Government Data (OGD) environment in Brazil, the difficulties that researchers encounter when searching for official databases, the possible value generated by the expansion OGD based research, and the process and findings of applying the design thinking methodology to try and solve the major pain points of researchers in this field. Using the design thinking method, we developed a search platform for open data from Brazilian municipalities, named CAVUCA. The ideation, prototyping and test of the platform are described. We found that open data, although numerous and available are difficult to find and extract. Users also offered suggestions of additional functionalities for CAVUCA's dashboard.

Keywords

Open government data, official municipal databases, Brazilian data.

Introduction

Data is all around us, it is gathered when you browse sites or open up apps when you buy products or pay your rent, even your walking habits are starting to be recorded in some cities. Organizations, public and private, use this data to feed their decisions, to discover how their actions affect their users, and to gather insights on how to best solve their clients' problems.

As they saw the proof of the valuable learnings to be had with data, societies started to push for the opening of datasets from their biggest data gathering corporation, the government. In 2010, the United Kingdom, after 4 years since the start of the "Free Our Data" campaign by the guardian (Arthur & Cross, 2006), launched a site to centralize the publication of Open Government Data, with the aim to start a new wave of services that find novel ways to make use of the information (BBC,2010).

In Brazil, the federal government enacted a law consolidating its Open Data directives and launched "dados.gov.br", its own OGD centralized (Brasil, 2021). But even though the number of datasets published is great, their accessibility often hinders the impact of this initiative, as most entities focus on compliance over fermenting the use of their data (Zuiderwijk & Janssen, 2014).

As a company provides its services, it accumulates information about its customers, like time of purchase, the value received, geolocalization, and products purchased. This data is used by big companies to analyze the business potential of new products, segment their product lines and plan expansion on new locations. It is so valuable that some companies receive most of their revenue from selling this data (Beckett, 2012). Likewise, state services are information hubs, generating enough data points to answer important questions regarding the citizens' health, transportation, and housing needs for example.

Running alongside the OGD movement is the push for smarter cities. Technological advancements are fomenting a drive for innovative solutions to the cities' daily problems, including garbage collection, energy efficiency, education, pollution, and policing [18]. Most of these solutions leverage the ubiquitous use of technology to collect and share data inside the city hall's systems, amassing zettabytes of useful information.

A more recent change to the public policy landscape is the idea that the citizens are the cornerstone to social impact. Some humane smart city projects are propping up in Europe (Oliveira & Campolargo, 2015) where citizen-driven initiatives are fomented through ideation to implementation.

The success of such projects leads us to believe that the trend to increased collaboration due to the internet that we see both science and software world is also a factor in public policy, meaning that, as in an open-source project, we see evidence of meaningful collaboration from dispersed but engaged common citizens, at the right environmental conditions (Noorden, 2014).

In 2016 the policy regarding OGD in Brazil was consolidating, demanding each government entity to elaborate an Open Data Plan (Plano de Dados Abertos, PDA), listing the datasets that they hold and elaborating a schedule to disclose them (Brasil, 2016). Those datasets are published usually in two sites: the entity's site and its governing body (federal, state, or city government).

The use of open data is not widespread thought, because even though the amount of datasets is great, the ease of search is a problem. Most portals are badly designed (Sá et al., 2018), hindering access to non-specialists.

Considering strategic role of data for public organizations and its potential on fomenting smart cities development, the present article aims to describe the development of CAVUCA, a search platform for municipal open government datasets. CAVUCA was developed through design thinking method and each step is described on results.

Literature review

The Open Data movement has its origin in the scientific community, facilitating the reuse of datasets between papers through their linkage in the publication. The Open Knowledge Foundation (OKF), a big advocate for the Open Data movement, defines "open" as “Knowledge is open if anyone is free to access, use, modify, and share it — subject, at most, to measures that preserve provenance and openness.” (Open Knowledge Foundation, 2005, pp. 2). With "measures that preserve provenance and openness.", the OKF means that the only restrictions that could possibly be applied to the reuse of open data are the need to source the authors and to apply the same copyright to any derivative works. Proponents of the Open movement like to make this comparison: "Free as in freedom, not free as in beer"(White House, 2009, pp.3), making clear that the idea goes beyond simple ease of distribution.

The OKF struggled to convince some scientists that viewed their datasets as an asset but progressively more and more caved in as the community saw that the benefits were clearly visible, as Molloy (2011) points out:

> "... it does appear that publicly sharing your data increases citation rate, at least in cancer microarray experiments, which is positive encouragement that open biological data is being reused. Evidence is also emerging that data archiving leads to an impressive scientific return per research dollar, which corroborates the obvious benefits of shared data in established databases such as GenBank and the Protein Data Bank (PDB) that have had such a huge impact on the biological field..." (Molloy, 2011, pp. 1)

Simultaneously, the USA government made a commitment to make the state more transparent, participatory and collaborative, with the objective to strengthen the government's institutions (White House, 2009). According to Davies and Bawa (2012), both OGD movements are pushing both for reuse and transparency:

> "... narratives of "open government" have generally been understood as a reaction to long-standing cultures of governmental secrecy, and, more recently, to the limited scope for citizen participation in policy making. The latter position has emerged, in part, as a response to the gap between government practice and new or evolving articulations of the democratic rights of citizens. A significant number

> of OGD interventions in countries such as the UK and India have been formulated on this notion of citizen entitlements over the state, and the need to foster greater transparency and accountability in decision-making and resource allocation processes. However, others draw more on technological narratives of openness as facilitating new modes of production, enabling more efficient delivery of services, or as supporting the role of competitive market forces in the operation of government services."(Davies & Bawa, 2012, pp.3)

This duality of commercial and non-commercial drives for OGD is also pointed out by Jetzek, Avital and Bjorn-Andersen (2014). In the paper, they discuss how OGD generates value by improving transparency and efficiency (which is mostly an independent endeavor of the government) and fomenting participation and innovation (which demands great collaboration from society), resulting in both social and economic value. They study the case of a private company (Opower) being founded because of an opportunity hypothesis created by the analysis of a research paper based on OGD, from a state energy company, on the topic of household energy efficiency in the U.S.A. The company then constructed a plan to use this data to help the company lower the households' energy needs, generating revenue for itself and making the company profit out of bonuses given by the government (private economic value), as well as lowering carbon emissions and reducing energy bills to the public (social value). They explain a process value generation that is enabled by opening the government's datasets:

> "We have suggested that the archetypical mechanism that can best explain the value generation in the case of Opower is the mechanism of innovation, where novel combinations of resources and new methods of analysis lead to the generation of a new service, which, in turn, leads to the transformation of the energy market, thus increasing value. We propose that in the case of Opower, the innovation is in essence based on utilizing a specific resource, namely, data. We use the term data-driven innovation to generalize this finding to include any innovation that is, to a large degree, based on utilizing data to generate value"(Jetzek et al., 2014, p. 116)

In practice, Open Government initiatives have variating results. Janssen and Zuiderwijk (2014) show the influence that the government's goal for enacting an OGD policy has on its execution, comparing the USA, which had a focus on government transparency, and the UK, focusing on the economic value generation. The focus passes down to lower-level entities, prioritizing their efforts. Their analysis also found out the possible inhibitors of public entities to share their data:

Brazil is a member of the Open Government Partnership since 2011 and in 2016 the laws enacting an obligation to the active publication of public datasets were consolidated. According to Silva and Pinheiro (2019), even though by 2019 only 61% of federal entities enacted a plan to publishing the public data, as required by law, and only 16% of those completed this plan, Brazil is still one of the global leaders in OGD, publishing a great number of high-quality datasets in open formats. One hindrance to the use of those valuable datasets are their level of accessibility, in 2018 Sá et al. (2018) performed a study testing the usability of some transparency portals in Brazil, a normal test in the market where users need to perform a core task of the website, validating the interface design. 71% of participants weren't able to perform this core task (downloading Amazonas' state budget plan).

The cause of those technical problems can be traced to the lack of clear impact of open data policies and lack of technical capabilities on the governmental agencies' part (Michener & Ritter, 2016). Comparing Brazil's and the UK's OGD environment, Michener and Ritter showcase the difficulties of opening up datasets without the proper technology background and lack of resources, as well as the resistance of professionals worried that the transparency provided by open data will lead to improper blame and criticism being thrown at them due to shallow analysis of the data, without taking the agencies' context into account, being more open to sharing the data inside the organization and with the organization's direct beneficiaries.

Resonating this finding, Viterbo, Pires, Franzosi, and Chaves (2012) point out how the first heavy data aggregation initiative in Brazil was enacted to provide insights to the country's own presidency staff, being later on published as open data. They analyze the OGD context in Brazil and found the biggest hurdle to researchers was the diversity of information sources, amplifying the pre-analysis step complexity.

On a high note, some thematic fields of data in Brazil show the potential for OGD research. With dozens of open datasets and multiple open-sourced algorithms for preprocessing those specific datasets, the healthcare open records in Brazil are a mark on how OGD can allow country-wide evaluations of social policies and new technologies (Ali, et al., 2019). With the potential to the linkage between individual records, with non-identifying information such as name, sex, and age, through machine learning algorithms, there is a potential to perform longitudinal studies that would normally need huge budgets and be performed on a small scale. The authors comment on how the size of the datasets was so huge it crashed their computers while trying to run their usual analysis tools.

Methodology

Design Thinking is a loosely structured cyclical process for creating customer-focused solutions for hard problems popularized by Tim Brown (2020). It focuses on design techniques, empathy, and creativity to understand a problem, ideate a solution and validate it with the final user. In practice the process has four distinct stages:

- Inspiration: Research and definition of the problem.
- Ideation: Definition of the solution.
- Prototyping: Implementation of an artifact that represents the product.
- Test: Gather user feedback to validate the idea and learn.

After the test stage, if the solution isn't ready to market, another iteration is conducted. This process is performed successively until necessary, but the iterations tend to get progressively shorter as the conductors learn more about the context of the problem and the target users and because of that are able to perform faster inspiration and ideation stages (Brown, 2020).

The beginning of the iteration is the process known as "double diamond", where the team diverge, each one seeking inspiration and more context of the problem and converge on one single definition of the problem to be dealt with. Then the team once more diverges, generating multiple possible solutions, and then converges on one solution to tackle the problem.

Both the problem and the solution definition need to be open enough to allow revolutionary solutions to emerge. Constraining too much the solution by defining a small problem or by specifying too much the implementation in this stage will guarantee an incremental, tiny, improvement over similar solutions, not a market setting, radical change, that is the goal of the process.

Prototyping is essential to solution discovery, it forces the designer to make aesthetic decisions early, it conveys the ideas in a visual way, and it exposes errors early in the implementation process, according to Tim Brown (2020): "A nimble team of design thinkers will have been prototyping from day one and self-correcting along the way. As we say at IDEO, “Fail early to succeed sooner”.

After the ideation process, the solution is defined but most times there are yet a plethora of decisions to be made, that's why most prototyping stages are also an iterative process, where many prototypes are made in quick succession and compared against each other (Brown, 2020). At this stage, questions of technical visibility should be answered, and, if possible, specialists should be contacted to evaluate the prototypes (Norman, 1998).

The prototype is presented to real users, and the conductors observe the interaction. While this is a great moment to learn more about the target audience, the design thinkers need to also try to answer questions about the product risks (Cargan, 2008), especially:

- Usability risk: The user is not able to use the product with ease.

- Value risk: The product does not solve the customer's problem, or the problem is not big enough for the customer.

Most test stages bring forth important insights about the solution and about the users, maybe some planned features are more useful than others, maybe the conductor's hypothesis about the users is wrong, maybe the product idea solves another, more painful problem for the customer (Brown, 2020).

The test stage normally is made by interviewing 3 to 6 target users. The number of interviews is small when compared with scientific or marketing research, with the intention to prove a hypothesis, but the purpose

of this stage is to get some feedback, validation, and insights (Norman, 1998). Also, as the team iterates quickly, the number of interviews can mount 18 to 25, somewhat validating the solution.

While the inspiration and ideation steps usually should be separated, since it is important to clearly define the problem during the inspiration before beginning to ideate the solution, those steps will be conducted together, as a one person team has the flexibility to go back and forth between those processes.

The prototype will be built in accord with the minimum effort required to answer the risk hypothesis (Cargan, 2008). The test will be done with interviews until the artifact built has the required features to be tested quantitatively with real or possible users(Brown, 2020).

Results

First iteration - Inspiration and Ideation

During the research, it was clear a worldwide problem with OGD, the countries would have their Open Data platform, aggregating the datasets published by their subordinated organizations, while the lower level government would follow by deploying their own platforms, dispersing the datasets, and making comparisons harder. These platforms, both in Brazil and worldwide, are of diverging quality and the interfaces are not standard, making the search process more difficult.

The problem to solve was defined as "The OGD search process in Brazil requires too much time and skill". The first and easiest fix would be standardizing the existing platforms, flattening the learning curve o OGD search, as researchers would need to get used to only one common interface. This would have a big drawback, as governments would be stuck with one standard and so would not be able to improve on this interface.

Another way to improve the experience for researchers is aggregating even more the government's datasets by creating an umbrella site, concatenating all OGD for the country. The solution, named CAVUCA, was defined as "Create an umbrella site to aggregate Brazilian OGD, facilitating the search through different governments by standardizing and connecting their datasets". Both the problem and the solution were later understood as open enough to focus on a broader target audience, namely heavy users of OGD: Researchers, Journalists, Students.

First iteration - Prototyping

As the technical viability of the solution was not clear, it was decided to implement a simple search site and a web scraper to populate it. The prototyping process took 3 months and prints of the final prototype are annexed. The usability functions were:

- Simple text search: The user can type to a text input box and the site would deliver matching datasets.
- Dataset detail: The user can enter a dataset to receive its information and be able to download it.
- Site listing: The user can see the original government's site and enter them, searching the old site through the new site's interface.
- Organization listing: The same usability as the site listing but branched out to the government's subordinated organizations.

First iteration - Test

The prototype was shown to 7 people. The interviewees were of diverse backgrounds, some representing a target user (a researcher, a journalist, and a student) and some having specific skills that would provide important insights (design, marketing, user experience, and lack of experience with similar user interfaces). The interviews were conducted differently for the two groups:

- First group:

First, some user research questions were applied, there was no standard questionnaire as the goal was to validate some user hypothesis (how and when they use data, where they look for it, and how vital is OGD

for them). Then it was conducted a usability test. The goal was to find the information on how many barrels of oil were produced by Petrobras (Brazil's state oil company) in the last year.

Finally, some non-standard questions were asked to understand how they felt about the site if they would use the final product and how would they improve upon it. The possibility of product fit was corroborated by all interviewees in their respective fields, but to a lesser degree in students, as their use would be sporadic. They shared most of the pains and the test approved the usability with flying colors, but while asking for clarification on what each button should represent, there was clear miscommunication between the interface and the user. The users could not tell which problem the site was supposed to solve until they got a quick overview, showing that there may be a design or storytelling problem.

The users asked for specific features to be added:

- Notifications on new dataset publications.
- Advanced filters.
- Dataset suggestions, based on similarity

Additionally, it was discovered that the target users have a deep need for trust in both that the dataset is official and that it is in its current version.

- Second group:

The second group was arranged to validate the design flaws perceived by the first group, the interview was conducted by starting with a usability test and following up with some questions to validate the lack of understanding of some tags and buttons, as well as a talk about how the design could be improved. The following points were gathered:

- The landing page should showcase the site's features, explaining their value.
- The site should have a mobile-friendly layout.
- The site needs a header and a stronger aesthetic design.

Overall, the iteration was a success in creating and validating the potential of the solution, as well as providing actionable insights.

Second iteration - Inspiration/Ideation:

With the feedback from the previous iteration, the problem came to be defined as: "The users are not able to easily understand the value of the site" and the solution was defined as "A complete design overhaul to tell a story on why and how the site can help its users". One additional thing the design should answer is what feature is more relevant to the target user, namely the filter, dataset suggestion, and notification. Also, as the site would need funding, a mock ad would be presented to test the user's reception.

Second iteration - Prototyping:

To quickly test the new design, the prototype was built with Figma, an application that helps designers and software engineers to build mock apps. Many prototypes were built in quick succession, generating an evolution process as new ideas were tested and discarded. The user interviews guided the design, a serifed font was chosen to convey that the site can be trusted, and a green and purple color pallet was chosen to brand the site as the explorer archetype. The landing page switched to a "storytelling page", existing to directly tell the user what the site is for, who should use it and how it delivers value.

The new features were added to the design, including:

- A button to the dataset's source, validating its trustworthiness.
- A component to show similar and complementary datasets (a feature that would be hard to implement, but could be of great value to the users.
- An advanced filter, inspired by amazon's filter system.

The prototype worked as a series of PDFs, with mock buttons working as links between each one of them, simulating a real site.

As the design would require a complex design, the notification feature would be only a theoretical question to present to the interviewees.

Second iteration - Test

It was conducted a user interview. The design was validated through usability tests and value tests, also, a new persona hypothesis was defined, as is discussed later. The users could point out how they would conduct each query before trying to do so. The users were receptive to the advertisement but were also receptive to a paying version.

Discussion

Value/validation

Even though design thinking focuses on rapid learning through user feedback and small iterations, it cannot validate the product/market fit of the solution. It functions more like a compass to the product team rather than a GPS. But it does present evidence that the solution solves a real problem to the target users, leading to more tests and validations.

For example, the interviewees had an interest in both the free and paid versions of the site (the paid versions having the notifications), but there is no way to know yet if they would make that decision during their search process, in a different context from an hour-long interview. And there is no data on how the cost structure would work for the application or if the business model is viable.

Usually, startups need a years-long learning journey until they find and validate what to build and to whom, or big companies need to spend a lot of resources on user research to validate an idea. While the design thinking process enables a team with vastly fewer resources (both in time and money) to create a working solution, accelerating the process. The next step would be delivering the product to the market and analyze quantitative data from real users.

Personas

Personas are constructs used to share understanding about a segment of customers by personifying the group. Most times personas are working documents, always being added to, joined, and validated. Through the interview process 3 segments were found:

- Tom the exploring scientist:

Tom is a 35-year-old researcher with a drive to understand a specific subject. He finds data to discover and express his insights by whatever means necessary. He already browsed tens of difficult-to-use governmental sites only to discover that there is a really important dataset that is not published yet, but a government agency clearly already has the data, and Tom's paper could really use it. Tom has emailed both the agency and some agency's employees but to no use. He recently created a tweeter account and has contacted the agency through the site and scheduled an interview.

Tom sees all this work as a scientist's hurdle as if it would be expected from scientists to overcome those obstacles. From the use of the government's portals, Tom developed a high-level technology alphabetization, being able to learn to use almost any interface in a rapid and thoughtful manner.

- Rita the conformed researcher:

Rita is a 47 years old university professor. She loves her field and is invited to interviews from time to time. Her data tends to be from self-conducted research since the data she needs is not easily found. She performs interviews and surveys and analyses them with proficiency. She has no tweeter account and tends to revert to her peers when a technical problem is out of reach. People find her by email and sometimes messaging her LinkedIn account, which is really active.

- John the data-minded journalist:

John is an example of what recruiters call a unicorn, he aggregates skills from different fields into his own, creating a powerful combination. John is a 30 years old journalist tasked with the contemporary segment of a relevant magazine. He needs to accompany closely some entities, saving their home sites on his taskbar and checking them first thing in the morning. He also looks close to his state's legislative chamber to keep an eye on what will be passed in the upcoming weeks. Sadly for him, most of his work is not with what he wants to do. He outputs some mundane articles weekly but, from time to time, he can do an insightful analysis on some government's recently published dataset, like a list of expanding or geolocation of healthcare services. When he does that his publication gets a spike on engagement and his peers look at him with admiration. He is really active on tweeter and sees LinkedIn mostly as a way to look for a job.

Feature analysis

We will use a common feature analysis tool to understand better the relevance for each feature in the roadmap for the solution, both implemented and waiting for development: the Kano model. The first tool is the Kano model, it classifies each feature as a basic, a satisfied, or a delighter feature. Basic feature erodes value if they are not implemented, customers expect it and will migrate from your product if they are missing, like a password retrieval system. Satisfier features are expected from your value proposition, they are what drives the customer to use your product. Delighter features are not expected, they are the cherry on the top that makes the customer remember the experience of using the product.

Some decisions along the process could be perceived as wrong, the product development process needs to be ever-evolving and that forces us to analyze our previous mistakes, to improve our future decisions.

Even though the first iteration answered the question of if the product could be built in a reasonable time (the viability risk), it took too much risk by spending two months on a non validated idea, a quick mockup and some interviews could have reduced this risk is less than a week, as well as provide an opportunity to fail earlier, like invalidating the site's design. Also, the first iteration's feedback was too muddied by the lack of a good interface design, as the interviewees were too focused on the poor solution, and not their problems.

Both sets of interviews were too unstructured, which made some key insights to be lost, like a lack of questions of where the product could meet the customer (Tweeter, conferences, Facebook) that some interviews had.

Overall, in hindsight, the process was well put together, but like most product development sprints, it was too focused on the solution, instead of focusing on the problem and on the customer.

Conclusion

Design Thinking is a great way to start up a product development process, aimed to tackle a big tricky problem. While a paper's structure leads us to think linearly, analyzing the problem and proposing a solution, the design thinking leads us to iterate even on the problem's definition. With trial and error, we discovered not an untapped potential for state and citizenry integration, but a community set to make the best out of the tools it has. The pain points we tried to solve exist because even though the Brazilian's OGD is scattered, and sometimes hiding behind poor interfaces, researchers and journalists still venture out and find the bases for their research.

Brazil is an interconnected, open, smart country in the making. Both the top-down push for transparency and publishing of open data and the bottom-up pull for research material are steering the country into a data-driven policy decision environment. Where actors from the whole system collaborate to evolve society's shared understanding. Our solution aims to aid this collaboration, providing a better state-researcher interface.

Even with a goal to surpass the current interfaces, our process failed to incorporate design and user-experience decisions on its first iteration. This is evidence of the importance of early user feedback for clearing out common solution traps.

This paper aimed to show a clear example of the design thinking process and to better understand the problem with OGD search in Brazil. As a side benefit, we created a product and learned a lot about its potential users. As the technical viability of the project and the user interface were validated, important

questions are still unanswered, namely how well received by the community the solution will be and if the cost structure will add up.

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