

Poster: Evaluating PDPL Compliance in E-Commerce Websites: Insights and Lessons Learned from Human and LLM Analyses

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1 Introduction

Background. Most countries worldwide have recognized the importance of personal data protection and have enacted laws and regulations accordingly. To list a few, the European General Data Protection Regulation (GDPR) [24], California Privacy Rights Act (CPRA) [5], and China’s Personal Information Protection Law (PIPL) [36]. More recently, Saudi Arabia introduced its Personal Data Protection Law (PDPL) [35].

Natural-language text-based privacy policies have long been known to be time-consuming and difficult to read and comprehend [7, 10, 13, 17, 23, 27].

Research on privacy policy analysis can be divided into two main themes: manual and automated analysis. While manual analysis approaches have been shown useful, they are difficult to scale. Thus, research aimed at automating privacy policy analysis has emerged, which can be divided into two lines: ML-based [1–3, 6, 12, 20, 30, 39], and more recently, research is exploring LLM-based approaches [8, 14, 19, 28, 29, 34, 38].

Motivation. To our knowledge, none of the previous studies analyzed Saudi e-commerce websites at a fine-grained level of detail, despite their extensive personal data processing, or explored the feasibility of using Large Language Models (LLMs) as supportive tools for privacy policy analysis against the PDPL.

To bridge this gap, we analyzed 100 e-commerce websites operating in Saudi Arabia to assess their compliance with key PDPL requirements at the privacy policy level. We examined the existence of a privacy policy and, if present, conducted a fine-grained analysis of four policy items, selected for their

perceived importance, namely: the policy’s declarations of: (1) personal data retention period, (2) the right to request the destruction of personal data, (3) the right to request a copy of personal data, and (4) a mechanism for filing complaints. See Appendix A for details. Furthermore, we explored the effectiveness and limitations of LLMs as automated tools for privacy policy analysis compared to human analysis.

Research Questions. **RQ (1):** How compliant are e-commerce websites operating in Saudi Arabia with the PDPL’s privacy policy requirements? **RQ (2):** How do websites’ ranking and e-commerce hosting platforms relate to compliance with the PDPL’s privacy policy requirements in e-commerce websites operating in Saudi Arabia? and **RQ (3):** How reliable are LLMs when used as an automated analysis tool for assessing privacy policy compliance with the PDPL requirements compared to human analysis?

2 Methods

Our method comprises both quantitative and qualitative analyses. Quantitative analysis was conducted using descriptive statistics to count frequencies [15]. Qualitative analysis was performed by two experienced members of the research team who are native Arabic and fluent English speakers, using template analysis, a style of thematic analysis that combines both inductive and deductive coding [4, 16]. In what follows, we outline the main methodological stages:

Compiling a list of e-commerce websites with their ranking and e-commerce hosting platforms. To compile a list of e-commerce websites operating in Saudi Arabia (i.e., collecting and processing personal data for data subjects residing in Saudi Arabia), we used Google web search [9], from a device located in Saudi Arabia. We performed two queries. The first used English keywords: “purchase”, “store”, “shopping”, “product”, and “buy”, while the second used the Arabic equivalents of the English keywords. After validation, we randomly selected 100 websites. Then, we ranked the websites according to their appearance in the search results. Finally, we identified the e-commerce hosting platforms for the websites,

if any, using the “Wappalyzer-Technology profiler” Google Chrome browser extension [37].

Manual analysis of privacy policies. The manual qualitative analysis is divided into two phases: coarse-grained, followed by fine-grained analysis. The coarse-grained manual analysis employed a survey completed by two researchers (see Appendix B for the survey). After completing the coarse-grained coding and having survey responses agreeable to both researchers for the whole dataset, the two researchers conducted a fine-grained qualitative analysis of the policy text segments captured in the survey. By the end of this phase, both researchers reached an agreement on the answers to the privacy policy questions for the whole dataset.

Automated analysis of privacy policies. The automated analysis was conducted only at a coarse-grained level. To provide the LLM agent with privacy policy texts, we extracted only the text from the locally saved HTML pages for the privacy policies using the BeautifulSoup Python package [25].

We developed an LLM agent in Python [26], backed by OpenAI’s GPT-5 model [21]. For each privacy policy, the agent constructs a prompt (depicted in Figure 1 in Appendix D) to query the GPT-5 model. The prompt starts with the following instruction: “You are a privacy compliance expert. Use ONLY the provided policy text below to answer the question. Do not rely on outside knowledge. If the answer is not found, state that clearly”. The prompt was followed by the privacy policy’s text read from a text file, and a question to be answered by the LLM, drawn from a CSV file containing the four privacy policy questions. The prompt is automatically generated for each question in the CSV, ordered from 1 to 4. See Appendix C for the LLM questions.

Comparing Human and LLM Answers. After the LLM-agent run completed, two experienced researchers conducted a comparative qualitative analysis of human and LLM privacy policy answers using template analysis. For each discrepant answer between the human and LLM, the researchers reviewed the LLM’s and our reasoning and coded the potential reason for the discrepancy.

Compliance definitions. In our context, we define fully compliant websites as those that provide a privacy policy that informs data subjects about the four examined items. Partially compliant websites are those that offer a privacy policy that informs about some, but not all, of the four items. Non-compliant websites are those that either do not provide a privacy policy or provide one but do not declare any of the four items we examine. The privacy policy items we examined are listed in Table 1 in Appendix D.

Ethics. Our study does not involve interaction with human subjects. Therefore, we did not need Institutional Review Board (IRB) approval.

3 Results

RQ (1): E-Commerce Websites Showed a High Non-

Compliance Rate With the PDPL. At the level of privacy policy existence, 9 websites failed to provide a privacy policy. Our coarse-grained analysis, in which we examined the items’ declaration only, shows that across the 91 policies, the declaration rate for any of the examined items ranged from 40% to 56% only. Even the privacy policies that declared the examined items, when analyzed at a fine-grained level, often lacked required details.

RQ (2): Top-ranked websites and those hosted in local e-commerce platforms tend to have higher non-compliance rates compared to med- to low-ranked and those hosted in non-local e-commerce platforms. Our analysis revealed that 60% of the top-ranked websites and 70% of websites hosted in local e-commerce platforms were categorized as non-compliant. One potential reason for this phenomenon is a loss of accountability. This is especially true for small and medium-sized businesses and freelancers, including a specific category of freelancing license in Saudi Arabia known as “productive families” [18], for businesses running from homes, which tend to be hosted on local hosting platforms.

RQ (3): Considerations for Using LLMs in Privacy Policy Analysis. The agreement rates between our answers and the LLM are as follows: 87/91 (96%) in the retention, 84/91 (92%) in the destruction, 53/91 (58%) in the copy, and 74/91 (81%) in the complaint answers. Based on our qualitative analysis for each discrepancy case between the human and LLM’s answers to the privacy policy questions, we distilled the following recommendations:

- **For website developers:** (1) Align inner and outer privacy policy content in HTML pages. (2) Specify the policy text boundaries.
- **For privacy policy analysts:** (1) Simple HTML text extractor does not work for all. (2) Caution in writing privacy policy questions for LLMs.
- **For privacy policy authors:** (1) Respect regional privacy laws and regulation terminology.

4 Conclusion

We analyzed 100 e-commerce websites operating in Saudi Arabia against compliance with key aspects of the PDPL. Most websites in our dataset are not compliant with the PDPL. Additionally, top-ranked websites and those hosted on local e-commerce platforms have the highest non-compliance rates, compared to mid- and low-ranking websites and those not hosted on any platform. Finally, agreement rates between the LLM and human answers show promise for LLMs in automating privacy policy analysis and suggest avenues for improvement. We proposed evidence-based considerations to enhance LLM-based automated privacy policy analysis, which can be used in future benchmarks aimed at improving LLM-based privacy policy analysis.

5 Acknowledgment

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A Privacy Policy Items

In this section, we list the policy items we analyzed along with their PDPL requirements [31–33].

Table 1: The policy items we analyzed along with their PDPL requirements [31–33]^a. In the left column, items followed by ** are explicit rights in the law document [31].

Item	Requirements checked
	The website should ...
Privacy policy	1) Provide a privacy policy and make it available to data subjects before data collection. 2) The privacy policy should be written in understandable language. 3) The privacy policy should contain other links related to the privacy policy, such as the cookie policy and terms and conditions.
	The privacy policy should ...
Retention	1) Inform data subjects about the retention period or the criteria used to determine that period. 2) Provide retention periods for each personal data category. 3) Provide the method for destroying the data after it is no longer needed.
Destruction**	1) Inform data subjects of their right to request the destruction of their personal data. 2) How to exercise this right. 3) The communication channels for submitting requests. 4) The time frame for response.
Copy**	1) Inform data subjects of their right to request a copy of their personal data in a readable and clear format. 2) How to exercise this right. 3) The communication channels for submitting requests. 4) The time frame for response.
Complaint	1) Provide a mechanism for data subjects to file complaints and objections related to their data rights and processing. 2) The name of the department or division for handling the complaints. 3) Its contact details. 4) The time frame for response. 5) Name the competent authority in case of unsatisfactory outcome.

^a In August, 2025, we retrieved the latest version of the implementing regulation and found that it differs from the previous version we retrieved in April 2025 and started with. Neither of the two regulation documents has a version or date stamp. We revised our work in accordance with the latest version [33]. The changes made in the initial document did not affect our analysis or findings.

B Analysis Surveys

In this section, we provide the survey used in the manual analysis¹.

¹The survey used in the study contained three additional sections: 1) Halting the Reception of Advertising or Awareness Materials, 2) Halting the Reception of Direct Marketing, and 3) Communication Channels to Respond

Title: Compliance Survey

1) Email:

[requires sign in to Google account]

2) Enter password:

[open-text entry]

Part#0: Before you begin. Setting up a clean environment (checklist)

3) Coder (analyst) name:

[open-text entry]

4) Are you using the Google Chrome browser’s Incognito mode?

◦ Yes

◦ No

5) Are you signed out of any online services from the browser?

◦ Yes

◦ No

6) Are all browser tabs closed?

◦ Yes

◦ No

Part#1: Retrieve the homepage and privacy policy content

7) Enter the name of the controller as in the provided domains’ list (e.g., “google.com”)

[open-text entry]

8) In which language the controller’s default homepage is presented?

◦ English

◦ Arabic

◦ Other: [open-text entry]

9) Does the controller have an English homepage?

◦ Yes

◦ No

◦ Other: [open-text entry]

[If Q.9 answer is “No” go to Q.17]

[English homepage]

[The controller has an English homepage]

10) Copy and paste the controller’s English homepage URL: [open-text entry]

11) Retrieve the content of the controller’s English homepage

to Data Subjects’ Requests Related to their Rights. We omitted them here as we did not pursue analyzing or reporting them due to project scope adjustment.

- Done
- Other: [open-text entry]

12) On the English homepage, is there a link to the controller's English privacy policy named "privacy policy" or an equivalent name – some controllers use different terms for privacy policy (e.g. "privacy")? **If you do not find a link in the home page, click the account or create account icons or areas, check for privacy policy there without creating an account or entering personal information.**

- Yes, it is named "privacy policy"
- Yes, it is named other than "privacy policy"
- No
- Other: [open-text entry]

[If Q.12 answer is "Yes, it is named 'privacy policy'" go to Q.14. If Q.12 answer is "No" go to Q.17]

[Other names for English privacy policy]

13) If the previous answer is "Yes, it is named other than 'privacy policy'", what is it named?

[open-text entry]

14) Does the English privacy policy link work?

- Yes
- No
- Other: [open-text entry]

[Retrieve English privacy policy]

[The controller has an English homepage AND it has a link to an English privacy policy AND the English privacy policy link works]

15) Copy and paste the controller's English privacy policy URL:

[open-text entry]

16) Retrieve the content of the controller's English privacy policy.

- Done
- Other: [open-text entry]

17) Does the controller have an Arabic homepage?

- Yes
- No
- Other: [open-text entry]

[If Q.17 answer is "No" go to Q.25]

[Arabic homepage]

[The controller has an Arabic homepage]

18) Copy and paste the controller's Arabic homepage URL: [open-text entry]

19) Retrieve the content of the controller's Arabic homepage.

- Done
- Other: [open-text entry]

20) On the Arabic homepage, is there a link to the controller's Arabic privacy policy named "سياسة الخصوصية" or an equivalent name – some controllers use different terms for privacy policy? If you do not find a link on the home page, click the account or create account icons or areas, and check the privacy policy there without creating an account or entering personal information.

- Yes, it is named "سياسة الخصوصية"
- Yes, it is named other than "سياسة الخصوصية"
- No
- Other: [open-text entry]

[If Q.20 answer is "Yes, it is named 'سياسة الخصوصية'" go to Q.22. If Q.20 answer is "No" go to Q.25]

[Other names for Arabic privacy policy]

21) If the previous answer is "Yes, it is named other than 'سياسة الخصوصية'", what is it named?

[open-text entry]

[Arabic privacy policy]

[The controller has an Arabic homepage and it has a link to an Arabic privacy policy]

22) Does the Arabic privacy policy link work?

- Yes
- No
- Other: [open-text entry]

[If Q.22 answer is "Yes" or "Other", go to Q.23. If Q.22 answer is "No" go to Q.25]

[Retrieve Arabic privacy policy]

[The controller has an Arabic homepage AND it has a link to an Arabic privacy policy AND the Arabic privacy policy link works]

23) Copy and paste the controller's Arabic privacy policy URL:

[open-text entry]

24) Retrieve the content of the controller's Arabic privacy policy.

- Done
- Other: [open-text entry]

[Branch: either proceed or terminate]

25) If you found a policy (either in English or Arabic), visit the privacy policy page of the controller's default homepage. If no policy exists (either in English or Arabic), choose "No policy exists".

- Done
- No policy exists

[If Q.25 answer is "No policy exists" go to Part#4 – Q.58]

[Working default homepage's privacy policy]

26) Enter the URL for the privacy policy page of the controller's default homepage.

[open-text entry]

27) In which language is the privacy policy page of the controller's default homepage presented?

- English
- Arabic
- Other: [open-text entry]

Part#2: Privacy policy high-level presentation

28) At this point, enter the data collection starting date as shown in your computer's clock:

[Month-Day-Year]

29) At this point, enter the data collection starting time as shown in your computer's clock:

[Time]

30) How is the privacy policy mainly presented?

- Textual
- Graphical
- Other: [open-text entry]

31) Does the privacy policy contain any of the following: (select all that apply)

- ☐ Table of contents
- ☐ Additional link related to privacy policy, such as "terms and conditions", "cookie policy", and "personal data protection law", etc
- ☐ None of the above
- ☐ Other: [open-text entry]

32) If you have additional comments or observations, please add them here.

[open-text entry]

Part#3: Measure privacy policy compliance with PDPL

Part#3.1: Retention Period

33) [if policy_version = "English"]: Search for terms like "retent" or similar terms in the privacy policy to find information about the retention period or the criteria used to determine it. Also, skim through the policy headings to double-check.

[else if policy_version = "Arabic"]: Search for terms like "حفظ", "حفظ", "حفاظ" or similar terms in the privacy policy to find information about the retention period or the criteria used to determine it. Also, skim through the policy headings to double-check.

- Done
- Other: [open-text entry]

34) Does the privacy policy inform data subjects about the retention period or the criteria used to determine how long the controller will retain their personal data?

- Yes
- No
- Other: [open-text entry]

35) Copy and paste the section heading(s) in the privacy policy that describe the retention period or the criteria used to determine how long the controller will retain the data subjects' personal data. If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied heading(s), and leave an empty line between multiple headings.

[open-text entry]

36) Copy and paste the paragraph(s) in the privacy policy that describe the retention period or the criteria used to determine how long the controller will retain the data subjects' personal data. If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied paragraph(s), and leave an empty line between multiple paragraphs.

[open-text entry]

37) If you have additional comments or observations, please add them here. [open-text entry]

Part#3.2: Request Destruction of Personal Data

38) [if policy_version = "english"]: Search for terms like "delet", "clos", "remov", "destruct", "eras" or similar terms in the privacy policy to find information about destruction of personal data. Also, skim through the policy headings to double-check.

[else if policy_version = "arabic"]: Search for terms like "تلف", "تلاف", "زال", "غلق", "غلاق", "مسح" or similar

terms in the privacy policy to find information about destruction of personal data. Also, skim through the policy headings to double-check.

- Done
- Other: [open-text entry]

39) Does the privacy policy inform data subjects about the right to request the destruction of their personal data held by the controller?

- Yes
- No
- Other: [open-text entry]

40) Copy and paste the section heading(s) in the privacy policy that describe the data subjects' right to the destruction of their personal data held by the controller. If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied heading(s), and leave an empty line between multiple headings.

[open-text entry]

41) Copy and paste the paragraph(s) in the privacy policy that describe the data subjects' right to the destruction of their personal data held by the controller, **including any related information such as the method of exercising the right, response time, etc.** If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied paragraph(s), and leave an empty line between multiple paragraphs.

[open-text entry]

42) If you have additional comments or observations, please add them here.

[open-text entry]

Part#3.3: Request A Copy of Personal Data in a Readable and Clear Format

43) [if policy_version = "english"]: Search for terms like "copy", "readable", "clear", "format" or similar terms in the privacy policy to find information about requesting a copy of data in a readable and clear format. Also, skim through the policy headings to double-check.

[else if policy_version = "arabic"]: Search for terms like "نسخ", "واضح", "مقروء", "صيغ" or similar terms in the privacy policy to find information about requesting a copy of data in a readable and clear format. Also, skim through the policy headings to double-check.

- Done
- Other: [open-text entry]

44) Does the privacy policy inform data subjects about the right to request a copy of their personal data in a readable and clear format?

- Yes
- No
- Other: [open-text entry]

45) Copy and paste the section heading(s) in the privacy policy that describe the data subjects' right to request a copy of their personal data in a readable and clear format. If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied heading(s), and leave an empty line between multiple headings.

[open-text entry]

46) Copy and paste the paragraph(s) in the privacy policy that describe the data subjects' right to request a copy of their personal data in a readable and clear format, **including any related information such as the method of exercising the right, response time, etc.** If not specified in the privacy policy, write "n.a." Use double quotes to mark the start and end of the copied paragraph(s), and leave an empty line between multiple paragraphs.

[open-text entry]

47) If you have additional comments or observations, please add them here.

[open-text entry]

Part#3.4: Submitting Complaints or Objections Related to Data Subjects' Rights

53) [if policy_version = "english"]: Search for terms like "complain", "object", "concern" or similar terms in the privacy policy to find information about the mechanism provided by the controller for filing complaints and objections related to their data rights and processing. Also, skim through the policy headings to double-check.

[if policy_version = "arabic"]: Search for terms like "مخاوف", "شكوى", "اعتراض", "شكاوى" or similar terms in the privacy policy to find information about the **mechanism provided by the controller for filing complaints and objections related to their data rights and processing**. Also, skim through the policy headings to double-check.

- Done
- Other: [open-text entry]

54) Does the privacy policy inform data subjects about the mechanism provided by the controller for filing complaints and objections related to their data rights and processing?

- Yes
- No
- Other: [open-text entry]

55) Copy and paste the section heading(s) in the privacy policy that describe the mechanism provided by the controller for filing complaints and objections related to their data rights and processing. If not specified in the privacy policy, write “n.a.” Use double quotes to mark the start and end of the copied heading(s), and leave an empty line between multiple headings.

[open-text entry]

56) Copy and paste the paragraph(s) in the privacy policy that describe the mechanism provided by the controller for filing complaints and objections related to their data rights and processing. If not specified in the privacy policy, write “n.a.” Use double quotes to mark the start and end of the copied paragraph(s), and leave an empty line between multiple paragraphs.

[open-text entry]

57) If you have additional comments or observations, please add them here.

[open-text entry]

Part#4: Additional comments

58) Do you have any additional comments or observations?

[open-text entry]

59) At this point, enter the data collection ending date as shown in your computer’s clock:

[Month-Day-Year]

60) At this point, enter the data collection ending time as shown in your computer’s clock (use 24-hour format):

[Time]

[End of survey]

You reached the end of survey. Thank You!

C LLM List of Questions

In this section, we list the questions used by our LLM agent on each privacy policy in our dataset. The LLM retrieves the question and choices from a CSV file (these questions were also listed in Appendix B (Q.34, Q.39, Q.44, and Q.54) and were answered manually by human analysts). The answers are (“Yes”, “No”, “Other (please specify):”. The LLM-based analysis was on the coarse-grained privacy policy questions.

LLM Questions

- 1) Does the privacy policy inform data subjects about the retention period or the criteria used to determine how long the controller will retain their personal data?
 - Yes
 - No
 - Other (please specify):

- 2) Does the privacy policy inform data subjects about the right to request the destruction of their personal data held by the controller?
 - Yes
 - No
 - Other (please specify):
- 3) Does the privacy policy inform data subjects about the right to request a copy of their personal data in a readable and clear format?
 - Yes
 - No
 - Other (please specify):
- 4) Does the privacy policy inform data subjects about the mechanism provided by the controller for filing complaints and objections related to their data rights and processing?
 - Yes
 - No
 - Other (please specify):

D LLM Prompt

The LLM prompt is shown in [Figure 1](#) below.

You are a privacy compliance expert. Use ONLY the provided policy text below to answer the question. Do not rely on outside knowledge. If the answer is not found, state that clearly.

Privacy Policy:
 ""[privacy policy text]""

Question:
 [question]

Options:
 [option 1]
 [option 2]
 [option 3]

Respond in this format:
 Answer: <exact option(s)>
 Reasoning: <why you selected that answer>
 Heading: <policy section>
 Confidence: <0.0–1.0>

Figure 1: The prompt template used by the LLM agent in the automated coarse-grained privacy policy analysis. The LLM retrieves the privacy policy text from a text file, and the question to be answered and its options are retrieved from a CSV file.