



SINGAPORE UNIVERSITY OF  
TECHNOLOGY AND DESIGN

Singapore University of Technology and Design

Capstone Term 7

Capstone 9 Project 07

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## AsiaCloud\_AI4PDPA

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# Acknowledgements

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# Executive Summary

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# 1

## Introduction

Rapid digitization has transformed how organizations collect, analyze, and rely on personal data to deliver services, optimize resources, and make critical decisions (Zul, 2022). In Singapore, this shift is significant due to nationwide efforts to build a Smart nation and accelerate AI adoption across industries (Choudhury, 2024). As organizations rely heavily on data to drive productivity and innovation, the protection of data has grown into a critical governance concern. At the same time, the risk associated with data misuse, unauthorized access, and large-scale breaches have increased. High profile incidents in Singapore demonstrate the tangible consequences of poor data governance. For example, Marina Bay Sands was fined SGD 315000 by the Personal Data Protection Commission (PDPC) after a data breach exposed the personal information of more than 665000 customers, highlighting the magnitude and impact of failures in data protection practices (Chan, 2025). Such cases illustrate that even larger organizations with substantial resources can face compliance challenges, while smaller organizations are often less equipped to manage these risks. To ensure responsible data practices, Singapore enacted the Personal Data Protection Act 2012 (PDPA). It establishes baseline data protection obligations, balancing individual rights with business innovation (Personal Data Protection Commission, 2023). The PDPC further supports compliance through advisory guidelines and compliance toolkits that are publicly available on its website (Personal Data Protection Commission, 2022). However, as technology evolves and new regulatory requirements emerge, organizations face ongoing difficulty in interpreting and applying PDPA requirements. An example from Singapore illustrates how easily organizations can violate the PDPA during routine operations. In the case of Credit Counselling Singapore (Personal Data Protection Commission, 2017), an employee sent a follow-up email to 96 clients but mistakenly placed their emails addresses in the “To” field instead of using “Bcc”. As a result, 96 email addresses and associated names were visible to all recipients (Personal Data Protection Commission, 2017). This incident demonstrates that even a simple administrative error can lead to a data breach, regulatory consequences, and the exposure of sensitive personal information. It also highlights a broader issue: many organizations, especially smaller ones, lack accessible and practical guide to help them understand and comply with PDPA requirements in everyday situations.

While PDPA information is publicly available, it remains complex and difficult to navigate for non-specialists. Existing compliance tools may be costly, generalized, or not tailored

to Singapore's regulatory context. SMEs, which often operate without dedicated legal or compliance teams, face difficulty obtaining reliable PDPA guidance that is both comprehensible and operationally relevant. This project addresses the problem by developing an AI-driven platform that provides contextualized PDPA information, practical templates, training materials, and insights into organizational compliance concerns. The goal is to create a modular, scalable proof-of-concept that meets SME needs while supporting AsiaCloud's longer-term plan to develop a commercial PDPA compliance solution. The platform aims to integrate a PDPA chatbot, a document template generator, a training module with automated scoring, and a dashboard offering aggregated analytics, all built on a lightweight, cost-efficient architecture suitable for future expansion.

The project spans two academic terms. Term 7 focuses on laying the foundation, which includes defining the system architecture, developing a preliminary chatbot prototype, conducting initial testing, and refining the project requirements based on client feedback. This foundational work clarifies key constraints, safety considerations, and the design direction needed to support the full platform. Term 8 will focus on implementation. The planned work includes completing the chatbot's features—such as safe-answer behaviour and Singapore-specific responses—building a browser-based chat history system, generating PDPA document templates, creating a scoring-enabled training module, and developing a dashboard that presents aggregated usage insights. The dashboard will incorporate both a free version and placeholders for future paid-tier features. The architecture will prioritize modularity, cost efficiency, and extensibility to support AsiaCloud's long-term commercial ambitions.

The platform is intended primarily for SMEs operating in Singapore, particularly those without dedicated compliance teams. It is designed to support staff who handle personal data in day-to-day operations, new employees undergoing PDPA training, and managers responsible for data protection practices. AsiaCloud is also a key stakeholder, as the dashboard's aggregated insights will inform future product development and market positioning.

The success of the platform will be assessed based on its functional accuracy, relevance, and clarity in delivering PDPA information to users. It should demonstrate safe and responsible behaviour when responding to sensitive or out-of-scope queries, while maintaining an intuitive user experience across the chatbot, templates, dashboard, and training modules. The architecture should remain modular, with components that can be independently enabled to support a free version and future paid-tier enhancements. Cost efficiency is also a key criterion, as the platform must remain accessible and sustainable for SMEs. This working definition will be refined further in consultation with the course instructor.

## 2

# Literature Review

Rapid digitalization has increased the scale at which organizations collect and process personal data, making data protection a key concern, especially in Singapore (Zul, 2022). The growing reliance on technologies and artificial intelligence results in the need for a clear governance framework to manage the collection, use, and disposal of personal data responsibly (Schubert & Barrett, 2024). As digital services expand across different industries, the risk of data misuse, unauthorized access and breaches has also grown (KPMG US, 2023). In response to these challenges, PDPA was established to safeguard individual's personal data while supporting organizations' business interest (Personal Data Protection Commission, 2023). To aid compliance, PDPC uploads advisory guidelines to aid organizations and individuals in their understanding of PDPA (Personal Data Protection Commission, 2022). However, despite the availability of these resources, many organizations and individuals struggle to understand and comply with PDPA requirements correctly due to constant evolving regulations (i-Sprint Innovations Pte Ltd., 2024). According to the PDPC's 2015 industry survey, about 58% of organizations required support to achieve compliance, reflecting knowledge and resource gaps (Personal Data Protection Commission of Singapore, 2015). This suggests that as innovative technologies and regulations emerge, traditional resources may not be sufficient for compliance support. Also, there is growing interest in leveraging artificial intelligence (AI) to automate retrieval of knowledge and comprehension of regulatory compliance (Gültekin-Várkonyi, 2025). Hence, there is an opportunity to combine AI and compliance to create tools that can interpret legal frameworks and make regulatory knowledge more accessible.

Small and medium enterprises (SMEs) form the backbone of Singapore economy, accounting over 99% of all enterprises and employing 70% of the workforce (Lim, 2025). However, SMEs often face greater obstacles in meeting compliance requirements compared to larger organizations due to limited finance resources and the growing complexity of regulatory obligations (Bello et al., 2024). Because SMEs must prioritize day-to-day operations and revenue generation, compliance is viewed as a secondary priority. Hence, many do not allocate sufficient time, budget, or staff to interpret and implement compliance regulations (Compliance Consultant, 2025). Digital capability gaps further worsen the compliance challenge. According to a survey conducted by Capterra, 32% of SMEs still rely on spreadsheets to manage customer's information, while another 35% uses manual methods or email communication, which are

insufficient under modern data protection guidelines (Navarrete, 2019). These informal or decentralized data management methods make it difficult to track consent, update records accurately, or ensure secure retention and disposal. In this context, there is a clear need for accessible, low-barrier compliance support tools tailored to SMEs. Solutions such as AI-driven PDPA chatbots can lower the knowledge and resource barrier by providing SMEs with immediate, accurate guidance without requiring legal expertise, formal training, or expensive consultancy services.

A variety of resources are available to support PDPA compliance, primarily provided by PDPC. These include advisory guidelines, compliance checklists, assessment tools, and the Data Protection Essentials programme for SMEs (Personal Data Protection Commission, 2025). Although these materials are comprehensive, they are spread across multiple documents and written in technically dense language, making them challenging non-experts to navigate efficiently. During the team's review of these materials, it became clear that users often struggle to identify which specific sections apply to their situation or to interpret PDPA requirements without legal or technical expertise (Lonzetta & Hayajneh, 2020). In addition to PDPC materials, several commercial and professional solutions are available. Many organizations engage outsourced Data Protection Officers or legal consultants to interpret PDPA requirements on their behalf. Others adopt enterprise-grade privacy management systems such as Varonis or Verasafe, which offer data governance dashboards and risk assessment modules. However, they are costly, require ongoing subscription fees which are impractical for SMEs with limited budgets. For example, Onspring's privacy management software costs approximately \$30 000 to \$56,000 for initial setup with annual subscription fees ranging from \$10 000 to \$50 000 (Randall, 2025). Furthermore, existing solutions lack conversational, real-time interaction. Users must manually search through documentation, navigate dashboards, or rely on external consultants. Taken together, these findings highlight the absence of an accessible, affordable, and PDPA-specific digital tool capable of providing real-time compliance support. This gap underscores the need for an AI-powered PDPA chatbot that allows users to obtain accurate, scenario-specific guidance without requiring legal expertise or substantial financial investment.

The increasing complexity of legal and regulatory frameworks has driven organizations to adopt AI solutions to automate and streamline compliance processes (Bleach, 2024). AI technologies such as natural language processing (NLP) and large language models (LLMs) allow systems to interpret, analyze, and generate human-like responses to text-based queries (Vaniukov, 2024). In the legal industry, AI tools are being used for document analysis, legal advice support, and contract drafting, reducing mundane works and improving efficiency (SMU Social Media Team, n.d.). A key innovation in this area is AI chatbots which act as conversational agents to answer user queries about legal and compliance matters. In the legal industry, AI chatbots have already begun transforming how professionals access and interpret information. For instance, Harvey AI, developed on OpenAI's GPT technology, has partnered with law firms and consulting giants such as PwC to assist in legal research, contract review, and compliance analysis (PwC, 2023). This growing adoption highlights the potential for AI to streamline legal workflows and enhance user understanding of complex legal texts. Similarly, there is growing recognition that such tools can extend to the data protection and compliance domain.



Developments in this area align with Singapore’s Smart Nation initiatives, which encourages the use of AI to improve governance, productivity, and security (Government of the Republic of Singapore, 2023). Therefore, AI-powered PDPA chatbots represent a promising approach to bridging compliance gaps, especially resource-constrained SMEs.

AI chatbots introduce a range of privacy and data protection concerns, particularly when deployed in compliance-related environments. LLMs rely on vast amounts of training data and probabilistic generation techniques, which means they may inadvertently produce inaccurate, misleading, or hallucinated responses (Gültekin-Várkonyi, 2025). In legal and regulatory contexts, such errors carry heightened risks, as organisations may unknowingly act on incorrect information. Studies have shown that users often ascribe unwarranted authority to AI systems, further amplifying the potential for misinterpretation. A significant privacy risk lies in how chatbots process, store, or transmit user inputs. If poorly designed, chatbots may inadvertently retain personal information through server logs, analytics tools, or model telemetry, creating compliance obligations under data protection regimes such as the PDPA (Personal Data Protection Commission, 2023). Research has highlighted that users frequently input sensitive identifiers—names, national IDs, contact details—into AI systems without understanding how the data will be used or stored. Such behaviour can expose organisations to liability, especially when combined with insufficiently transparent data handling practices. Another concern is the lack of jurisdictional awareness in generic AI models. Without explicit controls, chatbots may provide privacy guidance derived from other countries’ regulatory frameworks, leading to inaccurate PDPA interpretations. This issue was also observed in broader AI deployment studies, which noted that models trained on globally diverse datasets often generate advice incompatible with local regulatory requirements (KPMG US, 2023). Furthermore, AI chatbots may amplify existing privacy risks by enabling large-scale, automated dissemination of erroneous information. The conversational fluency of AI systems can mask underlying inaccuracies, making hallucinations particularly dangerous in compliance settings. These concerns reinforce the need for strict data minimisation, embedded refusal behaviour, jurisdiction-specific guardrails, and robust safeguards to ensure that AI chatbots do not themselves create new vectors of privacy or data protection risk.

Retrieval-Augmented Generation (RAG) has emerged as a key method for improving the factual accuracy, grounding, and explainability of LLM-based systems. Unlike standalone generative models, which rely solely on their pre-trained internal parameters, RAG enhances responses by retrieving relevant information from an external knowledge base and injecting it into the model’s context window. This significantly reduces the likelihood of hallucination and supports transparency by grounding answers in verifiable sources (Gültekin-Várkonyi, 2025). In regulatory domains, RAG is particularly advantageous. It ensures that generated responses are anchored in authorised documents such as PDPC guidelines, enforcement decisions, and advisory notes. This is critical in compliance settings, where organisations must rely on accurate, consistent, and up-to-date interpretations of legal obligations. RAG also supports modular and iterative updates to the system’s knowledge base, allowing new or revised PDPC guidelines to be integrated without retraining the underlying model. This flexibility is essential in fast-evolving regulatory landscapes where interpretations and enforcement practices change over

time. RAG also helps enforce jurisdictional boundaries. By constraining the retrieval corpus to Singapore-specific privacy documents, the system can avoid providing irrelevant or incorrect advice drawn from foreign regulatory frameworks—a frequent problem in non-RAG chatbot deployments. This targeted retrieval thereby reduces compliance risks associated with general-purpose LLMs that lack built-in awareness of local laws. From a privacy perspective, RAG also supports controlled knowledge exposure. Since the retrieved documents are predefined and auditable, their use mitigates concerns regarding reliance on opaque or unpredictably trained model parameters. This aligns well with PDPA’s emphasis on accuracy, minimization, and accountability. Overall, RAG provides a technologically robust foundation for AI-assisted PDPA guidance, combining the generative flexibility of LLMs with the factual reliability and explainability required in compliance-critical domains.

# 3

## System Design

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Item	Quantity	Price
Apple	3	\$5
Orange	2	\$4
Banana	6	\$6

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## 3.1 Backend Design

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## 3.2 Frontend Design

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# 4

## System Implementation

### 4.1 Term 7

#### 4.1.1 Iteration 1

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# 5

## System Validation

### 5.1 Frontend Verification

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## 5.2 Model Evaluation

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# 6

## Conclusion

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# Appendix A

## Survey Questions

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# Appendix B

## Additional Figures

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