Attitude toward online privacy of Brazilian users with a focus on the Metrology community

V C de Oliveira

Instituto Nacional de Metrologia, Qualidade e Tecnologia (Inmetro), Av. Nossa Senhora das Graças, 50, Xerém, Duque de Caxias - RJ - Brazil

vcoutinho@inmetro.gov.br

Abstract. As Industry 4.0 comes into reality, Metrology must evolve with it. The digital transformation in Metrology implies data transport instead of measuring instrument transport. Hence, massive amounts of data will be exchanged between calibration laboratories and client facilities, where the measuring devices are placed. Since sharing data poses risks, controls are necessary to protect information assets. Nevertheless, the human element is often the weakest link in the Information Security chain and deserves attention. This study evaluates the attitude toward privacy of Brazilian internet users with a focus on the Metrology community by surveying 324 respondents to assess their attitudes, worries, and perception of privacy, the use of privacy tools, and the susceptibility to providing data through a simple social experiment. Data analyses consisted of descriptive statistics and hypotheses testing. Results do not indicate differences between the Metrology and the general public groups. Users are aware of online threats, but this awareness needs to translate into actions to increase privacy. Such actions, in turn, depend on user training. This paper points out the privacy tools less used – whose adoption should be encouraged – and brings recommendations for the digital transformation in Metrology to take place in compliance with basic data protection requirements.

1. Introduction

A quality infrastructure (QI) system is a country's legal and organizational framework that supports and strengthens the quality, safety, and environmental soundness of products, services, and processes [1][2]. QI is a crucial tool to allow a nation to enter the global market by achieving international recognition of its goods and services while ensuring the effective operation of the domestic market. Thus, QI is crucial for economic development.

QI leans on four pillars: Standards, Conformity Assessment, Accreditation, and Metrology [1][2]. Metrology is defined as the "science of measurement and its application" [3] and is a vital part of daily life, from food bought by weight to fuel metering.

In the wake of Industry 4.0, Metrology must reinvent itself. The concept of digital transformation in Metrology embraces establishing virtual linkages between calibration laboratories (responsible for providing traceability to the standards) and client facilities (where sensors are to be remotely calibrated) [4]. It means data transport instead of measuring instrument transport. Therefore, clients, calibration laboratories, and even National Metrology Institutes will transfer significant amounts of data to each other electronically.

Sharing data implies risks to sensitive information. One of the challenges of digitalization is providing data transparency with adequate security [4]. Therefore, Information Security (InfoSec) is a fundamental aspect of digital transformation. Although InfoSec is not a novel subject – most testing and calibration laboratories already comply with control of data and information management requirements defined by the ISO/IEC 17025:2017 standard [5] – it builds up momentum as it presents itself as a pillar of Industry 4.0 [6].

InfoSec involves applying and managing administrative, technical, and physical controls to protect information assets [7][8]. However, the abovementioned controls may not suffice as the human factor is often the weakest link in the InfoSec chain [8][9]. Therefore, this work aims to contribute to the understanding of how the people involved with Metrology in Brazil perceive their online privacy and how experienced with privacy tools they are, as well as to the discussion on ways to improve online safety to pave the road to the oncoming digital transformation.

A survey of Surfshark conducted with users from Australia, Canada, Germany, the United Kingdom, and the United States [10] served as a starting point for this work. As far as possible, the base of questions from [10] was maintained in the survey carried out in this study. The questionnaire was sent primarily to Brazilian nationals, both from the general public and the Metrology public.

2. Purpose of the study

This study intends to provide a comprehensive view of the attitudes toward privacy of the Metrology public and to assess potential differences in the attitudes toward privacy between this public and the general public. This study also aims to verify the level of online privacy awareness of the Metrology public and compare it with that of the general public.

3. Relevance of the study

This study intends to contribute to the discussions to raise awareness about online privacy among the online services users of the Metrology public, given that InfoSec is a critical issue in Metrology for Digital Transformation and that, in the InfoSec chain, the human element is often the weakest link. Aware, trained Internet users represent a reduction in the risks associated with data security.

4. Scope of the study

This study is restricted to Brazilian Internet users and the Brazilian Metrology community. The table with the raw data of the answers to the survey conducted in this work and the original questionnaire (both in Portuguese) are publicly available at https://github.com/Chicao01/metro_privacy_survey.git.

5. Method

To gather data, a questionnaire that originated from a study of Surfshark [10] was drawn up. Some questions relevant to this survey were added to the set of original questions, which were subjected to translation to Portuguese language and cultural adaptation. A group of five volunteers, with mixed educational backgrounds, tested the questionnaire for eight days and helped perfect it. After this, the final version of the questionnaire was produced. It was structured as follows:

- Block 1: profile survey questions (age, sex, education level, nationality, field of work).
- Block 2: 22 questions divided into three subsets to assess the respondents' perception of the importance of privacy, their awareness of privacy rights, and their worries about online safety. Answers in this block had a five-point Likert scale, ranging from −2 (equivalent to "strongly disagree") to +2 (equivalent to "strongly agree").
- Block 3: 10 questions to assess the respondents' use of tools and services to increase their privacy.
- Block 4: a social engineering experiment based upon a set of questions whose answers were optional. In exchange for participating in a (bogus) lottery, respondents were required to provide sensitive data like monthly income and neighborhood of residence.

389 persons replied to the questionnaire. 292 persons gave end-to-end responses, which means a completion rate of 75 %. The average time to complete was 6 min 13 s. Data gathering occurred from 2022-10-28 to 2022-12-13, with the aid of the SurveyMonkey platform (www.surveymonkey.com).

Data analyses consisted of descriptive statistics through averages and distribution frequency of groups and responses, and hypotheses testing employing Kruskal-Wallis tests. R version 4.1.3 and Microsoft Excel were used for analyzing the data.

6. Results and discussion

6.1. Respondents' profile

389 persons replied to the questionnaire, but 65 answered only the profile survey questions (Block 1) and were excluded from the analysis. Thus, $n = 324$ corresponds to the remainder. 321 respondents were Brazilian and 3 from other nationalities. Table 1 summarizes the distribution according to the respondents' involvement with Metrology.

Table 1. Distribution of respondents by involvement with Metrology.

Involvement with Metrology (*definition of their professional activities*)	Total no. of respondents	% of respondents
Respondents who "work directly with Metrology" (*work in laboratory testing or calibration, production of reference materials, accreditation, model approval, drafting of rules and regulations, or are students, researchers, or professors in the field*)	59	18.2 %
Respondents who "work indirectly with Metrology" (*provide support to metrological activities by performing administrative, financial, human resources, planning or legal tasks, participating in or conducting audits, or providing services such as building maintenance, computer services, etc.*)	41	12.7 %
Respondents who "do not work with Metrology but have some relationship" (*use certified reference materials, send their equipment for periodical calibration, etc.*)	67	20.7 %
Respondents who "do not have any relationship with Metrology" (*or do not know what Metrology is*)	157	48.5 %
Total	324	100 %

6.2. Respondents' perception of the importance of privacy

To assess the perception of the importance of privacy, the respondents answered 7 questions (shown in table 2). A five-point Likert scale was adopted, and answers were graded as follows:

- Reply option "Yes, entirely" = grade +2.
- Reply option "Yes, partially" = grade +1.
- Reply option "Not sure" = grade 0.
- Reply option "Generally not" = grade −1.
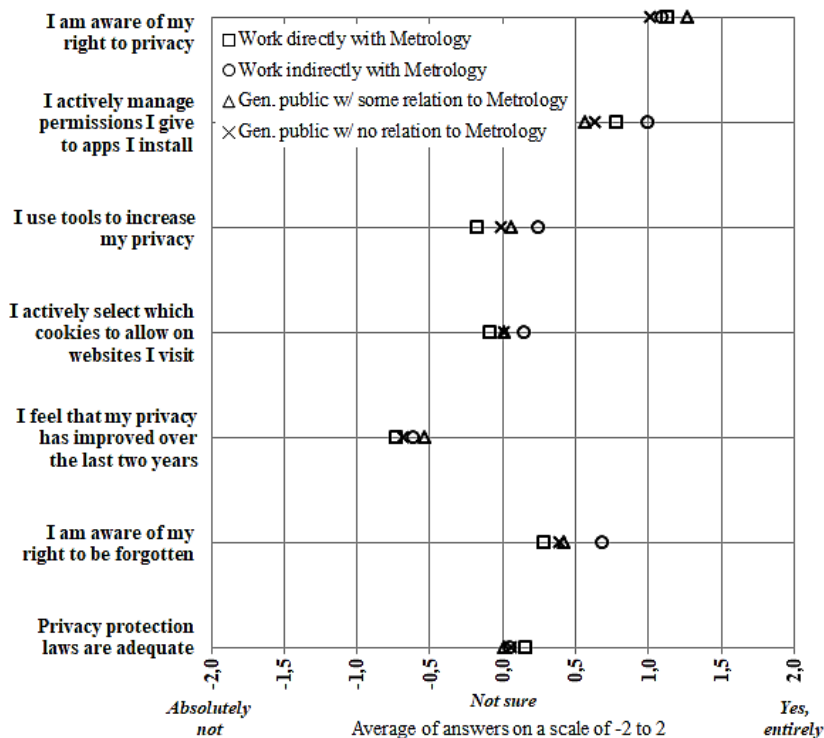- Reply option "Absolutely not" = grade −2.

This investigation aimed to assess whether the Metrology public perception of privacy is the same as that of the general public. For this purpose, the Kruskal-Wallis test was performed with the data from table 2. The resulting p-value was 0.9674 ($\chi^2 = 0.260$ with 3 degrees of freedom). Therefore, the null hypothesis (H_0), that is, the mean ranks of the groups are the same, was retained. In other words, the perception of privacy is similar among the groups surveyed. The same conclusion is reached when those who work with Metrology (both directly and indirectly) are grouped and compared to those who do not work with Metrology (also grouped).

Table 2. Average of answers to the questions related to the perception of the importance of privacy.

	Work directly with Metrology	Work indirectly with Metrology	General public with some relation to Metrology	General public with no relation to Metrology
Online privacy is important for me	1.78	1.85	1.88	1.78
I want to know more about how my data is used	1.73	1.88	1.81	1.72
I understand how my private data is collected	0.32	0.51	0.37	0.19
I understand how my private data is used	-0.36	-0.24	-0.28	-0.18
I think it is possible to spend time online without submitting any private data	-0.41	-0.56	-0.33	-0.52
I have control over my own data online	-0.80	-0.68	-0.78	-0.61
I think quality of services is more important than privacy	-0.66	-0.73	-0.69	-0.80

6.3. Respondents' awareness of privacy rights

To assess the awareness of privacy rights, the respondents answered 7 questions (shown in figure 1 and table 3). Answers grading was the same as the previously explained.

Figure 1. Average of answers to the questions related to the awareness of privacy rights on a scale of −2 to 2.

This investigation also aimed to evaluate whether the Metrology public awareness of privacy rights is the same as that of the general public. For this purpose, the Kruskal-Wallis test was performed with the data from table 3. The resulting p-value was 0.8685 ($\chi^2 = 0.720$ with 3 degrees of freedom). Therefore, H_0 was retained, which means that the awareness of privacy rights is similar among the groups surveyed. The same conclusion is reached when those who work with Metrology (both directly

and indirectly) are grouped and compared to those who do not work with Metrology (also grouped).

Table 3. Average of answers to the questions related to the awareness of privacy rights.

	Work directly with Metrology	Work indirectly with Metrology	General public with some relation to Metrology	General public with no relation to Metrology
I am aware of my right to privacy	1.14	1.10	1.27	1.02
I actively manage permissions I give to apps I install	0.78	1.00	0.57	0.64
I use tools to increase my privacy	-0.17	0.24	0.06	-0.01
I actively select which cookies to allow on websites I visit	-0.08	0.15	0.01	0.01
I feel that my privacy has improved over the last two years	-0.73	-0.61	-0.54	-0.68
I am aware of my right to be forgotten	0.29	0.68	0.42	0.39
Privacy protection laws are adequate	0.15	0.05	0.01	0.06

Yet, one can observe that the group of respondents who indirectly work with Metrology is slightly more aware of rights and tools than the others, given the average of their agreement to the statements "I actively manage permissions I give to apps I install", "I use tools to increase my privacy", "I actively select which cookies to allow on websites I visit", and "I am aware of my right to be forgotten".

6.4. Respondents' worries about online safety

To evaluate the worries about online safety, the respondents answered 8 questions (seen in table 4). Answers grading was the same as the previously explained.

Table 4. Average of answers to the questions related to the worries about online safety.

	Work directly with Metrology	Work indirectly with Metrology	General public with some relation to Metrology	General public with no relation to Metrology
I am aware how to behave online in a secure manner	0.12	0.39	0.25	0.04
I believe I can be targeted by cybercriminals	0.85	0.66	1.01	0.83
I worry about online safety	1.56	1.54	1.40	1.53
I use tools to improve online safety	0.54	0.61	0.34	0.36
I know how to avoid risks of cybercrimes	0.25	0.12	0.04	-0.03
I feel safe online	-0.46	-0.46	-0.52	-0.59
I think the internet now is safer than it used to be 2 years ago	-0.39	-0.02	-0.31	-0.11
I have lost sensitive information due to data breach	-0.27	-0.83	-0.21	-0.64

This investigation also sought to appraise whether the level of concern about the online safety of the Metrology public is the same as that of the general public. For such, the Kruskal-Wallis test was conducted using the data from table 4. The resulting p-value was 0.9482 ($\chi^2 = 0.361$ with 3 degrees of freedom). Therefore, H_0 was retained, meaning that the users are equally concerned, regardless of which group they belong. The same conclusion is reached when those who work with Metrology (both directly and indirectly) are grouped and compared to those who do not work with Metrology (also grouped).
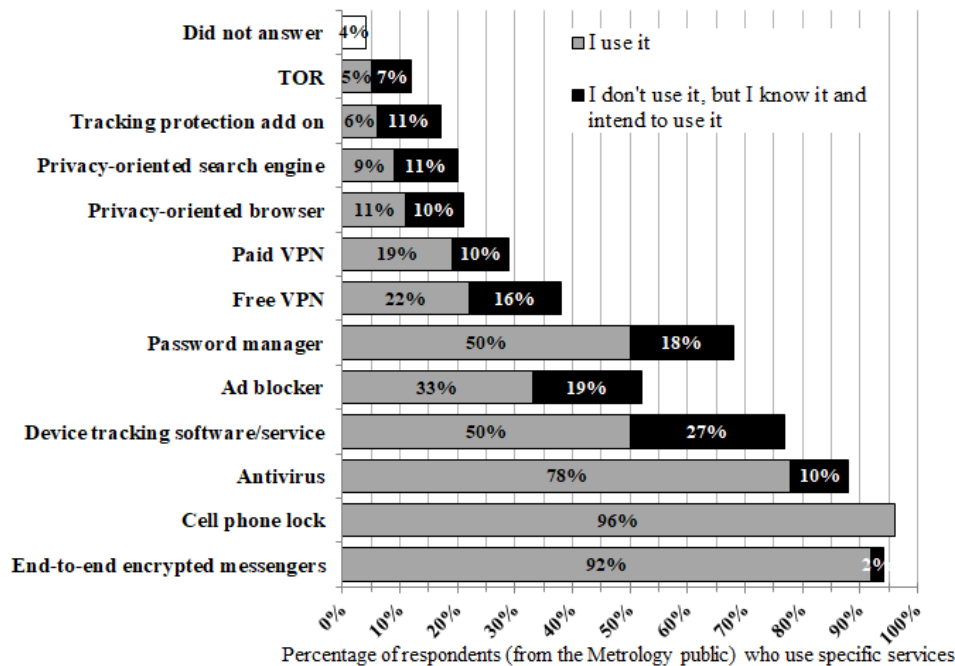
6.5. Partial conclusion

This investigation deduces that there exists no significant difference between the members of the Metrology community and the general public regarding attitudes toward privacy.

6.6. Use of privacy-oriented services

This work compared the Metrology public to the general public regarding the degree of utilization of privacy tools. The Kruskal-Wallis test resulting p-value was 0.7778 ($\chi^2 = 0.080$ with one degree of freedom) considering the percentage of use of the specific services by each group. Thus, H_0 was retained, indicating no statistically significant difference between the groups (splitting the Metrology and general public groups into their respective subgroups leads to this conclusion, too).

Nevertheless, from figure 2 and figure 3, it is possible to note that metrologists utilize privacy tools a little more than the general public. The use of antiviruses, end-to-end encrypted messengers, password managers, cell phone lock by password or biometrics, ad blockers, and virtual private networks (VPNs) is notably more frequent among the members of the Metrology community.

Figure 2. Percentage of metrologists (out of 100) who use or intend to use specific privacy tools and services.

6.7. Partial conclusion

This investigation deduces that there exists no significant difference between the members of the Metrology community and the general public regarding the degree of use of privacy tools and services, albeit metrologists do use such services and tools to a slightly more extent.

6.8. A social experiment to assess the users' susceptibility to providing sensitive data

The last page of the survey form consisted of four questions to bait sensitive data: city, neighborhood of residence, travel plan for the next months, and monthly income. On this page, it was emphasized (twice) that the answers to these questions were optional, but those choosing to fill in the form would compete for an "amazing prize" draw. It should be noted that at no time were the prize, date and form of the draw specified. Likewise, no contact data was requested, i.e., returning to the "awardee" would not be possible. Yet, 25 % of the respondents provided such sensitive data. The percentage is the same

for both the Metrology and the general public. The answers were screened to rule out farcical replies such as city = nowhere.
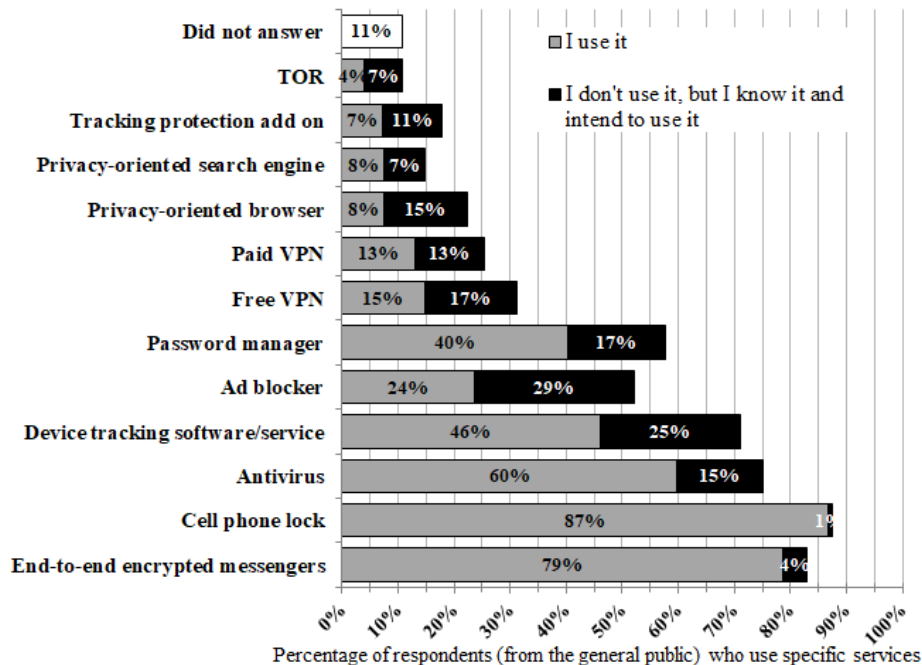
Figure 3. Percentage of the general public (out of 224) who use or intend to use specific privacy tools and services.

7. Recommendations

Since there is no significant difference in the attitude toward privacy between the Metrology public and the general public, the following recommendations are not restricted only to the scope of Metrology but apply to all types of users and all types of suppliers.

7.1. Need for transparency

Although 98 % of the respondents agree with the statement "online privacy is important for me", the same percentage of respondents wants to know more about how their data is used. Only 6 % declare to understand fully how their private data is used, and only 3 % claim to have control over their data online. Product suppliers and service providers should communicate transparently to the users. That is not always the case.

Therefore, organizations involved with Metrology should clearly define privacy requirements and penalties for non-compliance in the agreements with their suppliers. Moreover, the need to adopt products and services from the Big Techs should be carefully evaluated as their terms of service may be greedy and inflexible. For example, the license in [11] allows that provider to "host, reproduce, distribute, communicate, and use" the user's content as well as sublicense the rights to their contractors, fueling data brokers.

7.2. Need for discussion of the legal safeguards

81 % of the respondents agree with the sentence "I am aware of my right to privacy", but only 29 % agree with the statement "Privacy protection laws are adequate". The Brazilian General Personal Data Protection Law, also known as LGPD, fully entered into force in September 2020 [12]; however, only 17 % of the respondents answered affirmatively to the sentence "I feel that my privacy has improved over the last two years". It means that the LGPD has not yet produced, in this regard, noticeable

impacts on users in general.

This feeling of legal helplessness may be softened if society further discusses the relevant legal framework. Therefore, the LGPD debate should be part of the training programs in the organizations involved with Metrology (even as a way to ameliorate it).

7.3. *Need to turn awareness into action*

Users are aware of online threats. 93 % of the respondents agree with the sentence "I worry about online safety" and 70 % of the respondents agree with the statement "I believe I can be targeted by cybercriminals". Just 19 % agree with the sentence "I feel safe online", and only 3 % think the internet now is safer than it used to be two years ago.

Nevertheless, not more than 48 % of the respondents declare to be aware of how to behave online in a secure manner, and only 46 % of the respondents claim to know how to avoid the risks of cybercrimes. Not by chance, 26 % of the respondents have lost sensitive information due to data breaches.

Therefore, the prominent levels of awareness should be converted into actions to avoid privacy violations, data losses, or cybercrimes. The use of more privacy tools and services should be encouraged, especially the less prevalent ones (seen in figure 2 and figure 3). Some solutions are fast, free of charge, and free of controversy, e.g., using privacy-oriented browsers such as Brave (www.brave.com).

Beyond the use of tools, users should be educated on simple but effective actions to increase their privacy, such as never clicking on suspicious links, checking for the padlock symbol in encrypted (HTTPS) websites, and rejecting non-essential cookies when browsing the internet – in this survey, only 46 % of the respondents said they actively select which cookies to allow. More important, users should, by all means, refrain from giving away sensitive data to dispensable services or applications.

Reference [8] proposes some solutions to increase InfoSec awareness, but the most important is educating users. Thus, organizations involved with Metrology should train their teams not only in the use of privacy services and tools but also in the techniques of social engineering. Gamification may be a valuable strategy to reach users effectively [8].

8. Conclusion

Information Security is a crucial aspect of the oncoming digital transformation in Metrology. Although administrative, technical, and physical controls are necessary for protecting information assets, the human element is often the weakest link in the Information Security chain, thus requiring special attention.

In this paper, the attitude toward privacy of internet users from both the Metrology community and the general public in Brazil was examined. In a general way, no significant difference was found between these groups. This paper also brings some recommendations with a view to information security in the context of digital transformation in Metrology.

To increase data protection, some measures should be taken. It is recommended that online service providers communicate more transparently to the users. Organizations involved with Metrology should establish privacy requirements and penalties for non-compliance in the agreements with their suppliers. These organizations also should promote the debate of the Brazilian General Personal Data Protection Law, or LGPD, as a part of their training programs.

Users are aware of the online threats, but the awareness should be turned into concrete actions. Organizations involved with Metrology should foster the use of more privacy services and tools and educate their teams on these services and tools as well as on online defensive behavior.

References

[1]   United Nations Industrial Development Organization 2016 *Quality Infrastructure – Building Trust for Trade*. Available at https://www.unido.org/sites/default/files/2016-05/ UNIDO_Quality_system_0.pdf

[2]   American National Standards Institute 2022 *Standards, Metrology, & Conformity Assessment: Tools to Facilitate Trade and Market Access - An Interactive Reference Handbook*. Available at https://share.ansi.org/shared%20documents/standards%20activities/ international%20standardization/standards%20alliance/handbook/standardsalliance- handbook-2022-section1.pdf

[3]   BIPM 2012 *International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM)*

[4]   Varshney A *et al* 2021 *MAPAN* **36**(2) 215–226

[5]   ISO/IEC 17025:2015 *General Requirements for the Competence of Testing and Calibration Laboratories*

[6]   Vaidya S, Ambad P and Bhosle S 2018 Industry 4.0 – A glimpse *Proc. 2nd Int. Conf. on Materials Manufacturing and Design Engineering (Aurangabad)* p 233

[7]   ISO/IEC 27000:2018 *Information Technology — Security Techniques — Information Security Management Systems — Overview and Vocabulary*

[8]   Andress J 2014 *The Basics of Information Security: Understanding the Fundamentals of Infosec in Theory and Practice* (Waltham: Syngress)

[9]   Kizza J M 2017 *Guide to Computer Network Security* (Chattanooga: Springer)

[10]   Surfshark 2022 *How People See Their Privacy in 2022*. Available at https://surfshark.com/ attitude-on-privacy

[11]   Google LLC 2022 *Privacy & Terms*. Available at https://policies.google.com/terms?hl=en-us# toc-permission

[12]   The National Congress of Brazil 2018 *General Personal Data Protection Law, Law No. 13.709*. Available at http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2018/Lei/L13709.htm (in Portuguese only)