Winning Data

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Designing and testing a game to change civil servants' attitudes towards open governmental data provision

Fernando Kleiman

WINNING DATA: designing and testing a game to change civil servants' attitudes towards open governmental data provision

Dissertation

for the purpose of obtaining the degree of doctor

at Delft University of Technology

by the authority of the Rector Magnificus, Prof.dr.ir. T.H.J.J. van der Hagen,

chair of the Board for Doctorates

to be defended publicly on

Thursday, 23rd September 2021 at 15:00 o'clock

by

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Das Utopias (*Mario Quintana)*

Se as coisas são inatingíveis

Não é motivo para não querê-las

Tristes os caminhos, não fora

A mágica presença das estrelas

On the utopias *(free translation)*

If things are unreachable

It's no reason to set them apart

Sad would be the path, without

The magical existence of stars

ACKNOWLEDGEMENTS

Log-in

In March 2011, while reading the news, I came across an interesting article describing a whole new world of using games for serious purposes. By then, I was already part of the Brazilian Federal Government permanent staff, working with policies to support work activities for poor communities. Four years later, in April 2015, I decided to join a congress on public management innovation. It was hosted at the National School of Public Administration (ENAP), and the program included presentations by Vishanth Weerakkody, Jeremy Millard, and Yogesh Dwivedi. I was impressed by how these scholars' discussions seemed a bit distant from our local reality, still very stimulating to rethink horizons of public sector innovations. At the same event, the inauguration of the first national online website for transparency, Portal da Transparência, was a milestone in the Brazilian government's commitment to making data available to the public.

By that time, I had the nerves to walk towards the scholars and ask them a very direct question: did they know any Ph.D. program related to the use of games in governments? Coincidently, the three of them pointed to the same address: Marijn Janssen, from Delft University of Technology. I got excited about the idea. Still, I had no clue on how to make it happen. I got involved in innovation discussions, ranging from public policy to futurism. I started studying gamification and the use of games for different purposes on my own. I worked in different units in the Federal Government, which, by that time, was my main professional occupation.

The political instability caused by the 2016 parliamentary coup against President Dilma Rousseff took me from the Presidency executive team inside the Deputy Chamber to ENAP, where I was invited to join the starting team of the G*Nova. That innovation lab, inside the school, got games and design back to my agenda. The new position strengthened my curiosity about the use of games in governments, which increased my need to pursue a Ph.D. project. I decided to write that scholar, Marijn Janssen, and check his opinions on the idea of researching games for governments.

In June, I first came to the Netherlands to visit a friend, Felipe de Paula, who was doing his Ph.D. in Leiden and living in The Hague with his wife, Vanessa. As Delft was less the 20 minutes away, I asked Marijn if we could talk. He immediately scheduled a meeting and invited me to the beautiful city of Delft. On a rainy day, I took Tram 1 with my wife Barbara and arrived at the station. As we were still early for the meeting, we walked around for a while and then headed to TPM. I was surprised by such a modern structure for a faculty. I was also surprised by the meeting. That was my first professional interaction with a Dutch person, who was very direct and pragmatic: my project seemed feasible, it converged with his research agenda.

However, he had no available positions to offer me. If I could find the funding for developing such a project, he was available to supervise me.

That was also the first time I met one of the most important people for this thesis to happen, Ricardo Matheus. That young Brazilian researcher who was already working with Marijn came to me and said: this is a great opportunity for you – Marijn is a great researcher who can teach you a lot, and you can be useful to our research group, bridging academic knowledge to real policy-making. Ricardo was one of the greatest supporters I had during this whole Ph.D. journey, and I am very thankful for his friendship during all these years.

I came back to Brazil focused on the idea of making that project happen. As my professional career had a specific studies program, I decided to build a project and apply for it. After some email conversation with my still-to-be-promoter Marijn, I had a project and all the bureaucracy done for competing with other projects, also looking for funding. My proposal got the highest grade, and I was selected for a full-time granted leave to TUDelft by the end of 2016. That is where it all began, being this thesis a great outcome of this whole process.

Log-off

Fast-forward 3 years and ten months, the game is over. After mastering the basic commands, I have improved my skills to beat each and every challenge of this Ph.D. journey. Through this process, I have earned new research (and design) skills, learned many new languages (including engineering and a bit of Dutch), and developed my own game. My thesis is now ready, which allows me to finally put up these credits to thank all my friends, colleagues, and other supporters who were part of this work.

First and foremost, I have to thank Marijn Janssen for all his support and patience. He was the person that accepted the challenge of guiding me through a Ph.D. in Information Systems engineering, in English, in the Netherlands, and using gaming as my main method. Honestly, I do not know how Marijn managed to find the strength to support me even in our most difficult times. I am grateful for all his guidance and the many experiences we shared during these last years.

Secondly, I need to thanks Sebastiaan Meijer, my second promoter. Sebas has always been the “gaming guy”, the pragmatic person who would hear me out and have honest feedback: usually to calm down, breathe, and wait a bit that things would work out. The many bits and pieces that he managed to put together on this journey were more to a high-level Tetris challenge than only a thesis supervision. Thanks a lot for the advice and help!

Even if not formally part of my research team, I could not have done my Ph.D. without the support and friendship from Ricardo Matheus. Besides his wise words in moments of need, all his hints on how to survive the Netherlands, his perspectives on the e-Government community, political talks, and soccer jokes were crucial to getting me through the process: “Se é boa, você não contou ainda!”.

Besides the research team, I am also grateful for the institutional support I had to fulfill this challenge. I have to thank the Ministry of Economy from the Brazilian Federal Government for enabling my granted leave throughout these years. Specifically, Secretary Cristiano Heckert's support, Soraya Brandão, and Tito Froes, and all their team in the Management Secretariat, were central to my work. The Digital Government team, including Secretary Luis Felipe Monteiro, Luanna Roncaratti, Heber Fialho, and all their group. The National School for Public Service (ENAP) also had a major role in supporting my research, specifically their director Paulo Marques, who continuously kept our partnership alive, even in the distance. Many other colleagues from the school helped a lot, including Marizaura Camoes, João Granja, Ana Gualberto, Aline Soares, Fernando Filgueiras, Andrea Andrade, and all G*Nova team: Carol, Josi, Marina, Isa, Raissa, Leticia, Servio, Simonne, Murilo, Marcelo, and everyone!

Other Brazilian institutions were very helpful, specifically for supporting my survey data collection and gameplay. The Municipality of São Paulo and the Innovation team, led by my great friend, Vitor Fazio, allowed me to collect the first sample of my data which unleashed the research process. Also, the Accounts Court from the Municipality of Sao Paulo, their Chief of Staff, and life-brother, Marcos Barreto, and his team were important to test the game's virtual design even before the pandemic – visionary. I also need to thank Delfina Soares and Mario Peixoto from the United Nations University, Gilberto Perre from the Brazilian National Mayors Association (FNP), Andre Tamura from the Wegov network, and Pedro Pontual from the Anesp workers Association. Likewise, Clarissa Justino for the efforts to strengthen the Brazilian Researchers Association in The Netherlands (APEBNL).

The Delft University of Technology was the best environment I could expect to develop my research. A great part of it came from the support of the staff members such as Laura Bruns, who helped me in every task for my study to happen. Also, Jo-Ann Karna, Diones Supriana, and all our university staff colleagues. Besides, the head of the ESS Department, Caspar Chorus, with whom I shared a noisy wall (on my side), and Jolien Ubacht, who was always there professionally and for the game nights, helped a lot. Thanks to all of you!

The University also offered many courses to support my personal development for doing research. Their organizers Andrea Ramirez and Janine Drevijn, were always helpful. I could not forget the talks with Lara Lamberts in the Health Coach Program and Ana Luz and Laurens, putting me out of the box through the Upside-down. You rock! Besides, Sylvia Janssen was the best statistics teacher I could ask for, even publishing a paper together! Thanks!!!

As part of my journey, teaching and supervising master students was challenging and great. I thank Marcel Ludema for the opportunity of monitoring his game design class, besides Dorina Bodi and Ayushi Sinha, for trusting me as their advisor. To Davide Di Staso, more than thanks, I express my gratefulness for working together and for having him make my dream come true by developing a digital version of the game, improving its contents, and adding a critical layer to my work. I hope to keep working together on the many other projects to come!

The e-gov community also played an important role in my work. The encouragement and inspiration from other researchers from the ICT-section was crucial for my success: Anneke Zuiderwijk-van Eijk, Bram Klievink, Nadia Metoui, Dhata Praditya, Majeed Mohammadi, Wirawan Agahari, Mannat Kaur, Ahmad Luthfi, Clara Maathuis, Selinde van Engelenburg, Klara Pigmans, Rijk Mercuur, and all the others. I have to thank my officemates, Yuxin Wang and Arie Purwanto, for being generous in sharing our common space. On the Brazilian side of research, it was important the sharing and support from Maria Alexandra Cunha, Edimara Luciano, Leonardo Oliveira, Manuella Ribeiro, Gabriela Viale, Luiza Azambuja, Marie Anne Macadar and Bea Lanza. Also, Paulo Calmon, Gabriela Lotta, Jose Carlos Vaz, Gilson Schwartz, and many other inspiring partners of this journey.

Besides the government research community, I have to thank the colleagues on the game design side, who were there for me and this thesis: Heide Lukosch and Geertje Bekebrede introduced to the techniques of serious gaming; Menno van Pelt-Deen was crucial to my prototyping process; Rens van den Berg, Marcelo Vasconcellos, Fernando Tsukumo, Julia Carvalho, Alfie Bown, Gianluca Sgueo, Sebastian Deterding and Eric Tresce were inspiring friends.

Living in Delft, close to the historic site of Oostpoort, also introduced me to some great local business owners that made my life happier: Rob (Neef Rob), Derk Jan (Thuis by Ladera), Jan (Lander Slagerij), and Sonia (Café de Korpoort), Tess Fajardo (Accupunture Delft), you were great! Besides, I am also grateful to the many great friends I have made on this journey: Anique Kuijpers (and Peter), my greatest Dutch friend, who supported me from the beginning of our game design classes until the end; thank you very much! The many friends which I first met on courses and summer schools: Farzam Fanitabasi (and his wife, Vivian Tunn), Vittorio Nespeca, Andrea Raventos (and her husband, Andres Cedeno), Antonella Piaggio, Toyah Rodhouse, Bill Roungas, Jayanth Raghothama; the lovely “Brazilian” couple, João Deddeca and Natasa Roukouni; not to forget Tristan de Wildt, Shantanu Chakraborty, Shahrzad Nikghadam, Ioanna Kourounioti, Rodrigo Tapia (and his partner Fernanda Berlitz), Alexia Athanasopoulou (and her husband Emrah Balcıoğlu), Rado Dukalski, Maria Galeano, Arthur Feinberg, Annebeth Erdbrink, Patrick Fahim, Luca Tangi, Mathias Van Compernolle, Sina Eslamizadeh, Aashis Joshi, Wiebke Toussaint, Ozge Okur, Kasper Lange, Amir Ebrahimi, Ben Riemersma, Nacho Hernandez, Xavier Fonseca. From the large Brazilian community, I could not forget Vivi and Rodolfo, love at first sight; Ju, my third-generation friend in the Abramovay family; Mara, Renato, Roberto, Galo, Ligia, Pietro, Clarissa, Ivens, Karol, Rafa and the Henriques, amazing people; Fabio, Julio, Luana, Gi, Ninu, Roberta, Tymen and Felipe, our closest local community. My dearest friends Annika Herth and Indushree Banerjee (and her husband, Joost Agelink van Rentergem). My p-brother Javanshir Fouladvand, love you all!

From Brazil, the ones which I kept connecting even through the distance, Edu Granha, Adauto Modesto, Clara Sa, Celina Pereira, Tereza Campello, Romulo Paes, and Chico Gaetani, you were decisive since the beginning. Valessio, Gui (and Camila), thanks for getting me to start

designing games! Yaso, Poppi, Marco, and Augusto, you are living open data for me! Guga, Weber, Danilo, Pedro, Thomaz, Wagner, Sanchez, Paulinha, Bugre, Sonia, Denis, Helena, Marcelo, Fragelli, Michel, Bevan, Ju, Lais, Fe Papa, Thomas, Georgia, Romero, Ze, Cami, Aleks, Ana, Caca, Alysson, Pri, Regis, Camila, Gustavo, Bambini, Silvio, Marina, Dario, Natalia, Thor, Ivan, Lau, Claudinha, Leandro, Betão, Fabi, Laila, Julia, Renato de Vitto, Capi, Didi, Ale(s), Bia, Romero, Rogerio, Leo, Debora, Krishna, Ju Agatte, Ana Laura, Ze Klei, Beto, Karla, Barroca, Estevão Slow, Dario, Felipe Anghinoni, Oswaldo Oliveira, Carl, Bruno Jorge, Jorge, my remote-doctor Gigio and her husband Mabelê, thanks for keeping me alive. Jaldo, for your competence in the last 20 years. Dani (and Tiago), Bere (and Talita), Luma, Geraldo, Manu (and Dalva), Cabral (and Thais), Tato, Santos, Gobbi, I have no words! You are all amazing people, which I am grateful to have in life!

To my whole family, especially to my cousins Renato (and Melina), Mauricio (and Ju), Ilana, and Henrique, who were always in touch. Vania, Loli, Pipo, Ale, Vinicius, Rafa, Gildo, and Sonia, my extended supporting family. To my brother, Luciano, for all the support, even when none of us could do it. To my parents, for your example, and for always pushing me to learn and love.

Lastly, I need to thank my wife, Babu. More than a partner, you were my heroine for supporting me even through the most difficult times, including switching countries, houses, languages, and currencies. I hope that the forced coexistence of 24/7 in the pandemic will be the most challenging situation in our lives. And that we can share all the individual and common goals we have achieved in the last years. Amore, resumindo (como aprendi nesses últimos tempos): te amo!

Delft, May 2021

Fernando

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SUMMARY

Data is needed for a government to function, and civil servants generate data that can be opened. However, this data is not always publicly available. Governments open their data to meet societal needs to increase transparency, accountability, stimulate participation and innovation. The opening of governmental data can be seen as a source of uncertainty for public servants, or it can even be legally prohibited, depending on how the regulation is interpreted. For instance, open data might be experienced as a burden or not easy to practice, whereas the opening might create societal relevance.

This research focuses on overcoming behavioral barriers for civil servants to manage data release at the individual level by using a serious game. Open data relates to any data produced by any device or person, which is publicly shared for free or at a minimal cost, and that can be accessed by anyone. These behavioral barriers for civil servants influence governments' decisions to make data available to the public. *Behavioral barriers* are the impediments for governments to release open data which originates from human behaviors. The literature suggests that behaviors are difficult to measure, and therefore, we focus on *attitudes,* which are measurable through declared perception. Attitude refers to a set of beliefs and feelings which is a common predictor of behavior. In this research, we use governmental civil servants' *behavioral intention* to support open data to measure attitudes and the change in behavior intentions of civil servants as a proxy to analyze attitude change.

Serious games are game-based interventions designed for other goals than (only) entertaining the players. They offer a safe and controlled environment for experimentation and experiential learning. The research objective of this thesis is to develop and test a game to influence the attitudes of civil servants towards the release of open data by governments, by enabling them to experience the positive and negative sides of open data in the game. Design science research was used for prototyping development and testing a game in a quasi-experimental set-up. Four research questions guided the study:

> RQ1. What are the behavioral barriers for civil servants to support the opening of governmental data?
> RQ2. What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?
> RQ3. Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?
> RQ4. What are the effects of the open data game on civil servant's attitudes towards supporting the opening of data?

Each research question demanded the application of specific research methods. As the first step, systematic literature reviews were performed in the field of 1) open data provision behavioral barriers, 2) games for civil servants, 3) games for open data, and 4) games designed for attitude change. The first literature review was used to answer RQ1, whereas the other aimed at RQ2.

For RQ1 (What are the behavioral barriers for civil servants to support the opening of governmental data?), the literature review identified a list of 38 behavioral barriers for civil servants influencing the opening of data. These behavioral barriers discussed in this thesis should be considered to change civil servants' attitudes to support the opening of governmental data.

For RQ2 (What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?), three literature reviews were conducted to find game design requirements from previous research. They targeted at specific aspects of proven serious games: 1) for civil servants, to better understand the audience characteristics which could influence gameplay; 2) using open data content to inspire metaphors and operational representation of data release in the game; and 3) to change attitudes of players, targeting at successful use of game use towards attitude change. For civil servants, many games exist, whereas, for open data provision, no games were found. Even though many mechanisms exist in the literature, they did not prescribe an operationalization for an open data game. To evolve towards the most suitable game, we followed an iterative process to better understand how the game could be realized.

Games are context-dependent, particularly to our specific case, open data governmental provision. Likewise, the iterative process enabled testing the operationalization of such requirements into game mechanisms. Four prototypes resulted from this game design process. Each designed prototype was evaluated, updating the lists of requirements and mechanisms for the final version of the game.

- Prototype 1: *Cards for open data* debriefing showed that engaging mechanics could help connecting players to the open data challenges, but a card game resulted in lower levels of knowledge transfer about open data;
- Prototype 2. *Solvd*, a group debate play-setting, resulted in interactive content from group interactions. However, the game was not entertaining, resulting in a loss of engagement;
- Prototype 3. *Job-matching simulator*, a decision-making labor-market digital game, helped to map the real-life public service data production and use routines. This prototype highlighted the need to represent situations encountered by public servants in reality, including risks and ways to prevent them; and
- Prototype 4. *Open data office*, a role-playing game aimed at engagement and learning for attitude change. Still, it lacked a more precise metaphor for routines and the office environment. Likewise, playing roles with humans was found to be important for our learning goals, in addition to adjusting the number of players and rounds.

The prototypes resulted in the following main **requirements** on a serious game to influence civil servants support to the opening of data:

- Requirement 1. Open government data content used in the game should be highlighted;
- Requirement 2. The focus should be on a game experience that enables experiential learning;
- Requirement 3. Civil servants' practical knowledge should be reflected in the game;
- Requirement 4. The game should be used as a safe environment for experimentation;
- Requirement 5. The game setting should be realistic;
- Requirement 6. Game dynamics should be organized as a role-playing game; and
- Requirement 7. The number of roles, players, and rounds should be limited.

Additionally, the literature findings combined with the outcomes of the iterative design cycles, pilot-testing, and debriefing, enabled the answering of RQ3 (Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?). The final version of the game, named WINNING DATA, operationalized the requirements into mechanisms that enabled players to change their attitudes towards open data. These mechanisms emerged from the design process, where each prototype debriefing informed the next round of iteration and new prototype. For instance, the needs for open data content and realism are represented through assets such as forms, files, and demand cards; demand cards express pre-defined routines: service requests. Demands are identified by specific card codes, which enable an automatic scoring system for the game facilitation; the service delivery, processed by rolling sets of dice, results in the creation of datasets. Depending on the dice combinations, privacy and security crises can occur, affecting the challenges of the game. The following final list of **mechanisms** resulted from this process:

- Mechanism 1: Dataset description and labeling;
- Mechanism 2: Card codes;
- Mechanism 3: Pre-defined demands (not random);
- Mechanism 4: Forms, Files and Demand cards;
- Mechanism 5: Service delivery goal;
- Mechanism 6: Upgrades;
- Mechanism 7: Facilitation;
- Mechanism 8: Crisis board;
- Mechanism 9: Dice as processing machine;
- Mechanism 10: Multi-player (with different roles); and
- Mechanism 11: Time-limited rounds.

Based on these requirements and mechanisms, WINNING DATA was designed as a four-player role-playing in-person game that can be played in a two-hour session. The game was evaluated for its effects on the attitudes of civil servants towards supporting the opening of governmental data. Playing the game consists of five rounds in which participants switch roles. The roles are citizen, two civil servants, and a manager. The player, playing the role of a citizen, demands services to the one playing the role of a civil servant; the player playing the role of civil servant has to work together with the colleague and boss to deliver the service back. Each

service delivered results in a dataset which is discussed by the team and labeled by the boss. Labeling decisions influence the chances of having a privacy or security crisis in the coming rounds, resulting from specific dice combinations.

Lastly, game play, data collection, and statistical analysis were used to answer the RQ4 (What are the effects of the open data game on civil servant's attitudes towards supporting the opening of data?). Our main hypothesis is that the attitudes of civil servants can be changed by using a serious game. From the list of behavior barriers (RQ1), an initial list of factors influencing civil servants' attitudes emerged. Four influencing factors were defined to influence Behavioral Intention, the dependent variable representing civil servants' attitudes: lack of knowledge, performance expectancy, effort expectancy, and social influence. Explorative testing was conducted to determine which factors are at work and how the game affected them. The factors were hypothesized for testing game effects on civil servants' attitudes to supporting open data. All factors were measured using a 33-item 7-point Likert scale questionnaire.

The survey was used to measure the players' attitudes before and after the game was played. Comparison enabled the assessment of the effects of change in their attitudes. In a quasi-experimental set-up, 77 civil servants played the game and filled in the pre- and post-test survey. Another 35 civil servants filled in the survey on two different occasions, without the gaming intervention, as a control group. The data was analyzed.

Firstly, the internal reliability of the factors was checked, followed by explorative testing on the factors that did not load. The resulting factors were organized into a model which included Behavioral Intention as the dependent factor, measuring multiple dimensions of civil servants' attitudes towards open data. Other seven factors were defined: Data Management Knowledge (DK), Performance Expectancy (PE), Risks (RK), Social Influence (SI), Knowledge of Data Production (DP), Data Sharing Knowledge (DS), and Data Costs (DC). The eight resulting **hypotheses** were tested using the 112 completed surveys:

Hypothesis 1: Behavioral intention increases after playing the game;

Hypothesis 2: The game results in more knowledge about ways to open data;

Hypothesis 3: The game results in a better understanding of the expected benefits of opening data;

Hypothesis 4: The game decreases expectations of the risks related to making data available;

Hypothesis 5: The game reduces civil servants' perceptions of open data practice difficulties, as exerted by hierarchies and legal frameworks;

Hypothesis 6: The game increases civil servants' knowledge of data production;

Hypothesis 7: The game increases civil servants' knowledge of the possibility of sharing data; and

Hypothesis 8: The game increases civil servants' perception of data provision costs.

Through a Wilcoxon Signed Rank test, we assessed the main hypothesis and concluded that the game is likely to have a statistically significant effect on the dependent variable of Behavior Intention. As we did not find significant effects on behavior intention in the control group, our conclusion that civil servants who played the game are likely to have their attitudes towards open data increased by the game was strengthened.

After that, the WINNING DATA's gameplay additional seven hypotheses were tested. The game had a significant positive effect on Risks and Performance Expectancy. Though there were differences in the pre- and post-test scores of Data management knowledge, Social Influence, Knowledge of Data Production, Data Sharing Knowledge, and Data Costs, none of them were statistically significant.

Our research has limitations resulting from (1) the limited number of participants and their distributions' characteristics; (2) the absence of alternative strategies to which our results could be compared; and (3) the feasibility of more complex statistical analyses that were limited due to the available sample. Furthermore, this research (4) could not explore other diverse outcomes, such as a more complex model discussion on the factors influencing civil servants' attitudes to support the opening of governmental data, which is needed and still to be done. Additionally, these limitations shed light on other improvements for new versions of the game.

Future research is recommended to test the game with larger samples, players having a more diverse background, and coming from different countries. Using the same survey questions to different passive interventions, such as text and lectures, can also contribute to comparing the results. The long-term effects of the game were not investigated and recommended as a further research direction. Another further research direction is the digitalization of the game. Particularly in the light of the recent crisis of COVID-19, this is needed as playing the game with many persons in one room is not a good option. Likewise, advancing with the model discussions, including more open data elements, and extending the topics to other fields is also recommended by this thesis.

Concluding, the game developed and tested during this project has proven its effects on changing civil servants' attitudes towards the opening of governmental data. This thesis's results can be used to design better interventions to make more governmental data available to the public.

SAMENVATTING

De overheid heeft gegevens nodig om te kunnen functioneren. Ambtenaren verzamelen en genereren gegevens die kunnen worden geopend. Deze gegevens zijn echter niet altijd voor het publiek beschikbaar. Overheden stellen hun gegevens open om te voorzien in maatschappelijke behoeften om transparantie, verantwoordingsplicht te vergroten, participatie en innovatie te stimuleren. Het openstellen van overheidsgegevens kan worden gezien als een bron van onzekerheid voor ambtenaren, soms wordt het openen van data gezien als wettelijk verboden, afhankelijk van hoe de regelgeving wordt geïnterpreteerd. Het openstellen van data wordt door ambteneren daarom als een last worden ervaren of is niet gemakkelijk in de praktijk te brengen, terwijl het openen van data juist maatschappelijk belangrijk is.

Dit onderzoek richt zich op het beslechten van gedragsbarrières van ambtenaren voor het vrijgeven van data op individueel niveau middels een serious game. Open data heeft betrekking op alle data geproduceerd door een apparaat of persoon, die gratis of tegen minimale kosten openbaar wordt gedeeld en die voor iedereen toegankelijk is. Deze gedragsbarrières voor ambtenaren beïnvloeden de beslissingen van overheden om data vrij te geven aan het publiek. Gedragsbarrières zijn de belemmeringen voor overheden om open data vrij te geven die voortkomen uit menselijk gedrag. Verandering van gedrag is moeilijk te meten, daarom richt dit onderzoek zich op het meten van de houding (‘attitude’). In dit onderzoek worden houding gedefinieerd als de gedragsintentie van overheidsambtenaren om data te openen.

Serious games hebben niet als doel om spelers te vermaken, maar bieden een (relatief) veilige en gecontroleerde omgeving voor het experimenten en het geven van een leerervaring. Het hoofddoel van dit proefschrift is het ontwikkelen en testen van een *serious game* om de houding van ambtenaren ten opzichte van het openstellen van open data door overheden te beïnvloeden, door hen in staat te stellen de positieve en negatieve kanten van open data in het spel te ervaren. *Design science onderzoek* is gebruikt voor het ontwikkelen en testen van een spel. De invloed van dit spel op de houding van ambtenaren is getest middels een quasi-experimentele opzet. Vier onderzoeksvragen vormden de grondslag voor het onderzoek:

RQ1. Wat zijn de gedragsbarrières van ambtenaren om het openen van overheidsdata te steunen?

RQ2. Wat zijn de eisen voor het ontwerpen van een game om de houding van ambtenaren voor het openen van overheidsdata te veranderen?

RQ3. Welke spelmechanismen maken het mogelijk om de houding van ambtenaren ten opzichte van het openstellen van overheidsdata te veranderen?

RQ4. Wat zijn de effecten van het open data spel op de houding van ambtenaren ten aanzien van het openen van data?

Om de onderzoeksvragen te beantwoorden zijn voor elk van de onderzoeksvragen verschillende onderzoeksmethoden toegepast. Er zijn vier verschillende systematische literatuurreviews uitgevoerd op het gebied van 1) gedragsbarrières bij het openen van data, 2) games voor ambtenaren, 3) games voor open data, en 4) games voor attitudevandering. De eerste literatuurstudie werd gebruikt om de eerste onderzoeksvraag te beantwoorden, terwijl de andere drie literatuurstudies werden gebruikt om de tweede onderzoeksvraag te beantwoorden.

De eerste onderzoeksvraag (Wat zijn de gedragsbarrières van ambtenaren om het openen van overheidsdata te steunen?) is beantwoord middels een literatuurstudie waarin 38 gedragsbarrières gevonden zijn welke de houding van van ambtenaren voor het openen van data beïnvloeden. De lijst van barrières werd vertaald naar een lijst van factoren die de houding van ambtenaren ten opzichte van open data kunnen beïnvloeden. In de literatuur worden een houding omschreven als de manier waarop een persoon verklaart zich te voelen of te denken over een bepaald onderwerp. Voor dit onderzoek is houding gedefinieerd als de gedragsintentie van ambtenaren om het openen van data te ondersteunen. Deze gedragsbarrières zijn als uitgangspunt genomen om de houding van ambtenaren te veranderen bij het openen van data.

Voor de tweede onderzoeksvraag (Wat zijn de eisen voor het ontwerpen van een game om de houding van ambtenaren voor het openen van overheidsdata te veranderen?) zijn drie literatuurstudies uitgevoerd om de eisen voor game-ontwerp te inventariseren. De drietal literatuurstudies waren gericht op specifieke aspecten van geteste *serious games*: 1) voor ambtenaren, om beter de kenmerken van het publiek te begrijpen die de gameplay zouden kunnen beïnvloeden; 2) het gebruik en verschillende vormen van open data om via metaforen en operationele representatie de game te inspireren; en 3) games om attitudes van spelers te veranderen. Er bestaan al veel verschillende *serious games* gericht op ambtenaren. Echter er zijn geen *serious games* gevonden die zich richten op het openen van data. Eerder onderzoek over games die de attitudes van spelers beïnvloeden is niet uitgebreid, maar leverde toch een eerste lijst van factoren op. Op basis van eerdere onderzoeken konden we concluderen dat, afhankelijk van het doel, verschillende game-eisen en mechanismen de houding kunnen beïnvloeden.

Games zijn contextafhankelijk. Daarom zijn de eisen, afgeleid van de literatuurstudie, door middel van een iteratief proces verder verfijnd. Het iteratieve proces maakte het ook mogelijk om de operationalisering van bepaalde eisen in spelmechanismen te testen. Vier prototypes zijn hervoor ontwerpen en beproefd. Elk prototype werd geëvalueerd en droeg bij aan de operationalisering van de eisen, mechanismen, en voor de uiteindelijke versie van het spel.

- Prototype 1. *Cards for open data*: Uit de evaluatie van kaartspel kwam naar voren dat de mechanismen om spelers te betrekken kunnen helpen om spelers te verbinden met de open data uitdagingen, echter het kaartspel resulteerde in een lagere mate van kennisoverdracht over open data;
- Prototype 2. *Solvd:* Het groepsdiscussiespel gaf aan dat interactieve groepsinteracties helpen om inhoud beter te begrijpen. Het spel was niet onderhoudend, wat resulteerde in een verlies van betrokkenheid;
- Prototype 3. *Job-matching game*: Het digitale spel voor besluitvorming op de arbeidsmarkt hielp spelers om de routines van de productie en het gebruik van gegevens door de overheidsdiensten, zoals deze plaatsvinden in de werkelijkheid, te begrijpen. Dit prototype laat zien dat de situaties waarmee ambtenaren in de realiteit te maken krijgen moeten worden weergegeven in de games, inclusief risico's en manieren om de risico's te voorkomen; en
- Prototype 4. *Open data office*: dit rollenspel voor middelenbeheer laat zien hoe de behoeften aan engagement en leren, die tot attitudeverandering leidden, te operationaliseren. De game gaf de routines en de kantooromgeving niet goed weer. Het spelen van rollen met mensen bleek belangrijk te zijn voor het beïnvloeden van attitudeverandering. Ook hielp dit prototype om inzicht in het aantal spelers en rondes te verkrijgen.

De prototypes leiden tot de volgende **hoofdeisen** aan een serious game om de houding van ambtenaren voor de openen van data te beïnvloeden:

- Eis 1. Open overheidsdata die in het spel worden gebruikt moet benadrukt worden;
- Eis 2. De focus moet liggen op een spelervaring die leren mogelijk maakt;
- Eis 3. De praktijkkennis van ambtenaren dient terug te komen in de game;
- Eis 4. De game moet een veilige omgeving zijn om mee te experimenteren;
- Eis 5. De gamesetting dient realistisch te zijn;
- Eis 6. De speldynamiek dient georganiseerd te zijn als een rollenspel; en
- Eis 7. Het aantal rollen, spelers en rondes moet beperkt blijven.

De bevindingen uit de literatuur, gecombineerd met de uitkomsten van de iteratieve ontwerpcycli, pilot-testing en debriefing, leiden tot het beantwoorden van de derde onderzoeksvraag (Welke spelmechanismen maken het mogelijk om de houding van ambtenaren ten opzichte van het openstellen van overheidsdata te veranderen?). De uiteindelijke versie van het spel, genaamd WINNING DATA, vertaald de eisen in mechanismen die spelers houding ten aanzien van open data zouden moet beïnvloeden. Deze mechanismen zij afgeleid uit het ontwerpproces, waarbij elke debriefing van het prototype de volgende iteratieronde en het nieuwe prototype vormde. Zo worden de behoeften aan open data-inhoud realistisch gerepresenteerd door middel van middelen zoals formulieren, bestanden en vraagkaarten. De vraagkaarten bevatten verzoeken tot het openen van data. De behoeften

worden beschreven met specifieke kaartcodes gekoppeld aan een puntensysteem. De vragen worden verwerkt door het rollen van dobbelstenen waarvan de uitkomsten leiden tot de creatie van datasets. Afhankelijk van de combinaties van dobbelstenen kunnen er privacy- en veiligheidscrises ontstaan, die van invloed zijn op het optreden van uitdagingen van het spel. De volgende definitieve lijst van **mechanismen** is het resultaat van dit proces:

- Mechanisme 1: Dataset beschrijving en labels
- Mechanisme 2: kaartcodes
- Mechanisme 3: Vooraf-gedefinieerde eisen (niet willekeurig)
- Mechanisme 4: formulieren, bestanden en vraagkaarten
- Mechanisme 5: Dienstverleningsdoelstelling
- Mechanisme 6: Upgrades
- Mechanisme 7: Facilittering
- Mechanisme 8: Crisis bord
- Mechanisme 9: Dobbelstenen als verwerking machine
- Mechanisme 10: Meeerdere spelers met verschillende rollen; en
- Mechanisme 11: Tijds-gelimiteerde rondes

Op basis van deze vereisten en mechanismen werd WINNING DATA ontworpen als een rollenspel voor vier spelers dat in een sessie van twee uur kan worden gespeeld. Het spel werd geëvalueerd door de invloed op de houding van ambtenaren voor het openen van overheiddata te meten. Het spel bestaat uit vijf ronden waarin de deelnemers van rol wisselen. De vier rollen zijn burger, twee ambtenaren en een manager. De speler die de rol van burger speelt, vraagt diensten aan degene die de rol van ambtenaar speelt; de speler die de rol van ambtenaar speelt, moet samenwerken met de collega en de baas om de dienst te leveren. Elke geleverde dienst resulteert in een dataset die wordt besproken door het team en gelabeld door de baas. Labelbeslissingen beïnvloeden de kans op een privacy- of veiligheidscrisis in de komende rondes, als gevolg van specifieke dobbelsteencombinaties.

Ten slotte werden het spel, de dataverzameling en de statistische analyse gebruikt om de vierde onderzoeksvraag te beantwoorden (Wat zijn de effecten van het open data spel op de houding van ambtenaren ten aanzien van het openen van data?). De belangrijkste hypothese is dat de houding van ambtenaren kan worden veranderd door het spelen van de WINNING DATA. Uit de lijst van gedragsbarrières (onderzoeksvraag 1) kwam een eerste lijst van factoren naar voren die de houdingen van ambtenaren beïnvloeden. Gedragsintentie is de afhankelijke variabele die de houding van ambtenaren weergeeft. Er zijn vier beïnvloedende factoren gedefinieerd die de Gedragsintentie beïnvloeden, namelijk gebrek aan kennis, prestatieverwachting, inspanningsverwachting, en sociale invloed. Verkennende testen werden uitgevoerd om te bepalen welke factoren een rol spelen en hoe het spel deze beïnvloedde. Alle factoren werden gemeten met behulp van een enquête welke 33-items op basis van een 7-punts Likert schaal vragenlijst bevat.

De enquête werd gebruikt om de attitudes van de spelers te meten voor en na het spelen van het spel. Door de resultaten van voor en na het spelen te vergelijken werd de invloved van de game op de houding ten aanzien van het openen van data geëvalueerd. In een quasi-experimentele opzet speelden 77 ambtenaren het spel en vulden zij de pre- en posttestvragenlijst in. Als controlegroep vulden 35 andere ambtenaren de vragenlijst in bij twee verschillende gelegenheden, zonder het spel te spelen. Op basis van deze enquêtes is de analyse uitgevoerd.

Als eerste werd de interne betrouwbaarheid van de factoren gecontroleerd, gevolgd door een exploratieve toetsing van de factoren die niet laadden. De resulterende factoren werden georganiseerd in een model met Gedragsintentie als afhankelijke factor, die meerdere dimensies van de houding van ambtenaren tegenover open data meet. Zeven andere factoren werden gedefinieerd: Kennis van gegevensbeheer (DK), Prestatieverwachting (PE), Risico's (RK), Sociale invloed (SI), Kennis van gegevensproductie (DP), Kennis van gegevensdeling (DS), en Gegevenskosten (DC). De acht resulterende **hypothesen** werden getest aan de hand van de 112 ingevulde enquêtes:

Hypothese 1: Gedragsintentie neemt toe na het spelen van het spel;

Hypothese 2: Het spel resulteert in meer kennis over mogelijke manieren om data open te stellen;

Hypothese 3: Het spel leidt tot een beter begrip van de verwachte voordelen van het openen van data;

Hypothese 4: Het spel vermindert de verwachtingen over de inspanning die nodig is om data beschikbaar te maken;

Hypothese 5: Het spel vermindert de perceptie van ambtenaren over beperkingen van het openstellen van gegevens, zoals die door hiërarchieën en wettelijke kaders worden uitgeoefend;

Hypothese 6: Het spel vermindert kennis van de dataproductie;

Hypothese 7: Het spel vermindert kennis van de mogelijkheid om data te delen; en

Hypothese 8: Het spel vermindert de perceptie van de datakosten.

De WIlcoxon-Signed Rank test laat zien dat het spelen van de game een statistich significant effect heeft op de afhankelijke variabele gedragsintentie. Er was geen effect op de gedragsintentie in de controlegroep, wat de conclusies dat de houding van ambtenaren ten opzichte van open data is versterkt door het spel. WINNING DATA had niet aleen een significant positief effect op Gedragsintentie, maar ook een statistisch significant effect is gevonden voorKennis van Datamanagement, Risico's, en Prestatieverwachting.

Er zijn een viertal onderzoeksbeperkingen: (1) steekproef-gerelateerde beperkingen: een beperking in het aantal deelnemers en hen karakteristieken; (2) behandelings-gerelateerde beperkingen: de effecten met alternatieve strategieën zijn niet vergeleken in het onderzoek; (3) test-gerelateerde beperkingen: als gevolg van de steekproef grootte konden bepaalde statistische analyses niet uitgevoerd worden; en, (4) uitkomsten-gerelateerde beperkingen, andere factoren welke het gedrag beïnvloeden zijn mogelijk. Bovendien werpen deze beperkingen licht op andere verbeteringen voor nieuwe versies van het spel.

Als vervolgonderzoek wordt aanbevolen om het spel verder te testen met grotere steekproeven, spelers met een verschillende achtergronden en afkomstig uit verschillende landen. Ook kunnen de resultaten vergeleken worden met passieve interventies, zoals geschreven tekst en presentaties. Bovendien is het sterk aan te raden het spel verder te digitaliseren, om er uiteindelijk een volledig digitaal spel van te maken. In het licht van de recente crisis van COVID-19 is dit een belangrijke richting, omdat personen dan op afstand kunnen spelen. Ook het uitbreiden met andere open data elementen en ook het vertalen naar nieuwe onderwerpen is een aanbeveling.

Tot slot laten de resultaten zien dat het spel een effect heeft op de houding van ambtenaren ten opzichte van het openen van overheidsdata. De resultaten van deze dissertatie kunnen worden gebruikt om door overheden meer data te laten openen.

SUMÁRIO

Dados são necessários para o funcionamento de um governo, e servidores públicos geram dados que podem ser abertos. No entanto, nem sempre estes dados estão disponíveis publicamente. Governos abrem seus dados para atender às pressões públicas por mais transparencia e accountability, e para estimular a particpação e a inovação. A abertura de dados pode ser uma fonte de incerteza para servidores públicos, ou pode até ser ilegal, dependendo na interpretação da legislação. Por sinal, dados abertos podem ser vivenciados como um fardo ou de dificil realização, mesmo que a sua abertura possa gerar benefícios socialmente relevantes.

Esta pesquisa foca em superar as barreiras comportamentais em nível individual para que servidores públicos realizem a divulgação de dados abertos através do uso de um jogo sério. Dados abertos dizem respeito a qualquer dado, produzido por equipamentos ou pessoas, que é publicamente comportalhido gratuitamente ou com custos mínimos, e que podem ser acessados por qualquer pessoa. Essas barreiras comportamentais influenciam as decisões de governos em disponibilizar dados para o público. Barreiras comportamentais são impedimentos para a divulgação de dados por governos que tem origem no comportamento humano. A literatura sugere que tais comportamentos são dificeis de mensurar e, por isso, nosso foco será nas atitudes, que são mensuráveis através percepções declaradas. Nesta pesquisa, atitudes são definidas como a intenção de comportamento de servidores públicos para a apoio de dados abertos.

Jogos sérios são intervenções baseadas em jogos, construídas com objetivos que vão além da diversão dos jogadores. Eles oferecem um ambiente seguro e controlado para experimentação e aprendizagem experiencial. O objetivo de pesquisa desta tese é o de desenvolver e testar um jogo para influenciar as atitudes de servidores públicos em relação a abertura de dados por governos, permitindo que eles experimentem os lados positivos e negativos dos dados abertos por meio do jogo. Pesquisa em ciência do Design foi utlizada para o desenvolvimento e testagem de protótipos no numa configuração quasi-experimental. Quatro questões de pesquisa orientaram esse estudo:

> QP1. Quais são as barreiras comportamentais para que servidores públicos apoiem a abertura de dados governamentais?
> QP2. Quais são os requerimentos para construir um jogo que mude as atitudes de servidores públicos em relação a abertura de dados governamentais?
> QP3. Quais são os mecanismos de jogo que viabilizam a mudança de attitude de servidores públicos em relação a abertura de dados governamentais?
> QP4. Quais são os efeitos do jogo de dados abertos nas atitudes de apoio dos servidores públicos em relação a abertura de dados governamentais?

Cada uma dessas questões de pesquisa demandaram a aplicação de métodos de pesquisa específicos. Como um primeiro passo, revisões sistemáticas de literatura foram realizadas nos campos de: 1) barrieras comportamentais para o provimento de dados abertos; 2) jogos para

servidores públicos; 3) jogos para dados abertos; e 4) jogos feitos para mudança de atitudes. A primeira revisão de literatura foi utilizada para responder a primeira questão de pesquisa, enquanto as demais foram usadas para responder a segunda.

Para QP1 (Quais são as barreiras comportamentais para que servidores públicos apoiem a abertura de dados governamentais?), a revisão de literatura identificou uma lista de 38 barrieras de influencia sobre o suporte da abertura de dados por servidores públicos. Essas barreiras comportamentais discutidas nessas tese devem ser consideradas para realizar mudanças nas atitudes de servidores públicos em relação ao seu suporte a abertura de dados governamentais.

Para a QP2 (Quais são os requerimentos para construir um jogo que mude as atitudes de servidores públicos em relação a abertura de dados governamentais?) outras três revisões de literatura foram feitas para encontrar requerimentos para o desenho de jogos de pesquisas anteriores. Elas buscaram aspectos específicos de jogos sérios: 1) para servidores públicos, voltados a entender melhor as características desse público que poderiam influenciar a experiência de jogo; 2) que usassem conteúdos de dados abertos e pudessem inspirar as metáforas e representações de provimento de dados em situação de jogo; e 3) que focassem na mudança de atitudes, objetivando o uso de jogos bem sucedido para este fim. Muitos jogos foram encontrados para servidores públicos, enquanto nenhum especificamente para fornecimento de dados abertos. Apesar de existerem mecanismos relacionados na literatura, eles não apontaram para sua operacionalização em um jogo. Para avançar na direção do melhor jogo com esta finalidade, um processo de iteração foi realizado buscando entender melhor como o jogo poderia ser desenvolvido.

Jogos são dependes de seu context, particularmente nesse caso específico, de um jogo para provimento de dados governamentais. Da mesma maneira, o processo iterativo viabilizou a testagem da operacionalização dos requerimentos encontrados em mecanismos de jogo. Quatro protótipos resultaram desse processo de desenvovimento de jogo. Cada protótipo desenhado foi avaliado, atualizando a lista de requerimentos e mecanismos da versão final do jogo.

- Protótipo 1: A discussão (debriefing) das Cartas para a abertura de dados mostrou que mecanismos de engajamento poderiam ajudar a conectar jogadores a desafios, mas um jogo de cartas resultou em baixa transferência de conhecimento sobre dados abertos;
- Protótipo 2: Solvd, um jogo de debate em grupo, resultou num conteúdo interativo resultante das discussões. No entanto, o jogo não era divertido, e o grupo perdeu engajamento;
- Protótipo 3. Simulador de intermediação de emprego, um jogo de tomada de decisão digital que ajudou a mapear a produção real de dados em um escritório de governo e suas rotinas de uso. Esse protótipo realçou a necessidade de representar as situações

encontradas por servidores públicos na vida real, incluindo os riscos e alternativos para previní-los;
- Protótipo 4. Escritório de dados abertos, um jogo de interpretação de papéis focou no engajamento e mudança de atitude. Ainda assim, careceu de uma metáfora mais precisa para as rotinas e o ambiente do escritório. Da mesma forma, observar os papéis com jogadores hunanos foi importante para os objetivos de aprendizagem, além de contribuir para o ajuste no número de jogadores e rodadas.

Os quarto protótipos resultaram na seguinte lista de **requerimentos** para produzir um jogo que influencie o suporte de servidores públicos à abertura de dados governamentais:

- Requerimento 1. Conteúdos de dados abertos usados no jogo precisam ser ressaltados;
- Requerimento 2. O focos do jogo precisa ser emu ma experiencia de jogo que produza um aprendizado experiencial;
- Requerimento 3. O conhecimento tácito e prático de servidores públicos precisa estar refletido no jogo;
- Requerimento 4. O jogo precisa ser um ambiente seguro para experimentação;
- Requerimento 5. A configuração do jogo precisa ser realista;
- Requerimento 6. As dinâmicas do jogo precisam estar organizados como jogo de interpretação;
- Requerimento 7. O número de papéis, jogadores e rodadas precisam ser limitadas.

Adicionalmente, a combinação dos achados da literature com os resultados dos ciclos iterativos, testes e discussões, permitiram responder a QP3 (Quais são os mecanismos de jogo que viabilizam a mudança de attitude de servidores públicos em relação a abertura de dados governamentais?). A versão final do jogo, chamado WINNING DATA (GANHANDO DADOS), operacionalizou os requerimentos em mecanismos que permitiu que os jogadores mudassem sua atitude em relação a abertura de dados governamentais. Esses mecanismos emergiram do processo de design, onde cada discussão de protótipo informou o momento seguinte de iteração e novo protótipo. Por exemplo, a necessidade de conteúdos de dados abertos e realismo foram representados nos elementos de jogos como formulários, fichas e cartas de demanda; cartas de demanda expressaram rotinas pré-definidas: requisição de serviços. Demandas foram identificadas por códigos de cartas específicos, que viabilizaram um sistema automatizado de pontuação para a facilitação do jogo; a entrega de serviços, o processmento por meio do uso de dados de 6 faces, resultaram na criação de conjuntos de dados. Dependendo na combinação dos dados de 6 faces, crises de privacidade ou segurança ocorreram, afetando os desafios do jogo. A seguinte lista final de **mecanismos** resultou deste processo:

- Mecanismo 1: Descrição de conjuntos de dados e classificação;
- Mecanismo 2: Códigos de cartas;
- Mecanismo 3: Demandas pré-definidas (não aleatórias);

- Mecanismo 4: Formulários, Fichas and Cartas de demanda;
- Mecanismo 5: Objetivo de entrega de serviço;
- Mecanismo 6: Melhorias (Upgrades);
- Mecanismo 7: Facilitação;
- Mecanismo 8: Placar de Crise;
- Mecanismo 9: Uso de dados de 6 lados como máquinas de processamento;
- Mecanismo 10: Múltiplos jogadores (com diferentes papéis); e
- Mecanismo 11: Rodadas limitadas por tempo.

Baseado nesses requerimentos e mecanismos, WINNING DATA foi desenvolvido como um jogo presencial de quatro jogadores que pode ser jogado em sessões de 2 horas. O jogo foi avaliado por seus efeitos na atitude dos servidores para apoiar políticas de abertura de dados governamentais. Jogar o jogo passa por cinco rodadas nos quais os participantes trocam de papel. Os papéis são cidadão, dois servidores públicos e um chefe. O jogador cidadão demanda serviõs ao que joga como servidor públicoç o servidor precisa trabalhar com seu colega e chefe para entregar o serviço de volta. Cada serviço entregue resulta em um conjunto de dados que precisa ser discutido pelo time e classificado pelo chefe. Decisões de classificação influenciam as chances ter ter crises de segurança ou privacidade nas rodadas seguintes, resultando de combinações específicas nos dados.

Por fim, observação de jogo, coleta de dados e análise estatística foram usadas para responder a QP 4 (Quais são os efeitos do jogo de dados abertos nas atitudes de apoio dos servidores públicos em relação a abertura de dados governamentais?). Nossa hipótese principal era de que as atitudes dos servidores públicos em relação a abertura de dados governamentais poderiam ser mudadas através de um jogo sério. Pela lista de barreiras (QP1), emergiu uma lista inicial de fatores de influencia sobre as atitudes dos servidores públicos em relação a abertura de dados abertos. Quatro fatores de influencia sobre a Intenção de Comportamento, a variável dependente, foram definidos: falta de conhecimento, expectativa de performance, expectativa de esforço, e influência social. Uma testagem exploratória foi conduzida para determinar quais fatores estavam em ação e como o jogo os afetavam. Esses fatores foram transformados em hipóteses para testar os efeitos do jogo sobre as atitudes dos servidores públicos em seu apoio a abertura de dados governamentais. Todos os fatores foram medidas usando um questionário de 33 perguntas em escala Likert de sete pontos.

Essa survey foi usada para medir as atitudades dos servidores antes e depois do jogo ser jogado. A comparação possibilitou a anãlise dos efeitos de mudança na atitude. Num contexto quasi-experimental, 77 servidores jogaram o jogo e preencheram o questionário pré- e pós-jogo. Outros 35 servidores públicos preencheram o questionário em duas ocasiões diferentes, sem a intervenção de jogo, usados como grupo de controle. Os dados foram analisados.

Primeiro, a confiabilidade interna dos fatores foi checada, seguida por uma análise exploratória com os fatores que não carregaram suficientemente. Os fatores resultantes foram organizados em um modelo que incluiu Intenção de Comportamento como fator

dependente, medido por multiplas dimensões as atitudes dos servidores públicos em relação aos dados abertos. Outros sete fatores foram definidos: Conhecimento de Política de Gerenciamento de Dados; Expectativa de Performance; Riscos; Influência Social; Conhecimento da Produção de Dados; Conhecimento do Compartilhamento de Dados; e Custos de Dados. As oito **hipóteses** resultantes foram testadas usando os 112 questionários completos:

Hipótese 1: Intenção de Comportamento aumenta depois de jogar o jogo;

Hipótese 2: O jogo resulta em mais conhecimento sobre as formas de abrir dados;

Hipótese 3: O jogo resulta em melhor entendimento dos benefícios esperados pela abertura de jogos;

Hipótese 4: O jogo diminui as expectativas de risco relacionados a abertura de dados;

Hipótese 5: O jogo reduz as percpeções dos servidores públicos sobre as dificuldades de abrir dados, como as oriundas de hierarquia e arcabouço legal;

Hipótese 6: O jogo aumenta o conhecimento dos jogadores sobre a produção de dados governamentais;

Hipótese 7: O conhecimento dos jogadores sobre as possibilidades de compartilhamento de dados é ampliada pelo jogo; e

Hipótese 8: O jogo amplia a percepção dos jogadores sobre os custos dos dados.

Através de testes de Wilcoxon, a hipótese principal foi testada e concluímos que é provável que teremos um efeito estatísticamente significante na variável dependente de Intenção de comportamento com o uso do jogo. Como não encontramos efeitos significantes no grupo de controle, nossa conclusão de que os servidores públicos que jogaram o jogo tendem a mudar suas atitudes em relação aos dados abertos foram reforçadas.

Depois desta análise, as demais sete hipóteses de WINNING DATA foram testadas. O jogo mostrou um efeito positivo significativo em Riscos e Expectativa de Performance. Apesar de diferenças nos testes pré- e pós-jogo em Conhecimento de políticas de gerenciamento de dados, Influência social, Conhecimento da produção de dados, Conhecimento do compartilhamento de dados, e Custos de dados, nenhum deles foi estatisticamente significante.

Nossa pesquisa tem limitações oriundas de (1) número limitado de participantes e as caracterpisticas das distribuições de dados; (2) a ausência de estratégias alternativas às quais os resultados poderiam ser comparados; (3) a viabilidade de análises estatísticas mais complexas que foram limitadas à amostra disponível. Além disso, essa pesquisa (4) não pode explorar resultados mais diversos, como uma discussão mais complexa de modelo sobre os fatores de influência das atitudes dos servidores em seu suporte à abertura de dados

governamentais, a qual é necessária e ainda por ser feita. Além disso, essas limitações inspiram outras melhorias que podem ser desenvolvidas para novas versões do jogo.

Pesquisa futuras são recomendadas para testar o jogo com amostras maiores, com jogadores de orgiens mais diversas, vindos de diferentes países. O uso do mesmo questionário em outras intervenções passivas, como leitura de textos ou aulas, pode também contribuir para a comparação dos resultados. Os efeitos de longo prazo do jogo não foram pesquisados e são recomendados como direção de pesquisas futuras. Outra proposta para pesquisas seguintes é a digitalização do jogo. Particularmente no contexto da recente crise the COVID-19, isso é necessário dado que jogar o jogo com muitas pessoas em um mesmo espaço não é uma boa opção. Da mesma forma, avançar em discussões de modelo, incluindo mais elementos de dados abertos, e extendendo os assuntos para outros campos de pesquisa tam´bem é uma recomendação da presente tese.

Concluindo, o jogo desenvolvido e testado durante esse projeto provou seus efeitos em mudar as atitudes de servidores públicos em relação a política de dados abertos governamentais. Os resultados desta tese podem ser usados para desenvolver melhores intervenções para fazer com que mais dados governamentais sejam disponiblizados ao público.

1 CHAPTER 1 – Introduction

1.1 Open government data and civil servant attitudes towards data opening

Open Data can be defined as "data which is accessible for free or at minimal cost, and which can be accessed by anybody and reused for any purpose" (Hardy & Maurushat, 2017, p. 30). Though minimal costs are discussable, since some thresholds can be costly, the goal is to reduce them and maximize open data use. Making governmental data available to the public is high on the agenda of many countries worldwide (Davies, Walker, Rubinstein, & Perini, 2019; Ubaldi, 2013). Governments open their data not only to create transparency and accountability but also to benefit from input from the public to improve their service provision and generate economic value (Crusoe & Melin, 2018; Janssen & van den Hoven, 2015; Welle Donker & van Loenen, 2016). The specific field of enabling society to access, use and reuse governments' data is called *open government data*, or OGD (Conradie & Choenni, 2014; Janssen, Charalabidis, & Zuiderwijk, 2012; Ubaldi, 2013).

Governments' data releases can benefit both users and providers (Attard, Orlandi, Scerri, & Auer, 2015). The public sees increased transparency, accountability, means of participation, and sources of new economic activities and value creation (Zuiderwijk, Shinde, & Janssen, 2018). By opening data, OGD providers (governments) can reduce the number of Freedom of Information (FOI) requests and red tape by pro-actively releasing data, and they also desire to have a more transparent, accountable, and participatory administration (Hardy & Maurushat, 2017; Hossain, Dwivedi, & Rana, 2016).

Not only governments but also international alliances are supporting open data. Some researchers believe that transparency acts from the 1970s were already creating a culture of fostering openness of information, but it was only at the beginning of the twenty-first century that the major shift took place (Davies et al., 2019; Obama, 2009). Nowadays, many international initiatives are monitoring the opening of governmental data, such as the Open Government Partnership (OGP), which involves 78 countries worldwide. The United Nations (UN), the European Union (EU), the Organisation for Economic Co-operation and Development (OECD), the World Bank (WB), and other organizations also have dedicated projects on data opening (Davies & Calderon, 2020; OECD, 2018). Moreover, "open data initiatives resulted in greater availability of (public) data that can be freely reused by anyone for any purpose" (van Loenen, Kulk, & Ploeger, 2016, p. 338).

However, even with these advances, many governmental datasets remain closed (Conradie & Choenni, 2014; Ma, R. & Lam, P. T. I., 2019). On an institutional level, this problem can be explained by a lack of infrastructure, adequate personnel, and sufficiently digitalized information (Janssen et al., 2012). Likewise, in deciding for data to be opened, both

organizations and individual agents from those organizations can resist such openness based on their attitudes towards the topic.

From a stakeholder perspective, many different actors are involved in the process of releasing data, including decisions of politicians (legislators and decision-makers), IT workers, public officials, public sector practitioners, international organizations, and civil society activists (Gonzalez-Zapata & Heeks, 2015). Accordingly, different actors find a variety of trade-offs, opposing requirements for risks and benefits to support data release in an open data ecosystem (Luthfi & Janssen, 2017; Luthfi, Janssen, & Crompvoets, 2020). Civil servants can be especially influential in this area. As they are governmental staff, one of their duties can be to give support to relevant decision-makers. They can also act as data custodians, collecting, maintaining, and disclosing open data. Civil servants may oppose the idea that data should be opened, thus increasing OGD policies' resistance.

Researchers have investigated this type of behavior at the individual level (Martin, 2014; Schnake & Dumler, 2003). Technology adoption studies scrutinize mental models and factors that can cause individuals to support or oppose specific tools, protocols, or techniques. In particular, such studies have been applied to the open data use field (Gascó-Hernández, Martin, Reggi, Pyo, & Luna-Reyes, 2018; Zuiderwijk, Janssen, & Dwivedi, 2015; Zuiderwijk & Cligge, 2016); not many studies have focused on the providers of OGD. This thesis suggests a first model for open data provision at the individual level and explores the foundations of resistance of civil servants to support open data (Kleiman, Janssen, & Meijer, 2020). Based on that, we present and test a serious game to increase civil servants' support by changing their attitudes.

The game aims at changing civil servants' attitudes towards the release of open data by governments, by experiencing the open data's positive and negative consequences. It does so by exploring how OGD providers, particularly those who operate public policies, use and understand data, and using the findings to develop a game to influence their attitudes towards opening data. After all, these individuals can influence the decisions of governments to open the data they generate. To such discussions, targeting behaviors is unadvised by the literature, as they are difficult to measure (Ajzen, 1989). Attitudes are measurable through how a person declares to feel or think of a certain topic. In this thesis, *attitudes are defined as governmental civil servants' behavioral intention to support open data*. Hence, *Behavioral Intention* to support open data is used as an observable variable that can predict civil servants' willingness towards data release (Ajzen & Fishbein, 1975; Jurisch, Kautz, Wolf, & Krcmar, 2015; Kleiman, Janssen, Meijer, & Jansen, 2020). Hence, we use changes in behavioral intention as a proxy for measuring civil servants' attitude change.

Multiple approaches can be used to influence civil servants' attitudes towards opening data. National governments are formalizing laws and measures to publicize data (Parkes, Karger-Lerchl, Wells, Hardinges, & Vasileva, 2018 ; Vaz, Ribeiro, & Matheus, 2013; Weerakkody, Janssen, & Dwivedi, 2011). Top-down approaches of law and regulations have been

implemented in many countries with mixed results (Ubaldi, 2013). In some places, having national laws and policies in place did not result in more data being opened.

Furthermore, not many organizations can regularly publish and use data as there are differences in employees' skills and structures between governmental levels and agencies. Reports, campaigns, courses, publications, and other initiatives tackle public bodies' resistance to sharing data. Conferences are organized aimed at expanding the culture of opening data among researchers and professionals in the field. This thesis premise is that gaming targeting civil servants can result in the opening of more data. This is different from existing research and policies at stimulating the opening of data, which primarily focused on:

1) Strategies focus on users, assuming an increase in demand for data results in more data to be released. But in the literature, many of the barriers found are related not to the lack of demand but rather to providers' characteristics (Donker & van Loenen, 2016; Kleiman, Janssen, & Meijer, 2020; Martin, Sebastien, Foulonneau, Muriel, Turki, Slim, & Ihadjadene, Madjid, 2013);
2) When directed at providers, these strategies target decision-makers and do not value the role of operational staff in the decision-making processes surrounding open data. As top-down approaches are already common and many datasets remain closed, a bottom-up strategy is worth pursuing (Barry & Bannister, 2014);
3) Most actions are directed at the institutional level, making operational barriers a high priority (Ubaldi, 2013). Nevertheless, the operating teams' behavior that decides whether to open data is also essential, and specific efforts to address them are needed (DiMaggio & Powell, 1983).
4) Furthermore, beyond passive campaigns and reports, gaming can result in active, experiential learning. Furthermore, such a strategy can suit civil servants' needs (Kolb, 2000).

De Bruijn and Ten Heuvelhof (2010) found that "when a process leads to such incorporation of dynamics, the parties are in a position to learn. After all, they are constantly faced with others and with new views, which can stimulate them to reflect on their own views" (p.22). As will be discussed in this thesis, there is a need for bottom-up approaches that can help civil servants to better understand the benefits and risks of open data. It is possible to put open data at play and get bureaucrats to experience it. Therefore, our focus is on serious gaming, a powerful alternative tool that can be used to address OGD resistance.

1.2 Serious games for attitude change

Governments have long used games to help make decisions, build scenarios, crowdsource solutions, and foster civic engagement (Boyle et al., 2016; Olejniczak, Newcomer, & Meijer, 2020; Sgueo, 2018). Still, the most common use of games is education (Meijer, Reich, & Subrahmanian, 2014); they work well for learning and training purposes, for raising awareness, and for encouraging behavior change (Alonso-Fernández, Perez-Colado, Freire,

Martínez-Ortiz, & Fernández-Manjón, 2018; Mayer et al., 2014; Mayer, Carton, de Jong, Leijten, & Dammers, 2004).

Games are a simulated environment with which it is safe to interact, and they allow complex problems to be addressed through participative solutions (Duke & Geurts, 2004). According to Meijer (2015), "gaming is defined as `simulating a system through gaming methods'. The term 'gaming' exists within a loosely demarcated field of interactive, participatory activities aimed at involving participants, who may be actual stakeholders in an activity. Related terms include simulation games, gaming simulations, policy exercises, and serious gaming" (p., 516). Though this technique has been used for 50 years (Duke, 1974), it has recently been getting more attention due to its capacity to deal with complex situations (Klievink & Janssen, 2010; Lukosch, Bekebrede, Kurapati, & Lukosch, 2018). Games designed for more than entertainment offer a dynamic and interactive approach to discussing and developing solutions for wicked problems (Klabbers, 1996). For that, we use the term *serious games* in this thesis.

Serious games have proven beneficial for changing both attitudes and behavior; they function as experiential learning tools (Kolb, 2000). After all, the behavior is a consequence of a person's attitudes towards a particular topic formed by knowledge and experiences (Ajzen, 1989; Kroesen, Handy, & Chorus, 2017; Ruggiero, 2015). When games mitigate the risks and consequences of their actions, players can safely and freely practice how to act in real-life scenarios. This process can accelerate experiential learning and influence attitudes towards the topic at hand (Kleiman, Janssen, Meijer, et al., 2020; Kolek, Šisler, & Brom, 2019). Hence, serious games in the open data field serve as "new tools [that] are providing access and processes for collecting expertise from different sources, thus opening the process" (Janssen & Helbig, 2016, p. 3).

How can one tackle attitude change towards open data through a serious game? Some games seek to raise users' awareness of the topic's usefulness (Chiotaki & Karpouzis, 2020; Dunwell et al., 2016; Siriaraya, Kiriu, Kawai, & Nakajima, 2018). Likewise, games for creating policy awareness or targeting governmental personnel exists. However, at the time of the start of this research, no games target civil servants for the opening of data existed; no game focused on the process of releasing data instead of dealing only with its use, and no game tackled data providers' attitudes. Consequently, the requirements and mechanisms for a game to change civil servants' attitudes as data providers were unknown.

1.3 Research objective

The objective of this research is to develop and test a serious game influencing the attitudes of civil servants towards supporting the release of open data by governments. The game should enable the players to experience open data’s positive and negative sides influencing their attitudes. Hence, our main hypothesis is that a serious game can be used to change the attitudes of civil servants towards open data.

WINNING DATA is the name of the game, which was developed based on the literature and several prototypes. It allows role-playing of real-life scenarios of governmental data provision. Specifically, it simulates a public office with four roles (civil servant, colleague, boss, and citizen) where services are delivered to the population. In this new learning environment, governmental teams and agencies can experience and assess the previously unknown risks and benefits of having their data opened or closed to the public. WINNING DATA targets civil servants who operate governmental actions, who are part of public teams, and can prompt decision-makers to make data accessible.

This game was developed to change civil servants' attitudes towards the opening of data. The literature indicates that such resistance originates from having no awareness of possible benefits, focusing on the risks and possible adverse effects, or not knowing how to advance the opening of data (Conradie & Choenni, 2014; Janssen et al., 2012; Oliver, Innvar, Lorenc, Woodman, & Thomas, 2014). In light of their administrative burden and their quest to deliver policies, bureaucrats have well-defined procedures to follow, limiting their actions (Rehouma & Hofmann, 2018a). All too often, civil servants tend to focus on risks and overlook the potential benefits of open data policy-making (Martin, Foulonneau, & Turki, 2013). In such a risk-averse, restrictive, and hierarchical environment, as the public administration is expected to be, addressing the underlying individuals' behavior is another challenge (Buurman, Delfgaauw, Dur, & Van den Bossche, 2012). Indeed, in this context, the task of influencing civil servants operating at different government levels can be difficult.

Serious gaming can bring about real change by creating an interactive and experiential learning environment. The learnings of the game can result in an attitude change in their job. The existence of both technical problems (need for tools, support, and skills) and social challenges (many actors, risk-averse culture, and reduced willingness) makes it challenging to influence civil servants' attitudes. To create the targeted experiential learning outcomes, we used civil servants' decision-making processes as the leading starting point for designing games that may influence these individuals' intentions to support OGD. The experiential learning resulting from the game is the main mechanism to influence their attitudes. WINNING DATA can give them a different experience; their attitudes toward open data may change accordingly.

1.4 Design Science Research methodology

We developed WINNING DATA using the Design Science Research (DSR) approach. The DSR paradigm is rooted in engineering and is a sequence of activities towards problem-solving (Hevner, March, Park, & Ram, 2004). DSR results in artifacts that address unsolved problems, which evaluation criteria are the utility of designed solutions. Given that hardly any systematic methods to design games exist, the detailed design process of WINNING DATA is also a scientific contribution of this thesis. Also, the evaluation criteria are a contribution as the game is aimed at changing the attitude, and no evaluation criteria exist yet.

Civil servants played WINNING DATA in a quasi-experimental set-up to make their experiences and learning outcomes as comparable as possible. This setting enabled the exploration of results and limitations for using the game to influence civil servants' perceptions of open data. This thesis assesses the players' learning outcomes through a survey, which is based on information about the many behavioral barriers that cause civil servants to resist data opening.

Similar to an office simulation, our serious game embeds civil servants' work in the realm of data production and management at the operational level. WINNING DATA's gameplay, including challenges, and scoring system, aimed to highlight the differences that opening data can make to the office, the team, and delivering services to citizens. Unlike all the other games focused on open data use, this is the first civil servant game based on governmental data provision.

Overall, WINNING DATA has two main sub-goals. On the one hand, it was designed as an interactive learning tool for civil servants to experience the opening of data in a simulated public office; on the other hand, it was used to evaluate the players' behavior to evaluate the effects of the game. The literature search resulted in an initial list of requirements and gaming mechanisms to develop a serious game targeting civil servants in a governmental environment using open data provision content. Requirements are the characteristics taken from previous experiences, which the game should fulfill, while the mechanisms operationalize these requirements into game mechanics, dynamics, and aesthetics (also called game design elements). We developed four prototypes based on the initial requirements, each of them fulfilling parts of the two goals to arrive at the final list of requirements and mechanisms. The resulting game, WINNING DATA, emerged from this iterative process.

Apart from designing the game, a survey was developed to measure the players' attitude change. Additionally to our main hypothesis, we conducted explorative testing on these factors to check how the game affected them and to better understand how the game resulted in attitude change. We collected data before and after the game was played to evaluate the effect through pre- and post-test analysis. In a two-hour session, four participants played the game and decided on the opening of data that could arise in real life. WINNING DATA's development included debriefing sessions to collect feedback and enhance the learning by connecting these professionals with their daily dilemmas. Ultimately, this project yields insights for both governments and open data policy-makers regarding the use of games for learning and research, as will be discussed further in this thesis.

1.5 Thesis Outline

Figure 1 shows the visual outline of the thesis. Though specifically through chapters 3 and 4, there have been many iterations needed to progress with the game design, the presented logic shows how this thesis is also organized. This introductory chapter has explained how and why a new role-playing game is needed to influence civil servants' attitudes.

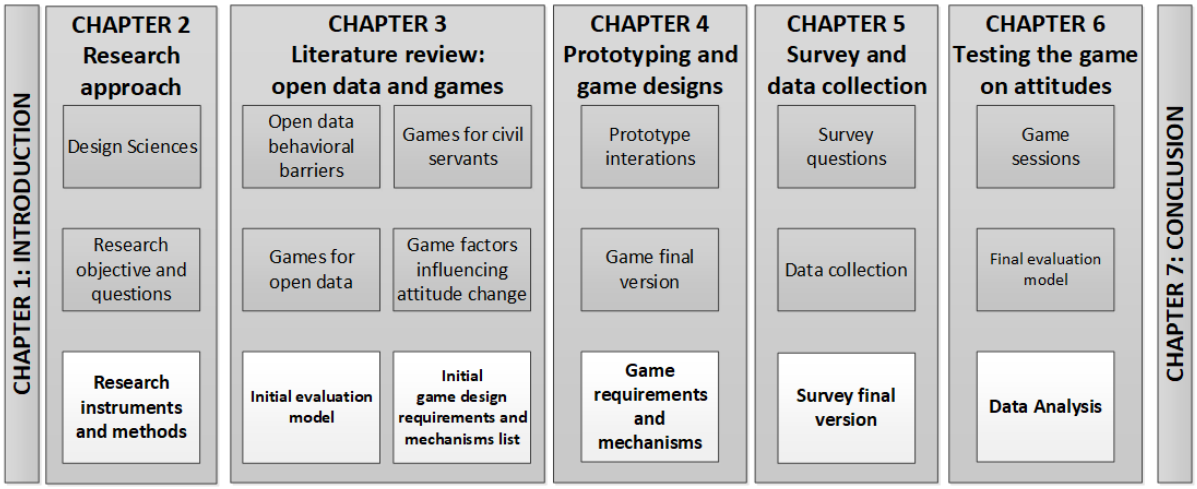

Figure 1 - Thesis outline

Chapter 2 presents the research approach, including the methods for the systematic literature review (SLR), design science research, and quasi-experimental setting. It describes the methods for defining requirements, prototyping, and designing a game; it also details the research questions and methodologies used in the thesis.

The SLRs are presented in Chapter 3 for the fields of open data and gaming. Reviews were conducted in four domains. This open data SLR resulted in factors influencing civil servants' attitudes to support the opening of data in governments. Another three reviews were performed targeting specific aspects of serious games: 1) games for civil servants, focusing on characteristics of the audience to design gameplay; 2) open data games to develop the data release content of the game; 3) games to change attitudes of players, towards the use of games for attitude change. These last three SLRs resulted in an initial list of requirements on an open data game and game mechanisms for creating attitude change.

In Chapter 4, the requirements and mechanisms from the SLR are used as the basis for game prototyping iterations of designing a serious game to change civil servants' attitudes. The chapter outlines each of the four prototypes developed throughout this research, highlighting the improvement in the artifacts. The prototypes are assessed and used to update the list of requirements and mechanisms, which builds up the final version of the game. This chapter concludes with the description of WINNING DATA game meeting the requirements and mechanisms emerging from the prototyping process.

Chapter 5 presents the survey to evaluate the impact of playing the game on attitude changes. In this chapter, the way data is collected through gameplay, the instrument's construction for the artifact evaluation, and its use are described.

Chapter 6 presents the results obtained while applying this evaluation instrument in the specific context of WINNING DATA. This chapter shows that attitude change can be accomplished by playing the game. Finally, Chapter 7 provides conclusions, contributions, research limitations and suggests an agenda for future research.

The model, the new game, and the gameplay results allow this thesis to shed fresh light on gaming as an instrument to persuade civil servants to support the opening of data by governments. The requirements, the design process, and the evaluation performed can bolster further endeavors to engage government professionals in releasing data to the public.

2 CHAPTER 2 – Research approach: design science and quasi-experiment

The overall objective of this thesis is to design and test a serious game for changing civil servants' attitudes towards opening data. In order to fulfill this goal, it is crucial to define a clear research approach. The work follows a design science approach to define requirements and mechanisms, to develop and test an artifact, e.g., the game. The testing of the game is done using a quasi-experimental setup.

In this chapter, we contextualize the methodological background of the thesis. In the first subsection, we detail the questions that guide the whole study. Next, we develop these questions into instruments and methods for the research. In the last part, we present the scientific and societal contributions of our research.

2.1 Design science research

Design science is the field of scientific investigation based on the practical perspective of building and testing artifacts and theories in the real world. Design science is a research paradigm rooted in engineering, directed at solving real-world problems. As defined by Hevner et al. (2004), design science "is fundamentally a problem-solving paradigm. It seeks to create innovations that define the ideas, practices, technical capabilities, and products" (p.2). These artifacts are purposeful in addressing unsolved problems. The utility of designed solutions should be its main evaluation criteria.

DSR must produce a viable artifact as a solution to significant and relevant business problems. The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via the application of rigorous methods in both the construction and evaluation of the design artifact. Results from design science must be presented effectively both to technology-oriented as well as management-oriented audiences (Hevner et al., 2004)

While the behavioral sciences focus their research on the development and justification of theories that explain or predict phenomena, DSR develops research on building and evaluating artifacts for real-world needs. The creation of new and innovative artifacts expands the knowledge boundaries by enhancing the understanding of problems and solutions. In Simon (1988), we find that design "is concerned with devising artifacts to attain goals" (p.69).

However, overemphasizing the technological aspects of solutions, failing to connect to theory is a risk for the design-science research paradigm. It can lead to producing well-designed useless objects for real organizational settings. On the one hand, DSR needs to produce and prove artifacts that work by addressing "important unsolved problems in unique or innovative ways or solved problems in more effective or efficient ways" (p.81).

Dorst (2010) defined design as "a mix of different kinds of solution-focused thinking, which includes both problem solving and a form of design that involves a reframing of the problem situation (in a co-evolution process)"(p. 133). Nevertheless, it is necessary to frame it by the "creation of a novel standpoint from which a problematic situation can be tackled" (opus cit.,

p.134). It demands knowledge of what has already been tested, how, and what the outcomes were. For Offermann, Blom, Schönherr, and Bub (2010), "the output of design science are not theories as known from behavioral research but predominantly designs so that the research output oftentimes is the same as the research object"(p.78).

As stated by Hevner et al. (2004), there are some requirements to define procedures to perform DSR: "formal, rigorous evaluation and comparison with alternative approaches in a variety of contexts become crucial to enable claims of generalizability"(…) since it is the first such artifact, its evaluation using formal methods is deferred until future research" (p. 97). In short, it is a "proof by construction," and success should be a consequence of the appropriate selection of techniques to develop or construct, and the means to explain or evaluate the artifact (p. 88). Though, to be highlighted, problem-solving and designing procedures are not simple assembly components towards solutions but need to find appropriate assemblies considering that not all side consequences, conditions, or goals are previously assured (p.74). Designing often needs many iterations (Brazier, Dunin-Keplicz, Jennings, & Treur, 1997) and is a problem-solving process for finding the appropriate solutions.

The research is developed through iterations by having a problem rigorously identified and clearly motivated in reality and theory. A problem itself refers to the differences in the current situation and an intended improved goal state. Likewise, the search to reduce such differences is named problem-solving. DSR is appropriate for dealing with unstable, complex, uncertain problems, dependent on human cognitive and social abilities (Hevner et al., 2004).

The solution objectives definition enables the design and development activities, which results in the artifact. Making it work (demonstrate) and its evaluation are the last steps before communicating the results. By iteration, the author means being able to return to a late stage in the research process and re-start it from there.

DSR takes kernel theory as the basis. Kernel theories can be defined as an explanatory theory coming from different domains which are used as a reference on the process of design (Fischer, Winter, & Wortmann, 2010). For this research, we use gaming as *kernel theory* for developing the game and open data theory for the domain at hand. Additionally, from an analytical perspective (Meijer, 2009), game design can be seen as a system with inputs and outputs defined from a game designer viewpoint. Inputs are the game design elements developed (roles, rules, objectives, constraints, resources, and scenario) and playing set-up (load and situation), which are controlled and known variables of the system in the analysis. After the game is played by the participants (to which the game designer has little control), qualitative and quantitative data are the outputs that are used for evaluation. In our research, this perspective supports the prototyping iterations, distinguishing the different inputs and outputs to be observed in each prototype. This perspective also suggests evaluating the effect of gaming using a quasi-experiment in which the inputs are consistent and the players vary.

As a practical method for producing good science, DSR offers a guideline for building solutions to real-world problems. In the next section, we present the research objective and research questions of this research. Thereafter, we discuss the research instruments and methods used to assess them. The analytical discussions of the game development will be assessed in Chapter 4 within the prototyping process.

2.2 Research questions

The objective of this research is to develop and test a serious game to change the attitudes of civil servants towards supporting the opening of governmental data. With such an objective, four research questions are formulated next - Table 1.

Table 1 - Research questions and methods

	RESEARCH QUESTIONS	Research methods
RQ1	**What are the behavioral barriers for civil servants to support the opening of governmental data?**	• SLR
RQ2	**What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?**	• SLR • Iterative design cycles • Requirements elicitation
RQ3	**Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?**	• Iterative design cycles • Pilot-testing • Acceptance test with debriefing
RQ 4	**What are the effects of the open data game on civil servant's attitudes towards supporting the opening of data?**	• Survey • Pre- and post-test • Statistical analysis

Research question 1 (RQ1: What are the behavioral barriers for civil servants to support the opening of governmental data?) focuses on understanding the challenge that needs to be addressed. Through SLR, it mends the overview of the open data real-world context with the existing body of knowledge related to the elements which hinder governments from releasing their data to the public. It goes deeper in understanding the stakeholders within and outside governments, which can influence data release. Furthermore, it addresses the specific problem of getting civil servants, the policy operators, to support the opening of data.

The second research question (RQ2: What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?) aims at defining the game. As defined by Brazier, Van Langen, and Treur (1998), "a requirement is a statement about necessary or desired characteristics of the artifact to be designed" (p.408).

Previous experiences and studies can inform the development of a game to tackle the RQ1 problem, the barriers for civil servants to support the opening of data. By performing a literature review in the game design techniques and tools, more insight is created into how a game should look like. Furthermore, the literature review summarizes previous experiences of using games for civil servants and open data. We also focus on previously developed and studied artifacts, which contribute to changing attitudes of players. The discussion of RQ2 results in an initial list of requirements for the game.

The game development progresses towards iterating prototypes and updating the requirements list coming from previous questions into playable artifacts. Through the third research question (RQ3: Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?), this process derives the mechanisms resulting from the iterative design options, expressed as the design options which operationalize the requirements into the game. They converge to a final version of a game to change the attitudes of civil servants towards open data. Another list emerges from the literature and prototyping, containing the game design mechanisms operationalized in this game's final version.

Lastly, research question 4 (RQ4: What are the effects of the open data game on civil servant's attitudes towards supporting the opening of data?) refers to the final stages of the research. It builds up the knowledge for assessing the effects of the game, collecting data, analyzing the results, and communicating them. We hypothesized that the attitudes of civil servants can be changed by using a serious game. It is the next step of DSR, which is based on accurate data collection from the experience and its proper analysis of the experimental data using statistical methods and techniques. The final step of DSR is reporting, presented in this research through published conference and journal papers, and the present thesis.

A design process can be described using Hevner et al. (2004) framework, as shown in Figure 2. The three criteria are represented to indicate the different aspects to build and evaluate the artifact through design research. The *research* itself is located within the *environment* box, where the facts happen, and the *knowledge base*, composed of the foundation and methodologies of scientific research. In short, the interaction of the observed reality and kernel theories. There are three cycles, which result in iterations between environment, research, and knowledge base. The first, within environment and research, results in the criteria of the relevance of the design. The criteria of rigor come from the second cycle, between research and knowledge base. Lastly, the cycle takes place within the research itself, between the built and evaluate actions, which results in design iterations. This cycle starts from the prototype and lasts until the final product.

Also referring to Hevner et al. (2004), we use Figure 2 to situate each of our research questions in the research design cycles.

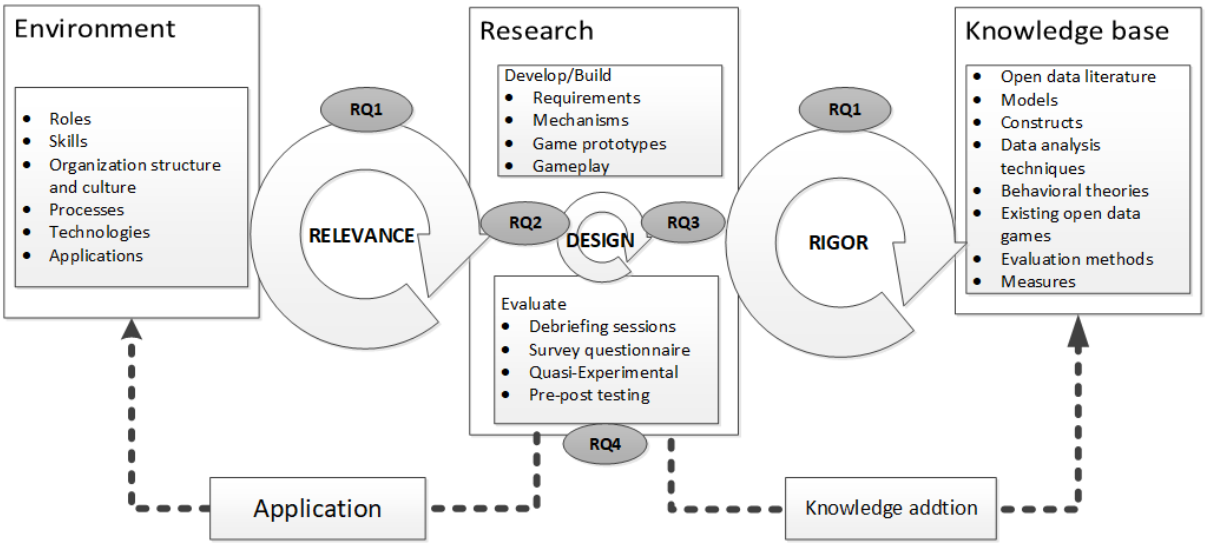

Figure 2 - Research question in the research design cycles (adapted from Hevner et al. (2004))

Aiming at developing a game intervention that can alter civil servants' attitudes to support open government data, the four research questions are associated with methods defined by the knowledge base. RQ1 defines the relevance of our research to the environment of the open data real-world governmental reality by investigating the barriers influencing the attitudes of civil servants towards open data; it also adds to the existing knowledge base by creating an overview of such barriers and translating them into measurement instruments to rigorously analyze attitude change; RQ2 and RQ3 prove the rigor to design and assess the problem from a methodological perspective of game design. Also, they set the process of game design and the design options of elements to be represented in the game; and, RQ4 uses both the environmental and knowledge base elements to evaluate the prototype and final version of the game.

Guided by each of the research questions, this research fulfills the criteria defined by Hevner et al. (2004) for a DSR to be (1) relevant to its community, addressing the problems and opportunities resulting from the interaction of people, organizations, and information technology (p.85); and (2) rigorous in its evaluation using methodologies from the knowledge base, including methods and metrics appropriately matched with the designed artifact (p.86).

The research questions are combined with instruments and methods for reaching the intended outcomes. For the design of artifacts to be the central element in the scientific experimentation, discussion, and conclusion, it shall be expressly related to concrete solutions (opus cit.). However, it is not a simple question to define the artifacts of research as found in Offermann et al. (2010): "Behavioral research usually produces theories about information systems, with information systems, or more general 'IT artifacts' being the object of research. On the other hand, the output of design science are not theories as known from behavioral research but predominantly designs, so that the research output oftentimes is the same as the research object" (p.78).

Likewise, in our case, the necessary design and study result in settings, processes, and outcomes towards a solution. It results in artifacts. This thesis aims at designing and testing a specific artifact to solve a scientifically defined problem. Consequently, the main research artifact is a game that aims at assessing the civil servants' resistance to support OGD. Moreover, Gong (2012) indicated that DSR produces more artifacts as different outcomes result in other research contributions. Table 2 indicates additional artifacts resulting from our research.

Table 2 – Overview research artifacts

ARTIFACT CATEGORY	RESEARCH ARTEFACT
1. Requirements	Requirements for an open data providers' game, derived from the literature and prototype iteration process
2. Mechanisms	Mechanisms of an open data providers' game, derived from the literature and prototype iteration process
3. Evaluation metrics	Civil servants' behavioral intention factors to support the opening of data by government used as a proxy to evaluate changes in attitudes
4. Game prototypes	Game prototypes assessed for the requirements to change civil servants' attitudes towards open data
5. Game design	The open data game (main artifact)
5.1. Game assets (metaphors)	Describing roles, processes, sequences
5.2. Game mechanics (rules)	Describing how the participants should play the game
5.3. Game dynamics (gameplay)	Describing how the actions and feedbacks happens in the game

Besides the game, our research also resulted in the requirements (1) and mechanisms (2) coming from the literature and prototype iterations, which are useful for other interventions aiming at civil servants, to change attitudes, and for attitude change of players'. Each of these dimensions has specific demands, which are described and discussed in this thesis.

Moreover, the evaluation metrics (3) used to assess the experiment also contribute to scientifically discuss other objects in the field of open data providers' behaviors. The measurements, questionnaire constructs, and relations between them build a new path for research on attitudes for open data provision.

Finally, the prototypes (4) and final version (5) of the game are delivered and contain several artifacts. The prototypes are described for their contributions towards our research goals and assessed in terms of requirements and mechanisms which work in practice. Specifically, the

final version of the game is the first playable intervention to change civil servants' attitudes towards supporting open data. As said, it is the main artifact resulting from our research. It has two additional dimensions, which can be considered by their specific contributions as well. The assets, roles, and actions (5.1) mimic real-life and set metaphors to further develop interventions for opening data in governments. Additionally, the game mechanics (5.2) and dynamics (5.3), expressed through the rules and facilitation techniques, indicate a working way to play these elements. Both are specific artifacts within the main artifact of the game. The methods used are detailed next.

2.3 Research instruments and methods

Several instruments and methods are used to perform this research. They represent the procedures to allow replication for doing good science, from the problem definition to designing and evaluating the artifact resulting from it. These methods are also connected to the research questions which guide this thesis.

As one of the main challenges for the present research is to design and assess an instrument targeting the change of attitude of civil servants, it also needs grounding in the literature related to attitude change. It is a step forward to define the specific elements of each stage in this kind of research. Figure 3 summarizes our research steps which is the reference for defining methods and instruments needed for progressing with the research. The instruments and techniques for each research step are exposed in the next section.

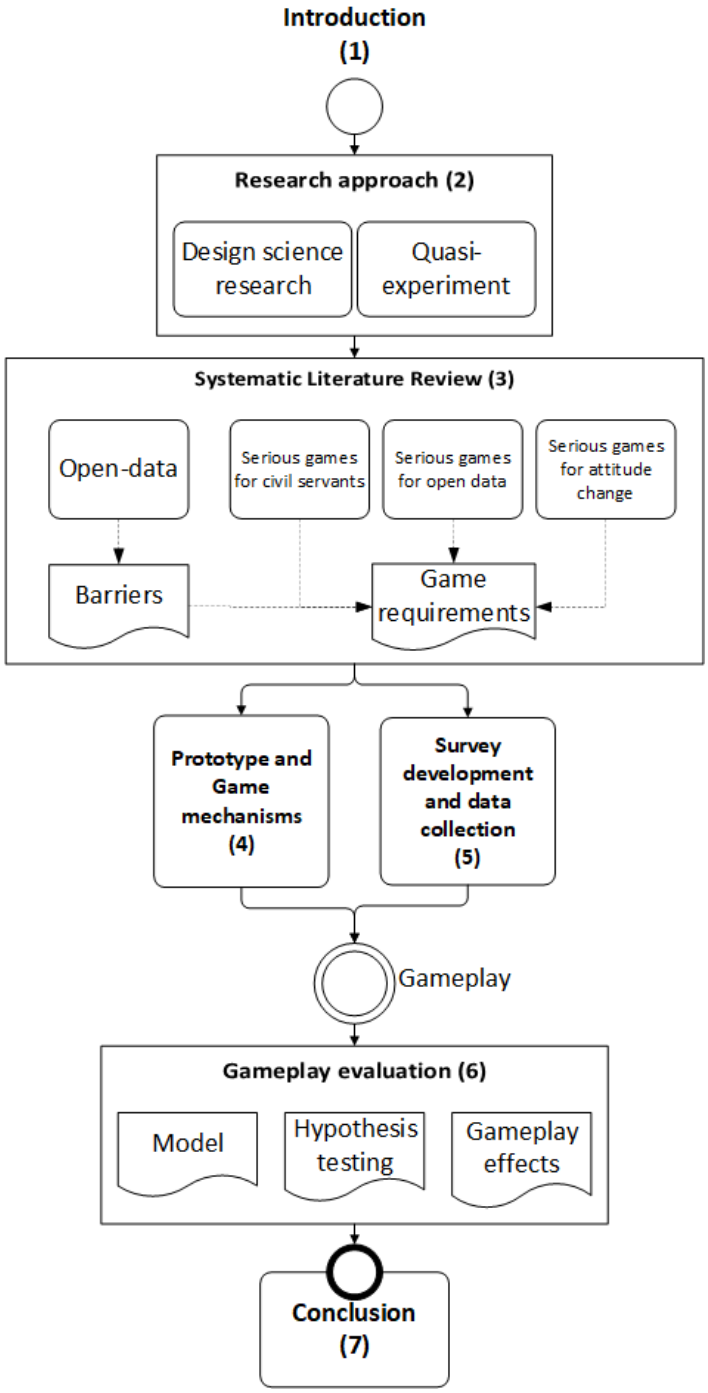

Figure 3 - Research outline

2.3.1 Systematic literature review and requirements elicitation

In both Hevner et al. (2004) and Peffers, Tuunanen, Rothenberger, and Chatterjee (2007), the problem definition is set as a pre-defined element of research that starts the whole research process or assumes it to be a consequence of iterations during the research process. Nonetheless, contextualizing the research within the academic production, referring it to the knowledge base while making it relevant to the real world, can be challenging. The realm of problems to be addressed by DSR is infinite, and also a method is needed to assess such complexity.

The non-stop activity from academia, which publishes new knowledge every day, is a challenge and Systematic Literature Review (SLR) is a method to help to deal with it. SLR is an evidence-based literature methodology for a rigorous review of research results aiming at aggregating existing literature on a particular topic and summarizing it in guidelines for practitioners (Kitchenham et al., 2009). It is based on research questions that direct the summarization efforts (Kuipers et al., 2014).

According to Kitchenham et al. (2009), an SLR "is a methodologically rigorous review of research results" (p.8). Differently than critical expert reviews, it aggregates existing evidence for the research question and can result in evidence-based guidelines (De Vries, Bekkers, & Tummers, 2016; Kuipers et al., 2014). Levy and Ellis (2006) argue that "an effective literature review should include the following characteristics: a) methodologically analyze and synthesize quality literature, b) provide a firm foundation to a research topic, c) provide a firm foundation to the selection of the research approach, and d) demonstrate that the proposed research contributes something new to the overall body of knowledge or advances the research field's knowledge-base" (p.182).

The purpose of the review defines its progress so that specific questions are needed to guide the SLR itself. These questions will further define the protocol composed of the steps proposed by Kitchenham (2004) in Figure 4.

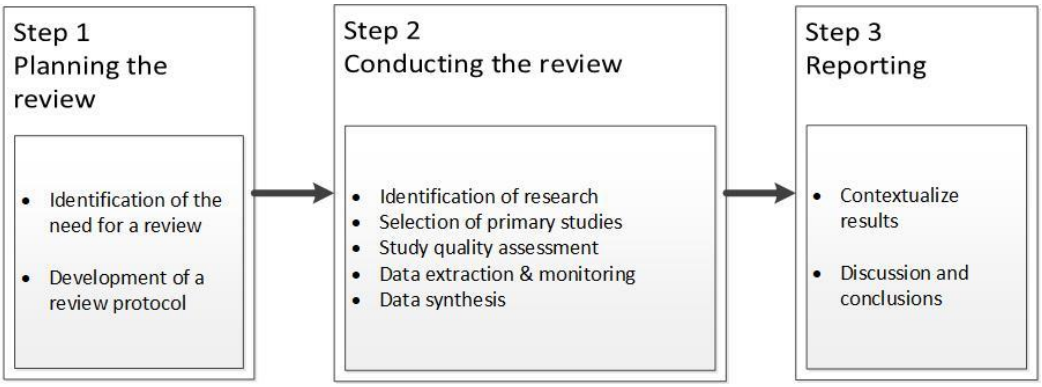

Figure 4 - Steps for SLR (based on Kitchenham, 2004, p. 3))

In the first step, planning, the goal is to set to guide the review process: define the gaps in the literature related to the content set by the defined questions. The five elements for a searchable question can be defined by the PICOC criteria (Petticrew & Roberts, 2008). PICOC helps to identify keywords related to each letter of the acronyms: (1) Population; (2) aimed Intervention; (3) Comparison references; (4) expected Outcome; and (5) the Context to which the SLR is being performed. As a result, finding other SLR performed on the same topic can set a clear path for stating the need for a systematic review.

Progressing Kitchenham's review protocol, the next steps are defined by (1) identification of research: refine keywords to have a suitable group of documents to be analyzed; (2) selection of primary studies: refine formats and language so the papers can be compared and summarized (format scan); (3) study quality assessment: refine content to have papers with a

similar object (content scan) and refine domains to set the final group of papers (domain scan). Lastly, data from the resulting protocol needs to be extracted, analyzed, and synthesized.

This final step of the SLR, reporting, is the most important for setting the readers aware of the findings. Searching the resulting terms, assessing the studies' quality, extracting the available data, and analyzing it shall result in a good overview of the scientific field for a specific topic. The outcomes from SLR may not be a definitive research gap as science can progress, and much knowledge can evolve even during a period of research. Nevertheless, the SLR can give a clear indication of research needs and ways to progress towards fulfilling them.

Research questions 1 and 2 from this thesis uses SLR as its primary methodology, applied to four different domains: (1) open data barriers, (2) serious games for civil servants, (3) serious games for open data, and (4) serious games for attitude change. RQ1 focuses on the field of open data and summarizes the behavior barriers to get data released by governments. It aims at transforming these barriers into factors that influence civil servants' attitudes towards open data. RQ2 directs at analyzing serious gaming to refine elements that can enhance a game's effects on attitude change.

Besides reviewing the literature and finding research gaps, SLR can also result in useful inputs for research. In our case, an initial requirement elicitation was performed to explore elements that could support the development of a game to change civil servants' perceptions of open data.

Our research project had the objective of developing a game, and previous studies supported the requirements for this intervention to be successful. In each section of Chapter 3, requirements are listed and, in Chapter 4, the requirements are used for prototyping the game. Both are presented in the next Chapters.

2.3.2 Iterative design cycles and pilot-testing

The development of the game itself is another step in the research process. It implicates operationalizing the requirements derived from the literature into practical, playable elements. The main activity of prototyping such artifacts demands the use of Iterative design cycles for progressing with drafts and final versions of the game.

We started testing simple designs that could influence attitudes of civil servants towards open data. The first prototype was an open data provision card game. Its debriefing showed that the game could be engaging, and that would help connect players to the challenges of open data. However, as a card game with simple mechanics, it leads players to enjoy competing though it did not result in much open data knowledge transfer.

The second prototype happened in a group debate play-setting. Each group had specific challenges, varying from the users and provider side of open data. Besides resulting in converging debates from group interactions on both teams, the debriefing indicated that it lacked engagement.

The third prototype progressed towards a digital decision-making game that simulated policy-making for labor-markets. This was the first prototype that got players to experience the dilemmas for governmental data provision, and it helped to map the data production in public service. The decision routines showed that representing public servants' real-life situations through the precise mimic lead to a boring game. A more free environment could unleash some insights and experiences, which could increase learning outcomes and attitude change.

The fourth prototype, before the final version of the game, was a resource-management game that engaged players in role-playing. The debriefing indicated that this dynamic helps to operationalize learning outcomes that could increase players' attitude change. The prototype was lacking precision in its routines and office environment metaphors, demanding a more realistic representation. Real people played the roles and actions that helped adjust the game dynamics. Specifically, the number of roles that could be performed by players without decreasing engagement, and the number of rounds to be played, were defined by this prototype.

Each of these prototype artifacts was checked against the previously defined requirements and set to play. From a software development perspective, Zowghi and Coulin (2005) defined that "requirements elicitation is the process of seeking, uncovering, acquiring, and elaborating requirements for computer-based systems" (p.19). The authors also indicate that it "is concerned with learning and understanding the needs of users and project sponsors with the ultimate aim of communicating these needs to the system developers" (p.21). Hickey and Davis (2014) argue that requirements elicitation aims at "learning, uncovering, extracting, surfacing, or discovering needs of customers, users, and other potential stakeholders" (p.67). The "poor execution of elicitation will almost guarantee that the final project is a complete failure" (p.66).

Pilot-testing is the basic activity of having participants unrelated to the development process to experience the built artifact and give feedback on its use. Tests on the prototypes were conducted through debriefing, aiming at feedback for improving one prototype to the next until reaching a final and playable version of the game. WINNING DATA, the final version of the game played in our research, is the result of these iterations. Chapter 4 details the theoretical background and practical use of game design techniques and describes each of the prototypes through our whole prototyping process.

2.3.3 Quasi-experiment and evaluation

> "*Today, the key feature common to all experiments is still to deliberately vary something so as to discover what happens to something else later – to discover the effects of the presumed causes (…) a given causal relationship will occur under some conditions, but not universally across time, space, human populations, or other kinds of treatments and outcomes that are more or less related to those studied. To different degrees, all causal relationships are context dependent, so the*

generalization of experimental effects is always at issue" (Shadish, Cook, & Campbell, 2002, pp. 3-5).

The development and testing of a serious game to change civil servants' attitudes towards open data demand a specific design to check the causal relations of the variables at work. To do that, producing an experimental setting is the most appropriate approach for checking this change, the differences between the pre- and post-treatment situation (Schrader & Lawless, 2004).

Shadish et al. (2002) defined an experiment as the "study in which an intervention is deliberately introduced to observe its effects" (p.10). As experimental causes must be manipulable and observable, it is ideal to set a randomized experiment for testing an intervention, isolating variables, and checking its effects. The objective of experiments is to find causal descriptions of what happens and causal explanations of why it happened: "to different degrees, all causal relationships are context-dependent, so the generalization of experimental effects is always at issue" (p.5).

Causal explanations explore the essential features of the causal relationships that can be expanded to other situations and contexts. This expansion is fundamental for the generalization of causal descriptions, one of the goals of scientific research. The same authors suggest that the best setting for such an objective would be a randomized experiment where units of treatment can be randomly assigned to receive treatment or a comparative condition. When that is not possible, a quasi-experiment can be used.

Quasi-experiments are experimentation settings in which conditions are not randomly assigned to units. The difference remains in the precision that with randomization, the observed differences ought to be caused by treatment and not by group differences. In that case, the researchers do not need to rule out alternative explanations for effects, given that the setting enables conditions for precise comparison of conditions.

In quasi-experiments, without such precise isolation, researchers have to check the plausibility of the potential effects of alternative explanations. However, the objective remains as the "two central tasks in experimental design are creating a high-quality but necessarily imperfect source of counterfactual inference and understanding how this source differs from the treatment condition" (p.6). With the proper setting, a quasi-experiment enables repeated measurements of treatment and comparison of effects for an alternative treatment or control group. It enables the needed verification of differences in counterfactual inferences.

In our research, the experimentation with a game follows a design science logic. As in Grogan and Meijer (2017): "research games benefit the principal as a researcher and provide a simulated environment to develop generalizable knowledge under controlled conditions. The game acts as a model of the real world to support observation, hypothesis generation, and hypothesis testing or, alternately, a platform on which to evaluate the efficacy of other artifacts" (p. 4). Subsequently, the game is used as a quasi-experimental tool.

For testing its effects, additional features are recommended for exploring the intervention. Shadish et al. (2002) highlight that "experiments require (1) variation in the treatment, (2) post-treatment measures of outcomes, (3) at least one unit which observation is made, and (4) a mechanism for inferring what outcome would have been without the treatment – the so-called "counterfactual inference" (p.xvii).

Variation in the treatment (1) means having groups of individuals receiving different stimuli or inputs that can lead to different reactions. The post-treatment measures (2) refer to having different moments of observation so that variations can be registered. Making at least one unit of observation (3) defines the need for participants that are assigned to such conditions. Finally, the counterfactual inference (4) demands instruments to register and compare the observations made. A well-balanced and calibrated instrument is essential to perform such measurements. Therefore we collected data from playing with and without the game.

Besides, we developed a survey to measure attitudes, translating the factors influencing civil servants' attitudes towards open data into constructs. The survey consisted of a questionnaire that was filled in by civil servants coming from different contexts. The survey aims at capturing the attitudes of these professionals before the intervention was conducted (e.g., the game was played). The same survey was used for collecting data after the intervention. For the alternative treatment (e.g., a control group who were not playing the game), the survey was applied to a group of individuals larger than those participating in the experiment. The collected responses were used as a reference, and the respondents that did not play the game were used as the control group, serving as the baseline measurements of the research. In that way, we compared the survey scores (1) before and after the game and (2) with or without playing the game.

The collected quantitative data was used for evaluating the effects of the game on attitudes. Various methods for statistical analysis were applied to the datasets producing the results of this thesis. The various data collection and analysis methods are discussed in Chapter 5 of this thesis, while Chapter 6 presents and discusses these results.

2.4 Scientific contributions

The contributions of research follow its research questions, its relevance, and the rigor of the instruments and methods used. However, defining such contributions needs to refer to previous knowledge and the field to which the research relates. Gregor and Hevner (2013) introduce the idea of assessing a DSR contribution based on two dimensions of scientific background - Figure 5.

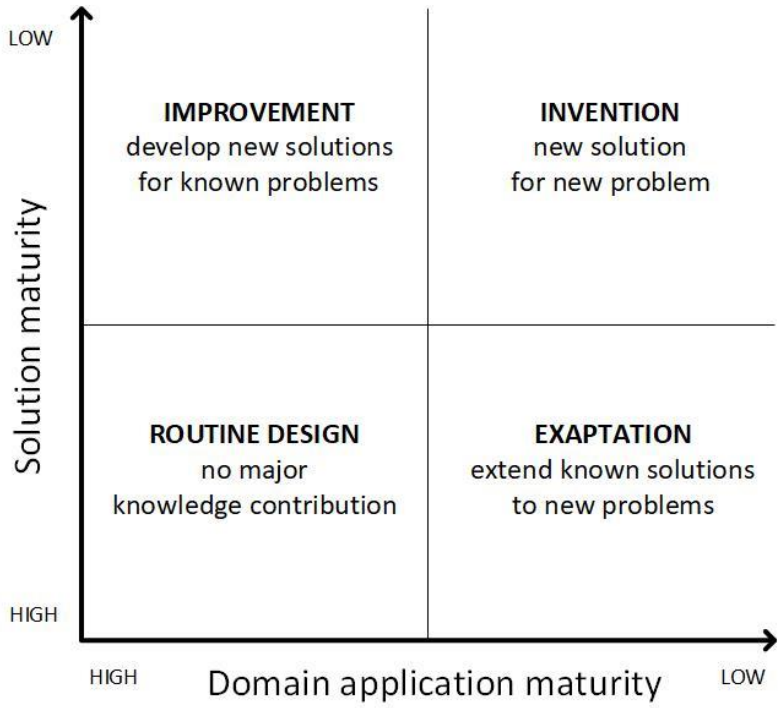

Figure 5 - Research contributions (taken from Gregor and Hevner (2013), p.345)

Gregor and Hevner (2013) assume the outcomes of DSR to be a tested solution to a relevant societal problem. In one dimension, it is related to the solution itself, which can be previously developed and assessed in terms of maturity. The longer a solution has been developed and tested, the more research is expected to have used its results. Also, more evidence on the design and effectiveness of the artifact should be available. On the other hand, the newer solution is, the less evidence is expected to come from previous research, but also more exceptional can be its contribution to solving a specific problem. On the second dimension, different solutions can be applied for a variety of domains. The authors refer to it as domain application maturity, given that already proven intervention applied to a new domain can also generate essential contributions.

In the eyes of the beholder, our game and research advances in both. On the one hand, from a game design perspective, many games exist for serious purposes, though not many focused on attitude change or having civil servants as their audience has been registered and scientifically assessed. On the other hand, from an open data viewpoint, games are almost an unexplored methodology, particularly for governmental open data providers. In that sense, a less mature solution in a low mature domain, in Gregor and Hevner (2013) terms, can be considered as an invention. Studies carrying no new solution and applied to previously studied domains can make contributions to the existing body of knowledge by incrementally approaching it with more evidence that confirms or questions previous results. Designing new solutions to previously studied problems is an improvement to previous research. While applying known solutions to new domains contributes as exaptation to previous knowledge.

The present thesis aims at developing a game to change civil servants' attitudes towards the release of data by governments. On the solution side, applying games to change players' perception is not new though it is still to have studies converging on the approach to assessing such effects. Also, games for civil servants or games applied to open data are new, though they can be considered as a solution with an increasing level of maturity. Chapter 3 will deepen the background of serious gaming and its application to different objectives and domains. From a domain perspective, the interest of researchers for open data has increased in the last two decades, and even papers on barriers to get data released have already been discussed. A list of barriers, to be presented in Chapter 3, results from such previous knowledge and will be used as the basis for the game design.

However, to our knowledge, no research could be found using games to change civil servants' attitudes to support open data. Furthermore, that results in different outcomes coming from such research that can contribute to science in different ways. From a more global level, deriving from Table 2, this thesis presents the following contributions (which are detailed throughout the text):

- **Scientific Contribution 1:** Based on the literature, this thesis summarizes the main behavioral barriers for civil servants to support the opening of data by governments. This resulted in the civil servants' attitude model for supporting the opening of data by governments.
- **Scientific Contribution 2:** This thesis sets a list of requirements for developing an open data game. We set a group of parameters for developing interventions towards changing civil servants' attitudes related to open data that can be used by other researchers and game developers.
- **Scientific Contribution 3:** The list of game mechanisms is an additional contribution to game design and the open data field, which relates practical elements at work, which resulted in the open data game.
- **Scientific Contribution 4:** WINNING DATA is the main artifact of this thesis and a concrete contribution to the field. It includes the game assets, which are metaphors representing the reality of open data in governments. They are operationalized in roles, processes, sequences of the game and may inspire other interventions and research. Also, the game rules defining dynamics and describing how the game should be played can be used in future projects.
- **Scientific Contribution 5:** The evaluation metrics of this thesis, including the survey questionnaire, the measured baseline, the experiment data, and results, contribute to the field of open governmental data.

On the one hand, by applying surveys to civil servants and checking individually the factors which lead them to support or resist releasing governmental data, this research contributes to previous knowledge on civil servants' behavior and open data. It adds to previous knowledge related to tackling resistance in public service to get data released and helps governments and society to get governments to release more data.

On the other hand, this research adds to the existing knowledge on the use of games applied to a new domain from a new perspective. By practically designing and testing a game, it can be considered as an expansion of previous knowledge on serious gaming, which references the solution and guides its development for the proposed problem.

Consequently, this research integrates open data knowledge to the gaming field by testing an intervention to influence civil servants' attitudes towards open data. This research combines both fields and contributes to both fields. It can also demonstrate the effects of the bottom-up approach on behavioral change towards open data. Moreover, it results in new evidence for realizing open data attitude change as well as evidence for game design effects applied to open data.

From a societal and practical perspective, this research also results in other contributions:

- **Societal Contribution 1:** Develop and disseminate a new method to engage civil servants in releasing open data.
- **Societal Contribution 2:** Explore triggers and incentives to overcome civil servants' behavioral barriers for supporting the release of data by governments.

By exploring the triggers to change players' attitudes towards open data, this research suggests ways for tackling resistance and increasing open data support. These results can be used for different audiences and improve policy-making about the opening of data and the actual opening of data as an overall outcome. Having a real game in action also demonstrates the effects and can inspire new initiatives and research to progress with the use of games in governments, mainly targeting civil servants or using open data as its background content.

2.5 Summarizing

DSR needs to be conducted carefully to scientifically build and test artifacts and theories in the real world. Collecting data and its instruments demands proper methods and rigorous use. The design process and reference to previous knowledge are determinants for evaluating results. The analysis and reporting of the collected data are the final steps for DSR protocol, which are crucial to materialize the scientific contributions. Lastly, the perishability of solutions can invalidate results and pose new challenges even before it has been implemented. Also, generalization might be challenging given the specifics of designs and their contexts.

This thesis is built upon previous research on behavioral barriers of civil servants to support open data to which no solutions were developed yet (Kleiman, Janssen, & Meijer, 2020). Based on the literature and through iterative prototyping, we designed the first game for changing civil servants' attitudes towards opening governmental data.

Prototypes were tested with researchers, and real civil servants play a game. The iterative process leads to WINNING DATA, the final version of the game. The elements of this game are

based both on previous research related to civil servants' behaviors towards open data and games previously used to influence the attitudes of players. Survey questionnaires, applied pre- and post-gameplay, were used for data collection. Quasi-experimentation and statistical methods are used to evaluate the effectiveness of the designed game.

Inspired by Gong (2012), we enlisted the design-science contributions of this research as the proposed game as the design artifact, its elements, such as assets, mechanics, and dynamics of play, and the evaluation instruments and results. These contributions advance our understanding of civil servants' attitudes towards open governmental data and how to change them. More in-depth background on open data and serious gaming is developed in the next Chapter, grounding the problem and the proposed artifact in previous knowledge.

3 CHAPTER 3 – Literature review: open data and games

3.1 Introduction

"Sola dosis facit venenum"

("The dose makes the poison" attributed to Paracelsus)

The objective of this thesis is to develop a game to change the attitudes of civil servants towards supporting the opening of governmental data. From top bureaucrats in ministries, public policy advisors, or data custodian at the operational level, the game targets at governmental personnel who plays a role in governments, considered as data providers. As explained in the previous chapter, we take a design science approach that demands a well-defined background as the foundation for the artifact to contextualize the outcomes and evaluate the results. In this chapter, extensive literature reviews in two fields are presented: open data and games. In so doing, it introduces concepts that will be crucial in designing the game, a process that is discussed at length in Chapter 4.

In its first literature review, this chapter answers our first research question (RQ1) by identifying barriers to the release of governmental data—particularly barriers related to civil servants' behaviors and attitudes (section 3.3). Later in this thesis (section 3.5.1), these barriers were translated into factors influencing the attitudes of civil servants towards their support to the release of open governmental data. Also, these factors are the aspects of open data content that the game must address, which links the chapter's section to game design. The second literature review aims at addressing the second and third research questions (RQ2 and RQ3) by showing which specific design elements are necessary to help civil servants assess, discuss, and understand the importance of open data. More specifically, this review focuses on three subtopics: games that address open data (section 3.4.2); games that are intended for civil servants and bureaucrats (section 3.4.3); and games that aim to change attitudes, e.g., via experiential learning (section 3.4.4). Overall, Chapter 3 outlines the current state of two different research fields, pinpointing significant knowledge gaps and laying the groundwork for this thesis's game design, which will bring those two fields together.

Parts of this chapter are based on published papers (Kleiman, Janssen, & Meijer, 2020; Kleiman, Meijer, & Janssen, 2020b).

3.2 Background: behavioral barriers preventing civil servants from opening data

This section aims at defining what open data is and, specifically, open government data (OGD), which is the data released by governments. This section describes the actual state of OGD in terms of its official release worldwide, explores the stakeholders related to the cycle of open data, and indicates the gaps in the literature to be addressed by this thesis. This chapter

concludes by pointing out the challenges to increase the release of data by governments. Whereas there is a lot of literature available for open data, we performed an SLR specifically on the behavioral barriers for governments to open data focusing on exploring the specific dimensions of OGD related to civil servants.

As our aim is to design the game targeted at changing attitudes of civil servants for opening governmental data, after listing these barriers, we progressed towards translating them into factors of influence. A list of factors that can influence the perception of civil servants on opening data was developed upon the description of potential benefits and also barriers for civil servants to support open data. These factors are the references used for evaluation of results and effects of the game on the player civil servants, as well as to compare it to control groups. As follows, the investigation of government, the environment where civil servants work, is used as background.

3.2.1 Open government data (OGD) definitions

The term open data is being widely used in and outside academia for research and practice. Within the many used concepts, some emerge as a reference and will be adopted in this thesis. First and foremost, “open data is data which is accessible for free or at minimal cost, and which can be accessed by anybody and re-used for any purpose” (Hardy & Maurushat, 2017, p. 30). This general definition suggests that any data produced by any device or person, which is publicly shared for free or at a minimal cost, and that can be accessed by anyone, is considered open data.

The idea of having government data to be opened, which started back in the 1990s, is closely connected to two movements: digital governments and open government. The first can be summarized as the intensive use of technology in public administration to increase the efficiency and efficacy of policy development and public service delivery. The second movement, open government, is a more political idea that democracy and representativeness can be strengthened by having public administration records available to its citizens. Most of its efforts are related to increasing transparency and participation, which results in greater accountability of politicians, civil servants, and governments in general. Open government data (OGD) is an essential element of this discussion, and it “refers to data sets that government agencies make available for third-party usage” (Crusoe & Melin, 2018, p.3). It also includes free data, which can be used for any purpose, or low-fee data, under restrictive licenses. These third parties include individual citizens, NGOs, private companies, other governmental units within the same government, or other governments and international institutions. Depending on the privacy, security, and sensitivity of specific datasets, they can be made available with limited access for certain parties instead of open for everyone.

Open Government Data (OGD) is the action by governments to get raw data to be available for manipulation by others. Many benefits are related in the literature towards making public data available such as “OGD can be used to help the public better understand what the government does and how well it performs, and to hold it accountable for wrongdoing or

unachieved results" (Ubaldi, 2013). Specifically, for the public sector data, many other consequences are expected: "Open data mends the traditional separation between public organizations and users. The opening of data leads to two important assumptions about government. First, it leads to an assumption of the readiness of public agencies for an opening process that considers influences, discourses, and exchanges as constructive, and welcomes opposing views and inputs. Second, it leads to an assumption that government is to give up control, at least to some extent, demanding considerable transformations of the public sector" (Janssen et al., 2012, p.258).

This thesis focuses on discussing the release of public data by governments, and the concept of open government data – OGD will be used throughout the text.

3.2.2 OGD international partnerships and monitors

Worldwide, governments increasingly understand the importance of making their data available to the public. Some positive results of the opening of data are found in the literature (Herala, 2018; Janssen et al., 2012; McDermott, 2010), open data:

- can increase transparency which is essential for the public legitimacy of governments and their public actions
- can prompt new economic activities attending to government and society needs
- can foster participation and get governments to benefit from the collective intelligence, crowdsourcing ideas, and solutions to public problems
- can also result in better diagnostic and focus for public strategies and programs, including more informed decision-making

Given these positive effects, some international organizations started monitoring, supporting, and fostering the opening of data by governments. Interesting results are found by just comparing their reports that express a great attempt to make OGD available.

Table 3 shows only the components of the published national datasets, though it also indicates that many countries are already involved in efforts to release open data. Other datasets can also be found on lower government levels as many regional, state, and even local governments are releasing data. As the listed initiatives involve more than a hundred countries, it can be said that there is a worldwide effort to make governmental data available.

Besides the increasing number of governments adhering to open government policies and engaging in releasing public data, many barriers are still to be tackled in order to have more and better datasets available to the public. A first step towards understanding these challenges is to explore the stakeholders related to OGD.

Table 3 - Open data monitors

Organization	Open government partnership	Open Knowledge Foundation	Open Data Barometer	World bank
Indicator	Open Data Watch	Global Open Data Index	Leaders Edition of the Open Data Barometer	Statistical Capacity Indicator (SCI)
Number of countries	78 countries	94 countries	30 countries	149 developing countries
Website	https://opendatawatch.com/blog/indexes-of-data-quality-and-openness/	https://index.okfn.org/place/	https://opendatabarometer.org/barometer/	http://datatopics.worldbank.org/statisticalcapacity/
Available datasets	• Anti-Corruption • Beneficial Ownership • Money in Politics • Open Contracting and Public Procurement • Civic Space • Defending Journalists and Activists • Freedom of Assembly • Freedom of Association • Digital Governance • Extractive Industries • Fiscal Openness • Gender • Justice • Marginalized Communities • Public Service Delivery • Education • Health • Water and Sanitation • Right to Information	• Government budget • Company registers • Election results • Emissions of (air) pollutants • Legislation • National map • Postcodes • Government spending • National statistics • Transport timetables	• Map data • Land ownership • Census • Government Budget • Government Spend • Company register • Legislation • Public transport timetables • International trade • Health sector performance • Primary or secondary education performance • Crime statistics • National environmental statistics • National election results	25 individual indicators

3.2.3 Open data stakeholders: public and private users and providers

A large number of stakeholders can be identified depending on the focus to discuss OGD. According to Bryson (2004), "what constitutes a 'reasonable' number of competently done stakeholder analyses is clearly open to debate" (p. 48). In the opening of the governmental cycle, they can be related to a diverse list of actors that emerge from the different analyses. In the first level, broader, two central dividers are related to the sectors (public or private) and roles stakeholders play in the open data cycle (user or provider). In the public sector, a sector interaction map can be used to situate our focus (Rehouma & Hofmann, 2018b). As in this thesis, we focus on OGD; we look at the government as a provider of data for different sectors.

It limits some of our discussions to understand better the role of government data release - Table 4.

Table 4- Stakeholders to open data: Governments, Citizens and Businesses

Provider / User	Government	Citizens	Business
Government (OGD)	G2G	G2C	G2B
Citizens	C2G	C2C	C2G
Business	B2G	B2C	B2B

Many perspectives can be considered in the open data ecosystem(van Schalkwyk, Willmers, & McNaughton, 2015; Welle Donker & van Loenen, 2016). For instance, Business to Business discussions involves different types of market strategies and specific property rights that can foster or reduce the private cooperation of companies. Our research focuses on the different interactions which governments can have as data providers. For example, from a Government to Government (G2G) perspective, the release of data by governments can be used by other units from the same government, from other levels of governments in the same country, by international institutions, or governments from other countries. It can also be used by private parties, such as citizens or firms (Siau & Long, 2009). Based on the frequent references for management literature, the provision of data results in G2G, G2C, and G2B uses of OGD (Rehouma & Hofmann, 2018b). This perspective adds to our background to define the advantages of official data releases, which are different in nature and outcomes than those originated in the private sector.

The second level of open data stakeholders can be visualized through the Open data cycle (Attard et al., 2015; Ghobadi, 2015; Zuiderwijk, 2015) - Figure 6.

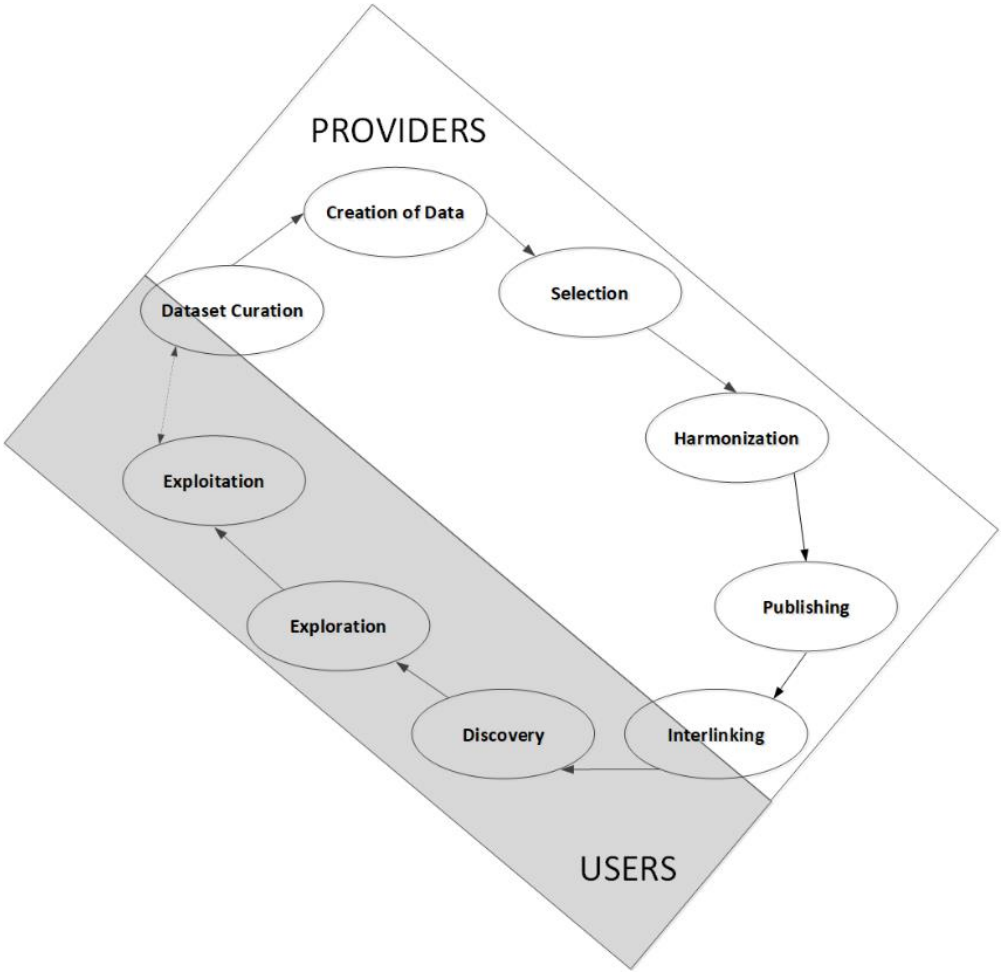

Figure 6 - Open Data Cycle (based on (Attard et al., 2015), p.10)

In short, the open data cycle indicates that after being generated, any dataset goes through several stages and operations (selection, harmonization, publishing, interlinking) before its release (Zuiderwijk, 2015). As Crusoe and Melin (2018) pointed out, data from an organization is created as closed within its organizational context. It needs a decision so that data can be opened. When the dataset is released from a source, it needs to be found and used (discovery, exploration, exploitation). Publicly available datasets can be curated and return into the data cycle, updated and verified to be found and used again.

The open data cycle approach enlightens the perspective of a dataset *lifecycle*. As mentioned before, two leading roles are at stake: users or a provider (Ghobadi, 2015). In the first role, data users are the ones who search and discover datasets, process them towards intended objectives, and use them. These are the most immediate beneficiaries of available datasets and the main channel through which benefits are accessed. Without users, the opening of data makes no sense, as Janssen et al. (2012) puts it as myths that "Publicizing of Data Will Automatically Yield Benefits" or "It Is a Matter of Simply Publishing Public Data" for it to produce outcomes (p. 264). Moreover, the potential users need to be able to use the open data published. In the case that data is unknown, unreachable, or does not fit the needs of users, publishing will not result in any benefit. Even if the users exist, the data will not be used.

The second role, data providers, are the ones who publish data. Independently of how the data is originated, the providers are the ones who make it available for others to find and use (Ma, C. & Lam, P. T. I., 2019). As mentioned before, both users and providers can also be split into different categories depending on their formal situation - Table 5.

Table 5 - Users and Providers in public or private sectors

	Private	**Public**
User	Citizens and firms searching for datasets for specific uses	Governmental agencies using datasets for policy-making
Provider	Citizens and firms sharing their data or from third parties	Governments making data available for other governments and the general public

From a provider's perspective, private individuals and companies can opt to share their data online or to publish third-party data (if legally allowed). A recent topic nowadays is related to data protection laws being adopted in many countries to protect their citizens from being exposed, voluntarily or not. In this case, the protection of data is needed as a safeguard to citizens to prevent the unconsented data collection or misuse of data by third parties. The European General Data Protection Regulation (GDPR) and many other international and national legislations aim at safeguarding data protection as a right (Altman, Wood, O'Brien, Vadhan, & Gasser, 2015; Vaz et al., 2013). Governments, also subject to the law, need to care for protecting data for security and privacy issues (Cetic.Br, 2019; Wang & Shepherd, 2020).

Another approach to map stakeholders to open data comes from Gonzalez-Zapata and Heeks (2015). The authors summarized dimensions of power and interest in a stakeholder map of different actors and their relations to datasets. Based on Luthfi et al. (2020), we adapt their stakeholders' overview to the open data context - Figure 7.

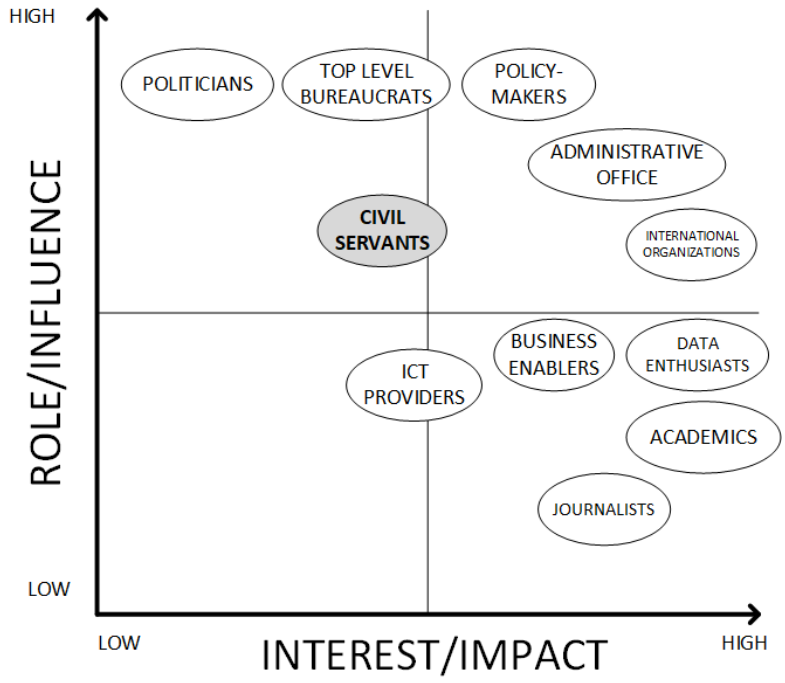

Figure 7 - Stakeholders map (based on Luthfi et al. (2020))

Within the many governmental stakeholders of OGD are politicians, top-level bureaucrats (decision-makers), and civil servants. Each stakeholder has its characteristics and might influence the decision-making process to get data released. Bryson (2004) mentioned that civil servants act "producing decisions and actions requires organizing participation; creating ideas for strategic intervention (which in turn depends on formulating problems and searching for solutions); building a winning coalition around proposal development, review and adoption; and implementing, monitoring and evaluating strategic interventions. Each of these main activities may contribute both directly and in various sequences to producing fundamental decisions and actions" (p.24). Hence, civil servants can play a well-positioned role in the OGD stakeholders map to help governments to engage in public data release.

How civil servants act in this process needs to be understood, as less attention has been given to their role in the process of opening data. Usually, the power is concentrated on top-level bureaucracy and politicians, and civil servants are analyzed only as part of the structure to which decisions are made. However, scholars that focused on bureaucracy studies concluded differently (Lipsky, 1971; Lotta & Marques, 2019). There are other powers that permanent staff and government operators have both on briefing decision-makers and also for supporting executing them. This perspective builds up the idea of a bottom-up approach, a better understanding of how these professionals influence and change governmental actions.

Additionally, different levels of analysis can be used when assessing governmental data release. As stated by DiMaggio and Powell (1983), some institutions are hard to change, given the roots of their challenges at the individual level. For example, institutional isomorphism may explain that organizations and their members may become more homogeneous. For

governments, such limitations may seem unsolvable if only the organizational level is viewed. Civil servants' culture and work environment are viewed as restrictions for changing governments (DiMaggio & Powell, 1983).

However, if at the organizational level, they are hard to address, other levels of intervention and measurements can help the development of more effective strategies. Schnake and Dumler (2003) indicated that the level of measurement would define the unit to which data is directly related, whereas the level of analysis defines the unit to which they are assigned for hypothetical testing and statistical analysis (p.292). They defined individual values and effects on tested constructs as the ones resulting from individual differences. While individual-level phenomena are more likely to have quicker effects than those at higher levels (organizational), the aggregation of individual-level measurements can contribute to higher-level analysis when the events originate at the individual level, such as individual perceptions (p.294). In this thesis, we analyze the barriers for civil servants' support to the opening of data by governments, at the individual level, to build up higher levels of analysis, such as the organizational level of the government. By doing so, we can assess, understand, and design strategies to tackle the barriers for civil servants to support the opening of data. Moreover, this is done to support the design of our game intervention.

In the next section, we elicit the barriers for governments to open data that are influential to civil servants at the individual level. The individual-level barriers are also the barriers for governments to open data that are influential to civil servants' attitudes towards the idea of opening data. Based on the literature, this group is named as behavioral barriers for civil servants to support the opening of data by governments.

3.2.4 Barriers for governments to release data

Much of the attention on literature discussion focused on the barriers to making data available (Conradie & Choenni, 2014; Crusoe & Melin, 2018; Janssen et al., 2012; Ma, R. & Lam, P. T. I., 2019; Wirtz, Piehler, Thomas, & Daiser, 2015). Specifically, in governments, the available literature converges to some interesting findings for our work (Barry & Bannister, 2014; Beno, Figl, Umbrich, & Polleres, 2017; Wieczorkowski, 2019). According to different authors, these barriers can be grouped into categories, as done by Janssen et al. (2012) and Crusoe and Melin (2018). These two studies aimed at summarizing the literature and explore the diverse dimensions to which open data can be limited. The initial identification of such a broad group is a first step towards understanding the individual challenges imposed to increase data released by governments.

Janssen et al. (2012) defined six categories to group the barriers for data release. Information quality and technical barriers summarize challenges related to the tasks of getting data to be opened. They refer to the operational aspect, which enables data to be shared and also connects to the conditions that these datasets will be further used. The barriers to legislation, use, and participation are more directed at the legal frameworks and consequences of opening data. It converges with Jong and Stout (2003), who indicated that “legal verdicts can

only be binary" (p.48), increasing challenges to the adoption of new practices, such as the opening of data. Lastly, task complexity and institutional barriers group many aspects related to public service culture or individual skills of policy operators, related to the level of efforts that a new routine would demand. However, the former groups can also have impacts on civil servants' behavior to support open data as these barriers are the ones more directly at the individual level.

Similarly, Crusoe and Melin (2018) performed a similar kind of research but categorized the barriers from the policy-cycle perspective. The policy-cycle defines the process of specific decision goes through within a government in order to be executed and evaluated (Howlett & Ramesh, 2003) as shown in Figure 8. The decision itself to publish datasets is challenging and possibly one of the most influencing roles of civil servants.

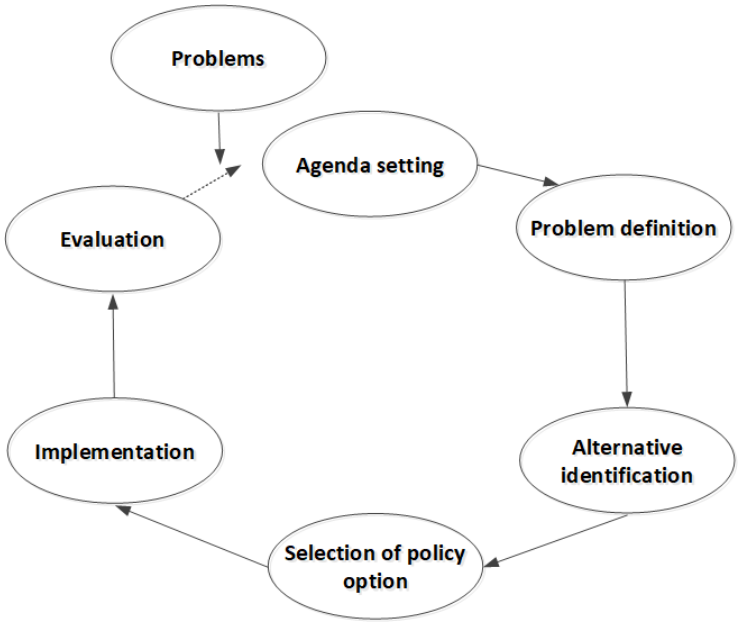

Figure 8 - The public policy cycle (based on Howlett and Ramesh (2003))

From this perspective, numerous actors are involved in the process that goes from generating an idea, putting it to the agenda, selecting it as a priority, and formulating alternatives to solve it. As Haas (1992) indicates, "among the factors that have contributed to the uncertainties faced by decision-makers are the increasingly complex and technical nature of the ever-widening range of issues considered on the international agenda" (p.12). With the proper sense of urgency, it gets to the agenda first (De Bruijn & Ten Heuvelhof, 2010, p.60), and then one of the policy options is to be planned, executed, generate outcomes, and will be evaluated afterward.

The five groups of barriers in Crusoe and Melin (2018) range from identifying data to be released, deciding, and publishing it. After it is used, the evaluation is processed. Once more, some of the barriers operate at the organizational level, and many of them are related to

actors external to governments. Nevertheless, until the data is published, many barriers are influenced by civil servants and should be the object of further analysis.

There are hardly any papers that focus on barriers for the civil servants who open data as part of their work (Conradie & Choenni, 2014; Ma, R. & Lam, P. T. I., 2019). Apart from the organizational level of infrastructure availability and technical limitations, another reason for data not been disclosed originates from the reluctance of civil servants to support the disclosure of data (Wirtz et al., 2015). Likewise, Blazhko, Luhova, Melnik, and Ruvinska (2017) indicated a relation of dataset quality to the engagement of governments in open data provision, which results in the opening of more datasets. As the authors explained that "the main reason for the low quality of OGD is that government officials fail to realize the importance of this topic and the citizens are unable to grasp its benefits" (p.181).

Civil servants can act as policy operators who execute public policies and can support the opening of data. However, the reluctance of civil servants to do so can be related to behavioral barriers for government data to be released. The empowerment of civil servants and their influence in governments' decision-making process suggest that they can be highly influential on the number of datasets that will be opened. It results in the need to analyze the previously discussed barriers for governments to open data by looking at its influence on civil servants' attitudes.

There are at least 57 barriers that can prevent governments from releasing data (Crusoe & Melin, 2018; Janssen et al., 2012). Some of these barriers operate at the individual level of civil servants and can influence the decision to release data. In the next section, this barrier overview is used to set the criteria to perform an SLR on the *behavioral* barriers for civil servants to support open data. The coming discussion is directed at exploring our first research question (RQ1 - "What are the behavioral barriers for civil servants to support the opening of governmental data?"), and the SLR results in a list of barriers, translated into a list of factors influencing civil servants' attitudes towards data release.

3.3 Systematic literature review on the factors influencing civil servants' OGD support

The discussion of behavioral barriers for civil servants to support the opening of data is developed based on the previous background (section 3.2) and presents an updated version of a paper presented at ICEGOV2020 (Kleiman, Janssen, & Meijer, 2020).

When addressing behavioral barriers, literature tends to focus on the institutional or organizational level (Kalampokis, Tambouris, & Tarabanis, 2011). In the case of the user-side studies, it is discussed that a barrier to data release is the lack of pressure on governments to disclose data. In that case, more data would be released if demands for data would be increased (Zuiderwijk & Janssen, 2014). Likewise, the limitations of people knowing how to

find, process, and use government data are turned into an essential aspect of data not being released by governments.

Aspects on the organizational level can originate from behavioral barriers to civil servants' willingness to support the opening of data. Hence, it is essential to explore the influences produced at the individual level to understand possibilities better to change attitudes (Schnake & Dumler, 2003). General conditions, such as legislation, costs, or technical complexities, also influence civil servants' decisions whether to support the disclosure of data or not. Additionally, Crompvoets, De Man, and Geudens (2010) emphasize that "providing the data comes with costs" (p.96). Alternatively, as Longhorn and Blakemore (2007) indicated, "In all information collection and dissemination transactions there are costs, and someone, somewhere, has to pay for them" (p.63). Nevertheless, there is little work in this field, focusing on the attitudes of civil servants (Conradie & Choenni, 2014; Ma, R. & Lam, P. T. I., 2019).

In order to better understand these variables and progress in mapping barriers for official data release, a literature review was performed (Kitchenham et al., 2009). The focus of the review was on extending the behavioral barriers previously presented by and summarizing other researched barriers in common categories for further discussions. As said, the outcome of such an effort is translated afterward in a list of factors influencing civil servants' support for open data policy-making.

On November 30th, 2018, the first search in Google Scholar was conducted by using the keywords "open government data" and "barriers". As more than three million publications were listed, another search was performed, excluding "user" in the title, resulting in 60 publications. The most quoted papers were analyzed in order to identify variables that can influence the support of the opening of governmental data by civil servants. Besides, a snowballing process was performed on the references specifically for the barriers to open data related to attitudes. The papers were scanned for civil servants' (individual) attitude-related papers with specific variables of influence. The final paper selection resulted in eight original papers, which are discussed hereafter.

These papers presented different perspectives on variables influencing the civil servant's individual attitudes. Through an iteration process, these variables were grouped and categorized. Merged into a matrix, the groups synthesized common categories between the references. Finally, an emerging group of labels, naming the categories, has been derived in order to summarize the findings on the influencing variables of civil servants' attitudes towards open data.

The previously discussed and most cited paper, Janssen et al. (2012), was taken as starting point to summarize benefits and barriers related to the adoption of open data policy-making by governments as users and providers. A first filter was used to select only the barriers related to the government side, e.g., the ones responsible for the provision of governmental data.

From the 30 listed benefits, only eight were directly related to governments' provision and might influence the attitudes of civil servants towards open data.

From the first scan performed at the enlisted 57 barriers for open data in general, twenty-two different issues were related to governments' challenges to release data. A second scan was performed, aiming at the challenges that directly or indirectly referred to behavioral barriers (individual level or organizational level influencing the individual one), resulting in a list of 11 behavioral barriers, the focus of this research. This first scanning exercise organized an initial approach to the different dimensions that could be used as a reference for further readings. Once more, our literature review confirmed that the behavior barriers of civil servants were hardly addressed in the literature, although they are mentioned in some of the works.

The resulting list of barriers was translated into factors that can, positively or negatively, influence civil servants' attitudes. This resulted in two types of factors, those enabling and those hindering attitude change. A second review was performed to regroup the content of these factors: the ones that could positively influence civil servants attitudes to open more data (to be discussed as drivers and benefits); and a second group of the different behavioral barriers described in the studies, related to those that would negatively impact the willingness of civil servants to disclose data (the behavioral barriers). Both groups are used for the further development of the serious game.

3.3.1 Open data drivers and factors

The first group (positive variables of influence) was composed form individual and organizational factors that unleashed civil servants' willingness for open data release, as shown in Table 6. In this group, most of the variables contain aspects of contextual forces that could incentivize the disclosure of data by governmental bodies. Most of the variables are connected to aspects of public service provision and how the opening of data can also improve civil servants' work.

Differently than benefits, the drivers set standards or conditions that are favorable for governments to opt for disclosing open data. They sum up exemplary policies and best practices, guidelines, and supporting tools that incentivize open data adoption. Even if not directly related to civil servants themselves, they define general conditions that might lead to the opening of data to be on the agenda.

Table 6 - Drivers and factors influencing civil servants support to open data positively (taken from Kleiman, Janssen, and Meijer (2020), p.532)

Reference	Drivers	Factors
(Janssen et al., 2012)	• Political leadership to develop guidelines and infrastructure and promote through learning." • Innovation • Economic value generation	• Avoid unnecessary duplication of data and associated costs (also by other public institutions) • Optimization of administrative processes • Access to external problem-solving capacity • External quality checks of data (validation) • Sustainability of data (no data loss) • Creation of trust in government • Improvement of citizen satisfaction
(Hardy & Maurushat, 2017)	• Provide policy-makers with data needed to address complex problems	• Improvement of policy-making processes • Creation of new insights in the public sector • Knowledge developments and new insights using the wisdom of the crowds • Creation of trust in government with More visibility (data provider)
(Hossain et al., 2016)	• Institutional pressure compelling policies that organizations cannot avoid • Pressure from other stakeholders (journalists, advocacy groups, and opinion leaders)	• Gains in transparency and accountability • More informed policy developer
(Parkes et al., 2018)	• Improve democratic systems	• Democratic accountability, participation, and self-empowerment of citizens • Improvement of citizen services, satisfaction, and policy-making processes

Once the government office initiatives a policy to open data, the willingness of civil servants towards its release becomes more critical. Therefore, the literature lists several benefits that might be of interest. Researchers often assume that being aware of such benefits may lead to more civil servants supporting the opening of data (Janssen et al., 2012) and that the positive outcomes can increase their willingness to support it (Parkes et al., 2018).

3.3.2 Open data behavioral barriers

The second group (behavioral barriers to support open data) informed our design process with challenges are faced by civil servants to support the opening of data. This second group was composed of variables that appeared to influence the willingness of civil servants towards data release negatively. The long list of 38 negative influencing factors for civil servants' open data support is shown in Table 7.

Table 7 – List of 38 individual-level barriers for civil servants to support data opening

Reference	Perception of Data in Work (Group 1)	Effort Expectancy (Group 2)	Risk Aversion (Group 3)	Social Influence (group 4)
(Janssen et al., 2012)	• Lack of Knowledge to make use of or to make sense of data • Unclear value • The unclear trade-off between public values (transparency vs. privacy)	• Lack of accuracy in the information • Concerns on quality and accuracy of data	• Risk-averse culture (no entrepreneurship) • Emphasis on barriers and neglect opportunities	• Lack of support to make data available • Threat of lawsuits • Privacy violations
(Hardy & Maurushat, 2017)	• Limited understanding of benefits	• Data processing (de-identifying government data and common metadata standards)	• Secrecy of information as the default position • Generational preference on public service: younger generation expects to be freely available	• Security risks • Lack of leadership to drive the opening of data
(Pasquier & Villeneuve, 2007)		• Public service not prepared for non-administrative communication with the public	• Bureaucratic culture: hierarchic, introverted, and risk-averse • Security-minded environment (especially after 09/2001)	• The tradition of not sharing data • Ownership of the ones in power
(Hossain et al., 2016)	• Lack of Knowledge	• Low Perceived Usefulness	• Dependent on personal understanding, awareness, and assessment of sharing data • Lack of Awareness and knowledge • Risk-averse leadership • Information privacy and security	• Individual and organization privacy • Business secrets • National security
(Conradie & Choenni, 2014)	• Unknown data locations	• Opaque ownership of data	• Fear of false conclusions • Financial effects of data release	• Lack of priority
(Peled, 2011)			• Lack of skills by powerful bureaucrats	• Control over information acquisition and dissemination as an asset for bargaining games
(Martin, Sébastien, Foulonneau, Muriel, Turki, Slim, & Ihadjadene, Madjid, 2013).			• Risk of protests against public actions by misinterpretation of data	

The 38 variables are clustered into four groups of factors by their characteristics and contribution to explore the barriers influencing civil servants' support for the opening of data. We renamed these groups inspired by the literature on technology acceptance which has a background in clustering factors of influence (Venkatesh, Morris, Davis, & Davis, 2003; Zuiderwijk et al., 2015; Zuiderwijk & Cligge, 2016).

The perception of data (Group 1) and Effort Expectancy (Group 2) provides different perspectives on the effects that the inaccurate perception of data management policies can influence public servants' behavior negatively. The first factor (Group 1) summarizes aspects of data production by public servants. Although many public servants produce data, they might have limited perception, especially non-IT professionals who might not be aware of data-related issues (Conradie & Choenni, 2014; Denis & Goeta, 2017). As a consequence of these factors, the efforts of making data available (Group 2) tend to be overestimated, resulting in less support for the opening of data.

On the other hand, Risk-Aversion (Group 3) and Social Influence (Group 4) originates from the cultural environment in which the public service operates and describes how it may affect the attitudes of civil servants. Both tend to have a negative influence on the support of opening data since they reinforce the conservative values and risk perceptions towards the opening of government. While assessments to risk (Group 3) have a higher personal sense of data opening, the environment in which the option to open data is made (Group 4) relates to public service culture (Bozeman & Kingsley, 1998; Martin, 2014; Martin, Sébastien et al., 2013).

A remark needs to be made that many of the selected papers did not assess individual-level barriers, e.g., personal interest not to open the data for corruption, threat to lose contact with clients, and other (Welle Donker & van Loenen, 2016). Though Table 6 and Table 7 show the list of factors influencing the attitudes of civil servants towards the opening of governmental data found in this SLR. The factors define that the willingness of civil servants to support the opening of data can be influenced by different knowledge and perceptions of data and its impact on their work. First, civil servants' perceptions can be influenced by their familiarity with the topic and the benefits that might derive from the opening of data. A professional that expects more positive outcomes to their work (and to society) by making more governmental data available shall be willing to open more data as well. Thus, the assessment of benefits that might result from data disclosure is key to their willingness to do so. Also, the existence of specific drivers in a particular administration context can create the necessary environment for data to be opened. Drivers at the organizational level and benefits at the individual level shall positively influence civil servants' support of data opening.

In turn, the efforts for getting data to be opened and the adverse outcomes that might result from it will decrease the willingness of civil servants to open data. If these professionals perceive that opening governmental is too complicated and complex or if they cannot understand the basic operations needed for making data available for the public, the idea of data disclosure will be frightening in itself. Besides, the lack of knowledge of the process of

data opening and its consequences will probably influence their risk perception of the consequences of the first action. In the same direction, the overestimation of risks will also increase their perception of efforts resulting from opening data thought to reduce their willingness to do so.

3.3.3 Clustering the factors influencing civil servants' intentions to support the opening of data

In the previous sections, we discussed the factors influencing civil servants' support to the release of data by governments and their role in the decision to get governmental data to be opened. We progressed to the discussion of general barriers for governments to open data and derived the behavioral barriers. The analysis of the behavioral barriers for civil servants to support government data release results in defining the factors which are influential to civil servants' behavioral intentions. In this thesis, we use behavioral intention as a proxy to measure changes in their attitudes towards open data.

This section will introduce and discuss the derived factors to explore the individual attitudes of civil servants towards supporting that governments should release data to the public. Each of these factors is analyzed next, starting with the dependent variable: civil servants' behavior intention to support the release of data by governments, followed by social influences, risks, performance expectancy, and data management knowledge (Kleiman, Janssen, Meijer, & Jansen, 2021).

3.3.3.1 Behavioral Intention

The game resulting from this research is aimed at changing the attitudes of civil servants. In this thesis, Behavior Intention is used as a proxy to measure these changes in attitudes. According to Davis (1989), Behavioral Intention can be used as a measure of strength on the intention to perform a particular behavior. Also, Behavioral Intention is a frequent category in the literature about behavior adoption. Behavior Intention is seen as the most important predictor of actual behavior and can be defined as "indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991, p.181). However, in the open data literature, it is usually applied to user's intentions and not to providers' inclination to release governmental data (Carter & Campbell, 2011; Jurisch et al., 2015; Schaupp & Carter, 2010).

Behaviors are ways of action that can be observed, whereas attitude represents how a person thinks or feels about a specific topic (Schrader & Lawless, 2004). In our case, the action is the opening data, and we want to influence civil servants' attitudes resulting in these actions. Thus, our focus is on the attitude influencing factors at the individual level that leads governments not to open their data.

Behavior Intention can be used as a proxy to estimate individual support of specific actions; in our case, the attitudes towards open governmental data. Such a position is described as resulting from different behavioral factors that can influence a civil servant's perspective of

open data (Kleiman, Janssen, & Meijer, 2020). As Technology Acceptance Models (TAM, TAM2, TAM3 and UTAUT -(Venkatesh & Davis, 2000) and other adoption (DeLone & McLean, 1992; Vallerand, 1997), Behavioral Intention is used as a compound variable that summarizes the effects of other factors towards a particular outcome, such as the adoption of technology. Focusing on variables that can influence civil servants' attitudes towards the opening of data, Behavioral Intention is defined as the willingness of civil servants to support the opening of data, particularly in intending to provide more governmental data to the public.

We suggest that to measure the willingness of civil servants to support the opening of data using three dimensions. The first, more practical, is to assess whether these professionals realize that they can be already providing governmental data to the public and if they are aware of doing so. The second dimension of civil servants' willingness to provide governmental data is their willingness to do so. The last dimension is their prediction of needing to provide data in the future. It checks the previous perceptions and sums up their vision of how is open data practices going to be adopted in the future of public service.

The compound variable of Behavior Intention results in one construct resulting from these three dimensions of willingness, which can be influenced by different sources of knowledge and perceptions. Behavioral Intention is also used as a proxy to measure changes in civil servants' attitudes towards open data. The measurement of the behavior intention is a reference to the strength of civil servants' support to governmental data opening. The factors of influence on such intentions are discussed next.

3.3.3.2 Contextual and social Influences

Governments are highly hierarchical organizations with many restrictions for civil servants to operate. How others open data can have a social Influence on the civil servant to open data as well. This can be the formal influence exerted using the hierarchy, but also coercive, mimetic, and normative isomorphic pressures influencing the opening of data (DiMaggio & Powell, 1983). Many aspects might have social influence, from hierarchy and teams to formal rules: "normative influence can be considered the result of integrating one's expectations and feelings with significant others' perceived expectations and feelings concerning the shared moral or social meaning of performing a prospective act" (Venkatesh et al., 2003, p.534). It is particularly important in the open data context for governments, expressing hierarchy and legal frameworks that limit civil servants' actions (Venkatesh et al., 2003; Weerakkody, Kapoor, Balta, Irani, & Dwivedi, 2017; Zuiderwijk & Cligge, 2016).

Civil servants can act in many different ways, from policy advisors to actual policy operators or data custodians. Different from the private sector, where legal frameworks are used to constrain illegal practices, in governments, civil servants tend only to be allowed to do what the law determines them to do. In general, this may leave little room for innovation and can result in a lack of autonomy even to support different practices. Social Influence should influence civil servants to adhere to the official data release policy.

3.3.3.3 Risks and effort expectancy

According to Bozeman and Kingsley (1998), risk can be defined as "the exposure to the chance of loss from one's actions or decisions" (p.110). One of the most used assumptions in public administration theory is that civil servants tend to behave in risk-averse manners. Studies conducted on different fields get to different conclusions depending on how it is tested or what it is compared to (e.g., private companies). "Among the many assumptions about public management widely embraced but rarely tested is the notion that public sector managers are more averse to risk than managers in the private sector" (opus cit., p.109). Furthermore, "individuals with a higher degree of risk aversion in their personal lives (i.e., concerning ensuring personal automobiles, use of seat belts, the extent of medical coverage, smoking habits and drinking habits) were more likely to seek employment in the public sector" (opus cit., p.111).

The same assumption is echoed in the open data literature. Janssen et al. (2012) found that Risk-averse culture (no entrepreneurship) and emphasis on barriers and neglecting opportunities (risk-averse behavior) are barriers to OGD policy development. Hardy and Maurushat (2017) described that public service tends to favor secrecy of information as the default position, which is convergent with civil servants' fear that mistakes or misconduct on behalf of government employees might be exposed. Pasquier and Villeneuve (2007) described the bureaucratic culture of organizations as hierarchic, introverted, and risk-averse by nature. What is coherent with the position of Peled (2011) is that "powerful bureaucrats who are not technically skilled manipulate the acquisition and application of technical skill within their organizations to ensure that computer technology operates on behalf of a predetermined agenda" (p.5).

Janssen et al. (2012) found that lack of support to make data available, the threat of lawsuits, or other violations, such as privacy or security, might lead civil servants to resist to the opening of data. Hardy and Maurushat (2017) pointed out that lack of leadership to support drives open data initiatives negatively influences its adoption. Bozeman and Kingsley (1998) found that the perception of trust between coworkers affects risk culture even more than internal control. Hence, it is expected that as civil servants receive more support to make data available, their willingness to open data will be positively influenced by social influence.

Also, Hossain et al. (2016) reinforced this position by finding that a lack of awareness and knowledge of the leaders as well as risk-averse leadership can be a crucial barrier for open data policy-making. It can also result from information privacy and security issues related to data licensing ownership. Conradie and Choenni (2014) added that the false conclusions and unknown financial effects of open data release are also feared in public service. Furthermore, that is confluent to the fear of potential increased control of citizens and their capacity to protests against public actions by using data that can be de-contextualized (Martin, Sébastien et al., 2013).

Personal understanding, awareness, and knowledge of and incentive to share data, privacy issues at the individual and the organizational level, business secrets, or national security issues are described by Hossain et al. (2016) to affect intentions of data opening. Pasquier and Villeneuve (2007) described that culturally a historical tradition in public service exists to accumulate knowledge without sharing. The consequence is that government officials tend to consider files and other data as being their own or the institution's property. This results in a practice of control of information that "has always been the ultimate asset bureaucrats possess in their internal bargaining games" (Peled, 2011). As a consequence, the less support civil servants have to open data, the more risks they tend to find for doing so, which results in expecting more effort too.

All the influencing variables contribute to the environment in which the option for disclosing governmental data happens. The public office is a professional space defined with two main characteristics that differ from many private spaces: legal framework and hierarchy (Lipsky, 1971). By definition, civil servants are only allowed to do in their job what the law states that they should do, leaving little room for innovation and personal decisions. Thus, if making data available is not clearly defined in the legal framework, some civil servants might increase their reluctance to publish public data. As open data policy-making progresses around the globe, more governments are having their laws adapted to allow (or even determine) that public data needs to be opened. In such a context, the lack of knowledge of the existing laws or even the unawareness of the practice will reduce the willingness of civil servants the opening of data (Hossain et al., 2016).

As a consequence of this rule-constrained environment, hierarchy tends to prevail in the decision-making processes. On the one hand, having a more open-oriented administration can positively increase open data policy-making and also civil servants' perception of such practice. On the other hand, a more opaque administration will also negatively influence the willingness of civil servants to get data to be published. Independently of the directions to which the actual ruling body has, hierarchy is also essential when checking civil servants' willingness to open data.

Another aspect of the issue is that public servants might see red tape and formalism as risk reduction strategies – getting the rules to impede them from certain practices. However, Bozeman and Kingsley (1998) found that these measures can increase the cost of risk (higher transaction costs) and reduce the benefits of favorable outcomes, implicating an even more risk-aversive situation. In this sense, the more the risks are overestimated, the more civil servants expect that more effort will be required to use and provide open data. As it is assumed that civil servants can overestimate risks (while lacking knowledge of its benefits), the more risk-averse, the higher the expected effort towards open data adoption.

The perceived amount of work and risks can be barriers to opening data. Venkatesh et al. (2003) suggested Effort Expectancy as a synthetizing variable influencing behavior intention. Effort expectancy can be defined as "the degree of ease associated with the use of an

Information System" (Venkatesh et al., 2003, p.533). Effort expectancy can be seen as the importance that the perception of risks and operations' technical complexities can have on open data technology to be adopted. These are the various barriers faced by data publishers to open data (Venkatesh et al., 2003; Weerakkody et al., 2017; Zuiderwijk et al., 2015; Zuiderwijk & Cligge, 2016). Effort expectancy is part of civil servants' risk perceptions, as it should result in more work, which converges with perceptions of risks of unintended outcomes from open data perceived by civil servants that should also increase their opposition to its release.

3.3.3.4 Benefits and performance Expectancy

The benefits coming from the release of data by governments may not be accepted or well-known by civil servants. Their assessment might positively influence the willingness to support the opening of data (Kleiman, Janssen, Meijer, et al., 2020). As defined by Venkatesh et al. (2003), "Performance expectancy is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance" (p.447). Performance Expectancy can derive from similar constructs, such as Perceived Usefulness (Weerakkody et al., 2017; Wirtz & Piehler, 2016; Wirtz, Piehler, Thomas, & Daiser, 2016).

In another context, Wirtz and Piehler (2016) found it not surprising that usefulness was the most important independent variable for e-government adoption (p.242). Performance Expectancy includes all the positive outcomes that releasing governmental data can offer for a civil servant.

Venkatesh et al. (2003) updated their original Technology Adoption Model (TAM) to a more integrated version of converging theories on the discussion of technology adoption in the Unified Theory of Acceptance and Use of Technology (UTAUT). From UTAUT originates the concept of Performance Expectancy, which includes "Perceived usefulness" (Davis, 1989), "Relative Advantage" (Moore & Benbasat, 1991), and "Outcome expectations" (Compeau, Higgins, & Huff, 1999). Resulting from data usage, Performance Expectancy also represents the expected outcomes of open data when accessed by governments, companies, and the general public (Bozeman & Kingsley, 1998; Zuiderwijk et al., 2015). From the data provision perspective, the perception of benefits and positive outcomes can result from open data practice, particularly at the individual level (Carter & Campbell, 2011; Janssen et al., 2012; Jurisch et al., 2015). Therefore a game should show the data providers what benefits can be created from open data for the data users.

Blazhko et al. (2017) found that one of the main reasons for the low-quality government data is that officials do not realize its importance or benefits. Janssen et al. (2012) summarized a long list of benefits resulting from OGD - Table 8.

Table 8 - OGD benefits

Open Government Data Benefits (Janssen et al., 2012)

1. More transparency 2. Democratic accountability 3. More participation and self-empowerment of citizens (users) 4. Creation of trust in government 5. Public engagement 6. Scrutinization of data 7. Equal access to data 8. New governmental services for citizens 9. Improvement of citizen services 10. Improvement of citizen satisfaction 11. Improvement of policy-making processes 12. More visibility for the data provider 13. Stimulation of knowledge developments 14. Creation of new insights in the public sector	15. New (innovative) social services 16. Economic growth and stimulation of competitiveness 17. Stimulation of innovation 18. Contribution toward the improvement of processes, products, and services 19. Development of new products and services 20. Use of the wisdom of the crowds: tapping into the intelligence of the collective 21. Creation of a new sector adding value to the economy 22. Availability of information for investors and companies 23. The ability to reuse data/not having to collect the same data again and counteracting	24. unnecessary duplication and associated costs (also by other public institutions) 25. Optimization of administrative processes 26. Improvement of public policies 27. Access to external problem-solving capacity 28. Fair decision-making by enabling comparison 29. Easier access to data and discovery of data 30. Creation of new data based on combining data 31. External quality checks of data (validation) 32. Sustainability of data (no data loss) 33. The ability to merge, integrate, and mesh public and private data

Benefits can be at various levels. To measure attitude change, the assessment of some of these benefits should be measured at the individual level (Kalampokis et al., 2011; Schnake & Dumler, 2003). The target of Performance Expectancy measurement is to estimate its influence on a particular person's behavior intentions. The more civil servants know that they can have positive outcomes by sharing governmental data, the more they will be supporting data disclosure.

3.3.3.5 Data management knowledge

Lastly, the basic knowledge of data management can help civil servants to understand how open data happens or can be done. The need for knowledge is also well acknowledged in the literature. In an extensive list of 57 barriers, Janssen et al. (2012) highlighted the lack of knowledge to make use of or to make sense of data and the lack of accuracy of the information itself when using open data. Hossain et al. (2016) described that the lack of knowledge results in less use of data. Hence, lack of knowledge clearly affects perceived usefulness.

Therefore, knowledge about ways for opening data is needed (Conradie & Choenni, 2014; Hardy & Maurushat, 2017). The many facets in which open data can be assessed should be influential to one's supporting its release by governments. Data management knowledge is included as a variable of influence to civil servants' willingness to support open data.

3.3.3.6 Synthesis: a list of factors influencing civil servants' open data support

The literature review was conducted to address RQ1 - "what are the barriers for civil servants to support the opening of governmental data?" and deepen the discussion towards individual-

level barriers faced by civil servants to support the opening of data. A gap in the literature related to factors that influences civil servants' attitudes towards supporting the opening of governmental data is confirmed. Also, it shows that the attitude influencing factors can be analyzed and used to improve actions oriented to increase the release of data governments.

The list of 38 barriers, from Table 7, was clustered into factors, which supports the progress of our research. These factors are used, in this thesis, as input to design a game to change civil servants' attitudes towards open data. The factors were also translated into a questionnaire used to evaluate the effects of the game. These factors emerged from the barriers list, which was clustered and named for similarities within their characteristics - Table 7 and Table 8. These factors are the basis for the game to be developed in this thesis:

1. Contextual and social influences
2. Risks and efforts expectancy
3. Benefits and performance expectancy
4. Data management knowledge

Each of the described factors contains a set of variables that influences civil servants' attitudes. For example, the data management knowledge or risks and efforts have different influences on how civil servants behave towards the opening of data. Each of the defined groups also implicates different perceptions of consequences for data opening and should be used to design the game.

The factor of contextual and social influences include institutional barriers, which barriers are broader than the individual effects of the described variables on civil servants' attitudes. Not only individual perceptions but also the context in which data is operated matters when fostering the release of data by governments is important.

As the main objective of this thesis is to explore and explain the use of games to change civil servants' attitudes to support the opening of data, we used these factors as a basis for the game development and further evaluation of its effects. In the next section, we will discuss the use of games to change players' attitudes, addressing our RQ 2 ("What design elements are needed to make a game to change civil servant's attitude towards supporting the opening of governmental data?"). We contextualize the discussion in the governmental environment, explicitly focusing on games for civil servants and those which have already been used on the topic of open data.

3.4 Systematic literature reviews on serious games for civil servants, open data, and attitude change

Another 3 SLRs were conducted on topics related to serious games. Governments are increasingly using games for civic engagement, decision-making, policy communication, and many other areas (Hassan, 2016; Sgueo, 2018; Vasconcellos, Carvalho, & Araujo, 2017). The history of games used in public service dates back to centuries, but only recently, the

importance of such activities has been recognized (Mayer, 2009; McGonigal, 2011; van de Ven, Stubbé, & Hrehovcsik, 2013). Alongside this increased practical use of games, understanding is needed to improve governmental interventions. Studies on policy-gaming, education, and even use gamification techniques by governments are known. However, some game interventions focus on changing the attitudes of the players, and there is a void in systematic approaches for accomplishing such a change (Connolly, Boyle, MacArthur, Hainey, & Boyle, 2012).

A recent increase has been noticed around games production, discussion, and its use for serious purposes (Boyle et al., 2016). Many of the newcomers in the gaming field take it as a novelty. Some even relate it to the boom in the video game industry or to the technology itself, which has enabled individuals to play on mobile devices (Association, 2019). However, if we take a more careful look at the history of games, other explanations are possible. First and foremost, games can be considered a human activity since our primates started to socialize (Harteveld, 2011). Most authors consider Egyptian S'n't (Senet), found in 2686 BC, to be the oldest, while others consider the Royal Game of Ur or Mancala to have a more extended existence (Harteveld, 2011). The Herodotus description of King Atys from Lydia using games to tackle hunger in the 2nd millennium BC is also referenced (McGonigal, 2011). There are even painting on walls from the pre-historic era, which indicates playful activities within the first human communities.

Broader than games, the idea of playing games belongs to our culture since the beginning of our times. Huizinga (1949) describes playing as "a voluntary activity or occupation executed within certain fixed limits of time and place, according to rules freely accepted but absolutely binding, having its aim in itself and accompanied by a feeling of tension, joy and the consciousness that it is "different" from "ordinary life" (p.28). The author is the one who coined the *Homo Ludens* concept, which reminds us of our playful human nature.

The situation is quite similar when looking at the history of games in governments. Particularly the registers for wargaming used for training or strategic thinking date back thousands of years (Mayer, 2009). Some authors found that already in ancient China, Egypt, and some other African communities, games such as Senet, Go, or Mancala has being played with "serious purposes" and initially by the ruling classes and governments. Many types of training activities and teaching can also be analyzed as games (wrestling is considered the first official sport and defined within combat training) (Halter, 2006).

However, the use of games in government is much more complicated than merely looking at its examples (Woodcock, 2019). With a starting goal of training and strategic thinking, it evolved in many other directions. As to be described, some games focused on supporting better decision-making, particularly those more based on simulations (further named simulation games and policy gaming) (Klabbers, 2009). Others used for scenario building and crowdsourcing. Recently is remarkable the number of games aiming at increasing citizen engagement and participation on public issues within and outside governments.

Mayer (2009) described many similarities between games and the development of policy making and decision sciences. The increase in simulation techniques, especially with the development of computation and technology, has supplied the necessary tools for these fields to improve. Gaming, simulations, decision-making, and engagement, all in the same process.

Lastly is the discussion of games as a means of persuasion (Bogost, 2007). The recent development in video games and its billionaire markets has called attention to some not-so-apparent effects of gaming. At first, it discussed the non-intended effects of games, increasing violent behaviors. More broadly, by experiencing situations and making decisions in a safe environment, players' attitudes and behaviors might also be changed. Moreover, besides discussing the unintended game effects, a new trend has emerged, discussing how to design games for changing attitudes. A part of this approach is named persuasive games, and others include games for awareness, empathy, participation, and many others. Within the many games aiming at changing players' attitudes, not many targeted civil servants.

The first subsection of this section will discuss games in general and explore the background of using games in governments. We progress by reviewing games designed specifically for open data to estimate the gaps in the literature related to this content in games. Next, games for civil servants and attitude change are discussed separately to identify the elements needed to design a game for this audience and purpose.

This section aims our RQ 2 (“What design elements are needed to make a game to change civil servant’s attitude towards supporting the opening of governmental data?”) and summarizes the elements coming from game design literature, which can be used to change civil servants attitudes towards open data. This section results in the design elements used to prototype the game, which is tested and discussed in this thesis.

3.4.1 Serious gaming background

Serious games are one of the many definitions for the use of games for additional purposes than only entertainment. According to Duke and Geurts (2004), “game-design is a combination of a disciplined design approach with mimicry of existing game formats and styles; it is an elusive but real “art” (p. 273). The author has also coined the idea of games as a language that anticipated recent trends of analyzing games from a media studies perspective. Games are a means of communication of ideas and an environment for exchange and interaction.

Games are a particular kind of play where the players voluntarily join an activity with a defined goal (explicit or not) involving mechanics (rules) that results in dynamics that can be monitored through a feedback system (Abt, 1987; Duke & Geurts, 2004; McGonigal, 2011). Serious games can provide a safe environment where players get feedback from voluntary interaction with a plot and assets built up of unnecessary challenges (Duke & Geurts, 2004; McGonigal, 2011). They can be used for many purposes, from pure entertainment to decision-making facilitation (Boyle et al., 2016; Connolly et al., 2012; Mayer et al., 2004). Likewise, serious games are a set of games related to non-entertainment purposes such as learning, policy-making, or designing

complex systems (Abt, 1987; Djaouti, Alvarez, Jessel, & Rampnoux, 2011; Meijer et al., 2014). Backlund and Hendrix (2013) defined serious games as "games that engage the user, and contribute to the achievement of a defined purpose other than pure entertainment (irrespective of whether the user is consciously aware of this)"(p.3). Games can provoke attitude change of their participants generating new meanings and relations between players and tasks (Geurts, Duke, & Vermeulen, 2007; Kriz, 2009; Meijer et al., 2014; van de Ven et al., 2013).

Games can be used for pure entertainment though they will always have a learning outcome of fun (Koster, 2013). "The term 'gaming' exists within a loosely demarcated field of interactive, participatory activities aimed at involving participants, who may be actual stakeholders in an activity. Related terms include simulation games, gaming simulations, policy exercises, and serious gaming" (Meijer, 2015, p. 516). The simulation environment in the game can be used as a real-life reinterpretation to produce new insights on specific problems. In that sense, they are turned into simulated (safe) environments for human interaction on (multi-variable) complex (wicked) problems that demand creative (participative) solutions from multi-stakeholders (Duke & Geurts, 2004; McGonigal, 2011). Hence, they can also be designed and used for serious purposes. The focus is often on analyzing the outcomes after the game session has ended (Wenzler, 2002).

The field of gaming became complex, and it is hard to find a unified view of approaches or concepts. Named by Harteveld (2011) as the babel problem, the author lists the many names to which such interventions use. It ranges from virtual experiences, simulations, social impact games, practiceware, game-based learning, immersive learning environments, educational simulations, serious games, epistemic games, edutainment, edugaming, simulation/gaming, simulators, persuasive games, virtual training environments, advergames, educational games, training games, exergames. In his words, "the academic field of games can be seen as a 'kaleidoscope'" (p.17). The list is infinite.

Regardless of the lack of common ground, still, a concept is needed to progress with our discussions. Serious games have even been considered an oxymoron as games and fun are not serious, even in non-entrainment contexts (Klabbers, 2006). Though, recently, some authors agreed that the label has progressed as a common denominator within the many approaches. Described by Mayer (2009), "the notion of serious games (also called social impact games, persuasive games, games with a purpose, etc.) literarily and figuratively brings together a large international community of computer scientists, game designers, think tank consultants, decision-makers, and public policymakers. It is becoming a major global industry" (p.841). From Susi, Johannesson, and Backlund (2007): "there are many different terms, that all point to what is here called serious games. Nevertheless, the concept is defined in many ways; definitions agree on some matters, but also vary depending on different perspectives and interests" (p.7). Also, Connolly et al. (2012) performed a literature review in the field, aiming at the evidence of games' non-entrainment effects. Four years later, they published another

updated version indicating that more "serious games" papers using were reaching high-quality standards (a change from 8/129 to 34/143 compared to the original review). They suggest the term as becoming mainstream (Boyle et al., 2016).

Table 9 - Games type definitions by the approach

Type	Definition	Reference
Educational games / Game based-learning	"games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and experiences"(p.9)	(De Freitas, 2006)
Simulation gaming / Policy-gaming	"a gestalt communications mode which contains a game-specific language (the jargon employed to describe components of reality), appropriate communication technologies (e.g., wall charts and computer), and the multilogue (multiple, simultaneous dialogues) interaction pattern" (p. 195)	(Duke & Geurts, 2004)
Persuasive games	"games that mount procedural rhetoric – embedding a message into the systems and rules of games" (p.2)	(Jacobs, 2018)
Serious games	"[games used] for the purposes of instruction, training, or the prompting of attitude change among its players coupled with enjoyment" (p.335)	(Blumberg, Almonte, Anthony, & Hashimoto, 2013)

In this sense, we will use serious games as a reference for our approach in this thesis. Next, we will revise the literature related to the use of serious games for open data to explore the literature gap of such content. Then we discuss the use of games for civil servants and attitude change. We end this section by uniting games for civil servants, attitude change, and open data to explore our RQ 2 ("What design elements are needed to make a game to change civil servant's attitude towards supporting the opening of governmental data?").

3.4.2 Systematic literature review on serious games and open data

A first step to situate the discussions of this thesis is to analyze what has been published on games for open data. At first glance, studies published on games towards open data are scarce. Some papers have been published on games built upon open data. Blazhko et al. (2017) defined them as "games where gameplay and/or game content is based on real-world data external to the game, and where gameplay supports the exploration of and learning from this data" (p.181). However, there are not many games designed to discuss open data through gameplay and tap the awareness of players on the topic's importance. An SLR was performed to check such perception on the scientific research aiming at developing, testing, and analyzing games for open data.

3.4.2.1 Systematic literature review protocol

On 30/06/2020, an SLR protocol was performed in WOS, Scopus, and Google Scholar using:

- (gam*) AND (open data OR "open government data") AND ("provision" OR "provider" OR "government").
- ("policy gaming" OR "serious games" OR "serious gaming" OR "simulation game" OR "simulation gaming") AND (open data OR "open government data")

Table 10 - SLR on games and open data

Keywords	WOS	Scopus	GScholar
(gam*) AND (open data OR "open government data") AND ("provision" OR "provider" OR "government")	10	22	10k
("policy gaming" OR "serious games" OR "serious gaming" OR "simulation game" OR "simulation gaming") AND (open data OR "open government data")	9	13	1.5k

We scan the outcome using the specific keywords of “Gam*” or “Open” in the Title resulting in a list of 23 papers. Merging these outcomes with those 54 papers coming from WOS and Scopus resulted in a list of 77 papers. Within the references, 31 were repeated papers that were excluded to built the 46 papers final list.

3.4.2.2 Open data audience

A scanning process was run to label the relation of game use and open data in the papers. It resulted in 5 categories: open data provider-oriented (5), user-oriented (9), gamification (3), use of data in games (18), and 13 were related to other topics.

As our main focus was on games for open data providers, the five provider papers were checked. Only 3 of them were related to open data providers (Kleiman, 2019; Kleiman & Janssen, 2018; Kleiman, Janssen, & Meijer, 2018). Once more, these were the papers resulting from the research presented in this thesis, which is directed at the same specific object. The other papers found were related to the use of data in urban planning (Janssen & Helbig, 2018) or were not related to games at all (McCusker, Lebo, Chang, McGuinness, & da Silva, 2012). The final list is summarized in Table 11.

As only the papers resulting from previous work from the research presented in this thesis were found in the literature search, we conclude that no other study has ever focused on data provision of open data.

Table 11 – Games for open data by the targeted audience

Audience	Papers	%	References
Provider	3	7%	(Kleiman, 2019; Kleiman & Janssen, 2018; Kleiman et al., 2018)
User	9	20%	(Aguilar et al., 2019; Barker, Wolff, & van der Linden, 2016; Barres de Almeida et al., 2017; Dunwell et al., 2016; Gordon & Baldwin-Philippi, 2013; Himmelstein, Goujet, DUONG, BLAND, & LINDNER, 2016; Khan, 2018; Wolff, Barker, & Petre, 2017; Wolff, Valdez, et al., 2017)
Gamification	3	7%	(Blazhko et al., 2017; Sandoval-Almazan, Gil-Garcia, & Valle-Cruz, 2017; Schadenbauer, Sprung, Salhofer, Nischelwitzer, & Strohmaier, 2016)
Use Data	18	39%	(Alonso-Fernández et al., 2018; Bamparopoulos, Konstantinidis, Bratsas, & Bamidis, 2016; Brouns et al., 2017; Cardona, Hansen, Togelius, & Gustafsson Friberger, 2014; Chiotaki & Karpouzis, 2020; Friberger & Togelius, 2012; Gustafsson Friberger et al., 2013b; Janssen & Helbig, 2018; Ke, Xie, & Xie, 2016; Ketterl et al., 2011; Könnölä, Loponen, Krusberg, & Lehtonen, 2019; Massoud et al., 2018; Quesnel, Soula, Dufossez, & Beuscart, 2016; Shi, Kaneko, Ma, & Okada, 2019; Siriaraya et al., 2018; Togelius & Gustafsson Friberger, 2013; van Stegeren & Theune, 2018; Warren & Champion, 2014)
Other	13	28%	(Cobcroft, 2010; Fujii & Managi, 2016; Hayashi & Ohsawa, 2016; Jakóbik, 2020; Joe et al., 2018; Koff, Challenger, & Portillo, 2020; Koppelaar et al., 2018; Massoud, Bellotti, Berta, De Gloria, & Poslad, 2019; Matheus & Janssen, 2015; Meij & Pastoor, 2013; Petricek, 2017; Yasin, Liu, Li, Wang, & Zowghi, 2018)

3.4.2.3 Discussions and conclusion

Different from our review, which focused on academic research, some local initiatives have been developed in practice, used for open data provision. However, these initiatives are not presented nor analyzed in scientific outlets, or they might not have enough theoretical grounding in gaming. Nevertheless, we investigated them.

The open data bingo (http://gbonanome.github.io/opendatabingo/) is a fun quiz for civil servants but focuses only on monitoring other player's awareness against opening data by signaling common negative expressions when the topic appears. Datopolis (https://theodi.org/service/tools-resources/datopolis/) was developed by ODI game and aimed at sharing data within many different stakeholders; the Teresina municipality in Brazil developed a game connecting SDG 2030 agenda with open data (https://issuu.com/marianafiuza/docs/jogo_agenda_2030) and the Open Government Institute, and FastFood da Politica NGO did an open government card game (http://fastfooddapolitica.com.br/jogos/linhasdejogos/jogos-com-parceiros/governo_aberto/).

Though these games had open data as their focus, none of them focused on attitude change. There might be other games that were not explicitly developed for civil servants' open data release support or were not assessed in scientific publications, and for that reason, we could not assess them in our research.

In conclusion, there is a void in the literature related to games targeting open data providers. As this thesis aims at developing and testing a game to contribute to filling this gap, next, we present literature discussions for games and civil servants. The latter is our targeted audience. Lastly, a literature review on games aiming at attitude change is performed.

3.4.3 Systematic literature review on serious games for civil servants

It is known that governments have used games for a wide range of purposes, such as citizen engagement, civic participation, and even decision-making and scenario building. However, it is uncommon to find games targeting personnel that operates governments, civil servants, or bureaucrats.

3.4.3.1 Games for civil servants literature review

An SLR was conducted to understand what has been done in terms of games targeting this public and what were the outcomes of such game interventions (Kitchenham et al., 2009). Performed for the last time on 26/05/2020, the research protocol resulted in 2518 references on Google Scholar, Scopus, and Web of Science (individual searches over 1 thousand references were not analyzed -

Table 12).

The defined keywords for searching on Google Scholar, Scopus, and Web of Science were:

- “gam*” which resulted in large lists of references that included papers for areas that were not the focus of the present study, such as “game theory” (economics), “game model” (political sciences), gaming (to game the system) and many others. So, all other defined terms were combined with (“serious” + gam* OR “serious game” OR “serious gaming”);
- (attitude + change) was an effort to find general games that could focus on certain target audiences, such as civil servants, as performed next (the section on games for attitude change);
- A general search for serious games and government was performed to check if within games for governments, interventions towards civil servants could be found;
- Another specific search was done with “civil servants” and serious games, and alternatively, “bureaucrat” was also searched;
- As “serious games” could have been too restrictive (even with more than 2 thousand references), one last effort was made towards a general search for ("policy gaming" OR "serious games" OR "serious gaming" OR "simulation game" OR "simulation gaming") AND ("civil servant" OR "bureaucrat").

Table 12 - Games for civil servants (SLR references)

Field	Term	Search	Keywords	GScholar	WOS	SCOPUS
Serious game	Attitude change	KW1	Serious + gam* + attitude + change	53K	108	127
		KW21	"serious gaming" + attitude + change	3.8K	10	12
		KW22	"serious game" + attitude + change	12.1K	36	88
	Government	KW2	Serious +gam* +government	52K	229	312
		KW21	"serious gaming" + government	4.1K	8	20
		KW22	"serious game" + government	11.8K	23	74
		KW23	Serious + gam * +government +Attitude +change (-gambling -"game theory" -"game model")	56	1	0
	Civil Servant	KW3	Serious + gam* + "civil servant"	19K	2	2
		KW31	"Serious game" + "civil servant"	742	1	2
		KW32	"Serious gaming" + "Civil Servant"	25	1	1
		KW33	Serious + gam * +"civil servant" +Attitude +change	18.5K	0	0
	Bureaucrat	KW4	Serious + gam* + bureaucrat	13K	2	2
		KW41	"Serious game" + bureaucrat	1.1K	0	1
		KW42	"Serious gaming" + bureaucrat	342	1	1
		KW43	Serious + gam * +bureaucrat +Attitude +change	642	0	0
		KW5	("policy gaming" OR "serious games" OR "serious gaming" OR "simulation game" OR "simulation gaming") AND ("civil servant" OR "bureaucrat")	309	1	4

Next, a general matching criterion was set for:

- academic papers (books, thesis, and reports were excluded)
- English-written (mostly French, German, and Chinese papers could not be read)
- accessed through the internet (corona times, no access to libraries)
- unique papers (duplicates excluded)

Filtering the outcomes for non-duplicate academic papers in English and that could be accessed through the internet resulted in a list of 38 papers. The 38 abstracts were scanned

for those explicitly involving gaming activities that had civil servants (or bureaucrats) as targets. Lastly, content matching criteria were set for the analyzed titles, and abstracts were to focus on papers that involved the use of games specifically for civil servants (or bureaucrats). Papers that did not have games or were not related to government and had other audiences (i.e., students) were excluded. Papers discussing the following topic were also excluded:

- usage that did not relate directly to our audience, such as focusing on decision-making, scenario building, modeling, participation, or games as co-creation tools;
- cultural studies (history of use of games by the aristocracy in the 17th century); or
- games to change the image of bureaucracies to the public (specifically two papers discussing image effects of "papers, please").

Figure 9 shows the filtering process to the final list of papers analyzed.

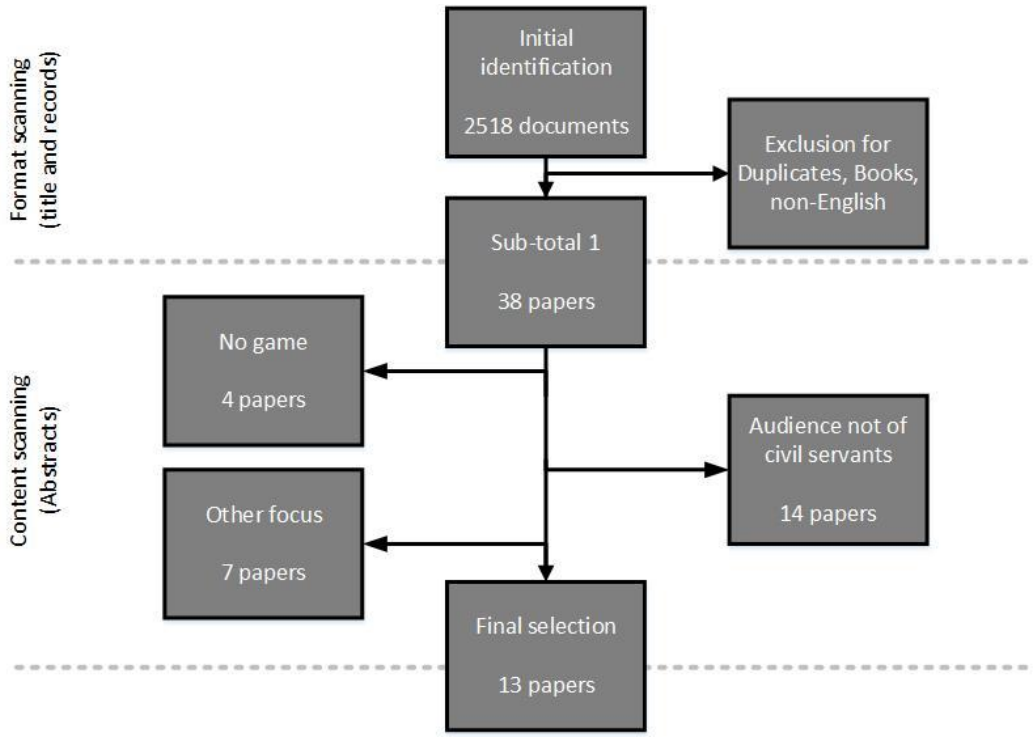

Figure 9 – Systematic Literature Review on games for Civil Servants

The 13 papers were mostly journal papers (54%) from the e-government field (46%). Surprisingly, after scanning abstracts for papers that presented games, still four papers were theoretical, not presenting any games in their discussions. They presented ideas of future interventions still to be designed.

In a general overview for this literature review purposes, the three papers by Kleiman (Kleiman, 2019; Kleiman & Janssen, 2018; Kleiman et al., 2018) were the only strictly focused on using games for civil servants. As these papers refer to previous work from the same research team and present results of the present thesis, it was already expected to have them found by the SLR protocol.

Within the other papers, de Caluwé, Geurts, and Kleinlugtenbelt (2012) presented a closer experience with three different interventions described: a research game, a second for policy development, and a third for organizational change. Joldersma and Geurts (2000) also presented many common goals in different governmental interventions and assessing them from an organizational change perspective. Olejniczak, Kupiec, and Widawski (2016) developed an experiment also with civil servants divided into teams during one day of training (http://knowledgebrokers.edu.pl/). It is an unusual game-based workshop intervention with its focal point on public policies. Adding to the first three papers, these three also used a game and had civil servants participating in their activities.

Carrel (2000) developed an intervention that targets only top-level civil servants, which ended up limiting its contributions to our discussions. Bharosa, Janssen, Klievink, Van Veenstra, and Overbeek (2010), Estrada, Groen, and Ramirez-Marquez (2017), and Spitters et al. (2018) used role-playing games with many stakeholders for collaboration and crowdsourcing purposes, not explicitly observing civil servants in their games. Some interesting insights come from their research thought civil servants were not the main focus of the interventions.

Lastly, Rogach, Frolova, Demina, and Ryabova (2018), Ahmed, Mehdi, Moreton, and Elmaghraby (2014), and Cavada and Rogers (2019) did not present games. The first used gamification techniques to improve virtual learning of distance training, while the other two only presented principles for designing games.

Next, the foremost common characteristics found within the papers will be discussed, focusing on our RQ 2 ("What design elements are needed to make a game to change civil servant's attitude towards supporting the opening of governmental data?"). The objective is to extract the design elements which will be used to prototype a game targeting civil servants.

3.4.3.2 Outcomes

A common issue in the selected papers was to discuss the outcomes of the game intervention. Some were more straightforward and tested the results objectively from their games or experiments (Olejniczak et al., 2016; Rogach et al., 2018; Spitters et al., 2018), while others presented expectations given previous analysis (Ahmed et al., 2014; Cavada & Rogers, 2019; Kleiman et al., 2018).

Bharosa et al. (2010) found that games produce more interaction between participants when compared to other interventions, such as presentations or training sessions, and results in greater creativity and solutions. According to Rogach et al. (2018), one-sided communication of a lecturer with an adult audience has low effectiveness and loses its value for professional training of personnel. On the contrary, games can motivate the achievement of high personal and professional goals, specifically for civil servants (Rogach et al., 2018).

Participants in Spitters et al. (2018) study experienced policymaking as a collaboration process that takes time and energy to develop as 39 of 48 respondents indicated acquiring useful

experiences for real-life work. In Joldersma and Geurts (2000) case, games contributed to increasing awareness of participants' roles captured through debriefing sessions focused on processes and persons. They also found that fictitious content is appropriate for design when the exercise focus is not the content.

The engagement properties of games are the observed outcome from Estrada et al. (2017), who focused on crowdsourcing solutions. Attracting large audiences can be done by framing problems as games as done by BioGames, Phylo, EyeWire, and FoldIt that engaged thousands of players to participate. It converges with the theoretical discussions from Cavada and Rogers (2019), who indicate the same conclusions to use serious games for smart cities' bottom-up approach.

Olejniczak et al. (2016) found that the game design can work though they recommend it to be integrated into more consistent educational experiences. It is unsure if Ahmed et al. (2014) experiment is feasible for one serious game given its focus on two different audiences and objectives: the increase of citizen participation and training of civil servants.

The evidence that games are valid for civil servant learning and engagement gives light to other elements that need to be considered in the game design. The increase in interaction and motivation are indications that can be combined with other outcomes coming from games that should be included in our game design.

3.4.3.3 Uses of games

The games in the papers had a variety of purposes. Most of the games targeted learning or educational purposes through direct gaming interventions or gamifying existing training activities (54%). Other goals were related to policy-making (supporting decision processes – 15%), participation (engaging stakeholders – 15%), or crowdsourcing (to tap the collective intelligence for better solutions – 15%). Multiple uses are possible, as crowdsourcing a solution requires increasing participation and engaging actors.

Observation of civil servants' behaviors was one of the uses found in the papers. As de Caluwé et al. (2012) puts it, “in a real-life context, it is almost impossible to find situations in which comparable systematic research can be done, and both qualitative and quantitative comparisons can be made” (p.607). They highlight that the safe environment of games can enable a diversity of behaviors to emerge by removing limitations related to the honesty needs of real life. The more tailor-made a game is, the more observable and visible behaviors can be. What has to be learned by the players becomes explicit as the participants play and use the experienced action for reflection. As in Duke (1974), the players can “look back” into new futures. This idea converges with Joldersma and Geurts (2000), who indicated that having pre-determined outcomes with strict rules makes it easier to test and observe players' behavior, particularly in a bureaucratic environment such as governments.

Another adjacent use of games was organizational change. Within the 13 papers, almost half of the games relate a case where besides learning or decision-making, the effects on individual

players could also be observed. Furthermore, the observed individual change builds up to organizational change by creating insights from the gaming practice (de Caluwé et al., 2012). According to Joldersma and Geurts (2000), individuals and the organization can learn by seeing new things in new ways and act based on these new insights. Such perspective on game use helps in the further game design described in this thesis.

Finally, as Joldersma and Geurts (2000) indicated, "different game objectives correspond with different game designs" (p.271). The authors suggested a matrix to organize gaming interventions as systems with different elements related to participants, setting, constraints, reflection, and learning cycle**.** The matrix converges to the description of other game inputs that fits the needs for game purposes. Olejniczak et al. (2016) showed how different game mechanics could trigger intended behaviors. By introducing achievements, countdown, resource management, collaboration, and unexpected events in the plot of their game, civil servants were engaged and could contribute to the activity as needed. They add to our discussion of RQ2, targeting the requirements for the game to change civil servants' attitudes. In short, getting this audience to be engaged and play is cumbersome for this strategy to change attitudes to work, which is translated into a requirement, later in this thesis.

3.4.3.4 The need for realism

Only 6 out of 13 papers focused primarily on civil servants, whereas the other papers also included other stakeholders like citizens and businesses. The reason for the games to include these other stakeholders was to ensure realism, e.g., that reality is represented closely. The included papers did mention games and civil servants in their abstract but discussed them in the main body. Civil servants were part of the environment or part of other stakeholder groups and were not the focus. This situation highlights the limited number of papers focusing on games for civil servants.

The papers, which did not only included civil servants, presented artifacts aimed at engaging participants in decision-making processes (de Caluwé et al., 2012; Estrada et al., 2017; Joldersma & Geurts, 2000). For this type of intervention, the variety of stakeholders is a critical factor of success, given the need to consider different perspectives and represent reality as precisely as possible.

As de Caluwé et al. (2012) pointed out, the degree of realism of the metaphors used in the game needs to be valid to enable change. Another requirement for the game design in this thesis is to get participants to recognize their past or present situations in the game experience so that it can influence their attitudes later. Hence, realism is a critical factor for involving players in serious games.

3.4.3.5 Role-playing

Role-playing was another joint facet of all the selected papers, independently of focusing on civil servants or not. Bharosa et al. (2010) found that role-playing increases participants' engagement with outcomes when different actors play an imitated governmental agency

work situation. Cavada and Rogers (2019) discussion on smart cities drew similar conclusions. Joldersma and Geurts (2000) suggested that stakeholders such as civil servants, politicians, citizens, central government, local companies, non-profit organizations need to be represented as "government is not the only policy-maker anymore" (p.271). Their role description was adopted by Estrada et al. (2017) due to the importance of simulating the policy-maker perspective in the game.

Joldersma and Geurts (2000) argued the importance of changing roles between rounds for participants to increase insights on new perspectives. In this way, participants are confronted with the consequences of their behavior in the roles they play in the game as in real life (de Caluwé et al., 2012). The simulation of roles in games enables perceptions and reflections of participants' real-life situations. Role-playing shall be considered as key for developing games targeting civil servants as well.

3.4.3.6 Bureaucratic environment

Ahmed et al. (2014) viewed serious games as a type of training intervention of public personnel, which is a critical success factor for attitude change. For serious games to contribute to training, Joldersma and Geurts (2000) highlighted the need for finding common characteristics of the play environment ("magic circle") when targeting civil servants. The bureaucratic environment of governments is often related to the culture of public service.

Carrel (2000) indicated that constraints and limitations derived from the bureaucratic environment give light to discussing barriers for training, learning, and changing civil servants' attitudes. The author pointed out compartmental thinking and benchmarking as some of the characteristics that hinder these processes. A clear example is exposed as "restricted organizational curiosity and openness - the willingness of civil servants to 'play around' with new ideas and policies is very limited (…) The climate of openness is further suffocated by tight internal rules regarding who participates at which level, from which department, and at which training" (p.196).

Such ideas are corroborated by Olejniczak et al. (2016), who describe civil servants as very conservative and demanding, while the risk-averse and concerns on costs of errors limit the needed experimentation towards learning from actions and mistakes. As said, to increase the realism of games and boost their performance, these cultural characteristics are critical in the design process for serious games to help civil servants experiment outside the usual restrictions.

3.4.3.7 Tacit knowledge

Finally, civil servants have an important role in open data release and need to be the focus of the game. Based on Cavada and Rogers (2019), the bottom-up discussions used for citizen participation can also be applied within the government in the context of empowering mid-level bureaucracy in decision-making. As an essential part of problem analysis and advisory

for decision-makers, civil servants play an essential role in decisions to be made in a certain way.

Addtionaly, Bharosa et al. (2010) suggested that service employees will identify customer preferences easier than management. The authors indicated that using role-playing games is appropriate to mobilize tacit knowledge resulting from many years of experience, which is also a change management instrument. This tacit knowledge is particularly adequate to the top echelon of government, which tends to prioritize internal resources in learning activities resisting the exposure to outside expertise As Carrel (2000) found, the tendency of high officials, who may "see knowledge as something an individual possesses by right of position and experience" (p.194), can be extended to the rest of public service, including civil servants.

Using such knowledge allows designers to create a progression structure, starting more simple and adding complexity based on the chronology of processes and unleashing players' understanding of the logic behind procedures from real-life situations (Olejniczak et al., 2016). Besides the authority posited in tacit knowledge, it also adds realism to the game and can increase its performance. On the one hand, it appears as mandatory; on the other hand, as a powerful boost on learning processes and attitudinal change interventions.

3.4.3.8 Game requirements to design games for civil servants

In summary, games are not commonly designed to target civil servants. Despite the primary goal of the analyzed games for this audience (learning, decision-making, participation, or crowdsourcing solutions), they tend to have an adjacent use for attitude change.

Realism is critical when designing gaming interventions for this audience. Including the bureaucratic environment of public service is suggested by the literature. Focusing on civil servants implies a bottom-up approach that needs to consider the tacit knowledge for creating metaphors and also validating the game. Many outcomes can be expected as a diverse set of evidence exists for interventions targeting different purposes.

Besides the use of games by the government not being new or unknown, changing players' attitudes can be combined with the many uses of games in governments. How this is done will be discussed next.

3.4.4 Systematic literature review on serious games and attitude change

After assessing the literature on serious games for open data (Section 3.4.2) and civil servants (section 3.4.3), we discuss the existing studies of games designed to change their players' attitudes. This section, based on Kleiman, Meijer, et al. (2020b), aims at identifying the factors that influence change in attitude through games. Although there is increasingly more literature on games and advances in theoretical and empirical evidence, there is a gap related to the factors through which a game influences attitude changes (Blythe & Coventry, 2012; Boyle et al., 2016; Connolly et al., 2012). Chappin, Bijvoet, and Oei (2017, p.558) state that "there are few hard robust findings on how serious games may cause behavioral change. The reason for that lies in the diversity and complexity of games and the range of different

perspectives taken by researchers, which makes it hard to generalize results". This complexity is the aim of the present section.

There is previous research on factors influencing attitude change through the game; however, this is scattered (Boyle et al., 2016; Connolly et al., 2012; Shi & Shih, 2015). To our knowledge, no Systematic Literature Review has been conducted to identify factors influencing attitude in general and of civil servants specifically. This section reviews the state-of-the-art in the use of serious games to change attitudes. Specifically, it starts discussing learning in games and targets exploring which of these factors can foster changes in civil servants' attitudes.

3.4.4.1 Learning for attitude change

Learning is the basis for attitude change. The game-designer Koster (2013) argued the need for viewing the human mind as a pattern seeker, in which the learning in the games will arise from the patterns it finds. Mastering a game, entering the flow, and having fun are all parts of the same process. If any game has something to teach, it is imperative to understand the learning process. Using different perspectives to analyze a game intervention as learning, Kirriemuir and McFarlane (2004) summarized their extensive literature review with a matrix of methods for assessing learning through games.

Table 13 - Theories to analyze learning processes through games (based on Kirriemuir and McFarlane (2004)

Aspect	Behaviorist	Cognitivist	Humanist	Social and situational	Experiential Learning
View of the learning process	Behavior change	Individual knowledge acquisition within the brain	Personal development	Group interactions	Behavior and attitude cycle
Site of learning	External stimuli	The brain and its connections	Feelings such as emotions, attitudes, and thoughts	Relationships with people and the environment result in learning	Interaction of attitudes with new experiences (behaviors)
Purpose in education	Result in a desired behavioral change	Improve learning as better knowledge acquisition	Autonomy and self-resilience	Development of communities of practice	Create new knowledge through experience

Still, none of the theories alone can explain the learning process in a game. The behaviorist approach helps to understand the relation of players and games as an external object to which the player reacts. The cognitivist theory enlightens the way the brain can process new information and create knowledge. The humanist approach adds the emotional aspects of learning, while the social and situational learning highlights the social networks that operate on knowledge production.

Experiential Learning is a more recent theory that summarizes many of the stated dimensions in a cycle. It assumes that learning is a process, not an outcome. It is a tension between

previous knowledge, skills, and attitudes, and experiences, which creates new ones. In Kolb (2000), “learning is the process whereby knowledge is created through the transformation of experience” (p.38)

The main idea is that the way we conceive things is not permanent but a process of interpretation and re-interpretation of the world. It assumes that our concepts and ideas are continually being confronted with experiences and resulting in new ones. As Kolb (2000) defined, “ideas are not fixed and immutable elements of thought but are formed and reformed through experience” (P.26). Between our active experimentation (living in the world and interacting with it) and our reflexive observation (thinking about ideas and experiences), we have an abstract conceptualization which leads us to new experimentations - Figure 10. The experiential learning cycle is one of the main references for the game designed in this thesis, targeting changing attitudes of civil servants towards open data.

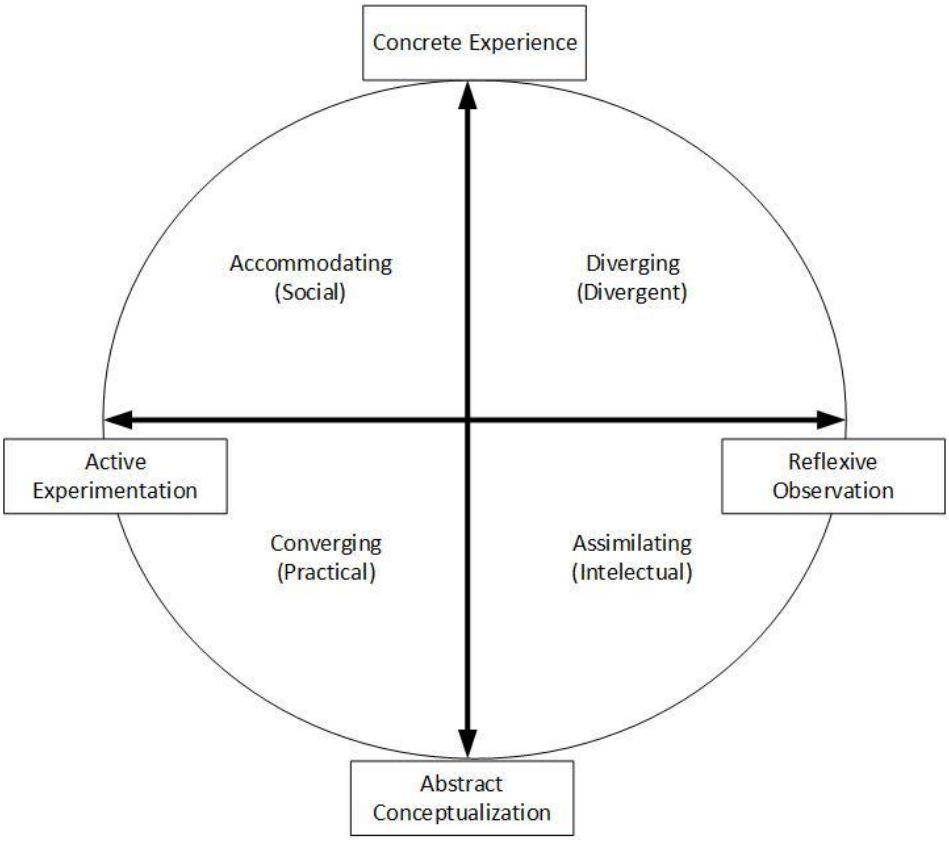

Figure 10 - Experiential learning cycle (adapted from Kolb (2000), p. 21))

Freire (2005) reinforces the idea of experiential learning by his social constructivist approach. The author defines knowledge as an emergent result of the world's invention (and reinvention) in constant inquiry in the world and with each other: “no one teaches another, nor is anyone self-taught. People teach each other, mediated by the world” (Freire, 2005, p.80). This quote resumes the main idea behind the Experiential Learning conceptual model (Kolb, 2000), used to design and assess a game towards changing players' attitudes.

Schrader and Lawless (2004) found that “knowledge instruction alone is a poor agent for influencing changes in behavior as successful outcomes of interventions in education and performance improvement involve more than knowledge gains” (p.13). As said, the experiential learning approach suggests this relation to be a cycle where attitudes result in behavior that updates attitudes as well. Attitudes are learned and correspond to the ways people respond to certain situations (De Freitas & Jarvis, 2009. p.216). Games can influence these reactions by getting the participants to learn from the in-game experience (Kolb, 2000). Moreover, Antle, Tanenbaum, Macaranas, and Robinson (2014) suggested that the use of games is highly dependent on context.

The game itself is the world where experience can happen. Harteveld (2011) stated that a well-designed game would connect with the reality that makes the experience intuitive and understandable: “as games are systems, they enable us to understand how the little pieces of a ‘system’ fit together, over time and under different circumstances. It is about seeing the overall structures, patterns, and cycles, rather than seeing only specific events” (p.58).

Also, the patterns of learning (fun) can become boring through time, or as Koster (2013) puts it: “a game is destined to become boring, automated, cheated, and exploited. Your sole responsibility is to know what the game is about and to ensure that the game teaches that thing” (p.128). Humans are lazy, as the author says. It also adds to Kahneman (2011): “as you become skilled in a task, its demand for energy diminishes. Studies of the brain have shown that the pattern of activity associated with action changes as skill increases, with fewer brain regions involved” (p. 35).

In the governmental context, gaming can facilitate policymakers’ experimentation and learning about the behavior of complex systems before implementing plans, policies, or regulations (Mayer, 2009). Adjacently, they can be used to change the attitudes and behaviors of its participants.

In gameplay, players have attitudes and behaviors. Behavior is the actual action performed by an agent, which is a reaction to a stimulus or the environment. It is highly dependent on occasion, situation, and action, which is easy to observe, but challenging to measure (Janakiraman, Watson, & Watson, 2018). Research has found that attitude is an essential factor of influence though it can influence multiple behaviors (De Freitas & Jarvis, 2009).

Janakiraman et al. (2018) defined attitude as “the psychological evaluations a person has about an object, person or event” (p.178). It expresses the individual’s disposition to react to an object, person, or event. Inaccessible through direct observation, it can be inferred from measurable responses (Ajzen, 1991). From an experiential learning perspective, attitudes can be influenced by experience and might lead participants to change their behavior (Kolb, 2000). Attitude and behavior are closely related, as behavior are the observable actions, whereas attitude is the beliefs or opinions of a person towards something. Attitudes can be shaped by the experiences in which the desired behavior is practiced. The change in attitudes through

gaming has been discussed in other contexts, which can be applied to civil servants. An SLR on the topic is presented next.

3.4.4.2 Systematic literature review protocol for serious games on attitude change

Besides the general use of games in governments, it is necessary to review what has been published on the use of games for changing attitudes of civil servants. After understanding the importance of learning, we again focus on attitude change. An SLR was performed following the procedures of Kitchenham et al. (2009). The purpose of this section is to identify factors that influence change in attitude through serious games for civil servants. The research questions that guided the SLR were:

1. Which are the factors that can lead an attitude to change through games?
2. Which factors influencing attitude change through games can foster civil servants' attitude change?

The starting review protocol had the expression “gam*” and “attitude*” defined and was performed on 27/08/2019 on different outlets resulting in a large number of references: JSTOR (54 thousand), WOS (1.3 thousand), and Google Scholar, which resulted in more than 1.5 million papers. Also, “gam*” and “government” resulted in more than 100 thousand references, which was impossible to analyze. If the keyword “civil servant” was included, the resulting references were still plentiful as many publications included the terms for other public policy analyses, which were outside our scope, such as economic “game theory”.

The expression “serious game” helped to shorten the list and focus our analysis. Another trial included “attitude” in the filters (41 thousand in Google Scholar). Following De Vries et al. (2016), “change” was introduced in our scan. Still, a large number of documents were found (10 thousand documents). Many of the papers addressed the different attitudes resulting from gaming interventions without discussing the factors which would lead to such a change in attitude. As our focus was on reasons for such change in attitude and not on other aspects of these changes (i.e., if it happens or its types), we used the expression “attitude change”. It resulted in a refined set of references that had “attitude change” in its text and was appropriate to explore the reasons for it to occur. For the SLR protocol, the resulting outcome was assessable (one thousand publications) and allowed us to progress our search for factors influencing “attitude change” through games.

A remark on the attempt to refine serious games related to “serious game”, "attitude change", and "civil servant" was frustrated with no results. Even though, as “attitude change” of civil servants was the specific goal of our review, the protocol was performed at factors influencing “attitude change” through games in general, expecting to derive its results to the governmental field. Specifically, for civil servants, it is expected to use the findings as input for the game design process.

In Table 14, the following used keywords are shown as the results were refined in JSTOR, Web Of Knowledge, and Google Scholar. The following outcomes matched our goals:

Table 14 – Documents online on Games and Attitude Change

Keyword iterations	Jstor	WOS	GScholar	Repeat	Total
"Policy gaming" + "attitude change"	*0*	*0*	*3*	1	**2**
"Factors influencing attitude change" + "game"	*0*	*0*	*9*	0	**9**
"Factors affecting attitude change" + "game"	*0*	*0*	*13*	0	**13**
"Serious gaming" + "Attitude Change"	*0*	*1*	*152*	15	**138**
"Serious game" + "Attitude Change"	*0*	*4*	*424*	107	**321**
					483

The initial group of 483 resulting papers for all the scanned keyword combinations ("Policy gaming", "attitude change", "Factors influencing attitude change", "game", "Factors affecting attitude change" and "Serious gaming"). This already showed a clear research interest reflected by a large number of publications. Also, the rapidly rising trend seen over the last decade seems to be stabilizing, as the last two years indicate a change in the slope. Still, the rising trend in research interest is shown by the number of publications, to be further discussed - Figure 11.

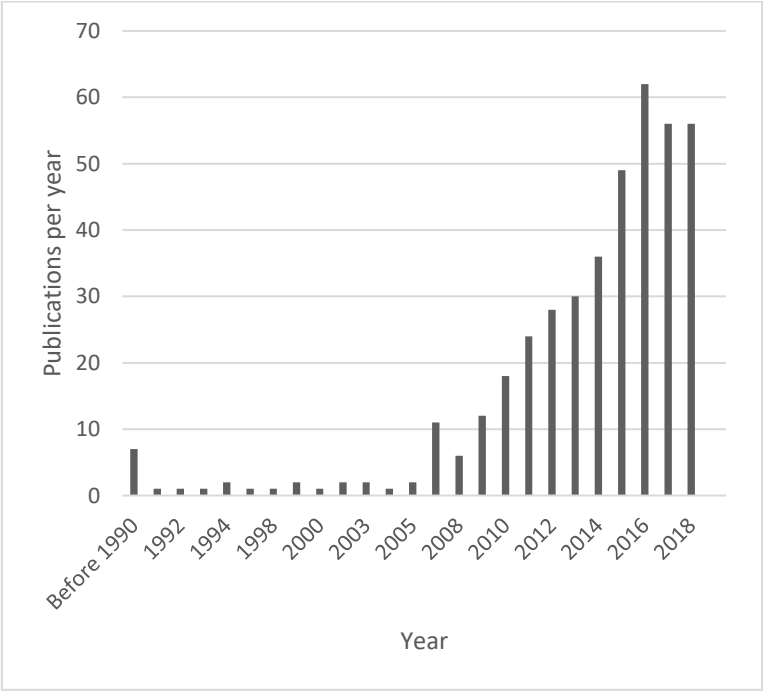

Figure 11 - Mapping The Articles based on Publication Year

Next, only journal and conference papers were selected. Books were excluded as they are often general overviews and should be mentioned by papers if presenting valuable contributions. Furthermore, other document formats (such as reports and other media) were excluded as they do not have the validity of published papers. Finally, we excluded papers that

were not written in English because of difficulties in translating and discuss the findings. As a result of the format scan, 359 papers were suitable for content analysis - Table 15.

Table 15 – Online papers in English for Games and Attitude Change

Keywords	Not in English	Not a book or paper	Books	English written Papers
"Policy gaming" + "attitude change"	0	0	1	**1**
Factors influencing attitude change + "game"	0	2	1	**6**
"Factors affecting attitude change" + "game"	1	1	0	**11**
"Serious gaming" + "Attitude Change"	12	8	22	**96**
"Serious game" + "Attitude Change"	8	18	50	**245**
				359

The content scan was then performed to identify whether these papers had the targeted focus of analysis: game and factors influencing attitude change. For games, we decided to search for explicit mentioning of a game or a theoretical discussion related to games. Pure simulations, interactive media, social networking, and other means were excluded from our selection. On the criteria of factors influencing attitude change, papers that focused on other content in their analysis, such as game design, economic impact, or cultural studies, were excluded. The content scan resulted in 68 selected papers.

Table 16 - Online papers with Attitude Change and Games

Keywords	Attitude change	Game	Both
"Policy gaming" + "attitude change"	0	0	**0**
Factors influencing attitude change + "game"	3	0	**0**
"Factors affecting attitude change" + "game"	8	0	**0**
"Serious gaming" + "Attitude Change"	47	69	**38**
"Serious game" + "Attitude Change"	87	122	**30**
			68

The abstracts of the 68 papers were scanned for the subjects that they focused on, e.g., attitude change. We aimed at finding whether the papers discussed attitude change or just mentioned it as a secondary subject. Also, the domain under study and the research methods utilized were observed as this was an informative scan of the selected papers.

Our scanning shows that most of the papers (48) were aiming at increasing the knowledge of their participants in a particular domain. Some of them (15) also included discussions on habits (changing routines), and five papers were related to increasing inspiration through gaming (increasing positive perceptions of a topic).

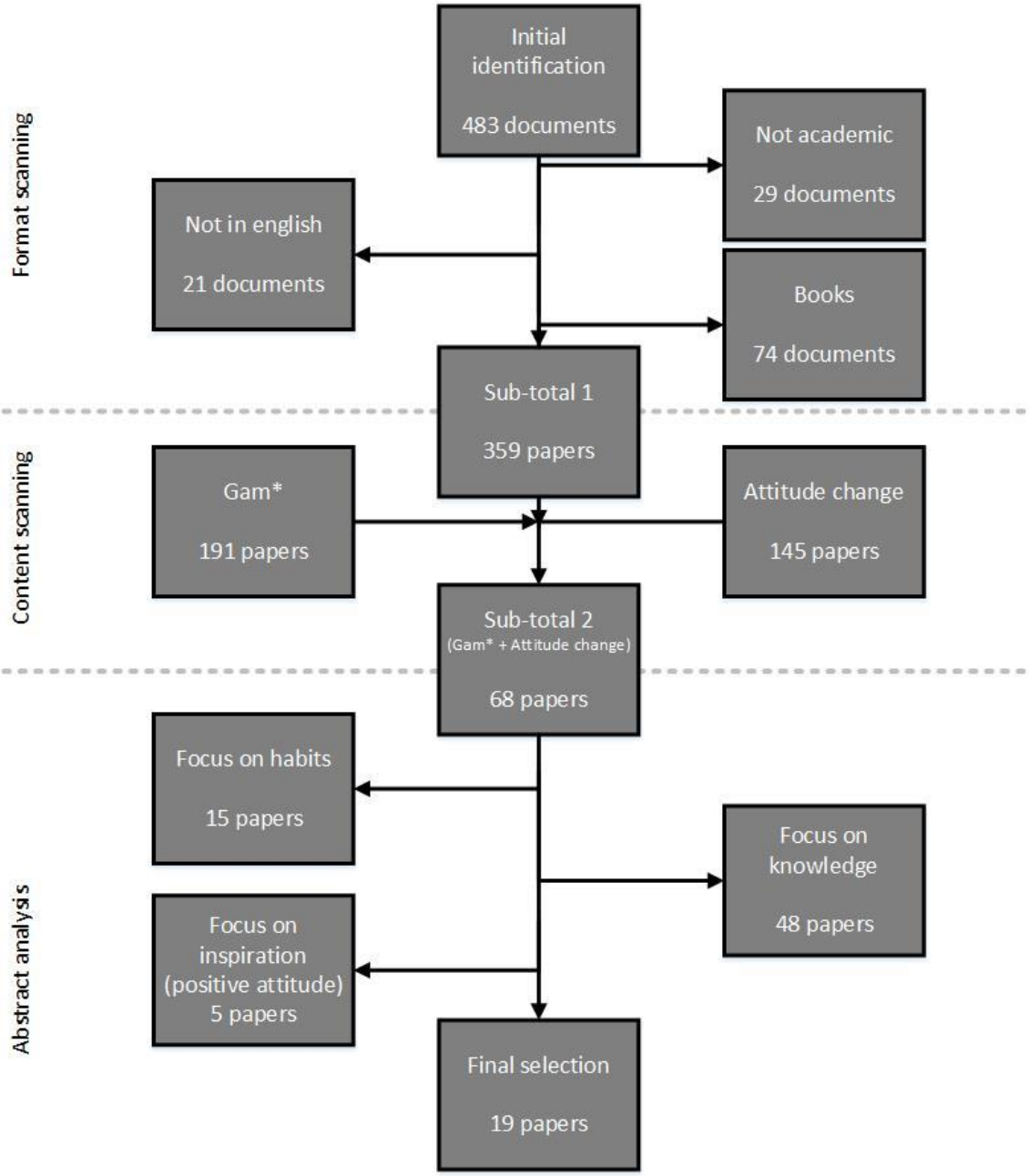

Figure 12 - Paper selection process summary

The papers focusing on habits, knowledge, or inspiration were excluded. Only 19 papers, out of the 68, contributed directly to the discussion of attitude change. The group of 19 papers resulting from the SLR protocol was extracted and analyzed.

In the next subsections, the analysis identifies contents that appeared while performing the protocol. They aggregate essential elements for the attitude change discussion context, even not been directly related to it. Elements such as the content related to the research approach, paper domains, and the theories used for analysis resulted in relevant information for our discussion. Also, standard game features are presented as many studies seem to mix the factors coming from games with the effects of specific game features on players. All these

distinctions explore the environment to which the discussion of factors belongs and the factors influencing attitude change (the aim of our protocol).

3.4.4.3 Research approach and real games

Our SLR protocol resulted in 19 papers, which were scanned for the essential elements to designing serious games for attitude change. The first analysis focused on the research approaches of the 19 papers. Many of the papers presented case studies (10). Surprisingly, this first scan also found that almost half of the papers were literature reviews (9) performed for different topics in games, such as evaluation or evidence presented in previous research. However, none of them focused on attitude change, which confirms the need for our research.

The nine literature review papers summarized thousands of papers and will be described next. The other 10 case study papers were based on different experimental settings involving more than 1000 participants in different experiments.

Table 17 – Overview of Research approach used

Approach	N	References
Literature Reviews	9	(Antle et al., 2014) (Blythe & Coventry, 2012) (Chow, Susilo, Phillips, Baek, & Vlahu-Gjorgievska, 2017) (De Freitas & Jarvis, 2009) (DeSmet, Shegog, Van Ryckeghem, Crombez, & De Bourdeaudhuij, 2015) (Flood, Cradock-Henry, Blackett, & Edwards, 2018) (Janakiraman et al., 2018; Soekarjo & van Oostendorp, 2015) (Williams, Nurse, & Creese, 2019)
Experimental setting	10	(DeSmet, A. et al., 2018a) (Fijnheer, van Oostendorp, & Veltkamp, 2018) (Jacobs, 2018) (Knol & De Vries, 2010) (Kolek, Šisler, & Brom, 2018) (Nilsen, LeDonne, Klemperer, & Olund, 2011) (Richey Smith, Ryder, Bilodeau, & Schultz, 2016) (Ruggiero, 2014) (Steinemann, Mekler, & Opwis, 2016) (Yang, Lin, & Liu, 2017)

A large variety of games were found, and in total, 81 different games are presented in the 19 papers, as listed in Appendix 1. “Spent”, an online game created by an NGO that targets raising awareness of citizens on poverty issues, is mostly referee and mentioned in four different studies. “Enercites” appears in three, and Peacemaker is used two times. One of the reasons for the use of these three games might be their free online playing availability[1]. The other four papers discuss their own prototypes.

Of the 81 games used, 50 are environment-related games (23 climate, 16 energy, and 11 general sustainability). Another 23 games are related to Health and psychology (8 Health, 14 empathy, and one cyberbullying), while 11 deal with Cybersecurity. Two games target historical content. Most of these researches focus on evaluating games as experiments, and they indicate a trend for influencing participants’ attitudes change, to be further discussed.

[1] They are available for access in their homepages or by download: http://playspent.org/, https://paladinstudios.com/enercities/ and http://www.peacemakergame.com/.

3.4.4.4 Domain

The papers and games target a particular domain under study. In content terms, 16 papers targeted topics related to Education in different fields (environment, safety, and job-related issues), as shown in Table 18.

Table 18 – Mapping the papers based on content

Content	Subtopic	2nd iteration
Education	No specific topic	7
	Environment/Water/Energy	5
	Risk/Safety/CyberSecurity	3
	Job/recruiting/HR	1
Politics/Social	-	4
Health	-	3

Politics and social issues were the two topics that have gained increased attention in the last couple of years, particularly on issues related to empathy and international conflicts. Unfortunately, no papers out of the 19 selected did discuss our specific audience of civil servants. One paper did target open data (Johnson, Puussaar, Manuel, & Wright, 2018), which is a critical issue for government, but as it did not focus on games in government nor attitude change, it was also not included within the 19 papers list.

More games on government were expected from our scanning. Though, the SLR was continued even if none of the papers would address civil servants or governments specifically. The purpose is to further apply the findings on factors influencing general players' attitude change in games to our audience.

3.4.4.5 The use of Theories

The theoretical frameworks used to discuss games in the papers were another emerging topic. They are the basis for understanding and analyzing attitudes and designing interventions for attitude changes.

In total, 13 different theories were identified. The two most used references were the Theory of Planned Behavior (TPB) (found in three papers) and Procedural Rhetoric (also used in three papers). TPB is considered as an expansion of the Theory of Reasoned Action (TRA), which suggests Behavior Intention as one of the most accurate predictors of actual behavior (Ajzen, 1991). Procedural Rhetoric, as formulated by Bogost (2007), focuses on the analysis of rules and dynamics (components of play) as influencers for attitude change through persuasion. The reference for the papers on the used theories is listed in Table 19.

Table 19 - Mapping The Articles based on Theory Used

Theory	N	Description	Reference
1. Theory of Planned Behavior / Theory of Reasoned Action	3	Expansion of the Theory of Reasoned Action suggests that Behavior Intention is one of the most accurate predictors of actual behavior, and Perceived Behavioral Control influences it.	(Blythe & Coventry, 2012) (Knol & De Vries, 2010) (Williams et al., 2019)
2. Procedural Rhetoric	3	Focus on rules and dynamics (play) as great influencers for behavior change through persuasion	(Antle et al., 2014) (Chow et al., 2017) (Ruggiero, 2014)
3. Game-based learning	2	Discuss the learning outcomes of playing games	(Janakiraman et al., 2018) (Yang et al., 2017)
4. Protection motivation theory	2	Explore factors that lead people to protect themselves when triggered by fear	(Blythe & Coventry, 2012) (Williams et al., 2019)
5. Attribution Theory	1	Focus on understanding the explanation people develop to describe a specific behavior	(Richey Smith et al., 2016)
6. Bystander Intervention Model	1	Focus on the analysis of triggers for an observer to be active or passive in certain conflictive situations	(DeSmet, A. et al., 2018a)
7. Contact theory	1	Under conditions, contacts affect inter-group resistance and result in inter-group perceptions to out-group	(Nilsen et al., 2011)
8. Emergent Dialogue	1	Focus on creating authentic participation through intrinsic motivation by getting participants to express/ communicate with multiple bidirectional outcomes	(Antle et al., 2014)
9. Experiential learning	1	Assumes that knowledge is built through practical experience that by reflection changes perceptions	(De Freitas & Jarvis, 2009)

Theory	N	Description	Reference
10. Information Deficit model	1	Assumes that people change their perceptions by assessing more information	(Antle et al., 2014)
11. Instructional design theory	1	The use of media artifacts explicitly designed for specific purposes can change the audience perceptions	(Janakiraman et al., 2018)
12. Self Determination Theory	1	Focus on exploring the different motivations that lead people to perform a particular behavior (intrinsic and/or extrinsic)	(DeSmet, A. et al., 2018a)
13. Social Cognitive Theory	1	Focus on the influence of social factors and media on people's behavior	(DeSmet, A. et al., 2018a)

The theories are different in nature and look at different aspects. It shows the diversity of the field, as there is no single dominating theory. Furthermore, diversity will hinder the integration of the theories into a uniform one. Which is most suitable depends on the problem at hand and the context.

The literature scan also shows that depending on the theory used, different focuses are considered in the attitude change discussion. An example is a difference between defining factors that can influence attitude through gameplay to looking for game features that have an impact on gameplay itself. The variety of theories found indicates another dispersion in the field on frameworks for analysis. The following game features found in our scanning are presented next.

3.4.4.6 Game features for attitude change

Game features are the characteristic included in-game, and they tend to have an impact on the gameplay itself. The analysis of game features was used as the counterpart for the variables influenced by the game in some of the studies. Some features were aggregated into groups or categories as they were similar to each other to make a comprehensive discussion.

In that sense, "Realism" is the most used category when considering game features on analysis (9). "Feedback, rewards, and outcomes" comes second (6). Interactivity is used in 5 papers as well as "Persuasive message, Meaningful Mode of communication or Beliefs" (considered here as a group). "Personalization" also appears in 5 studies. The list of features that are mentioned by at least two papers is shown in Table 20.

Table 20 - Game features

Game feature	N	Reference
1. Realism	8	(Chow et al., 2017) (De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (Flood et al., 2018) (Janakiraman et al., 2018) (Nilsen et al., 2011) (Ruggiero, 2014) (Williams et al., 2019)
2. Feedback, rewards, and outcomes	6	(Antle et al., 2014) (Chow et al., 2017) (DeSmet et al., 2015) (Janakiraman et al., 2018) (Williams et al., 2019) (Nilsen et al., 2011)
3. Interactivity	5	(Chow et al., 2017) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Steinemann et al., 2016) (Williams et al., 2019)
4. Persuasive message / Meaningful Mode of communication / Beliefs	5	(Antle et al., 2014), (De Freitas & Jarvis, 2009), (Flood et al., 2018), (Ruggiero, 2014), (Steinemann et al., 2016)
5. Personalization	5	(Chow et al., 2017) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Kolek et al., 2018) (Williams et al., 2019)
6. Narrative / Content	5	(Antle et al., 2014), (DeSmet et al., 2015), (Williams et al., 2019), (Jacobs, 2018), (Steinemann et al., 2016)
7. Goals / Challenges / Competition and cooperation	4	(Antle et al., 2014), (Chow et al., 2017), (DeSmet et al., 2015), (Williams et al., 2019)
8. Mood / Enjoyment / Excitement / Entertainment	4	(Chow et al., 2017), (DeSmet et al., 2015), (Jacobs, 2018) , (Steinemann et al., 2016)
9. Flow / Planned redundancies	3	(Chow et al., 2017), (DeSmet et al., 2015), (Janakiraman et al., 2018), (Ruggiero, 2014)
10. Active engagement	2	(Janakiraman et al., 2018) (Ruggiero, 2014)
11. Facilitation	2	(De Freitas & Jarvis, 2009) (Flood et al., 2018)
12. Visualizations	2	(Janakiraman et al., 2018) (Jacobs, 2018)
13. Involving the target group in the design	2	(De Freitas & Jarvis, 2009) (DeSmet et al., 2015)
14. Autonomy / Limitations on the player's agency	2	(Flood et al., 2018) (Kolek et al., 2018)

Another long list emerged from the scanning process. Negotiation, multiplayer, accessibility, dialogue, "High or low exposure to the game/video", intuitiveness, multimodality, use of Non-player characters (NPC), praise (images symbols sounds words for feedback), role-playing, strategic level of decision-making, suggestion (hints) and time-limitations are some of them. They reinforce the challenges for converging semantics within the 19 papers resulting from our SLR.

As defined in the introduction, attitude expresses the individual's disposition to react to an object, person, or event, which can be inferred from measurable responses. In our scanning,

attitude variables are factors that are observed and discussed in the papers as resulting from gameplay. They are the units or references used to discuss game effects on players or their attitudes. Differently, Game features are the aspects considered when looking for characteristics of the game itself from a design or gameplay perspective. They aim at creating the experiences and feelings resulting from the game instead of having an effect on the participants' behaviors – which is the focus of this SLR and will be presented in the next section. Given that game features were not the main focus of this protocol, the full list was excluded from the SLR.

3.4.4.7 Factors influencing attitude change

As in the former subsection, a diverse list in terms of game factors also emerged from the SLR - table 8.

Table 21 - Variables observed related to attitude change

Variable	N	Description	References
1. Attitude	8	Observable behavior	(Blythe & Coventry, 2012) (De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Kolek et al., 2018) (Nilsen et al., 2011) (Soekarjo & van Oostendorp, 2015; Steinemann et al., 2016)
2. Behavior	7	Actions of a person in real life	(De Freitas & Jarvis, 2009) (DeSmet, A. et al., 2018a; DeSmet et al., 2015) (Fijnheer et al., 2018) (Janakiraman et al., 2018) (Knol & De Vries, 2010) (Williams et al., 2019) (Yang et al., 2017)
3. Self-efficacy / Locus of control / Perceived behavioral control	7	Beliefs that the individual contribution will influence the success or failure of a situation or the control on influences from others	(Blythe & Coventry, 2012) (DeSmet, A. et al., 2018a; DeSmet et al., 2015) (Flood et al., 2018) (Yang et al., 2017) (Nilsen et al., 2011) (Knol & De Vries, 2010)
4. Affective / Bystander behavior / Coping approach / Vulnerability Perception / Appreciation	6	Affective, actions towards the observed scene or others influences in it	(De Freitas & Jarvis, 2009) (Janakiraman et al., 2018) (Steinemann et al., 2016) (Blythe & Coventry, 2012) (DeSmet, A. et al., 2018a) (Jacobs, 2018)
5. Cognitive or Knowledge	6	Objective information of an object or event	(De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Flood et al., 2018) (Janakiraman et al., 2018) (Yang et al., 2017)
6. Response cost / Efficacy / Benefits / Outcomes	5	Outcome, Positive reward or Negative punishment (removal effect)	(DeSmet, A. et al., 2018a) (Blythe & Coventry, 2012) (Williams et al., 2019) (Kolek et al., 2018) (Steinemann et al., 2016)

In total, 30 variables were found. “Attitude” emerged in 8 papers, mostly defined as an observable behavior or an evaluative effect about performing a behavior (Ajzen, 1991; Venkatesh et al., 2003). As mentioned, the experiential learning cycle connects attitude and behavior, turning one as a variable of the other, depending on the approach. Consequently, “Behavior” appeared as a used concept for another group of papers and is mentioned in second place (7)[2].

Concepts related to “Self-efficacy” (Bandura, 1977) (such as “Locus of control” from Yang et al. (2017) or “Perceived behavioral control” from Ajzen (1991)) are mentioned in another seven studies. Cognitive or Knowledge variables are defined for six studies. Another six papers use “Affective” variables as their primary reference (such as “Bystander behavior”(DeSmet, Ann et al., 2018) or “Coping approaches”, “Vulnerability Perception” or “Appreciation”). “Response cost”, “Efficacy” or “Benefits” form a group of variables mentioned in the other five papers. Table 21 shows the variables used by five papers at least (the complete table of mentioned factors is available in Appendix 2.

As seen, the dispersion of references is again confirmed, this time on the topic of game variables to change attitudes, which strengthens the challenges for building up knowledge on influence factors for attitude change. The comparison between analyses is impaired even by selecting attitude as the keyword. The variable mostly mentioned does not appear as central in half of the studies. A similar use of concepts for building up common ground and dialogue within studies is still needed.

3.4.4.8 Measuring civil servants’ attitude change game effects

Assuming the game is well designed, the last challenge is to measure its effects. The quasi-experimental setting with pre- and post-testing is appropriate to observe the change in players' attitudes. We need to define the attitude variables in which change is to be observed, and the literature review on factors influencing attitude change is referred to.

First, attitude itself needs to be conceptualized and objectified for measuring their observable behaviors (Kolek et al., 2018; Soekarjo & van Oostendorp, 2015; Steinemann et al., 2016). Besides defining the attitudes of players that are to be observed, also the related behaviors to which they correspondently influence should be explicit (Knol & De Vries, 2010; Yang et al., 2017).

Depending on the chosen theory of analysis, a conceptual framework can be built for the added variables. For example, if adopting a more self-efficacy (Bandura, 1986)or locus of control perspective, the focus will direct at the individual beliefs of the influence their contribution will have on the success or failure of a situation (Blythe & Coventry, 2012) or on

[2] A remark to be made, in different analysis behavior and attitude are used as part of the same learning cycle. Some might take attitude as the leading factor and use it as influence to define behavior; others use the behavior, particularly past behavior, as a factor for updating attitudes. As both appear in the analysis, they are included in the same table as different variables.

the control on influences from others (Yang et al., 2017). If a more empathetic perspective is used, variables related to affective (De Freitas & Jarvis, 2009; Janakiraman et al., 2018) or coping approach (DeSmet, A. et al., 2018b; Jacobs, 2018; Yang et al., 2017) are indicated. Alternatively, as Kolek et al. (2018) put it, "the most common technique for measuring attitude change is self-reports assessing explicit (conscious) attitudes. However, when dealing with socially sensitive topics, participants may tend to avoid giving an undesirable impression" (p.446). They can be refined by using indirect questions such as asking for their perception of someone else's actions.

As the goal of a game is to change civil servants' attitudes towards open data, which is an external topic involving consequences to their routines, a more cognitive skills, and beliefs approach seems more recommended (Fijnheer et al., 2018; Flood et al., 2018). The importance of outcomes, positive rewards, or negative punishment should be considered in the model and measured in its effects (Kolek et al., 2018; Steinemann et al., 2016).

The challenge of measuring the effects of a game to change players' attitudes is not to be underestimated. The game features and variables to be considered in the open data provision game are a result of the findings of the previous sections. The open data content and game design elements are the basis for developing a game to change civil servants' attitudes to support the opening of governmental data. The next step is to merge these elements with those coming from the factors influencing the behavior of civil servants' support to open data. That is the focus of the last section of this chapter, which will be further developed in Chapter 5. Also, it is the ground on which the prototype is built, a topic to be discussed in the next chapter.

3.5 Synthesis

As found, a game to change civil servants' attitudes towards open data is still to be developed, tested, and analyzed. Moreover, requirements need to be identified. Our efforts aimed at summarizing the literature coming from games having civil servants as audience and those designed for changing players' attitudes and applying it to governmental open data provision content. We summarize the requirements, mechanisms, and measures to evaluate the impact of the game as found in the literature.

This chapter aims at synthesizing the conclusions from research question 1 (RQ1 - "What are the behavioral barriers for civil servants to support the opening of governmental data?"), and 2 (RQ2 - "What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?"). It also shed light on initial mechanisms which can be used to prototype the game (RQ3 - Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?). Consequently, these conclusions also support the design process of the game to change civil servants' perceptions of open data, which comes in the next chapter.

The increased attention of governments on issues and practices of open data indicates the importance of the topic. The numerous studies dealing with the limits and challenges to make more governmental data public also demonstrate the relevance of finding solutions to get governments to release more data.

Civil servants play an important role in supporting decision-makers to be favorable in making data public. From a bottom-up perspective, they can influence these decisions and get more data to be published even if not directly deciding to disclose data themselves. Getting civil servants to support data opening is on the agenda, and a game can improve their attitudes towards it.

The games that aim at changing general players' attitudes can be explicitly designed for civil servants, the professionals that operate public policies (Chen & Bozeman, 2014). While operating public programs and actions, civil servants have to deal with various challenges. Lipsky (1971) already indicated a “tendency on the part of street-level bureaucrats to develop defense mechanisms, in order to reach accommodation and resolution of stress tendencies, that results in a distortion of the perceived reality” (P. 396). More broadly than street-level bureaucrats, we can assume the resistance to change of civil servants in general as a defense mechanism. It converges with the findings of Carrel (2000), to whom civil servants tend to prioritize internal resources resisting exposure to outside expertise.

Adding to that, Gould-Williams (2004) indicated that the desire of public managers to enhance civil servants' positive attitudes would make good use of team working activities with appropriate individual training programs. The resistance might be influenced by new experiences, which can result in attitude change. Both the dependence on routines for security and unfamiliarity with new procedures to operate differently can be put to practice in a safe environment of a game. As found, such new experience can be influential to attitudes in other contexts (Kolb, 2000) and might work for civil servants as well (Gould-Williams, 2004).

Another challenge is that civil servants become shielded from awareness of the impact of their behavior and lead them to resist change, which seems to be even more influenced by new experiences. By simulating or role-playing actions of different stakeholders, it might be easier to assess the perception and produce empathy of the participants in play (Jacobs, 2018; Nilsen et al., 2011; Ruggiero, 2014).

Also, Hossain et al. (2016) reinforced this position by finding that a lack of awareness and knowledge of the leaders as well as risk-averse leadership can be a crucial barrier for open data policy-making. It can also result from information privacy and security issues related to data licensing ownership. Buurman et al. (2012) “found clear support for the hypothesis that public sector employees are more risk-averse than private-sector employees” (p.290). Their analyzed studies indicate that “risk-averse people are more likely to be employed in the public sector than in the private sector” (p.281)

Conradie and Choenni (2014) added that the false conclusions and unknown financial effects of open data release are also feared in public service. Moreover, that is confluent to the fear of potential increased control of citizens and their capacity to protests against public actions by using data that can be de-contextualized (Martin, 2013).

The open data discussion converges with the findings coming from games in terms of reality. Bottom-up strategies fit well for working with civil servants (Cavada & Rogers, 2019) towards learning and attitude change at the individual level (Olejniczak et al., 2016). The experiences resulting from the simulated real-life work (Spitters et al., 2018) shall increase awareness (Joldersma & Geurts, 2000) and engagement (Estrada et al., 2017). The culture of valuing tacit knowledge (Cavada & Rogers, 2019) as knowledge is seen as an individual asset owned by right of position and experience (Carrel, 2000)

An attitude change can be expected by having players facing the consequences of new behaviors in the safe environment of the game, as long as the metaphor holds (de Caluwé et al., 2012). Role-playing in the game with changing roles, as in the real world, shall strengthen its effects (Joldersma & Geurts, 2000). Once more, realism is also the main attribute to observe (Chow et al., 2017; De Freitas & Jarvis, 2009; DeSmet et al., 2015). Realistic metaphors can connect players and experiences (de Caluwé et al., 2012).

In short, a game to change civil servants' attitudes towards supporting open data needs to have it as a precise setting for the game metaphors' to be understood and operationalized. However, before describing the iterative design process, our last subsection presents the elements of play and summarizes the conclusions of our chapter. The requirements for a game to change civil servants' attitudes towards opening governmental data are presented.

3.5.1 Attitude factors resulting from the open data literature

We performed several literature reviews looking for a previous body of knowledge on the many aspects needed to design such a game. The findings support the development of the game. First, we summarized the answer to research question 1 (RQ1 - "What are the behavioral barriers for civil servants to support the opening of governmental data?"). The content coming from behavioral barriers to open data feeds the game in content. This content builds up a list that is needed to be represented in the game to foster civil servants' behaviors towards open data - Table 22.

Our main hypothesis is that the civil servants' attitudes can be changed through playing a serious game. We set Behavior Intention as the primary goal for the game to influence. It refers to the attitudes of civil servants in intending to support that governmental data is released. As it is the focus of the game, it needs to be experienced through simulated mechanics to be developed.

The complete underlining content of the game needs to be based on the needed Data management knowledge to understand what open data is. The game must balance benefits (Performance Expectancy) and problems (Efforts and risks) caused by the release of data.

Lastly, the game needs to generate an environment where realistic social interactions between different roles represent the public office.

Table 22 - Open data game content representation

Factor	Description	Game translation
Behavior Intention	Attitude measurement of the availability of civil servants to support governmental data release	Create actions that demand support for having data published in a public office
Open Data Knowledge	The different perspectives civil servants can have of data production and management in their daily activities	Generate operations that represent basic operations of data creation and exchange
Performance Expectancy	Group of related benefits civil servants perceives coming from data release	Enable different benefits to result from various situations of data being released
Risks and efforts	The resulting group of different perspectives of risks related to working in government, from data ownership to misuse of released data	Include problems resulting from data release which civil servants are subject
Social Influence	Summarizes influences of the legal framework and hierarchy, which are characteristics of public service	Create an environment that represents the public office social interactions

Our findings for RQ1 ("What are the behavioral barriers for civil servants to support the opening of governmental data?") indicate that there already are studies exploring barriers to get civil servants to support open data. From our review, the Behavioral Intention of civil servants can be defined as the main dependent variable, which is influenced by four factors: Data management knowledge, Performance expectancy, Efforts and risks, and Social Influence. The data collected for gameplay can contribute with evidence for testing these factors and the effects of the game.

To summarize, our factors can help to measure attitude change, supporting the development of instruments to register perceptions of participants, such as a survey questionnaire. We discuss the factors influencing civil servants' attitudes towards open data through explorative testing, as will be presented in Chapter 5.

3.5.2 Towards Initial requirements resulting from serious games literature

The synthesis follows to elaborate on our second research question (RQ2 - "What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?"). The content coming from the SLRs must also embed the diverse aspects of design coming from the serious games' literature. Summarizing the SLRs performed on the topic, as shown in Table 23 – Systematic Literature Review summary for the

open data game. Table 23 indicates the most relevant gaps, requirements, and conclusions on each topic.

Table 23 – Systematic Literature Review summary for the open data game

	Attitude Change	Civil Servants	Open data
Gap in literature	No single frameworks define the factors most influencing attitude change in games	Most governmental serious games focus on participation and decision-making, indicating a gap on games for bottom-up approaches targeting civil servants	Open data games focus on users or use open data for generating game content (no providers' game)
Requirements	Game features are more explored to impact attitude change; factors can be built to underline mechanisms of change	Realism is crucial for effective experiential learning Role-playing helps empower and empathize gameplay Need for a hierarchical environment with strict rules (risk-aversion) Tacit knowledge through practice can connect players to the game	Stakeholders can be represented in the game Open data contents are available for real examples Approaches and techniques for releasing data are supported
Conclusions	Games can change attitude but are context-dependent	Include challenges related to working with governments and training governmental personnel such as civil servants	Open data games can be engaging, although no games were developed for public data providers

The SLR focused on "Attitude Change", which resulted in several divergent approaches addressing the effects of the game. Some game features have been explored, but no previous converging model exists to base a game for changing participants' attitudes. Analysis of game features appeared as dominating when not many discussed factors influencing attitude change. The successful existing games towards attitude change were very particular in their design, which was very context-dependent.

Our review on games for "Civil Servants" indicated the long tradition of games being used in governments though hardly focusing on personnel. Most of the games targeted increasing participation, crowdsourcing solutions, and support decisions in policy-making processes. Besides some training activities reported, no games designed explicitly for changing civil servants' attitudes could be found.

Within the educational activities involving civil servants, realism was always the most central characteristic to get these professionals on on-board. Adding to the realism, the representation of roles, environment, and interactions in the office should be based on comprehensive metaphors. The underlining mechanism should value the tacit knowledge of

civil servants' practice. These elements should help to tackle the many challenges to game designing for governments, particularly to governmental personnel.

Games for open data were the least common in literature, but still, some practical examples are available. The majority of games focus on getting users to understand open data and learn how to take advantage of it. Some games already use the data which is publicly available to generate the content of the game. They also raise awareness on open data importance by making it explicit that the game was being performed using available data. From them, many stakeholders and techniques represent a promising open data context. Most importantly, the content used in games is inspiring to build other open data gaming interventions. This open government data content can be translated into game assets, dynamics, and metaphors in a realistic way, enabling the players to connect the game to the needed OGD experience.

The conclusions related to RQ 2 ("What design elements are needed to make a game to change civil servant's attitude towards supporting the opening of governmental data?") is a preliminary list of main requirements that emerged as needs for the game design process:

- Requirement 1. Open government data content used in the game should be highlighted;
- Requirement 2. The focus should be on a game experience that enables experiential learning;
- Requirement 3. Civil servants' practical knowledge should be reflected in the game;
- Requirement 4. The game should be used as a safe environment for experimentation; and
- Requirement 5. The setting should be realistic;

Our discussions of RQ2 also indicate a gap in the literature related to games connecting attitude change, civil servants, and open data. Having a game played generates data to progress with discussions on elements for games to change attitudes and the ones targeting civil servants. Above all, it contributes to the literature on interventions related to open data from a providers' perspective.

3.5.3 Towards initial game mechanisms

Besides the conclusions related to answering our two first research questions, the four SLRs performed also shed light on our third research question, RQ3 (Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?). Though the answer to this research question could only be found through the iteration process of prototyping described in the next chapter, we could start our discussions with inputs coming from the literature.

First, as civil servants are the target audience, a game for developing bottom-up strategies fits well (Cavada & Rogers, 2019). Also, the learning aspect to which the game is directed combines content and attitude change at the individual level with potential organizational change consequences (Olejniczak et al., 2016).

Given the conservative and risk-averse trend of civil servants, which can limit experiments (Olejniczak et al., 2016), the effects of more interaction (Bharosa et al., 2010) and motivation (Rogach et al., 2018) of games are useful. Moreover, for acquiring experiences on simulated real-life work (Spitters et al., 2018) that increases awareness (Joldersma & Geurts, 2000) and engagement (Estrada et al., 2017).

To achieve such positive outcomes of games, participants, setting, constraints, reflection, and learning cycle should be defined (Joldersma & Geurts, 2000). In the case of an open data game, besides changing, behavior insights into content issues are essential for experiencing new practices in a safe game environment. Experiential learning indicates that experiencing outcomes can influence attitudes as players can face consequences of these new behaviors in the roles they play in the game as in real life (de Caluwé et al., 2012). Also, changing roles and viewpoints strengthens its effects (Joldersma & Geurts, 2000).

Dealing with real actors imposes some cultural limitations, such as the perception of knowledge as an individual asset owned by the right of position and experience (Carrel, 2000). Valuing tacit knowledge can empower civil servants' importance on providers' decisions (Cavada & Rogers, 2019).

Also, making open data a fictional case with common characteristics helps the generalization of discussions where diverse backgrounds can fit the experiment (Olejniczak et al., 2016). Designing strict rules with specified outcomes makes game experiences comparable for research purposes, aiming at isolating some noises of particular cases (Joldersma & Geurts, 2000). The repeated rounds in terms of mechanics with varying content unleash reflections focused on the process more than content, persons, or roles themselves. Following Olejniczak et al. (2016), other game mechanics add adequately, such as achievements, countdown, resource management, collaboration, and unexpected events.

From the games' attitude change literature discussions, two main lists contribute to our design. First, the evidence found in other game studies related to game features can result in a library of elements to be considered when designing the game. Converging with literature, ensuring game realism is also the main attribute to observe (Chow et al., 2017; De Freitas & Jarvis, 2009; DeSmet et al., 2015).

Realistic metaphors connect players and the game experience (de Caluwé et al., 2012). It is probably the most critical characteristic that absence might lead the experiment to fail (Joldersma & Geurts, 2000). Feedback systems, goals, and challenges, part of a game definition, are also strategic features for reaching the purposes of interventions and should be adjusted to reality as well (Janakiraman et al., 2018; Nilsen et al., 2011; Williams et al., 2019).

Moreover, the target for attitude change increases its importance since having a similar-to-real-life experience is key for reflecting on actions and changing attitudes (Cavada & Rogers, 2019). Realism again adds importance to existing roles and narrative (Antle et al., 2014;

Jacobs, 2018) as game features (Olejniczak et al., 2016). On the other hand, autonomy and limitations to players' agencies should be in balance with the strict plot for observation (Kolek et al., 2018). The interactivity factor (Fijnheer et al., 2018; Steinemann et al., 2016) and persuasiveness of messages (Flood et al., 2018; Ruggiero, 2014) should be carefully designed to result in desired experiential learning.

Though these mechanisms are still not developed for a practical game design, they inspired the game design process and will be further discussed in the next chapter. For now, our initial requirement and mechanism lists can support the design of the game to change civil servants' attitudes towards open data. In the next chapter, these requirements will be used to support the prototyping process for designing this game. We will discuss the resulting mechanisms which operationalize such requirements and fulfill the goals of such a game. Exploring the possibilities of changing civil servants' attitudes towards open data using a game is the focus of this thesis to be developed next.

4 CHAPTER 4 – Designing and evaluating game prototypes

In Chapter 2, we presented design science as a research approach for creating and testing artifacts to elucidate and resolve problems. In Chapter 3, we reviewed several specific fields, outlining the requirements for a game that will change civil servants' attitudes toward open data. It resulted in a preliminary requirements list: 1) game as a safe environment; 2) realistic setting; 3) reflect practical knowledge in the game; 4) use open government data content. Furthermore, it became clear that no such game has yet been developed, despite a clear need for it.

In Chapter 4, we design this game, named WINNING DATA. We iterate through four distinct prototypes updating the preliminary requirements list before presenting the final game. We also describe the iteration process to assess the game mechanisms that support these requirements. In the next section, we briefly review the background on the game design process that underlines our original prototypes; we revisit the research problem and the game requirements, the inputs and outputs of each prototype. Next, we confront the insights from the literature with the learning outcomes for each prototype. Thereafter, we present the final game, WINNING DATA.

4.1 Game objectives and initial requirements

Our research objective is to influence the attitudes of civil servants towards supporting the release of open data by governments through a game. Consequently, such a game needs to be grounded in previous experiences of interventions with this goal, audience, and content. We use DSR to prototype and test the game in a quasi-experimental set-up.

From our four research questions, RQ1 (What are the behavioral barriers for civil servants to support the opening of governmental data?) was discussed in Chapter 3 and resulted in a list of factors influencing civil servants' attitudes towards open data. Our main hypothesis is that civil servants' attitudes can be changed by a serious game. We translated the attitude influence factors into a survey to collect data from players, used to evaluate the effects of the game.

Also, in chapter 3, RQ2 (What are the requirements to design a game to change civil servants' attitudes towards supporting the opening of governmental data?) was discussed, resulting in a preliminary list of requirements.

- Requirement 1. Open government data content used in the game should be highlighted;
- Requirement 2. The focus should be on a game experience that enables experiential learning;
- Requirement 3. Civil servants' practical knowledge should be reflected in the game;
- Requirement 4. The game should be used as a safe environment for experimentation; and
- Requirement 5. The setting should be realistic;

This preliminary list is the starting point of our prototyping process. The prototype iterations, described next, resulted in an extended and refined requirement list. Also, in a mechanism list to answer our RQ3 (Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?), as presented in the conclusions of this chapter.

4.2 Teaching and learning from practice: Game design prototypes

Our initial list indicates the need to base the game design process on open government data content and to use civil servants' practical knowledge to develop the game (requirements 1 and 3). Also, it highlights the use of games as a safe environment for experimentation to enable experiential learning (requirements 2 and 4). The idea is to foster players to allow themselves to behave differently in the game than as they would do in real life. By feeling safe, they can enable actions and see them from a different perspective. Players can learn from the outcomes of these new behaviors, which can influence their attitudes afterward.

Through requirement 5, to make the setting realistic, another challenge is set for game design: defining the level of realism, as shown in Figure 13. In Chapter 3, one of the most important characteristics of a game for civil servants is having a representative working environment. Depending on the needed level of abstraction, more or fewer details will be represented in the game. This decision needs to be adjusted for the game to represent reality and be played (Duke & Geurts, 2004):

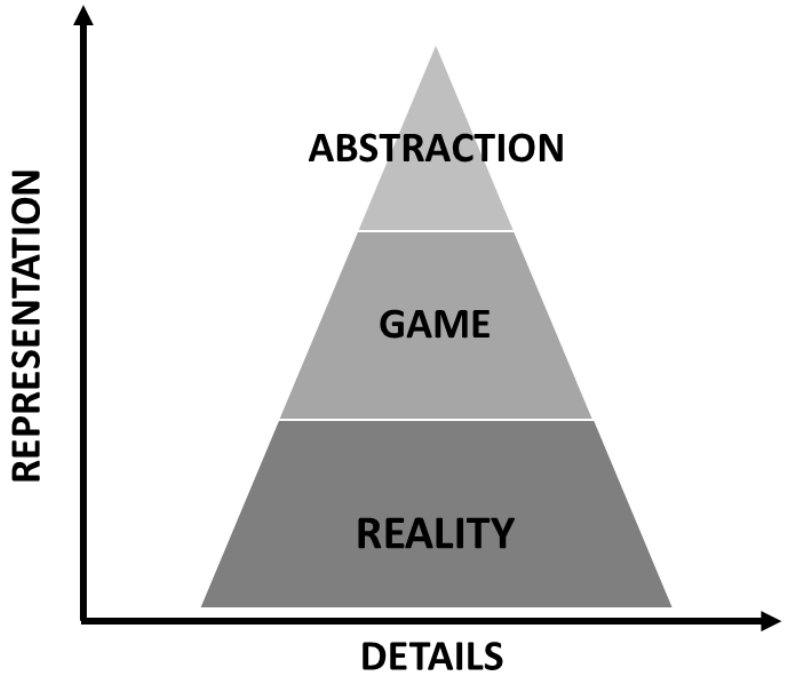

Figure 13 - Abstraction Cone (based on Duke and Geurts (2004))

The game is to be played by real civil servants in their actual reality. Each game prototype was evaluated by observing participants in action and by having debriefing sessions immediately

after the gameplay. At least four players joined these evaluations, initially students and colleagues from TUDelft. Some open data experts and experienced civil servants participated in the testing thereafter.

The debriefing sessions were not structured in topics, though they focused on fostering feedback related to the open data content of the game, the level of engagement achieved, and how the governmental context was represented in the game. We set high-level criteria for open data, attitude change, and engagement at first.

Besides supporting the game development, e.g., by building up our requirements and mechanisms lists, the prototypes and debriefing sessions helped to improve the evaluation. Our need for feedback could be provided initially by a diverse audience, like students and researchers, progressing to more specific players afterward.

It is then necessary to bridge the theoretical concepts of the game with the living scenario of the players. Correspondingly, the problem needs to be grounded with the stakeholders to ensure the validity of the game metaphor.

The requirements gave no support on the desired type of games and the desired characteristics. Therefore we decided to prototype various types of games. This would provide us an understanding of what types would be more suitable and which characteristics would be most suitable. We iterated through these different game types until finding one that suited our purpose of designing a game to change civil servants' attitudes towards open data.

We present the prototypes, including a brief description of the learning process which enabled it - Table 24. Four different prototypes are presented. Each game represents a different type. The first two prototypes (Cards for open data and SolvD) were developed during game design courses and summer schools, which demanded practical exercises, and were developed in collaboration with Anique Kuijpers. Further details on the collaboration are presented within the description of each prototype. The last two (Job-matching simulator and Open data office) aimed at the development of the actual game played in this research and resulted in significant contributions to successfully design the final version game, which is presented later.

Additionally to this perspective, we mapped and compared roles, rules, objectives, constraints, resources, scenarios, situations, and loads in each prototype based on Meijer (2009). The result is the updated list of requirements needed for the game to change civil servants' attitudes towards data released by the government.

Table 24 - Game prototypes and their characteristics

Name	Cards for open data	Solvd	Job-matching simulator	Open data office
Type	Card-game	Collective quiz	Decision-making	Role-playing
Media	Analogic	Analogic	Digital	Analogic
Roles	• General player	• Users and providers	• Civil Servant	• Civil Servant • Boss • Colleague • Citizen
Rules	• Matching	• Matching • Solve problems	• Register data • Matching	• Register data • Deliver services • Label data
Objective	• Knowledge • Engagement	• Knowledge • Collaboration • Benefits	• Experience • Awareness • Benefits	• Experience • Attitude change • Benefits
Constraints	• Data cycle	• Challenges • Shared solutions	• Risks	• Risks • Dara production
Setting	• Cards	• Problems and solutions	• Computer screen	• Service routines (demands) • Files/forms • Datasets
Feedback system	• Groups of cards	• Number of solved quiz	• Recognition points	• Recognition points • Dataset labeling
Evaluation (Needed improvement)	• Increase learning	• Balance risks • Increase fun	• Balance risks • Increase fun	• Improve cards design and dataset description • Adjust scoring system and include data protection technology

Next, we describe each of the prototypes first, including a description and their evaluation. Thereafter we present the details of game inputs coming from each of the prototypes, the resulting game mechanisms and present the final version of the game. This answers our third research question.

4.2.1 Prototype 1: Cards for open data

Our initial prototype was a card game with open data content. Developed together with the researcher Anique Kuijpers and play-tested with colleague students, Cards for Open Data was a card game focused on learning the players the open data cycle. Supporting the open data

cycle would enable players to understand the whole process, as shown in Figure 6 for the open data cycle. The idea was that once they understand the full open data cycle, then their attitude would be influenced. With a set of cards including all operations composing the cycle (creation, selection, harmonization, publishing, interlinking, discovery, exploration, exploitation, and curation), the players would need to match complete cycles to get points. This would force them to have knowledge of which stops are included in the open data cycle. Different card combinations and rules were tested, adjusting the gameplay for more engaging dynamics.

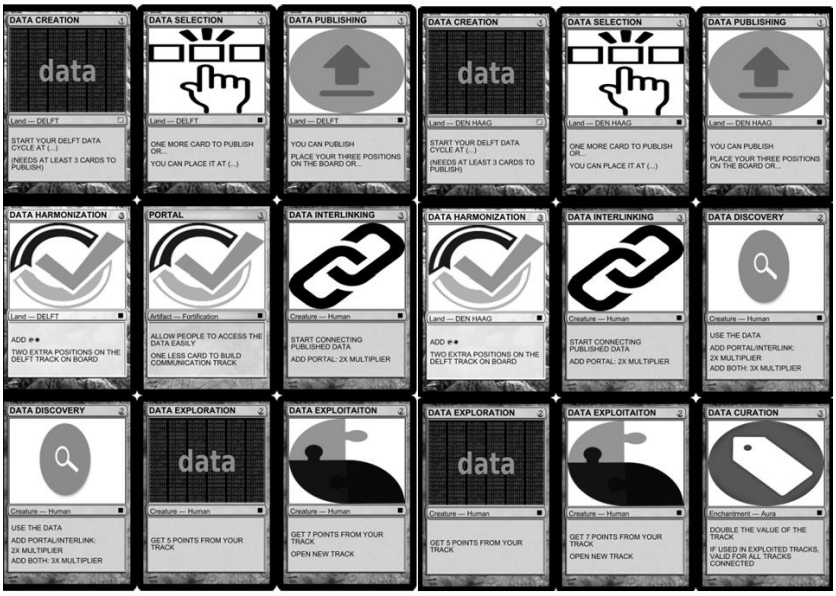

Figure 14 – Overview of the cards for open data

The game was aimed at increasing participants' knowledge of the open data cycle. The card game was based on the idea that opening data was not clear for every player due to their different backgrounds. We opted for initially evaluating the game with colleagues from TUDelft, as this enabled short iterations. Furthermore, this ensured that their expertise in gaming and open data could be used for arriving at a better game. This first prototype, developed during a game design course, was evaluated by two colleagues researchers from TUDelft, who worked at the TPM-Game Lab, and another two master students selected from the class. The idea was to have game experts to assess the outcomes coming from the developed prototype. After some playtest rounds, they reported that the game mechanics were engaging as they wanted to draw the right cards and score; they were focused on drawing the cards to score points and beat the game.

However, when asked about the open data content used in the game (the stages of the cycle or the card information), they could remember what the game was about or even mention any details like what the open data cycle was. The comments sounded as the game was working like any other card game.

In this sense, the discussions during the debriefing sessions indicated that the game did not achieve its objective since players were just checking if they got the right cards instead of evaluating and understanding the open data cycle. The players found the game to be fun to play, though, when asked, they did not learn about the specific open-data content from it. Based on these debriefing sessions, the following conclusions were drawn:

- Clear roles needed to be defined to understand the problem and to give an insight that there are barriers on two levels: by the community and within governmental bodies;
- An incentive needs to foster players' discussions to focus on the learning outcomes.

4.2.2 Prototype 2: SolvOD – a discussion game

The improvement of the first prototype resulted in a new game that could fulfill the limitations of the evaluation. Progressing beyond the open data cycle, SolvOD aimed to be a general game in which various stakeholders would be involved, including open data users and providers. It was a group discussion facilitating game that that tried to overcome the backlash of no learning outcome on the card game. The participants were distributed into four groups representing providers and users of open data from two different cities. A mediating platform was created in a kind of collective quiz where teams would need to solve open data-related problems with some available solutions. Based on the literature, the main objective was to assess open data benefits as if the Data gets to be accessible, providers and users could benefit from it - Table 25.

Table 25 - Open data game benefits

Providers (governments)	Users (citizens and firms)
• Greater returns from public investment • Can generate wealth through the downstream use of output • Provides policy-makers with data needed to address complex problems	• Enables citizens to learn about the activities of their government • To hold their government accountable for its actions and its spending • Participate in the political process

Opening governmental data is within each country different and is influenced by various factors, as discussed in chapter 3. The objective of the game is to create an understanding of the barriers and what possible solutions are for opening governmental data. Two imaginary cities are the basis of this game to overcome the issue that players will get biased by the assumptions that they have when actual cities are mentioned. The fictional cities were called Heideland and Geertjeland. The setting of the game consisted of a division in the room for the two cities, each with its own providers and users. We expected that different people with diverse mindsets would lead discussions on each group for multiple solutions. Additionally, a meeting point (solution table) for both these roles in each city was created where the game could be played - Figure 15.

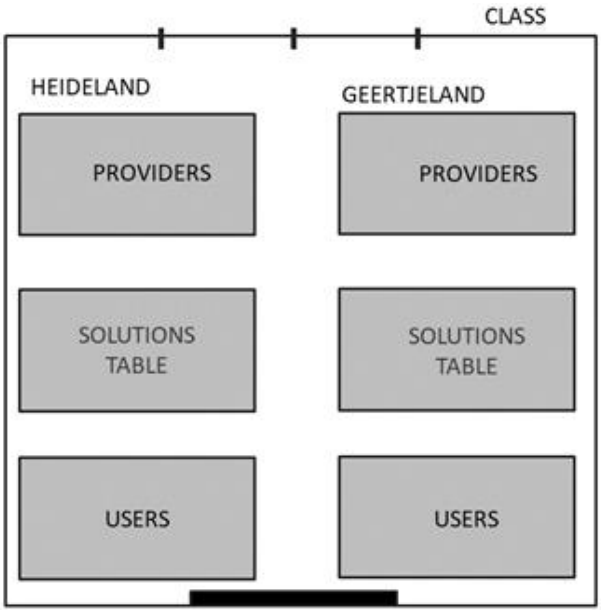

Figure 15 - SolvOD play setting

The scoring of the four teams was done accordingly to an answering sheet corresponding to the number of matching solutions. Nevertheless, during the discussion round that takes place after each round, the players need to justify their answers and responses different than the first table could be accepted (in the end, most of the answers were out of the table – which was highlighted as an interesting outcome on the debriefing of the game).

Despite challenges being specific to each team, the solutions could be common to both groups. Each round had a topic, e.g., lack of open data knowledge of policy operators or lack of information standards for data opening. In these cases, providers and users would need to share solutions, integrating decisions that could work for both in each city. Both cities would have the problem stated for the round and would need to find pre-defined solutions on the solutions table.

The game was tested with a group of master students who participated in a game design course at TUDelft, as it was part of the course requirement to play and evaluate other games. From our perspective, it was useful to have non-experts assessing the prototype; our aim was to play the game with civil servants later, many of them without previous expertise in games or open data. It resulted in an interesting environment of discussion between players assigned as data users or providers and the challenges to be tackled - Figure 16.

Figure 16 - SolvOD game session

All players were briefed first. After the game was played, the groups were invited for a debriefing session. It was suggested that the debrief could happen in two rounds: (1) discussion on the content of Open Data; and (2) feedback for the game itself.

As expected, it was very difficult to separate users' and providers' solutions, which raised awareness among players that most of the topics were interrelated. The only isolated answer of the groups on the first topic was that their knowledge about open data increased, showing that the game had achieved its main purpose. They had actively thought and discussed the challenges, and it got them to understand the complexity of the problem.

In the debriefing session, a general comment was that it would be good to have a game to get people involved to find reasons for selecting a solution to the different problems presented in the game, instead of merely providing a random solution with no supporting background. However, some participants mentioned that the design was not well balanced. They reported that people who would not support the idea of sharing open data might feel annoyed because there was no space for divergence in the game, as opening data was a mandatory action in the game. They expected the game to give room for deeper open data-related discussions, e.g., concrete cases of open data sharing or use, besides the debate on the available solutions.

As data could only be opened in this prototype, there was little room for discussing the disadvantages of open data or even opposing the idea of open data at all. This was a tricky remark since it would need a whole different approach to discuss the pros and cons of opening data, which could also be addressed at the start briefing of the game – the designers normatively assumed opening data to be the goal, and to do so, it was supposed to be a good target. However, the players' feedback shed light on the idea of a balanced game where

participants could choose whether to share open data and also on the positive and negative consequences coming from it.

Another comment was related to the definition of who were the users or providers – the differences were not clear. As the game started with a short briefing on the roles which should be played during the game, the players also suggested expanding this first briefing on the game roles. They highlighted the need to better onboard players instead of expecting them to only learn by playing. All these insights were useful to progress designing the next prototype versions, which needed to be more balanced and include improved ways to onboard the players.

Different teams of providers and users from each city were working together on different rounds. Again on the post-game discussions, players said that the collaboration purpose was interesting, getting them to see that sitting at the same table led them to better decisions. Some reported the feeling of building a common perspective through the solutions table of the game. The players also pointed that some solutions worked for both providers and users and that the used pre-written solutions stimulated the debate, such as defining clear rights and obligations for open data sharing and use. The players found that different solutions could solve the same problem. This was considered a positive aspect of the game. Even though the problems were stated at a high level and the discussions were on abstract solutions, the teams managed to solve all challenges within the given 5 minutes (with an extra minute). Furthermore, it was surprising for the group that they got to pretty reasonable solutions. This process was described as a "magical level Open data policy," and it got people to learn from it.

Additionally, there was also feedback on the usage of the open data cycle model. There was no relationship between the answering sheet/answer cards and the open data cycle model in the game. Some said that the way the open data cycle was presented was not necessary for the game and that this information was confusing since they did not need it to play the game. However, the different interpretations of the challenges and their potential solutions led people to discuss them. This should be kept and stimulated even with groups that might have a specialist on the session - the ones who know more are able to share their knowledge through the game.

Repeating solutions for different problems was also a remark since participants could see that some simple decisions can serve for more than one challenge. Having a larger number of solutions for more than one problem stimulated some players to understand that there is not one only way. All the groups missed a moment to share the solutions among the groups and missing a ranking of the performance of each group. A trade-off would be established between discussing more challenges or taking more time for fewer topics. It was suggested to use more randomized solutions to increase the fun – this would lead to another tricky trade-off between more luck (fun) and less precision (learning).

Summarizing the debriefing inputs, the game seemed to have achieved the purposes of engaging non-experts into an open data discussion, though some unexpected outcomes demanded more iterations towards another prototype design. The game made the participants discuss and learn about open data policies; it also led them to find out that providers' and users' common ground for solutions can be useful when dealing with this topic. Surprisingly the game showed that pre-defined answers could stimulate the debate without needing a pre-defined “correct answer”. Getting groups to work together and build solutions turned out to be more important than the answers themselves; getting the group to validate the discussion instead of having a limited accounting system was key to be open for this result.

SolvOD was a successful prototype for open data content. The prototype addressed the interrelations of users and providers in finding common solutions for open data policy. However, the game presented some limitations that could weaken the effects of the intervention when applied to our specific audience of civil servants, such as unnecessary information in the briefing or the lack of balance between positive and negative outcomes coming from open data. Also, the game focused on very specific learning content, and from the feedback received from the participants, it did not seem to achieve a change in the attitudes of players towards open data. As our focus was to change the attitudes of civil servants towards open data, a more realistic context of the government should be in the game, in a more balanced gameplay. In that sense, we decided to use it as a fruitful reference to progress to another prototype, designed more specifically to the civil servants' audience, a public service delivery simulation, our next prototype.

4.2.3 Prototype 3: Job-matching simulator

(This section is based on Kleiman (2019))

For the next game, we started developing the first prototype of a game to address the specific problem of changing the attitudes of civil servants instead of a general learning exercise for designing a game with open data content. A second prototype was developed, as the iteration process made clear the need to restart the process. The second version game changed into a time management game, a game with limited resources and roles in which players need to work within a pre-defined timeframe.

Fixing the existing prototype to include stakeholders and increase the interactions and dependencies for decision-making demanded the core mechanics of the coding to change. The aim of the job matching simulator was to tackle the resistance of civil servants to support open data. The game was built upon the collective quiz experience (SolvOD) previously described that supported the idea of progressing the design to a decision-making game - Figure 17.

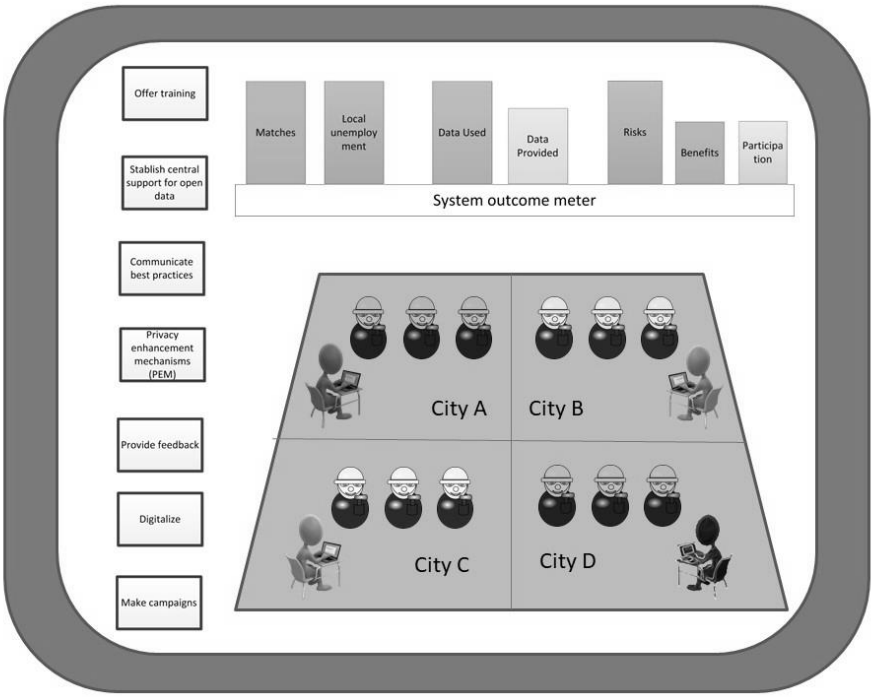

Figure 17 - Job-matching simulator

Instead of having both data providers and users, in this prototype, a civil servant was the main role. The main goal of the players would be to help workers finding a job in a simulated public job agency. The game set rules for registering information in a system that would keep the data. The players' actions would be to selected different options towards matching available workers and job positions in the system. The game players should register new workers and try to match the jobs available. After a tutorial round, where the player would learn how to operate the system, a new option would be enabled, allowing them to opt for open data. Open data was represented as a separate database, which the player could provide or access. Providing and using open data increased the matching chances, allowing the player to score (based on the number of match making).

This prototype was developed in very simple interfaces, basically using a screen-by-screen PowerPoint demonstration of how the mechanics would work. Though very basic, such a simple interactive artifact enabled the playtesting of the main structures to be at work in the game. The prototype was a first-person game, a simulated environment where the players make decisions in the eyes of their game character. The game was played by one person and could be tested through simple demonstrations and debriefing of the game. Some research colleagues with a background in serious gaming or open data were invited to run through the screens of the game and give feedback.

From the initial testing, the game feedback from players indicated that the way open data was represented in the game was focused more on the objective of increasing awareness rather than properly on attitude change. The game seemed to enable players to experience open data in a simulated practice, also allowing us to represent benefits and risks in the game, e.g.,

not all data should be opened for privacy reasons. It was the first *digital* prototype of this research, designed to be played individually on a computer screen.

Additionally, playtesting the job matching simulator mechanics indicated that it tended to result in too bureaucratic gameplay, demanding a large number of decisions in a repetitive environment. It seemed a good idea to have data as the main focus of the simulation and to result from the job matching activity. The data that was produced could be opened or closed. Still, the balance between benefits and risks was biased, as no risks were represented in the game. For the first attempts to design the game, players would only receive the benefits of opening data. Moreover, the simulation also indicated a low level of interaction between the civil servants and other stakeholders.

The job-simulator prototype was the first to aim at including the attitude barriers of civil servants its four factors: (1) Data management knowledge; (2) Performance Expectancy; (3) Risk Aversion; and (4) Social Influence. Including these factors resulted in the necessary complexity that needed to be represented in the game.

The assessment of this third prototype set the direction for taking the next prototyping steps by increasing the complexity of data in the game. Furthermore, it was found that highlighting dependencies to increase interaction between different roles was important as it would unleash better ways to increase players' engagement. Also, in game-design terms, the idea of a decision-making game evolved to a more specific design, e.g., a time-management game. Hundreds of these games already exist simulating a broad range of activities ranging from city planners (e.g., SimCity), farm managers (e.g., Farmville), general business (e.g., Idle Factory), tourism (hotel, restaurant, and others) to many other services (hospital, traffic, and others). Besides, the next prototype could relate to other games focused on governments and public service provision, such as Papers Please, Airport Scanner, Democracy, etc. We registered games that could inspire the next prototyping iteration with more than 100 examples (the full list is in Appendix 1).

From the inspiring already existing games, it seemed useful to simulate a public service routine in a fun and engaging time-management game. This could enable the introduction of new technologies and procedures to the office, such as open data. Eventually, a timeline could show the digitalization of the public office from ancient history to a high-tech future, easily changing the available resources, scenarios, and characters, maintaining the gameplay coherently.

The idea evolved towards building a mobile digital time-management game version where players would need to move the character to interact with other characters or objects (screen-clicking-based). They would “get demands” from citizens (demand for open data) and deliver open data. Time would run differently from task to task, and some activities would demand closing data. The open data option should begin in between rounds with data labeling activities. Data labeling refers to analyzing datasets from a privacy and security perspective

and selecting their level of sensitivity, as will be described in the next section. The game should stimulate the reflection on types of data and risks associated with them.

4.2.3.1 Description of the time management game

The fourth prototype was developed as a time-management game where the player would need to click on different spots of the screen to make the character move around and grab or interact with other characters or objects. From getting demands from citizens to taking a stamp from the boss, time runs as you try to deliver services to citizens. In the game-play, the open data option would appear, enabling (positive and negative) consequences of it, such as saving time in some activities or getting the office to be at risk.

Figure 18 - Example: simulated screen-shot

The objective of the new prototype was to let players experience positive and negative consequences of open data policy-making, e.g., saving time in some activities or getting the office to be at risk. The office was taken as a background where new elements could appear with the increasing use of technology. The only role for players would be the civil servant who works in the public office and, within other activities, would need to deliver services for citizens. The player would perform simple jobs intending to progress in the public career. To do that, recognition from the citizens and his boss would be achieved by delivering services as fast (and the best) as possible.

The plot would integrate the group of levels with the increasing use of technology. For example, a tutorial mode was set at a tech-averse office that works only with paper; a second level would have computers and, then, the internet. With digitalization, routines would become faster and with new challenges. Freedom of Information requirements would give priority to certain demands as long their information was not yet public and had no privacy or security issues related to it. The possibility of sharing data should challenge the players (civil servants) to decide which information to disclose (open data). These decisions resulted in consequences, task speed, and risks. A boss would allow or impede data from being opened.

The player's quest would be making the job the best possible to achieve more recognition from citizens, from the boss or the mayor – a scoring system is to be set as feedback for actions in the time-restricted set-up.

A first paper prototype was used to start simulating the actions and program the interaction system. Figure 19 shows some of the designed scenes expected to represent the in-game actions.

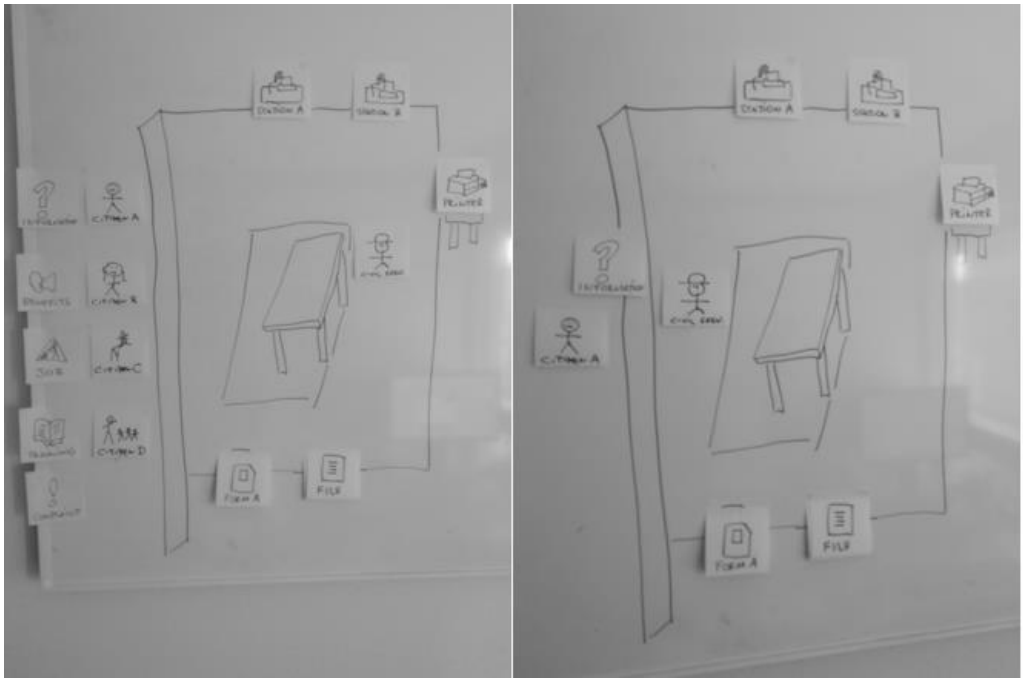

Figure 19 - Paper prototyping

Like entertainment time-management games, with the clock running down, the civil servant would click on the demand to open the action options; click on the actions and wait for them to be done; multi-tasking would happen in cases where the task demands processing from a machine or other people (citizens, colleague, and boss). When the outcome is ready, the data should be delivered to the citizen. Recognition points levels-up the career, and by leveling up, new scenarios are played with different resources and tasks, such as a more or less digitalized office. With simple moves, such as touching specific spots on the screen, tasks are assigned to the character – accepting tasks, doing activities, using resources, and delivering outcomes.

The learning, storytelling, gameplay, and user experience (UX) expressed some of the expected dimensions for designing the game. Table 26 summarizes the player experience goals on each dimension.

Table 26 - Player experience goals

	Design	Play	Experience
Learning	Experiential learning	Simulate different situations with or without open data resources	Different settings can benefit or not from adopting open data practice
Storytelling	The civil servant (player) needs to do time-consuming activities in order to deliver demanded services from citizens and bosses	As the civil servant progresses in delivering, he can be promoted or have more resources available to work (level up)	With technological development, new digital resources change the public office routine, and it is important to learn about them to take the best from it
Gameplay	Clicks on the screen to define which task and activities come first	Resources (such as forms, files, copies, etc.) needs to be processed in work stations and processed (print, stamp, sign) to deliver different tasks	The Open Data option changes the dynamics of tasks, making some faster, other less safe impacting scores
UX	Mobile device	One player time-management game	Online and connected to social networks

Designing a digital game with different iterations demanded progressing with the requirements of the in-game content. It also demanded making the stakeholder discussion deeper and grounding the actions to the reality of a simulated public office. A realistic metaphor was needed to involve the players and let them experience decision-making for releasing governmental data.

A digital time-management game was prototyped, having a civil servant in its main role. Additionally, a boss would iterate with the civil servant. The main rules targeted the delivery of services that would produce data and demand proper labeling. Likewise, risks, benefits, and data production could be highlighted through game objectives and constraints.

The setting now included service routines, represented by demands, and files and forms that were exchanged in the game. They built the metaphor of the office and its bureaucratic environment. The feedback system evolved to a recognition points system that would result from the delivered services. It should be directly affected by the data management options. Moreover, it was the first prototype actually to focus on attitude change through experiential learning.

The game was presented to two specialists, one game designer, and one open data expert, coming from the research communities of serious gaming and open data. Besides playing the game, they could also discuss the grounding of the presented prototype. Within many suggestions, the game designer reacted to the prototype with a simple question: Were the

human behaviors assumed for NPCs in the game real? In short, he suggested testing the game dynamics in a setting with real humans, observe them acting, and them translate it into the game (Deen, 2019). To move from a single-player game to a multi-player game in which real people playing could be observed.

Additionally, the open data specialist suggested that the open data labeling activities were hidden behind the game's main service delivery activities. She indicated that increasing the relevance of data labeling and balancing the datasets' sensitivity in a more complex set-up could increase the learning outcomes of the game (Cordova, 2018). Both considerations, related in their specific debriefing sessions after gameplay, indicated improvements that still could be done in the prototype and were the reference for the development of the last prototype of this research. WINNING DATA is the final version of this last prototype after some improvements resulting from its playtest.

4.2.4 Prototype 4: Open data office

The main challenge for progressing to this version of the prototype was representing simple dynamics that were designed for a digital environment to a non-digital environment. This requires revising each of the roles, metaphors, actions, and assets to represent them in a physical world where real people could associate the in-game experience to their previous and future concrete reality.

From September 2018 until January 2019, many translations and revisions were made. The office had to be redesigned to a set-up of the room where people could move around; the interactive elements of the game, such as processes and files, game assets, needed a physical representation that could be exchanged between players; the scoring system was transferred to automatic tables that players could interact.

The roles were particularly challenging as they demanded specific rules for each human function in the game. It indicated the importance of having not only a civil servant and boss with playing rules but also citizens (demanding and receiving services) and the civil servants' colleague, who would support some of the operations in the office. This resulted in the inclusion of these four roles in the game.

The new game elements also profited from a more advanced open data theoretical discussion, which resulted in better-defined factors of influence. Also, the game mechanics were based on a larger group of game examples available for real-world interactions. After its design cycle was complete, the final prototype could be tested with other researchers from TUDelft. The playtest sessions resulted in the final design feedback to adjust the game, set the parameters, and make the real play for analysis.

The role-playing version of the game simulated the public office where civil servants interact with other roles to deliver services to citizens. Different operations were performed, producing datasets that needed to be labeled. Data management options resulted in obstacles

and performance boosters, mimicking the change in benefits and risks of data options in the office.

The goal was to define new parameters that could inform the digital prototype with new roles and actions. Still, the game was designed to observe civil servants' attitude changes when dealing with data management in a simulated office. It should create an environment for experiencing and learning the possibilities of opening data in different situations.

The role-playing version was developed and tested to explore real human behavior in the open data dynamic for a governmental office - Figure 20. The scenario is set by:

- Each participant has a table (or chair) to be permanently seated (no moving around is allowed for the boss, colleague, and citizen). Except for the Main Player that runs around to receive, process (resources), and deliver the demands. And the Game-master out of the office.
- All places for boss, colleague, working station, and citizen starts with: a pair of dice and one pen (and an identification tag)
- Two other tables have forms and files, and another one processing station (and files). One last has the Datacenter.
- A corridor is set in between all tables, forming a path through which the player needs to walk (run) around to receive, process (resources), and deliver the demands.
- The Game-master stays out of the office to perform his tasks without interfering with the game dynamic.

Briefing and Debriefing need to be done out of the office so people can reflect on a different position from the one they played.

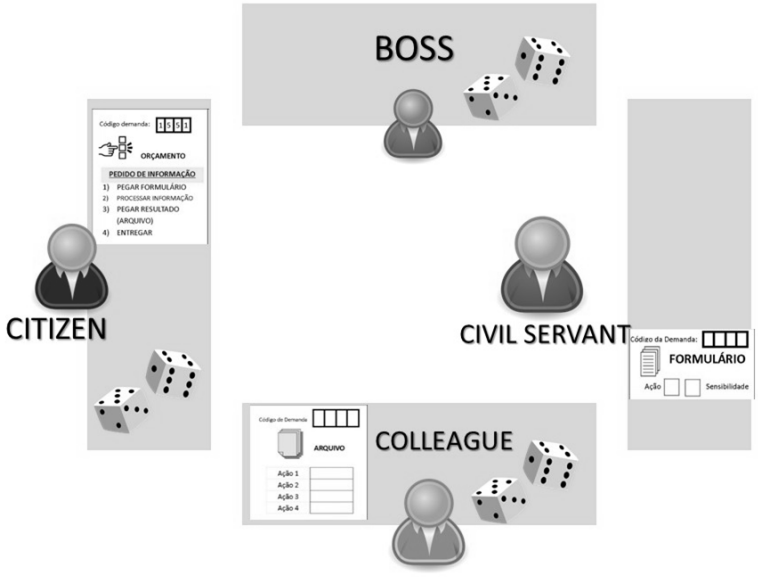

Figure 20 - Scenario (room set-up)

Different rules, and consequently guidelines, were referenced for the development of the roles of the game. The game was played by four players that needed to role-play different positions in the office. The citizen is the player that starts the process by demanding services from the office. To do that, the citizen demands open data from the civil servant through a pre-set of cards with specific activities organized in routines that need to be fulfilled. The civil servant walks across the office to distribute resources and deliver services to the citizen. The civil servant is helped by a colleague that has machines that produce certain codes for the demands to be delivered. These machines are dice that are rolled, targeting specific combinations. A boss stays in the middle of the office, monitoring the work and authorizing specific types of service deliveries.

Both the civil servant and colleague represent the operational workers in public service that needs to implement decisions in order to deliver services. In real life, they follow routines defined in law and decisions made by higher echelons. In the game, it is assumed that the law sets the task list, which is to be executed by citizens' demands. Supposedly the boss has already defined the goal to deliver as many services as possible—service delivery results in recognition points.

To design these routines, we refined actions from previous prototypes (section 4.2) to prototype specific actions for the new game. This initial list resulted in twelve different routines that could realistically represent the actions of civil servants to deliver services and produce datasets - Table 27.

Table 27 - Defining in-game actions

Recipes / Citizen demands	Get Document from citizen	Request action from citizen	Form A	Form B	Colleague	File 1	File 2	Boss Stamp	Boss Sign	Deliver
Request information		2	1		3	4				5
Request other documents		2		1	3	4				5
Authenticate	1				2	3			4	5
Update file	1				2		3		4	5
Include new documents	1	3	2		4	5				6
Merge processes		3	1	2	4		5		6	7
Request ID		3	1	2	4	5			6	7
Complaint		3	1	2	4		5		6	7
Request decision	1		2	3	4		5	6	7	8
Request benefit		3	1	2	4		5	6	7	8
Request revision	1	4	2	3	5		6	7	8	9
FOI		2	1		3	4				5

Each routine involved performing a number of actions that would result in a deliverable service. For instance, some routines start with receiving a demand for information, coming from the citizen, which needs to have some form filled-up, and getting a signature from the boss to deliver it back to the citizen. The idea was to simulate different routines, adding complexity to the gameplay, but based on some standardized actions which could be learned in a short time. Also, the setting and language were adapted to have a realistic representation of daily work at a public office.

The initial version of this last prototype included too many routines, as represented in Table 27. As it was found too complex for players to master them, the final prototype and game included only the main four of them, still keeping the complexity, realism, and fun for the game.

These routines also demanded resources for demand processing. A system of codes was designed specifically to represent these exchanges and ended with three assets remaining as a resource. The routines, called Demands cards, were the initial resource managed by citizens to request services. The civil servant would pick this card and follow the instructions. Usually, they started with filling up a Form, another resource, including a demand-code that identified the process. The colleague would be able to roll the dice and fill in a File based on the Form information. Some demands would demand the boss's signature, also performed by rolling a die and registering the outcome on the same form.

The card codes and dice combinations defined rules that each role had to fulfill. The resulting File with these codes could be inserted into an Excel table and, if they matched these rules, points would be automatically scored. The facilitator would fill in these codes in the first version of the game. For research purposes, it was unfeasible for the facilitator to be part of the game. This task is then transferred to the player having the citizen role that would receive his demands back and “score” the recognition points to the office.

For matching probabilities and making the tasks easier or harder, a dice combination study was performed - Table 28. This study was also used to balance the game crisis resulting from the combination of the dice. There were two types of crisis.

- Privacy crisis: when any of the dice individually match the exact number of files in the data center, the Game-master would announce that there has been a privacy breach in the office, with data from citizens being inappropriately accessed by third parties. After an explanation of the meaning of a privacy crisis, the colleague and working station would lose the extra die, and the unfinished tasks of the round were also lost.
- Security crisis: when the combination of dice matches the exact number of files in the data center, the Game-master would announce and explain the breach in the security of information of the office. As it is more serious, involving strategic information from

the government, the colleague and working station loses the extra die and the unfinished tasks of the round and makes the boss lose one die for the round.

Table 28 - Dice combination study

Combination	1 die	Exact	higher	2 dice	Exact	higher	3 dice	Exact	Higher
1	16,67%	16,67%	83,33%	0,00%	100,00%	0,00%	0,00%	0,00%	100,00%
2	16,67%	33,33%	66,67%	2,78%	97,22%	2,78%	0,00%	0,00%	100,00%
3	16,67%	50,00%	50,00%	5,56%	94,44%	8,34%	0,50%	0,50%	99,50%
4	16,67%	66,67%	33,33%	8,33%	91,67%	16,67%	1,40%	1,90%	98,10%
5	16,67%	83,33%	16,67%	11,11%	88,89%	27,78%	2,80%	4,70%	95,30%
6	16,67%	100,00%	0,00%	13,89%	86,11%	41,67%	4,60%	9,30%	90,70%
7				16,67%	83,33%	58,34%	7,00%	16,30%	83,70%
8				13,89%	86,11%	72,23%	9,70%	26,00%	74,00%
9				11,11%	88,89%	83,34%	11,60%	37,60%	62,40%
10				8,33%	91,67%	91,67%	12,50%	50,10%	49,90%
11				5,56%	94,44%	97,23%	12,50%	62,60%	37,40%
12				2,78%	97,22%	100,00%	11,60%	74,20%	25,80%
13							9,70%	83,90%	16,10%
14							7,00%	90,90%	9,10%
15							4,60%	95,50%	4,50%
16							2,80%	98,30%	1,70%
17							1,40%	99,70%	0,30%
18							0,50%	100,00%	0,00%

The game was designed to be played in 5 rounds. It starts with a tutorial round for each player to learn the basic operations of their roles. Players get to switch roles every week so that they can experience different positions in each round. Each round is set by a time limit of 5 minutes that was defined, creating some pressure on the players. At the beginning of each round, the resources are distributed, and the citizen receives a group of demands. If these demands are not delivered in between rounds, they accumulate for the next round. Except for FOI requirements that would generate penalties if not delivered at the end of the round, as they have pre-defined deadlines for delivery (one round).

After each round, the Game-master or Facilitator, which is an extra role played outside the "magic circle", announces the scores and prepares the upcoming week. Each delivered service generates a dataset that has a sensibility. In between rounds, the players discuss the sensitivity of these datasets and suggests how to label them. Low risk and aggregated data such as budget or street names can be labeled open, while very sensitive data such as police operations should be closed. Data in between, which demands some cleaning, anonymization, or other operation to reduce risks, can be labeled as shared.

The civil servant and her colleague discuss and suggest a label for the datasets. They may invite the citizen to take part in the discussions, and the final position for labeling each dataset is set by the player in the boss role. New resources or demands are added to the upcoming week, depending on the labeling options. A certain combination of numbers on the machines generates a Privacy or Security Crisis. Hence, the players also feel the risk of having privacy and security risks.

The main mechanisms are the following:

- Service demand: routines related to document processing for service delivery. They have different time frames that need to be followed depending on urgency, importance, or complexity. They can also vary accordingly to the round and options made by the player.
    - Demands from citizens: numbered tasks ordered for each round.
- Document processing: activities that take time to transform a certain type of resource (document) into another.
    - Form: document to be processed on a routine.
    - File: outcome from Form processing, with proper fields to be completed in processing.
    - FOI: a special kind of demand that needs to be delivered in the received round. If not, they result in penalties for the Office.
    - Datasets: every activity generates data that is stored in a specific place (datacenter). Closing, sharing, and/or opening these datasets impacts the next round.
- Service delivery: register the final codes in an excel sheet that monitors completeness and time.
- Recognition points: feedback system for the civil servant to deliver services as best and fast as they can. Certain amounts of points lead to career progression that can improve the document processing of the office.
- Rounds: each round represents a day in the office. There is a limited global time for a pre-defined number of demands that need to be processed and delivered per day. Each task has its own delivery time.

- Special events: events that occur depending on the round and options made by the player. They can affect all the processes in the office (e.g., increase or reduce the productivity of certain tasks, increase or reduce certain types of demands).

A final version of the mobile digital game was dependent on the feasibility of transferring the electronic version parameters to real-life and back. However, the evaluation of such transfer found the results of the role-playing version to be surprisingly successful in terms of engagement, fun, and knowledge transfer. The pre-test indicated that the real interaction of role-playing resulted in an intensive discussion on the targeted attitudes. As it sufficed the goals of the present research, we adopted it as the final version of the game and proceeded with the quasi-experiment.

By January 2019, the role-playing game was the first prototype to have a pilot session. As this was a more well-developed prototype, we organized two game sessions with four researchers each in the Faculty of Technology, Policy, and Management from TUDelft, The Netherlands - Figure 21. Though these researchers were also selected by convenience, they were related to fields of open data, simulations, and serious gaming, enabling them to react to the game from an informed perspective. We opted to have always different participants in the sessions to avoid bias and receive new ideas, as they could be influenced by the experience of a previous prototype.

Figure 21 - TUDelft pilot testing session

These colleagues joined a 3-hour session which started with a tutorial round, had another five rounds to play, and ended with a debriefing session, like all the other prototypes. This last activity focused on the game itself and the knowledge transfer perception of the participants

as they were not the targeted audience for the experiment. The debriefing sessions resulted in relevant feedback and suggestions, which were used to improve the gameplay, especially the assets and set-up for the game - Figure 22.

Figure 22 - Winning data game assets

Also, the game introduction was changed based on the colleague's suggestions to make the game more dynamic and easy to play. Lastly, the roles and rules were adjusted to make the game more inclusive to the players. As it was designed primarily for the civil servant role, the other players did not have many tasks to perform. Adding activities and goals for these roles adds up to the realism of the game and also increased the fun resulting from the experience.

After the pilot sessions, each of the last adjustments was individually tested. The colleague and citizen were defined as supporting positions, adding to the civil servant and boss roles; a dataset description was added to the demand card, enabling the labeling sessions to work with the same works; and a crisis board was created to register the number of times the critical dice combinations happened so that the whole team could monitor (and experience the pressure of) risks - Figure 23. A permanent timer was also designed to create time tensions for performing the routines, and the scoring system was adjusted with the consequences of rounds.

WEEK	DOUBLES			DOUBLE 6	
WEEK 1					
WEEK 2					
WEEK 3					
WEEK 4					
WEEK 5					

Figure 23 - Crisis board

The final version of the game was used in the game sessions described further in this thesis. The questionnaire was also finalized to capture the game effects on participants, which will be discussed in the upcoming Chapters.

The testing of the prototype of the game indicated it to be effective in meeting the objectives of changing players' attitudes towards open data. As shown, evolving from the job simulator to the open data office prototype demanded some improvements. Specifically, we needed to transform the digital game paper prototype in the role-playing setting, and that implied in new game mechanics, such as increasing the number of roles in the game so more players could influence each other, resulting in an improved game dynamic that would lead to better learnings, allowing them to connect to their real behavior. A role for colleague and citizen were added to the boss and civil servant as active roles, which resulted in expanding the activities between the four roles in the game. The live-action situation increased the face-to-face interaction of the game and enabled a more realistic experience than the digital version should produce.

The datasets were included as resulting from service delivery to highlight the labeling importance in the office set-up, with a specific description of sensitivity that also made labeling a crucial step in the game. The labeling of data was turned into a new activity in between rounds, with specific timing for completion. The outcomes from data labeling could also impact the scoring system, resulting in a more direct connection for negative and positive impacts of the labeling in the feedback system of the game. Crisis and time limits were explicit to give players a more engaging experience through play. As the last prototype in this research before the actual game was played, it resulted in many insights that made the final version of the game to be more realistic and potentially impactful on players' attitude change.

The pilot sessions of the role-playing game version lead to the final improvements added to the final version of the game, WINNING DATA. First, a crisis board was designed to explicitly show all the players how far the risks of having certain dice combinations were. The elements

increased the players' sense of risks for operating the data management policies. Even if the metaphor was not directly related to the labeling activities, feedback from players indicated that they felt pressured to decide the disclosure of open data, depending on the tensions created for crisis risks on the round before.

The card design of the game was also improved by the pilot session feedbacks. A color reference was created to differentiate the many routines and types of services being provided to the citizen. The dataset description was added to the back of the cards, so it was easier to connect the production of data coming from service provision and data sensitivity. Typos were corrected together with visual improvements in the cards, such as font size and type.

Moreover, including the dataset descriptions, some of them were adjusted to a less biased communication. The idea of the description was to generate debate and doubts, so the more clear message of the correct labeling was, the more balanced the experience could be. Likewise, the scoring system also had some imbalanced values between actions and results. We fine-tuned the relation of scores and actions.

Lastly, some of the available technologies for improving open data policy-making were absent in the game. The inclusion of upgrades for technologies, such as Privacy Enhancement Technologies (PET) and Open by Default (OBD), made a final change that could increase the experience for players of the open data release.

4.3 Inputs from prototypes to the final game

We aimed at developing a game to change the attitudes of civil servants towards open data. During the development of the four prototypes, insight was gained for defining the game inputs for the final game. Inputs are the elements of the game that need to be clear in advance and include n roles, rules, objectives, constraints, resources, scenario, situation, and load (the controlled and known variables for a system analysis) (Meijer, 2009). Inputs support the improvement of the prototypes and the mechanisms of the final version of the game. The list of requirements could also be updated with new inputs coming from the prototype iteration process; and resulted in the list of mechanisms that answer our RQ 3 (Which game design mechanisms can enable change of civil servants' attitudes towards opening governmental data?).

The outcomes of the literature review resulted in preliminary game requirements. Through the prototyping process, we tested, modified, and refined these requirements and operationalized them into playable games. We confirmed that the game was a safe environment in which experimentation (Requirement 4) could result in attitude change through experiential learning (Requirement 2). Realism (Requirement 5) connected the players to the fictional scenario, which could be related to a real-life situation (Requirements 1 and 3) and allow the knowledge transfer to happen.

The restricted environment, with hierarchy and rule-constrained actions, which were adopted in the prototypes, is also a finding from section 3.4, coming from other game interventions. They expressed the idea of tacit knowledge to connect civil servants to the play. Once more, realism is crucial to make the setting believable and the knowledge transferable to real-life situations.

All the content of the game (including assets, routines, actions) should come from the open data. The open data resources, operations, and the positive and negative consequences need to be valid enough so the session can happen without discussions on the reality fit of the game. Moreover than the specifics of games with open data actually is the general open data practice in government that needs to be reflected.

These initial requirements can be translated into game elements meaning that they need to be operationalized into the prototypes. Based on Meijer (2009), these requirements were converted into game inputs for our discussions. The defined problem (changing civil servants' attitudes towards open data) is defined for three different aspects of the game: OGD (content), attitude change (goal), and civil servants (audience). These aspects converged to our requirements, now translated into game inputs. These game inputs resulted in the gameplay elements. Figure 24 shows these inputs, which supported the prototyping process, followed by their description in the next sub-sections.

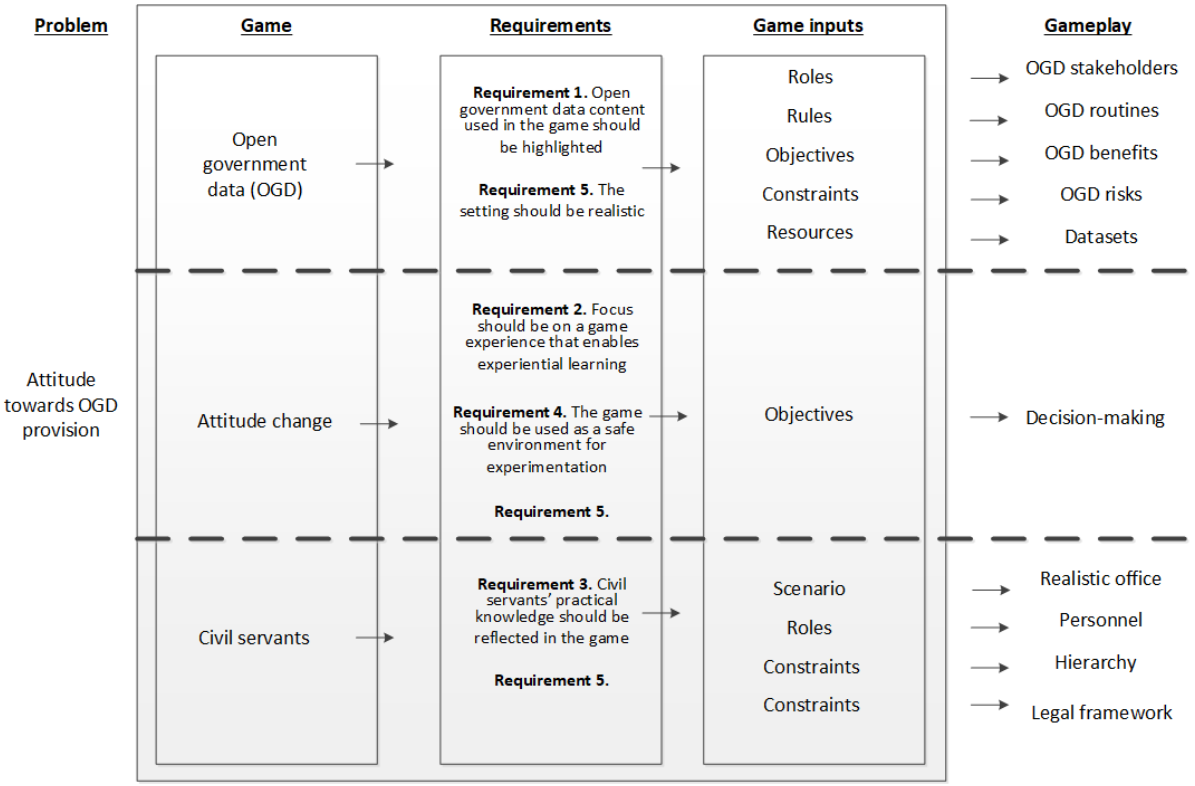

Figure 24 – Game design inputs from the literature (based on Meijer, 2009, p.33)

The experiential learning setting for a government data management exercise indicates that a decision-making game[3] can be appropriate for the players to experience the choice and consequence of their practice. The tacit knowledge and role-playing set points to building characters inspired by governmental personnel in a realistic office, with hierarchy and rigid legal frameworks. The idea of having pre-defined routines of actions also adds to the public office idea.

Lastly, once more, all the setup for releasing open data makes all its assets and elements as candidates to figure into the game. This includes the stakeholders, their tasks, resources, benefits, and risks. Particularly important are the datasets which can be released to the public that should be represented in a comprehensive way that the players can connect data production and release to their gameplay.

We reorganized these inputs to make a summary of the prototyping background. Each of the inputs is detailed in the next sections, followed by the prototyping description, which comes after. Roles, rules, objectives, constraints, situations, and load were the game inputs that were operationalized through gameplay.

4.3.1 Roles

Meijer (2009) defined roles as "abstract interpretations of real-world roles or envisioned future roles that do not exist at present. Roles in a gaming simulation are distributed over the participants. Roles can differ in the actions that they can perform or in the objectives associated, or both" (p.25). We have two main sources to develop the roles of our game. First, it is intuitive to reflect that a game for civil servants needs to have governmental personnel as part of the game. Once more, the realism and ways of representing such functions will depend on other features of the game, built through iterations. Nevertheless, it is highly probable to find objectively (as a role) or subjectively (as a viewpoint) that civil servants' perspectives of open data should be in the game.

The stakeholders related to open data, as discussed in Chapter 3, shall inform the design process. Different actors can influence decisions, and the interest of having data released opens possibilities of designing different settings for the game. Besides civil servants being influential in the data opening process, many other stakeholders are involved in it. We concluded in Chapter 3 that the metaphor for the game is crucial for a game to be effective in changing its participants' perceptions. Mapping the stakeholders that can be represented in the game is crucial to explore roles and functions that can be mimicked in the game.

The first distinction for "playing" open data refers to the cycle of data release and use. In that perspective, four groups were used to connect open data providers and users and their belonging to the public or private sector. The users could be (1) citizens and firms searching for datasets for specific uses in the private sector or (2) governmental agencies and personnel

[3] Many different game genres and mechanics were explored as potential designs for the open-data game. Some of these games which inspired the prototyping and final game development are summarized in Appendix 1.

using datasets for policy-making. The providers' public group represents (3) governments making data available for other governments and the general public while the (4) private providers are citizens and firms sharing their data or from third parties - Table 29. As to be developed further, these groups were initially used in our project to design the first two prototypes of our research game.

Table 29 - Open Data stakeholders

Inside Government	Civil society	Other
• Civil servants • Politicians • Top-level bureaucracy • Controlling bodies • ICT providers	• Citizens • Civil society activists • Academics • Journalists • Opinion leaders	• Non-profit organizations • Advocacy groups • International Organizations • Funding donors • Businesses and companies

Two of the learning prototypes described earlier used a broader view of the open data cycle and had a less specific list of stakeholders enrolled in their design process. Each prototype can demand a different set of stakeholders, depending on the perspective of the problem that the game used. Another approach would be to relate these actors in a map - Figure 25. Likewise, this map is useful to progress with the prototyping process, addressing the relations and tensions between stakeholders towards governmental data release.

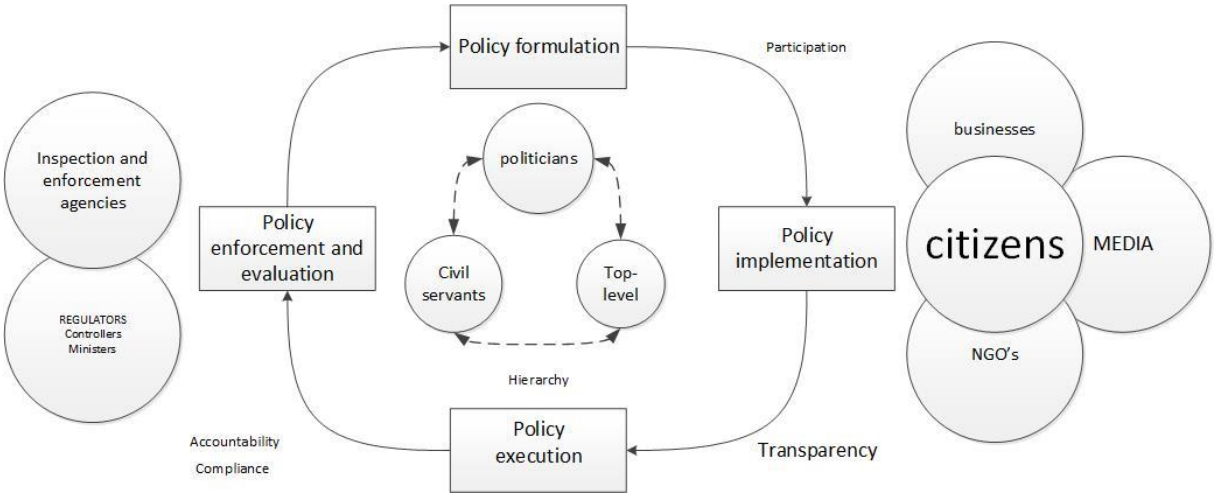

Figure 25 - Stakeholders map

As to be described in the following section, the next prototypes had a broader stakeholders list to include a diverse set of actors which can potentially interact within the governmental data release. This extended list was the basis for the open data game that was played with real civil servants and its use helped to enforce the metaphor precision to the context of open data release. The general description of the open data stakeholders supported all the designed prototypes. We will get back to stakeholders' specifics when describing each of the prototypes in detail.

4.3.2 Rules

Adams (2014) defined rules as the "instructions that dictate how to play" (p.2). They direct the actions that players can make and their consequences to the game. Additionally to stakeholders, these in-game actions also need to be based on real-life operations. These operations can be represented through commands or routines, which define the work of a civil servant. Basically inspired by the field of open data, the many tasks needed to make data available to the public are useful to design the game. They set the actions, hence the rules, which need to be performed by players to open data. Groups of actions build routines that also converge with the idea of a limited environment of a governmental office.

The more realistic the representation of these routines, the better the knowledge transfer is expected to be (de Caluwé et al., 2012; Joldersma & Geurts, 2000). A list of actions was explored to derive potential actions for a game to be designed. Fifty-nine operations were enrolled and described before advancing with the game design - Table 30. These were defined as the behavioral dimensions of operationalizing open data both as an object as an action to be performed in the game.

Table 30 – Knowledge and attitudes representations

Knowledge/Attitude dimensions	Action	How is it done in reality
Open Data can be an option	Opting for open data	Digital registries from public offices can stay closed in local servers. It is necessary to publish data produced in order for it to be available to the public
Some data can be opened	Opening data	In a set of data, some data can be sensitive, so they need to be labeled in order to anonymize sensitive data or even close the classified ones (putting the value of the dataset also at risk)
Data can be created (different types)	Creating data	When doing an activity, data can be produced by registering them
Data can be selected/labeled	Labeling data	In a set of data, some data can be sensitive, so they need to be labeled in order to anonymize sensitive data or even close the classified ones (or ask for authorization)
Data can be anonymized	Anonymizing data	In a set of data, some data can be sensitive, so they need to be anonymized
Data can be harmonized	Harmonizing data	In a set of data, some data which are not following certain standards for access may need to be harmonized for users
Data can be published	Publishing data	When data is ready, it needs to be published
Some data cannot be opened	Opting not to open data	In a set of data, some may need to remain closed, the classified ones
There are risks in opening Data	Labeling data	Understand differences between types of datasets

Knowledge/Attitude dimensions	Action	How is it done in reality
Some data are sensitive for Privacy issues	Labeling data	In a set of data, some data can be sensitive, so they need to be labeled in order to anonymize sensitive data or even close the classified ones
Some data demands Privacy classification	Labeling data	In a set of data, some data can be sensitive, so they need to be labeled in order to anonymize sensitive data or even close the classified ones
Some data needs to be protected	Labeling data	In a set of data, some data can be sensitive, so they need to be labeled in order to protect sensitive data
Some data needs to be corrected	Labeling data	In a set of data, some data can be wrong, so they need to be corrected
Some data needs to be erased	Labeling data	In a set of data, some data can be wrong, so they need to be erased
It is possible to ask for support/help	Asking for support	It can be possible to ask for help when in doubt or having trouble on how to operationalize open data
Tools to support opting for open data exists	Using support tools	It can be possible to have tools to help when in doubt or having trouble on how to operationalize open data
Help to publish data exists	Being helped	It can be possible to have tools to help when in doubt or having trouble on how to publish open data
Privacy Enhancement Mechanisms exists	Using PEM	It can be possible to have PEM to help when in doubt or having trouble on how to operationalize open data
System integration can help opening data	Using integrated system	If data is opened, other people can use it and change routines in the office through system integration
Regulating Quality before data is collected can help its use	Qualification data	Data can be checked before being published
It is possible to get data to be open routinely (Open by Default)	Opting for routines	If data is opened, other people can use it and change routines in the office through system integration
It is possible to establish Central Support	Being helped	It can be possible to ask for help when in doubt or having trouble on how to operationalize open data
There are tools that complicate opening data	Not finding appropriate tools	Some tools may complicate opening data, instead of helping
Insecure networks can complicate the opening of data	Accessing insecure networks	When registering or using data, an insecure network can result in leakages
Lack of protocols can complicate the opening of data	Lacking protocols for opening data	The absence of protocols can make it more difficult to open data
The public/citizens can demand open data	Providing data	Physically oy digitally, citizens can demand the opening of data

Knowledge/Attitude dimensions	Action	How is it done in reality
Freedom Of Information requirements can drop with open data	Providing data	In some countries, Freedom of Information requirements have special urgency when requiring data
The government can demand open data	Providing data	Physically oy digitally, governments can demand the opening of data
Bosses can support opting for open data	Having support to open data	Physically oy digitally, bosses can demand the opening of data
It is possible to have Transparency Laws to enforce the opening of data	Having support to open data	In some countries, Transparency Laws can make the opening of data mandatory
Colleagues can support opting for open data	Having support to open data	Having colleagues that know how to open data can make it easier to open
Bosses can complicate the opening of data	Having difficulties in opening data	Some bosses might be against open data and make it more difficult to open (risk of being relocated, persecuted, etc.)
People with hidden interests/corruption can complicate the opening of data	Having difficulties in opening data	Corrupt people tend to be against transparency and open data (to keep their businesses) and make it more difficult to open (risk of being relocated, persecuted, etc.)
Colleagues can complicate the opening of data	Having difficulties in opening data	Having colleagues that do not know how to open data can make it more difficult to open
Office culture against transparency can complicate the opening of data	Having difficulties in opening data	Having an office without a transparency culture can make it more difficult to open data
It can be difficult to open data if the team does not know how to do it	Having difficulties in opening data	Being part of a team that does not know how to open data can make it more difficult to open
Open data can be searched/found	Searching for data	Searching for data on the internet, on other offices, governments, institutions databases
Open Data can be acquired/accessed	Acquiring data	Searching for data on the internet, on other offices, governments, institutions databases
Open Data can be explored	Exploring data	Passively consulting data obtained on the internet, on other offices, governments, institutions databases
Open data can be exploited	Exploiting data	Actively working with the data obtained on the internet, on other offices, governments, institutions databases
Open Data can be curated	Curating data	Reviewing data used by others on other databases
More people can know what the government does with open data	Receiving recognition	People access open governmental data and understand what the government does
More people can trust the government with open data	Receiving recognition	People access open governmental data and understand what the government does and trust more on it

Knowledge/Attitude dimensions	Action	How is it done in reality
More people can contribute to the government (participation) with open data	Receiving contributions	People access open governmental data and make suggestions or even help government operations
The government can work more integrated (offices knows more about other offices) with open data	Receiving contributions	Other offices in government access information and contribute in between the government
Open data can reduce red tape burden	Saving time	Less paperwork is needed to obtain and use information from the government
Open data can reduce the necessary time for the government to find information	Saving time	Less time is needed to obtain and use information from the government
Open data can reduce the necessary time for citizens to find information	Saving time	Less time is needed to obtain and use information from the government
Data leakage can happen with open data	Having crisis	Governmental crisis happens after data is leaked
A security breach can happen with open data	Having crisis	A governmental crisis happens after a security breach
More complaints can happen with open data, with people knowing more of what is happening	Having crisis	More people know about governmental problems and make more complaints
Fewer complaints can result from opening data as people might have better information about the work	Receiving recognition	More people know about governmental problems and make fewer complaints
A local political crisis can affect the opening of data	Having crisis	Governmental crisis happens after a security breach/data leakage
An international political crisis can affect the opening of data	Having crisis	Governmental crisis happens after a security breach/data leakage
Open data can enhance local political opposition through espionage	Having crisis	Governmental crisis happens after a security breach/data leakage
Open data can enhance international political opposition through espionage	Having crisis	Governmental crisis happens after a security breach/data leakage
Open data can result in misuse of information	Having crisis	Governmental crisis happens after the information is misused

The definition of tasks and operations that players can perform in the game defines the core mechanics that make the game work. These are presented as rules of the game, another input to be defined in the game design process, which constitutes a central element of the prototype.

4.3.3 Game goals

Another game input, coming from the prototypes and resulting in the final version of the game, was the objectives of players in the game, their game goals. Goals define the achievements that players should fulfill by playing the game (Adams, 2014). McGonigal (2011) found that clear objective is one of the main differences of games in comparison to real-life. Clear objectives can support a well-designed feedback system and support the engaging mechanisms of a game.

For Meijer (2009), "different roles can have different objectives to create a multiple attribute incentive system. Objectives can be individual or the combined goal of a set of roles. Objectives are needed to steer the actions in a session" (p.26). From Chapter 3, we discussed the challenges of making a game to change players' attitudes. From the experiential learning perspective, the safe environment of the game is useful to enable participants to experience making choices they would not do in real-life situations; and to face its positive and negative consequences as in concrete situations.

We needed to recreate a situation where the option for data opening is available to provide civil servants with experiences of the data release. Consequences from this decision can be experienced, allowing them to learn from it. Again, the realism of these choices and their consequences can be supported by real cases from the literature. As to be seen in the Load discussion, the many datasets which are already being opened by governments and the diverse positive and negative outcomes of data opening supply the game design with the necessary content.

Many game genres are available for defining game prototypes. Within the possible goals for players in the game indicates that a decision-making game might fulfill the needs for simulating a real-life situation of choice, which results in consequences. The challenge of creating a valid experience can be easier using a clear metaphor for the game (i.e., a shooter game could also be used, but the game metaphor could be more difficult to connect to the situation of civil servants). A decision-making game is defined as a management simulation focus on processes and has its goals to build something into an ongoing plot. Adams (2009) argued, "the better the player understands and controls the process, the more success she has in building it (…) pattern recognition and exploitation challenges may also be present" (p.527). A game can hybrid include elements of coordination and conflict by introducing elements from other genres such as role-playing.

Additionally to a decision-making setup, once more, the specific elements of open government data can inform the development of the game. As the objectives are set to be achieved by players, in the open data context, we need them to will for gaining the benefits of data release - Table 31. As described in Chapter 3, the various open data benefits can be listed and used in the game depending on the prototyping iterations. Making decisions for accessing the open data benefits is a starting point for prototyping the game.

Table 31 – Individual and collective benefits and risks of open data

Individual benefits	Organizational/Societal benefits	Risks
Avoid unnecessary duplication of data and associated costs (also by other public institutions)	Creation of trust in government with More visibility (data provider)	Individual and organization privacy
Optimization of administrative processes	Gains in transparency and accountability	Security risks
Access to external problem-solving capacity (innovation)	Improvement of citizen satisfaction	The unclear trade-off between public values (transparency vs. privacy)
External quality checks of data (validation)	Improvement of policy-making processes	Concerns on quality and accuracy of data
Sustainability of data (no data loss)	Knowledge developments and new insights using the wisdom of the crowds	Risk of protests against public actions by misinterpretation of data
Creation of new insights in the public sector	Democratic accountability, participation, and self-empowerment of citizens	Threat of lawsuits
More informed policy developer	Better service delivery	More powerful/centralized governments
Economic value generation	More economic activities	Economic concentration due to higher processing power

Once more, our realism requirement appears as a crucial characteristic of games on any of the researched designs, open data, civil servants, or for attitude change. As the achievements of benefits from open data define the main objectives for the prototype, to be realistic, these benefits need to be balanced by risks. Table 31 provides a diverse list of risks related to releasing governmental data provides the needed counterweight. Also, from Chapter 3, these enlisted barriers for governments to open data can be categorized towards risks that can be represented in the game.

These risks work as constraints to our inputs discussion. According to Meijer (2009), "constraints shape the values of punishments, the minimum and maximum values of time, money and points. Constraints can be set to make a gaming simulation match the real world or to make it explicitly different" (p.26). Besides the negative consequences of open data, the specific set-up of the office will demand different constraints to add realism (and fun) to the game.

From a civil servant perspective, hierarchy and rigid legal framework can also add limitations to players' agency. For a decision-making game, the number of available possibilities, consequences of decisions, and also the costs involved (in terms of time or other resources)

are possible to include in the game. More details on the options for different constraints and benefits will be described in conjunction with the other elements of each prototype.

4.3.4 Resources and Scenario

Resources and scenarios are also inputs coming from prototypes to our final game design. A scenario is the setting in which the game is developed and can be adjusted according to the audience (Adams, 2014). As realism is again a crucial characteristic of the game for attitude change and civil servants need to experience opening data in a governmental situation, simulating an office seems to be an option for prototyping the game. It can provide the environment for practicing an open data policy and include open data routines.

Also, opening data involves many different resources which can be at play. First, there needs to be a source of the register that generates the data. It means that for data to be shared, first, it needs to be generated. Also, it is crucial that this data is registered somewhere. Drawings, paper, and pen, books, tapes, disks, or hard drives, independent of the historical moment, the media are needed so data can be recorded and shared. Expanding resources, we can explore the setting with (or without) electricity, internet, Wi-Fi, or means for transmitting registered data. Depending on the chosen elements, different games and game metaphors will emerge.

In our case, a central resource for the open data game is Datasets. These are groups of data that can be produced, shared, and used by different actors with varying objectives. It defines a set of complexities related to the variety of data that can be represented. In a way, datasets can be as broad and complex as stakeholders or actions: they can go from simple administrative registers of daily actions to specific data on national contracts and agreements. Issues like budgetary importance of data, privacy, or national security matters will be set to each context with diverse involved parties. Therefore, scoping is needed to refine the relevant variables of the game to be developed, knowing that each context might demand different setups.

Also to be considered is the sensitivity of data (Janssen, Matheus, Longo, & Weerakkody, 2017; van Loenen et al., 2016). Different types of data demand classification and definition of source and consequences. To be opened, partially opened, or classified is something to be considered in relation to the actual legislation and its effects (van Loenen et al., 2016). According to each specific set-up, the dataset definitions will be set to better represent the reality of data management in governments. As the research aims at producing concrete evidence of change in attitudes through gameplay, this metaphor also needs to be precise so the players can compare different cases and learn about open data provision. Therefore, some assumptions are considered to set the experience to be developed in the game:

- National Governments have open data strategies;
- Public policies are executed through national schemes that are influenced by other levels (regional and local) to be implemented;

- To be played by civil servants; and
- To be played different contexts (comparable); and
- Adaptable to different government levels, such as municipalities/regional/federal level (generalizable).

Additionally, other parameters were set to define the prototypes. Depending on the setting, different criteria were adopted to select policies that could benefit from opening data and have a national operational scheme. Depending on the size, source, and access allowance, it is possible to label data and decide to release it (Figure 26).

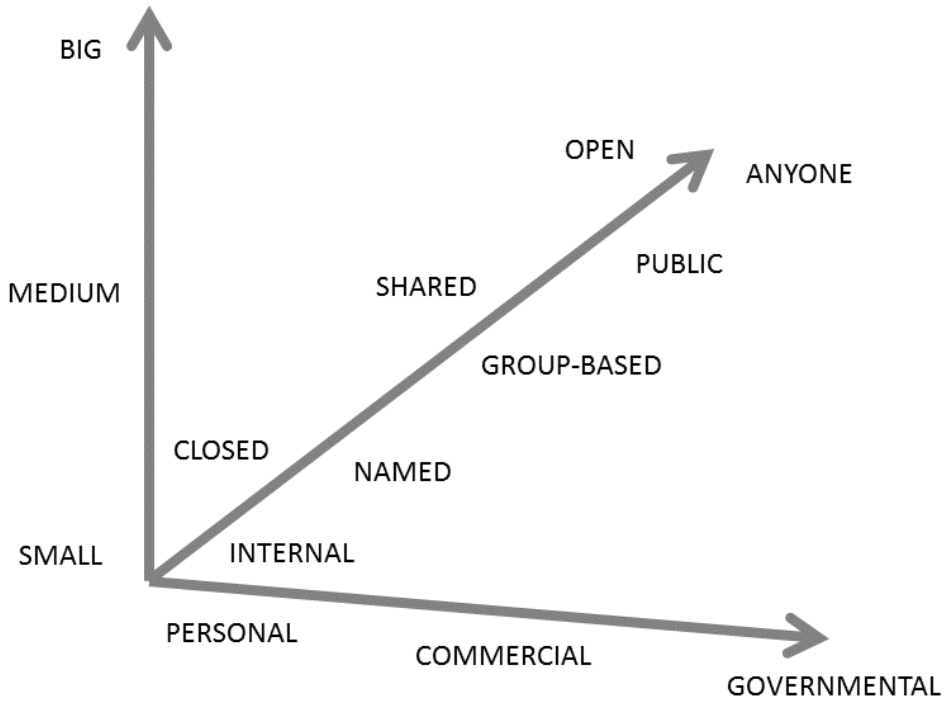

Figure 26 - Open data Dimensions (based on OECD (2018))

Using multiple sources [4], we identified a list of potential datasets, which accessibilities' could be discussed in the game. It resulted in the first list of commonly available data from governments that could be used as a reference to design the data contents of the game (Davies et al., 2019; Ruediger & Mazzotte, 2018; WorldBank, 2014). In Table 32, a design exercise was performed with some of the most commonly used datasets – as part of the prototyping process, it was a normative exercise of selecting some contents and translating them into a playable set of data, which could be improved for new versions of the game.

[4] The list was also inspired by the Open Data Inventory (https://opendatawatch.com/publications/open-data-inventory/), the Global Open Data Index (https://index.okfn.org/place/), the World Bank data catalogue (https://datacatalog.worldbank.org/) and the open government partnership panel (https://www.opengovpartnership.org/), accessed first on 27.11.2018.

Table 32 - Governmental Datasets Exploration

Policy	Content	Dataset type				Data Sensitivity			
						Internal		Public	
		Time-series	Geospatial	Microdata	Complete Dataset	Security	Privacy	Shared	Open
Urban	Housing	X	X	X	X		X	X	
	Land ownership				X	X	X	X	
	Traffic	X	X	X	X		X	X	
	Crime	X	X	X	X	X	X	X	
Environment	Water	X	X	X	X	X	X	X	
	Trees	X	X						X
	Pollution	X	X	X	X		X	X	
	Weather	X	X						X
	Air quality	X	X		X	X	X		X
	Lawsuits	X		X	X	X	X	X	
Infrastructure	Streets		X						X
	Buildings	X	X	X					X
	Plans	X	X	X	X		X	X	
Economic	Personnel	X		X	X		X	X	
	Budget	X		X					X
	Investment	X	X	X	X	X	X	X	
	Business registry								
	Employment	X	X	X	X		X	X	
	Public acquisitions			X	X	X	X	X	
	Trade	X		X	X		X	X	
	Contracts			X		X	X	X	
Politics	Voting records	X	X	X			X	X	

Policy	Content	Dataset type				Data Sensitivity			
						Internal		Public	
		Time-series	Geospatial	Microdata	Complete Dataset	Security	Privacy	Shared	Open
Services	Social Benefits	X	X	X	X		X	X	
Education	Students	X	X	X	X		X	X	
	Teachers	X	X	X	X		X	X	
	Schools	X	X	X	X		X		X
	Grades	X	X	X	X		X	X	
Health	Patients	X	X	X	X		X	X	
	Doctors	X	X	X	X		X	X	
	Diseases	X	X	X	X	X	X	X	
	Units	X	X	X	X		X		X

Besides the data itself, the other resources would depend on the design selected to develop specific prototypes. Using chairs and tables, staplers, or computer screens would result from the setting of the game itself. The resources and scenario can vary according to the defined prototype. It will be further discussed when describing each of the performed iterations of this research.

In the next section, the final version of the game is described in detail. We have decided to extend this discussion to solidly ground the design options made and clarify the research discussions resulting from it. The analysis and evaluations of the game compose the next chapters of this thesis.

4.4 WINNING DATA: final game version

Initially, the idea was to have a *digital* game focusing on local governments' civil servants. The idea of making a game that could be viral and played by mobile phones indicated that a digital game could be more flexible and impactful for the civil servant audience. The idea of focusing on local governments came from the diagnosis that data was released on the national level more often than by municipalities. However, the prototype iterations resulted in unexpected results concerning the audience and digitalization.

First, we found that, in general terms, the game elements used as inputs from local settings should not differ much from the ones with which national civil servants are involved. The game

elements needed for the game, such as hierarchical environment and rigid legal framework, make the game applicable to a larger public[5]. This allowed the quasi-experiment to be extended and include the government level as a variable in our discussions.

Second, through the digital prototyping process, some human behaviors were defined for NPC (non-player characters). To make the game realistic, these NPCs needed testing. It leads to a face-to-face role-playing version to be developed for observing real-life behavior. Moreover, the outcomes of the role-playing were surprisingly favored and provided many insights for the participants. Also, the ability to play different roles was expected to contribute to attitude change. Hence, the role-playing version was adopted as the final version of the game.

After a long process of trial, error, evaluations, and adjustments, a final version of a playable game was available for testing the research. In this section, we describe the game in detail. We follow Olejniczak et al. (2016) as a reference for making each of the active game elements explicit in the description. After presenting an overview, each element is discussed, e.g., the office, players/roles, game assets, and game structure and mechanics.

4.4.1 Game overview

The game aims to change civil servants' attitude to opening governmental data. The game simulates a public office where the players deliver services to a citizen (Kleiman, Janssen, & Meijer, 2019). While the services are provided, datasets are created with various levels of sensitivity regarding privacy and security issues. This ensures that players learn to deal with various types of datasets and data protection. Different service delivery performances and data labeling options (open/do not open certain datasets) lead to results. In a time-restricted in-person role-playing set-up, the players perform their roles so that all the participants experience all the functions and perspectives of the office in terms of service delivery and data provision.

The chronological metaphor of the game simulates five weeks in the office. Each week corresponds to a round of play (around five minutes) in which the players have to deliver certain service demands. The first week has general demands related to information requests. The next three weeks concern defined topics: education, health, the environment, and urban issues. The last round assesses themes of corruption and red tape burden reduction. The datasets contain a variety of sensitive data so that some should not be opened, some partially and others fully.

The final version of the WINNING DATA RPG version is a game for four players and one facilitator who plays the role of the game master. Participants are distributed over four roles: civil servant, colleague, boss, and citizen. Each role has specific rules to perform their activities during each moment of the game. The common goal is to have as many services delivered to the citizen in one round as they can; and then to label the corresponding datasets in terms of

[5] Tests within academia also indicates that non-public servant audiences could benefit from playing the game. However, they were out of this research scope and can be discussed in further research.

sensitivity between the rounds. All players get to play a different role in each round, enabling them to experience the governmental data release from different perspectives.

As the players have played all four roles by the end of the 'five weeks', they have a better understanding of the various perspectives of the need and benefits of open data. The differences in performance, the chance provided by using dice in the service processing routines, and the feedback system of recognition points immerses the players in the plot and ensures fun.

As games should be educating and entertaining, time pressure is used to generate fun in the game (Koster, 2013). A timer is used to represent Monday to Friday in the five-minute rounds. The service delivery 'week' is then followed by a data labeling session in which the civil servant and colleague read the description of each dataset produced in the week and suggest a sensitivity label to the boss. Whether datasets are closed, shared, or opened to the public depends on the content and context of the dataset and has consequences for the next round, which leads the participants to engage in experiential learning (Kolb, 2000). As the game progresses, improvements are suggested depending on the group performance – these improvements can change the routines and the number of demands received in the upcoming round. As a design option, only the quantity of services could be represented in the game, being the idea of improving service quality to be developed.

Lastly, specific dice combinations (doubles or triples) can produce privacy or security crises, simulating the risks of making data management decisions. Each of these elements is described next to detail how the game was played. By doing that, our experiment is described, preceding the analysis of the data collected through it. These analyses and results are exposed in the upcoming chapters of this thesis.

4.4.2 The office

The office is the space where the game is played. It is where each role needs to be performed to reach recognition points at the end of the week. The more recognition points the group achieves, the more options are offered to improve their performance.

To represent the office, we organize a room so the participants can play their roles. Each group of players consists of a civil Servant, circulating in a corridor between the boss and stations; a boss, in the middle of the office, backward to the team; a colleague, sitting beside the civil servant; and a citizen, sitting facing the office, to demand services. The game-master stays out of the office (our magic circle).

Each participant has a table or chair to be permanently seated. No moving around is allowed for the boss, colleague, and citizen. Only the civil servant runs around to receive and process resources and deliver the demands. The game-master stays out of the office. All places for the boss, colleague, and citizen start with a pair of dice and one pen, and an identification tag.

A corridor is set in between all tables, forming a path through which the player needs to walk (or run) around to receive and process the resources and deliver the demands. The game-master stays out of the office to perform his tasks without interfering with the game dynamic. Also, the introductory briefing and debriefing run out of the office, so participants can reflect on a different position from the one they played.

4.4.3 Players and roles

Each player has a role per round. WINNING DATA was designed for a four-player session. In each round, the players will play another role, allowing them to choose a role at the beginning, which is repeated in the 5th round. Eventually, exceptions were made for sessions with more players, and the participants could not repeat a role.

The four main roles are the citizen, who demands services and gives recognition points for the services delivered; the boss who supervises the action and has the final word in the data labeling process; the civil servant who manages the resources to deliver services to the citizen; and, the colleague who processes the demands and helps the civil servant collect the data for labeling.

4.4.3.1 Citizen

The citizen represents the civil society urging for governmental services. It also represents businesses looking for new economic opportunities. The game-master gives to the person playing the citizen's role a pre-defined set of cards with demands at the beginning of each round (Appendix 5 – Game assets). This player decides how many and which order to pass these demands to the civil servant. Some of the demands may demand the citizen to fill in some papers, and in that case, the player roll dice to fulfill a business rule for the role: achieving a number seven or higher in two dice allow them to sign the document, which moves on to other tasks. This resulting number needs to be written into the civil servants' form to be processed and as data to be delivered to the citizen.

After all the operations described in the card are performed, the citizen receives a file containing the original demand code and the resulting processing digits. The player inserts these codes in an excel table on a laptop, which allows the automatic scoring system to work, and ends his attributions in the round.

Depending on the group decision, the citizen role player can participate in the dataset sensitivity labeling discussions, representing citizen participation. The civil servant and colleague are the ones to invite the citizen player to be active.

4.4.3.2 Civil servant

The civil servant player is the only one allowed to move around the office. This player receives the demands from the citizen and registers its code in a form to keep track of this task. Depending on the routines, actions from the other players are needed to fulfill all the required operations from each card—every card results in a file with the corresponding digits from

these performed tasks. When the file is complete, the civil servant delivers it back to the citizen.

Between each round, the civil servant participates in the labeling by discussing with the colleague the sensitivity of each dataset produced. If consensus is reached, they can suggest the advice to disclose the data to the boss. Otherwise, the divergence can also be reported so the boss player will decide what to do.

4.4.3.3 Colleague

The colleague is another civil servant that helps with the processing of the citizen's requests. By rolling two dice, this player must achieve a number seven or higher to consider the task done. This result is registered in a file that the civil servant delivers back to the citizen, which allows the group to score. For instance, some routines, such as a file update requirement, might demand the colleague to roll the dice more than one time, which causes confusion in the office and demand some planning by the players.

The colleague also has a stapler to bind and keep the demand cards with the initial forms used by the civil servant. The demand and form set are the datasets labeled in terms of privacy and security sensitivity. The colleague organizes these card sets and the labeling discussion afterward, acting as a kind of datacenter in the game.

4.4.3.4 Boss

The boss has the final word in the office on labeling datasets. This player is the one monitoring the office work, particularly in terms of time. The boss oversees the timer and should inform the team to deliver demands on time.

Also, some requests need to be signed or approved by the boss, which is done by rolling a number four or higher in the two dice. Lastly, the boss receives the suggestions for labeling and decides whether to follow it or change, based on his own interpretation of the dataset description (and previous experience) or by asking the other players for more details, which is also allowed in the game.

In the case that the office reaches certain scores, the boss in charge also decides whether to accept or not the offered improvements, such as the adoption of privacy enhancement technologies, which creates protocols that dismiss labeling some datasets.

4.4.3.5 Facilitation (Game-master)

The main task of the Game-master is to keep the game flow. To do that, all demand cards need to be correctly distributed to the citizen at the beginning of each round. By the end of the round, the laptop with demand codes and processing digits also needs to be transferred to the boss's desk to insert the sensitivity labels. The game-master coordinates the timer, crisis board, and labeling sessions. Finally, it is part of this role to give feedback to the participants by the end of each round. First, recognition points are generated in the scoring system, based on the number of services delivered, the number of FOI requirements not delivered (penalty),

and the datasets disclosed (the more precise the labeling, the more points are scored). The score is informed to the players. The labeling precision and consequences for next week are also announced, explaining the metaphor of the labeling consequences, such as describing that the increase in FOI requirements will occur as more datasets have been closed. Eventually, upgrades are offered to the round's boss, depending on the score achieved by the group.

The Game-master also applies the pre-test survey; presents the game introduction; coordinates the tutorial round. After the game ends, apply the post-test survey and coordinates the debriefing session for feedback and discussions.

4.4.4 Game assets

Game assets are the visual and physical objects used in the game. The game to change civil servants' attitudes towards open data has as its main assets the datasets. These are assets that represent the data that is produced, used, and labeled in the office. The datasets result from the completion of routines and are labeled accordingly to their privacy and security sensitivity afterward.

4.4.4.1 Forms, Files, and Demand Cards

Each round of the game has a pre-defined set of services available to be demanded by the citizen. The player in this role receives Demand Cards with specific codes for each of these services and hands these cards to the civil servant player, as shown in Figure 27. They can choose to give all the available demands at once, making the logistics for the civil servant messier or giving these demands one-by-one, risking the round to last without delivering all the services.

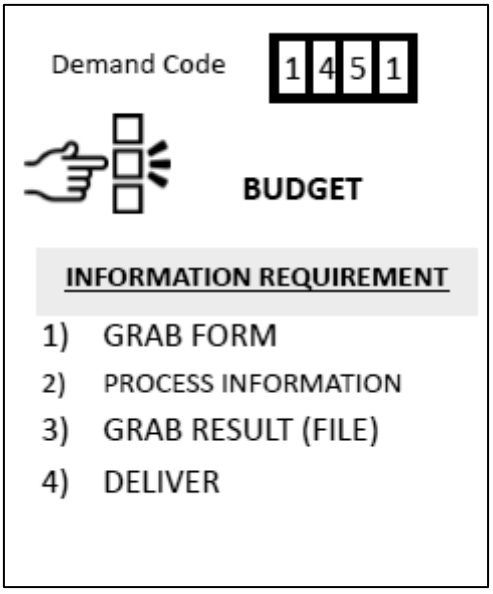

Figure 27 - Demand Card

These demand cards have four main types of information: a title indicating the policy to which the demand is related; a type of routine to be performed related to that specific topic; the

tasks that need to be performed for fulfilling that routine; and a code to be used when processing that information, which will be explained later. It is assumed that each service generates a dataset to be labeled in the next game session. A dataset sensitivity description is on the back of each card, only used if the service is delivered and then subject to labeling - Figure 28.

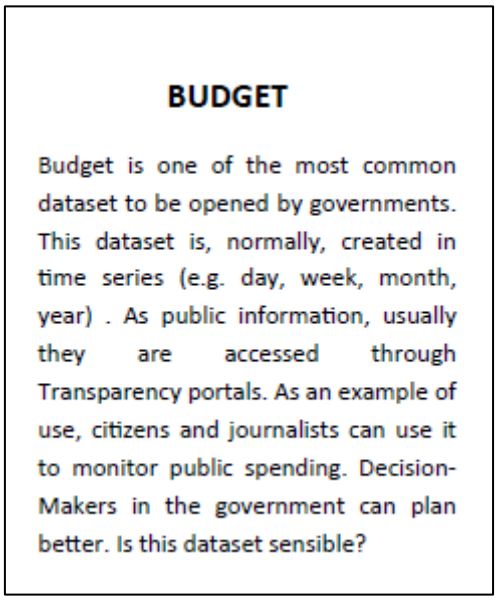

Figure 28 – Example of the back of a Demand card

The civil servant receives the demand card and moves to her working station. There she finds a pile of Forms - Figure 29. These are cards with three blank fields: one to copy the demand code, another to fill with the citizen codes, and the last one to label that dataset sensitivity. The civil servant takes both cards and moves to the next activity.

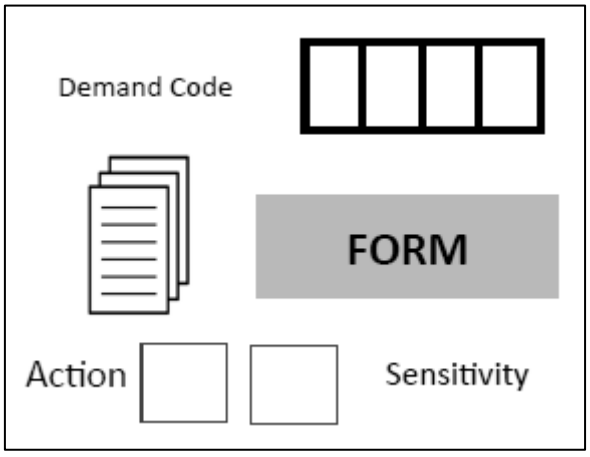

Figure 29 - Form card

Information requests are the most simple routines in the game and do not demand any processing by the citizen. So for this type of demand, the fields for citizen processing remain empty, and the civil servant moves directly to her colleague. For the other demands, the civil servant asks the citizen to fill in the form by rolling the dice and fulfilling her targeted number,

which is seven or higher. Initially, citizen, boss, and colleague have two dice each, which they need to roll and match some combinations. As previously explained, all the numbers were defined based on their probability to make the processing last more or less.

The colleague receives both cards, Demand, and Form, and copies the codes to a File - Figure 30. Besides the fields for Demand Code, Files also have four blank lines for “processing”. If the demand has already been registered with citizen digits, this goes as the first line. Otherwise, the colleague dice combination goes on the first line. Again, a number 7 or higher is needed to fulfill this processing rule.

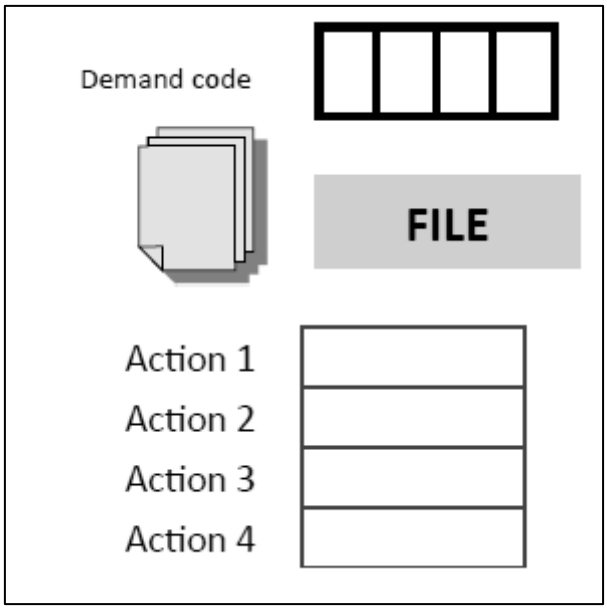

Figure 30 - Filecard

Information requests and Authentication routines end up with this File being delivered back to the citizen, who inserts the resulting codes in the Excel Sheet, also later explained. The first, Information requests, will have only one combination of processing resulting from the colleague. Authentication should have two combinations, one coming from the citizen and another from the colleague.

Update requests will also demand the civil servant to take the File to the boss and get her to sign the document – rolling dice to a number higher than 3. This third number goes on the third line of processing in the File card. Besides the boss's signature, Revisions also needs to go back to the colleague and get a fourth number to have the bureaucracy complete. Each card has its routine and should be delivered back to the citizen with the correct number combinations. Table 33 summarizes these routines.

The services and their corresponding datasets have proper coding and a description on the back of the card. The code, which logic is unknown for the players, is composed of four numbers: the first indicates the level of sensitivity of that dataset, from 1 to 3; both of the middle digits refer to the round being played and help the game-master to control the exact

moment to distribute each card; the last number defines the routine to be performed to complete that task.

Table 33 - Service delivery routines

Information requisition	Authentication	File update	Decision revision
Form	Form	Form	Form
Processing (Colleague's action)	Processing (Citizen's action)	Processing (Citizen's action)	Processing (Citizen's action)
File	Processing (Colleague's action)	Processing (Colleague's action)	Processing (Colleague's action)
Delivery	File	File	File
	Delivery	Boss signature	Boss signature
		Delivery	Processing 2 (Colleague's action)
			Delivery

The citizen should insert the File's final numbers in the Excel file, which contains three sheets with few available spots to be inserted by the players. She should insert these numbers in the first table named "Citizen", the initial code source for the demand code and its final outcome. The table automatically copies the code to the other Tables.

4.4.4.2 Dataset description

The round ends by completing all the available Demands or when the timer runs out of time. The Game-master should save and move the computer to the boss, putting the Excel file on the next table. The Labeling session starts, and all the delivered Demands are now analyzed by the civil servant and colleague. They read the back of the delivered Demand cards and register a suggestion for Labeling each Dataset with a corresponding sensitivity in the blank spot of the Form. They can invite the citizen for discussion, and some groups even included the boss in this debate. The "Boss" table copies the Demand Code inserted by the citizen and enables one spot for players to fill in their decision on the labeling of datasets. This blank space only accepts 1, 2, or 3 as a register. The player in the boss role is the one to fill this field with his final decision, agreeing or not to the other players' suggestions.

Labeling datasets is a grey zone and very dependent on the context. Game-wise, we developed a reference system based on the literature to define the correct answer for the descriptions (Davies et al., 2019; Ruediger & Mazzotte, 2018; WorldBank, 2014). Rather than leading participants to learn about specific dataset sensitivity, these descriptions provide content for

discussions. The imprecise text of some datasets was purposely created to trigger divergences and bring personal experiences and beliefs to play. Table 34 details these datasets and their reasoning used in the game.

Table 34 - Dataset cards

Card code				Action	Subject	Card text	Explanation
1	4	5	1	INFORMATION REQUEST	BUDGET	Budget is one of the most common datasets to be opened by governments. This dataset is created in time series (e.g., day, week, month, year). As public information, usually, they are accessed through Transparency portals. As an example of use, citizens and journalists can use it to monitor public spending. Decision-Makers in the government can plan better. Is this dataset sensible?	Usually, the public budget is approved in Congress and implicated in a budget law. It is supposed to be publicly accessible, so its sensitivity is considered low
2	4	6	1	INFORMATION REQUEST	EMPLOYMENT	Employment datasets can help citizens, businesses and policy-makers understand local, regional, and even national economic activity, enabling them to monitor and improve decision-making. They can also be interested in knowing the available workers' profiles. The data stored on labor policies can contain private information (name, address, etc.) from workers, employers, and other parties. Can there be risks for individuals or security in these datasets?	Jobs and work positions can be part of public work policy systems. However, it can have personal information from both employers and workers. Accessing this information shall require control to guarantee proper usage. Otherwise, if legal requirements define, these datasets need to be aggregated or, at least, anonymized in order to be publicly released.
2	4	7	1	INFORMATION REQUEST	SOCIAL BENEFITS	Part of governmental expenses is social benefits. Different programs exist in social benefits frameworks such as social security programs, food allowances, and others. The disclosure of social benefits expenses can allow citizens to identify poverty diversity within regions and policy-makers improve decision-making. These datasets can contain private information (name, address, etc.) from beneficiaries and providers. Can there be risks for individuals or security in these datasets?	Social benefits are part of social policies, and they tend to have values and conditions publicly defined. However, the operational information on payments and schedules can have personal data from beneficiaries. Accessing this information shall require control to guarantee proper usage. Otherwise, to be publicly released, this information needs to be aggregated or, at least, anonymized.

Card code				Action	Subject	Card text	Explanation
3	4	8	1	INFORMATION REQUEST	CRIME	Crime datasets can help people analyze safety in their place. It can help to build safety routes and or give support to public and private investment decisions. Can these datasets contain strategic information from the government (and the police)? Can the release its release result in segregation? Is this dataset sensitive?	Two main issues might derive from crime datasets. First, they can contain specific information on ongoing cases and might expose the people involved. They can also collect strategic details of police operations. For security reasons, most of its data can be sensitive. However, it is a gray area from the literature, and we opted to be conservative in this labeling for game purposes.
1	4	9	1	INFORMATION REQUEST	WEATHER	Many sensors around the city can help people know and even predict the weather. Apps were developed in some countries using the publicly available data to inform the population on a precise weather forecast. How sensible are these datasets?	One of the most successful cases of opening data is related to weather. It has unleashed new apps and services which contribute to society - from more precise weather forecasts to anti-disaster strategies. With the expansion of personal and smart data meters, recent discussions are happening towards regulation. Still, it is a dataset that tends to be fully opened.
2	5	5	1	INFORMATION REQUEST	TRAFFIC	The public information of transportation can support citizens to analyze bus routes through GPS. It can also support them to compare regions where most regularly parking tickets are issued or speed limit violations happen. Can there be risks for individuals or security in these datasets?	General traffic information can help citizens to understand routes and support firms to improve transport services. However, different types of data can make up these datasets, including fines, licenses, and registration. In these cases, private data can be found and needs to be anonymized before sharing.
1	5	6	2	AUTENTICATE	TREES	Some governments register the location of trees in their city with geospatial data. It can help the community identify where they are and even discuss where they lack or how to maintain them. Shall it be opened?	Evaluating and planning the greens in a neighborhood can be useful for governments, NGOs, and citizens. Tree mapping exists for public use and can be shared publicly.

Card code				Action	Subject	Card text	Explanation
2	5	7	2	AUTENTICATE	HOUSING	Housing data can support people and companies to choose where to live or build. Aggregated Data can be useful to discuss the neighborhood or other related issues. Can there be risks for privacy or security in these datasets?	Housing policy targets solving people's living conditions. However, many of the actions are developed at the individual level with subsidies and loans. This information may be sensitive to privacy reasons and needs treatment before sharing.
1	5	8	3	UPDATE	STREETS	Streets can change from time to time. The government shall control them all and keep them geospatially referenced and up-to-date. People might be interested in accessing this information for many reasons. Is it safe?	Most people do not see it, but the street map can be a live organism in the city. From constructions to names, this data needs a permanent update and is useful for many reasons. It can be publicly available.
1	5	9	3	UPDATE	PUBLIC BUILDINGS	The registry from public buildings is used by governments to manage their teams and policies. Citizens can also be interested in accessing this information to discuss and improve policies. Shall they be able to access, use and reuse it?	The reference address of public administration offices needs to be available, so that citizens and firms know where to go. Even the buildings which are not street-level service providers are also to be known by the population (there has been some discussion as the address can identify people who use or own them, concerning privacy issues... anyway, in general, it can be fully shared)
2	6	5	1	INFORMATION REQUEST	STUDENTS	Knowing the distribution of students into schools can help society participate and contribute to educational policies. Aggregated students' datasets can give a big picture, but individual information could refine discussions. Are there risks for privacy and security in these datasets?	From enrolments to attendance lists, there are many datasets related to students. As they tend to contain private information, they demand some work to be published.
2	6	6	1	INFORMATION REQUEST	TEACHERS	Teachers are education providers at schools. Information from the ones working on public schools might be interesting to reflect on their availability and distribution.	The educational staff of schools and universities is a component of major administrative data from governments. However, depending on the aggregation level of information, these professionals can be

Card code				Action	Subject	Card text	Explanation
						Can there be risks for individuals or security in these datasets?	exposed. So these datasets demand some work to be published.
1	6	7	3	UPDATE	SCHOOLS	As public buildings, schools are also public units for educational service provision. People might use it to collaborate with the government or even offer private services. Are there risks for privacy and security in these datasets?	The schools are the units for educational service provision and need to be available for the population (there has been some discussion as the address can identify people who use them, concerning privacy issues... anyway, in general, it can be fully shared).
2	6	8	3	UPDATE	SCHOOL GRADES	The aggregate information of educational performances might get society to have insights and contribute to education discussing priorities and challenges. Is it risky for privacy or security to expose it?	Other personal information can help people discuss and decide on educational policies. Individual records might demand specific access to control their use. The aggregate data can be shared.
2	6	9	2	AUTENTICATE	PERSONNEL	Civil servants are public employees that should be accountable for their public action. It may also be important to compare governments from different regions or to analyze their distribution in the country. Are there risks for privacy and security in these datasets?	The professionals working for governments have many registers throughout their own units or in central datasets. Some of this information is sensitive for privacy reasons and demands some work to be published. I.e., payroll, personal profile with address, telephone, etc.
2	7	5	1	INFORMATION REQUEST	PATIENTS	Patients' health services usage datasets can help society participate and contribute to public life. They can have insights into new solutions or demands for specific issues or regions. Are there risks for privacy and security in these datasets?	From patients to consultation lists, there are many datasets related to patients. Health data is considered a special category of personal data which is highly sensitive. As they contain personal data, they demand some work to be published, subject to very restrictive rules. Their health history, besides personal profile with address, telephone, etc. Also, in the case of rare diseases, patients can be easily individually identified.

Card code				Action	Subject	Card text	Explanation
2	7	6	1	INFORMATION REQUEST	DOCTORS	Doctors are the health service providers. Insights from society and public service itself can come from their dataset availability. They can identify certain flaws or even suggest new public and private actions. Are there risks for privacy and security in these datasets?	The medical staff of health units and hospitals are a component of major administrative data from governments. However, depending on the aggregation level of information, these professionals can be exposed. So these datasets demand some work to be published.
1	7	7	1	INFORMATION REQUEST	HEALTH UNITS	Health units are places for health service provision. From hospitals to clinics, different geospatial or even administrative information can foster discussions and insights. Are there risks for privacy and security in these datasets?	The units for health service provision needs to be available for the population (there has been some discussion as the address can identify people who use them, concerning privacy issues, depending on the country regulation... anyway, in general, it can be fully shared).
3	7	8	3	UPDATE	DISEASES	The aggregate information of health might get society to have insights on the service provision. Better public information on disease occurrences or even spreads can lead society to take action. Are there risks for privacy and security in these datasets?	Other personal information can help people discuss and decide on health policies. Individual records might demand specific access to control their use. Even the aggregate information can cause major issues such as informing the spread of certain diseases, which can have a placebo effect on the population (and needs to be carefully controlled). There are cases when releasing disease data of a certain type of infection resulted in many people declaring symptoms even being healthy (placebo or nocebo effect) and mass behavior.
2	7	9	4	REQUEST REVISION	POLLUTION	What if the public information on pollution could be shared with citizens? Knowing the distribution or even its strength in different regions or producers can organize	Pollution can be an important dataset for policy-makers and the general population. However, individual firms sued for pollution records might be exposed before final judgment. Some of this

Card code				Action	Subject	Card text	Explanation
						public life. Are there risks for privacy and security in these datasets?	information is sensitive for privacy reasons and demands some work to be published.
2	8	5	1	INFORMATION REQUEST	WATER	Water is a very important dataset for people to understand supply and use in their place. These datasets can also result in strategic information for government and water management services. Are there risks for privacy and security in these datasets?	Water can be generally useful information regarding water quality, water use, waterways, and other water-related information. In some countries, it might concern the security of state policies. In those cases, some protection might be needed.
2	8	6	1	INFORMATION REQUEST	INVESTIMENTS	People can analyze public spending using investment datasets. Governmental priorities can be assessed to evaluate actual and future actions. Are there risks for privacy and security in these datasets?	Even if the general investment plan from the government is public, specific operations can be sensitive due to regulations or even international competition. In that sense, the data might need some extra work to be published. Many contractors adapt their offers to the requirements of public investment. It is needed to keep a bit of secrecy on some of the plans to prevent predatorily competition or monopoly
2	8	7	2	AUTENTICATE	CONTRACTS	People can analyze public spending using contracts' datasets. By knowing which services and goods are being hired can increase private sector profits or result in a decrease in public spending. Are there risks for privacy and security in these datasets?	Contracts are public in general. They need to be published in official media and available for consultation. However, some specific operations can be sensitive due to regulations or even international competition. In that sense, the data might need some extra work to be published. Some contracts might have specific information used for the hiring process, which is for government use only - the situation is worse with private algorithms processing information which can be their competitive factor in markets, such as Uber.

Card code				Action	Subject	Card text	Explanation
1	8	8	4	REQUEST REVISION	PLANS	Governmental plans define actions that governments are willing to do. Society can organize itself based on this kind of information and even suggest changes. Are there risks for privacy and security in these datasets?	Plans are public information for the population to know the decisions of the government for short and the long run.
3	8	9	4	REQUEST REVISION	LAW SUITS	By assessing public lawsuits, citizens can monitor problems related to public life. Tax evasion, misuse of public assets could be shared with citizens? Are there risks for individuals or security?	Depending on the judicial situation of certain processes, which has implications for individuals and firms, these datasets will be public. However, during disputes, this information should be protected until final decisions. And it might demand some work to make it available as well.
1	9	5	1	INFORMATION REQUEST	AIR QUALITY	What if public information on air quality could be shared with citizens? Knowing the distribution or even its cleanness in different regions can help organize public life or define land values. Are there risks for individuals or security?	Air quality is important information for life quality, neighborhoods, and many environmental policies. With the expansion of personal and smart data meters, new discussions are happening towards regulation. Still, it is a dataset that tends to be fully opened.
2	9	6	2	AUTENTICATE	BUSINESS REGISTRY	A business registry is an authorization for people to invest and work. It is a public register that guarantees the person to undertake economic activities and also gets the government to know what they are doing. Are there risks for privacy and security in these datasets?	Business registers are public in general. They need to be published in official media and available for consultation. However, some specific information can be sensitive and might need some extra work to be published. There is much bureaucracy involved in registering a business officially. Many countries tackled the red tape burden with digitalization. Still, some information on the address of certain individuals who owns the firm, some specific information on the property, there can always be some private information involved that needs to be cared about

Card code				Action	Subject	Card text	Explanation
2	9	7	1	INFORMATION REQUEST	PUBLIC ACQUISITIONS	Governments are also part of markets but buying goods and services with the public budget. Public acquisition datasets could lead society and the public service to monitor who provides for this market. Are there risks for privacy and security in these datasets?	Public acquisitions are public in general. They need to be published in official media and available for consultation. However, some specific operations can be sensitive due to regulations or even international competition. In that sense, the data might need some extra work to be published.
3	9	8	4	REQUEST REVISION	LAND OWNERSHIP	A land ownership registry gives rights for individuals to use terrains in ways they want (if in accordance with specific laws). The interchange of ownership needs to be publicly validated so it gets clear who owns these rights. As a function of public service, this is also a piece of public information. Are there risks for privacy and security in these datasets?	Landownership registers are public in general. They need to be published in official media and available as open data. However, some specific information can be sensitive and might need some extra work to be published.
2	9	9	2	AUTHENTICATE	VOTING RECORDS	As many policies use polls and other kinds of voting systems for participation, these expressions can be audited. Also, they can show different information for exploring the voting samples and populations and extract information on who is voting for what. Divergences can be authenticated in order to correct errors. Are there risks for privacy and security in these datasets?	Votes are private information at the individual level. The aggregate information needs to be public for control and accountability (difficult in terms of political freedom to vote). Here are many technologies for anonymizing the ballots. Still, if someone accesses the different codes from the system, it makes it weaker. It is a long discussion, still a good example for the game.

The “game-master” is the last table which copies all inserted numbers and compares them to the correct combinations. First, if the processing codes were correctly inserted, it scores the corresponding points to the players. Routines vary from 5 to 20 points depending on their complexity, and only the correct code generates points. Second, the system compares the labeling of data and indicates to the game-master eventual consequences of incorrect labeling. Data that is correctly labeled is marked with a simple OK. Datasets that should be opened but were closed will generate FOI requests for the next round. The Game-master will pick an extra demand card set as FOI and insert it in the rounds card set.

Datasets that should have been closed and were opened will result in an in-game punishment. The colleague will receive an extra die for the upcoming round. The die has two effects on the game dynamic: first, making a dataset more open increases the risks of crisis in the office, as the greater the possibility of rolling doubles on dice will be. Second, it increases the productivity of the office as fewer demands will come, and it will be easier to process some of the requests. Open data makes more information available and simplifies some of the access of people to information, reducing red tape in the office but increasing the risks on privacy and security issues.

4.4.4.3 Other assets in the game

Other game assets are used to simulate the office. The dice represent the machines that civil servants need to work to deliver services to citizens. A stapler is available to bind documents, increasing the feeling of the bureaucratic environment. The computer works as a central database where all the final codes are digitally registered. All the visual and physical aspects of the gameplay setting are organized to contribute to making the room look like a governmental office.

4.4.5 Game structure and mechanics

WINNING DATA is structured as a progression decision-making game. It is organized by a controlled sequence of actions to be performed by players, which offers compelling challenges (Adams, 2014; Olejniczak et al., 2016). To enable comparison between groups, the same sequence of events and scenarios is played within the predefined timeline and resources - Table 35.

The game recreates the decision-making of data release in governments as a well-defined process based on literature and practice. The progression structure supported the recreation of this chronology for the players to understand the logic behind the different roles they can play in real-life situations.

Given the complex nature of the data release in governments, this design allowed the facilitator to control the gameplay. The predefined progression of events and rounds enables an overview of each game situation and entails the Game-master to intervene, adjusting challenges and problems faced by players. The overview by the Game-master results in better conditions for observation, assistance, and feedback to improve gameplay and research.

Table 35 - Round sequence

Round step	Description
Game set-up	The player in citizen roll receives a pre-defined number of Demand cards corresponding to the round at play
Demand distribution	Citizen gives demand cards to civil Servant
Processing	Civil servant performs the tasks described in each card and delivers a File back to the citizen
Registering outcomes	Citizen inserts File codes in the scoring system
Labeling Session	Civil servant and colleague (and citizen) discuss the Datasets sensitivity and suggest labeling to boss
Decision	Boss inserts a final position in the system
Feedback session	Game-master reports the results to players
Role change	Players move to a new role for a new Round to start

Finally, all these resources resulted in the possibility of adjusting also the level of challenges to participants' skills to balance the game flow (Csikszentmihalyi, 1990). Being able to control some of the bottlenecks of demands and events is crucial to avoid the anxiety or boredom of gameplay. Disruptions, failures, and time constraints of the rounds can comprise the game context and effects.

The game starts with a tutorial round for the players to understand the basic actions they perform to win the game. They learn that everything starts with the citizen receiving demands and requesting them to the civil servant; the civil servant, who is the only person moving, gets the other players to perform their actions to fulfill the demand. The demand is delivered back as a file with codes that are introduced in the laptop system, which generates recognition points to the office. Depending on the precision of the numbers registered in the form, according to the pre-set template, each service will reward the office. The more complex is the routine, the greater the score, which can also be increased by upgrades in the office.

Also, the dice dynamics are explained, discussing each player's business rules to achieve completion. They run through labeling round and understand the level of discussions needed to suggest sensitivities to the boss. Also, the boss is trained to decide and insert decisions into the system.

4.4.5.1 Crisis introduction and board

When the first week is about to start, the chances of crisis are explained. The players need to inform the Game-master of any doubles on dice. These doubles go to the crisis board, which is a new asset also introduced in the game. Three doubles in a round result in a privacy crisis

which consequences are to be discovered when it happens. The Game-master uses these events to contextualize privacy or privacy breaches that could have happened in the office. By not explaining the gameplay consequences immediately, the players fear and curiosity is triggered.

The security crisis is introduced in the same way by the second week. Different from privacy, it happens when double six is rolled in the dice. Again the consequences are not known until the crisis happens and used for the Game-master to explain information breaches involving governmental strategic information.

In terms of gameplay, the privacy crisis, which is easier to happen, results in the boss losing one die to play. Having a number four or higher gets more difficult, representing that the boss is more strict about signing documents. The security crisis, more difficult to occur, implicates in an audit, interrupting the round and transferring all its demands to the next one.

4.4.5.2 Adjusting gameplay flow and upgrades

As the game flow is crucial for the experience, it is part of the Gamemaster's role to adjust the rules and challenges to the participating group. Eventually, relieving them from a crisis, reducing the number of recognition points to achieve upgrades, or even scoring corrections might be needed to keep the energy in the group.

Also, it is important to discuss the results of the data labeling as many groups diverge from the suggested answers to certain sensitivities of datasets. The consequences previously explained of having datasets labeled more or less open than suggested can be adjusted to these discussions as well.

4.4.5.3 Feedback for ending rounds and the game

Each round ends with a report of score and labeling by the Game-master, which explains the mistakes made by the players. The players switch roles and read the instructions for their new activities. Also, the next round is prepared with the new set of Demand cards to be played. Throughout the game rounds, players have to deliver and label 25 demands and label their datasets. Undelivered demands last for the upcoming rounds until they are completed except the FOI requests, which result online in penalties if not delivered.

The game master feedback includes three parts: (1) the recognition points achieved by the group and a commentary on their performance. Explaining the undelivered routines is important for the group to understand how to improve the performance in the next round; (2) a complete description of the data labeling. As getting the players to assess the consequences of data labeling is one of the main targets of the game, the game-master should detail the reasons for eventual mistakes and even discuss them with the group; and (3) depending on the players' performance, new resources may be offered by the game-master. Achieving a score of 100 enables the use of Privacy Enhancement Mechanisms which adds scores to demands labeled as shared given it allows the office to better prepare the data for sharing; A score of 200 allows the game-master to offer the office to adopt Open by Default

routines. This scoring can only happen by the last round, and it results in canceling the labeling session since these routines make it unnecessary.

The game goals correspond to the content listed in the literature research previously described. They are translated into the game, which is accessed through interaction and play. In short, to achieve the aimed attitude, players get to experience dilemmas in deciding whether to release data or not.

After the last week ends, the Game master presents the final result of the game and congratulates the group for their performance. Before starting any discussions, the post-test survey is applied.

After waiting until every player finishes the survey, a debriefing round allows participants to give feedback on the game. Also, the Game master can explain the context of the research, the goals and solve doubts that could not be discussed during the gameplay. Saving the files and organizing all the resulting material is important for the research.

4.4.5.4 Playing requisites

Some basic rules were developed during the game sessions and resulted in improved gameplay. First, it is important that the four players arrive together in the game place. Having people there too early or too late results in increased anxiety to other players and can contaminate the play session.

Second, it is crucial that all the players stay in the activity for the whole period. In specific situations, having higher echelon players was avoided for they not being able to compromise of staying full the session.

Third, similar to the previous, all mobile phones were turned off. In sessions where players would do something else than playing the game lead them not to engage and disturb the other players.

After playtesting, we concluded that the game fulfilled all the needed requirements and was ready to be played. In the next chapter, we describe the experimental setup used to evaluate its gameplay and effects on players. Before that, we summarize our conclusions from this prototyping process and indicate the list of mechanisms that operated in the game for it to work.

4.5 Conclusion

The final playtesting with colleagues indicated that experiential learning for attitude change could be achieved in the safe environment of this decision-making game. Also, it indicated that a more general metaphor of public service worked, and a broader audience of civil servants could fit in the game. Adding to local governments, we could experiment with civil servants from different government levels. In the end, the many aspects and details seemed

to provide the necessary realism so the game could result in the aimed transfer of knowledge and experience to change players' attitudes.

Debriefings played an important role, as the players' qualitative feedback could detail experiences and feeling about the game. After each playtest session, debriefing was used to capture such emotions and feedbacks. Also, in the real gameplay, debriefing was performed after the game sessions to help the players process the information and actions of the game. Discussion is proven to be an important part of the serious game intervention and was incorporated as part of our game(Peters & Vissers, 2016; van den Hoogen, Lo, & Meijer, 2016).

4.5.1 Requirements assessment

From a game design perspective, the various levels added up to the experience of producing and making decisions on governmental datasets. Named WINNING DATA, the game created the environment for testing options, observing outcomes, and making new decisions.

The learning curve enables the players to learn by playing. Playing the game does not demand much previous knowledge of the data management process but also could be not boring for more experienced participants. The flow of the game within and between rounds would be kept by increasing challenges of tasks and time, as shown in Figure 31.

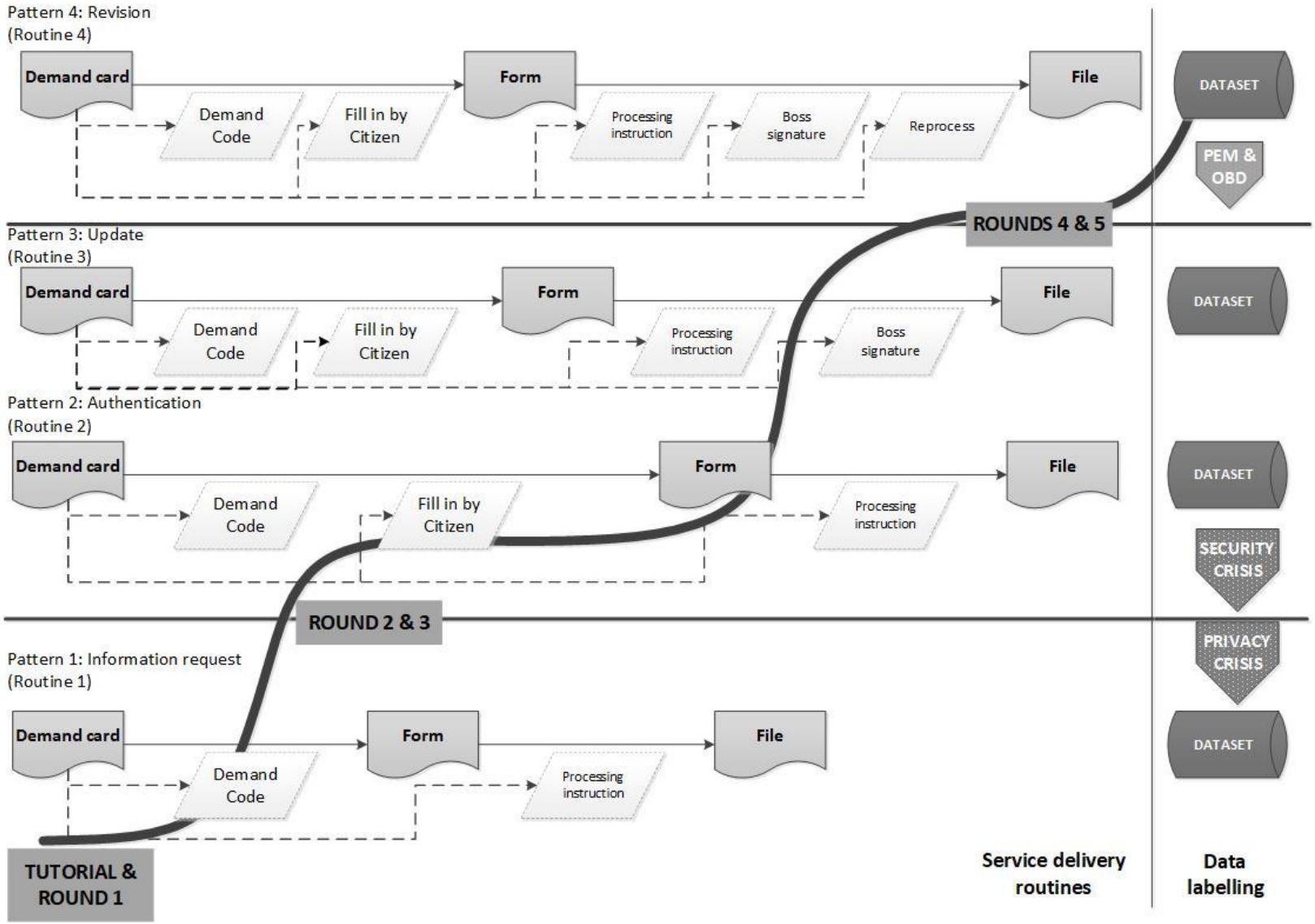

Figure 31 - WINNING DATA Flow

Besides the five initial requirements from the literature, which were used in the four prototypes, the last prototype and final version of the game resulted in new requirements for the game to work. First, it became clear that the game should have dynamics operating for interaction, and a role-playing game could be an appropriate design. From the final version playtest, it appeared that the number of roles, players, and rounds needed to be limited to increase fun and learning. Including these last two requirements, a final list could be summarized as an outcome of the game design:

- Requirement 1. Open government data content used in the game should be highlighted;
- Requirement 2. The focus should be on a game experience that enables experiential learning;
- Requirement 3. Civil servants' practical knowledge should be reflected in the game;
- Requirement 4. The game should be used as a safe environment for experimentation;
- Requirement 5. The setting should be realistic;
- Requirement 6. Game dynamics should be organized as a role-playing game; and
- Requirement 7. The number of roles, players, and rounds should be limited.

Adding to the initial requirement list from Chapter 3, the additional requirements resulted in requirements for the final game. Together, these requirements indicated the need for the game to influence civil servants' attitudes towards open data. First, the in-game required tacit knowledge for playing represented the open data stakeholders' functions for making data available. This knowledge added to the role-playing governmental personnel in a scenario of a simulated public office.

The additional requirement 6 is about including hierarchy and legal frameworks to define the game constraints. It summed up the many risks of governmental data release. Adversely, the objective of the game was expressed in its scoring system, which also profited from the in-game open data benefits. To achieve them, the rules were built upon realistic routines to get data to be labeled.

Requirement 7 should ensure that the role-playing mechanics are included to ensure the engagement of players to their in-game roles. Limiting the number of rounds and game participants improved the gameplay. Furthermore, the game experience itself expanded the learning opportunities and attitude change. All these final requirements resulted in a functioning game for influencing the attitudes of civil servants towards open data.

4.5.2 Game mechanisms

The discussions of RQ3 (Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?) progress as we define the final version of the game. These are the game mechanisms that could deliver the expected requirements for the

experiential learning goal. These mechanisms are derived from the initial discussion in Chapter 3.

Our first prototype, Cards for open data, referred already to our first requirement and resulted in the idea of dataset description and labeling in the cards. This was also our first game mechanism. The Cards for Open Data evaluation suggested the need to increase fun which inspired the development of a card code system used in Solvd (Mechanism 2). The evaluation of Solvd indicated the need for balancing risks which resulted in the idea of pre-defining demands instead of randomly assigning tasks to players (Mechanism 3). This mechanism was incorporated in our third prototype, the time-management game. It also added to the list a fourth mechanism, the representation of office assets as forms, files, and demand cards. Still, this third prototype's risks were unbalanced, which indicated the fitting for defining service delivery as a goal that could streamline the gameplay (Mechanism 5). Open data office was the closest prototype to our final version of the game. Besides introducing upgrades (mechanism 6), it also contributed to the idea of increasing interaction. Facilitation emerged as a good solution (Mechanism 7).

The evaluation of the last prototype resulted in the four last mechanisms which were used to develop Winning Data. Following the efforts to balance risks, it inspired the final version of the game to have a crisis board (Mechanism 8) and to use dice as processing machines (Mechanism 9). To operationalize the roles in a more observable way, the assessment of the Open data office suggested the use of the multi-player feature with different roles (Mechanism 10). Lastly, Winning Data playtest resulted in the need to limit time through rounds (Mechanism 11). Table 36 explains these 11 mechanisms that fit in the game, how they related to different requirements, their expected effect, and references.

Table 36 - Game mechanisms

Mechanism	Related requirement	Expected effects	References
1. Dataset description and labeling	Requirement 1. Open government data content used in the game should be highlighted	• Grey zone of sensitivity – balanced description • Generate discussions and doubts • Connect to real-life experience • Tacit knowledge (practical information)	(Christl W, 2013) (Gustafsson Friberger et al., 2013a) (Siriaraya et al., 2018)
2. Card codes	Requirement 2. The focus should be on a game experience that enables experiential learning;	• Secrecy • Formality • Communication • Organization • Bureaucracy (again) • Automated scoring system	(de Caluwé et al., 2012) (van de Ven et al., 2013)

Mechanism	Related requirement	Expected effects	References
3. Pre-defined demands (not random)	Requirement 3. Civil servants' practical knowledge should be reflected in the game;	• Make sessions comparable • Keep the flow (learning curve)	(Olejniczak et al., 2016) (Bots & van Daalen, 2007) (Raghothama & Meijer, 2018)
4. Service delivery goal	Requirement 4. The game should be used as a safe environment for experimentation;	• Contextualize data production (data is abstract, gives concrete sense) • Intrinsic motivation (serve better) • Bureaucratic context • An official announcement of scores	(Duke & Geurts, 2004) (Bharosa et al., 2010) (Vallerand, 1997)
5. Forms, Files and Demand cards	Requirement 1. Open government data content used in the game should be highlighted Requirement 5. The setting should be realistic;	• Bureaucracy • Confusion • Need for planning and order	(Joldersma & Geurts, 2016) (Hassan, 2016) (Mayer, 2009)
6. Upgrades	Requirement 2. The focus should be on a game experience that enables experiential learning;	• Include open data technology content • Extrinsic motivation to perform better • Surprise on effects	(Adams, 2014) (Vallerand, 1997)
7. Facilitation	Requirement 4. The game should be used as a safe environment for experimentation; Requirement 6. Game dynamics should be organized as a role-playing game;	• Organize session • Keep the flow • Extrinsic motivation	(Roelofs, 2000) (Kriz, 2010) (Vallerand, 1997)
8. Crisis board	Requirement 5. The setting should be realistic;	• Risk feeling • Experience consequences • Different for privacy and security	(Adams, 2014) (Rudinsky & Hvannberg, 2017) (Carrel, 2000)
9. Dice as processing machines	Requirement 5. The setting should be realistic;	• Include chance factor in the game • Make operations less obvious (a bit of black-box of certain tasks)	(Koster, 2013) (Salen & Zimmerman, 2004) (Harteveld, 2011)
10. Multi-player (with different roles)	Requirement 6. Game dynamics should be organized as a role-playing game;	• Interaction • Different perspectives	(Kikkawa, 2014) (Spitters et al., 2017) (van den Hoogen et al., 2016)

Mechanism	Related requirement	Expected effects	References
	Requirement 7. The number of roles, players, and rounds should be limited		
11. Time-limited rounds	Requirement 7. The number of roles, players, and rounds should be limited	• Pressure and stress • Challenge and fun • Intrinsic motivation (perform better than previous rounds / other groups)	(Zúñiga-Arias, Meijer, Ruben, & Jan Hofstede, 2007) (Olejniczak et al., 2016) (Vallerand, 1997)

The game mechanisms in the above table are the mechanisms that support meeting the requirements for the game to change civil servants' attitudes towards open data. The multi-player design with different roles (mechanism 10) should allow civil servants to perceive reality in public service, including the many stakeholders' perspectives involved in the process of releasing data. It also enables interaction the enforces the dynamics of an office with many actors. The facilitation (mechanisms 7) performed through the game support the session organization to keep the flow of gameplay even with an audience that might resist participating. The game-master also helps to keep the environment controlled, as in the government.

The goal set at service delivery helps to contextualize data production, given that abstract data turns into a concrete activity. Also, it refers to the main goal of public administration, which triggers intrinsic motivation to serve better. The metaphors of the bureaucratic context, such as having a stapler, contribute to it and are consolidated with the media to announce scores: an official announcement.

Using time-limited rounds introduces a bit of stress to the game. Also realistic to civil servants' daily life, some pressure reinforces the context. From a game design perspective, it adds challenge and fun and is convergent to intrinsically motivating players to perform better than previous rounds or other groups.

Adding also to the office mimic is the dataset description and labeling coming from the literature. These descriptions and labels are based on concrete examples and work as fuel for discussion between the participants. The generated grey zone of sensitivity resulting in balanced description purposely generates discussions and doubts and connects to real-life experience. Moreover, it highlights the strength of tacit knowledge with real and practical information and cases. The crisis board delivers the necessary risk feeling, which results in the players experiencing consequences. The option for differences between privacy and security also highlights the aspects of sensitivity that vary from one dataset to another.

For research purposes, the pre-defined demand list distributed equally in each round reduces the randomness of gameplay and makes experiences comparable. However, the use of dice

as processing machines compensates for this predictability with some luck element. They make the service delivery operations less obvious in a type of black-box for certain tasks – also adding to reality metaphor.

The card codes have been set to ensure formality and secrecy in the process. They generate the need for communication and organization within the groups of participants dealing again with bureaucracy. From a flow perspective, the codes active the automated scoring system, which makes the game easier to facilitate. Bureaucracy and confusion also result from the many assets of forms, files, and demand cards exchanged in the game. Again planning and order are needed to fulfill each weeks' demands.

Lastly, the upgrades create a surprise effect on performance, adding another layer of extrinsic motivation. It also enabled the game to assess open data technology contents such as privacy enhancement mechanisms and open by default strategies.

The combination of these mechanisms into Winning data resulted in the experience aimed at this research. In the next chapter, we will describe the evaluation methods and instruments. These will be used to evaluate the game in chapter 6.

5 CHAPTER 5 - Survey design and data collection

5.1 Introduction

After designing WINNING DATA in Chapter 4, this game's impact in the context of real-life action needed to be assessed. As part of our design science approach, we set up a quasi-experiment, guided by our fourth research question (RQ4): what are the effects of the open data game on civil servants' attitudes towards supporting the opening of data? In this research, we assess the game from a design perspective, testing its requirements and mechanisms in the previous chapter. Instead, the evaluation is focused on measuring the change in players' attitudes and the game's effects on change. Our main hypothesis is that a serious game can change civil servants' attitudes. Likewise, to answer the research question demanded translating the attitude influence factors into a survey, collecting data, and checking both the factors and the effects of the game.

To run the quasi-experiment, we used several methods. We translated the list of factors described in Chapter 3 into a survey and used it to collect data from participants. By collecting data before and after the game was played, we were able to ground our discussion of the game's impact in pre- and post-test analysis. We performed several statistical tests to analyze the game effects and other changes captured by the data we collected. We focused on using the quantitative analysis for the impacts, though each game session ended with a debriefing moment where participants could share their experiences and learning outcomes. This qualitative feedback was used to improve the facilitation and also to compare some of the outcomes coming from the quantitative analysis of the game.

In this chapter, we present the questionnaire development for collecting data to check the list of factors influencing civil servants' attitudes towards open data in governments; and to assess the effects of the game developed in this research. We detail the options made, the collection methods, and the gameplay sessions. To start, the collection of data through multiple Likert scales is discussed next. The testing, data analysis, and results are presented in the next chapter.

5.2 Survey design

The central part of a design science quasi-experimental research is collecting evidence of a certain artifact at work. Evidence is the proof-of-concept for both baselines and effects for treatment and control groups (Shadish et al., 2002). However, collecting evidence imposes challenges starting from designing its instruments and data collection strategies (Brinkman, 2009; Field, 2009; Hof, 2012).

The artifact characteristics define the appropriate strategies and instruments for data collection. Physical artifacts can be tested for their properties and actions. In the case of our research, the focus is on measuring the effects of a game as a behavior intervention. Surveys

and questionnaires can be used for data collection to verify changes in perception. However, also depending on the research design, different questionnaires can be used.

5.2.1 Data collection method

More detail is needed to decide which type of instrument to adopt. As Brinkman (2009) indicated, "although they can be very useful, designing a good questionnaire takes considerable effort and thinking" (p.31). Also, applying it can be challenging, as the author suggests to make it as similar as possible to a normal conversation (p.31): introduce yourself, explain the research motivations and perform your question and answer session. It is also suggested to ask for extra comments and thanking the person for the time spent in the end.

Though the application has its rituals, developing the instrument itself needs more attention. The data collection instrument shall include an introduction to the research and a consent form for using the information supplied. The General Data Protection Regulation (GDPR) needs to be complied with to safeguard participants' individual privacy on the collected data. Likewise, collecting biographical data can be useful for further analysis though it implies some extra care given the risks on privacy (i.e., outliers can be traced back to individual participants in some specific conditions and might demand extra measures for anonymization).

Every questionnaire opened with a research statement, explaining the experiment to the participant and getting them to allow the use of their anonymized information for analysis. This procedure was submitted and approved by the TUDelft Human Research Committee on February 22nd, 2019. To be highlighted that both the language and explanation of the research were general enough not to bias the participants on what was expected from their answers in the questionnaires. By signing the document, they were agreeing to formally participate in the research as well as allowing us to use their data for further analysis. The questionnaire followed immediately after the consent form. The full questionnaire is available in Appendix 3.

The questions themselves also demanded attention for the questionnaire design. First, the purpose of the research and the type of data to be collected might give some clues on which questions to be used. Again Brinkman (2009) indicates this decision can be summarized in defining the goals of the data collection.

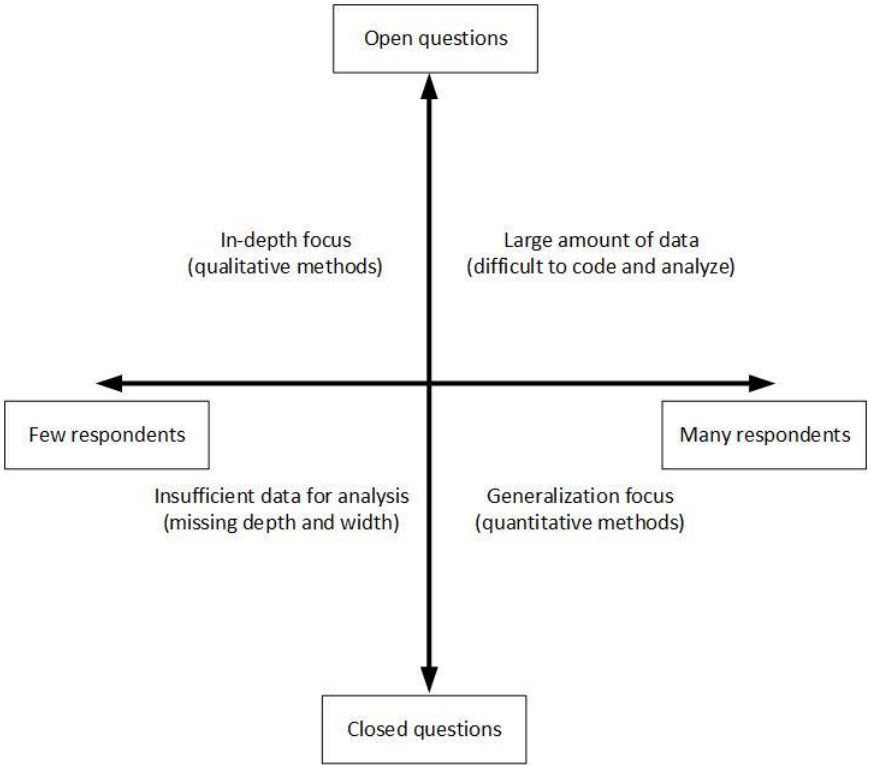

Figure 32 - Type of data collection (adapted from Brinkman (2009) p.35)

Figure 32 indicates that the fewer the number of participants expected in a sample, the more appropriate will qualitative approaches be to extract more detailed and more profound information from the respondents through open questionnaires. On the other hand, the more generalizable is the goal of the research, the greater the sample should be and more closed the questions so they can be aggregated and compared: "In a situation where I have access to a large number of people, I cannot expect that they can all set aside an extensive amount of time. I, therefore, have to streamline the process by using closed-questions that people can answer easily" (p.35). For this research, we opted for more closed questions in our survey to increase the comparability of the results.

Brinkman (2009) also suggests deciding on the level of measurement previously to defining answer options, so the intended statistical analysis can be applied. Questions should be clearly stated, answerable, and follow specific attributes for more precise results (Brinkman, 2009):

- one question at a time
- unambiguous
- language and expected knowledge fit the target group
- questions neutrally formulated
- avoid leading questions
- avoid unnecessary sensitive questions
- avoid negative or double negative questions

Finally, when administering the questionnaire, other conditions need to be considered. First, the order of the questions might influence respondents' answers, so the instrument needs to

be carefully designed to prevent bias. Also, the number of participants has consequences in the length of the questionnaire and the ways for its application. Considering that a census produces exact numbers of a population, for many reasons, it is not applicable most of the time. By defining samples, approximations are targeted, and the represented population size, the variable type being collected, and the expected size effect (in case of an intervention) demand attention. In our research, each of these aspects was considered, though not all of them could be fully achieved, e.g., the original sample size, which targeted more than 300 data points, had to be reduced given the restrictions imposed by the pandemic.

Lastly, the distribution of questionnaires is essential. Next, we describe how it was performed and the outcomes obtained in our research.

5.2.2 Data collection

We defined the treatment group as the civil servants that filled in the survey and played the game. After gameplay, they fill in the survey again to check if the game changed their perception of open data and management policies. The control group is the group also of civil servants who filled in the survey online and received a new link to fill in the survey again. This group is used to check if the survey changed their perception or if there is evidence that pre- and post-answers did not change. The contrasts of treatment and control groups are presented in the upcoming chapter.

Quasi-experiments can make it difficult to isolate bias from researchers and the supporting organizations. As required for the application of the surveys and to perform the game activity, participation was voluntary. Nevertheless, to prevent orienting the participants towards certain opinions and avoid bias, the pre-test surveys were applied before any kind of communication took place between the facilitator and the players. Suggestive formulations were avoided in all correspondence with participants. Finally, the game mechanics and dynamics were balanced to include both the benefits and risks of open data release. All the sessions and all participant selection were conducted in a similar manner. This enabled a comparison of the change in participants' behaviors as a consequence of the game (Olejniczak et al., 2020).

Data collection is just the first step to using and publishing data. The preparation of datasets for analysis involves different actions to process, harmonize, and analyze the collected data. Often it demands to create specific coding for constructs and statistical operations. To orient the tests in convergent directions, it can also demand reversing scores. The data collection as a whole, including the connections between the Likert scale and other collected data, enables the researchers to discuss and explore the data resulting from research. Depending on the goals of the analysis, different statistical tests can be used, also further to be discussed in the data analysis chapter of this thesis.

5.2.3 Multiple-items Likert scale

Multiple Likert scales are one of the most used self-assessment measurements for perception. It can be applied in different domains. According to Doane and Seward (2011), the Likert scale is a particular case that is frequently used in survey research (...) a statement is made, and the respondent is asked to indicate his or her agreement/disagreement on a five-point or seven-point scale using verbal anchors. The coarseness of a Likert scale refers to the number of scale points" (p.28)

As discussed in Chapter 2, attitudes are the central element to analyze the change resulting from the game. Assessing attitudes through Likert scales is a common alternative. However, Brinkman (2009) indicates that attitude scores can be considered as interval-level measurements, which need to create pools of candidate items to be discriminated against afterward (p.39). A greater number of items may lead to better measurement.

It is a characteristic of questionnaires using the Likert scale to use multiple items. Through them, it is possible to assess a concept from a more robust perspective than using single items. Different dimensions on a common issue can be assessed moreover if the questionnaire focuses on complex and abstract concepts. To do that, it is necessary first to define high-level constructs and operationalize them through measurable items. The use of multiple questions reduces the chances of receiving wrong or partial answers by surrounding the topic through different perspectives and aspects (Brinkman, 2009).

As the Likert scale sets ranges of scores for respondents to choose, these ranges definitions have consequences in the collected data. An example is the interpretation of the neutral option, sometimes represented by zero with positive and negative values. The neutral might seem like a lack of opinion or impossibility of answering, besides a neutral position resulting in a problematic interpretation. It converges with Doane and Seward (2011), that "surveys may omit the neutral midpoint to force the respondent to "lean" one way or the other (p.28). The authors also highlight the controversy for the assumption that Likert scales can be treated as interval data, which might be explained to allow performing statistical calculations, such as averages and correlations (p.28).

Although multiple-item constructs make attitude measurements more precise, they also demand more operations when using them. Hof (2012) indicates that researchers usually ask for respondents' degree of agreement with evaluative statements to assess an attitude and aspects related to it, to avoid socially preferred answers. However, they are not necessarily reliable and valid reactions to the aimed attitude as some items may assess a different construct than the one intended initially (p.1). Using indirect questions (self-report indirectly), i.e., asking for feedback on the game, can lead participants to report more accurate responses about their situation.

To avoid that, the reliability test of the constructs is the first step. According to Hof (2012), "a questionnaire is reliable when an individual item or a set of some items renders the same

result as the entire questionnaire" (p.8). Brinkman (2009) indicates the need to verify the consistency of the measured results. Cronbach alpha is one adequate measure for the reliability of constructs, which calculates if all items are measuring the same construct and in the same direction (p.48).

Additionally, Constructs validity should be checked concerning the content of the questionnaire. Once more, Brinkman (2009) indicated that it checks the strength to which its measurements assess what they should be measuring. Different types of validity can be assessed, including face, content, criterion, and construct validity. For Hof (2012), "if a questionnaire is construct valid, all items together represent the underlying construct well" (p.2).

After designing the questionnaire, it is crucial to test it and verify its constructs. The first step is to pilot test the questions and instrument with specialists and also with the target population. Our research was developed in English, but the target population was Portuguese speaking, so translating the questions was another challenge.

The questionnaire was pilot-tested with colleagues researchers in an English version. A Portuguese translated version was tested with Brazilian civil servants online – by that time, the available platform was collector, which was used only for pilot testing purposes. Brazil was selected as our reference case given its outstanding position in terms of national policies fostering open data in the last decade (Ruediger & Mazzotte 2018). Also, the Open Data Barometer is a reference commonly used to assess and compare open data policies between different countries (Safarov, Meijer, & Grimmelikhuijsen, 2017). In 2019, Brazil scored as the second-largest country in the world, ranking within the top 20 countries ranked, making it an important case for studying open data.

The validity and reliability tests of the constructs will be presented beside each of the analyses performed in the research, which is the next chapters' content. Suffice to say that the collected data was used to analyze the constructs, aiming at checking the reliability of the measurements and instrument in general.

5.3 Operationalizing the factors into a questionnaire

To test our main hypothesis, that the attitudes of civil servants can be changed by using a serious game, we defined Behavioral Intention as the main attitude targeted by the research. The list of factors described in Chapter 3 sets another four groups of variables that are expected to influence the civil servants' behavior intentions: Open Data Knowledge; Benefits and performance Expectancy; Effort expectancy; and, Social influences. Explorative testing needed to be conducted on these four constructs to find how the game affected them (Field, 2009). They were translated into assessable content that can measure the individuals' perceptions. They were operationalized into questionnaire items applied to capture the difference of attitudes before and after the activity.

Following Brinkman (2009), instead of single direct questions towards these concepts, we developed a questionnaire based on several items. Three different groups of questions composed the research: repeated measures, game assessment, and personal characteristics.

5.4 Repeated-measure questionnaire items

The dependent variable of Behavioral intention was set for our aim to measure attitude change and its influencing factors. As identified in chapter 3, the questionnaire items were derived from the literature. A first main group of 33 questions defined the questionnaire to be repeated before and after the game intervention. These are the items to assess the multiple dimensions of factors that can influence civil servants' intentions to open data. Most of the questions enlisted assessed personal familiarity with topics. Other items were asked indirectly, asking their perception of other's skills or knowledge. The idea of merging direct and indirect questions was surrounding the topics from multiple views, given that individuals do not always have clear opinions of their performance but are judgmental of others' behaviors.

Table 37 lists the 33 questions, referring them to the factors built as groups. Organization-wise, we aggregated the groups of questions towards the initial list from Chapter 3. The table also references the literature which inspired the questions. Moreover, we used the first digit to indicate whether the question was posed on the pre or post-test moment; the last digit orders the questions to avoid repetition.

Table 37 - Repeated measure questionnaire items

Code		Content	Reference
Behavioral Intention			
BI_11	BI_21	I already provide open public sector data in my work	(Wirtz et al., 2016; Zuiderwijk et al., 2015)
BI_12	BI_22	I intend to provide open public sector data in the future	(Venkatesh et al., 2003; Zuiderwijk et al., 2015)
BI_13	BI_23	I predict that I will provide open public sector data in the future	(Venkatesh et al., 2003; Zuiderwijk et al., 2015)
Open Data knowledge		**Public sector data in my actual work**	
LK_11	LK_21	I produce public sector data in my work	(Venkatesh & Davis, 2000; Zuiderwijk et al., 2015)
LK_12	LK_22	Some public sector data can be shared	(Venkatesh & Davis, 2000; Weerakkody et al., 2017)
LK_13	LK_23	I know how to make the public sector data available for others to access	(Venkatesh et al., 2003)

Code		Content	Reference
LK_14	LK_24	People in my office knows how to make the public sector data available for others to access	(Venkatesh et al., 2003)
LK_15	LK_25	The public sector data that results from my work cannot be shared for privacy issues	(Hossain et al., 2016)
LK_16	LK_26	The public sector data that results from my work cannot be shared for security issues	(Hardy & Maurushat, 2017)
Benefits and performance expectancy		**Providing open public sector data**	
PE_11	PE_21	improves citizen services	(Weerakkody et al., 2017)
PE_12	PE_22	improves policy-making processes	(Hardy & Maurushat, 2017)
PE_13	PE_23	creates trust in government	(Hossain et al., 2016; Weerakkody et al., 2017)
PE_14	PE_24	promotes citizen participation	(Hossain et al., 2016)
PE_15	PE_25	increases transparency	(Janssen et al., 2012)
PE_16	PE_26	is of benefit to me	(Venkatesh & Davis, 2000; Wirtz et al., 2016)
PE_17	PE_27	will help me doing my job	(Davis, 1989; Wirtz et al., 2016)
PE_18	PE_28	will increase my productivity	(Davis, 1989; Wirtz et al., 2016)
PE_19	PE_29	improves my performance in my job	(Wirtz et al., 2016; Zuiderwijk et al., 2015)
PE_20	PE_30	has benefits which are difficult to explain	(Moore & Benbasat, 1991; Venkatesh & Davis, 2000)
Effort expectancy		**Procedures to make public sector data accessible to the public**	
EE_11	EE_21	I clearly understand how to provide open public sector data	(Venkatesh et al., 2003; Zuiderwijk et al., 2015)
EE_12	EE_22	Providing public sector data is a threat	(Venkatesh et al., 2003)
EE_13	EE_23	I fear individual privacy by providing public sector data	(Moore & Benbasat, 1991; Venkatesh et al., 2003)
EE_14	EE_24	The costs of providing public sector data are too high	(Conradie & Choenni, 2014)
EE_15	EE_25	I fear people will have false conclusions if public sector data is provided	(Weerakkody et al., 2017)

Code		Content	Reference
EE_16	EE_26	Learning to provide open public sector data will be easy for me	(Venkatesh et al., 2003; Zuiderwijk et al., 2015)
Social influences		**The environment to make public sector data accessible to the public**	
SI_11	SI_21	People who are important to me think that I should provide open public sector data	(Venkatesh et al., 2003; Weerakkody et al., 2017)
SI_12	SI_22	License and legal frameworks make it difficult to provide public sector data	(Janssen et al., 2012)
SI_13	SI_23	Providing public sector data is not a priority for me	(Moore & Benbasat, 1991)
SI_14	SI_24	Providing public sector data is not a priority for the office I work for	(Venkatesh & Davis, 2000)
SI_15	SI_25	I have the necessary autonomy to provide public sector data	(Wirtz et al., 2016; Zuiderwijk et al., 2015)
SI_16	SI_26	My work does not require me to provide open public sector data	(Zuiderwijk et al., 2015)
SI_17	SI_27	My superiors expect me to provide open public sector data	(Venkatesh & Davis, 2000; Zuiderwijk et al., 2015)
SI_18	SI_28	I have assistance available concerning the provision of open public sector data	(Venkatesh et al., 2003)

The first group, targeting our main hypothesis, consisted of three of the repeated questions towards measuring the behavioral intentions of civil servants towards supporting the opening of data: BI_11/21 (I already provide open public sector data in my work), BI_12/22 (I intend to provide open public sector data in the future) and BI_13/23 (I predict that I will provide open public sector data in the future). As described in Chapter 3, all the constructs, including Behavior Intention, were developed based on the literature. The compound questions were inspired by previous questionnaires that focused on similar concepts as the exact terms were not found in previously used questionnaires. We decided to move the questions of Behavior Intention for last, not to bias other previous answers from the questionnaire.

A second group focused on Data management knowledge. Two general items focus on a general perception of data in the office by assessing LK11/LK22 (I produce public sector data in my work) and the possibilities of sharing data LK12/22 (Some public sector data can be shared). Another three items come next, targeting the participants' acquaintance with data production and management in the office. The logic is to start with a general perception of data in the office by assessing yourself or your colleagues' capability of making data available - LK13/23 (I know how to make the public sector data available for others to access). LK14/24 (People in my office know how to make the public sector data available for others to access)

assesses the perception of other conditions to provide data. An approach to general consequences of data sharing aimed at reasons for not sharing data, explicitly privacy or security issues – LK15/25 (The public sector data that results from my work cannot be shared for privacy issues) and LK16/26 (The public sector data that results from my work cannot be shared for security issues).

Benefits and performance expectancy is the third group of questionnaire items, based on the perceptions of benefits and usefulness of sharing open data from governments. All the items were based on the same statement, "Providing open public sector data", which demanded a reflection on the consequences of data opening. The first five items targeted the organizational benefits from the literature, namely: PE_11/21 (improves citizen services), PE_12/22 (improves policy-making processes), PE13/23 (creates trust in government), PE_14/24 (promotes citizen participation) and PE_15/25 (increases transparency). The next four items targeted individual benefits from open data: PE_16/26 (is of benefit to me), PE_17/27 (will help me doing my job), PE_18/28 (will increase my productivity), and PE_19/29 (improves my performance in my job). Lastly, an additional item checked the individual perception of explaining those benefits to others PE_20/30 (has benefits which are difficult to explain).

Another group of items tested in the questionnaire was composed of risks and effort expectancy. It groups individual perceptions of conditions to provide data or learn how to do it, EE_11/21 (I clearly understand how to provide open public sector data), a reaction to a more general statement was exposed through EE_12/22 (Providing public sector data is a threat), and fearing sharing governmental data EE_13/23 (I fear individual privacy by providing public sector data). At last, we asked about the costs of opening data are demanded by EE_14/24 (The costs of providing public sector data are too high) another reason for fear EE_15/25 (I fear people will have false conclusions if public sector data is provided) and challenges to improve sharing EE_16/26 (Learning to provide open public sector data will be easy for me).

Lastly, we assessed the contextual and social influences in the questionnaire. Composed of nine items, it starts with the perception of influences to decide on supporting open data through SI_11/21 (People who are important to me think that I should provide open public sector data) and SI_17/27 (My superiors expect me to provide open public sector data). The legal framework is the topic of SI_12/22 (License and legal frameworks make it difficult to provide public sector data). The personal and organizational priority to supporting open data comes next, SI_13/23 (Providing public sector data is not a priority for me) and SI_14/24 (Providing public sector data is not a priority for the office I work for). SI_15/25 (I have the necessary autonomy to provide public sector data) and SI_16/26 (My work does not require me to provide open public sector data) aim at the perception of autonomy and pressure to support data opening. The support for making data available is assed next by SI_18/28 (I have assistance available concerning the provision of open public sector data).

Besides the pre- and post-testing items, other questions related to personal traits are useful for a full discussion on the results coming from the collected data. The description of demographic data and its use for controlling effects is discussed next.

5.4.1 Personal characteristics and demographics

The analysis and results of the collected data will be further explored in the next chapters of this thesis. There, different analytical procedures and tests will be explained in detail to sustain the discussions developed for each test. However, before progressing to the next topic, a remark on data collection needs to be stated. That is related to the importance of collecting and analyzing the personal characteristics of respondents in a survey.

Named as demographics, this information helps researchers to describe, understand, and compare samples from a population. Brinkman (2009) indicated that by collecting demographics on the pre-test, the application could be crucial for further relating some personal characteristics of individuals to a certain behavior. Demographics are the characteristics that should not be subject to change when exposed to the treatment. They can also help in revealing confounding variables. One way of isolating the effects of traits on those of treatment is using separate tests, including or excluding this information. Procedures such as hierarchical regressions can be used to correct such effects or check them as moderators or mediators of a construct effect on the dependent variables.

Besides its importance, recent regulations on data collection impose limits and specialized care for such information. Regulations, such as GDPR and other data protection laws aimed at safeguarding citizens' personal information limit public exposure. Consequently, personal information collected through surveys demands anonymization for use and further publishing. It also results in a second challenge related to threats of triangulation techniques, which can reverse the anonymization of certain types of data.

We operationalized personal characteristics in four groups: previous experience with open data, experience in the public sector, personal risk aversion, and demographics - Table 38. The first group of items assessed the participants' previous experiences with open data by reacting to three simple statements: EO_11 (I have heard about public sector data before), EO_12 (I have studied public sector data before), and EO_13 (I have used public sector data before). The purpose was to contextualize the novelty of the topic, which could afterward be crossed with other variables from the questionnaire.

Table 38 - Demographics and personal characteristics

Code	Content
Experience with open public sector data	
EO_11	I have heard about public sector data before
EO_12	I have studied public sector data before
EO_13	I have used public sector data before
Experience in the public sector	
EPS_11	How long have you been working in the public sector?
EPS_12	Since you have started working for the public sector, which of the following better describes your most common role
EPS_13	Which was your last work relation with the public sector
Risk-Aversion	Which of the following situations describes you best?
RA_11	I feel comfortable to share my data on the internet
RA_12	I would go against the law to reach an important goal
RA_13	I feel positively excited with the unexpected
RA_14	Professional stability is the most important thing in my life
Demographics	
A_11	Year of birth
G_11	Gender
Group	Local, Federal, Other
Civil servant	Is or has been a civil servant
Play game	Participated in the game sessions

The second group, experience in the public sector, intended to capture the time and relation of the person with government and governmental work. EPS_11 (How long have you been working in the public sector?), EPS_12 (Since you have started working for the public sector, which of the following better describes your most common role) and EPS_13 (Which was your last work relation with the public sector) demanded information on the public work background of the participant.

Different from the group of risks and effort expectancy, a personal risk aversion group of questions focused on the individual disposition for risks. Through four items, RA_11 (I feel comfortable to share my data on the internet), RA_12 (I would go against the law to reach an

important goal), RA_13 (I feel positively excited with the unexpected), and RA_14 (Professional stability is the most important thing in my life) different dimensions of personal risk disposition could be capture and analyzed in the context of the research. Though the questions might relate to each other, e.g., the comfort of sharing data on the internet (specific) can connect to the excitement of the unexpected (general). Still, they approach different aspects for threats on personal risks.

Lastly, demographics information was collected related to age, gender, if the participant is a civil servant, and the level of government the participant worked for (Local, Federal, Other). For controlling the sample, we marked the individuals who participated in the game sessions for further comparisons. A control group resulted from the pre- and post-test applied to non-participants.

5.4.2 Game-assessment questionnaire items

As DSR is also related to developing the artifact, assessing the game was useful to adjust and improve the gameplay experience. These questions are only asked after the game was played; it is aimed at collecting feedback on the main mechanisms represented in the game - Table 39.

Table 39 - Game assessment questionnaire items

Code	Content
GA_21	The context of my office is well represented by the game
GA_22	Data-related issues of my office are well represented in the game
GA_23	The in-game colleague behavior reminds me of my actual colleagues
GA_24	The in-game boss behavior reminds me of my actual boss
GA_25	Role played
GA_26	The game changed my perception of data management policies
GA_27	I know more about the benefits of opening data after playing the game
GA_28	I know more about the risks of opening data after playing the game
GA_29	I will open data after playing the game
GA_30	The game helped me to open more data in my daily work

First and foremost, it was important to assess the participants fit of reality with the whole office represented in the game through items GA_21 (The context of my office is well represented by the game), GA_22 (Data-related issues of my office are well represented in the game), GA_23 (The in-game colleague behavior reminds me of my actual colleagues) and GA_24 (The in-game boss behavior reminds me of my actual boss).

The last questions are aimed at checking the correspondence of self-assessment of players' experiences with the data collected in the repeated measurement. The group GA_26 (The game changed my perception of data management policies), GA_27 (I know more about the benefits of opening data after playing the game), GA_28 (I know more about the risks of opening data after playing the game), GA_29 (I will open data after playing the game) and GA_30 (The game helped me to open more data in my daily work) are used to confirm the perception of change analyzed by the differences of the items in the rest of the questionnaire. Question GA_25 (Role played) was introduced in some questionnaires as the session could test fixing roles for gameplay which did not happen, and the question was skipped.

5.4.3 Survey data register

A challenging part of data collection is compiling all the gathered information and making the complete dataset ready for analysis. First, the completeness of the answers coming from respondents needs to be checked, also making a first check on visually accessible outliers. Already in the first step, some registering mistakes can be found and eventually corrected or marked for further analysis. The goal is to have a dataset with valid responses and to check the accuracy of answers related to the whole group of respondents.

An overview of the collected data also enables us to realize some questions found to be on a negative formulation that leads respondents to answer it in opposing ways. In this case, the scores from the item need to be inverted, so all the questions flow in the same direction. Afterward, it is crucial to revisit those scores for interpretation of meaning on the relation between variables in the analysis.

In the case that the questionnaire demands categorical answers such as classes or ranges of measures, these data need to be transformed for further analysis. Different sources of data might result in different coding for the variables, which also needs to be checked. As all the different datasets are harmonized in the same standard, they can be merged into a common table which enables the data analysis to begin. Of the total of 33 items, ten were negatively formulated (LK_15, LK_16, PE_20, EE_12, EE_13, EE_15, SI_12, SI_13, SI_14, and SI_16), and their scores were reversed. This was done to avoid acquiescence bias – when participants agree with questions without reading them properly.

Lastly, it is crucial to check the whole dataset for personal information. Any field which can be used to track the respondent identity needs to be processed to be anonymous in the final processing dataset. In our case, one challenge was related to connecting pre- and post-test answers of participants who eventually did fill in the survey online and then played the game. In that case, the field of the email was used to match the datasets, being erased afterward for privacy protection. For those who played the game and answered the survey in the physical questionnaire, a participant code was used by session to revise the registers afterward. The specific transformation of data performed on our datasets will be described accordingly to the analysis described in the upcoming chapters.

5.5 Conclusion

Designing the survey, applying it to different audiences, collecting data, and having the game played resulted in the data used for the analysis of our research. In the next chapter, this data is used for testing the theoretical factors and discussing the predictors of civil servants' support to opening governmental data. The other chapter analyses the results of the game played, looking for significant changes in scores for pre- and post-testing. The findings and conclusions are analyzed in the last chapter of this thesis.

6 CHAPTER 6 – Testing civil servants' attitude change towards open data resulting from the game

6.1 Introduction

In the previous chapters, we presented the theoretical and practical background that underlies the process of designing and testing a game to change civil servants' attitudes towards open data. The main hypothesis of our research is that civil servants' attitudes can be changed by a serious game. In a quasi-experimental setting, WINNING DATA was played, and a survey was applied to collect data before and after the game sessions.

Additionally, factors influencing civil servants' attitudes towards open data emerged from the literature, as presented in Chapter 3. In this chapter, we use the survey data to build and check the reliability of constructs deriving from the factors. Explorative testing was conducted to find which factors are at work. We also use these constructs to evaluate the effects of gameplay. The basis of the upcoming analysis is the published paper by Kleiman, Janssen, Meijer, et al. (2020), demonstrating the findings from our research. Since it was published, we managed to process the control group dataset that needed to be matched for pre- and post-testing from different collection instruments and was not available by the time of the paper analysis.

Besides the control group, three items from the survey which were excluded from the previous analysis are also included and tested in this chapter. These items, therefore, refine and deepen the discussions from Chapter 3. It results in a model of factors influencing civil servants' attitudes towards open data.

The comparison of the findings coming from the literature reviews presented in Chapter 3 with the outcomes of the analysis, the inclusion of the control group dataset results, and the new items analysis added strength to our tests and are incorporated in the upcoming description and discussion. Chapter 6 is structured as follows: the context of the experiment and its setting is presented; the main and additional hypotheses to be tested in the game experiment are exposed, based on an overview of each factor that can influence behavioral intention. The findings are then discussed, and the main conclusions are presented. These findings and conclusions are revisited in the upcoming chapter 7, Epilogue, where we derive them into our research contributions, limitations, and suggested future research agenda.

6.2 Data collection

The data used for the analysis comes from the application of our survey into civil servants who played our game. Additionally, another group of these professionals filled in the questionnaire without the game intervention and are used as a control group for our quasi-experiment. The applied survey is discussed in Chapter 5 and was distributed in two different ways: online and through face-to-face physical questionnaires. The online distribution happened through the

distribution of a link for Qualtrics, a digital survey website, by email using a mailing list targeting civil servants by some organizations. Even if the comparison would increase the challenges for analysis, an effort was put in broadening the sample for an international data collection to check results with different backgrounds. This effort involved networking with open data-related organizations and the UNU-eGov (United Nations University). The efforts were more successful within civil servants working for different levels of government in Brazil than from other countries, which defined the sample of our research.

The main partners targeting civil servants in the country were the Frente Nacional dos Prefeitos (one of the national association of municipalities from Brazil), the Municipality of São Paulo, the Management Secretariat in the Ministry of Economy, and the WeGov Network. Besides the institutional distribution, the survey link was also shared by some civil servants on their personal social network profiles. From 29 November 2019 until 5 April 2020, the survey was distributed, reaching 463 civil servants. Approximately 64% of those who clicked on the link completed the survey, resulting in 295 completed pre-test online questionnaires. As 168 respondents did not answer all questions, these were excluded from the analysis.

Besides the online data collection, face-to-face questionnaires were applied to the participants of the game experience. In Sao Paulo, the municipality invited all 120 members from their Technology and Innovation Secretariat to participate in the game, and 32 civil servants joined eight gameplay sessions in one week. Another 55 civil servants from Brasilia that were enrolled in an 'Advances in Open Government' course at the National School for Public Service were invited to participate in the game. A total of 41 players joined nine game sessions during one week. Finally, another four civil servants from the accounting court of Sao Paulo played the game through a video call[6]. Each game session lasted for two hours on average and was divided into three moments: (1) a pre-test was applied immediately before the game was played and the game rules were explained; (2) the game was played in five pre-defined rounds; and (3) a post-test was given containing the same 33 questions.

In total, 77 civil servants played the game, and another 15 civil servants completed the physical pre-test questionnaires but did not play. Brazil is a Republic Federation subdivided into Regional Governments and Municipalities. To summarize, we reached 92 civil servants from the Municipality of Sao Paulo and the Federal level through a paper-based survey. As our set-up involved testing the effects of pre- and post-testing of gaming experience, the 295 individuals that completed the online survey were invited to complete the same survey online for one more time. We processed the 67 responses received from this second request and found 35 answers to be complete. Some of the 67 respondents could not be matched with their pre-test answers or simply fill in only the post-test questionnaire. The 35 complete responses were coded as a control group for further analysis in the upcoming chapter. The

final sample of our research is composed of 112 respondents of the pre- and post-test questionnaires -Table 40.

Table 40 -Survey sample

	Pre-test	Complete pre-test	Post-test	Complete post-test
Online	463	295	67	35
Paper-based	92	92	77	77
Total	555	387	144	112

6.2.1 Demographics

Within the 112 participants, a total of 77 civil servants played the game during March and June 2019. Their age ranged from 21 to 61 years old, with an average of 35.51 (SD=9.5). Males accounted for 61% of the game group. The group of 35 participants that did not play the game, considered as the control group, had a similar gender distribution, as shown in Table 41. The average age was also similar, though the game group was more skewed towards younger participants than the control group.

Table 41 - Demographics

Category	Values	Game	%	Control	%	Total	%
Gender	Female	28	39%	14	41%	42	40%
	Male	44	61%	20	59%	64	60%
Age	21 – 30	23	30%	1	3%	24	21%
	31 – 40	29	38%	16	46%	45	40%
	41 – 50	16	21%	11	31%	27	24%
	51+	4	5%	5	14%	9	8%
Government Level	Municipal	32	42%	3	9%	35	39%
	Federal	41	53%	6	17%	47	9%
	Other	4	5%	25	71%	29	22%
Years in Public Sector	0 – 5	33	43%	2	6%	35	31%
	5 – 10	17	22%	12	34%	29	26%
	10 – 15	15	19%	7	20%	22	20%
	15 – 20	5	6%	9	26%	14	13%
	20+	3	4%	3	9%	6	5%

Category	Values	Game	%	Control	%	Total	%
Type of contract	Politically appointed	18	23%	4	11%	22	20%
	Permanent staff	40	52%	29	83%	69	62%
	Hired	4	5%	2	6%	6	5%
	Other	11	14%		0%	11	10%
Previous knowledge of open data	Heard of open data	69	90%	33	94%	102	91%
	Studied open data	51	66%	27	77%	78	70%
	Used open data	62	81%	30	86%	92	82%
Personal risk	Comfortable sharing personal data on internet	33	43%	9	26%	42	38%
	Would go against the law to reach an important goal	8	10%	4	11%	12	11%
	Feel positively excited with the unexpected	44	57%	14	40%	58	52%
	Professional stability is the most important thing in life	45	58%	16	46%	61	54%

In both groups, most participants claimed previous knowledge of open data and data management policies in government. This is not surprising, as some of the institutions that disclosed the survey were related to innovation in governments, and the game sessions focused on civil servants who are involved in opening data. More than 80% of the control group and over half of the game participants were permanent government staff. Hence, we can consider the sample to represent our aimed audience of civil servants.

6.2.2 Constructs reliability

The collected data enabled a step further to build a list of factors influencing attitudes of civil servants towards open data provision. The initial groups of questionnaire items, e.g., performance expectancy and lack of knowledge, were composed of different statements, coming from the literature discussions presented in Chapter 3. As mentioned in Chapter 5, a construct that is developed based on multiple items is usually more reliable than a single item. However, these question groups derived from the literature and different combinations could inform us on different discussions. A question related to knowledge could build up the data management construct or social influence, depending on the defined group.

The initial 33 survey questions could be grouped and tested in clusters representing constructs that can influence behavior intention. The Cronbach's alpha reliability test was performed to

check the reliability of these groups and turn them into constructs. The tests confirmed the reliability of three of the original concepts: performance expectancy (Cronbach α: .727; ten items), social influence (Cronbach α: .709; nine items), and behavioral intention (Cronbach α: .764; three items). The reliability measurements for the concepts open data knowledge and effort expectancy were below 0.6 and could not be improved by omitting statements. Thus, the reliability of these concepts could not be established. Explorative testing was conducted to define the factors that could be at work.

Principal component analysis (PCA) was performed on the remaining 12 items to find underlying concepts. Oblimin rotation was used to allow factors to correlate so that underlining relations could be considered when testing the new groups (Hof, 2012). The PCA resulted in two factors that could be interpreted in a logical way. Risk-related topics, labeled 'risk perception' (Cronbach α: .686) loaded five survey items: LK_15 (The public sector data that results from my work cannot be shared for privacy issues), LK_16 (The public sector data that results from my work cannot be shared for security issues), EE_12 (Providing public sector data is a threat), EE_13 (I fear individual privacy by providing public sector data) and EE_15 (I fear people will have false conclusions if public sector data is provided). Data management knowledge was updated (Cronbach α: .704), loading three items: LK_13 (I know how to make the public sector data available for others to access), EE_11 (I clearly understand how to provide open public sector data), and EE_16 (Learning to provide open public sector data will be easy for me). Three items, namely LK_11 (Knowledge of data production), LK_12 (Knowledge of data sharing, and EE_14 (Data costs), were treated as separate variables as they did not load (in reliability terms) on the defined constructs. Based on the final grouping of variables, we updated the conclusions from Chapter 3. Figure 33 presents the updated factors, organized into a Behavioral Intention model, which is used in this research to measure changes in attitudes.

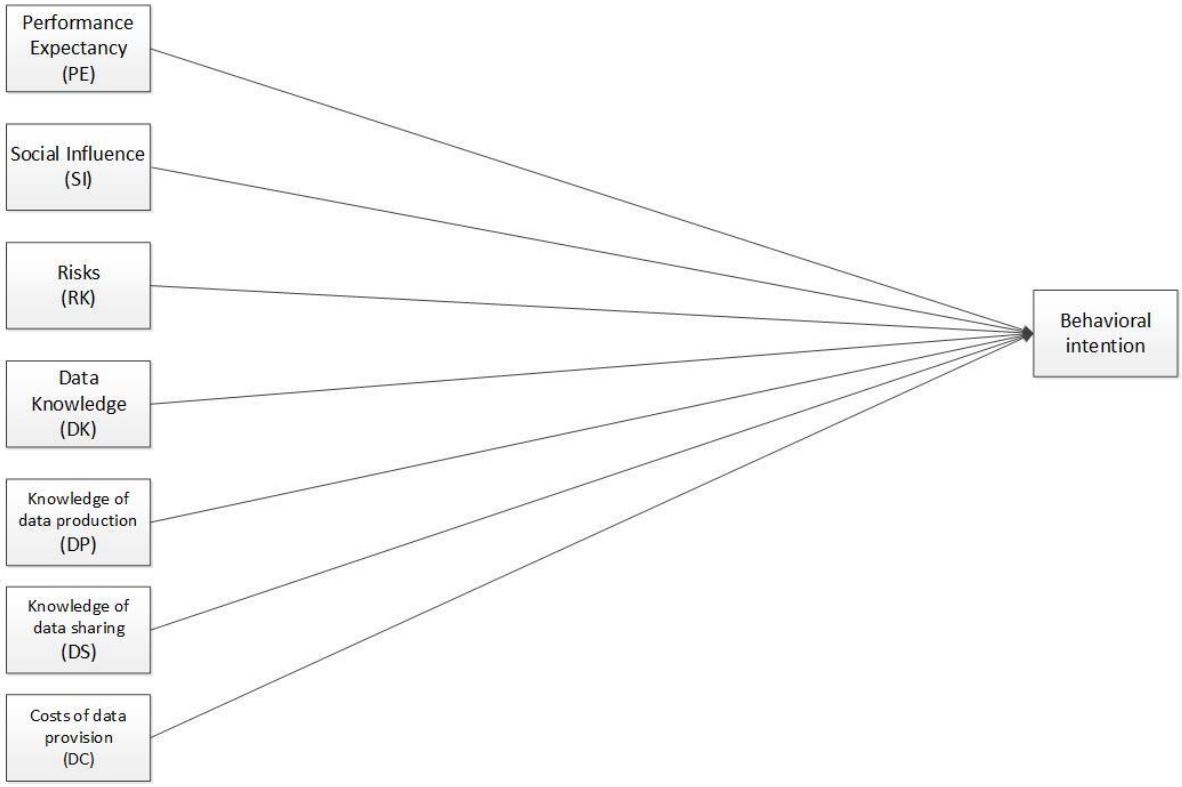

Figure 33 - Behavioral Intention Model

For testing purposes, the model resulted in eight hypotheses to be tested by comparing the pre- and post-game survey scores. The effects of the game on each of the model constructs and individual items are discussed in the next section, including the comparison of effects for the game and control group.

6.3 Hypothesis formulation

The game hypotheses were formulated to test the game effects using the data collected in the quasi-experiment. The focus is checking whether the game had effects on the participants who played it and also which of their perceptions were more or less significantly influenced. Based on the model (Figure 33), we formulate these hypotheses and use the data to generate the results.

Our main hypothesis indicates the dependent variable, Behavior Intention, as the focus of our testing. Seven additional predictors are defined, namely, Data Management Knowledge (DK), Performance Expectancy (PE), Risks (RK), Social Influence (SI), Knowledge of Data Production (DP), Data Sharing Knowledge (DS), and Data Costs (DC). The survey and constructs follow the descriptions from Chapter 5 and are presented in Figure 34.

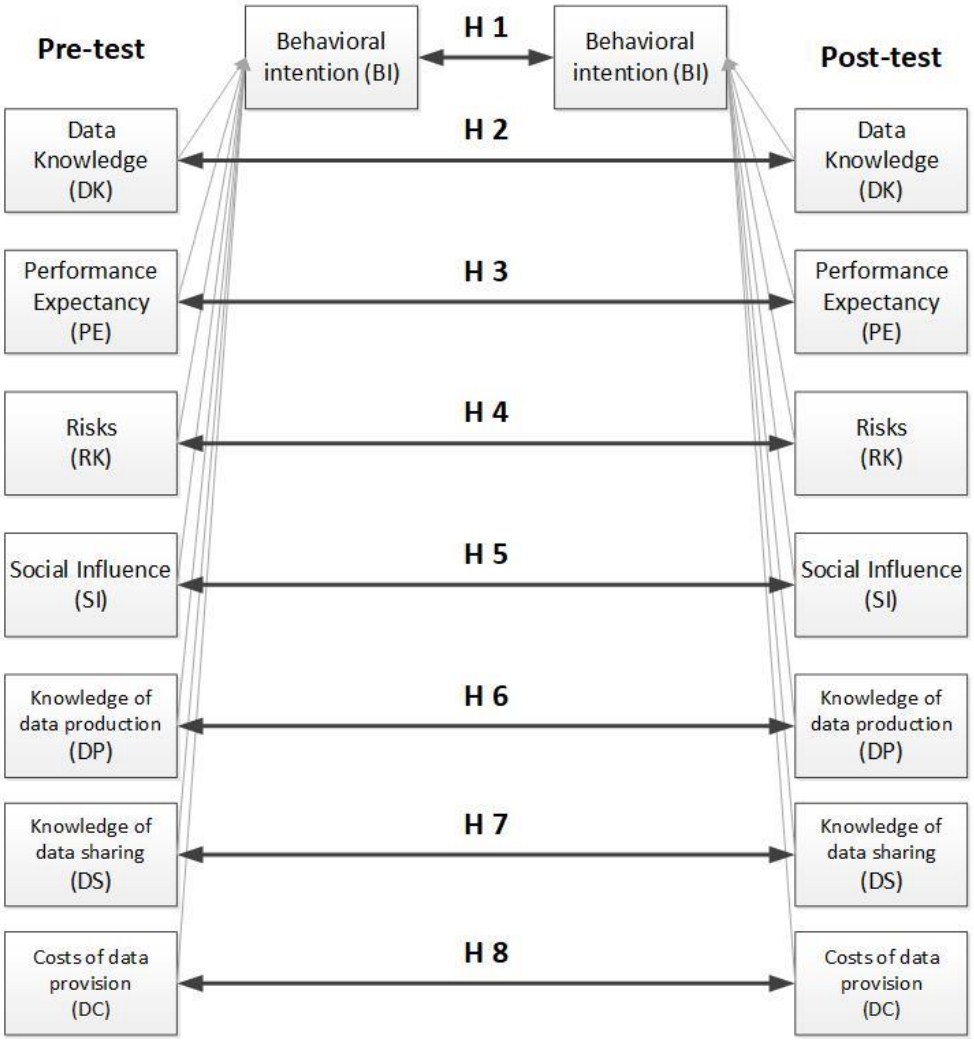

Figure 34 - Hypothesis for testing

The main dependent variable is behavior intention (BI) which is considered as a good proxy of actual behavior. As explained, given that behavior can be difficult to measure and compare, the use of behavior intention helps as an indirect measurement (Ajzen, 1989; Davis, 1989). BI indicates the declared willingness of people towards performing a certain action.

In our study, BI aims at capturing the disposition of civil servants to support the release of data by governments. Different from previous surveys, which used the same construct applied to data usage (Carter & Campbell, 2011; Jurisch et al., 2015; Schaupp & Carter, 2010), in our survey, we aimed at data release.

The construct BI merges three of the repeated survey questions: BI_11/21 (I already provide open public sector data in my work), BI_12/22 (I intend to provide open public sector data in the future), and BI_13/23 (I predict that I will provide open public sector data in the future). Based on these questions, the main hypothesis is formulated as:

Hypothesis 1: Behavioral intention to open up data increases after playing the game

Besides our main targeted construct, the survey also aimed at the seven independent variables set from the literature to influence behavioral intention. Except for the new items, Chapter 3 presents these factors' full discussion and references.

6.3.1 Data management knowledge (DK)

The first influencing variable would be the level of knowledge a civil servant has that should affect his or her disposition to support governmental data opening. The lack of knowledge on data management could lead to a decrease in civil servants' disposition to support the opening of data (Conradie & Choenni, 2014; Crusoe & Melin, 2018; Hardy & Maurushat, 2017). The better the understanding of the operations and routines related to data release, the easier it should be for them to support.

As previously mentioned, as a result from the PCA analysis, it grouped three repeated survey items: LK_13 (I know how to make the public sector data available for others to access), EE_11 (I clearly understand how to provide open public sector data) and EE_16 (Learning to provide open public sector data will be easy for me). The group defines our second hypothesis:

Hypothesis 2: The game results in more knowledge about how to open data

6.3.2 Performance Expectancy (PE)

Our previous discussions also indicate that the perception of benefits should influence the behavior intention to support data opening. On the one hand, the construct Performance Expectancy (PE) originates in the general discussion of technology adoption models (Venkatesh et al., 2003). On the other hand, the societal benefits are considered more broadly, including dimensions of Perceived Usefulness (Weerakkody et al., 2017; Wirtz & Piehler, 2016; Wirtz et al., 2016). Our construct also includes the specific literature of open data from the user perspective, adding to it concerns the expected outcomes of opening data to governments, companies, and the general public (Bozeman & Kingsley, 1998; Zuiderwijk et al., 2015).

In survey question terms, the construct included items relating the statement "Providing open public sector data" to consequences of data opening: PE_11/21 (improves citizen services), PE_12/22 (improves policy-making processes), PE13/23 (creates trust in government), PE_14/24 (promotes citizen participation) and PE_15/25 (increases transparency), PE_16/26 (is of benefit to me), PE_17/27 (will help me doing my job), PE_18/28 (will increase my productivity) and PE_19/29 (improves my performance in my job), PE_20/30 (has benefits which are difficult to explain). All these outcomes of releasing governmental data are included as benefits and are hypothesized as:

Hypothesis 3: The game results in a better understanding of the expected benefits of opening data

6.3.3 Risks (RK)

The organizational and political risks involved in sharing governmental data is another construct from our model. Fears of having data to be misinterpreted or misused by others are some examples of such perceptions (Bélanger & Carter, 2008; Carter & Bélanger, 2005; Schaupp & Carter, 2010). They also relate to barriers faced by data publishers in opening data and their perception of efforts required to avoid such risks (Venkatesh et al., 2003; Weerakkody et al., 2017; Zuiderwijk et al., 2015; Zuiderwijk & Cligge, 2016).

Once more, the group items resulted from the PCA analysis and was defined by: LK_15 (The public sector data that results from my work cannot be shared for privacy issues), LK_16 (The public sector data that results from my work cannot be shared for security issues), EE_12 (Providing public sector data is a threat), EE_13 (I fear individual privacy by providing public sector data) and EE_15 (I fear people will have false conclusions if public sector data is provided). For our testing, this group of barriers is hypothesized as follows:

Hypothesis 4: The game decreases expectations of the risks related to making data available

6.3.4 Social Influence (SI)

Social influence refers to how the behavior and expectations of others inside and outside the organization can influence civil servants' attitudes to open data. From formal or coercive hierarchy to rules and legal frameworks, the result of expectations and feelings may affect their willingness to perform a certain act. In the context of open data, the civil servants' perceptions of incentives and limits can be more or less clear (Venkatesh et al., 2003; Weerakkody et al., 2017; Zuiderwijk & Cligge, 2016). And it can result in a perception of existing little room for autonomy (Kleiman, Janssen, Meijer, et al., 2020; Pasquier & Villeneuve, 2007; Schepers & Wetzels, 2007).

In the questionnaire, Social influence was assessed through nine items: SI_11/21 (People who are important to me think that I should provide open public sector data), SI_12/22 (License and legal frameworks make it difficult to provide public sector data), SI_13/23 (Providing public sector data is not a priority for me), SI_14/24 (Providing public sector data is not a priority for the office I work for), SI_15/25 (I have the necessary autonomy to provide public sector data), SI_16/26 (My work does not require me to provide open public sector data), SI_17/27 (My superiors expect me to provide open public sector data), SI_18/28 (I have assistance available concerning the provision of open public sector data) and LK14/24 (People in my office knows how to make the public sector data available for others to access). The fifth hypothesis derives from this group:

Hypothesis 5: The game reduces civil servants' perceptions of open data practice difficulties, as exerted by hierarchies and legal frameworks

6.3.5 Data production knowledge (DP)

The recognition of the role that data production has in the process of data sharing can be of value to position the civil servants' support for governmental data release (Crusoe & Melin,

2018). Civil servants' perception that their own work produces data was assessed through the item LK11/LK22 (I produce public sector data in my work) and is hypothesized as:

H6: *Increased knowledge of data production (DP) will influence the Behavioral Intention of civil servants to support open data positively*

6.3.6 Data sharing Knowledge (DS)

Moreover, some of the data produced are stored locally, and civil servants do not come up with the idea to share this data with a broader public (Conradie & Choenni, 2014). Civil servants might not also be aware of opportunities to share the data produced or the support they can have for making it available (Crusoe & Melin, 2018; Hossain et al., 2016). The awareness of sharing data possibilities is expressed by the item LK12/22 (Some public sector data can be shared) and results in our next hypothesis:

H7: *Increased knowledge of the possibility of sharing data (DS) will influence the Behavioral Intention of civil servants to support open data positively*

6.3.7 Data costs knowledge (DC)

Lastly, sharing data might imply costs that can influence the support to make the data public. Even lack of time or resources to open data (Conradie & Choenni, 2014; Crusoe & Melin, 2018) can be influential and is represented by the question EE_14/24 (The costs of providing public sector data are too high). This last dimension of perception is hypothesized as:

H8: *The perception of costs (DC) for open data provision will negatively influence the Behavioral Intention of civil servants' to support open data*

6.4 Hypothesis testing

The hypotheses were tested by comparing the scores before and after the game. All the hypotheses were tested using 33 statements to which a response could be provided on a 7-point Likert scale. The sample size of 77 game participants and 35 individuals in the control group imposed some limits to the convenience of applying more advanced statistical analysis techniques. Also, as most of the data was not normally distributed, and because the scores are related to each other (because they come from the same person), we had to perform non-parametric tests to analyze the outcomes.

The Wilcoxon signed-rank test was the most appropriate test for checking differences between groups and was performed for comparing the pre- and post-test situation (Field, 2009). First, the difference in pre- and post-game scores for each construct (i.e., combinations of questions) was tested for the game and control group. A comparison of every single question in the constructs followed. Lastly, the contrasts of the game influence to the control group were checked for a piece of additional information. As there is a lack of such a non-parametric procedure, we assumed the distribution to be normal and performed a repeated-measures analysis of variance.

The Wilcoxon signed-rank test indicated that three of the eight constructs displayed significant changes from before to after the game. These changes appeared only in the game group and not in the control group, suggesting that it is likely to be an effect of the game. The greatest game change was in the questions related to risk, followed by behavioral intention and performance expectancy. Differences in data management knowledge and social influence were not statistically significant.

The repeated measures ANOVA indicated that the game and control groups were likely to be the same in the pre-test situation for all variables except Data costs (DC). After the game was played, BI, RK, and DP were significantly different, confirming the effects of the also in creating a difference for groups after the game was played. PE also indicated a change, but it was not statistically significant.

We refer back to Chapter 3 to compare these outcomes with the previously discussed literature. Next, we present each of these results, followed by a discussion on the reasoning of differences for the game and control group.

6.5 Behavioral intention (Hypothesis 1: Behavioral intention increases after playing the game)

Behavior intention was used as a proxy to measure changes in civil servants' attitudes towards open data. The results of the Wilcoxon signed-rank test show that the behavioral intention to open data increases significantly after playing the game. The game increases the willingness of participants to support open data policymaking. As such difference between pre- and post-testing does not appear in the control group, it is likely that the gameplay explains the change found in the group of game players - Table 42.

Table 42 - Differences for game and control group (Behavioral Intention)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
Game Group	4,97	1,56	5,33	1,37	<0,01
Control Group	4,68	1,69	4,74	1,54	0,836

The increase in game-group behavioral intention is probably related to differences in the statements - Table 43. First, the increase in scores for question BI_11 (from 3.67 to 4.13) might indicate that the game creates awareness in the participants that they are already producing and sharing data in ways they did not realize. By performing the routines in the game and understanding that open data is less complex than they imagined, their perception change indicates that this is likely to be a relevant effect of the game. Question BI_13 also changed positively (from 5.58 to 5.83) and influenced the increase in scores for the general measures of behavioral intention.

Table 43 – Behavioral intention items differences (game group)

	BI_11: I already provide open public sector data in my work	BI_12: I intend to provide open public sector data in the future	BI_13: I predict that I will provide open public sector data in the future
Mean pre	3.67	5.65	5.58
Std. dev pre	2.227	1.698	1.690
Mean post	4.13	6.03	5.83
Std. dev post	2.166	1.337	1.601
Mean dif.	0.46	0.38	0.25
Wilcoxon, p-value	0.001	0.106	0.034
Statistically significant	Y	N	Y

Both participants' individual intentions and future perceptions are likely to be influenced by the game. An increase in the intention to provide open public sector data in the future is also observed for BI_12, but this is not statistically significant. In conclusion, hypothesis 1 was confirmed.

6.5.1 Data management knowledge (Hypothesis 2: The game results in more knowledge about ways to open data)

Data management knowledge did not significantly differ after playing the game. However, the statistical significance of the gameplay group was half of the control group result - Table 44. This difference could be caused by the sample size differences or by the game. In the next section, we will discuss the limitations of this research, sample size included.

Table 44 - Differences for game and control group (Data management knowledge)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
Game Group	4,64	1,363	4,84	1,231	0,153
Control Group	4,56	1,255	4,63	1,382	0,321

As Table 45 shows, the constituting statements for the game group also showed no statistically significant differences, except for EE_11, which increased from 4.26 to 4.68. This hypothesis could therefore not be confirmed.

Table 45 – Data management knowledge items differences (game group)

	LK_13: I know how to make public sector data available to others	EE_11: I clearly understand how to provide open public sector data	EE_16: Learning to provide open public sector data will be easy for me
Mean pre	4.50	4.26	5.17
Std. dev pre	1.957	1.650	1.540
Mean post	4.60	4.68	5.26
Std. dev post	1.779	1.482	1.542
Mean dif.	0.10	0.41	0.09
Wilcoxon, p-value	0.123	0.041	0.788
Statistically significant	N	Y	N

6.5.2 Performance expectancy (Hypothesis 3: The game results in a better understanding of the expected benefits of opening data)

> *"I don't work on the topic, but there are datasets that could be better used if they were opened to the public": federal-level participant after the game session.*

The construct that showed the second-largest difference between pre- and post-testing in the game group was performance expectancy, from 5.82 to 6.04 - Table 46. The increase also reaches statistical significance for the game group, which is not present in the control group. This might indicate that the game provides its participants with a better understanding of the positive effects of open data as they experience the benefits in the game, which did not occur with the control group.

Table 46 - Differences for game and control group (Performance Expectancy)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
Game Group	5,82	0,737	6,04	0,676	<0,01
Control Group	5,88	0,735	5,83	0,809	0,517

As shown in Table 47, of the ten statements that make up the concept of performance expectancy, only three show a statistically significant increase in the game group when individually analyzed (PE_11, PE_14, and PE_19), and one shows borderline significance (PE_15). PE_11 had an increased score of 0.68, indicating that benefits for citizens were greatly perceived. PE_19 increased from 5.25 to 5.79, indicating that participants' perceptions of benefits are more influenced by the game's in-office direct benefits – red tape reduction and decrease in FOI requirements.

Table 47 – Performance expectancy items differences (game group)

	PE_11: Providing open public sector data improves citizen services	PE_12: Providing open public sector data improves policymaking processes	PE_13 Providing open public sector data creates trust in government	PE_14 Providing open public sector data promotes citizen participation	PE_15 Providing open public sector data increases transparency	PE_16 Providing open public sector data is of benefit to me	PE_17 Providing open public sector data will help me do my job	PE_18 Providing open public sector data will increase my productivity	PE_19 Providing open public sector data improves my performance in my job	PE_20 Providing open public sector data has benefits which are difficult to explain
Mean pre	6,03	6.75	6.41	6.07	6.76	6.19	5.88	5.20	5.25	3.34
Std. dev pre	1,871	0.598	0.980	1.250	0.628	1.182	1.530	1.822	1.635	1.857
Mean post	6,71	6.75	6.44	6.44	6.64	6.14	6.13	5.65	5.79	3.65
Std. dev post	0.604	0.610	0.993	0.966	0.759	1.285	1.092	1.528	1.380	2.217
Mean dif.	0,68	0.00	0.04	0.37	-0.12	-0.04	0.25	0.45	0.54	0.31
Wilcoxon, p-value	>0.01	0.338	0.361	0.007	0.055	0.531	0.323	0.167	0.024	0.279
Statistically significant	Y	N	N	Y	≈Y	N	N	N	Y	N

Also, PE_14 increased from 6.07 to 6.44. This is highly statistically significant, despite the possible ceiling effect where high scores in initial response are difficult to be increased in the post-test. Interestingly, PE_15 was negatively influenced by the game (a decrease from 6.76 to 6.64, p = 0.05). This may be due to the lack of consequences for citizens when data is opened in the game –qualitative feedback provided in some game sessions.

6.5.3 Risk perception (Hypothesis 4: The game decreases expectations of the risks related to making data available)

"Excellent game, helped me understand the procedures to open data and its risks": municipal-level participant.

As explained in the previous section, the new loadings obtained through the PCA resulted in the 'risk perception' construct. The scores obtained for this construct decreased (from 5.08 to 3.82) and were statistically significant ($p < 0.001$) for the game group - Table 48. Once more, the effect found for the intervention group was absent in the control group, indicating that it is likely that the change in participants' responses resulted from the gameplay.

Table 48 - Differences for game and control group (Risks)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
Game Group	5,08	1,171	3,82	1,296	<0,01
Control Group	5,42	1,099	5,46	1,008	0,764

As shown in Table 49, most of the questions in the risk perception construct showed a statistically significant decrease. The score for question EE_12 decreased from 6.15 to 3.86, indicating that the game is likely to improve participants' perceptions of what constitutes a risk for public data provision. As the score before the game was high on average (6 out of 7), the game may reduce participants' perceptions of risk related to the release of public data, resulting in opening more data.

Table 49 – Risk perception items differences (game group)

	LK_15: The public sector data that results from my work cannot be shared for privacy reasons	LK_16: The public sector data that results from my work cannot be shared for security reasons	EE_12: Providing public sector data is a threat	EE_13: I fear individual privacy by providing public sector data	EE_15: I fear people will have false conclusions if public sector data is provided
Mean pre	4.84	5.23	6.15	4.45	4.77
Std. dev pre	1.860	1.872	1.273	1.782	1.762
Mean post	3.94	3.87	3.86	3.68	3.79
Std. dev post	2.035	2.117	2.383	1.568	1.915
Mean dif.	-0.91	-1.36	-2.29	-0.76	-0.98
Wilcoxon, p-value	0.02	<0.001	<0.001	0.006	0.011
Statistically significant	N	Y	Y	Y	N

The decreases in LK_16 (from 5.23 to 3.87), LK_15 (from 4.84 to 3.94), and EE_15 (from 4.77 to 3.79) may result from the same effect as for question EE_12, but more specifically concerning security, privacy, and misinterpretation risks as the game included privacy and security challenges. As described previously, specific dice combinations produced crises that were increased or reduced by previous dataset labeling options. It is likely that the mechanics metaphor of increasing risks by opening more data had an effect on players.

Finally, EE_13, which was also a reversed score, decreased from 4.45 to 3.68. We, therefore, conclude that the game reduces participants' perception of risks concerning the opening of governmental data.

6.5.4 Social influence (Hypothesis 5: The game reduces civil servants' perceptions of open data practice difficulties, as exerted by hierarchies and legal frameworks)

Social influence did not significantly change through gameplay, although some of its constituting questions did show significant changes. No changes were also found in the control group. One explanation for the lack of change in the game group is that the participants played the game voluntarily, so there was no institutional pressure or change in social influence in the game. The game may also have been perceived as neutral.

Table 50 - Differences for game and control group (Social Influence)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
Game Group	4,03	1,023	4,15	1,007	0,128
Control Group	3,65	0,974	3,85	0,842	0,257

From Table 51, game group answers for item SI_13 were a reversed score and showed a significant decrease (from 5.46 to 3.95), indicating that open data becomes a higher priority

in future work. On the other hand, SI_12 (also a reversed score) increased significantly from 3.52 to 4.64. This suggests that respondents perceived more difficulties in opening governmental data after the game than before. The in-game discussions might have increased participants' willingness to share more governmental data while also making them more aware that governments might not be as supportive in real situations. The game mechanics probably increased participants' perception of the potential for opening data, which is reflected in the in-game discussions for labeling data.

Increases were seen in SI_15 (from 2.26 to 2.97) and SI_18 (from 2.90 to 3.48). Interestingly, both questions had a very low benchmark on the pre-survey, indicating an increase in awareness of autonomy and support through the gameplay. Participants were allowed to make choices and convince the boss to label data more openly, which might result in a greater perception of autonomy and support. The perceived direct influence of familiar people (SI_11) or superiors (SE_17) does not seem to be influenced by the game.

Table 51 – Social influence items differences (game group)

	SI_11: People who are important to me think that I should provide open public sector data	SI_12: Licensing and legal frameworks make it difficult to provide public sector data	SI_13: Providing public sector data is not a priority for me	SI_14: Providing public sector data is not a priority for the office I work for	SI_15: I have the necessary autonomy to provide public sector data	SI_16: My work does not require me to provide open public sector data	SI_17: My superiors expect me to provide open public sector data	SI_18: I have assistance available concerning the provision of open public sector data	LK_14: People in my office knows how to make the public sector data available for others to access
Mean pre	4.74	3.52	5.46	4.44	2.26	4.09	3.39	2.90	5,04
Std. dev pre	1.865	1.679	1.500	2.061	1.675	2.248	1.916	1.762	1,896
Mean post	5.22	4.64	3.95	4.43	2.97	4.12	3.71	3.48	4,88
Std. dev post	1.774	1.813	2.102	2.168	1.933	2.127	2.045	2.004	2,065
Mean dif.	0.48	1.12	-1.51	0.00	0.71	0.02	0.33	0.58	-0.16
Wilcoxon, p-value	0.268	<0.001	<0.001	0.784	0.003	0.718	0.113	0.005	0.877
Statistically significant	N	Y	Y	N	Y	N	N	Y	N

6.5.5 Data production, data sharing, and costs

Our last tests were performed on the items which were not part of a construct. In Table 52, the questions related to data production, data sharing, and costs were tested for differences between pre- and post-test scores in the game and control group. None of the scores showed significant changes. The lack of statistically significant difference in game- or control-group indicates that it is likely that the game did not affect any of these items.

In that direction, we reject the three related hypotheses, namely, hypothesis 6 (The game increases civil servants' knowledge of data production), hypothesis 7 (The game increases civil servants' knowledge of the possibility of sharing data), and hypothesis 8 (The game increases civil servants' perception of data provision costs). It is important to highlight that none of the game mechanics were related to data provisioning costs, making this a surprising result.

Table 52 - Differences for game and control group (Data production, sharing, and costs)

	Mean pre	Std. dev pre	Mean post	Std. dev post	Wilcoxon, p-value
DP*Game Group	6,10	1,435	6,00	1,717	0,709
DP* Control Group	5,69	1,558	5,20	1,997	0,225
DS*Game Group	6,47	1,158	6,4	1,435	0,405
DS* Control Group	6,11	1,45	6,09	1,38	0,958
DC*Game Group	3,53	2,035	3,14	1,812	0,112
DC*Control Group	2,44	1,252	2,26	1,268	0,412

In summary, the statistical differences found demonstrates that the game has effects on its participants, particularly on their tendency to support the opening of data. Based on the hypotheses, it is likely that participating in a WINNING DATA game session changes civil servants' behavioral intentions, and therefore probably also their future behavior towards supporting the opening of data. Still, this research could not assess the long-term effects needed to confirm such tendencies in future behavior.

6.5.6 Repeated measures ANOVA

To confirm the findings from the Wilcoxon differences testes, we decided to release the normality assumption and check the differences between the game and control group in the pre- and post-test scores using a parametric test of repeated measures ANOVA - Table 53. As there are no similar non-parametric tests, such a procedure is used only to discuss previous findings and explore further insights.

The repeated measures ANOVA indicates that it is likely that the game creates a significant difference between the game and control group in the pre- and post-test situation. It also confirms the outcomes of the Wilcoxon test as the game had a significant statistical effect on the game group and did not in the control group.

Table 53 - Repeated measures ANOVA

Difference between Game/Control group	Pre-test Wilcoxon, p-value	Post-test Wilcoxon, p-value
BI	0,54	**0,04**
RK	0,15	**>0,01**
DP	0,18	**0,03**
PE	0,57	0,17
DK	0,16	0,14
DS	0,22	0,27
SI	0,10	0,12
DC	**>0,01**	**>0,01**

The game creates a significant difference in Risks which is also convergent with previous results of the Wilcoxon testing. However, in Data Production, the ANOVA indicates that the game creates a significant difference which was not accused in the Wilcoxon testing. Actually, the statistical significance of differences in the control group was greater than in the game group, and the ANOVA outcome could be indicating a similarity created by the game. Awareness resulting from the survey could explain a more attentive response in the item as it was the first question in the survey.

In Performance Expectancy, no difference was found before or after the game. Although the ANOVA results in a non-significant difference, the differences in the game group were significant by the Wilcoxon testing. Data management knowledge and Data Sharing accused no difference before or after, whether on the ANOVA or Wilcoxon testing, indicating that the game is likely not to have effects on such factors. Lastly, Social Influence indicates that the groups were different before the game was played and became similar after gameplay. In that sense, the game would make the groups less different. One possible explanation to be further explored is that there could be an effect of the game environment on participants' perceptions of SI. The environment where the survey was applied could have influenced pre-test responses as the game is played in an office setting. Also, Data costs repeated measures ANOVA indicates that a difference that existed before the game is maintained. Such differences could also be related to the influence of the setting of gameplay – and, in that case, the game has no effects on such factors. Given the violation of the normality assumption, the repeated measure ANOVA was not expected to be precise. However, in both cases, it is recommended to explore why the control group perceptions were different in the pre-test situation as a research insight.

6.6 Discussion

This chapter presented the outcomes of the hypothesis testing performed upon the survey data collected before and after civil servants played Winning Data, the open data game. These outcomes refer back to the initial factors presented in Chapter 3, which were updated with

the testing results. The resulting model is the reference to such analysis and is used to proceed with the discussion of the game evaluation.

WINNING DATA aimed at changing civil servants' attitudes towards open data. We evaluate the effects of playing the game using eight constructs, the main hypothesis on behavioral intention (1), and seven additional model factors: 2) data management knowledge, 3) performance expectancy, 4) social influence, 5) risk perception, 6) data production, 7) data sharing and 8) data costs. These constructs were translated into hypotheses, tested using data collected through the survey developed to measure civil servants' attitudes before and after the quasi-experimental gameplay. A control group was also tested to contrast the outcomes of the different tests. Related to our main hypothesis, the outcomes indicate that the game significantly influences the attitudes of participants to support the opening of more data. Thus, it is likely that the game produces an effect on its participants and increases their willingness to support the opening of data by governments.

The explorative analysis added five new factors to the underlying constructs of behavioral intentions, social influence, and performance expectancy, presented in Chapter 3: data management knowledge, risk perception, data production, data sharing, and data costs. With this final set, the change observed in behavioral intention was compared to that observed in the defined constructs and compared to the effects of a group without intervention. Additionally, a repeated measure ANOVA (with a relaxed assumption on the normality of the distribution) was used to check differences between the game and control group in the pre- and post-test situations. A difference created by the game would strengthen the idea of game effects. Based on these, the hypotheses were formulated and tested - Table 54.

Table 54 - Hypothesis testing summary

Variable	H1 (BI)		H2 (DK)		H3 (PE)		H4 (RK)		H5 (SI)		H6 (DP)		H7 (DS)		H8 (DC)	
Group	GG	CG	GG	CG	GG	CG	GG	CG	GG	CG	GG	CG	GG	CG	GG	CG
Wilcoxon (p-value)	<0,01	0,84	0,15	0,32	<0,01	0,52	<0,01	0,76	0,13	0,26	0,71	0,23	0,41	0,96	0,11	0,41
Hypothesis testing	***		*		***		***		*						*	

GG: Game Group; CG: Control Group

*** - significant difference, rejecting the null hypothesis

* - an almost significant difference, still accepting the null hypothesis

Starting with our main hypothesis, H1 (Behavioral intention increases after playing the game), the observed behavioral intention change was found to be statistically significant. This change, and its relation with the change in the other tested constructs, shows that the game is likely to have an effect and that it is likely that – by playing WINNING DATA – more civil servants will support the opening of data by governments. Such effect was not found in the control group and was also indicatively confirmed by the repeated measures ANOVA.

Concerning H2 (The game results in more knowledge about how to open data), we found that – although playing WINNING DATA increased participants' knowledge of data management –

the increase was not statistically significant. Such change was not present in the control group also, as shown in the ANOVA results. However, our participants started with high levels of knowledge (almost 90% had used open data before - Table 41), and other civil servants with less previous knowledge and experience might profit more from this aspect of the game.

As discussed in Chapter 3, the next hypothesis, H3 (The game results in a better understanding of the expected benefits of opening data), merged expected outcomes of opening data to others, including partners from government or the private sector (Bozeman & Kingsley, 1998; Zuiderwijk et al., 2015). This perception of benefits and positive outcomes was expected to increase at the individual and the institutional level due to the open data practice simulated in the game (Carter & Campbell, 2011; Janssen et al., 2012). The results show that the increase was, in fact, statistically significant, even for such an experienced audience which did not occur in the control group. Although the repeated measure ANOVA did not indicate significant differences between the game and control group, that result needs to be checked in a larger sample that fulfills the normal distribution assumption.

The difficulties faced by civil servants in making data accessible (Venkatesh et al., 2003; Weerakkody et al., 2017; Zuiderwijk et al., 2015; Zuiderwijk & Cligge, 2016) are synthesized in H4 (The game decreases expectations of the effort needed to make data available). Specifically regarding the risks involved in open data release, we – unexpectedly – found a statistically significant decrease in the game group which did not occur in the control group. It is, therefore, likely that game participants improved their understanding of the actual risks and some of the possible mitigating mechanisms. Though public news on the topic might have influenced the participants' perception change, such results also were strengthened by the repeated measure ANOVA which indicates that the game creates a difference that did not exist before the game was played. It would be interesting to further explore the relationship between the decrease in risk perception and the increase in civil servants' behavioral intention to support open data.

Through H5 (The game reduces civil servants' perceptions of constraints to open data practice as exerted by hierarchies and legal frameworks), hierarchies, legal frameworks, and other social pressures are expressed as social influences. As found in our literature study in Chapter 3, this is particularly important in the governmental context of open data, as this can limit civil servants' actions (Venkatesh et al., 2003; Weerakkody et al., 2017; Zuiderwijk & Cligge, 2016). Again, a change was found in the WINNING DATA participants' perceptions, but this was not statistically significant. Besides this difference increase, the repeated measure ANOVA did not indicate significant changes. Once more, testing the game with a less experienced group could produce new outcomes.

Lastly, three other hypotheses were tested for individual items. None of them, namely, H6 (Knowledge of data production will influence the Behavioral Intention of civil servants to support open data), H7 (Knowledge of data sharing as a possibility will influence the Behavioral Intention of civil servants to support open data) and H8 (The perception of costs

for open data provision will negatively influence the Behavioral Intention of civil servants to support open data) indicated statistically significant changes through Wilcoxon difference testing. Such lack of differences also resulted in the control groups, indicating that the game is likely not to have effects on such factors, leading to a hypothesis rejection in the three cases.

However, the knowledge of data production did result in a difference through the violated repeated measure ANOVA which might indicate a hidden effect caused whether by the sample size, experience, or the survey itself. Furthermore, in the case of data costs, differences between the game and control groups were found both in the pre-test and the post-test occasions. Again, further research is needed to confirm or reject such results and explanations.

6.7 Conclusion

Using a survey to compare the situation before and after the game was played confirmed that it is likely that gaming alters the behaviors of civil servants concerning the expected performance and risks. The conclusions are taken from our published paper (Kleiman, Janssen, Meijer, et al., 2020). Confirming our main hypothesis that a game could be used to change civil servants' attitudes towards open data, the outcomes suggest that gaming is a suitable instrument for knowledge transfer, awareness creation of possibilities for opening governmental data, and attitude change.

The analysis shows that a more realistic perspective of opening governmental data results from civil servants interacting with the benefits and risks of open data. An increase in awareness of elements of individual privacy and institutional security risks of open data is also triggered by the game. The game seems to balance players' perceptions of risks as all the risk perception items had a statistically significant decrease.

As the second-largest difference between pre and post-test measurements happened in performance expectancy, we found benefits perception to be significantly changed by the game also. Therefore, participants understood better the positive outcomes of data opening after the game was played. As the starting score for some items was already high, there is a possibility that this result was limited by the ceiling effect, given that participants were not allowed by the scales to express greater increases. Indeed, the item PE_19 (Providing open public sector data improves my performance in my job) indicates that the game's in-office direct benefits (red tape and FOI requirements reduction) had more influence in this regard. Besides, item PE_15 (Providing open public sector data increases transparency) had a negative influence which could be explained by the game's lack of consequences for citizens when open data is released; one qualitative feedback received in a game session.

Some of the constituting items of the concepts of social influence and data management knowledge did show changes despite the fact that these effects were not statistically significant. This can be an indication that the game was perceived as neutral as the participants played the game voluntarily. Furthermore, data management, privacy, and security

knowledge transfers were declared to have happened through the game. The item SI_13 (Providing public sector data is not a priority for me) showed a decrease which indicates that participants might consider supporting more data opening in the future. Some increase in perception of autonomy or available support might have resulted from gameplay as items with a low benchmark suggest, e.g., as SI_15 (I have the necessary autonomy to provide public sector data) and SI_18 (I have assistance available concerning the provision of open public sector data). Though the awareness that the government might not be as supportive may be increased, the participant's willingness to share more governmental data may increase also.

Lastly, the game had effects on participants' attitudes towards supporting the opening of governmental data, as indicated by the significantly positive change in behavioral intention to share open data after the game was played. All the three items BI_11 (I already provide open public sector data in my work), BI_12 (I intend to provide open public sector data in the future), and BI_13 (I predict that I will provide open public sector data in the future) indicate an increase on the awareness of participants, which was created by the game – both that they already produce and share data in a way that they did not realize before and that they will do so in the future. The in-game routines might help people to understand that open data is less complex than they thought. The statistical differences found indicate that the game is effective for changing civil servants' attitudes towards open data.

7 CHAPTER 7 – Epilogue

7.1 Introduction

In this thesis, we evaluated the effects of gaming on public servants' attitudes towards open governmental data. In the previous chapters, we described the literature background that supports our hypothesis and defines the game's requirements. The collected survey data was analyzed and led us to conclusions on WINNING DATA's effects, the game developed in our research to influence civil servants' attitudes towards releasing governmental data. This chapter presents the findings of the thesis and extends its application to other situations. Next, we present the contributions resulting from such findings and discuss the limitations and consequences of the research. We end this chapter by suggesting further research agenda, which is supported by our work.

7.2 Revisiting the research questions

We investigated four research questions in this research focused on developing and testing a game to change civil servants' attitudes towards open data. Our first research question, RQ1 (What are the behavioral barriers for civil servants to support the opening of governmental data?), was assessed through an SLR in the field of open data.

The prevalence of research on open data use supported the need for discussing the factors influencing data provision, specifically within governments. We operationalized the list of barriers for civil servants to support the release of open data into factors. We defined Behavior Intention as the dependent variable, representing a proxy to measure changes in attitudes towards open data. Another four factors appeared from literature, which was decomposed into seven factors using explorative analysis. These seven factors of influence were defined and tested: Data Management Knowledge (DK), Performance Expectancy (PE), Risks (RK), Social Influence (SI), Knowledge of Data Production (DP), Data Sharing Knowledge (DS), and Data Costs (DC). Besides advancing towards a model of open data support factors, such discussion also supplied our research with open data-related content for the consequent game development process.

Another aspect found in the literature study was the gaps in the literature to discuss behavioral barriers towards open data. We assessed a growing number of studies in open data related to multiple topics. However, hardly any studies used or explored the use of games, positioning our research as one of the first to do so. Also, we found that many e-government or other governmental-focused games exist, but most of them were developed by practitioners. Only a few of them had scientific grounding or were systematically evaluated.

To address RQ2 (What are the requirements for a game to change civil servants' attitudes towards supporting the opening of governmental data?), we performed another SLR on the topics of serious games and attitude change; serious games and civil servants; and serious

games and open data. It resulted in a map of literature gaps related to each serious gaming topic. No single framework was found capturing factors most influencing attitude change in games. Besides that, most of the governmental serious games focused on participation and decision-making, indicating a gap in games for bottom-up approaches targeting civil servants. Additionally, the existing open data games focused on users or use open data for generating game content, indicating the inexistence of hardly any data providers' games.

The SLR also resulted in a list of 5 requirements that could be used to develop the game. The prototyping process resulted in the identification of an additional two requirements resulting in 7 requirements in total. During the prototyping, it became clear that realism should be crucial for effective experiential learning; role-playing would help empower and empathize gameplay; tacit knowledge through practice should connect civil servants to the game; governmental stakeholders could be represented in the game. Also in the list was a need to simulate a hierarchical environment that appeared as an appropriate metaphor to operationalize strict government rules, which could trigger the expected risk-aversion of public servants. The open data contents were taken from real examples, including approaches and techniques supporting data release.

The requirements were the starting point for RQ3 (Which game design mechanisms enable the change of civil servants' attitudes towards opening governmental data?). As no open data provision game focusing on civil servants existed, and various types of games could be developed for such purpose, it was unclear what type of game would be most suitable. Therefore, we developed the mechanisms using an iterative process requiring four prototypes. The enlisted requirements were converted into mechanisms incorporated in the game that would result in the desired effects:

- Mechanism 1: Dataset description and labeling;
- Mechanism 2: Card codes;
- Mechanism 3: Pre-defined demands (not random);
- Mechanism 4: Forms, Files and Demand cards;
- Mechanism 5: Service delivery goal;
- Mechanism 6: Upgrades;
- Mechanism 7: Facilitation;
- Mechanism 8: Crisis board;
- Mechanism 9: Dice as processing machine;
- Mechanism 10: Multi-player (with different roles); and
- Mechanism 11: Time-limited rounds.

The iterative design process was applied in cycles, aiming at meeting all the enlisted requirements in the open data game. Pilot-testing aiming at acceptance through debriefing helped improve the prototypes until a final version was reached. The result is the final version of the WINNING DATA game, presented in chapter 4.

Our last research question, RQ4 (What are the effects of the open data game on civil servant's attitudes towards supporting the opening of data?), required the analysis of pre- and post-tests data resulting from the application of our survey on all participants of the game. In total, 112 civil servants participated in the quasi-experiment, 77 actively playing the game, and 35 by answering the survey questionnaire. The Wilcoxon Signed-Rank test indicated that a statistically significant effect happened on the dependent variable of the model, Behavior Intention, which was used to measure the changes in civil servants' attitudes towards open data. By contrast, none of the control group tests resulted in statistically significant effects. Therefore, our conclusions that civil servants who played the game are likely to have their attitudes towards open data increased by the game were strengthened. The tests also indicated that the game significantly affected Risks and Performance Expectancy, whereas the effects on Social Influence and Data Costs were not statistically significant. No significant differences were found in Data management knowledge, Data sharing, and Data production.

From a qualitative perspective, the game was entertaining, and most players declared to be willing to continue playing even when the rounds were done. The experience resulted in learning outcomes related to privacy mechanisms and data management in general. The interlayer of stressing action for service delivery and decision-making debates for labeling players, and enabled deeper conversation of risks and benefits of open data. Therefore, we concluded that the game was successful both from a quantitative and qualitative point of view.

7.3 Research contributions

The SLRs performed in this thesis confirmed three existing gaps in the literature researched. First, no previous models were found to discuss the factors influencing attitudes of civil servants towards open data. Also, no previous games used open data content focusing on this audience of governmental personal who can influence the release of open data by governments.

Second, a few games have been designed focusing on civil servants, and not many were previously researched. The scientific assessment of those games still lacks in the literature, which we contribute with our research.

And third, researches on games have discussed many topics, such as education, training, decision-making, persuasion, and empathy. However, no single framework has defined factors that can influence players to change their attitudes.

Moreover, these clear gaps help us to set the six scientific contributions resulting from this thesis. Our first research contribution is that our thesis is the first to integrate the main behavioral barriers for civil servants to support governments' opening of data in a model. Our civil servants' behavioral intention model for supporting the opening of data by governments included: Data Management Knowledge (DK), Performance Expectancy (PE), Risks (RK), Social

Influence (SI), Knowledge of Data Production (DP), Data Sharing Knowledge (DS) and Data Costs (DC). This model is the first attempt to systematically assess the variables influencing civil servants' perceptions of open data. Moreover, it is a clear contribution to the existing studies of digital government and open data that extends the behavioral discussions of open data adoption to the providers' side.

As a second contribution, this thesis lists requirements for developing an open data providers' game: a safe environment for experimentation, realistic setting, practical knowledge, open government data content used in the game, experiential learning, role-playing game dynamics, and a limited number of roles, players, and rounds. These requirements can be used by other researchers and game developers for developing interventions towards changing civil servants' attitudes related to open data. The requirements and the iterative design process also add to the body of knowledge on game design studies, particularly those focused on governments' games. It is important to enlarge the available inventory for designing games both for civil servants and for open data provision.

Third, the initial prototypes resulted in insights on matching open data contents into engaging routines for players to interact. The resulting game mechanisms also included discussion activities that inspired the final data labeling sessions that get participants to perform live debates on dataset sensitivity. We concluded that the discussions integrated into the game's realistic bureaucratic office setting unleashed the needed engagement for the experiential learning to happen. The roles, processes, sequences of the game, and its rules already inspired other interventions and research on the topic. As the game indicates effectiveness to involve participants in the play and results in changes in attitude, it contributes to both fields of digital government and serious gaming, which expands the existing successful cases, with concrete evidence, for using games to influence the attitude of players.

This research resulted in a working open data game as its main artifact. WINNING DATA is the fourth contribution of this thesis, a concrete contribution to the field, a game to play the reality of governments' open data. We evolved from a simple open data content prototype based on matching cards to a fully working in-person role-playing game in the design process to include all the defined requirements and mechanisms.

Based on the model constructs, a fifth contribution is the evaluation metrics used in this thesis. The survey questionnaire, the baseline measurement, the collected data, and the results add to the field of open government data with knowledge on civil servants' attitudes and the actions to foster change. From a gaming perspective, the new field and improved evaluation methods also contribute to its scientific discussions. The collected evidence also updates the baseline measurements for gaming intervention and adds to the historical data available for further analysis and comparisons.

The last contribution of this research is the use of games in an original field. From a Design science perspective, the originality of research can be classified based on the maturity of both

proposed solutions and their application to a certain domain. We use Figure 35 to explore a perspective of solution and application maturity as in Hevner et al. (2004).

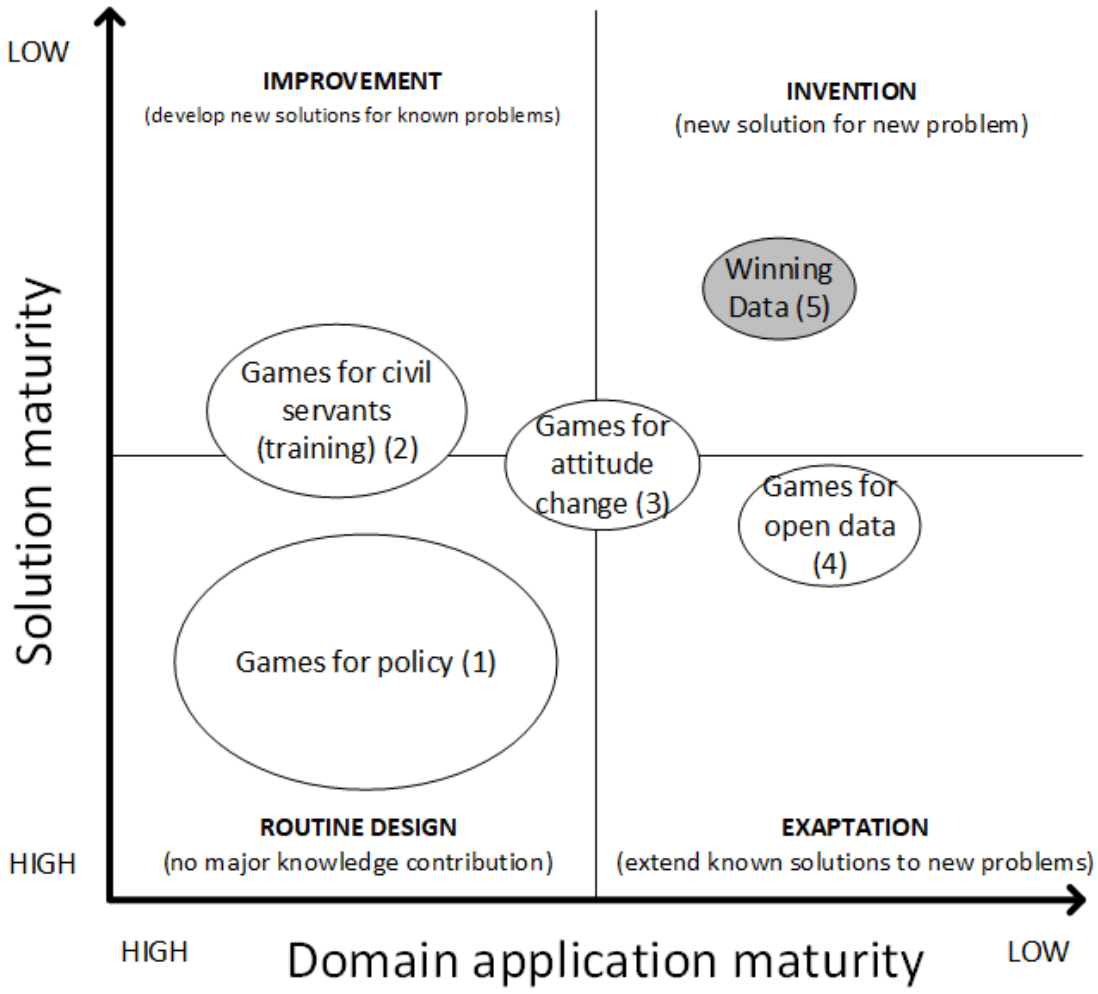

Figure 35 - Research contributions (based on (Gregor & Hevner, 2013))

Policy gaming (1) is already a well-defined field of study, with an established community researching on the topic for decades (Duke, 2011; Geurts et al., 2007). Although there are not many games designed specifically for civil servants, games for training (2) are also a very well-known application for games (Meijer et al., 2014; Rogach et al., 2018). The whole discussion on the use of games for education has different research groups also researching the topic for a long time (Deen, 2019; Gee, 2003). As found in our study, research on games for attitude change (3) is already a bit innovative as there is a gap in the literature in a more systematic approach. There are debates on the use of persuasive games for changing beliefs and behaviors (Antle et al., 2014; Bogost, 2007). However, the specific discussion of attitude change is to be further developed. The application of games for open data (4) is more recent than other topics, and, as shown, there are anecdotal cases of whether to use open data to generate games or to teach people how to use open data. Our game, merging games focused on the attitude change of civil servants towards open data, is still one of a kind (5).

As explained in Chapter 2, we consider WINNING DATA to be an invention. It has contributions from a solution maturity perspective in exploring new frontiers on games for civil servants and open data; also exploring domain maturity in using it specifically to change attitudes towards open data. Our research opens new tracks for other researchers to better understand the use of games to change players' attitudes in those fields, expanding the frontiers of gaming in governments and serious games for open data.

7.4 Research limitations

Four groups of limitations could be related to the developed research: (1) sample-related limitations, on the number of participants and their characteristics' distributions; (2) treatment-related limitations, on the effects of not having alternative strategies compared in the research; (3) test-related limitations, as a consequence of the size and treatment, the statistical analyzes were restricted to those appropriate to the available data; (4) outcomes-related limitations, which explores other results that could not be achieved at this point of this study, and (5) the role of the facilitator in playing the game. They can be used as a reference for further research to advance in the discussions exposed in this thesis.

First, the limitations on the sample used for the analysis of the effect of the game (1): the sample size limited some of the analysis performed in this thesis; the lack of normality in data distribution also prevented us from performing certain tests; a more diverse background in terms of experience and government levels to which civil servants work for could increase the validity of some results; and, the inclusion of civil servants from other countries could extend our discussions.

Second, we used our questionnaire to measure at two moments in time and compared the intervention with one control group (2). Measuring the groups in additional moments and having other groups with different interventions (such as video or text) could enrich the discussions and conclusions. The role of the facilitator, who ensures the running of the game, could also have been evaluated, as different facilitators might result in different outcomes, especially at the debriefing sessions. The measurement and analysis of the group of civil servants who played the game compared to the outcomes of the other different groups could lead to new findings, particularly in the field of game design and interaction.

Besides using alternative treatment, other sectors could also be tested for the game, like companies and civil society. Adding to the previous group discussion, a larger sample size for control groups could also add to discuss the results from our research.

Third, if greater samples with more normally distributed data are acquired, other tests could be performed (3). The lack of precision in the repeated measures ANOVA, as in chapter 6, could be tackled and be more conclusive for the research. Other statistical methods, such as a multivariate mixed model or structure equation modeling, could fit the game effects'

purposes. These tests would enable a deeper discussion of the presented model of variables influencing civil servants' support to open data.

Lastly, by performing these tests, it can be expected other differences to be found (4). Unexpected results could contrast with the ones we found in this thesis and advance the scientific discussion to address civil servants' attitudes towards open data. Similar to the debate on the user perspective of open data adoption, a deeper discussion on the model of factors influencing civil servants' support to open data could also be developed. Also, our survey was built to assess the change in attitudes caused by the game. In case the mechanisms were the focus, another survey and methods would be needed. Further research is recommended to explore what mechanisms are at work.

To summarize, WINNING DATA can be used as a starting point for new game interventions related to open data topics. A digital version was already developed in a master thesis (Di Staso, 2021). Our developed game gives insights into assets, mechanics, and dynamics that can be used and improved in further games. Another version could expand the types of data and datasets presented to the players, including other open data operations, or even present new mechanics to engage the participants in a more realistic setting of WINNING DATA.

Besides, our results can be explored in upcoming studies, as extending the repeated measurements and testing the long-term effects of behavioral intention change can increase the understanding of the effects of the game. Although it would have been interesting to test the participants' perceptions a third time and check the mid-term effects of the game, this was not feasible. Additionally, having more data points in a more normally distributed sample would allow testing the results with more advanced techniques unreachable with the existing dataset.

7.5 Future interdisciplinary research

As in any research process, particularly in a Ph.D., the need to focus prevents us from discussing many different subjects and issues which appear throughout the journey. A list of the topics is presented next as inspiration for further discussions and research.

We start with one of the most undeveloped topics of this research: the history of government digitalization and its consequences for policy-making. Much of human history is still to be written specifically for the many dimensions implicated in the adoption of technology by public service through time. From the ancient escribes in Egypt and the power related to their knowledge monopoly (Gil-Garcia, Dawes, & Pardo, 2017; Harari, 2016) until today's transparency frontiers, there are many implications to be studied in each stage of governmental digitalization (Cucciniello, Porumbescu, & Grimmelikhuijsen, 2017; Matheus, 2017). By advancing in these reflections, many insights on the barriers, solutions, and digital government perspectives should be found. The open data game could also profit from

introducing historical content on the actual state of open data, as each context could represent progress coming from previous scenarios.

Another discussion surrounding our research was the topic of democracy and open data. We know there are already many studies on data sharing's effects on transparency, accountability, participation, and trust (Bélanger & Carter, 2008; Warkentin, Gefen, Pavlou, & Rose, 2002). However, there are many overlays of political sciences research and technology which are still to be explored. There is room to advance reflections on the consequences of major changes in citizens' and civil servants' culture towards a more transparent and participative public service and how such changes can impact governmental service delivery and democracy. Particularly, exploring the connections of data availability and processing power of actors, groups, and institutions is a topic that is already demanding increased attention.

On the same note, democracy and games is another not-so-developed topic that can inspire new research. Starting from the use of games for participation, civic engagement, and policy crowdsourcing (Mayer, 2009; Raghothama & Meijer, 2015; Sgueo, 2018), many other aspects of game development and game use can be discussed. Democracies are high on the world political agenda, and insights from a game design perspective can contribute.

As in Bown (2018), the connection between psychology and games has many unexplored insights. Moreover, from a psychoanalytic perspective, connecting game mechanics and dynamics to desire, belonging, meaningful interaction, different topics emerged. Such discussion also gains space last year with the pandemic and increased virtual video call interactions (Kleiman, Meijer, & Janssen, 2020a).

The economic relevance of games is a more common discussion in other fields, such as media and communication. However, there seem to be many unexplored opportunities, such as information transfer through games, art in games, and many others. As in Bogost (2011) and Walz and Deterding (2015), there is much room for progress on games studies in general. Also, discussions on political economy and serious games are another large field for exploration. From gaming industry, workers and collective action (O'Donnell, 2014; Schreier, 2017) to ideology, alienation, and praxis (Woodcock, 2019), the many topics related to game leads us back to politics and the world of video games.

Moreover, testing WINNING DATA content and dynamics in different media such as digital facilitated or fully digital game designs could generate new insights compared to the actual role-playing in-person game - Table 55. DATA BELT is a digital version of WINNING DATA, developed in a Master thesis, deriving from this research (Staso, Kleiman, Crompvoets, & Janssen, 2021). The results of the digital game and non-digital game can be compared with each other in future research.

Table 55 - Digitalization in games

Interaction media	Interaction Elements	Players	Example
Fully Digital	Only virtual interaction	Human / Computer	Mobile version of WINNING DATA (to be developed)
Digital Mediated Interface	Virtual board, scenario, and assets	Human / Computer	Automated Data Belt (to be developed)
	Virtual board, scenario, and assets	Human	Data Belt (developed in master thesis project)*
Role-playing game	Digital scoring system	Human	**WINNING DATA**
Board game	Only physical interaction	Human	WINNING DATA Board Game (to be developed)

*(Di Staso, 2021)

On top of game discussions, the last hype of gamification could not be addressed in this thesis. Gamification is the use of gaming elements in non-gaming situations, and it has been increasingly adopted in companies and public service for many purposes (Hamari, Koivisto, & Sarsa, 2014; Harviainen & Hassan, 2019; Werbach & Hunter, 2015). Conceptualizing it better and going deeper on its effects is a topic still to be explored (Chou, 2015; Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011; Landers, Auer, Collmus, & Armstrong, 2018). Gamification for public service would have an additional challenging layer related to the legal framework and strategy implementation, where designing interventions would depend on the administration to approve and execute the projects (Hassan & Hamari, 2020; Sgueo, 2017).

7.6 The end

In this thesis, we connected the topics of open data, and serious games in a technical application tested for a defined use. Moreover, WINNING DATA is a game designed for such an endeavor. Using a survey to compare the situation before and after the game is played, our research confirmed that it is likely that gaming alters attitudes of civil servants concerning the expected performance and risks of open data. The realism represented by the role-playing mechanics, metaphors built upon tacit knowledge, connected civil servants to the game, and enabled experiential learning. The strict rules and hierarchical environment of governmental operations fostered risk-averse behaviors of public servants towards open data contents. The outcomes prove gaming to be a suitable instrument for knowledge transfer and create awareness of possibilities for opening governmental data on governmental employees.

An immediate follow-up agenda could start from evaluating long-term effects and ensuring different players play at different levels (e.g., experienced once get more challenging content and issue). Once a challenge is solved, new ones might appear. Therefore, new mechanisms might be needed to ensure that the game helps civil servants to be more aware of the possibilities and risks of open government data. Both open data and serious games can contribute to changing the world we live in. Depending on how they are used, different

outcomes can be expected. That is the reason why we need a better understanding of these topics. Furthermore, progressing with research on them is highly recommended.

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ACRONYMS

Acronym	*Description*
Anesp	National Association of Public Policy and Management Specialists (organization)
ANOVA	Analysis of Variance (statistics)
APEBNL	Brazilian Researchers Association in The Netherlands (organization)
AVG	Average (statistics)
BI	Behavior Intention (model variable)
DC	Data Costs (model variables)
DK	Data Management Knowledge (model variable)
DP	Knowledge of Data Production (model variable)
DS	Data Sharing Knowledge (model variable)
DSR	Design Science Research (conceptual reference/model)
EE	Effort Expectancy (model variables)
e-gov	Electronic Government
EO	Experience with open public sector data (model variable)
EPS	Experience in the public sector (model variable)
EU	European Union (organization)
FNP	Brazilian National Mayors Association (organization)
FOI	Freedom of Information
GA	Game assessment (model variable)
GDPR	General Data Protection Regulation
Gscholar	Google Scholar (website)
ICEGOV	International Conference on Theory and Practice of Electronic Governance
ICT	Information and Communication Technology
IT	Information Technology
JSTOR	Journal Storage (website)
LK	Lack of Knowledge (model variable)
NPC	Non-player characters
OBD	Open by Default
ODI	Open Data Institute (organization)
OECD	Organization for Economic Co-operation and Development (organization)
OGD	Open Government Data
OGP	Open Government Partnership (organization)
PCA	Principal Component Analysis (statistics)
PE	Performance Expectancy (model variable)
PET	Privacy Enhancement Technologies
RA	Risk-Aversion (model variable)
RK	Risks (model variable)
RPG	Role-Playing Game
RQ	Research Questions
SD	Standard Deviation (statistics)
SG	Serious Gaming
SI	Social Influence (model variable)
SLR	Systematic Literature Review
TAM	Technology Adoption Model (theory)
TPB	Theory of Planned Behavior (theory)
TRA	Theory of Reasoned Action (theory)
TUDelft	Delft University of Technology (organization)
UN	United Nations (organization)
UNU-eGov	United Nations University (organization)
UTAUT	Unified Theory of Acceptance and Use of Technology (theory)
UX	User Experience
WB	World Bank (organization)
WOS	Web of Science (website)

Appendix 1 – References for game prototyping

Table 56 - List of reference games for prototyping process

Type	Games	Publisher/Developer	Source	Media
Data-related games	People's budget	Committee for a Better New Orleans - 2016	https://peoplesbudget.com/	Digital
	Jogo de Governo Aberto	IGA (Open Government Institute), Fast Food da Politica (Brazilan NGOs), and CGU (Comptroller General of the Union, Brazilian Federal Government)	https://tabletopia.com/games/jogo-de-governo-aberto	Card
	Bar Chart Ball	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	Beat the Press: A competitive newsroom game using ABC news data.	Independent	https://www.secretlab.com.au/govhack2016	Digital
	Data Dealer	Independent	https://datadealer.com/	Digital
	Flight Leader	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	Game Free Science!	Independent	https://zenodo.org/record/3522126#.XcQpj_lKiUk	Digital
	games using open data	Independent	https://opensource.com/government/16/10/open data-video-games	Digital
	Open Data Civilization	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	Open Data Monopoly	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	OpenStreetRacer	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	OpenTrumps	Independent	http://game.engineering.nyu.edu/data-games/	Digital
	Run that Town	Independent	http://runthattown.abs.gov.au/	Digital
	What is Gov?	Independent	https://www.secretlab.com.au/govhack2014	Digital
	Open Data Game	ODI	http://opendataboardgame.github.io/about/	Boardgame
	Data gedreven werken game (Data-driven work)	Provincie Zuid-Holland	NA	Boardgame
	Dataspel (Data game)	Provincie Zuid-Holland	NA	Boardgame

Type	Games	Publisher/Developer	Source	Media
	Datak - A Serious Game About Personal Data	RTS	http://www.gamesforchange.org/game/datak/	Digital
	Open Data Bingo	Spaghetti	http://gbonanome.github.io/opendatabingo/	Cards
	Agenda 2030: Monitoramento dos Objetivos do Desenvolvimento Sustantvel (Sustainable Development Goals Monitoring Game - monitoring game)	Teresina Municipality (Brazil/Piaui)	NA	Boardgame
	WatchDogs	Ubisoft	https://www.ubisoft.com/en-us/game/watch-dogs/	Digital
	WatchDogs 2	Ubisoft	https://www.ubisoft.com/en-us/game/watch-dogs-2/	Digital
	Digitale Identiteit Ganzenboard (Digital Identity Goose Board – Privacy game)	Waag (Dutch Research Foundation)	NA	Boardgame
Politics, bureaucracy, and public policy	Mobilog	Axies	http://axies.com.br/	Digital
	Airport Mania: First Flight	BigFish	https://www.bigfishgames.com/online-games/4405/airport-mania-first-flight/index.html	Digital
	Kleptocrat	BumbleBear	http://www.indiecade.com/2018-games/kleptocrat/	Digital
	Doctor Dash: Hospital Game	CrazyGames	https://play.google.com/store/apps/details?id=crazygames.games.hr	Digital
	Reigns Her Majesty	Devolver	https://store.steampowered.com/app/717640/Reigns_Her_Majesty/	Digital
	Held	Dutch Heart Foundation (developed by TUDelft Gamelab)	http://www.seriousgaming.tudelft.nl/games/held	Digital
	Simcity	EA	https://www.ea.com/games/simcity	Digital
	Cidade em Jogo / Cidade at Play/Stake	Fundação Brava	http://cidadeemjogo.org.br/	Digital
	Win the White House	Icivics	https://www.icivics.org/games/win-white-house	Digital
	Peace Maker	Impact	http://www.peacemakergame.com/	Digital
	Marvelous Ultimate Appliances: A combat game using	Independent	https://www.youtube.com/watch?v=bLppE0mx5DE&feature=youtu.be	Digital

Type	Games	Publisher/Developer	Source	Media
	household appliances.			
	Question Time: A competitive game using politicians voting records.	Independent	https://www.secretlab.com.au/govhack2015	Digital
	Jogo do Estatuto da Cidade / City Law Planning Game	Instituto Polis	http://polis.org.br/publicacoes/jogo-do-estatuto-da-cidade-ruropolis/	Boardgame
	Detector de Ficha de Político	Instituto Reclame Aqui	http://www.vigieaqui.com.br/	Digital
	Airport scanner	Kedlin	https://www.airportscannergame.com/	Digital
	Jogo da Politica (Politics game)	Labhacker	http://jogodapolitica.org.br/	Digital
	Papers, please	LucasPope	http://papersplea.se/	Digital
	Corrupt Mayor Clicker	MeigaLabs	http://www.meigalabs.com/games/corrupt-mayor-clicker	Digital
	Democracy 2	Positech	http://www.positech.co.uk/democracy2/	Digital
	Hidden Agenda	Supermassive	https://www.playstation.com/nl-nl/games/hidden-agenda-ps4/	Digital
	Corruption: Welcome to Brazil	ThereBits	http://www.diariodigital.com.br/geral/baseado-na-corrupcao-brasileira-jogo-faz-sucesso/168211/	Digital
	Fiscal Ship	Wilson Center	https://fiscalship.org/	Digital
	Dismissal simulator	YourCompany	https://play.google.com/store/apps/details?id=com.yourcompany.dismiss&hl=en_US	Digital
Management games	Farm Frenzy	Agame	http://www.agame.com/game/farm-frenzy-2-mobile	Digital
	Monster Pet Shop	Beeline	http://www.beeline-i.com/index.php	Digital
	Home Sweet Home	BigBlueBubble	https://www.bigbluebubble.com/?page=game_detail&cat_id=115&game_id=483	Digital
	Artist Colony	BigFish	https://www.bigfishgames.com/games/5356/artist-colony/	Digital
	Cooking Academy	BigFish	https://www.bigfishgames.com/online-games/4491/cooking-academy/index.html	Digital
	Go-Go Gourmet: Chef of the Year	BigFish	https://www.bigfishgames.com/games/2614/go-go-gourmet-chef-of-the-year/	Digital
	Nanny Mania 2	Bigfishgames	https://www.bigfishgames.com/games/2888/nanny-mania-2/	Digital
	Penguin Diner 2	Bigwig	https://www.bigwigmedia.com/	Digital

Type	Games	Publisher/Developer	Source	Media
	Shop Heroes	CloudCade	http://shopheroes.com/	Digital
	Papa's pizzeria	Coolmath	http://www.coolmath-games.com/0-papas-pizzeria	Digital
	Iron Chef America: Supreme Cuisine	Destineer	http://destineergames.com/games/ds/ironchefamerica/	Digital
	Dr. Panda Restaurant 2	DrPanda	https://drpanda.com/games/dr-panda-restaurant-2	Digital
	Order Up!! To Go	EA	https://www.ea.com/studios/chillingo	Digital
	Restaurant Empire II	Enlight	https://www.enlight.com/re2/	Digital
	Heavy rain	Epic	https://www.epicgames.com/store/en-US/product/heavy-rain/home	Digital
	Papa's Pizzeria to Go!	Flipline	http://www.flipline.com/apps/papaspizzeriatogo/	Digital
	Food Court Fever 2	Flow	https://www.flowmotionentertainment.com/	Digital
	Stand O' Food	G5E	https://www.g5e.com/games/stand_o_food_3_android	Digital
	Supermarket Mania	G5E	http://www.g5e.com/	Digital
	Cafeland: World Kitchen	GameGos	http://www.gamegos.com/	Digital
	Cooking Tale	GameGos	http://www.gamegos.com/cookingtale	Digital
	Cathy's Crafts	Gamehouse	http://www.gamehouse.com/#/	Digital
	Delicious Emily's New Beginning	GameHouse	http://www.gamehouse.com/#/series/delicious	Digital
	Diner Dash	GameHouse	http://www.gamehouse.com/#/games/diner-dash	Digital
	Gardens Inc 4: Blooming Stars	Gamehouse	http://www.gamehouse.com/#/ (series)	Digital
	Sally's Spa	Gamehouse	http://www.gamehouse.com/#/games/sallys-spa	Digital
	Cooking Dash	Glu Games	https://www.glu.com/games/cooking-dash/	Digital
	RESTAURANT DASH WITH GORDON RAMSAY	Glu Games	https://www.glu.com/games/restaurant-dash-gordon-ramsay/	Digital
	Burger Shop	GoBit	https://www.gobit.com/	Digital
	Game Dev Tycoon	GreenHeart	https://www.greenheartgames.com/app/game-dev-tycoon/	Digital
	Achron	Hazardous	http://www.achrongame.com/site/	Digital

Type	Games	Publisher/Developer	Source	Media
	Goodgame Café	HRA	http://goodgamecafe.hrajonline.net/	Digital
	Citizen Burger Disorder	Kritz	http://kritz.net/	Digital
	My Cafe: Recipes and Stories	Melsoft	http://melsoft-games.com/	Digital
	Sushi Go Round	Miniclip	https://www.miniclip.com/games/sushi-go-round/en/	Digital
	Cake Mania	MSN	http://www.shockwave.com/gamelanding/cakemania.jsp	Digital
	Dinopark Tycoon	MyAbandomware	https://www.myabandonware.com/game/dinopark-tycoon-1ps/play-1ps	Digital
	My Kingdom for the Princess	Nevosoft	http://android.nevosoft.com/games/my-kingdom-princess-iv	Digital
	Sky Burger	NimbleBit	http://nimblebit.com/	Digital
	Happy Chef	NordCURRENT	http://www.nordcurrent.com/games/happy-chef.html	Digital
	Cooking Mama 5: Bon Appetit!	OfficeCreate	http://www.ofcr.co.jp/new/mama5.html	Digital
	Fashion World	Oxo	http://www.oxoapps.com/	Digital
	Baking Life	Papcap	https://www.eurogamer.net/articles/2012-01-20-popcap-to-shut-down-baking-life	Digital
	Cities skylines	Paradox	https://www.paradoxplaza.com/cities-skylines/CSCS00GSK-MASTER.html	Digital
	Restaurant City	Playfish	https://www.youtube.com/watch?v=n35wI9Efl2g	Digital
	Farm to Fork	Playrix	https://www.playrix.com/index.html	Digital
	Detroit become human	QuanticDream	https://www.quanticdream.com/en	Digital
	Jane's Hotel	Realore	https://realore.com/games/pc/janes-hotel/	Digital
	Coffee Shop Tycoon	Riff	http://riffcg.com/	Digital
	Kitchen Scramble	Rockyou	http://rockyou.com/rockyou-games/kitchen-scramble/	Digital
	Kitchen Scramble: Cooking Game	Rockyou	http://rockyou.com/rockyou-games/kitchen-scramble/	Digital
	Ministry of time	Sony	https://store.playstation.com/nl-nl/product/EP2405-CUSA10017_00-0000000000000000	Digital
	Bakery Story	Storm8	http://www.storm8.com/	Digital

Type	Games	Publisher/Developer	Source	Media
	Chef Rescue	Tapp	http://tappsgames.com/	Digital
	Overcooked	Team17	https://www.team17.com/games/overcooked/	Digital
	Overcooked 2	Team17	https://www.team17.com/games/overcooked-2/	Digital
	Weed Firm 2: Back to College	Thumbspire	https://www.thumbspire.com/connect/	Digital
	CatHotel: Hotel for Cute Cats	Tivola	https://www.tivola-mobile.com/en/	Digital
	Let's Eat! Seaside Café	Zoo	https://store.steampowered.com/app/444950/Lets_Eat_Seaside_Cafe/	Digital

Appendix 2 – Attitude change factors list

Table 57 - Complete game attitude change factors list

Factors	N	Description	References
1. Attitude	8	Evaluative affect about performing a behavior	(Blythe & Coventry, 2012) (De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Kolek et al., 2018) (Nilsen et al., 2011) (Soekarjo & van Oostendorp, 2015) (Steinemann et al., 2016)
2. Behavior (see footnote 3)	7	Actions of a person in real life	(De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (DeSmet, A. et al., 2018a) (Fijnheer et al., 2018) (Janakiraman et al., 2018) (Knol & De Vries, 2010) (Williams et al., 2019) (Yang et al., 2017)
3. Cognitive or Knowledge	6	Objective information of an object or event	(De Freitas & Jarvis, 2009) (DeSmet et al., 2015) (Fijnheer et al., 2018) (Flood et al., 2018) (Janakiraman et al., 2018) (Yang et al., 2017)
4. Subjective Norm	4	Someone's perception of how people who matter think about performing a behavior	(Blythe & Coventry, 2012) (DeSmet et al., 2015) (DeSmet, A. et al., 2018a) (Knol & De Vries, 2010)
5. Affective	3	Emotions and feelings towards a certain object	(De Freitas & Jarvis, 2009) (Janakiraman et al., 2018) (Steinemann et al., 2016)
6. Self-Efficacy	3	The belief that the individual contribution will influence the success or failure of a situation	(Blythe & Coventry, 2012) (DeSmet et al., 2015) (DeSmet, A. et al., 2018a)
7. Response Cost	3	Negative punishment (removal)	(Blythe & Coventry, 2012) (Williams et al., 2019)
8. Psychological Ownership	2	Self-perception of freedom to act	(Blythe & Coventry, 2012) (Flood et al., 2018)
9. Locus of Control	2	Self-perception of individual contribution to an event (success or failure)	(Blythe & Coventry, 2012) (Yang et al., 2017)
10. Engagement	2	Participation in certain action	(DeSmet, A. et al., 2018a) (Fijnheer et al., 2018)
11. Perceived Severity /Vulnerability	2	Strength perception of a specific condition	(Blythe & Coventry, 2012) (Williams et al., 2019)
12. Outcome of the game	2	Feedback	(Blythe & Coventry, 2012) (Steinemann et al., 2016)
13. Appreciation	1	Positive emotion received from others	(Jacobs, 2018)
14. Benefits	1	Positive outcome	(Williams et al., 2019)
15. Bystander Behavior	1	Observer actions towards the observed scene	(DeSmet, A. et al., 2018a)

Factors	N	Description	References
16. Choice for Donation	1	Option to give resources	(Steinemann et al., 2016)
17. Coping Approaches	1	Action to solve problems	(Steinemann et al., 2016; Williams et al., 2019)
18. Denial	1	Refusal to accept or act in a certain situation	(Jacobs, 2018)
19. Enjoyment	1	Pleasure	(Steinemann et al., 2016)
20. Fidelity	1	Acting in an expected way	(Antle et al., 2014)
21. Outcome Expectations	1	The belief in receiving or seeing something in return for a certain action	(DeSmet, A. et al., 2018a)
22. Perceived Behavioral Control	1	Perception of the facility to perform a behavior	(Knol & De Vries, 2010)
23. Perceived Environmental Constraints	1	Perception of limits imposed by the environment	(DeSmet et al., 2015)
24. Perception of "actors" and "actions"	1	Perception of other stakeholders and their capacities	(Nilsen et al., 2011)
25. Relational	1	Perception of the influences of others	(DeSmet, A. et al., 2018a)
26. Response Efficacy	1	Perception of capacity to act	(Kolek et al., 2018)
27. Suspense	1	Effect of unpredicted outcomes	(Steinemann et al., 2016)
28. Time of Gameplay	1	Duration of gameplay	(Flood et al., 2018)
29. Workload	1	Amount of tasks	(Jacobs, 2018)
30. Group Membership	1	Identity within group	(Ruggiero, 2014)

Appendix 3 – Survey questionnaire

WINNING DATA RPG – SURVEY QUESTIONNAIRE

Participant Code:_____

Thank you for participating in this survey. Your inputs will be very important to understand how data management policies are happening in the public sector.

This survey is part of a Ph.D. Research is being developed at the University of Technology of Delft / The Netherlands. It aims at developing a game for public sector policy management policies.

Filling in the survey should last around 4 minutes.

Before you start, please do not forget to fill the consent form in order that your contributions can be used in our research.

CONSENT FORM

Please tick the appropriate boxes	**Yes**	**No**
Taking part in the study		
I have read and understood the study information dated __/__/2020, or it has been read to me. I have been able to ask questions about the study, and my questions have been answered to my satisfaction.	□	□
I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions, and I can withdraw from the study at any time without having to give a reason.	□	□
I understand that taking part in the study involves filling in a survey by myself before and after playing a role-playing game that simulates a public office. The activity will be observed and registered with written notes and can be audio-recorded that can be transcribed afterward and the audio files destroyed.	□	□
I understand that information I provide will be used to improve a game developed for a research on data management policies in the public sector that will result in publications in scientific journals	□	□
I understand that personal information collected about me that can identify me, such as [e.g., my name or where I live], will not be shared beyond the study team.	□	□
I give permission for the data collected by this survey and the observation of the gameplay that I provide to be stored in Surfdrive during the research and archived in DataverseNL so it can be used for future research and learning. All data archived will be anonymized, having any individual reference to be specifically coded for further research use.	□	□

Signatures

_____ _____ _____

Name of participant:

PRE-GAME SURVEY

Please, in each table below, choose the corresponding option the best represents your opinion.

Choose only one answer for each question.

Public sector data in my actual work	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
1. I produce public sector data in my work							
2. Some public sector data can be shared							
3. I know how to make the public sector data available for others to access							
4. People in my office knows how to make the public sector data available for others to access							
5. The public sector data that results from my work cannot be shared for privacy issues							
6. The public sector data that results from my work cannot be shared for security issues							

Providing open public sector data	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
7. improves citizen services							
8. improves policy-making processes							
9. creates trust in government							
10. promotes citizen participation							
11. increases transparency							
12. is of benefit to me							
13. will help me doing my job							
14. will increase my productivity							
15. improves my performance in my job							
16. has benefits which are difficult to explain							

Procedures to make public sector data accessible to the public	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
17. I clearly understand how to provide open public sector data							
18. Providing public sector data is a threat							
19. I fear individual privacy by providing public sector data							
20. The costs of providing public sector data are too high							
21. I fear people will have false conclusions if public sector data is provided							
22. Learning to provide open public sector data will be easy for me							

The environment to make public sector data accessible to the public	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
23. People who are important to me think that I should provide open public sector data							
24. License and legal frameworks make it difficult to provide public sector data							
25. Providing public sector data is not a priority for me							
26. Providing public sector data is not a priority for the office I work for							
27. I have the necessary autonomy to provide public sector data							
28. My work does not require me to provide open public sector data							
29. My superiors expect me to provide open public sector data							
30. I have assistance available concerning the provision of open public sector data							

Me and the public sector data	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
31. I already provide open public sector data in my work							
32. I intend to provide open public sector data in the future							
33. I predict that I will provide open public sector data in the future							

Experience with open public sector data	1 (Strongly Disagree)	2	3	4	5	6	7 (Strongly Agree)
34. I have heard about public sector data before							
35. I have studied public sector data before							
36. I have used public sector data before							

Experience in the public sector	0 to 5 years	5+ to 10 years	10+ to 15 years	15+ to 20 years	20+ years
37. How long have you been working in the public sector?					

Public sector role	Operational	Technical	Advisory	Decision-maker	other
38. Since you have started working for the public sector, which of the following better describes your most common role					

Public sector work relation	Appointed	Elected	Permanent Staff	Hired	other
39. Which was your last work relation with the public sector					

Which of the following situations describes you best?	1 (Strongly Disagree)	2	3	4	5	6	7 (Strongly Agree)
40. I feel comfortable to share my data on the internet							
41. I would go against the law to reach an important goal							
42. I feel positively excited with the unexpected							
43. Professional stability is the most important thing in my life							

Age and Gender
44. Year of birth:
45. Gender (G):

POST-GAME SURVEY

Please, in each table below, choose the corresponding option the best represents your opinion.

Choose only one answer for each question.

Public sector data in my actual work	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
1. I produce public sector data in my work							
2. Some public sector data can be shared							
3. I know how to make the public sector data available for others to access							
4. People in my office knows how to make the public sector data available for others to access							
5. The public sector data that results from my work cannot be shared for privacy issues							
6. The public sector data that results from my work cannot be shared for security issues							

Providing open public sector data	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
7. improves citizen services							
8. improves policy-making processes							
9. creates trust in government							
10. promotes citizen participation							
11. increases transparency							
12. is of benefit to me							
13. will help me doing my job							
14. will increase my productivity							
15. improves my performance in my job							
16. has benefits which are difficult to explain							

Procedures to make public sector data accessible to the public	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
17. I clearly understand how to provide open public sector data							
18. Providing public sector data is a threat							
19. I fear individual privacy by providing public sector data							
20. The costs of providing public sector data are too high							
21. I fear people will have false conclusions if public sector data is provided							
22. Learning to provide open public sector data will be easy for me							

The environment to make public sector data accessible to the public	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
23. People who are important to me think that I should provide open public sector data							
24. License and legal frameworks make it difficult to provide public sector data							
25. Providing public sector data is not a priority for me							
26. Providing public sector data is not a priority for the office I work for							
27. I have the necessary autonomy to provide public sector data							
28. My work does not require me to provide open public sector data							
29. My superiors expect me to provide open public sector data							
30. I have assistance available concerning the provision of open public sector data							

Me and the public sector data	**1 (Strongly Disagree)**	**2**	**3**	**4**	**5**	**6**	**7 (Strongly Agree)**
31. I already provide open public sector data in my work							
32. I intend to provide open public sector data in the future							
33. I predict that I will provide open public sector data in the future							

Game experience assessment	1 (Strongly Disagree)	2	3	4	5	6	7 (Strongly Agree)
34. The context of my office is well represented by the game							
35. The game changed my perception of data management policies							
36. I know more about the benefits of opening data after playing the game							
37. I know more about the risks of opening data after playing the game							
38. I will open data after playing the game							
39. The game helped me to open more data in my daily work							

Comments:

Would you like to receive a follow-up on this research?
email:_____

RESEARCHER STATEMENT

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____ _____ _____

Researcher name [printed] Signature Date

Study contact details for further information: Fernando Kleiman, f.kleiman@tudelft.nl, +31(0)15 2783599

Appendix 4 – Wilcoxon-test differences table

Table 58 - Individual questions differences in game-group (Wilcoxon)

	LK_11 I produce public sector data in my work	LK_12 Some public sector data can be shared	LK_13 I know how to make the public sector data available for others to access	LK_14 People in my office knows how to make the public sector data available for others to access	LK_15 The public sector data that results from my work cannot be shared for privacy issues	LK_16 The public sector data that results from my work cannot be shared for security issues	PE_11 Providing open public sector data improves citizen services	PE_12 Providing open public sector data improves policy-making processes	PE_13 Providing open public sector data creates trust in government	PE_14 Providing open public sector data promotes citizen participation	PE_15 Providing open public sector data increases transparency	PE_16 Providing open public sector data is of benefit to me	PE_17 Providing open public sector data will help me doing my job	PE_18 Providing open public sector data will increase my productivity	PE_19 Providing open public sector data improves my performance in my job	PE_20 Providing open public sector data has benefits which are difficult to explain
Mean pre	6.16	6.42	4.50	5.11	4.84	5.23	6.13	6.75	6.41	6.07	6.76	6.19	5.88	5.20	5.25	3.34
Std. dev pre	1.340	1.158	1.957	1.886	1.860	1.872	1.700	0.598	0.980	1.250	0.628	1.182	1.530	1.822	1.635	1.857
Mean post	6.00	6.40	4.60	4.88	3.94	3.87	6.71	6.75	6.44	6.44	6.64	6.14	6.13	5.65	5.79	3.65
Std. dev post	1.717	1.435	1.779	2.065	2.035	2.117	0.604	0.610	0.993	0.966	0.759	1.285	1.092	1.528	1.380	2.217
Mean dif.	-0.16	-0.02	0.10	-0.23	-0.91	-1.36	0.59	0.00	0.04	0.37	-0.12	-0.04	0.25	0.45	0.54	0.31
Wilcoxon (2-tailed)	0.709	0.405	0.123	0.877	0.02	<0.001	0.006	0.338	0.361	0.007	0.055	0.531	0.323	0.167	0.024	0.279
Cohen's d	0.10	0.02	0.05	0.60	0.46	0.68	0.45	≈0	0.03	0.36	0.17	0.04	0.19	0.27	0.36	0.15

	EE_11 I clearly understand how to provide open public sector data	EE_12 Providing public sector data is a threat	EE_13 I fear individual privacy by providing public sector data	EE_14 The costs of providing public sector data are too high	EE_15 I fear people will have false conclusions if public sector data is provided	EE_16 Learning to provide open public sector data will be easy for me	SI_11 People who are important to me think that I should provide open public sector data	SI_12 License and legal frameworks make it difficult to provide public sector data	SI_13 Providing public sector data is not a priority for me	SI_14 Providing public sector data is not a priority for the office I work for	SI_15 I have the necessary autonomy to provide public sector data	SI_16 My work does not require me to provide open public sector data	SI_17 My superiors expect me to provide open public sector data	SI_18 I have assistance available concerning the provision of open public sector data	BI_11 I already provide open public sector data in my work	BI_12 I intend to provide open public sector data in the future	BI_13 I predict that I will provide open public sector data in the future
Mean pre	4.26	6.15	4.45	3.39	4.77	5.17	4.74	3.52	5.46	4.44	2.26	4.09	3.39	2.90	3.67	5.65	5.58
Std. dev pre	1.650	1.273	1.782	1.938	1.762	1.540	1.865	1.679	1.500	2.061	1.675	2.248	1.916	1.762	2.227	1.698	1.690
Mean post	4.68	3.86	3.68	3.14	3.79	5.26	5.22	4.64	3.95	4.43	2.97	4.12	3.71	3.48	4.13	6.03	5.83
Std. dev post	1.482	2.383	1.568	1.812	1.915	1.542	1.774	1.813	2.102	2.168	1.933	2.127	2.045	2.004	2.166	1.337	1.601
Mean dif.	0.41	-2.29	-0.76	-0.24	-0.98	0.09	0.48	1.12	-1.51	0.00	0.71	0.02	0.33	0.58	0.46	0.38	0.25
Wilcoxon (2-tailed)	0.041	<0.001	0.006	0.112	0.011	0.788	0.268	<0.001	<0.001	0.784	0.003	0.718	0.113	0.005	0.001	0.106	0.034
Cohen's d	0.27	1.19	0.46	0.13	0.53	0.06	0.26	0.64	0.82	≈0	0.39	0.01	0.16	0.31	0.21	0.25	0.16

Appendix 5 – Game assets

Demand Code 1451

BUDGET

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2461

EMPLOYMENT

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2471

SOCIAL BENEFITS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 3481

CRIME

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 1491

WEATHER

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2551

TRAFFIC

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 1562

TREES

AUTHENTICATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) DELIVER

Demand Code 2572

HOUSING

AUTHENTICATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) DELIVER

Demand Code 1583

STREETS

UPDATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) DELIVER

Demand Code 2593

PUBLIC BUILDINGS

UPDATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) DELIVER

Demand Code 2651

STUDENTS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2661

TEACHERS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2673

SCHOOLS

UPDATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) DELIVER

Demand Code 2683

GRADES

UPDATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) DELIVER

Demand Code 2692

PERSONNEL

AUTHENTICATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) DELIVER

WEATHER

Many sensors around the city can help people know and even predict the weather. Apps were developed in some countries using the public available data to inform the population on a precise weather forecast. How sensible are these datasets?

CRIME

Crime dataset can help people analyse safety in their place. It can help building safety routes and or give support to public and private investment decisions. If these dataset can contain strategic and private information for government and the police or if they can also bias and segregate, is it sensible?

SOCIAL BENEFITS

Part of governmental expenses are social benefits. Different programs exists in social benefits frameworks such as social security programs, food allowances and others. The disclosure of social benefits expenses can allows citizens identify poverty diversity within regions and policy -makers improve decision-making. These datasets can contain private information (name, address, etc.) from beneficiaries and providers. Can there be risks for individuals or security in these datasets?

EMPLOYMENT

Employment datasets can help citizens, businesses and policy-makers understand local, regional and even national economic activity, enabling them to monitor and improve decision-making. They can also be interested in knowing the available workers profiles. The data stored on labor policies can contain private information (name, address, etc.) from workers, employers and other parties. Can there be risks for individuals or security in these datasets?

BUDGET

Budget is one of the most common dataset to be opened by governments. This dataset is, normally, created in time series (e.g. day, week, month, year) . As public information, usually they are accessed through Transparency portals. As an example of use, citizens and journalists can use it to monitor public spending. Decision-Makers in the government can plan better. Is this dataset sensible?

PUBLIC BUILDINGS

The registry from public buildings is used by governments to manage its teams and policies. Citizens can also be interested in accessing this information to discuss and improve policies. Shall they be able to access it?

STREETS

Streets can change from time to time. The government shall control them all and keep them geospatially referenced and up-to-date. People might be interested to access this information for many reasons. Is it safe?

HOUSING

Housing data can support people and companies to choose where to live or build. Aggregated data can be useful to discuss the neighbourhood or other issues related. Can there be risks for privacy or security in these datasets?

TREES

Some governments registers the location of trees in their city with geospatial data. It can help the community identify where they are and even discuss where they lack or how to maintain them. Shall it be opened?

TRAFFIC

The public information of transportation can support citizens to analyse buses routes through GPS. It can also support them to compare regions where most regularly parking tickets are issued, or speed limit violations happens. Can there be risks for individuals or security in these datasets?

PERSONNEL

Civil servants are public employees that should be accountable for their public action. It may also be important to compare governments from different regions or to analyse its distribution in the country. Are there risks for privacy and security in these datasets?

GRADES

The aggregate information of educational performances might get society to have insights and contribute to education discussing priorities and challenges. Is it risky for privacy or security to expose it?

SCHOOLS

Like public buildings, schools are also public units for educational service provision. People might use it to collaborate with the government or even to offer private services. Are there risks for privacy and security in these datasets?

TEACHERS

Teachers are education providers at schools. Information from the ones working on public schools might be interesting to reflect on their availability and distribution. Can there be risks for individuals or security in these datasets?

STUDENTS

Knowing the distribution of students into schools can help society participate and contribute to educational policies. Aggregated students datasets can give a big picture but individual information could refine discussions. Are there risks for privacy and security in these datasets?

Demand Code 2751

PATIENTS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2761

DOCTORS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 2771

HEALTH UNITS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 3783

DISEASES

UPDATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) DELIVER

Demand Code 2794

POLLUTION

REVISION

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) PROCESS INFORMATION 2
7) DELIVER

Demand Code 3851

WATER

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 3861

INVESTMENTS

INFORMATION REQUIREMENT

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 3872

CONTRACTS

AUTHENTICATE

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) DELIVER

Demand Code 2884

PLANS

REVISION

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) PROCESS INFORMATION 2
7) DELIVER

Demand Code 3894

LAW SUITS

REVISION

1) GRAB FORM
2) FILL IN BY CITIEN
3) PROCESS INFORMATION
4) GRAB RESULT (FILE)
5) COLLECT BOSS SIGNATURE
6) PROCESS INFORMATION 2
7) DELIVER

Demand Code 1011

BUDGET

FREEDOM OF INFORMATION

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 1021

WEATHER

FREEDOM OF INFORMATION

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 1031

TREES

FREEDOM OF INFORMATION

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

Demand Code 1041

PUBLIC BUILDINGS

FREEDOM OF INFORMATION

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

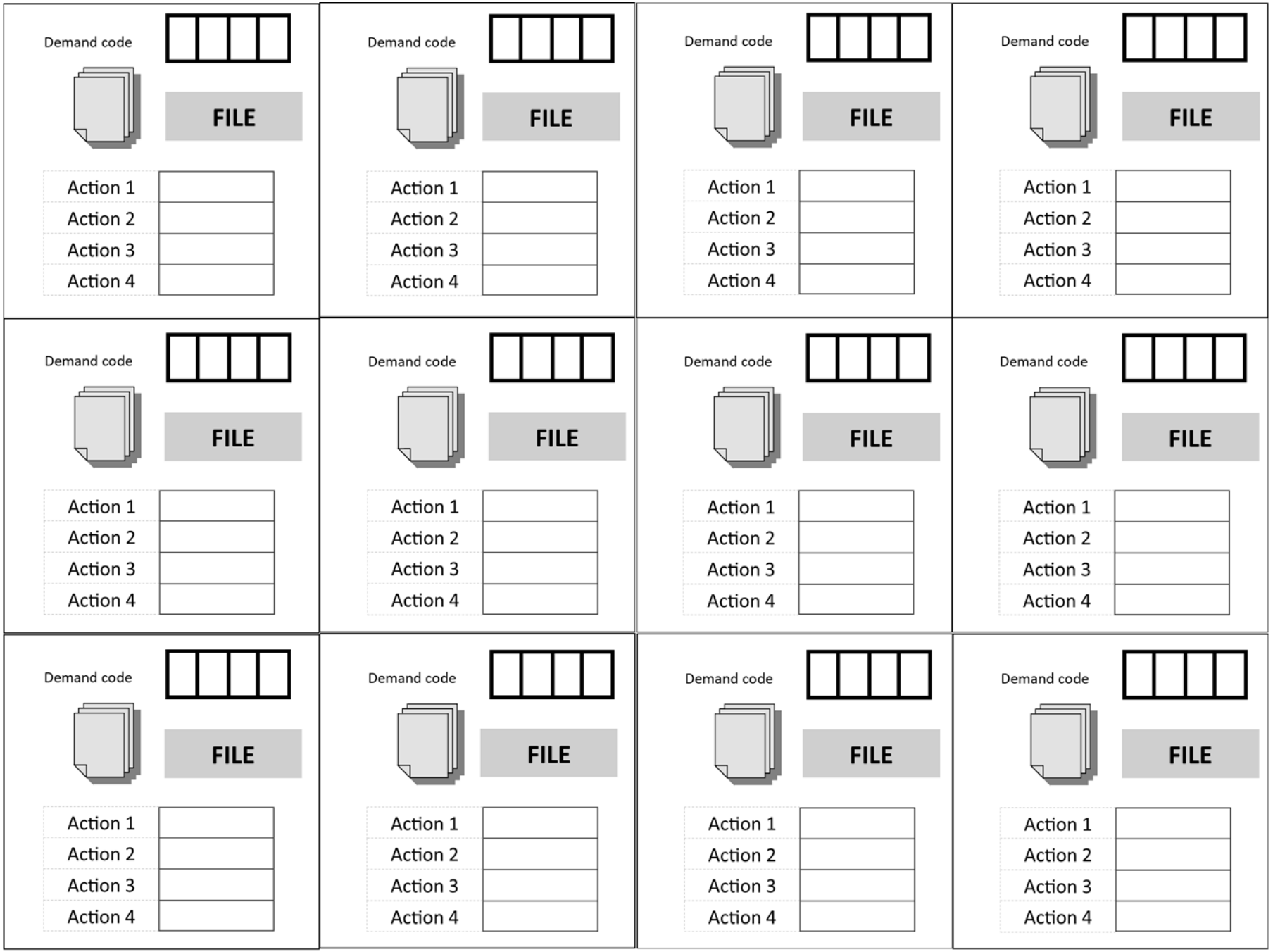
Demand Code 1051

STREETS

FREEDOM OF INFORMATION

1) GRAB FORM
2) PROCESS INFORMATION
3) GRAB RESULT (FILE)
4) DELIVER

POLLUTION What if the public information of pollution could be shared with citizens? Knowing the distribution or even its strength in different regions or producers can organize public life. Are there risks for privacy and security in these datasets?	**DISEASES** The aggregate information of health might get society to have insights on the service provision. Better public information on diseases occurrences or even spreads can lead society to take action. Are there risks for privacy and security in these datasets?	**HEALTH UNITS** Health units are places for health service provision. From hospitals to clinics, different geospatial or even administrative information can foster discussions and insights. Are there risks for privacy and security in these datasets?	**DOCTORS** Doctors are the health service providers. Insights from society and public service itself can come from their dataset availability. They can identify certain flaws or even suggest new public and private actions. Are there risks for privacy and security in these datasets?	**PATIENTS** Patients health services usage datasets can help society participate and contribute to public life. They can have insights in new solutions or demands for specific issues or regions. Are there risks for privacy and security in these datasets?
LAW SUITS By assessing public law suits citizens can monitor problems related to public life. Tax evasion, misuse of public assets could be shared with citizens? Are there risks for individuals or security?	**PLANS** Governmental plans define actions that governments are willing to do. Society can organize itself based on this kind of information and even suggest changes. Are there risks for privacy and security in these datasets?	**CONTRACTS** People can analyse public spending using contracts datasets. By knowing which services and goods are being hired can increase private sector profits or result in a decrease of public spending. Are there risks for privacy and security in these datasets?	**INVESTMENTS** People can analyse public spending using investments datasets. Governmental priorities can be assessed to evaluate actual and future actions. Are there risks for privacy and security in these datasets?	**WATER** Water is a very important dataset for people to understand supply and use in their place. These datasets can also result in strategic information for government and water management services. Are there risks for privacy and security in these datasets?
STREETS FREEDOM OF INFORMATION REQUIREMENTS DOESN'T NEED TO BE LABELLED	**PUBLIC BUILDINGS** FREEDOM OF INFORMATION REQUIREMENTS DOESN'T NEED TO BE LABELLED	**TREES** FREEDOM OF INFORMATION REQUIREMENTS DOESN'T NEED TO BE LABELLED	**WEATHER** FREEDOM OF INFORMATION REQUIREMENTS DOESN'T NEED TO BE LABELLED	**BUDGET** FREEDOM OF INFORMATION REQUIREMENTS DOESN'T NEED TO BE LABELLED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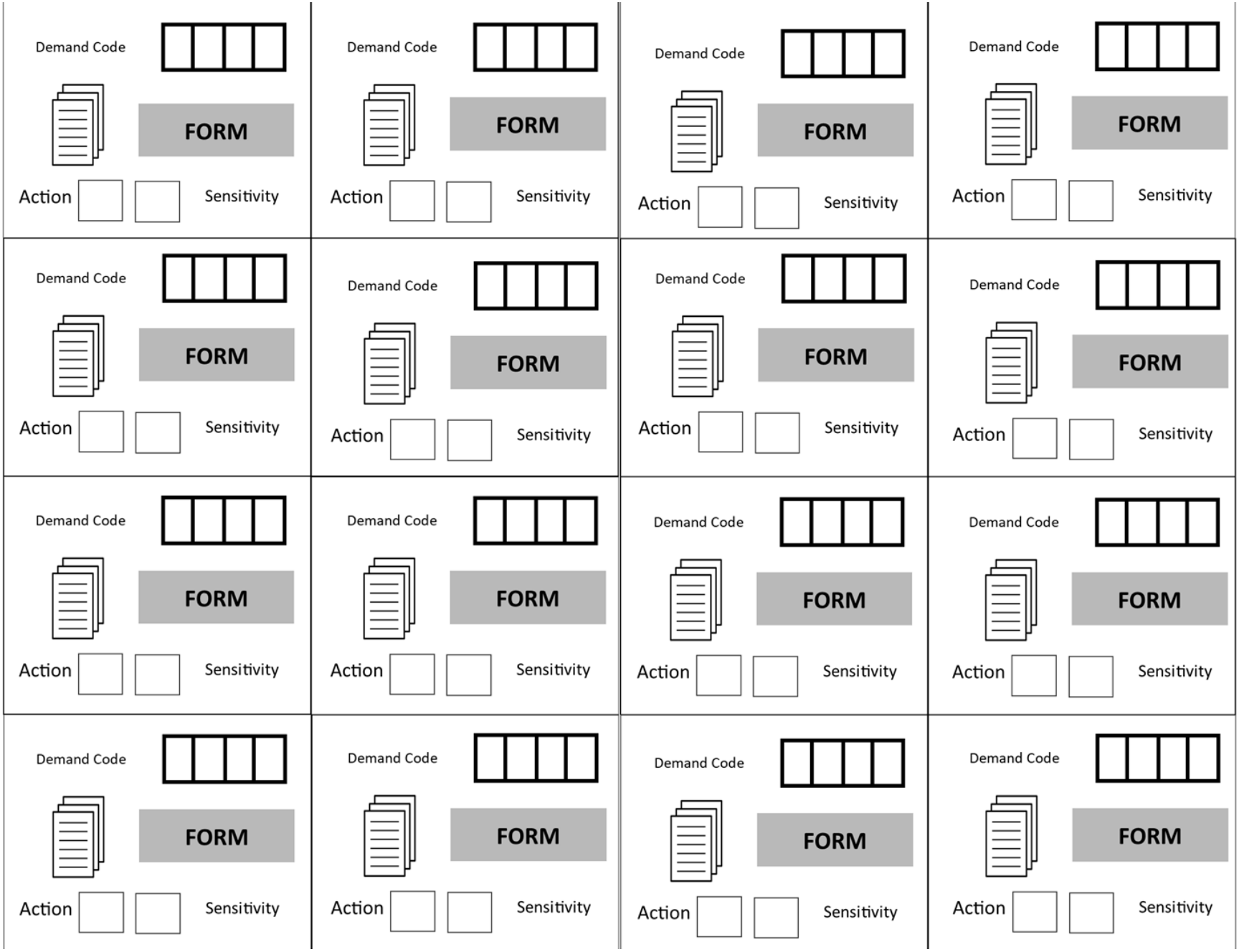
Action 2
Action 3
Action 4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Publications by the author

Ph.D. related publications

2021

Kleiman, F., Janssen, M., Meijer, S., & Jansen, S. J. T. (2021). Understanding civil servants' intentions to open data: factors influencing behavior to disclose data. *Manuscript accepted for publication with revision*.

Staso, D. D., Kleiman, F., Crompvoets, J., & Janssen, M. (2021). Changing Civil Servants' Awareness about Open Data Using a Collaborative Digital Game. *Paper presented at the DG.O2021: The 22nd Annual International Conference on Digital Government Research*.

2020

Kleiman, F., Meijer, S., & Janssen, M. (2020). A Systematic Literature Review on the Use of Games for Attitude Change. *International Journal of Electronic Government Research, 16*(4), 1-20. doi:10.4018/ijegr.2020100101

Kleiman, F., Janssen, M., Meijer, S., & Jansen, S. J. T. (2020). Changing civil servants' behaviour concerning the opening of governmental data: evaluating the effect of a game by comparing civil servants' intentions before and after a game intervention. *International Review of Administrative Sciences*. doi:10.1177/0020852320962211

Kleiman, F., Meijer, S., & Janssen, M. (2020). Gaming for Meaningful Interactions in Teleworking Lessons Learned during the COVID-19 Pandemic from Integrating Gaming in Virtual Meetings. *Digital Government: Research and Practice, 1*(4), 1-5.

Kleiman, F., Janssen, M., & Meijer, S. (2020). Behavioral factors influencing the opening of government data by civil servants– initial findings from literature. *Proceedings of the 13th International Conference on Theory and Practice of Electronic Governance (ICEGOV2020), Athens, Greece*.

Kleiman, F., (2020). *Mudando atitudes em relação a abertura de dados governamentais através de um jogo.* Paper presented at the III APEB-NL INTERNATIONAL CONFERENCE. - https://www.youtube.com/watch?v=2QQakRazeB0 (PT/BR)

2019

Kleiman, F., Janssen, M., & Meijer, S. (2019). *Evaluation of a pilot game to change civil servants' willingness towards open data policy making.* Paper presented at the Wardaszko, M. (ed.), Simulation & Gaming Through Times And Across Disciplines. Past And Future, Heritage And Progress. Proceedings of the 50th Anniversary ISAGA Conference, Kozminski University, Warsaw, Poland.

Kleiman, F., Janssen, M, Meijer, S (2019). *Testing a game intervention to change local civil servants' willingness to engage in open data policies.* Paper presented at the II APEB-NL INTERNATIONAL CONFERENCE - The day after tomorrow: Re-inventing futures.

Kleiman, F. (2019). *Engaging Governments in Open Data Policies through Gaming*. Paper presented at the Proceedings of the 12th International Conference on Theory and Practice of Electronic Governance, Melbourne, VIC, Australia.

Presentation: Campus Party Brasil 12 – Games and Governments (PT/BR): https://www.youtube.com/watch?v=4-dc7ye_8cA

2018

Kleiman, F., & Janssen, M. (2018). *Gaming to improve public policies by engaging local governments in open data policy-making.* Paper presented at the Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age.

Kleiman, F., Janssen, M., & Meijer, S. (2018). *Serious gaming for developing open government data policies by local governments.* Paper presented at the Proceedings of the 11th International Conference on Theory and Practice of Electronic Governance.

Other topics

Sanchez, F., & Kleiman, F. (2020). Tribute to Paul Singer (1932–2018): A Socialist Activist. In C. Brundenius (Ed.), *Reflections on Socialism in the Twenty-First Century: Facing Market Liberalism, Rising Inequalities and the Environmental Imperative* (pp. 155-165). Cham: Springer International Publishing.

Kleiman, F. (2016). Livelihoods and Social Inclusion: Public Policy as a Result of Social Struggle–The Experience of Brazil Without Poverty Plan. *The Geopolitics of cities: old challenges, new issues*, 333.

Paes-Sousa, R., de Teixeira Soares, A. R. D., & Kleiman, F. (2011). Broadening social protection and integrating social policies. *Innovative*, 63.

Kleiman, F. (2008). *Lições de catende: a construção de uma autogestão em Pernambuco*: Annablume Editora.

Puntasen, T., Kleiman, F., Taylor, P., & Boothroyd, P. (2008). *Higher Education and Participatory Development: Opportunities for Strengthening the Linkage.* Paper presented at the Asia Pacific Sub-regional Preparatory Conference for the 2009 World Conference on Higher Education September.

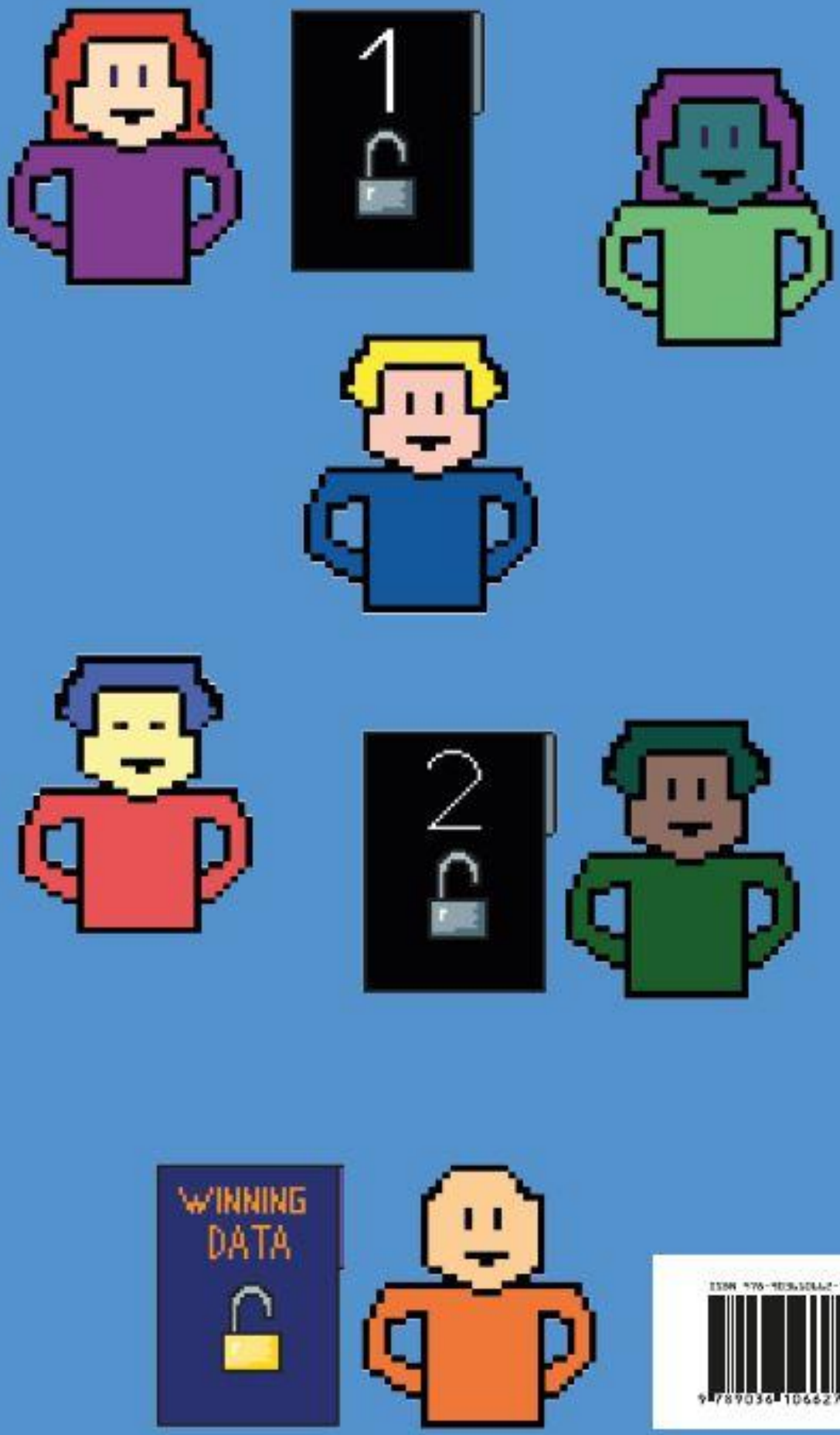
Curriculum Vitae

Fernando Kleiman was born in Sao Paulo, Brazil, on January 10, 1978. He studied Economics at the University of Sao Paulo (Brazil) and earned his Bachelor of Science degree in 2013. Since 2003, he joined the Brazilian Federal Government, and he got increasingly interested in Government and Public Policy. At the same time, he was in touch with many policy problems, and it triggered him to return to university for a master's degree.

He started the Sociology program at the University of Brasilia, besides his role as chief-of-staff at the Federal Government. In this period, his interest focused on solidarity-based economy policies. He did a case study on the biggest Latin-American self-managed project, a 5,000 workers sugar mill cooperative in the Pernambuco State in Brazil. He got his Master of Science degree in Sociology, having his dissertation published with the support of the local rural workers' union.

After completing his master's program in 2008, Fernando was selected to be permanent staff for the former Ministry of Planning from the Brazilian Federal Government, the actual Ministry of Economy. In this position, he worked in many roles in the government, including advisor to Secretaries and Ministries and chief of the chambers of deputy team for the Brazilian Presidency office. The 15 years working in public administration provided Fernando solid knowledge and experience of decision-making in governments and public policies in general. Before leaving for his Ph.D., Fernando was involved in the implementation of the G*Nova Innovation Lab at the National School for Public Service.

In 2017, Fernando applied for a granted leave from his duty and started his Ph.D. research at the Faculty of Technology, Policy, and Management. His research focuses on the design of a game to influence civil servants' attitudes towards the release of government data. During this research project, he developed a reference model to discuss civil servants' attitudes towards open data and designed a game tested with civil servants. Furthermore, he has published more than ten peer-reviewed articles in journals and conferences. He received two awards for best poster papers in conferences and also published articles on public-policy-related websites. His game, model, and survey have inspired other research projects on the topic. He also monitored game design courses and workshops and supervised game-related master projects at TUDelft. One of these theses, derived directly from his research, resulted in a digital version of the game, which is now available for civil servants to play all around the globe.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2
WINNING
DATA