University of Essex Online

Computing Department

Masters in Cybersecurity

Module Name: **Security and Risk Management August 2022**

Assignment 2: Unit 11 - Executive Summary

Description: Pampered pets sell pet food to local users, Using ingredients from local suppliers. Employs four members of Staff and has a small digital footprint.

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Introduction

In this assignment, we have provided an executive summary which outlines the risks involved with digitalisation of Pampered Pets using an international supply chain and the operations of the business. The executive summary consists of

- Potential risks of the quality and the supply chain
- Selecting an appropriate quantitative risks model with justifications
- Producing results and recommendations
- DR strategy

1. Enumerate the potential risks to quality and supply chain for the company

1.1 Quantitative Risk Modelling Approach

Multi-criteria decision-making (MCDM) provides necessary tools for decision-making when many attributes are considered. These can be subdivided into categories ranging from choice, Sorting, Ranking, and Description the MCDM offers a systematic approach to helping with ranking. The MCDM is broken down into two groups, which are Multi-Objective Decision Making (MODM) and Multi-Attribute Decision Making (MADM). The MODM goes into a holistic view of all the possible alternatives, while the MADM is scaled down on requirements (Michalowski, 1997).

The first process is to select the type of decision required, such as ranking or sorting. The second process is to use the possible techniques and tools these ranging from TOPSIS, AHP, and ANP (Belton, 2002).

1.1.1 AHP - Analytic Hierarchy Process

The Analytic Hierarchy Process is one of the most precision-orientated quantitative risk methodologies in use. Due to its complex functional nature its results are widely considered the most accurate, although as a trade-off it does lack qualitative output. (Oguztimur, 2011).

The AHP is a hierarchical structure broken down into three parts. The first identifies the issue. The second is to identify the solutions, and the third is the criteria used to evaluate the solution. (Prachi Juneja, 2021)

The advantages are

- AHP provides a flexible model for a given problem.
- Any level of detail about the main issue can be structured in this method.
- AHP relies on experts from different backgrounds to give a holistic view.
- Computer software can help decision-makers.

1.1.2 ANP - Analytic Network Process

This tool follows on from AHP however instead of using a hierarchical approach uses a network structure approach. This allows for outside factors to be accounted for. Making

the model more flexible to integrate or indicate the dependencies on attributes that do not fit. (Thomas L. Saaty, 2022)

The Analytic Network Process (ANP), which considers the interdependence between the hierarchy's constituents, is a generalisation of the Analytic Hierarchy Process (AHP). As a result, a network rather than a hierarchy is used to illustrate ANP. (T. R. Sahroni and H. Ariff, 2016)

The key advantages are

- Interaction
- Survey/Assessment
- Feedback

AHP (Analytic Hierarchy Process) of Pampered Pets

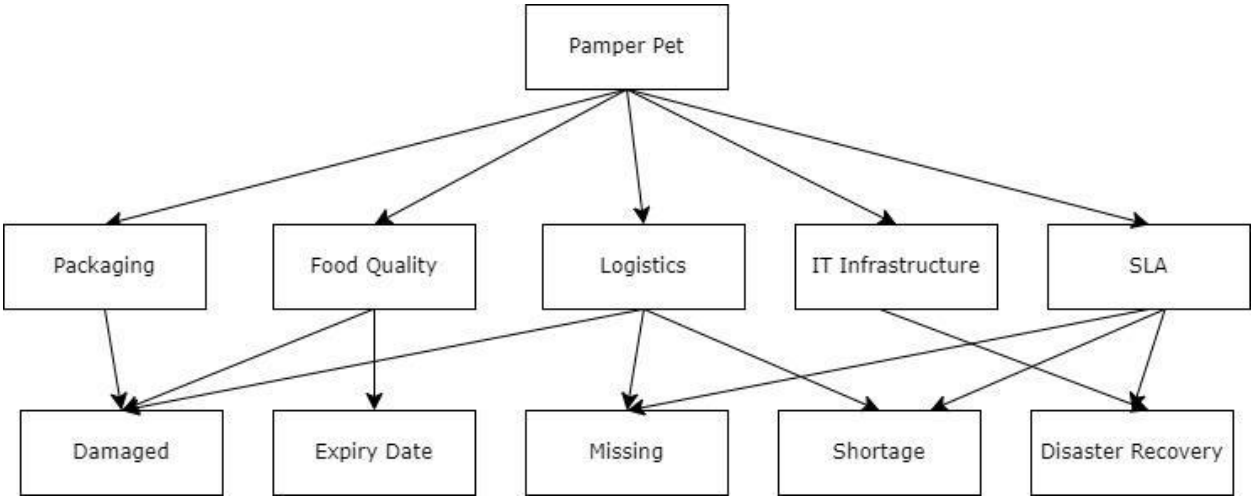


Diagram 1 - AHP Risk Diagram

Pair-Wise comparison matrix								
	Damaged Go	Expired	Logistics	IT Infrastruct	SLA	Supply Short	Disaster	GDPR
Damaged Goods	1	0.75	0.5	0.33	0.75	0.33	0.75	0.33
Expired	0.75	1	0.33	0.33	0.33	0.33	0.75	0.33
Logistics	0.5	0.33	1	0.5	0.5	0.33	0.75	0.5
IT Infrastructure	0.33	0.33	0.33	1	0.5	0.33	0.5	0.75
SLA	0.75	0.33	0.5	0.5	1	0.75	0.75	0.75
Supply Shortage	0.33	0.33	0.33	0.33	0.75	1	0.75	0.33
Disaster	0.75	0.75	0.75	0.5	0.75	0.5	1	0.33
GDPR	0.33	0.33	0.5	0.75	0.75	0.33	0.33	1
Sum	4.74	4.15	4.24	4.24	5.33	3.9	5.58	4.32

Keys	
Strong Importance	0.75
Moderate Importance	0.5
Low Importance	0.33

Normalized pair-wise compariso									
	Damaged Go	Expired	Logistics	IT Infrastruct	SLA	Supply Short	Disaster	GDPR	**Weight**
Damaged Goods	0.210970464	0.180722892	0.117924528	0.077830189	0.140712946	0.084615385	0.134408602	0.076388889	0.146224841989746
Expired	0.158227848	0.240963855	0.077830189	0.077830189	0.061913696	0.084615385	0.134408602	0.076388889	0.130311236085185
Logistics	0.105485232	0.079518072	0.235849057	0.117924528	0.09380863	0.084615385	0.134408602	0.115740741	0.138192892451855
IT Infrastructure	0.069620253	0.079518072	0.077830189	0.235849057	0.09380863	0.084615385	0.089605735	0.173611111	0.129208347374893
SLA	0.158227848	0.079518072	0.117924528	0.117924528	0.187617261	0.192307692	0.134408602	0.173611111	0.165934234764504
Supply Shortage	0.069620253	0.079518072	0.077830189	0.077830189	0.140712946	0.256410256	0.134408602	0.076388889	0.13038848512184
Disaster	0.158227848	0.180722892	0.176886792	0.117924528	0.140712946	0.128205128	0.17921147	0.076388889	0.165468641805901
GDPR	0.069620253	0.079518072	0.117924528	0.176886792	0.140712946	0.084615385	0.059139785	0.231481481	0.137128463263218

Calculations of Consistency											
									Weighted Sum Value	Criteria Weight	
Damaged Goods	0.146224842	0.109668631	0.073112421	0.048254198	0.109668631	0.048254198	0.109668631	0.048254198	0.693105751031397	0.21097046414	3.28532126
Expired	0.097733427	0.130311236	0.043002708	0.043002708	0.043002708	0.043002708	0.097733427	0.043002708	0.540791629753516	0.24096385542	2.244285263
Logistics	0.069096446	0.045603655	0.138192892	0.069096446	0.069096446	0.045603655	0.103644669	0.069096446	0.609430655712682	0.22675736961	2.687589192
IT Infrastructure	0.042638755	0.042638755	0.042638755	0.129208347	0.064604174	0.042638755	0.064604174	0.096906261	0.525877973815814	0.2457002457	2.140323353
SLA	0.124450676	0.054758297	0.082967117	0.082967117	0.165934235	0.124450676	0.124450676	0.124450676	0.884429471294808	0.18761726079	4.714009082
Supply Shortage	0.0430282	0.0430282	0.0430282	0.0430282	0.097791364	0.130388485	0.097791364	0.0430282	0.541112213255637	0.24096385542	2.245615685
Disaster	0.124101481	0.124101481	0.124101481	0.082734321	0.124101481	0.082734321	0.165468642	0.054604652	0.881947860825454	0.18761726079	4.700782098
GDPR	0.045252393	0.045252393	0.068564232	0.102846347	0.102846347	0.045252393	0.045252393	0.137128463	0.592394961297103	0.23148148148	2.559146233
				L Max	3.51101031						

1.1.3 TOPSIS (Technique for Order Preference by Similarity to Ideal Solution)

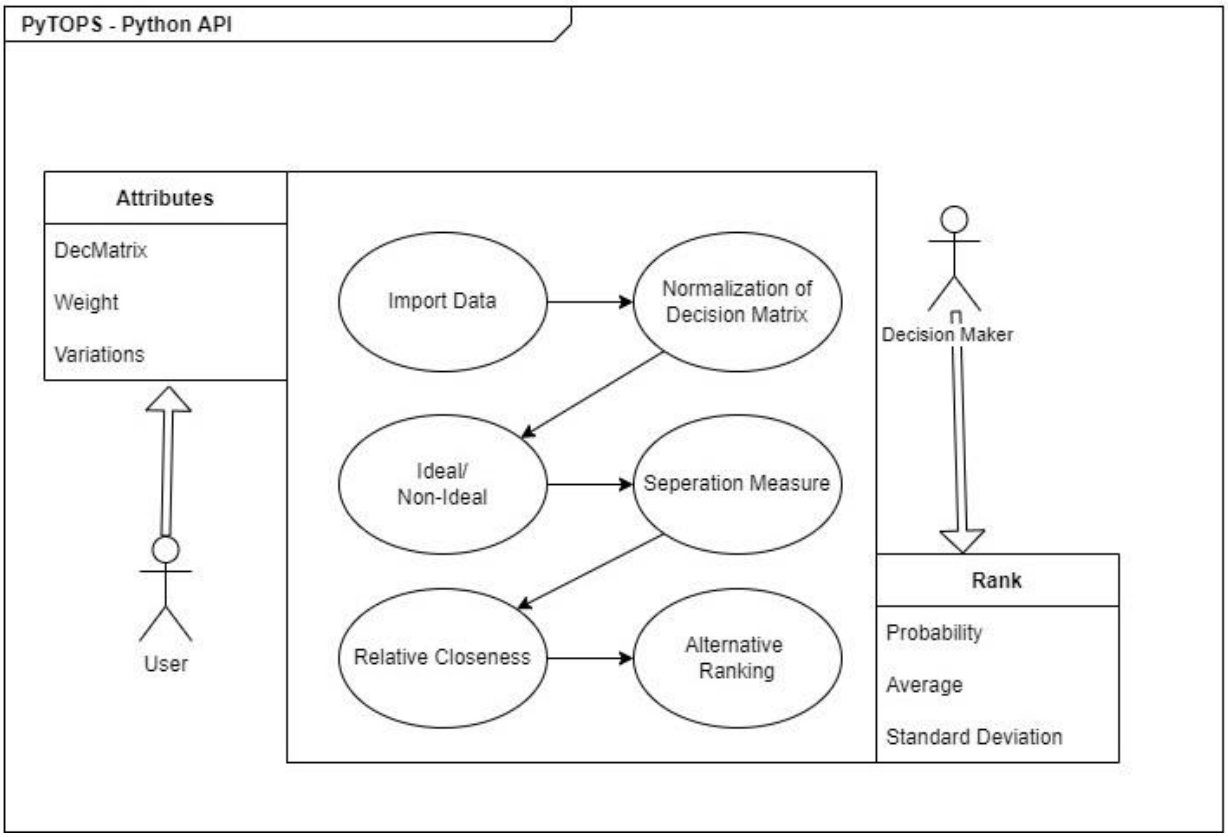
TOPSIS is a distance principle tool that lets you collate the relevant information on the attribute and then provide a weighted matrix on each possibility. The matrix is normalized, and the values are multiplied by the criteria weights (Tsaur, 2011).

Both positive and negative arrangements are solved. Each elective to these arrangements is then calculated in regards to their respective degree of separation from the ideal. The results are then sequenced (Samvedi, 2013).

TOPSIS is used alongside AHP, since it provides both a qualitative as well as quantitative result set (Roszkowska, 2011).

The advantages are

- Clear Logic is applied that represents a true weighting
- Visualisation is possible in the form of graphs and tables to quickly show the best decision.
- Significantly simpler and more efficient to calculate



Example of PyTOPS process, largely based on Yadav et al (2019)

Domain	Criteria	Code	Measure
Economic	Investment < 5	C.E.1	GBP/ton
	Investment 5-9	C.E.2	GBP/ton
	Investment 10-14	C.E.3	GBP/ton
	Waste	C.E.4	Percentage of Product discarded
	Labour cost	C.E.5	
Social	Work hours	C.S.1	N+40/40 (Hrs exceeding 40 per week)
	Localness	C.S.2	Percentage
Socio-Political	Strikes	C.P.1	N/14 (Duration of days)
	Shipping Strike	C.P.2	N/14 (Duration of days)
Natural Disaster	Flood	C.N.1	N/10 (Severity of Impact)

Table 2.1 - Supply Chain Risk Criteria

Code	Type name	Orientation
S1	Packaging	Purchasing
S2	Food Quality	Purchasing
S3	Logistics	Operations
S4	IT Infrastructure	Operations
S5	SLA	Operations

Table 2.2 - Types of Risks

Criteria	Code	From max	Weight	From min	Weight	Compromise
Investment	C.E.1	45	0.129310345	60	0.133037694	0.131174019
Investment 5	C.E.2	20	0.057471264	30	0.066518847	0.061995056
Investment 1	C.E.3	20	0.057471264	30	0.066518847	0.061995056
Waste	C.E.4	100	0.287356322	120	0.266075388	0.276715855
Labour cost	C.E.5	20	0.057471264	25	0.055432373	0.056451818
Work hours	C.S.1	40	0.114942529	60	0.133037694	0.123990111
Localness	C.S.2	100	0.287356322	120	0.266075388	0.276715855
Strikes	C.P.1	1	0.002873563	2	0.00443459	0.003654077
Shipping Stri	C.P.2	1	0.002873563	2	0.00443459	0.003654077
Flood	C.N.1	1	0.002873563	2	0.00443459	0.003654077

Table 2.3 - Swing Weighting

	Weight	S1	S2	S3	S4	S5
Investment	0.13	0.2	0.2	0	0	1
Investment 5	0.06	0.2	0.2	0	0	1
Investment 1	0.06	0.2	0.2	0	0	1
Waste	0.28	0.5	1	0.5	0	0.5
Labour cost	0.06	0	0	0.5	0	0.5
Work hours	0.12	0	0	0.5	0	0.5
Localness	0.28	0	0.2	0.5	0	0
Strikes	0.00	0	0.5	1	0.2	0.5
Shipping Stri	0.00	0	0.5	1	0.2	0.5
Flood	0.00	1	0.5	1	0.2	0.5
Score		0.21	0.33	0.5	0.06	0.6
		4	3	2	5	1

Table 2.4 - TOPSIS Results

1.2 Explanation of the calculations carried out

Full spectrum AHP and TOPSIS functions were performed, both manually and via Python API's. This helped to envision deviations from accuracy.

For the Analytic Hierarchy Process, the following was performed:

- ✓ Breakdown of Domain/Risk Criteria
- ✓ Pair-wise Comparison Matrix
- ✓ Normalized Pair-wise Comparison Matrix
- ✓ Weighted Consistency evaluations
- ✓ For Graphing the following was utilized:

```
import matplotlib.pyplot as plt
import numpy as np
```

For the TOPSIS

- ✓ Identification of Risk Domains and Categories
- ✓ Codification of the Risk Types themselves
- ✓ A Min and Max weighting matrix with compromised deviation
- ✓ A correlative matrix assigning the values of the risks to their respective causal factors
- ✓ For Graphing the following was utilized:

```
import matplotlib.pyplot as plt
import numpy as np
```

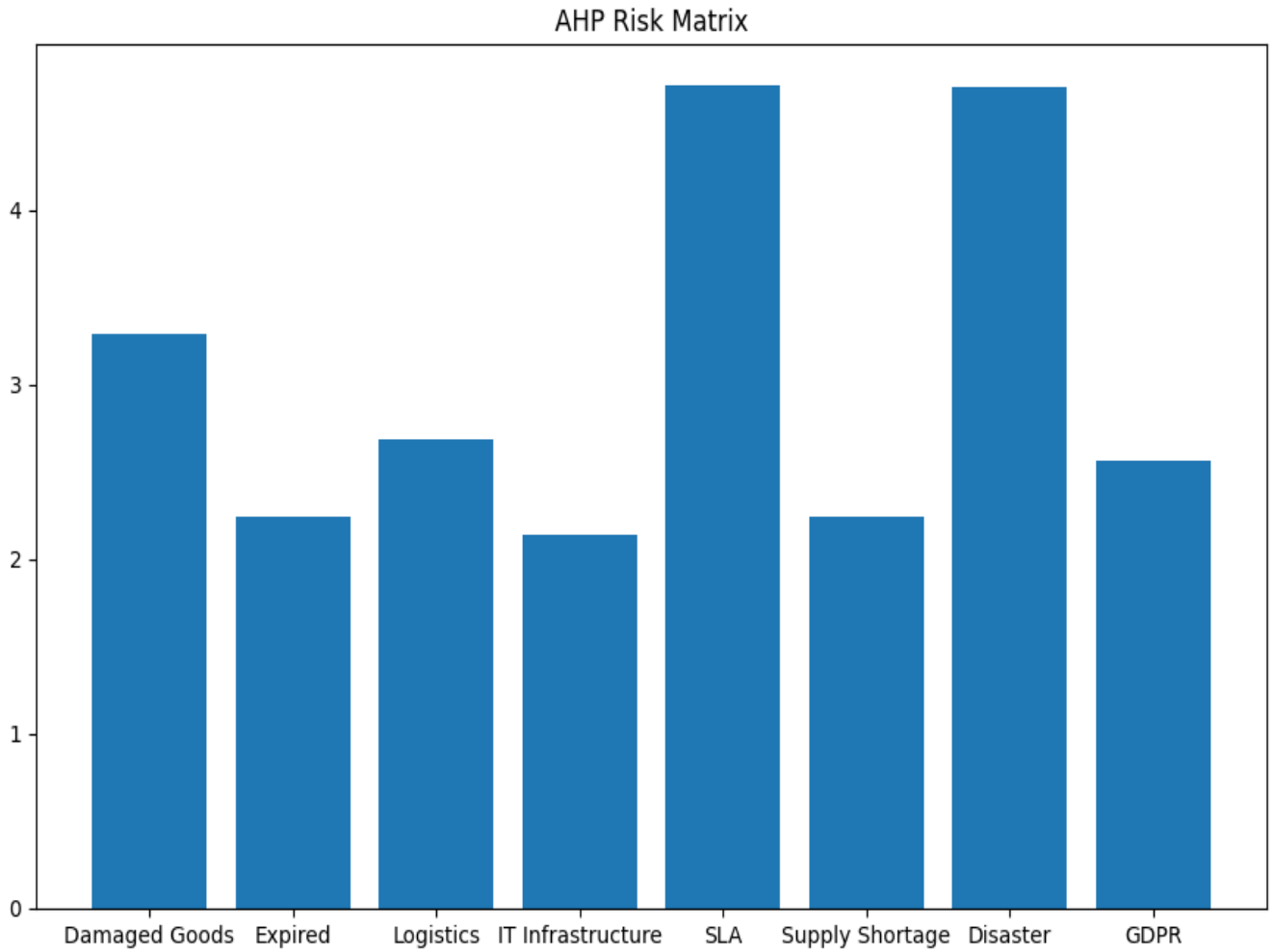


Figure 1 - Analytic Hierarchy Process Risk Bar Graph

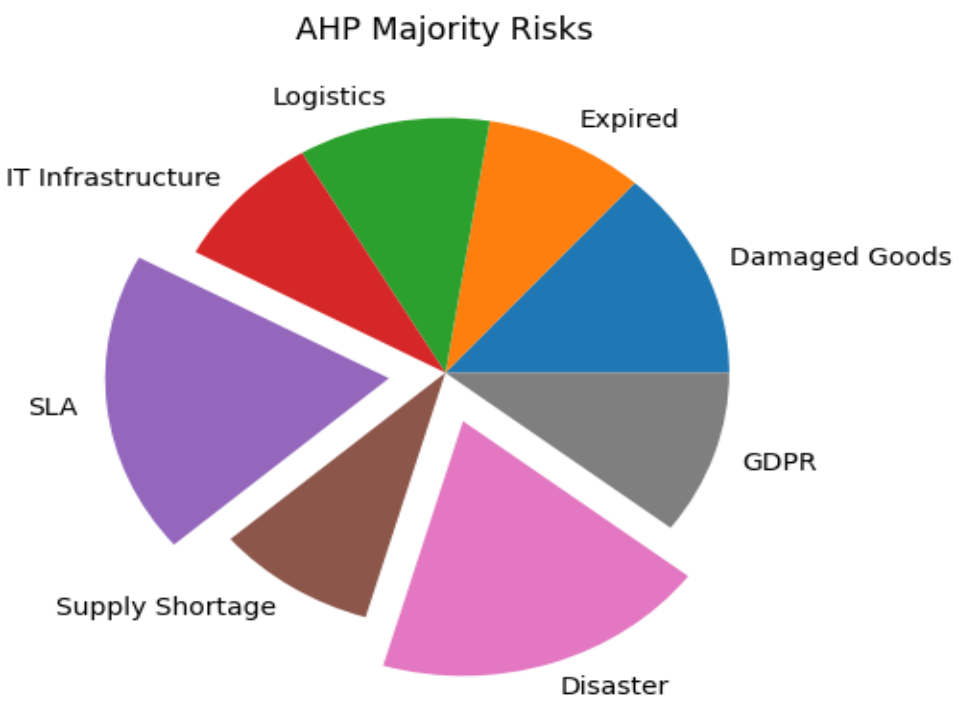


Figure 2 - Analytic Hierarchy Process Risks

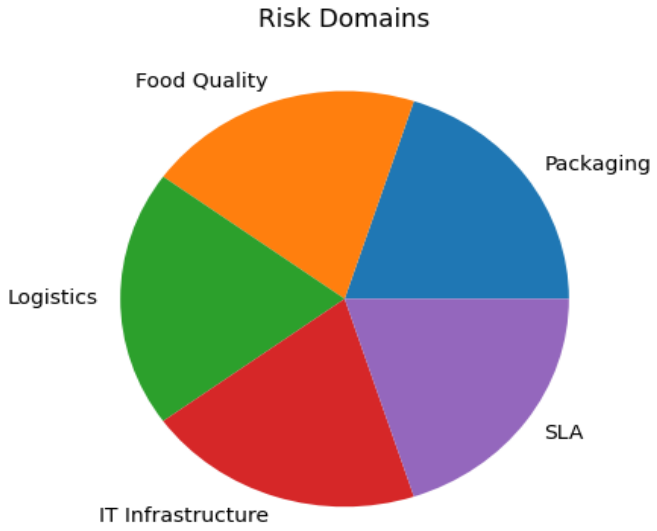


Figure 3 - Primary TOPSIS Risk Domains

SLA Graph below clearly indicates lack of investment to be the number 1 risk.

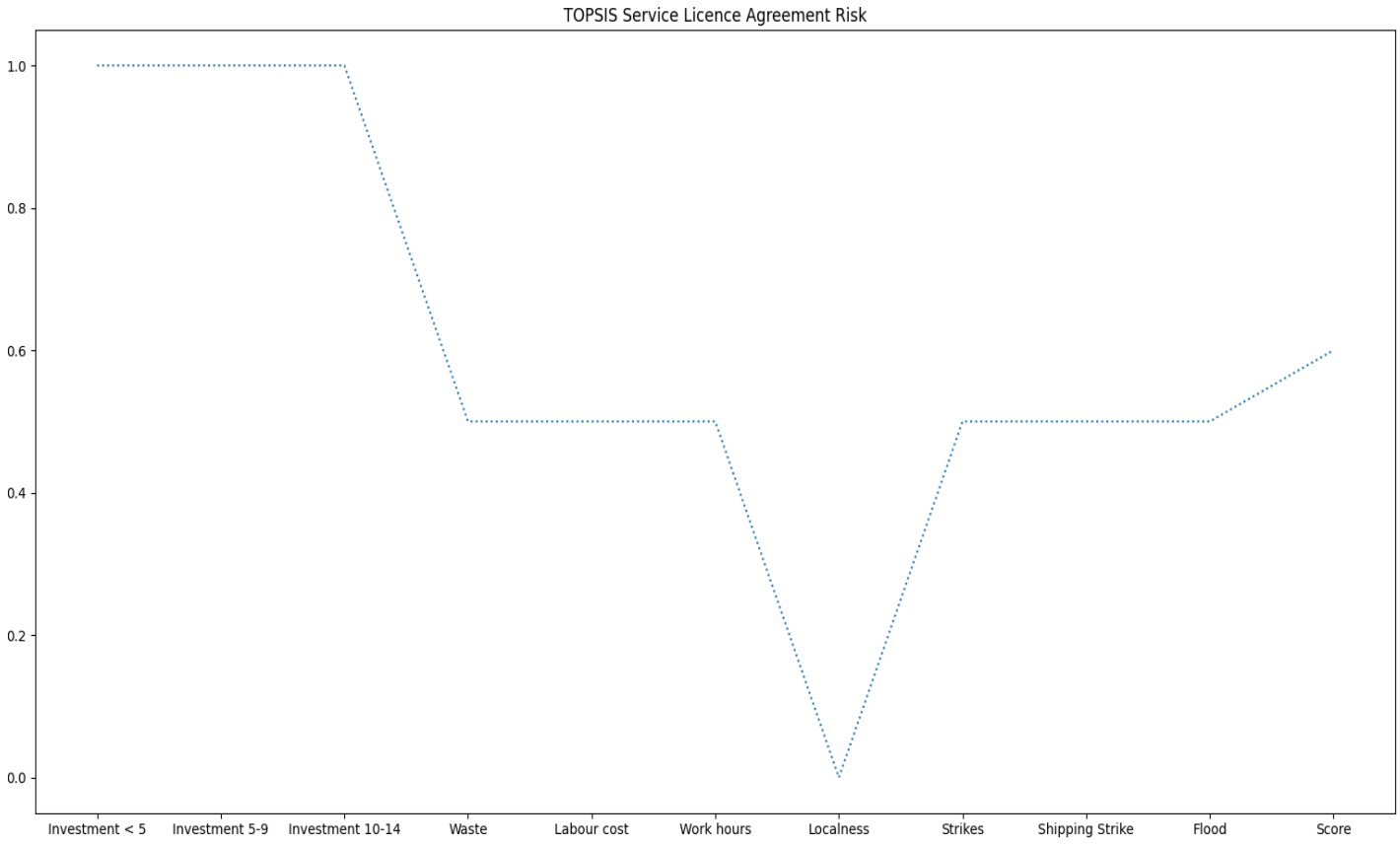


Figure 4 - TOPSIS SLA Risk Distribution

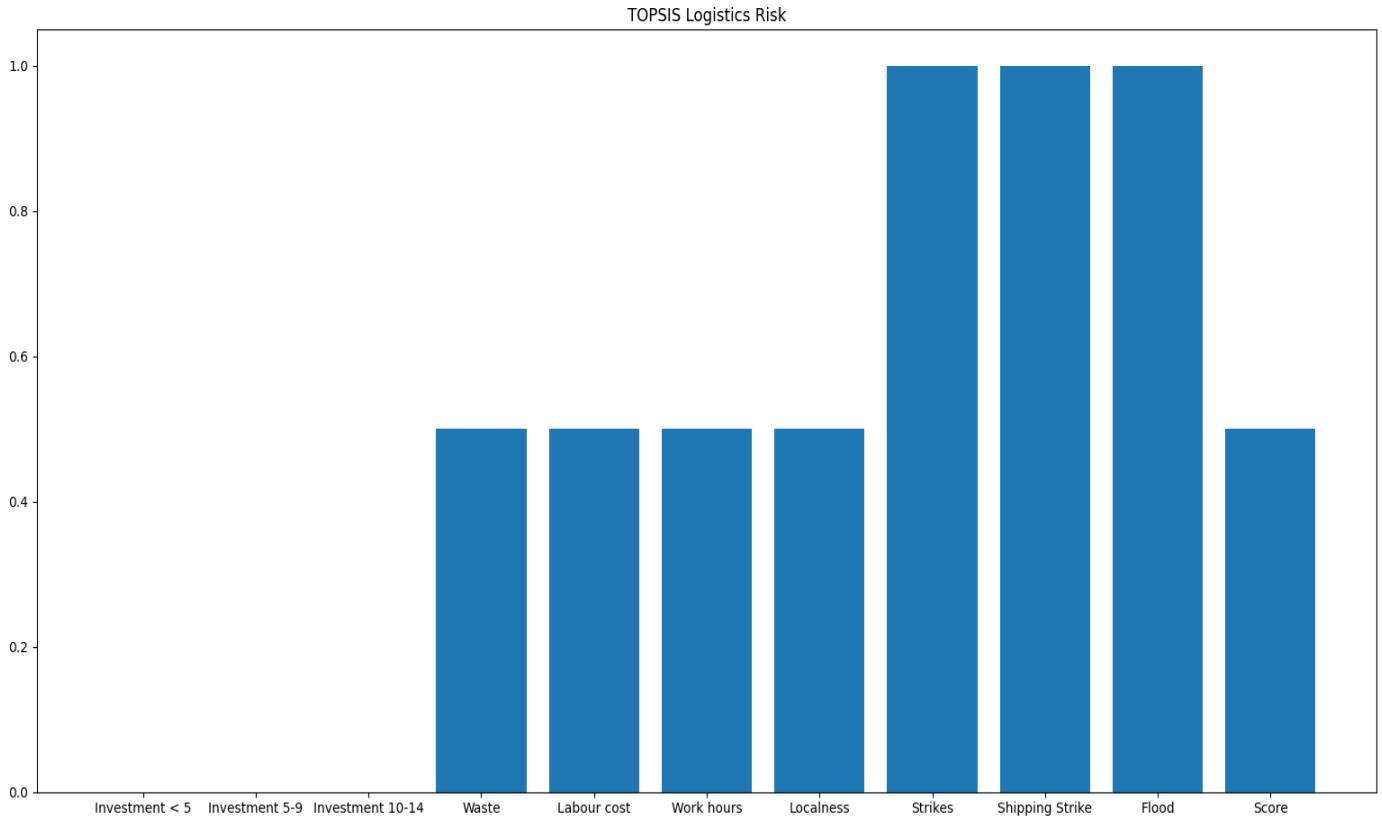


Figure - 5 Strikes and natural disasters play the number one risk to logistical delivery.

2. Summary of Results

The results of both Risk Methodologies employed overlap considerably.

According to the AHP analysis, natural disasters and strikes play major roles in the risk to the logistical supply chain model of Pampered Pets. This revelation is further supported by the TOPSIS analysis in Figure 5. TOPSIS did however indicate that lack of Investment is a bigger threat facing service license agreements (Snedaker, 2013).

These sorts of fears could be rooted in the following:

- Logistics provider strike
- Supplier blacklisted/country embargo

- Brexit related export issues (no longer have a free trade agreement with Monaco)

A primary focus should be placed on securing funding and having alternative distribution channels to mitigate against strikes. The risk that many supply chains now confront has increased because of international supply chains, shorter product life cycles, and the emphasis on efficiency. Modern production approaches like just-in-time and lean manufacturing. Any company's success depends on its ability to effectively manage the risks that its supply chain faces. When managing supply chain risk, current techniques do not take the reaction of the market or decision makers' preferences into account.

3. Business Continuity/Disaster Recovery

The disasters that could impact Pampered Pets' operations are covered in this document, along with the responses that would need to be considered. It also looks at how the business could carry on with only minor interruptions to its essential operations. The document comprises a Business Continuity Plan which focuses on office facilities, employees, and safety; and a Disaster Recovery Plan which focuses on Information technology recovery, backup facilities and telecommunication recovery (Wright, 2022). By merging the two types of planning, the document aims to discuss important incidents and actions that have an influence on personnel, facilities, and IT components in order to provide a thorough understanding of the recovery and continuity process.

3.1 Business Impact Analysis

The Business Impact Analysis (BIA) aims to identify the effect of certain events on the operation of the business (Krahulec & Jurenka, 2015). The business processes in Pampered Pets include:

A. Receive and check orders from customers.

B. Check availability of stock.

C. Replenish inventory levels.

D. Communicate availability of goods requested.

E. Start the delivery process.

F. Check stock availability via supplier.

G. Communicate unavailability of goods requested.

These business processes are illustrated in Figure 6.

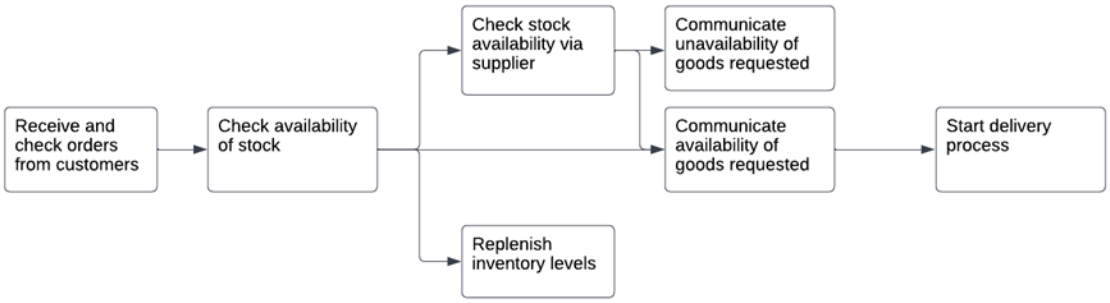


Figure 6 – Pampered Pets Business Processes

The individual activities in the business processes are done by humans or Information Systems (IS). For example, the ‘communicate the availability of goods requested’ or ‘communicate unavailability of goods requested’ could be generated by an e-mail messaging system or a staff. The business processes suitable for Business Impact Analysis (BIA) as illustrated in Figure 7.

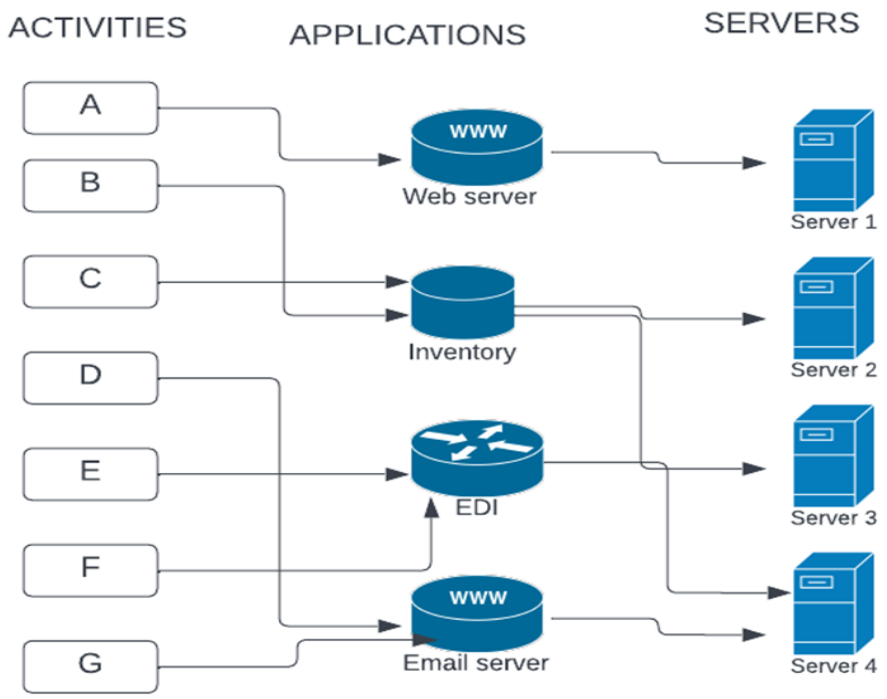


Figure 7 – Pampered Pets Business Impact Analysis Scenario

The Pampered Pets’ BIA scenarios show that if server 4 crashes or experiences performance degradation, the Electronic Data Interchange (EDI) and the e-mail applications will be impacted negatively. That will, in turn, affect the performance of activities D, E, F and G namely, communicate the availability of goods requested, start

the delivery process, check stock availability via supplier and communicate the unavailability of goods requested respectively. Collectively, these activities are carried out to fulfil a purchase order from a customer. Some of the circumstances that could negatively impact businesses include sudden expansions, acquisitions or mergers, new technology implementation, natural disasters, global pandemics, cyber-attacks and interruptions in supply chain among others (Stojanovic, 2022). Although businesses have several parts, not all of them are equally critical to their survival. Stojanovic (2022) identified 5 critical areas in organisations that, if disrupted, could trigger negative reactions. These critical areas, namely, technology, people, process/policy, and organisation have been modified to carry out the BIA at Table 1.

Business functions	**Compliance & Regulations**	**Reputation**	**Financial**	**Mission**
Purchase process	Low	High	High	High
Billing system	Low	Low	High	High
Supply chain	Low	Low	High	High
Information technology	Low	High	High	High

Information security	High	High	Low	High
Staff	Low	High	Low	High

Table 1 – Pampered Pets Business Impact Analysis

3.2 Staff Responsibilities

Key contact informations:

Name	Position	Main	Alternate
Alice	Manager	0712345670	0712345671
		alice@pets.com	alice@pam.com
Cathy	Shop Manager	0712345672	0712345673
		cathy@pets.com	cathy@pam.com
Andrea	Store Assistant	0712345674	0712345675

		andrea@pets.com	andrea@pam.com
Harry	Warehouse Manager	0712345676	0712345677

Table 2 – Pampered Pets Staffs Responsibilities

3.3 Business Continuity Plan — Location Recovery

The Pampered Pets will operate two warehouse locations such that one will be an alternative to the other during a disaster. Furthermore, staff can work from home when the office location is negatively impacted by the disaster.

3.4 Disaster Recovery Plan — Information Technology Recovery

Figure 8 below shows an environment where the system is running in both Production and Disaster Recovery, which is point-to-point connectivity. This is to ensure we meet the SLA of the Recovery Point Objective of one minute. We have ensured that each component has a backup in case of any hardware issues. The Database has replication back to a standby Database in a different Data Centre in case we have issues. The dotted lines represent backups being performed, which will follow a full back up over the weekend and incremental backups during the week. This ensures the data is kept in two separate locations if we need to ever restore it (Nollau, 2009).

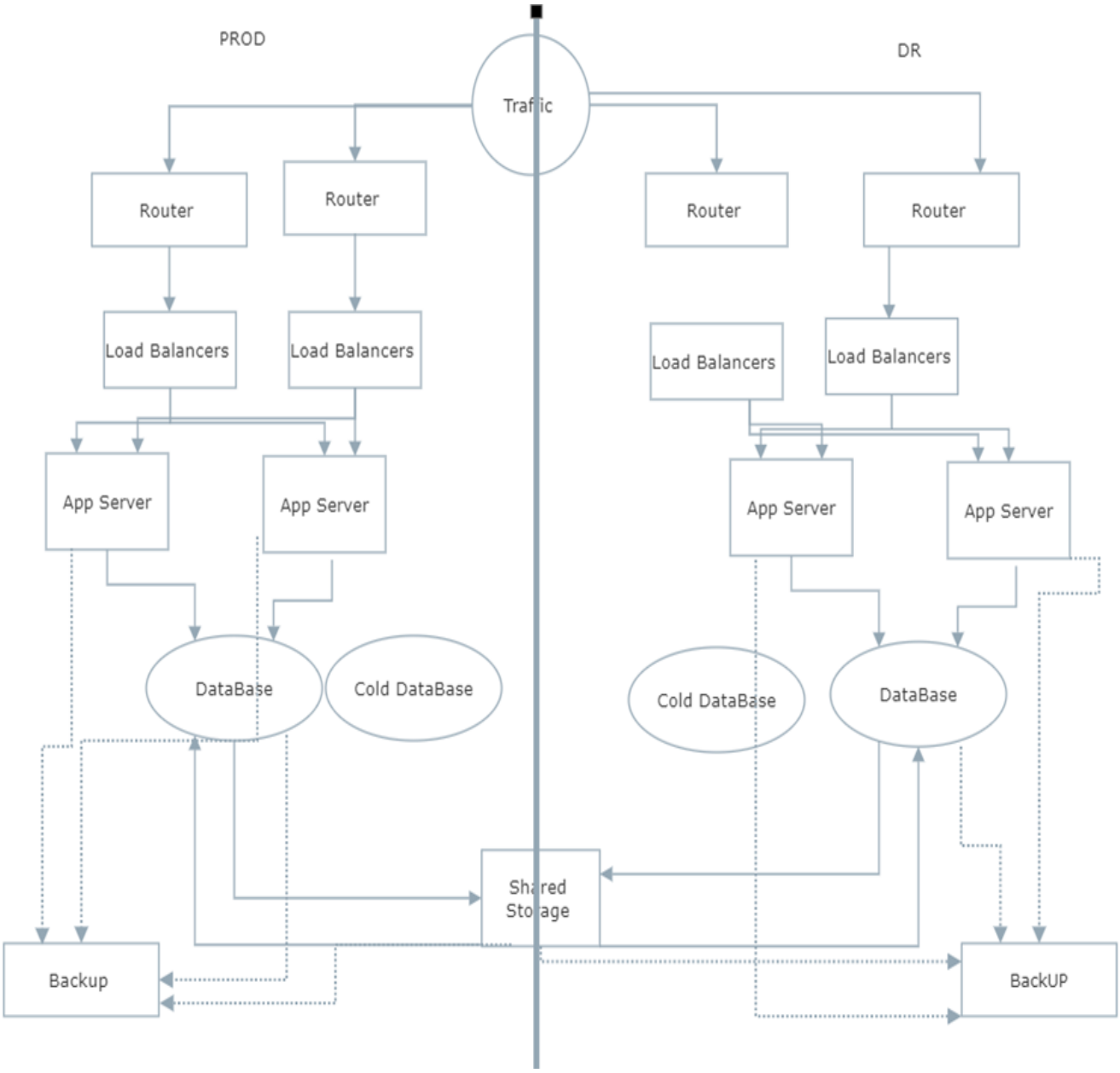


Fig 8 A cloud alternative to the On-Premises Disaster Recovery Solution

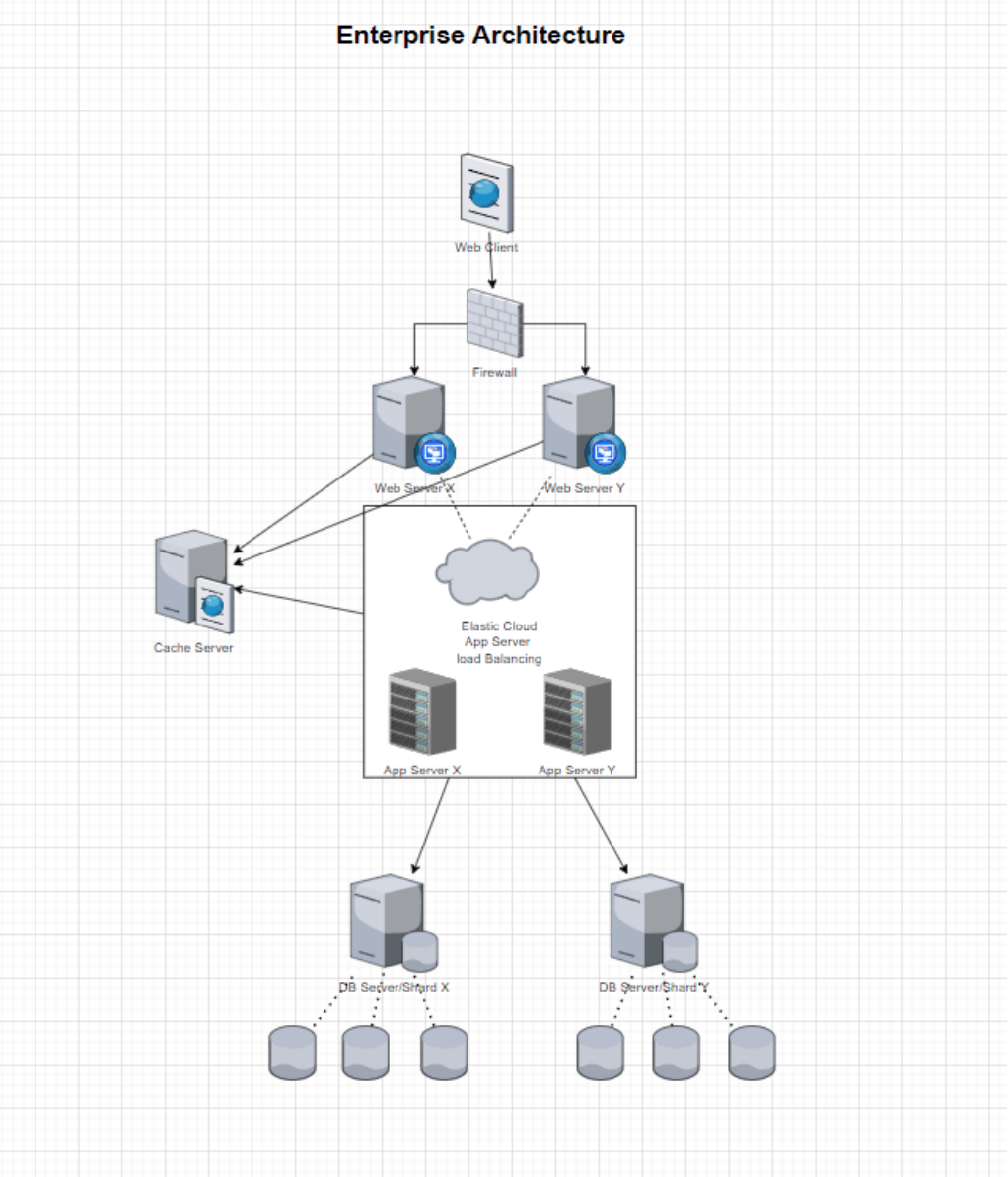


Fig 9 An On-Premises Disaster Recovery Solution

4. Recommendations (Descending order based on Statistical results)

- ✓ Encourage stronger investor commitment in the short to medium term.
- ✓ Attempt to minimize influential risk on strikes and logistical issues, by having secondary and tertiary distribution and courier plans.

- ✓ Invest strongly in I.T Infrastructure and on-premises, elastic failover servers to assist the SLA of having no longer than a 1-minute downtime.

5. Conclusion

There appears to be minimal risk to the organization. Due to the low statistical distances, the minimal effort can be taken to address all business concerns. A proper disaster recovery and business continuity plan can mitigate all the possible known risks and reduce their impact to a tolerable extent. An on-premises solution has been chosen in place of a cloud solution so that maximum versatility can be pursued without external vendor lock-in.

Some of the main vendor lock-in issues range from cost, being time-consuming, lack of standards among the vendors, and incompatible technology between the vendor and the organisation. Data stored with cloud vendors may be stored in their own format making it difficult to move between vendors.

In summary, due to the nature of the website, costs can be minimised while still implementing an efficient and potent risk mitigation strategy.

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