



INFORMATICS
INSTITUTE OF
TECHNOLOGY

UNIVERSITY OF
WESTMINSTER

6BUIS020C – Final Project Report

**Ceylon2World (C2W): Empowering Agri-SME owners to discover
lucrative export markets and navigate the exportation journey**

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This report is submitted in partial fulfillment of the requirements
for the

**BSc (Hons) Business Information Systems
Business School**

Informatics Institute of Technology, Sri Lanka

in collaboration with

University of Westminster, UK

Date: 7th May 2024

Declaration

This report has been prepared based on my own work. Where other published and unpublished source materials have been used, these have been acknowledged in references.

Word Count: 60 pages

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Abstract

Sri Lanka is a developing nation, heavily relies on its Small and Medium Enterprise (SME) sector, which accounts for 75% of the total enterprises in Sri Lanka. Agri-SMEs, comprising over 75% of all SMEs in Sri Lanka, play a crucial role in the national economy. However, despite the Sri Lankan policy standards framework developed to foster the SME sector development, majority of the SME ventures that start within Sri Lanka are closed down after three years of commencement and 60% of them occur within the first two years. Given the circumstances of the situation, it is clear that necessity for a solution to address this issue.

Through a comprehensive literature review, key challenges faced by SMEs during internationalization were identified. These challenges encompass lack of capital, insufficient infrastructure, lack of innovation and market information, higher competition, obsolete technology and managerial skills. Exporters' and domain expert's questionnaire were further employed to validate these findings and gather insights. Apart from the initial challenges users mentioned challenges such as finding new markets and new market opportunities were identified. Also, users mentioned that export becomes riskier due to lack of structured system to facilitate transactions with buyers and information to identify safe shipping routes including risks and opportunities involved. Based on above data system requirement application was created to build a business intelligence application to provide exporters with required information to make effective decisions while facilitating an environment to build healthy relationships with other buyers and exporters.

The incremental and iterative approach was employed to build the final prototype of “C2W”. Final solution consists of all the core functionalities and the basic structure to implement the escrow system. Furthermore, underlying infrastructure is developed to scale the final solution to serve the target audience with growing data needs.

Finally, solution was evaluated by subject matter experts and technical expert based on concept and design to ensure the reliability, accessibility and the security of the final solution.

Keywords: Agri-SMEs, Export, Internationalization, Business Intelligence, Predictive analytics

Acknowledgements

First and foremost, I would like to express my sincere gratitude to Ms. Abarnah Kirupananda and Ms. Janice Abeykoon for their clear guidance and continuous support throughout the year and in times of need. Secondly, I would like to extend my sincere gratitude to my supervisor Mr. Thamal De Silva for his continuous support and guidance throughout the course of this project, with his valuable feedback, suggestions, and continuous motivation to think outside of the box.

My sincere gratitude also goes out to the industry professionals, Mrs. Nilanthi Vitharana, Mr. A.D.S. Saman kumara, Mr. Milan Swanthra, Mr. Praneeth Perera, Mrs. Nadeesha Gamage, Mr. Gevin Batuwangala, Mr. Krishanth Aravindan, Mr. Sachith Sulakkahna, Mr. Dilshan Dekumpitiya, who assisted with me their valuable insights even amongst their busy schedules.

I wish to extend my special thanks to my fellow batchmates, colleagues, seniors and friends for being my pillars of support and motivation throughout every obstacle during my university life.

Last but not least, I would like to extend my deepest gratitude to my parents and my sister who always believed in me, encouraged me, and ensured I worked up to my capabilities. This would not have been possible without your love, blessings, sacrifices and support.

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ABREVIATIONS

A	AI	Artificial Intelligence
	API	Application Programming Interface
	ARIMA	Autoregressive Integrated Moving Average
B	BI	Business Intelligence
C	C2W	Ceylon To World
	CBSL	Central Bank of Sri Lanka
	CE	Concept Evaluation
D	DB	Database
	DDS	Decision Support Systems
	DE	Data Exploration
	DE	Design Evaluation
	DMS	Document Management Systems
	DOM	Document Object Model
E	EDB	Export Development Board
	ETL	Extract, Transform, Load
	EU	European Union
F	FAO	Food and Agricultural Organization of the United Nations
	FR	Functional Requirement
G	GDP	Gross Domestic Product
I	IBM	International Business Machines
	ICT	Information Communication Technology
	ID	Identification
	IP	Intellectual Property
	IS	Information System
	IT	Information Technology
J	JSON	JavaScript Object Notation
	JSX	JavaScript XML
	JWC	JSON Web Token
K	KPI	Key Performance Indicator
M	MIS	Management Information Systems
	MNC	Multi-National Corporations
	MVC	Model View Controller

O	OECD	Organisation for Economic Co-Operation and Development
P	PDPA	Personal Data Protection Act
	POC	Proof Of Concept
	PSPD	Preliminary Specifications Design and Prototype
R	RBAC	Role Based Access Control
	RD	Research and Development
	REST	Representational State Transfer
S	SaaS	Software as a Service
	SME	Small and Medium Scale Enterprises
	SQL	Structured Query Language
	SRS	System Requirements Specification
T	TC	Test Case
	TNC	Trans-National Corporations
U	UAT	User Acceptance Testing
	UI	User Interface
	UK	United Kingdom
	UML	Unified Modelling Language
	UN	United Nations
	URL	Unified Resource Locator
	US	United States
	USD	United States Dollar
	UX	User Experience

1. Introduction

1.1 Chapter overview

This chapter lays the groundwork by discussing the underlying sub problems and the fundamental problem that the proposed solution aim to address. It delves deeper in to the presented sub problems, drawing upon evidence from researches done by subject matter experts and periodicals. Finally, it clearly states the project's delivered aim and objectives, along with defined scope.

1.2 Problem Statement

Even though Sri Lanka needs a export oriented policy agenda that is especially attuned to the needs of cohorts including SMEs which account for more than 75% of the total number of enterprises within the island ([Sri Lanka Growth Diagnostic, 2018; Asian Development Bank, 2022](#)). Majority of Sri Lankan Agri-SME ventures are closed down before three years of commencement and 60% of them occur within the first year of commencement ([Priyanath and Premaratne, 2015](#)). Above mentioned problem of Sri Lankan Agri SME ventures not being able to survive in the industry will be discussed in detail in this section.

Export growth has been the main determinant of economic growth of Sri Lanka according to investigation of annual data over the period 1962 to 2015 ([Ramos, 2001; M.I.M. Riyath and A. Jahfer, 2016](#)). Due to the global economic crisis ([World Economic Outlook : Countering the cost-of-living crisis - World | ReliefWeb, 2022](#)) and ongoing political crisis in the island, export demand has diverted to neighbouring countries and global brands have relocated from Sri Lanka to India ([George, George and Baskar, 2022](#)).

In most of the countries, SMEs contribution to the total exports lies between 30 percent to 50 percent and only 5 percent of Sri Lankan SMEs contribute to total exports. SMEs cannot survive without market expansion or internalization. Jalali ([2012](#)) pointed out that export barriers seriously affect the export activities of SMEs. Sri Lankan SMEs encounter difficulties such as lack of capital, insufficient infrastructure, lack of innovation and market information, higher competition, obsolete technology and managerial skills when moving into international markets. Fernando and Samarakoon ([2021](#)) identifies four main variables or issues in internalization process of SMEs such as competition, support from the government, technology, and legal requirements.

Barries for the global commerce have been reduced and internationalization has become prominent throughout SMEs ([Lu and Beamish, 2001](#)). Unfortunately, Sri Lankan SMEs who are not engaging in exporting activities perceive the international environment as a risky, unprofitable and unmanageable because of less awareness and experience with the global businesses.

Sri Lanka's extensive SMEs sector constituting 75% of all enterprises contributes annually 5% to total exports as mentioned above. This limited performance compared to similar developing nations suggests that lack of market expansion through internationalization is a critical factor hindering the growth and potential failure of many Sri Lankan SMEs. According to researchers SMEs within Sri Lanka face many difficulties when internationalizing or market expanding whereas direct exporting is considered as the most effective method for Sri Lankan SMEs to enter international market ([Madushanka and Sachitra, 2021](#)).

Sri Lanka's Ten year Development Framework (2006-2016) identified the need for stronger commercialization of Agri-SMEs with increased private sector involvement in marketing ([Annual Report 2007 | Central Bank of Sri Lanka, 2008](#)). This policy framework emphasizes agri-business development, despite the limited research on the challenges faced by SMEs in the internationalization process. This study discusses the status, challenges, and constraints of Agri-SMEs to address the technological changes that is needed to position Sri Lankan Agri-enterprise sector in a more globalized marketplace. Problems investigated through a systematic literature review and validated through questionnaire of targeted audience are further explained below.

1.3 Fishbone diagram

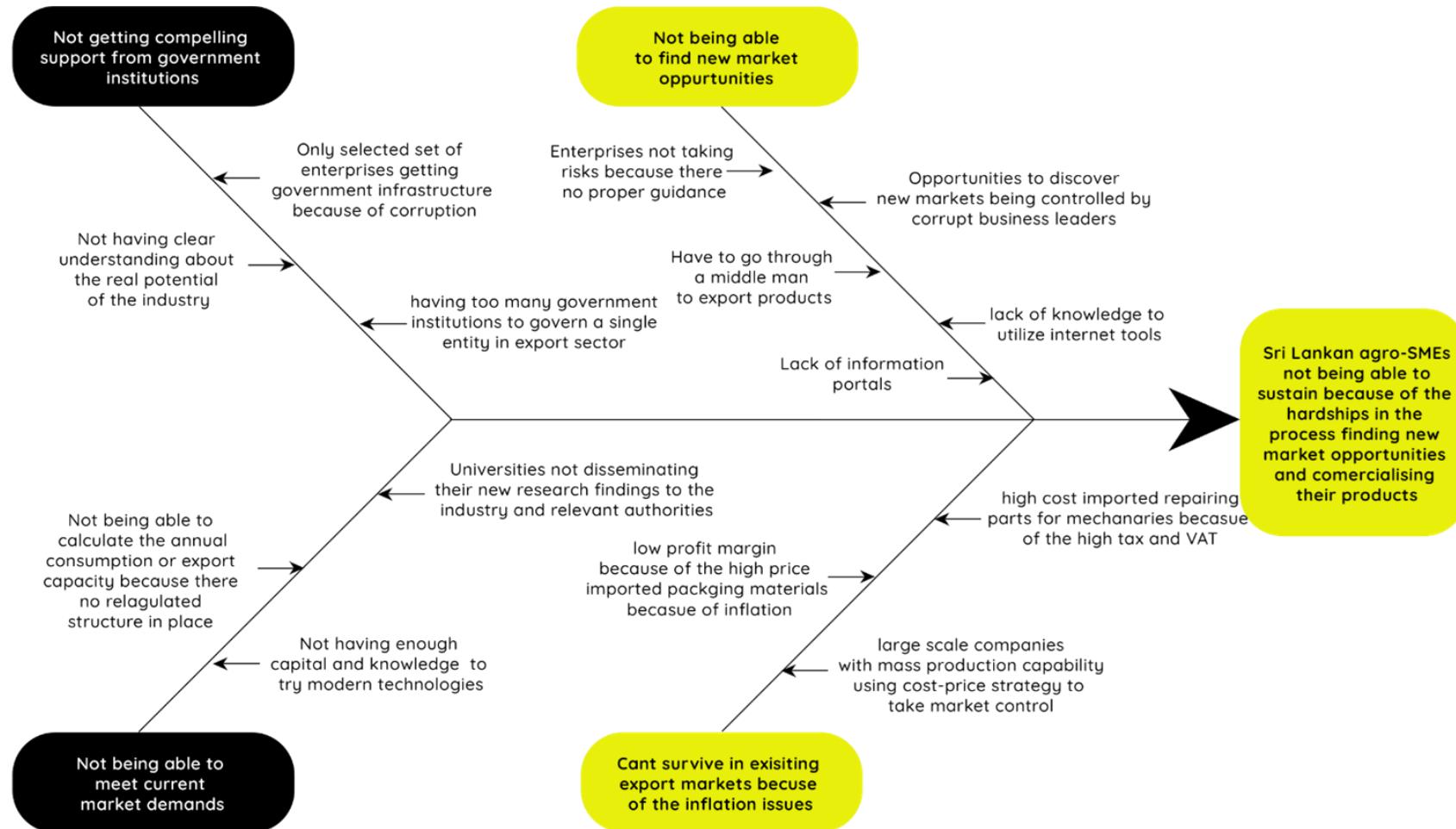


Figure 1.1 Fishbone diagram

1.4 Sub problems and justification

Globalization has increased the competition of Agri-SMEs market. As a result mortality rate of new SME ventures are relatively high ([Acheampong and Hinson, 2018](#); [Perren, Berry and Partridge, 1998](#)). Literature highlights many issues faced by SMEs and the nature of the issues varies according to the type of the SME. Particularly, implementation of new business models for SMEs, along with the modern consumer preferences and competitor behaviour, is needed to improve the survival chance ([Acheampong and Hinson, 2018](#)). Rest of the issues such as lack of capital, in educate technical know-how, basic utilities, improved technology and training and skill development can be identified as issues affecting the growth performance of SMEs ([McAdam et al., 2015](#); [González-Cruz and Cruz-Ros, 2016](#); [Bilal and Al Mqbali, 2015](#)). Researchers on this subject have divided export challenges or barriers in various ways; pre-export vs post- export stage ([Leonidou and Katsikeas, 1996](#); [Bilkey and Tesar, 1977](#)), initiation barriers vs ongoing barriers ([Bilkey and Tesar, 1977](#)) and internal barriers vs external barriers ([Leonidou, 2004](#); [Leonidou, 1995](#); [Leonidou and Katsikeas, 1996](#); [Morgan, 1997](#); [Morgan, Kaleka and Katsikeas, 2004](#); [Khan Khattak, Arslan and Umair, 2011](#)). For the purpose of this study challenges are categorized in to four different categories aiming to develop a information technology solution to assist exporters struggling with 3 main barriers excluding institutional support.

1.4.1 Not being able to find new market opportunities

Sri Lankans SMEs should be able to enter new market to create business opportunities to reconcile pressure from other competitors in the domestic market ([Malawige and Nanayakkara, 2014](#)). Globalization and intensifying competition among competitors have affected every economic activity including agriculture which has forced small and medium Agri entrepreneurs to expand to international markets ([Gosavi and Balkruhsna Samudre, 2016](#)). Most SMEs are struggling to find business opportunities in domestic markets because of large number of competitors focusing the same category of traditional products. Globalization have opened doors for SMEs to enter new markets with different cultural background to sell their products.

Global competition generated by market globalization has been identified as a key challenge for SMEs ([Muhammad Auwal et al., 2018](#); [Ahmedova, 2015](#)). Singh, Pathak and Naz ([2010](#)) identified that, various SMEs or various products have different markets according to the demand and the customer preference. Poter ([2008](#)) and Singh,

Pathak and Naz (2010) states that economies of scale, diversification, product differentiation, the degree of concentration and barriers for market entry and exit are the determinants of that need to analyse when entering international market successfully.

Furthermore, A study conducted by Necmi Karagozoglu and Lindell (1998) inadequate knowledge of management of SME owners and the management issues is the main underlying issue that affects to the internationalization failures of many SMEs. Hall and Harvie (2003) explains that, poor understanding about the foreign markets, lack of managerial knowledge in internationalization process and lack of experienced workforce are the constituents of managerial knowledge and competence. Global competition have forced SMEs to focus more on their business strategies, especially on innovation (Gunday et al., 2011). Yet in Sri Lankan context Upulwehera et al. (2022) have identified access to financial resources, access to human capital, access to market information as the key challenges faced by SMEs in adopting to new innovation and scientific discoveries which are essential for business model regeneration.

1.4.2 Struggle to maintain profitability in existing export markets due to inflation

Fernando and Samarakoon (2021) states that open economic policies introduced by Sri Lankan government assuming that it would help country move along with global economy have affected negatively on Sri Lankan SMEs. Sri Lanka's exports are losing market due to economic crisis, which is largely due to misgovernance and the cascading effect on vital sectors of the economy (M. Nazeeruddin and M.Jafarullah Baig, 2022). Not being able to manage the economic crisis in national scale have reduced the profitability because of the rising exchange rates. Existing SMEs must invest extra capital to change markets and products nature due to inflation which critically affect the stability of SMEs. Starting new ventures within Sri Lanka involves high risk given the situation of current industry. Also, SMEs heavily focusing into few products and markets which are deviated from global markets is the underlying problem of SMEs struggling to adapt to market turbulence occurred because of high inflation (Rajapaksha et al., 2017).

Even though it is difficult to find exact causes of global economic crisis, economists indicate that the combined effect of many factors causes the crisis in credit market in the United States, and it has affected to the rest of the world. Those factors can be summed up as the world trade imbalance, consumption patterns of united states, excessive financial market deregulation, and the dominant role of US dollar (Ramadhan

and Naseeb, 2011). SMEs are heavily dependent on the markets (Butler and Sullivan, 2005; Aswicahyono, Hill and Narjoko, 2010), consumers and suppliers. Due to this nature of SMEs, economic crisis has caused major complications on globalized business activities of SMEs. The effect of the crisis has resulted in a decrease in the rate of SME development and by an increasing the number of bankruptcies (Man and Macris, 2014). Even under advantageous circumstances, SMEs face challenges such as maintaining the existing customers, making long-range plans and maintaining the payroll (Myles, 2010; Manalastas, 2009; Hill and McGowan, 1999; Yin, 1994; Muranda, 2003).

Ifekwem and Adedamola (2016) claimed that one of the major obstacles faced by SMEs is getting funds to expand their business. In addition to that, SMEs face problems with power supply, low patronage, high machine maintenance costs, erratic government policies and other challenges such as network and infrastructure problems (Ifekwem and Adedamola, 2016; Yoshino, 2016).

According to Sinnathurai (2013), there are numerous challenges faced by Sri Lankan SMEs which led to failure of business ventures. The factors that hinder growth of Sri Lankan SMEs which are heavily affected by inflation are the inadequacy of organized major industry, shortage of infrastructure and raw materials, civil strife, and governance issues (Dasanayaka and Sardana, 2010). These issues coupled with high inflation rates caused by economic crisis have created a highly critical businesses environment for SMEs in both global and domestic markets.

1.4.3 Struggle to keep pace with evolving market requirements

According to Fernando and Samarakoon (2021) competition is the highest affecting factor on performance of internationalized SMEs. Study conducted by Bilkey and Tesar, (1977) identified lack of knowledge about foreign sales practices as the major problem when internationalizing businesses operations. The composition of Sri Lanka's basket of exported goods has remained largely unchanged for 25 years (Sri Lanka Growth Diagnostic, 2018). SMEs not being provided with knowledge to analyse and find foreign markets is the main underlying issue for their struggle to keep pace with evolving market requirements.

Markets for Agriculture based products are dynamic, due to opportunities and challenges that producers have to encounter in every step of seed-to-fork journey. (Prabhu Pingali, 2010) highlighted that developing countries are faced with a critical challenge of meeting the needs of growing urban populations while addressing the

issues of poverty, hunger, and malnutrition in other demographics. Similarly in Sri Lanka, it has affected food consumption patterns as depicted in Table 1.1.

	1970	1980	1990	2000	2009
Calorie contribution from cereals to total calories intake (%)	59	55	55	53	56
Protein contribution from cereals to total protein intake (%)	61	55	51	48	48
Protein contribution from cereals to total protein intake (%)	1	2	3	6	7
Protein contribution from cereals to total protein intake (%)	19	23	25	32	30

Source 1.1 Ariyawardhana (2005) and Department of Census and Statistics (2010)

Table 1.1 Major indicators of Sri Lanka's Food Consumption 1970-2009

Data clearly indicates that consumption of cereal based foods are declining whereas consumption of animal-based foods as a protein source has increased in the same time duration. Similarly, consumers in developed countries are interested in value added products with a combination of factors such as food safety, traceability, provenance, ethical production, and third-party certification. As standard imposed by developed countries are higher than local Sri Lankan standards, meeting those requirements with poor technology and financial capital for research and development is major underlying issue for Sri Lankan SMEs to meet market demands.

Saunila, Ukko and Rantanen (2014) Have stated that companies that make investments to increase their capacity for innovation have higher chance of success in the future. According to research done to study the technological readiness of Sri Lankan Agri-SMEs by Prasanna *et al.* (2019), some Sri Lankan SMEs owners or managers are unsure about the possible benefits from adapting to innovative strategies and new scientific discoveries; hence the management does not utilize their resources in training, research and development, new product development. At the same time Sri Lanka spice council have identified high production cost, low volumes of production, product quality, skill development and lack of financing facilities as major issues of minor export crops industry of Sri Lanka which can be controlled by integration of new technological advancements. Therefore, institutional readiness is essential for SMEs to understand the potential advantages of innovation and the application of new scientific discoveries, particularly in the current globalization era to increase the competitive positioning by aligning their products with evolving market requirements.

1.4.4 Not getting compelling support from government institutions

Sri Lankan Agri SMEs need better strategic focus, coordination along the supply chain and government support to improve their competitiveness and survival in the face of global pressures (Ariyawardana and Collins, 2012). Sri Lanka SMEs need favourable

environment through legislative governance and effective partnerships between government and commercial players in the agri-business sector to strengthen Agri-SMEs competitiveness at the initial stages of development ([Ariyawardana and Collins, 2012](#)). [Upulwehera et al. \(2022\)](#) highlights that Sri Lankan SMEs repeatedly stated lack of institutional support, lack of financial resources, lack of technological knowledge to adapt new technologies lead to practical problems that arose when commercializing new products. In fact, the government and relevant authorities should consider developing effective market structures to favour those SMEs struggle in commercializing their new products.

The governmental support for SMEs through various institutional arrangements has a significance impact on performance and sustainability of SMEs ([Kang and Park, 2012; Thongsri and Chang, 2019](#)). Due to government institutions control and influence on the behaviour of the actors in particular environment, prior research has offered insights from the institutional environment logic to contend that increases in institutional support for SMEs will be linked to performance increases ([Dunning and Lundan, 2008](#)). [Prasanna et al. \(2022\)](#) States that government intervention is an essential strategy in sectors that are affected by legislation, financial discipline, human capital, technology, quality, education training and price control. Yet study done [Wijayarathne and Perera \(2018\)](#) at university of Sri Jayawardhanapura to identify export barriers of Sri Lankan SMEs have ranked financial barriers and governmental barriers as the highly affected barriers while stating information barriers, economic barriers, functional barriers, political and legal barriers, marketing barriers and procedural barriers have considerable impact on export activities. The findings of the study stated that top ten barriers faced by SME exporters are high cost of capital to finance exports, lack of government incentives, lack of new technology, complexity of export documentation procedure, lack of financing sources, high tariff and non-tariff barriers, currency fluctuations, lack of competitive prices to foreign customers, high insurance cost and inadequate institutional support. It is evident that most of the barriers belongs in the top ten list could be addressed by direct government intervention.

However given the Sri Lankan setting, Sri Lankan SMEs are uniquely reliant on the private sector, as substantial government led improvements appear unlikely in the near future.

1.5 Delivered aim and objectives

1.5.1 Delivered aim

To identify and analyse the reasons for the failure of the majority of small and medium scale Agri-export ventures, in order to design, develop and evaluate an information system(IS) solution to deliver insightful resources with user friendly accessibility to assist small and medium scale entrepreneurs to find successful business opportunities across the globe while helping them to overcome their day-to-day challenges.

1.5.2 Delivered objectives

ID	Objective	Deliverable
O1	Analyse existing research papers and evidence from local newspapers to understand sub-problems that create the main problem.	Fishbone Diagram
O2	Analyse similar solutions in a worldwide context and technology stack and data sources used.	Project Proposal
O3	Interview official from Export Development Board (EDB is the official government body for Export Development within Sri Lanka) to understand the facilities provided by government.	Interview Transcript
O4	Survey successful and unsuccessful small and medium scale exporters to identify the pain points they are dealing in the export industry.	Survey Results
O5	Define and Document the detailed project requirements.	SRS
O6	Create a structured plan to outline the tasks and breakdown the project in to more manageable components.	Project Timeline
O7	Confirm data availability and technical feasibility to develop the final solution.	Proof of Concept (POC)
O8	Map how users interact with the system and visualize functionalities for relevant users.	Use case diagram
O9	Creating the sequential flow of actions and decisions within the system.	Activity diagram
O10	Simplify and visualize the core components of the system.	High level Design

O11	Visualize and simulate the user interface and user experience of the application.	Prototype
O12	Define the building blocks of the system for clear understanding and development.	Class Diagram
O13	Define the scope, tasks, and deliverables of the development process.	Work Breakdown Structure
O14	Create a structured framework to test features, functionalities, and scenarios.	UAT Plan

Table 1.2 Delivered Objectives

1.5.3. Scope

Project scope is set to limited number of products and countries due to time constraints. The project focuses on eleven countries across western and central Europe including the United Kingdom, Netherlands, Belgium, France, Spain, Switzerland, Italy, Poland, Ukraine, Hungary, and Germany. These countries constitute a diverse ranges of export destinations for Sri Lankan agricultural export products ([OECD and FAO, 2023](#)). A sample of 10 products, drawn from 10 Agri product categories identified by *Sri Lanka Export Development Board (2022)*, serves as the focus of this project.

To assess the proposed solution's potential across various segments, product selection followed criteria aligned with opportunities and challenges in Sri Lanka's Agri food trade ([Dissanayake&Thibbotuwana,2021](#)). [Figure 10.1 Agriculture export destination map](#)

1.6 Chapter summary

This chapter initially examined the problem domain of majority of Sri Lankan Agri-SMEs not being able to sustain more than three years in the industry and continued to explain the underlying issues of the main problem. In conclusion, it is evident that Sri Lankan SMEs need modern technological applications to gather information and find new business opportunities in emerging markets. Furthermore, the aim, objectives and the scope of the proposed solution are discussed. The following chapter will thoroughly discuss the project-based literature and a review of existing solutions.

2. Background

2.1 Chapter Overview

This chapter presents a discussion of literature about Agri-SMEs, internationalization process and associated challenges with relevant survival strategies. Furthermore, tools and technologies selected for the project are explained with a study of competitors in the specific market segment that provide similar application.

2.2 Internationalization of Agri SMEs

2.2.1 Introduction to Agri SMEs

SMEs are widely recognized as the cornerstone of economic growth in many countries. There is no universal definition for the SME and definition of an SME vary quite widely from country to country. Developing countries in the Asia pacific region stated SMEs including micro-enterprises as commercial entities with maximum 300 employees. According to Jayasekara and Thilakarathna (2013) SME policy framework introduced by Sri Lankan government defines SMEs based on the number of employees and annual turnover. In general, SMEs are enterprises with less than 300 employees and have annual turnover less than RS.750Mn and micro enterprises are also read with SMEs for any policy related measures.

According to Sri Lanka department of census and statics, 75% of the total number of businesses accounts for SMEs and provides employment for around 45% of the population and contributes to 52% of the gross domestic production ([UN Global Compact Network Sri Lanka» SMEs: A Boon to the Sri Lankan Economy, 2021](#)).

Agri-SME is a generic term that refers to the various SMEs that operate along the chain from farm to suppliers through to consumers. Agri-SMEs link the farm sector with consumer through handling, processing, transportation marketing and distribution of food and other agricultural products ([Ariyawardana and Collins, 2012](#)). In 2007, the department of census and statics, recorded a total of 4725 Agri enterprises in Sri Lanka ([Department of Census and Statistics, 2002; Department of Census and Statistics, 2008](#)). Majority of the SMEs are classified as manufacturers of food products including manufacturers of sugar confectionary, tea, coffee and soya products.

Subsectors	Number of enterprises	%Total employed	%Value added
Production, processing and preserving of meat, fish, fruit and vegetables	186	7.04	3.05
Manufacturers of grain mill products and prepared animal feeds	974	9.45	9.42
Manufacture of other food products	3079	68.00	53.12
Manufacturers beverage products	173	3.78	7.23
Manufacturers of tobacco products	129	3.30	13.91
Fertilizer and pesticides	62	3.20	7.71
Agricultural machinery & equipment	63	1.76	0.52
Total	4725	100.0	100.0

Table 2.1 Agri-Enterprises: Indicators of Industrial Activity, 2007

Source 2.1 Department of census and statistics

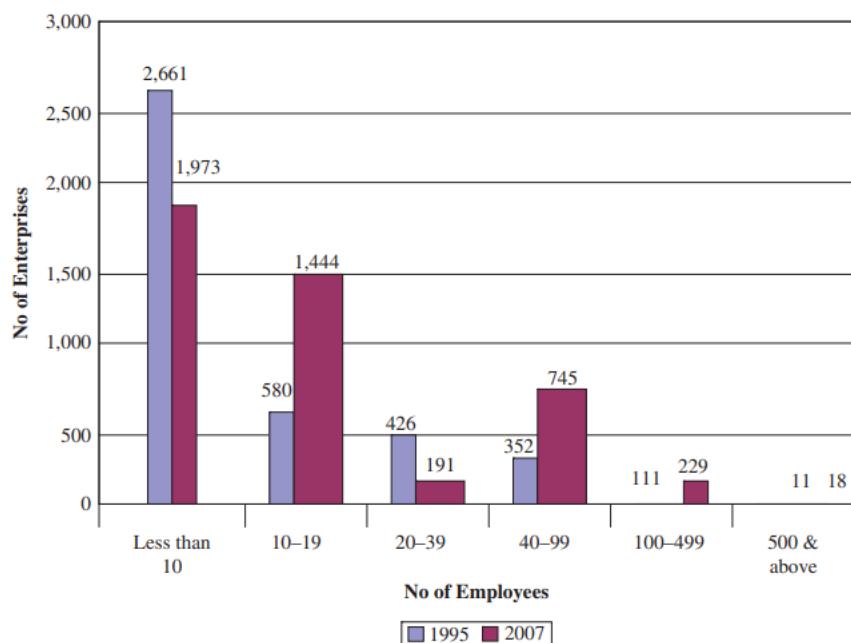


Figure 2.1 Distribution of Enterprises by number of Employees in the food, Beverage and Tobacco Industries, 1995 and 2007

Source 2.2 Department of census and Statistics (1998,2008)

Agri-SMEs accounted for 30% of the total export revenue in 2010, the highest contribution coming from tea, followed by food, beverage and tobacco as shown in Table 2.1. Food, beverage, and tobacco industries saw value addition as a share of GDP rise over the period 1995 to 2008 from 4.5% to 7.4%, yet tea, rubber and coconut industries declined from 5.0% to 4.2% during the same period. Given the scenario, it is evident that Agri-SMEs who can develop strong downstream linkages can exploit consumer markets by enhancing commercialization and competitiveness. Furthermore,

World Development Report 2008 ([2013](#)) states that dynamic Agri-SME sector linking producers with consumers can be a major driving force in agricultural and rural nonfarm sector growth.

	Share of exports(%)					Value of exports (US\$ Million)		
	1990	1995	2000	2005	2010	2008	2009	2010
Product sector								
Tea	24.98	12.62	12.70	12.80	16.98	1189.79	1068.69	1244.54
Rubber	3.84	2.91	0.50	0.70	2.09	116.81	83.85	153.56
Coconut	3.49	2.66	2.10	1.70	2.04	149.00	140.60	149.91
Fisheries Product	1.10	1.87	2.50	1.60	2.06	159.23	161.14	150.85
Spices	1.98	1.13	1.40	1.50	2.25	145.22	102.68	164.96
Vegetables and fruits	0.51	0.26	0.20	0.30	0.52	35.38	38.83	38.33
Cut flowers and foliage	0.24	0.22	0.10	0.20	0.15	13.21	10.69	10.79
Essential oils, cashew and others	1.30	1.78	0.90	0.90	0.93	64.69	53.28	68.00
Food, Beverage and tobacco	0.59	0.70	3.20	3.20	2.76	207.5	174.09	202.63

Table 2.2 Performance of Agri-Based Exports

Source 2.3 Sri Lanka Export Development Board (1991,1996,2001,2005,2011)

2.2.2 Agricultural trade patterns in Sri Lanka

Sri Lanka is dependent on trade: exports and imports accounted per 53% of the GDP in 2018 ([World Bank, 2019](#)). Supply chain disruptions and declining global demand due to ongoing global economic crisis led to short term export setbacks for Sri Lanka. The poor performance of the key trading partners such as EU, US, India, and China have affected Sri Lanka's export earnings and caused supply-side disruption, which impacts the export capacity of all the industries including agri-business industry ([CBSL, 2020](#)). The export revenue from the agriculture sector declined by USD 125 million in 2020 when compared to the value in 2019.

[Table 2.3](#) presents the Sri Lanka's agricultural trade data for the past three decades, including annual trade series, net trade, growth rates, share in national export total,

global agricultural exports, and imports. Sri Lanka's net agricultural trade value fluctuated between 2006 and 2018, peaking at USD 794 million in 2013 but dropping to USD 140 million 2018 due to lower export values. In order to become strong pillar in Sri Lankan economic growth SMEs have to increase to expand to international markets and built new business opportunities by leveraging the opportunities created by globalization.

Year	Sri Lanka's Agri exports (USD Mil)	Annual change(%)	Share in Sri Lanka's total exports(%)	Share in World's Agri exports(%)	Sri Lanka's Agri, Imports (USD Million)	Annual change (%)	Share in Sri Lanka's total imports(%)	Share in world's Agri imports(%)	Agri. Net trade (USD Million)
2000-01	1002.10	5.63	18.50	0.24	767.00	-0.63	10.64	0.18	235.10
2001-02	952.40	-4.96	19.77	0.22	718.70	-6.30	12.13	0.16	237.70
2002-03	971.10	1.96	20.67	0.21	807.10	12.30	13.22	0.17	164.00
2003-04	1012.00	4.21	19.75	0.19	831.00	2.96	12.46	0.15	181.00
2004-05	1143.00	12.94	19.85	0.18	926.00	11.43	11.61	0.14	217.00
2005-06	1381.70	20.88	22.02	0.21	1010.10	9.08	11.24	0.15	371.60
2006-07	1795.00	29.91	25.70	0.10	1465.00	45.04	13.79	0.64	330.00
2007-08	2103.00	17.16	26.00	0.10	1619.00	10.51	13.26	0.13	484.00
2008-09	2380.00	13.17	27.40	0.88	1977.00	22.11	13.36	0.25	403.00
2009-10	2173.00	-8.70	29.43	0.87	1658.00	-16.14	16.03	-0.22	515.00
2010-11	2617.00	20.43	30.78	0.85	2243.00	35.28	15.84	0.41	374.00
2011-12	3018.00	15.32	28.33	0.89	2740.00	22.16	13.27	0.21	278.00
2012-13	2801.00	-7.19	28.50	0.82	2152.00	-21.46	11.70	-0.22	649.00
2013-14	2934.00	4.75	28.55	0.79	2140.00	-0.56	11.12	-0.01	794.00
2014-15	3114.00	6.13	27.41	0.87	2554.00	19.35	11.69	0.17	560.00
2015-16	2928.00	-5.97	26.93	0.99	2539.00	-0.59	11.96	-0.01	389.00
2016-17	2885.00	-1.47	26.61	0.99	2368.00	-6.37	12.33	-0.06	517.00
2017-18	3297.00	14.28	27.29	1.01	2765.00	16.77	13.10	0.14	532.00
2018-19	2431.00	-26.27	21.91	0.85	2291.00	-17.44	12.26	-0.15	140.00
Pre-2006 average	815.98	4.17	27.77	0.21	637.53	7.60	14.95	0.15	178.45
Post 2006 average	2652.00	5.51	27.30	0.77	2193.15	8.35	13.05	0.10	458.85

Table 2.3 Profile of Sri Lanka's Agricultural Trade

Source 2.4 http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37

2.2.3 Internationalization process of Agri-SMEs

Internationalization presents challenges for SMEs venturing into unfamiliar corporate environments ([Figueira-de-Lemos, Johanson and Vahlne, 2011](#)). Yet remaining non-internationalized in a globalized economy can be even riskier proposition ([George,](#)

[Wiklund and Zahra, 2005](#)). SMEs that neglect internationalization efforts jeopardize their competitive standing, potentially leading to ultimate failure in the domestic and global marketplace.

Scholars in International business management emphasize the importance of the internationalization process for both advancing academic knowledge and practical guidance to firms ([Santangelo and Meyer, 2011; Casillas and Moreno-Menéndez, 2013; Oehme and Bort, 2015](#)). Uppsala internationalization process model by Johanson and Vahlne ([1977](#)) is at the core of the internationalization process literature which is series of refinements and updates ([Johanson and Vahlne, 1990; Johanson, 2003; Johanson and Vahlne, 2006; Johanson and Vahlne, 2009](#)). The model states that company's depth of knowledge regarding foreign markets positively influences the allocation of resources towards internationalization efforts. In conclusion these factors move forward the SMEs internationalization process. Also Experts highlights that internationalization of Entrepreneurial enterprises requires an innovative culture that generates knowledge for successful foreign performance based on their entrepreneurial learning ([Weerawardena et al., 2007; Gabrielsson et al., 2008](#)). Pathirana and Andersson ([2022](#)) investigates how do SMEs from Sweden and Sri Lanka internationalize and how SMEs are affected by market turbulence. Throughout this study authors have compared data from developed country to developing country to understand what the steps Sri Lanka SMEs need to take in order to increase the export performance. This study states that Sri Lankan SMEs are only using export as market entry mode and Sri Lankan SMEs are not willing to take risks due to unstable domestic market, managerial implications and policy implications. Furthermore, psychic distance and market knowledge, network and relationships, scale, scope and speed are highlighted as the factors that SMEs should be focusing when entering new markets.

2.2.3.1 market entry modes

Whitelock ([2012](#)) discuss four different entry modes that are the most common for SMEs to use in their internationalization process. Above mentioned entry modes can be categorized along a spectrum of risk and resource commitment. Exporting typically represent the initial approach, requiring minimal investment and familiarity with the target market. As firms progress, they may consider modes with increasing resource allocation and risk, such as licensing, joint ventures, and ultimately foreign direct investment.

2.2.3.1.4 Exporting

Exporting is the most common entry method used by SMEs to enter new markets. Entering new markets can be challenging for new SMEs ventures because of the less credibility and less market knowledge in foreign markets. Exporting is the initial market entry mode used by most enterprises because it involves low risk and low resource commitment ([Malca, Peña-Vinces and Acedo, 2019](#)). On the other hand, this method provides limited control over SMEs' products and resources in foreign markets. This method divides in to two subsets as indirect and direct exporting. Indirect exporting means that the exporting activities are handled by independent intermediaries, It can be a agent or distributor. Direct exporting means SMEs handling the exporting activities through a network of representatives ([Whitelock, 2012](#)).

2.2.3.1.5 Licensing

Licensing is the second entry method, firms don't sell their products themselves, instead they issue a license to a firm in the market. Licensed firm get the authority to manufacture and sell products with authorized trademarks. This method is not resource dependent like exporting, but it involves greater risk. For example, if the business relationship comes to an unexpected end, pre licensed firms still have the company's valuable knowledge to continue their own business process. It creates an opportunity to build a high risk competitor in particular market and eventually losing access to that market ([Whitelock, 2012](#)).

2.2.3.1.6 Joint venture

The third entry mode is joint venture, where two or more parties form a business arrangement to contribute their resources and accomplish a certain business task. Compared to previous two method this approach is even more risky and requires more resources in exchange of more control over the business process. Despite the negative outcomes still research has shown that this approach is the most viable option for SMEs to establish themselves in international markets ([Whitelock, 2012](#)).

2.2.3.1.7 Foreign Direct Investment

SMEs can enter foreign markets by making direct foreign investments. For example, firms can establish their own manufacturing plant in foreign markets and develop their business. Compared to other method this method can be extremely resource dependent which increases risk involved. However it will give better control over the manufacturing and managing sale process of products ([Whitelock, 2012](#)).

2.3 Strategies adapted by successful SMEs to confront the challenges in the internationalization process

In the era of economic globalization, researchers have examined the different type of survival strategies taken by SMEs in developed and developing countries ([Alauddin and Chowdhury, 2015; Gamage et al., 2019; Siddiqui et al., 2018; Chowdhury, Alam and Arif, 2013; Ibrahim & Mas'ud, 2016; Gamage et al., 2019; Tarnima Warda Andalib et al., 2019; Andalib and Halim, 2019; Zaman, Hudaib and Haniffa, 2011](#)). Based on review of available literature on the subject, survival strategies are categorized as market competition, global and economic crisis, information communication technology, threat of multi-national and transnational operations, change in consumer and preferences, international dumping, trade wars and international terrorism based on the nature of the challenge. This section will further discuss about survival strategies with particular challenges.

2.3.1 The challenge of global market competition

Today the competition is viewed at global scale, and which became more stringent after the 1980s globalization. Jinjarak and Wignaraja ([2016](#)) state that in order for a business to be competitive in the global market, it must overcome financial obstacles, have enough capital, manage cash flows effectively and easily access global finance. Additionally, improving financial conditions, improving R&D, training human capital and collaborating with different institutions such as universities at local and global levels will strengthen SME's capabilities for competing globally ([Şener, Savrul and Aydin, 2014](#)). As mentioned by Ren, Eisingerich and Tsai ([2015](#)) finding niche markets and marketing is also an significant factor that derives the success of SME when they compete in the global market. In another aspect market innovativeness is generally defined as process of creative market analysis, advertising and promotion, as well as identifying new market opportunities and breaking into new market arenas ([Andrews and Smith, 1996](#)). Researchers have identified adoption of Information technology as the most cost-effective solution for SMEs to face competitive challenges ([Nugroho et al., 2017; Sinnathurai, 2013; Priyanath and Premaratne, 2014](#)).

2.3.2 The challenge of global financial and economic crisis

According to Jinjarak and Wignaraja ([2016](#)) the governments are prompted to create policies and implement interventions that can support the ventures' recovery process as the negative effects of global financial crisis worsen. The current financial crisis has

motivated Asian and OECD nations to create alternate SME financing models outside of traditional methods of depending solely on bank loans. Yet, the local banks have tied up the risk management throughout the world economic downturn. Consequently, there have been more overdraft limits and loan application rejections ([Jinjarak and Wignaraja, 2016](#)).

SMEs must confront greater challenges as a result of economic crisis compared to large scale corporations, yet SMEs are better equipped to face the crisis than large scale enterprises. As a result, it is anticipated that SMEs to respond more quickly and flexibly to the frequent changes in the external environment than large scale enterprises ([Eravia, Handayani and Julina, 2015](#)). Ahmedova ([2015](#)) determined that SMEs can overcome the negative consequences of the financial crisis by focusing on five critical areas for competitiveness and sustainable development such as financial access, innovation related endeavors, intellectual property related endeavors, internationalization, and application of best practices.

2.3.3 The challenge of Information communication Technology

SMEs located in developed countries has accelerated the internationalization with the development of information and communication technology ([Sung, Kim and In, 2016](#)). According to Lakshman, Kumarasinghe and Weerasinghe ([2023](#)) small business should be extremely grateful for advanced IT and telecommunication systems, a reliable transportation network, identical rules and regulations and the internet when expanding internationally which is very costly endeavour. As revealed by Ahmedova ([2015](#)) redirecting the business to niche markets with innovative high value-added products could possibly strengthen the SMEs to confront global competition. Modern Information technology tools assist SMEs to find niche markets around the world for their innovative products ([Şener, Savrul and Aydin, 2014; Rappa, 2004](#)). Through the internet, organizations can establish global relationships with new suppliers to reduce expenses, with new clients to increase sales, and with the benefit of decreased communication costs, thereby having an efficient and quick transaction procedure ([Kabanda, Tanner and Kent, 2018](#)). As studied by Christiansen ([2004](#)) and Tse and Soufani ([2003](#)), the adoption of web-based solutions reduce operational cost, improve service to customers, increase response speed between producer and customer, producer and input supplier, improve market intelligence and enhanced the relationship with trading partners. Hall ([1995](#)), as quoted by Bilal and Al Mqbali ([2015](#)), The web-

based solutions provide SME owners or managers the opportunity to get adequate and detailed information required for making business decisions.

Many researchers have highlighted that SMEs, who operate with limited resources, can take use of range of opportunities provided by the e-environment ([Ščeulovs and Gaile-Sarkane, 2014](#); [Sung, Kim and In, 2016](#)). Therefore, more effective ICT adaptation is necessary to both enhance internal venture procedures and obtain access to e-business ([Ahmedova, 2015](#)).

2.3.4 The challenges of Muti-national and Trans-national corporations (MNCs&TNCs)

Due to their monopolistic techniques and advantages of production and distribution under robust economies of scale, MNCs have largely contributed to the increasing product competition in the global market ([Prasanna et al., 2019](#)). The growing dominance of MNCs in both domestic and international markets through out the economic globalization era has created this trend challenging for SMEs.

Establishing connections with businesses that possess the necessary resources is essential for expanding globally and competing internationally. As a result, companies use an enterprise strategy that involves collaborating with creative projects to eliminate resource deficiencies. In the SMEs, these connections often build up with MNCs ([Maarof and Mahmud, 2016](#)). As mentioned earlier, SMEs contribute as potential suppliers of outsourced parts or services ([Tülüce and Doğan, 2014](#)). SMEs must manufacture the components in the required quality and supply them to MNCs in order to compete or obtain acceptable rates. Thus by assisting the MNCs, SMEs act as another subordinate role by helping the MNCs.

Concerning globalization, TNCs utilize territorially based industrial network as a sourcing and production trick, and they have a significant impact on host economies through their local sourcing mechanisms ([Yeung, 2001](#)). Technical knowledge and know-how are the most of resources of TNCs to produce quality products at low cost. Even though TNCs are specialized in a specific technology, they might not have incentives to transmit it to SMEs because of two causes. Firstly, it can be costly and secondly, local suppliers doesn't have required skilful resources ([Yeung, 2001](#)).

Local businesses, as opposed to transnational corporations, are valued more for their local expertise and soft technology ([Yeung, 2001](#)). According to Yeung (2001) local and regional SMEs are linked with highly significance localized wisdom aspects. As a result, there are examples of the reverse transfer of technological know-how from TNCs

to SMEs. Being aware of these opportunities and threats open opportunities for SMEs to improve their business activities.

2.3.5 International Terrorism and Religious Conflicts

Terrorism and religious disputes are currently a major global economic concern, with severe effects for many types of enterprises. Due to SMEs are considered as the most dynamic and sensitive enterprises in the global economy, particularly in economic competitiveness ([Caprio et al., 2013](#)), the negative repercussions for their long-term sustainability are intensified.

International terrorism and religious conflicts hinder foreign investments and money flows, causing significant negative consequences for the country's economic activities and international trade. Because of SMEs account for approximately 90% of state economic activities and benefit directly from foreign investments ([Gamage et al., 2019](#)), these conflicts increase insurance, transaction, transportation, and security risks of SMEs ([Asgary, Ozdemir and Özyürek, 2020](#)). SMEs must be aware of the situation in order to take effective and safe business decisions.

2.4 Adoption of Business Intelligence Tools to empower strategies adapted by SMEs.

Business Intelligence (BI) is one of the decision support tools that offer the opportunity to collect, store, retrieve and analyse large amounts of data in order to make more informed decisions. There is rich body of literature on BI tools adoption and related benefits for SMEs in developed countries, especially Europe, the United States and Australia. In Sri Lankan context, there is limited research on BI adoption in Sri Lankan SMEs.

With the advancement of Information technology, increasing competition, increased product versatility and higher consumer demands, business are now expected to operate in very complex and competitive environments ([Boonsiritomachai, McGrath and Burgess, 2016](#)). To survive in existing market environment, SMEs must take prompt, accurate and appropriate decisions ([Andreja Habjan and Popovic, 2007](#)).

BI systems assist SMEs in identifying potential customers and resolving issues, detecting business threats and opportunities, the forecasting of market processes, the estimation of customer operation, gain better understanding of business needs and manage client and supplier relationships ([Boonsiritomachai, McGrath and Burgess,](#)

2016). ([Li Zeng et al., 2006](#)) Define business intelligence as “the method of purposefully gathering, updating and disseminating information in order to minimize uncertainty in all strategic decision-making and in every strategic decision”. Furthermore, the IBM Tech trends Report, based on a survey of over 4000 IT professionals from 93 countries and 25 sectors, identified BI and Business analytics as one of four major organizational innovations, along with cloud computing, Artificial Intelligence, the Internet of Things and Data protection and analysis ([Arefin, Hoque and Bao, 2015](#)).

One of the policy objectives of National Policy framework created by Sri Lankan Ministry of Commerce and Industry is to facilitate the implementation of modern technologies for SMEs to increase innovation, quality, competitiveness and productiveness ([MoCI. 2013 Annual Report Ministry of Commerce & Industry Annual Report 2013, 2013](#)). Priyanath and Premaratne ([2014](#)) Stated that SME development programs need to focus their concentration to build a positive environment to provide trustworthy information in order to assist SMEs in making good decisions.

SMEs have varying perceptions of business intelligence and its role in supporting management decisions. Most Sri Lankan SMEs are managed by their owners, and they use less elaborated Decision Support Systems (DSS) for their business activities. SMEs must examine several variables when adopting and selecting a decision support solution and BI tools, including ITC infrastructure, human and financial capital ([Filofteia Tutunea and Rus, 2012](#)). However, one of the important competencies necessary for SMEs to achieve competitive advantages has been described as knowledge building repositories, and data collection as a major contributor to the creation of knowledge in the enterprise. By leveraging a BI framework, SMEs can ingest their data for analysis, monitoring and KPI tracking, empowering them to make data-driven decisions across all the aspects of their business, including marketing. Software as a service (SaaS) delivery enables this process with cloud-based access to tools that were previously only available to larger organizations through expensive on-premise solutions ([English and Hoffmann, 2018](#)).

Literature on adoption of business intelligence by Sri Lanka SMEs depicts Relative advantages, complexity, organizational resource availability and competitive pressure as the most significant factors that affect adoption of BI tools. Furthermore, researchers states that if there is a highly competitive pressure on SMEs from their competitive rivals that use BI systems and benefit from BI systems, SMEs will adopt BI systems.

2.5 C2W approach to assist exporters to employ strategies to confront the identified challenges

Initial proposed features of the C2W application identified as requirements of a information system tool to address the above discussed challenges by providing data to empower the strategies that SMEs could utilize and enhance their business model will be discussed in this section.

- **Finding new market opportunities:** Providing users with predicted values for different available market opportunities for particular products to assist exporters identify new markets and explore further.
- **Finding buyers:** According to initial survey done to validate the user requirements, most the exporters use social media to find new buyers and approach them. Data for potential buyers is very limited for Sri Lankan SMEs due to lack of profound information system tools therefore C2W aims to provide valuable potential buyers data to specific to market and product according to users requirement.
- **Global news data:** Being aware of the situations that suddenly arise due to global religious and terrorism conflict is the best approach to confront with possible outcomes. Global news page aims to deliver aggregated data relevant to user interest's such as product and markets.
- **Escrow agreements :** Due to unavailability of established financing system make transactions with foreign buyers due to variety of reasons, exporters have to rely on general methods to make foreign transaction. This lead to high risk which creates opportunity for buyers to not respond after shipment discharge or exporters not respond after payment is sent. Escrow platform provided by C2W creates a safe environment for both buyers and exporters with minimized risk. C2W aims to facilitate to structured transaction system for exporters and buyers.
- **Lesson page :** Above discussed literature suggests that exporters need to be constant learners to address the discussed challenges, C2W act as a portal for education materials which will be provided according to the subject exporters want to explore.
- **Q&A Forum:** Knowledge sharing is significant factor which empowers communities to improve. C2W aims to act as knowledge sharing hub by allowing users to ask question and gather assistance from other exporters.

2.6 Review of Existing applications

International Trade centre tool collection, UN comtrade database are the widely used free international trade analysis web applications available in the market. There are no similar applications developed for SMEs in Sri Lankan context. These application are developed to give broad overview of global trade statistics. Users require sound knowledge in using web-based technologies and global trade industry in order to gather insights to improve their business activities. The following Table 2.4 depicts the results of gap analysis performed to identify the similar and unique features in the existing free and paid applications.

2.6.1 Gap Analysis

Feature	ITC – Export Potential Map	UN Comtrade Database	Trade.gov	The Dollar Business	IBIS World	Frost & Sulivian	Ceylon2World (C2W)
Visualizing market Export potential, Actual Exports, Unrealized potential Remaining in graphical view (Gap Chart)	✓	✓	✓	✗	✗	✗	✓
Provide export market reports available online	✗	✗	✗	✓	✓	✗	✓
Provide Educational content on how to enter export market through videos	✗	✓	✓	✗	✓	✓	✓
Give access to available data in databases using graph charts	✗	✓	✓	✓	✓	✓	✓
Provide Information on import/export regulations and tariffs for different markets	✗	✓	✓	✗	✗	✗	✗
Platform targeting Sri Lankan users	✗	✗	✗	✗	✗	✗	✓
Buyer details tracker	✗	✗	✗	✓	✓	✓	✓
Three months free plan	✓	✓	✓	✗	✗	✗	✓
Profit/Revenue comparison for exporters	✗	✗	✗	✓	✓	✓	✓
Prediction using time series analysis	✓	✗	✓	✓	✗	✓	✓
Simple user interface	✓	✓	✗	✗	✓	✗	✓

Table 2.4 Gap analysis

2.6.2 Evaluation of Limitations

2.6.2.1 International Trade centre

International trade centre (ITC) website provide collection of distinct tools for users in three segments such as market intelligence and research, trade promotion and matchmaking, capacity building and training. Even though, ITC web applications consist of a collection of robust tools, application have areas that can be improved to improve the user experience. Also, ITC web application lacks localization and requires higher levels of digital inclusivity to harness the potential of the application. ITC application does not focus sustainability on which is very important aspect in the long run. [Figure 10.2 International Trade centre](#)

2.6.2.2 United Nations Comtrade database

UN comtrade database provide valuable free resources for users including detailed trade data over 200 countries and territories. Users are expected to have knowledge in international trade terms and data analysis skills to generate insights from data and visualizations provided by the platform. [Figure 10.3 United Nations Comtrade Database](#)

2.6.2.3 International trade administration

International trade administration (ITA) web application provides a collection of tools including highly comprehensive reports. ITA is developed to focus united states businesses and market. ITA application has a complex user interface which reduces the accessibility and effectiveness of the platform. [Figure 10.4 International Trade Administration](#)

2.6.2.4 The dollar business

The dollar business is a foreign trade analytics platform specialized in connecting international buyers and exporters. While this platform offers valuable insights for businesses seeking new international trade opportunities, its high monthly subscription fee may limit its accessibility for Sri Lankan SMEs. [Figure 10.5 The dollar business](#)

2.6.2.5 IBIS world

IBIS world is a business intelligence provider offering comprehensive business intelligence (BI) for market across the globe. It caters to business seeking in-depth analysis of political, economic, and social risks alongside the market trends. This comprehensive approach assists users to make informed decisions and mitigate

potential challenges associated with entering new markets. However, access to these reports requires a payment or membership. [Figure 10.6 IBIS World](#)

2.6.2.6 Frost & Sullivan

Frost & Sullivan is a well-known competitor in the business intelligence and consulting services industry. This market research firm provides full range of services, including customized strategic and economic business solutions. It is crucial to note, that access to Frost & Sullivan's studies is paid, thus limiting its availability for SMEs due to the high cost. [Figure 10.7 Frost & Sullivan](#)

2.6.2.7 EDB eMarketplace

The Export Development Board (EDB) of Sri Lanka operates EDB marketplace, a well-known e-commerce portal specially designed to connect Sri Lankan exporters with foreign buyers. Notably, it is the sole web application developed to assist Sri Lankan SMEs. EDB marketplace and corporate website provides diverse range of informative resources. The integration of business intelligence services specifically tailored to the requirements of Sri Lankan exporters could add a significant value addition to this platform. [Figure 10.8 EDB eMarketplace](#)

2.6.2.7 Conclusion

This competitor analysis has examined different business intelligence platforms catering to exporters. A key finding is that most platforms provide comprehensive reports and in-depth insights require a monthly payment. Additionally, with the exception of EDB marketplace, none of the evaluated platforms offers free services to improve their business decisions without sound knowledge in analysing data points provided by widely available data sources such as ITC and UN comtrade database.

By providing a cost-effective solution with above features can address a significant gap in the current market and assist Sri Lankan SMEs in their internationalization process.

2.7 Review of Tools and Techniques

2.7.1 Requirement gathering techniques

Objective	Techniques	Description
Understanding the context	Literature Review	Researched existing research papers about Sri Lanka's SMEs, agricultural export products and export procedure. This provided insights into the broader context.
	Engage with government, industry bodies and creating fish bone diagram	Talked with representatives from the Export Development Board to get insights about specific challenges and opportunities face by SMEs.
	Gap Analysis Table	Analyzed existing software's developed for Agri-SME industry.
Data collection methods	User stories	Conducted interviews with SME owners to understand their specific needs, pain points and desired outcomes from trade date and Business Intelligence analysis.
	Interviews	Talked with academic researcher actively specialized in Sri Lankan Agri product export development.
Consideration for language and accessibility	Meetings	Created glossary of general terms used by Tamil and English professional in the industry.
	Workshop	Assessed different type of visuals that can be used to display data graphic format.
Prioritization and feasibility	Identify high impact areas	Gathered requirement for technological support that address immediate and pressing needs of SMEs, such as market research and identifying export opportunities.
	Identified resource constraints	Identified the general technological knowledge and devices utilized by SMEs to develop a feasible solution.

Table 2.5 Requirement gathering techniques

2.7.2 Project Planning techniques

Objective	Techniques	Description
Scoping and Defining objectives	Defining project goals	Specifically defined the focus areas of the project and the final mission.
	Creating Project Initiation plan	Determined the timeframe for different phases of project.

Data collection and preparation	Assessing existing data sources	Gathered available existing data sources and data gaps that need further research.
	Developing data acquisition strategies	Defined technologies that need to be used through the internet for real time data.
	Ensuring data quality and standardization	Implemented data cleaning and harmonizing processes to address inconsistencies and ensure compatibility for analysis.
Project management and communication	Creating Work Breakdown structure	Outlined tasks, timelines, milestones, resources, and budget allocations.
	Implementing project development methodology	Considered iterative and incremental development practice to adapt evolving needs.

Table 2.6 Project planning techniques

2.7.3 Design and development techniques

Objective	Techniques	Description
User Centric design	Prototyping	Prototyping was used to test the final solution.
	Wireframes	Used to create the initial stage of the user interface and its functionality.
Development	Agile development methodologies	Implemented iterative development cycles, starting with core functionalities, and gradually adding features based on user feedback and testing results.
	Data flow diagram	Created a visual representation of how data moves within the system.
Testing and Deployment	User Acceptance Testing	Created a structured framework to test features, functionalities, and scenarios.

Table 2.7 Design and development techniques

2.7.4 Tools and technologies

Category	Selected Tool	Specifications
Planning	MS Project	MS project is ideal for complex and long-term projects, and it supports seamless integration with other Microsoft Office apps

	Trello	Easy to visualize tasks with Kanban boards, and it offers a free version with essential features
Documentation	MS word	Provide extensive formatting options which makes it ideal for creating professional documents.
Programming	Python (Data analysis)	Python is known for its clear and concise syntax. It comes with a wide variety of standard libraries that provide ready-made modules and functions that save time and effort in development and python can easily integrate with other languages.
	JavaScript (Web programming)	JavaScript is known for its flexibility in web development and it's rich ecosystem consist of libraries and frameworks that offer pre-built solutions for common task which simplifies development.
Designing	Figma	Compared to other similar prototyping tools, Figma excels in creating user interfaces and web designs.
Frameworks	Google Collab (Data Exploration)	It allows for live code executions, enabling users to run code cells and see immediate results, which is valuable for iterative data analysis and experimentation.
	Flask (Back End development)	Flask is simple and easy to use and has minimal boilerplate code, enabling rapid development of web applications with few lines of code.
	React (Front End development)	Code-reusability, virtual DOM, unidirectional data flow, and JSX are the main features that make it suitable for front-end development of C2W.
Database	MongoDB (Data storage)	MongoDB is a flexible data storage platform with horizontal scalability which is beneficial for handling large volumes of data.

Referencing	Zotero	Zotero is an open-source tool that integrates with web browsers, allowing users to capture references and metadata directly from websites.
Testing	Selenium	These tools are used in different testing areas such as automated web testing, performance testing, data validation and testing. These have excellent scalability and extensibility, which makes them most suitable for this project.
	Apache JMeter	
Time series forecast model	ARIMA (Autoregressive Integrated Moving Average)	ARIMA has been selected as statical modelling technique. This technique is focused on analysing time series data and it is ideal for short time forecasting with limited available data.

Table 2.8 Tools and Technologies

2.7.5 Data sources

Source Name	Link
Sri Lanka Export Development (Free)	https://www.srilankabusiness.com/
Department of Census and Statistics (Free & Paid)	http://www.statistics.gov.lk/
UN Comtrade Database (Free)	https://comtradeplus.un.org/
International Trade Administration (Paid)	https://www.trade.gov/

Table 2.9 Data sources

2.8 Chapter summary

This chapter sets the context for the suggested trade data analysis and business intelligence solution. The chapter begins by emphasizing the significant disparity in resources available to Sri Lankan SMEs. An examination of existing tools revealed a gap for in-depth analysis tools specially designed to assist SMEs in resource optimization. Furthermore, this chapter provided a foundational overview of the development process. The next chapter will delve into the social and ethical considerations crucial for the development of C2W.

3. Legal, social and ethical issues

3.1 Chapter Overview

This chapter discusses the relevant legal, social and ethical issues associated with the eco-system of the proposed solution.

3.2 Legal issues

3.2.1 Personal Data Protection Act, No. 9 of 2022

This was recently enacted by the Sri Lankan government, serves as the primary legal framework for the proposed solution. The act establishes fundamental principles governing the collection, processing, and storage of personal data. By adhering to PDPA's stipulations, the proposed web application enhances its credibility and user trust.

3.2.2 Intellectual Property Act, No. 36 of 2003

The act offers a comprehensive legal framework for the protection of organizations' intellectual property. Employing copyrights, trademarks and patents allows for the safeguarding of intellectual assets.

3.2.3 Electronic Transactions Act, No. 19 of 2006

The Electronic Transaction Act of 2006 (No. 19 of 2006) is the legislative foundation for electronic commerce in Sri Lanka, ensuring a secure environment for online transactions. A thorough evaluation of this framework informed the design of the proposed solution to ensure validity and enforceability of contract formed across the platform.

3.2.4 The Fair Trading Commission Act No. 01 of 2003

This framework emphasizes the ethical marketplace behaviour. It authorizes the governance of individuals or organizations that attempt to participate in exploitative market practices. This framework aligns with the key goal of ensuring that services provided by proposed solution's services comply with existing market regulations, thus preventing disruptions of fair competition.

3.3 Social issues

C2W prioritizes social inclusion by providing a user-friendly and simple interface catering to low computer literacy levels, bridging the digital divide ([Gutierrez, 2022](#); [Salemink, Strijker and Bosworth, 2017](#)). Web Content Accessibility Guidelines (WCAG) ensure user engagement for people with disabilities ([w3c_wai, 2019](#)). The

platform promotes knowledge exchange through user forums similar to online communities proven to improve agricultural innovation ([Wu et al., 2022](#)). Future enhancements such as mobile application, offline access and multi-language support will increase inclusivity and positive social impact of the “C2W”.

3.4 Ethical issues

Ethical norms are embedded to the design and development process of C2W to build a reputable and socially responsible multifaceted business intelligence platform ([Ahn and Lin, 2019](#)). Transparency extends to how insights are generated and how user feedback guides continuous improvement of the solution to deliver comfortable environment for users by mitigating ethical and security concerns of target audience ([Martinez, 2023](#)). C2W promotes sustainable business and agricultural practices ([Rajput, T.B.S.; Patel, Neelam, 2014](#)). Web application will be connected with google analytics to complement in-built user monitoring functionalities to detect abusive behaviour or potential collusion in future iterations.

3.5 Chapter summary

This chapter examines the legal, social and ethical aspects of project implementation within Sri Lankan jurisdictions. It explores factors influencing the development process to assure compliance and responsible operations. The following chapter will provide an overview of the design and implementation plan for the proposed solution.

4. Design

4.1 Chapter overview

This chapter discusses the design aspects of the proposed solution CEYLON2WORLD including high level design and class diagrams. Furthermore, design and development considerations, requirement mapping with the wireframes, design tools used, and changes made after the creation of project specification and preliminary design documentation are presented.

4.2 High-Level design

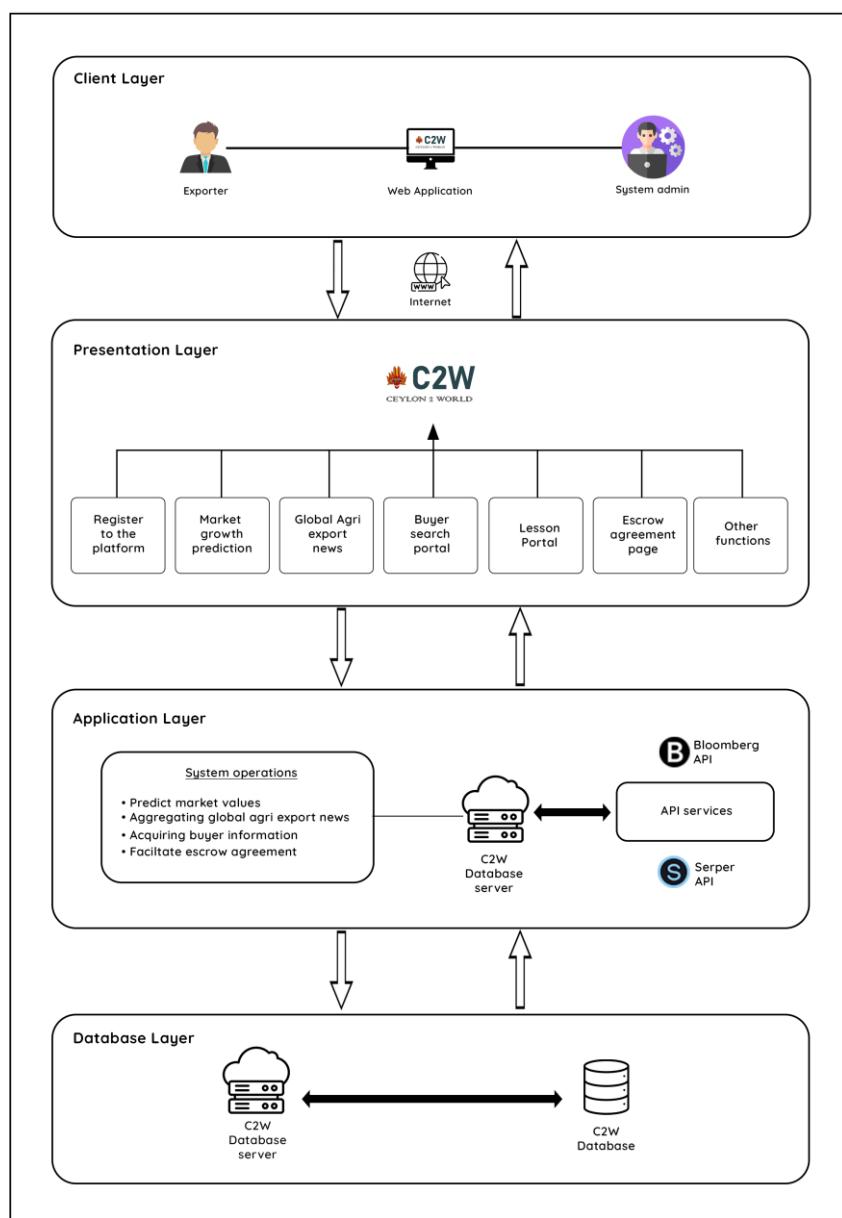


Figure 4.1 High level design diagram

4.3 High level class diagram of the proposed solution

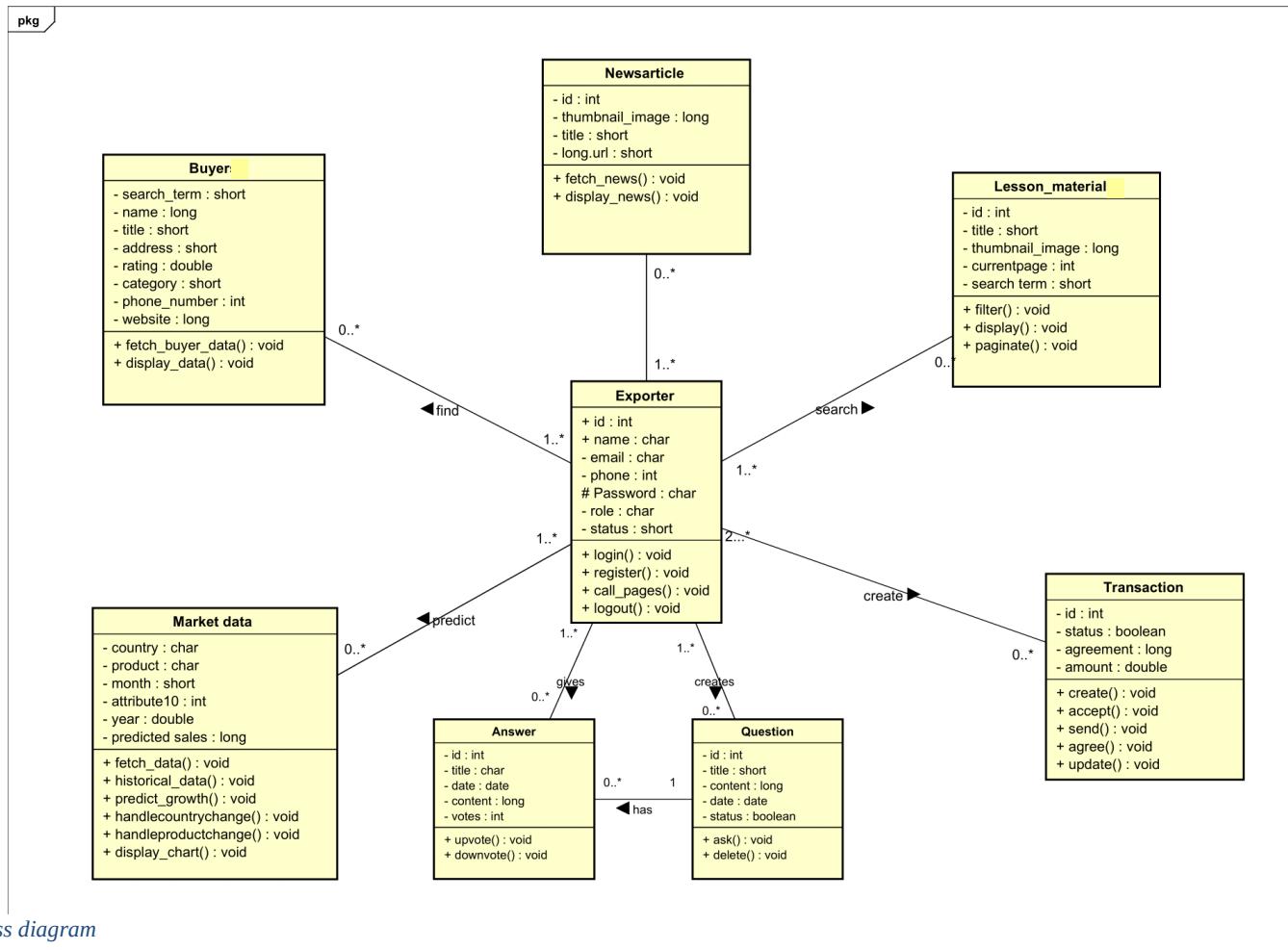


Figure 4.2 High level class diagram

4.4 Design and Development Considerations

4.4.1 User interface

The user interface of C2W has been designed focusing the audience of Sri Lankan exporters. Proposed Simple user interface of C2W allows users to access the application with low computer literacy and requires minimum learning to leverage the application to get valuable insights.

The Material design system introduced by Google was followed to develop an attractive and usable product to end users. The color forest green was used as the primary color to symbolize the applications relevance to the agriculture sector. Usually colour green represents the start of new beginnings and growth which aligns well with the aim of the proposed solution. Also emotions, privacy and ethical aspects were taken in to consideration throughout out the design process in order to make sure users feel comfortable with services provided by the application.

Foundations of visual designing were employed by using google design system, such as using grids and layouts for creating responsive elements, using appropriate colours to signify the meaning and hierarchy of elements, using typography optimize the readability and legibility, using iconography to increase the accessibility of the applications, and using animations to enhance interactions.

In conclusion, the final aim was to design a user friendly and easy to use UI for Sri Lankan exporters and address the user's behaviour and knowledge related issues identified in the literature review stage to ensure user will be able to understand the effectiveness of the application from a quick glance at the user interface.

4.4.2 User experience

C2W provides intuitive navigation and a clear visual hierarchy for users. C2W employs clear error prevention strategies and a self-explanatory design to ensure users can use the application without any prior knowledge about the application. Also, core focus were given on creating an interface that are usable by individuals with disabilities by utilizing colour-contrast and alt-text. Apart from the factors discussed early, accessibility, usability and interactive design principles were taken into consideration throughout the user experience designing process.

4.4.3 Privacy and Security

C2W only collects username, passwords, mobile numbers and emails from users. Data collection and data storage process were designed adhering to the PDPA, NO.9 of 2022

which was recently introduced by the Sri Lankan government. These security measures will help to protect the privacy of users data while ensuring compliance with legal and ethical standards within Sri Lankan jurisdictions. Furthermore, implementing standard privacy and security measures will increase the credibility of the application, ultimately improving the users' attitude towards the application.

4.4.3.1 Identity and access management

The C2W application prioritizes secure access and data security in order to build confidence among its users. Exporters, buyers and system administrators will be confidentially identified while ensuring their data and the ability to take legitimate actions are protected. C2W will employ Role-Based Access Control (RBAC) to streamline permissions management, to ensure the data security of profile base data. Data will be protected through encryption both at rest and during transmission. Security and user trust go hand-in-hand. Therefore, users will be able to see their role on the top right corner of the screen. This approach will allow C2W to provide personalized user experience without sacrificing the benefits of a simple-component based design.

In the wireframe mapping section all the core functional requirements will be discussed in detail in relevance to the general wireframes without considering users privilege. In the final solution users will be able to see a tailored view and transactions are categorized by flow direction (buyer-to-exporter or vice versa) for additional clarity. Freemium users will have limited feature set but will still have access to core functionalities.

4.4.4 Prediction model

ARIMA is specially designed for time series forecasting, which means it takes in to account factors such as order and timing of past observations. This is very critical for import data since it contains seasonal trends and cyclical patterns or any dependencies. ARIMA model is relatively simple to use due to its well defined structure (AR-autoregressive, I-integrated, MA – moving average). To identify the most suitable order for the available data auto_arima function has been utilized from pmdarima library. Furthermore ARIMA is most suitable for short term forecasts using limited number of data values. Components of the ARIMA model has been explained in detail below.

Autoregressive(AR)	To capture how much past import values influence future values
Integrated(I)	This component deal with non-stationery data such as data with trends or seasonality

Moving Average (MA)	This component considers the average of past forecast errors to improve predictions
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Table 4.1 ARIMA model

4.5 Wireframes of the proposed solution

Ideation, wireframing and UI mock-up creation stages were followed to create the final design of the C2W. The final solution is a comprehensive web application where exporters and buyers can access the services provided by C2W system. The core functionalities and the UI mock-ups are presented below, along with explanation of user flow.

4.5.1 Registration and Login

FR 09 – Guest user should be able to register to the system and FR10 – Registered user should be able to login to the system, C2W application will be publicly available for any user's access with limited functionalities, Users are required to purchase the premium membership plan to become registered members to access all the functionalities. The user interfaces which have been implemented to fulfil the FR 09 and FR10 are shown in [Figure 10.9 Sign up & Sign in UI](#).

4.5.2 Sales forecast page

FR03 & FR04 – Guest user and Registered user should be able to use annual sales forecast, The sales forecast page functions as the designated landing page within the C2W platform, reflecting its fundamental position as the starting point of the export process. The sales forecast page will provide market prediction values for the upcoming months and trend volume based on google trend data for the selected product and selected market. These functionalities will be implemented in the wireframes shown below and the navigation and other features of the user interface are explained in detail in [user interface](#) section. [Figure 10.10 Sales forecast page](#)

4.5.3 Global Agri-Export News Page

FR01 & FR02 – Guest user and registered user should be able to view world wide news page, registered users will be able to view an automatically updated news feed curated according to their profile and interests where they will be given the opportunity to have a own bookmarked list of news that they can view afterwards. Wireframes of the news page are shown in [Figure 10.11 Global agri-export news page](#).

4.5.4 Search buyers page

FR15 – Registered user should be able to search buyers, The search page provides the functionalities identified as FR15 and FR16. Users will be able to add, remove and

manage bookmarked buyers from the wireframe as shown in [Figure 10.12 Search buyers page](#).

4.5.5 Learn page

FR23 – Registered user should be able to get learning material suggestions, User will be able to chat with AI chatbot and find learning materials that provide the exact content they were looking for as identified in FR 23. UI element which presents above requirement consist with few more tools as shown in [Figure 10.13 Learn page](#).

4.5.6 Q&A page

FR24 – Registered user should be able to ask and delete questions, All the functionalities mentioned in FR24 and FR25 will be implemented as shown in wireframe in [Figure 10.14 Q&A page](#). Users will be able to search any question to find any similar questions asked earlier or create new question. Also, users will be able to answer any question and bookmark, vote, report any of the question to maintain the integrity of the community.

4.6 Design tools

The tools used for designing of C2W are explained in Table 4.2 with the justifications.

Tools	Justification
Figma	Figma excels in creating user interfaces and web designs. It supports integration with other similar tools, which can be used to design more unique graphics. Also, it offers a range of interactions and transitions for creating interactive user experiences.
Astah.UML	Astah.UML is software used by most of the industry officials it supports all the diagrams required for system designing of C2W.

Table 4.2 Design tools

4.7 Changes made after PSPD

This section details the changes made to the initial requirements due to the allocated project time and budgetary constraints.

- The following core functional requirements were de-prioritized from critical (must have) to optional and revised functional requirement list can be found in the [appendix](#).

Req ID	User	Requirements	Previous priority	New Priority
FR03	Registered user	Registered user should be able to view Q&A forum	Must have	Should have

FR07	Registered user	Registered user should be able to verify	Must have	Should have
FR08	Registered user	Registered user should be able bookmark news and manage bookmarked new	Must have	Should have
FR11	Registered user	Registered user should be able bookmark buyers and manage bookmarked buyers	Must have	Should have
FR15	Registered user	Registered user should be able to create agreements	Must have	Should have
FR14	Registered user	Registered user should be able to view and compare results.	Must have	Should have
FR26	System admin	System admin should be able to manage legal documents and learning materials.	Must have	Should have
FR37	System	System should be able to display rules and regulations for different markets.	Must have	Should have
FR38	System	System should be able to facilitate escrow services.	Must have	Should have
FR39	System	System should be able to verify user and display user role.	Must have	Should have

Table 4.3 Functional requirement changes

4.8 Chapter summary

This chapter delves into the design process and the final system design. It begins by outlining the high-level design, utilizing a class diagram to illustrate the structure of the system. Subsequently, the chapter explores design and development considerations along with the explanation of UI mock-ups with relevant functional requirements and how the design decisions made affected in design and development process. Finally, modifications made after the PSPD document are discussed. The methodologies and approaches employed throughout the development of the project will be discussed in the upcoming chapter.

5. Methodology

5.1 Chapter overview

This chapter discusses the fundamental approach employed, as well as the specific techniques used in the software development and project management processes throughout the project. This chapter aims to provide readers with a comprehensive overview of the methodologies used to implement the final solution.

5.2 General approach

The Iterative and incremental approach is taken as the general approach due to the nature of the C2W application. This approach is integral to the field of agile software development as it enables project managers to reap the advantages of both incremental and iterative development. In detail, this approach gives the opportunity to adapt the features with the evolving user needs, provide value to stakeholders in the early stage of the development process, break development in to increments and focus on specific functionalities at once, make improvements according to user feedback and test results after each iteration. The most important factor is, this approach avoids integration failures later in the project which leads to delays of project that doesn't meet the expectations. This approach gave the opportunity for time completion of the project without any delays due to integration issues even though the application was developed using two programming languages and frameworks.

5.3 Project management approach

After careful consideration of project scope and core functionalities agile scrum methodologies was selected as the project management approach. Agile scrum methodology combined with the minimum time and resources can be employed to develop a web application with constant refinement based on user feedback. Agile scrum framework provides a structured framework with clear sprints and retrospectives to track the progress of the project. Prioritized feature backlog approach of scrum methodology allows to initially prioritize core functionalities and develop the other functionalities on well-defined structure. Furthermore, agile framework's focus on building features and reducing excessive documentation gives opportunity to invest more time in improving the proficiency and efficiency in meeting user's requirements. Project management techniques used such as Ghant Chart, Work Breakdown Structure, Project Logbook are detailed in appendix.

5.4 Development approach

The Model-View-Controller (MVC) architectural pattern was selected as the development approach for C2W. MVC's clear separation of logic (model), presentation (View) and user interaction (Controller) enables development of diverse and evolving components of C2W. MVC gives opportunity to focus on individual components within sprints and make increments to get user feedback and adapt continuously. MVC architecture supports gracefully for future enhancements and keep the codebase organized and maintainable which is vital for handling complex errors. Also, MVC's emphasis on testability ensure the continuous testing of critical functions to increase the reliability of the C2W. This development approach aligned well with general approach as well as project management approach ensuring maximize value delivery for end users.

5.5 Chapter summary

This chapters explained methodologies used in the implementation process in order to create the final C2W application, as well as the justification for the selected methodologies. The following chapter will discuss the tools utilized and the implementation process.

6. Tools and Implementation

6.1 Chapter Overview

The chapter documents the software's, programming languages, libraries and other resources utilized throughout the development of the C2W application and rationale behind tool selection. Furthermore it discusses the how the selected tools were employed including the knowledge of the author in the selected platforms and the new skills learned by author to develop the final solution.

6.2 Tools

Component	Selection	Justification
Development Environment		
Development Environment	Visual Studio Code	Extensions available in visual studio code such as React-specific code snippets and debugging tools and cross-platform compatibility simplify the development process while improving coding efficiency.
Version Control	Git	Git was essential for maintaining code history and developing the application using iterative and incremental approach to explore avenues to increase the quality and efficiency of the code.
Back end		
Programming languages	Python	Python's readability, strong community and vast collection of libraries supporting machine learning makes the development process of the main features more efficient, therefore python was selected as the main programming language for backend. Even though there are available options with quick response time such as popular JavaScript frameworks, using python with flask's vast collection of in-built libraries that can be used to develop the main features of the application made python and flask approach more suitable considering authors prior knowledge in python and flask.

Framework	Flask	Flask provides a lightweight and flexible foundation, simplifying web request handling and routing process.
Database	MongoDB atlas	MongoDB is a cloud-based and document oriented database which provides scalability and flexibility for evolving data model of C2W after public deployment. Furthermore MongoDB is document-based database which provided extended support for big data analysis with in-build data analyzing services which can be utilized in the future.
Custom APIs	/register	Handles secure user registration, hashing passwords using bcrypt library for improved security.
	/login	Implemented JWT-based user authentication and session management by generating tokens to identify users.
	/arima_forecast_chart	This will be further explained in implementation section.
Front end		
Programming Languages	HTML, CSS, JavaScript	These languages are the building block of web interfaces.
Framework	ReactJS	React's component-based architecture aligns well with Model-View-controller development approach and declarative style simplifies the creation of dynamic and reusable UI elements, therefore react was selected to create a user friendly and accessible front-end for C2W application.
	Tailwind CSS	Tailwind is a CSS framework that provides a different approach to styling web pages compared to traditional frameworks like bootstrap or materialize. Tailwind offers a vast collection pre-defined CSS classes and allows extended customization.

APIs	News API	Bloomberg News which is a part of Bloomberg corporation, prioritizes in-depth, data driven reporting on financial markets, businesses and the global economy. All the features of services provided by Bloomberg well align with the identified functional requirements. Exporters need to be provided with latest news relevant to their interests which can assist them to make decisions. The legibility and real-time updates aspects provided by Bloomberg is critical for fulfillment of user requirements.
	Business API	Serper API which is provided by serper organization has been selected to provide potential foreign buyer information. Serper is legitimate organization which scrapes data from publicly available websites adhering to government laws and regulation. Furthermore, selected API has significant response time compared to other available solutions and delivers valuable data such as graph data, related questions and image URLs while giving option to target on multiple countries and cities. Above discussed factors well align serper API with refined user requirements.

Table 6.1 Tools

6.3 Existing skills and New Skills

The skills of the author before implementation of the proposed solution are detailed in the following table.

Existing Skills	Description
Research skills	Conduct thorough research to identify the root causes of main problems and understand the applicability of IS solution to achieve expected results.
Critical Thinking Skills	Planning a effective solution to address the key underlying issues with available resources.
Design Thinking Skills	Design a application which can be completely accessible and effective for the target audience to gather required information.

Project Management Skills	Prioritize the work and track the progress of the project
---------------------------	---

Table 6.2 Existing skills

Authors existing knowledge in programming techniques.

- Using flask to create full stack web applications.
- Using mongo-DB for data storage and retrieval.

The skills and programming techniques learned by the author during the course of the development of C2W are presented in following section.

New Skills	Description
Data Analysis	Build a accurate prediction model to predict market values.
Application testing	Create comprehensive testing plan to ensure the reliability and quality of the final solution.

Table 6.3 New skills

New Programming techniques learned by author

- React front-end state management techniques.
- Backend development with REST APIs.
- Incorporating external APIs.
- Building time series forecasting ARIMA models for market growth prediction.

6.4 Implementation

6.4.1 Market forecasting page

Market forecasting page has been set as the homepage due its significance in the export process. This core functionality is built in the backend flask application by gathering data from MongoDB database and performing predictions using ARIMA model. Afterwards data is been sent to the frontend to display as chart using chart.js library.

Front end

After initial import statements, chart components that are going to be used within the function which are collected from chart.js library are registered and functional react component stock data is defined. After defining states required for the function, useEffect hook has been used to send the data and get a response from the backend using a get request when either country or product ID columns changes. Functions which are used in the fetch data function are defined after this section.

First, transformChartData function has been defined to store data response gathered from backend in required format to display as a chart. Function getNextMonths which is used within transformChartData is used to get names of the next five months according to the

last available month. Furthermore, return values for transformchart data has been defined as json file which contains historical data in first part and predicted values in the following part including design options for the chart data.

```

client > src > pages > identify > 15 index.js > ⑩ StockData > ⑪ useEffect() callback > ⑫ fetchData
  └ Click here to ask Blackbox to help you code faster
1 import React, { useState, useEffect } from 'react';
2 import axios from 'axios';
3 import { Line } from 'react-chartjs-2';
4 import { Chart, CategoryScale, LinearScale, PointElement, LineElement, Title, Tooltip, Legend } from 'chart.js';
5 import Header from '../../components/Header';
6 import Footer from '../../components/Footer';
7
8 // Register components required for Line chart
9 Chart.register(CategoryScale, LinearScale, PointElement, LineElement, Title, Tooltip, Legend);
10
11 const StockData = () => {
12   const [country, setCountry] = useState('');
13   const [productID, setProductID] = useState('');
14   const [chartData, setChartData] = useState({}); // Initialize with empty object
15
16   useEffect(() => {
17     if (country && productID) {
18       const fetchData = async () => {
19         try {
20           const response = await axios.get(`http://localhost:5001/fetch_chart_data`, {
21             params: { country: country, product_id: productID }
22           });
23           const transformedData = transformChartData(response.data);
24           setChartData(transformedData);
25         } catch (error) {
26           console.error('Error fetching chart data:', error);
27         }
28       };
29       fetchData();
30     }
31   }, [country, productID]);
32
33 // Function to transform chart data
34 function transformChartData(data) {
35   const labels = data.map(item => item.month);
36   const salesData = data.map(item => item.sales);
37   const predictionsData = data.map(item => item.prediction);
38   const nextMonths = getNextMonths(labels.length - 1, 5); // Get labels for the next 5 months
39
40   // Concatenate the existing labels with the labels for the next months
41   const allLabels = [...labels, ...nextMonths];
42
43   // Fill in the sales and prediction data for the next months with null values
44   const allSalesData = [...salesData, ...Array(5).fill(null)];
45   const allPredictionsData = [...Array(nextMonths.length).fill(null), ...predictionsData];
46
47   return {
48     labels: allLabels,
49     datasets: [
50       {
51         label: 'Predictions',
52         backgroundColor: 'rgba(255, 99, 132, 0.2)', // Red color
53         borderColor: 'rgba(255, 99, 132, 1)',
54         borderWidth: 1,
55         hoverBackgroundColor: 'rgba(255, 99, 132, 0.4)',
56         hoverBorderColor: 'rgba(255, 99, 132, 1)',
57         data: allPredictionsData
58       }
59     ]
60   };
61 }
62
63 // Function to get labels for the next n months based on the last month in the data
64 function getNextMonths(lastMonth, n) {
65   const months = ['January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December'];
66   const lastMonthIndex = months.indexOf(lastMonth);
67   const nextMonths = [];
68   for (let i = 1; i < n; i++) {
69     const nextMonthIndex = (lastMonthIndex + i) % 12;
70     nextMonths.push(months[nextMonthIndex]);
71   }
72   return nextMonths;
73 }
74
75 const handleCountryChange = (e) => setCountry(e.target.value);
76 const handleProductChange = (e) => setProductID(e.target.value);
77
78 const options = {
79   responsive: true,
80   plugins: {
81     legend: {
82       position: 'top'
83     }
84   },
85   scales: {
86     x: {
87       type: 'category',
88       title: {
89         display: true,
90         text: 'Month'
91       }
92     }
93   }
94 };
95
96
97
98
99
100
101
102
103

```

Figure 6.1 Market forecasting - front end code snippet 1

```

client > src > pages > identify > 16 index.js > ⑩ StockData > ⑪ useEffect() callback > ⑫ fetchData
  └ Click here to ask Blackbox to help you code faster
11 ③ const StockData = () => {
12   ④   function transformChartData(data) {
13     ⑤     datasets: [
14       ⑥       {
15         ⑦         label: 'Predictions',
16         ⑧         backgroundColor: 'rgba(255, 99, 132, 0.2)', // Red color
17         ⑨         borderColor: 'rgba(255, 99, 132, 1)',
18         ⑩         borderWidth: 1,
19         ⑪         hoverBackgroundColor: 'rgba(255, 99, 132, 0.4)',
20         ⑫         hoverBorderColor: 'rgba(255, 99, 132, 1)',
21         ⑬         data: allPredictionsData
22       }
23     ];
24   };
25
26   // Function to get labels for the next n months based on the last month in the data
27   function getNextMonths(lastMonth, n) {
28     const months = ['January', 'February', 'March', 'April', 'May', 'June', 'July', 'August', 'September', 'October', 'November', 'December'];
29     const lastMonthIndex = months.indexOf(lastMonth);
30     const nextMonths = [];
31     for (let i = 1; i < n; i++) {
32       const nextMonthIndex = (lastMonthIndex + i) % 12;
33       nextMonths.push(months[nextMonthIndex]);
34     }
35     return nextMonths;
36   }
37
38   const handleCountryChange = (e) => setCountry(e.target.value);
39   const handleProductChange = (e) => setProductID(e.target.value);
40
41   const options = {
42     responsive: true,
43     plugins: {
44       legend: {
45         position: 'top'
46       }
47     },
48     scales: {
49       x: {
50         type: 'category',
51         title: {
52           display: true,
53           text: 'Month'
54         }
55       }
56     }
57   };
58
59
60
61
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102
103

```

Figure 6.2 Market forecasting - front end code snippet 2

Backend

```
3 import numpy as np
4 from statsmodels.tsa.arima.model import ARIMA
5 from bs4 import BeautifulSoup
6 from bs4 import json_util
```

Figure 6.3 Market forecasting - back end code snippet 1

```
10 # Function to predict sales using moving average
C:\Users\Jewel\PycharmProjects\MarketForecasting\MarketForecasting\app\models.py
11 sales = np.array([float(i) for i in historical_data])
12
13 if len(sales.shape) == 0:
14     sales = sales.reshape(-1)
15
16 stepwise_model = auto_arima(sales, start_p=1, start_q=1,
17                             max_p=1, max_q=1, seasonal=False,
18                             d=None, trace=True,
19                             error_action='ignore',
20                             suppress_warnings=True,
21                             stepwise=True)
22
23 model_fit = stepwise_model.fit(sales)
24
25 ...model = ARIMA(sales, order=(1,1,1))
26 model_fit = model.fit()
27
28 predicted_sales = model_fit.forecast(steps=5)
29
30 print(predicted_sales)
31
32 return predicted_sales
```

Figure 6.4 Market forecasting - back end code snippet 2

```
76 @app.route('/fetch_chart_data', methods=['GET'])
77 def fetch_chart_data():
78     country = request.args.get('country')
79     product_id = request.args.get('product_id')
80     products_collection = db['products']
81
82     # Retrieve historical sales data
83     historical_data = list(products_collection.find({"country": country, "product_id": product_id}))
84
85
86     # Perform prediction for the next 5 months using moving average
87     predicted_sales = predict_sales(historical_data)
88
89     # Combine historical data with predictions
90     combined_data = combine_data(historical_data, predicted_sales)
91
92     # Convert combined data to JSON using json_util
93     json_data = json_util.dumps(combined_data)
94
95     return json_data, 200, {'Content-Type': 'application/json'}
96
97 def combine_data(historical_data, predicted_sales):
98     # Combine historical data with predictions
99     combined_data = []
100     for data in historical_data:
101         data['prediction'] = str(data['id'])
102         data['id'] = str(data['id'])
103         data['id'] = str(data['id'])
104         combined_data.append(data)
105
106     # Add predictions to the combined data
107     for idx, data in enumerate(combined_data):
108         data['prediction'] = predicted_sales[idx] if idx < len(predicted_sales) else None
109
110     return combined_data
```

Figure 6.5 Market forecasting - back end code snippet 3

Above code snippets depicts how the data values requested by user is gathered from database and prediction values are generated in backend. Initially numpy library which is commonly used for array manipulations and ARIMA class from statsmodels library has been imported for time series forecasting. Thereafter predictions function has been defined, It takes historical data as input and then put the historical data in to numpy array. Then if `len(sales.shape) == 0`:`sales = sales.reshape(-1)` ensures the sales array is at least one dimensional even if it comes empty. Then ARIMA model object has been defined and ARIMA model has been explained in detail in [design section](#). After fitting historical sales data in to ARIMA model, sales prediction has been generated and returned as numpy array.

In the `fetch_chart_data` route initially data requested by user is collected from database and stored in list. In the following code predicted values for the historical data has been generated by using above defined function. Thereafter historical data and predicted data values are being combined in to one array using `combined_data` function which is defined below in the code. Finally Json file is being sent out with all the historical values and predicted values. This approach allows to make predictions using data that

is being constantly updated to database which allow system to provide real time outputs from available data.

6.4.2 Global Agri-export news page

The user will be able to navigate to global Agri-export news page by navigation bar in the left side of the screen. User will be able to view news that are gathered from around the world which are related to exporting Agri products across the globe.

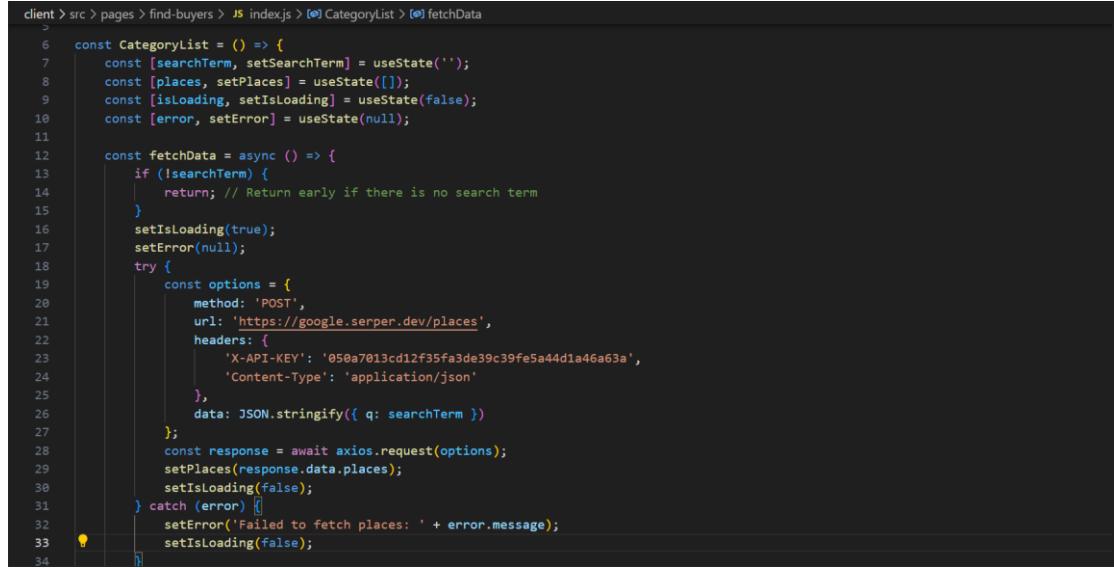
```
client > src > pages > worldwide-news > js index.js > ...
  3   import Header from '../../components/Header';
  4   import Footer from '../../components/Footer';
  5
  6   const NewsComponent = () => {
  7     const [newsItems, setNewsItems] = useState([]);
  8     const [error, setError] = useState('');
  9
 10    useEffect(() => {
 11      const fetchNews = async () => {
 12        const options = {
 13          method: 'GET',
 14          url: 'https://bloomberg-market-and-financial-news.p.rapidapi.com/stories/list',
 15          params: { template: 'CURRENCY', id: 'usdjpy' },
 16          headers: {
 17            'X-RapidAPI-Key': 'bd76d4e673msh4b9484eba9d350ep1d327bjsne55e1cf00ce3',
 18            'X-RapidAPI-Host': 'bloomberg-market-and-financial-news.p.rapidapi.com'
 19          }
 20        };
 21
 22        try {
 23          const response = await axios.request(options);
 24          setNewsItems(response.data.stories);
 25        } catch (err) {
 26          setError('Failed to fetch news');
 27          console.error(err);
 28        }
 29      };
 30
 31      fetchNews();
 32    }, []);
 33
```

Figure 6.6 Global agri export news page code snippet

Code snippet for the API connecting part for the Global news page is shown in Figure 6.6. As depicted in the code axios library is used to simply making API requests through out the application. Initially react component has been created and useState has been used to create newsitems and error states. fetchNews asynchronous function is created within useEffect and all the data required to make a API request are stored in options. Finally try-catch block has been used to handle errors when making the API call and store data in NewsItems array, when error occurs “failed to fetch news message” is displayed with the error using catch part in try-catch block.

As mentioned in functional requirements application will display news relevant user by including users requested market and relevant currency as parameters in the API call to gather only user relevant news from API.

6.4.3 Buyer finding page.

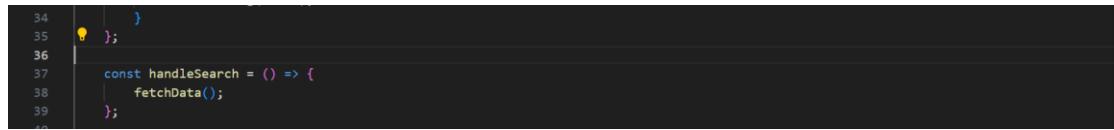


```

client > src > pages > find-buyers > js index.js > [e] CategoryList > [e] fetchData
>
6   const CategoryList = () => {
7     const [searchTerm, setSearchTerm] = useState('');
8     const [places, setPlaces] = useState([]);
9     const [isLoading, setIsLoading] = useState(false);
10    const [error, setError] = useState(null);
11
12    const fetchData = async () => {
13      if (!searchTerm) {
14        return; // Return early if there is no search term
15      }
16      setIsLoading(true);
17      setError(null);
18      try {
19        const options = {
20          method: 'POST',
21          url: 'https://google.serper.dev/places',
22          headers: {
23            'X-API-KEY': '050a7013cd12f35fa3de39c39fe5a44d1a46a63a',
24            'Content-Type': 'application/json'
25          },
26          data: JSON.stringify({ q: searchTerm })
27        };
28        const response = await axios.request(options);
29        setPlaces(response.data.places);
30        setIsLoading(false);
31      } catch (error) {
32        setError(`Failed to fetch places: ${error.message}`);
33      }
34    };

```

Figure 6.7 Buyer finding page code snippet 1



```

34  }
35  );
36
37  const handleSearch = () => {
38    fetchData();
39  };

```

Figure 6.8 Buyer finding page code snippet 2

Users can access this page through navigation panel. API calling code snippet is shown in [Figure 6.7](#) as it is the most significant code snippet which shows how the data is gathered from google serper API is being displayed according to users request. Initially categoryList react component and required states are defined. Then asynchronous function is defined to store values required to make the API call and to make the API call and store data or send a error message. Initially if statement has been used inside the main function to make sure only the function works after user enter a input in search field. After the asynchronous function, handle search function has been defined to call the function defined earlier when user press search button in the following code of this snippet. Also users requested search term is sent with the API request to gather business which is relevant to product user is looking for buyers as mentioned in the functional requirements.

6.4.4 Lessons page

User can navigate to this page from navigation panel. User will be able to enter a keyword for a subject and receive suggested videos from a vast collection tutorial video according to changes user make in the input field using react framework.

```

157 const lessons = () => [
158   const [currentPage, setCurrentPage] = useState(1);
159   const [videosPerPage] = useState(10);
160   const [searchTerm, setSearchTerm] = useState('');
161   const [menuOpen, setMenuOpen] = useState(false);
162   const [userName, setUsername] = useState('');
163 
164   const toggleMenu = () => {
165     setMenuOpen(!menuOpen);
166   };
167 
168   const indexOfLastVideo = currentPage * videosPerPage;
169   const indexOfFirstVideo = indexOfLastVideo - videosPerPage;
170   const filteredVideos = videoData.filter(video =>
171     video.description && video.description.toLowerCase().includes(searchTerm.toLowerCase())
172   );
173   const currentVideos = filteredVideos.slice(indexOfFirstVideo, indexOfLastVideo);
174 
175   const paginate = pageNumber => setCurrentPage(pageNumber);
176   const handleSearch = e => {
177     setSearchTerm(e.target.value);
178     setCurrentPage(1); // Reset pagination to first page when searching
179   };
180 
181   const handleLogout = () => {
182     localStorage.removeItem('userInfo');
183     window.location.href = '/login';
184   };
185 ];

```

Figure 6.9 Lessons page code snippet - 1

Initially lessons react component is defined to filter the videos relevant to keyword entered and display. Code starting from line 168 shows how the index is given to each video in filtered videos and a selected number of videos are displayed and a paginate function is defined following to set the number of videos needs to be displayed in one page when the search term changes. Following code snippet in figure shows how the currentVideos variable is used to display the number of videos for a page and how paginate function has been triggered.

```

232   <div className="grid grid-cols-1 sm:grid-cols-2 lg:grid-cols-3 gap-6">
233     {[currentVideos.map(video => (
234       <div key={video.id} className="bg-white p-4 shadow-md rounded-lg transition duration-300 hover:shadow-lg">
235         <a href={video.url} target="_blank" rel="noopener noreferrer">
236           <img src={video.thumbnail} alt="Thumbnail" className="w-full rounded mb-2 h-auto" />
237         </a>
238         <h2 className="text-lg font-semibold mb-2">
239           <a href={video.url} target="_blank" rel="noopener noreferrer" className="text-blue-600 hover:text-blue-800 transition duration-300">{video.title}</a>
240         </h2>
241         <p className="text-gray-700">{video.description}</p>
242       </div>
243     ))]
244   </div>
245   <Pagination videosPerPage={videosPerPage} totalVideos={filteredVideos.length} paginate={paginate} />
246 </div>
247 <Footer />
248 </>
249 );
250 };
251 
252 // Pagination component
253 const Pagination = ({ videosPerPage, totalVideos, paginate }) => {
254   const pageNumbers = [];
255 
256   for (let i = 1; i <= Math.ceil(totalVideos / videosPerPage); i++) {
257     pageNumbers.push(i);
258   }
259 
260   return (
261     <nav>
262       <ul className="flex justify-center space-x-2 mt-8">
263         {pageNumbers.map(number => (
264           <li key={number}>
265             <button onClick={() => paginate(number)} className="text-blue-600 hover:text-blue-800 px-3 py-1 border border-blue-600 rounded-lg focus:outline-none transition duration-300">{number}</button>
266           </li>
267         )));
268       </ul>
269     </nav>
270   );
271 };
272 
273 export default Lessons;

```

Figure 6.10 Lessons page code snippet - 2

6.5 Chapter summary

This chapter presented the tools and technologies used in the development of the prototype of the proposed solution. Furthermore, codebase used to implement the prioritized core functional requirements are explained in the implementation section including the libraries and techniques used in the coding process. The next chapter will provide a overview about techniques used to evaluate the proposed final application of C2W.

7. Testing

7.1 Chapter overview

This chapter explores the two testing methodologies employed for assessing the effectiveness of C2W. Functional testing methodology was used to test the core functionalities of the application using both black box testing and white-box testing methods. Feedback were gathered from real users, including domain experts, technical experts and general public for user testing. Testers evaluated the application's user friendliness and its ability to address the identified main research problem.

7.2 Functional testing

Functional testing was conducted using white-box and black-box techniques for the implemented core functionalities of the final solution.

7.2.1. *Evaluating ARIMA model performance*

Initially model was trained using a training dataset and holdout dataset which includes a variety of patterns such as trends and potential outliers to challenge the model. The dataset was tested using baseline forecasting methods such as moving average and naïve forecasting including previously mentioned holdout dataset to find a performance reference point. Finally same training dataset and holdout dataset was fed to ARIMA model, its proved that ARIMA model is able to capture more complex pattern in the provided datasets compared to baseline prediction methods. Initial process irritated multiple times to identify the accuracy the model of using `pmd_autoarima` library to define the ARIMA order to ensure that model is capable of providing accurate results for new datasets.

Test Case Description	Sample Input	Expected output	Actual output	Test Case Status
TC01 – User Registration	First Name = Robin Last Name = Alex Date of Birth = 01.01.1998 Email = alexrobins@gmail.com Phone Number = 0775234223 Password = jane1998peter	User will be directed to home page.	Same as Expected	Pass
TC02 – User registration	Mandatory fields are left empty by the user	User is prompt with alert message about empty fields.	Same as Expected	Pass
TC03 – User Login	User logins with invalid credentials Email: alexrobins@gmail.com Password: alex1998	User is notified of invalid credentials	Same as Expected	Pass
TC04 – User Login	User logins with valid credentials Email: alexrobins@gmail.com Password: alex1998	User is directed to the home page	Same as Expected	Pass
TC05 – Predict values	Select product and country	Upon selection predicted values for the product and market are displayed	Same as Expected	Pass
TC07 – Global news	Navigate to global news page	Latest news cards are displayed	Same as Expected	Pass
TC08 – Bookmark news	Bookmark news card by pressing the bookmark icon	News card is displayed bookmarked	Same as Expected	N/A
TC09 – Unbook mark news	Unbook mark the news card by pressing the bookmark icon	New card is removed from bookmarked list	Same as Expected	N/A
TC10 – Find buyers	User select a product and country from the drop down list	Users is provide with directory of buyers information relevant to the given input	Same as Expected	Pass
TC11 – Bookmark buyers	Bookmark buyer card by pressing the bookmark icon.	Buyer card is displayed bookmarked	Same as Expected	N/A

TC12 – Unbook mark buyers	Unbook mark the buyer card by pressing the bookmark icon.	Buyer card is removed from bookmarked list	Same as Expected	N/A
TC13 – Find lessons	User should be able to enter text and find videos related to it.	User should be given with relevant videos	Same as Expected	Pass
TC14 – Buyer registration	Users should be able to register as buyer by clicking register buyer button.	User should be displayed as buyers user in the profile and to other users	Same as Expected	N/A
TC15 – User registration	User enter already used usernames and credentials to register.	User is prompt with alert message about availability of the credentials used.	Same as Expected	Pass
TC16 – User logout	User click logout button to logout of the system.	User is logged out and directed to the login page.	Same as Expected	Pass
TC17 – Navigation	User clicks the C2W logo in the navigation panel to visit homepage.	User is directed to the homepage.	Same as Expected	Pass
TC18 – Navigation	User clicks the cards in the homepage.	User will be navigated to the relevant page.	Same as Expected	Pass
TC19 – Buyer registration	User clicks the buttons in the footer.	User is directed the relevant external or internal links.	Same as Expected	Pass
TC20 – Agreements	User selects a buyer from the buyer list.	Shows show agreements if there's any existing agreements and create agreement buttons.	Same as Expected	Pass
TC21 – Agreements	User create new agreement by selecting a another user.	New agreement will be shown in the agreements table.	Same as Expected	Fail
TC22 – Agreements	User clicks the view agreements button in agreements page.	User will be displayed with ideal buttons according to the progress in agreement table.	Same as Expected	Pass

Table 7.1 Test cases

7.3 User testing

Feedback for the application was gathered from real users to validate the effectiveness of final solution. Prototype was subjected to domain experts, technical experts and general public users for evaluation based on three main criteria's namely concept-based evaluation and designed based evaluation. Final outcome was defined as gathering feedback about users' perspective of the application effectiveness to assist exporters to find new market opportunities. Information of the evaluators are displayed in [Table 7.2](#) and the question asked from the evaluators are attached in [appendix](#).

Evaluator's name	Type	Designation/Description
Nilanthi Vitharana	CE	Assistant secretary at ministry of traditional industries and Small Enterprise Development
A D S Saman kumara	CE	SR Bio Food Production, Wathuragama, Lavalupitiya
Milan swantra	CE	Milan Agro Holding Private Limited, Variyapola (King coconut)
Praneeth Perera	CE	Excellensa Impex Pvt Ltd
Nadeesha gamage	CE	Nadeesha Trading Company (Rice Mill equipment)
Gevin Batuwangala	DE	Senior Software Quality Engineer at Sysco LABS
Krishanth Aravindhan	DE	UI Engineer at Intervest Software Technologies
Sachith Sulakkhana	DE	Senior Software Engineer at DMS Electronics
Dilshan Dekumpitiya	DE	Associate Software Engineer at DMS Electronics

Table 7.2 Details of evaluators

7.3.1 Evaluation based on Concept

The application was tested out by the experts in the domain to evaluate the effectiveness of the proposed solution to exporters. The necessity and suitability of the application was considered as two main criteria in the process of gathering feedback from testers. Furthermore, future roadmap of the application were thoroughly presented to the testers to provide a overview of scalability and the potential of the proposed solution.

All the testers mentioned that prototype of the proposed solution is capable of addressing main pain points of the targeted user audience and with future enhancements application will be able to be a very effective tool for any exporters willing to thrive in the market.

“Actually all the features that are implemented already can be very useful for me if its publicly available, I think this tool provide us lot of knowledge about areas we can explore as entrepreneurs”

- A D S Saman kumara, owner of SR Bio production

Furthermore, most of the testers mentioned that the approach the application has been taken to address the most critical issues of the exporters is very comprehensive and highly effective when they were questioned about the practicality of the C2W application.

“The software allows users to find relevant buyers, trends which is important to Sri Lankan exporters. The app will have a great impact on the export industry in our country with the features provided.”

- Praneeth Perera, director at Excellensa Impex pvt Ltd

Also, apart from the questionnaire some testers prompted the questions what is the approach C2W has been taken to make sure users can trust the data provided by the application. Even though ensuring the data integrity has been given key priority in the design process, systematic approach haven't been implemented to inform users about the accuracy of the data and it will be prioritize as a key future enhancement.

In conclusion, all the testers gave a positive feedback about the concept of the application and praised the design and development process for making sure final application address the initial pain points which was identified in the requirement gathering phase.

“I think all the features we discussed and prioritized are implemented properly, also I think anyone can actually get a idea if they just go through web application”

- Nilanthi Vitharana

Also, all the suggestions and key points pointed out by testers were taken in to consideration to improve the next iteration of the C2W application. Most of these factors were outside the scope of the proposed solution.

7.3.2 Evaluation based on Concept

The design and development of the solution was evaluated based on three main criteria such as user interface design, user experience design, structure of the codebase, functionality and the scalability. These criteria was identified according to the final delivered aim of the application. The questionnaire which was prompted testers can be found in the appendix and the final application was offered to testers for hands on experience to gather the feedback presented in this section.

Majority of the testers commented on the simple user interface and the application is understandable for any user without any prior knowledge in the domain.

“user flow is really smooth and very easy to understand.”

- Mr.Krishanth Aravindhan, UI Engineer at Intervest Software Technologies

Responses gathered from technical evaluators when they were questioned about codebase and the development approach depicts that most of the testers was satisfied with codebase as in readable code and adhering to industry standards.

“And I think the choice of programming languages and frameworks is good. Specially the approach taken to implement the predictive component is well thought. Specially considering that there’s lot of opportunities to improve this component in future.”

- Mr.Sachith Sulakkhana, Senior Software Engineer at DMS Electronics

“Selection of APIs to ensure all the user requirements is good. Also response time of the application at the moment and I think you can improve it by making few more changes when deploying the solution”

- Dilshan Dekumpitiya, Associate Software Engineer at DMS Electronics

“Yeah, the basic testing methods you have selected are suitable to ensure the core functionalities and also make sure you extend your testing process to user experience testing to ensure that your application meets the user experience requirements of the target audience”

- Gevin Batuwangala, Senior Software Quality Engineer at Sysco LABS

Furthermore, technical evaluators stated that codebase of the application seems to be designed in way to address the issues that could come up with the growth of user base. Also, more suggestions were provided to improve prediction approach. Most of the suggestions were already found in the initial functional requirement list and moved to the future improvements sections due to time and monetary constraints.

7.4 Chapter summary

This chapter presents the different testing methods used to evaluate the prototype of the proposed solution. Initially test cases that were rigorously tested using black box and white box testing methods are detailed. Feedback from experts and non-domain experts are discussed with the authors reflections. In the next chapter, a reflection of overall process will be presented, along with the uniqueness, strengths and weaknesses of the proposed solution.

8. Conclusions and reflections

8.1 Chapter overview

This chapter summarizes the completed project, highlighting the insights gained throughout the development of the final C2W application. This chapter analyse the application's strengths and weaknesses, discusses the knowledge and skills acquired throughout the process. Also, recommendations for further improvements are presented.

8.2 Evaluation of the solution

8.2.1 *Uniqueness of the proposed solution*

According to research conducted C2W stands as the only business intelligence application to provide valuable insights to Sri Lankan Agri exporters. All the aspects that C2W distinguish itself within Sri Lankan Agri-export landscape are explained in following table.

Unique Factor	Evaluation and justification of the Uniqueness
Focus on Agri SMEs	The application is designed to provide tailored support for small and medium enterprise who are actively engaged in manufacturing and exporting agricultural products. Unlike, broader BI platforms or identified competitors, C2W prioritizes the challenges faced by Sri Lankan SMEs when finding market opportunities across the globe.
Integration with Real-Time Market Data	The application is connected with live data pipelines through real-time APIs to provide users with valuable and informative insights.
Predictive Analytics Model	C2W utilizes a pre-trained ARIMA model on large set of historic data to predict future market values for specific markets on specific products to assist exporters in making effective decisions.

Table 8.1 *Uniqueness of the proposed solution*

C2W addresses the specific needs of the Sri Lankan SMEs by providing customizable data visualization of future market predictions, valuable buyer information and acting as key resource for global news about exporting of agricultural products around the world.

8.2.2. Strengths and Weaknesses of the proposed solution

8.2.2.1 Strengths

In additions to the factors that make C2W an unique IS solution in its landscape, additional key strengths of the application are explained below.

- The application's intuitive interface makes complex data and information easily understandable and accessible for users without extensive technical expertise.
- The solution design approach utilized gives opportunity to connect the application with extensive data pipelines to provide customized insights for users such as identified what markets have the highest profitability for certain products in upcoming months.
- The application is designed to handle moderate data volumes and deliver quick query responses to users.
- C2W acts as knowledge hub which facilitates environment for unique user base.

8.2.2.2 Weaknesses

Limitations of the final solution are explained below as weaknesses of the application.

- Due to time and monetary constraints, application is currently not connected with any bulk data pipelines from corporate data sources. Connecting application with data pipelines from corporate organizations requires legal documentation and large investments, therefore current scope of the provided services are limited only to 10 products in 10 different markets. All the functionalities are completely developed to connect platform with live data pipeline in the future iterations, currently data gathered from legible sources are stored in MongoDB database and delivered upon user's request.
- The reliability of the insights provided by C2W depends on accuracy and consistency of underlying data. Currently, data gathered from reliable and legible sources are uploaded to database after thorough manual cleaning and validation process. In order to increase scale of the application, integrating data cleaning and validation features is mandatory. Overall value provided by application to the users is dependent on the quality of the data therefore it has been identified as weakness of the application.

8.3 Reflection of New Knowledge and Skills Gained

The news skills and knowledge gained by author during the project duration are mentioned below.

- Improved documentation, requirement gathering and elicitation skills.
- Improved communication and presentation skills by conducting interviews and presenting project idea to domain experts and other stakeholders.
- Improved database design and ETL process design skills to consolidate data from various resources.
- Learned predictive analytics model development skills to develop ARIMA model for predictive analytics component.
- Improved understanding of export process and Sri Lankan Agri-export market dynamics.
- Improved knowledge in developing web application using react and flask frameworks.
- Gained knowledge in how to use APIs effectively.
- Improved knowledge in designing effective interfaces using Google's material design system.
- Completed google data analytics certification to get a thorough understanding about development of business intelligence applications.

8.4 Recommendations

- Support for multiple languages need to be implemented in C2W to improve the accessibility for users who are fluent in local languages.
- The mobile application version can be developed to increase the usability of the escrow agreement feature.
- The predictive ARIMA model can be improved by training with extended data sets with more variables.
- The news feature can be improved to provide alerts to users about significant news alerts that can be relevant to user based on their specific industry category by integrating with complex algorithm to provide users with news relevant to their previous activity in the application.
- The buyer feature can be improved by connecting with more buyer directories and provide a legibility measurement of each buyer based on a criteria.
- AI chatbot can be connected to answer exporters industry specific questions such as tariff and different export procedures used in different countries and provide relevant learning materials.

8.5 Future Implementations

- The application can be connected with government data sources to increase the credibility of the application.
- The application can be connected with real time data pipelines instead of manually uploading data.
- In-build data validation and cleaning mechanisms need to be implemented.
- Mechanisms need to be implemented to continuously monitor and improve the accuracy predictive analysis model.
- C2W application need to be connected with open Escrow API to facilitate escrow agreements for foreign and local arrangements, currently user interface for this feature is developed except for the backend Functionalities due to monetary constraints.
- In-built messaging between users and Q&A forum need to be implemented to improve the community building aspect of the application.

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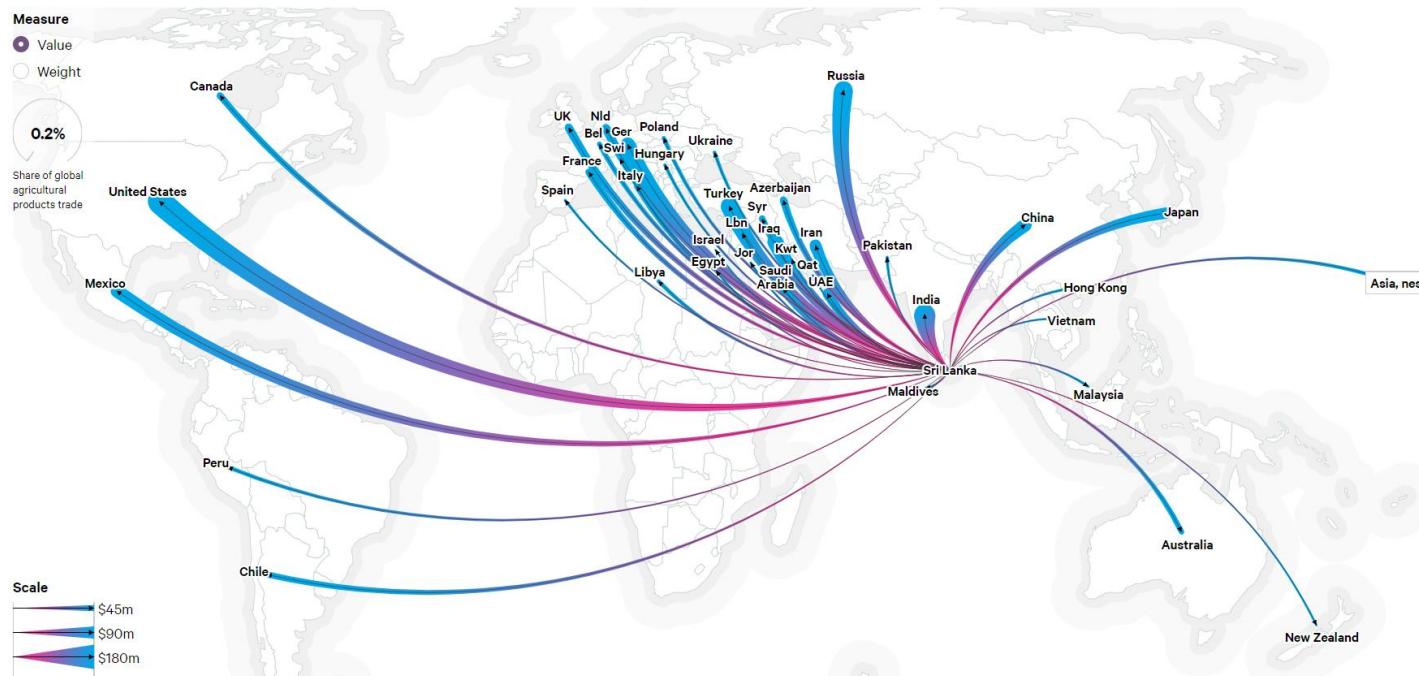
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10. Appendix

Appendix A – Images from report

A.1 Chapter 1: Introduction



Source 10.1 <https://resourcetrade.earth/?year=2020&exporter=144&category=1&units=value&autozoom=1>

Figure 10.1 Agriculture export destination map

[Go back](#)

A.2 Chapter 2: Background

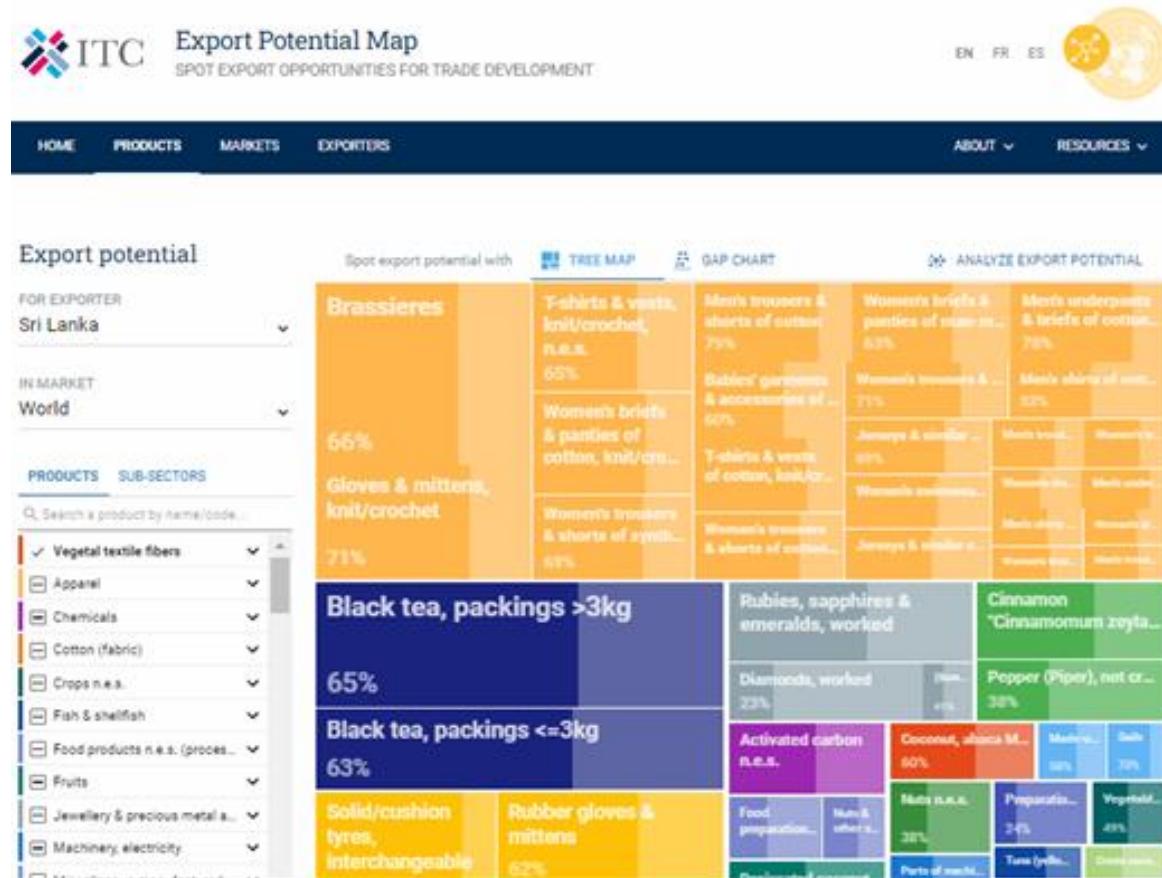


Figure 10.2 International Trade centre

[Go back](#)

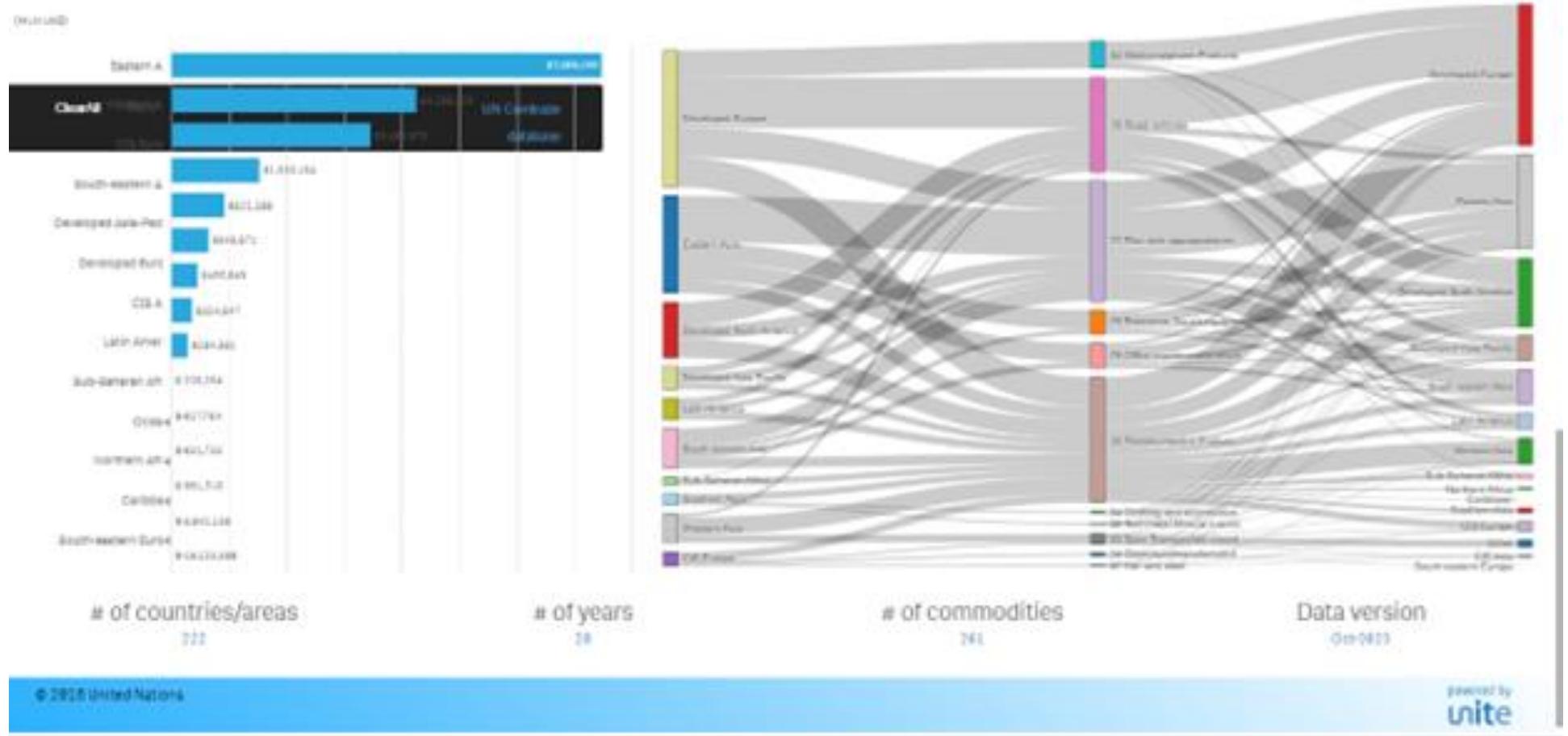


Figure 10.3 United Nations Comtrade Database

[Go back](#)



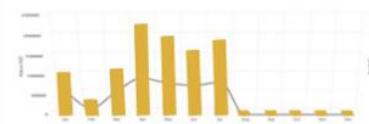
Figure 10.4 International Trade Administration

[Go Back](#)

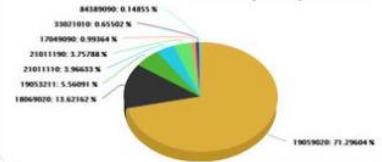
|| Features

Making technology, information, and actionable intelligence work better for your EXIM business:

Monthly Purchase Pattern Analysis



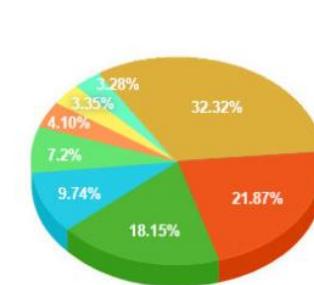
Main imports products



|| Smart Dashboard

It's an intelligent dashboard designed for our ever expanding network of the most astute customers on the planet.

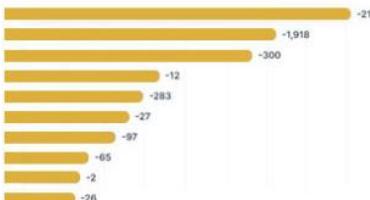
Top buyer country



|| Trade Analysis

It provides a deeper understanding of supply networks and export-import markets and aids in increasing their adaptability.

Top 10 importers



|| Port Analysis

It provides deeper understanding of supply networks and export-import markets and aids in increasing their adaptability.

Figure 10.5 The dollar business

[Go back](#)

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Hotels in Ireland - Market Size, Industry Analysis, Trends and Forecasts (2023-2028)

(NACE 155.100IE) · September 2023

Revenue €3.9bn '18-'23: +1.6% '23-'28: +XX%	Employees 56,468 '18-'23: -0.1% '23-'28: +XXX%	Businesses 1,583 '18-'23: +0.0% '23-'28: +XX%
Profit €XXX.Xm '18-'23: +XX%	Profit Margin X.X% '18-'23: +XX pp	Wages €X.Xbn '18-'23: +XX% '23-'28: +XX%

Hotels in Ireland industry analysis

Hotels in Ireland enjoyed sustained demand from both domestic and international consumers in the years before the COVID-19 outbreak. A reduced tax rate has also supported hotels in the years following the financial crisis, which made travelling in Ireland more affordable. This was axed in 2018 before being reintroduced to support tourism during

Instant access to hundreds of data points and trends

- Market estimates from 2013-2028
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- Incorporates SWOT, Porter's Five Forces and risk management frameworks
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Figure 10.6 IBIS World

[Go back](#)

Strategic Imperative ————— Growth Gap —————

the Yellow Brick Road

Transformational Growth —————

Let's Brainstorm

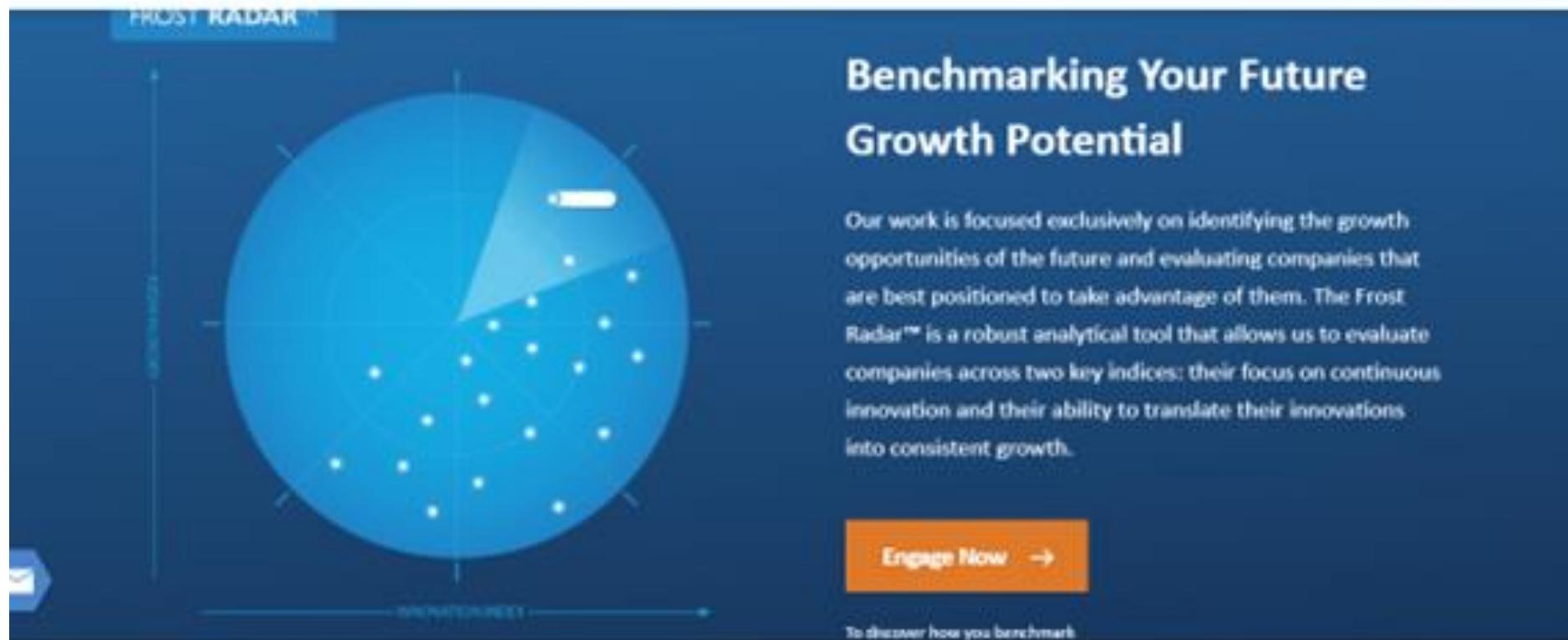


Figure 10.7 Frost & Sullivan

[Go back](#)

Currency USD ☰ Call 94-11-230-0705 / 11



HOME PRODUCTS ☰ SERVICES ☰ CORPORATE WEBSITE ☰

ABOUT ☰

FEATURED CATEGORIES



Ceylon Tea



Rubber & Rubber-based Products



Coconut & Coconut based Products



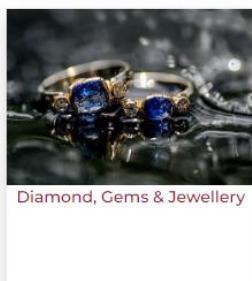
Apparel & Textile



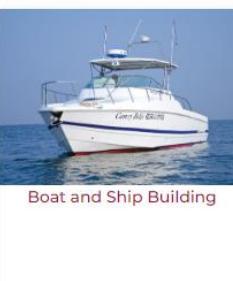
Spices, Essential Oils & Oleoresins



Food, Feed & Beverages



Diamond, Gems & Jewellery



Boat and Ship Building



ICT



BPM

Figure 10.8 EDB eMarketplace

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A.3 Chapter 4: Design

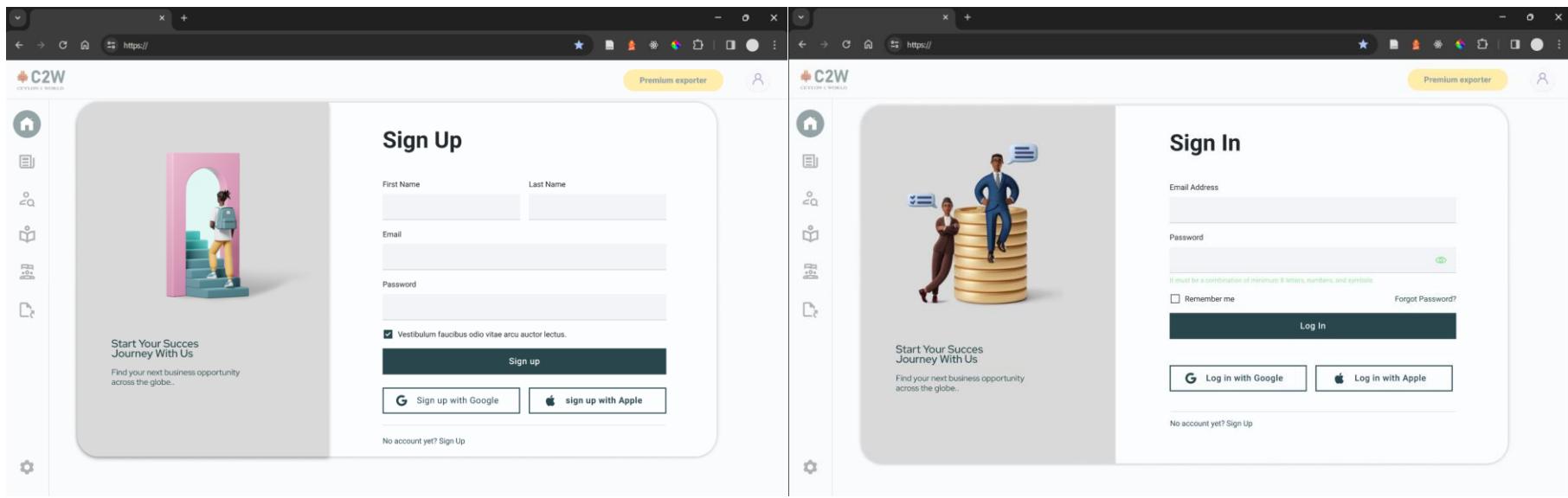


Figure 10.9 Sign up & Sign in UIs

[Go back](#)

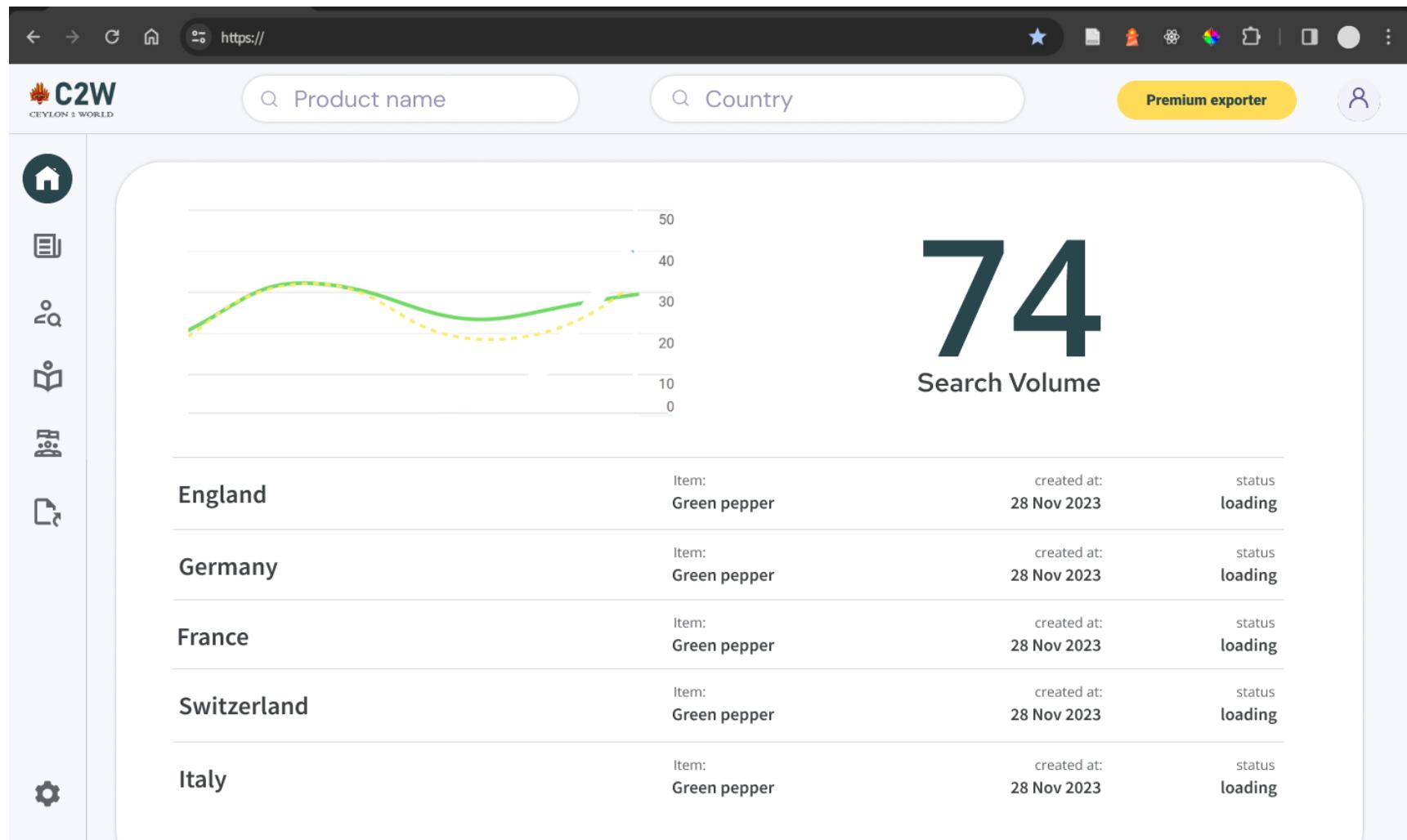


Figure 10.10 Sales forecast page

[Go back](#)

The screenshot shows the homepage of the C2W (Ceylon 2 World) website. The top navigation bar includes a search bar for 'Product name' and 'Country', a 'Premium exporter' button, and a user profile icon. On the left, there's a vertical sidebar with icons for Home, News (selected), Categories, Countries, and Help. The main content area displays three news cards:

- Australia: Crop exports set for record high after heavy rains**
Heavy rains, which were blamed for some food shortages in Australia, have also given crop exports a boost.
The country's farmers are predicted to see their most valuable year ever.
7 March 2023
By Annabelle Liang, Business reporter
- Why India's rice ban could trigger a global food crisis**
What happens when India bans exports of a food staple that is essential to the diets of billions around the world?
On 20 July, India banned exports of non-basmati white rice in an attempt to..
2 August 2023
By Soutik Biswas, India correspondent
- Ukraine war: Global wheat prices jump after India export ban**
The price of wheat has jumped on international markets after India banned the export of the staple cereal.
The benchmark wheat index rose as much as 5.9% in Chicago, the high...
16 May 2022
By Peter Hoskins, Business reporter

Each news card features a yellow square icon in the top right corner. A yellow circular arrow icon is located at the bottom right of the page.

Figure 10.11 Global agri-export news page

[Go back](#)

 C2W
CEYLON 2 WORLD

Product name Country Premium exporter 








Clover Banquets & Resorts
Hotel and Accommodation
  Clover Banquets & Resorts, 322/5, Gonawala, Biyagama Road (176.04 km) 11600 Kelaniya, Sri Lanka
A beautiful riverside setting less than (half an hour) from Colombo, a vast and luxurious pillar-less space with all the amenities you need, as well as lavish, star class cuisine – all you need to make your celebration matchless and truly.

Galle Caterers
Food and Drink
 We undertake orders for any occasion and We Prepare Sri Lanka, Indian, Pakistani and Chinese Menu Etc by experienced Chefs.

Herb Line

Figure 10.12 Search buyers page

[Go back](#)

The screenshot shows the 'Find Learning Materials' section of the C2W website. At the top, there are search bars for 'Product name' and 'Country', and a yellow button labeled 'Premium exporter'. A user profile icon is also present. On the left, a vertical sidebar contains icons for Home, My Profile, Notifications, and a Chatbot. The main content area features a large heading 'Find Learning Materials' and a message from a chatbot: 'Hey there, Let's have a chat. I am here to help you to find the best market opportunities around the world.' Below this is a text input field with placeholder text 'Enter something your interested here' and a send button.

C2W
CEYLON 2 WORLD

Product name

Country

Premium exporter

Find Learning Materials

Hey there, Let's have a chat. I am here to help you to find the best market opportunities around the world.

Enter something your interested here

Figure 10.13 Learn page

[Go back](#)

The screenshot shows a web browser window with the URL <https://>. The page is from the website **C2W** (Ceylon 2 World). The header includes a logo, search bars for "Product name" and "Country", a "Premium exporter" button, and a user profile icon. On the left, there's a vertical sidebar with icons for Home, Search, Ask question, and other site features. The main content area displays a question titled "Error with my random number generation code". Below the title, it says "Asked 1 year, 6 months ago" and "Modified 1 year, 6 months ago" (both in green), and "Viewed 48 times". The question text is: "My code generates a random number, it checks if it is in the list. If it is, it generates another random number and then it checks if it is equal or not and shows the result and repeats the process. But when I start the code it generated the normal number but it repeats the numbers and it shouldn't repeat the number. What do I do?". A user has downvoted the question with a "-1" rating. Below the question is a snippet of Python code:

```
from random import randint
import os
```

Figure 10.14 Q&A page

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Appendix B – Project Management

B.1 Pilot study details

Based on the project objectives and target audience, semi-structured interviews and questionnaire were chosen as the methods for eliciting user requirements.

Given the limited number of individuals with expertise in this domain, Interviews were selected as the most suitable method for eliciting requirements (*Product Research Rules*, 2022). This approach allows capturing rich insights and expert knowledge these individuals have accumulated through their extensive experience (*Mastering the Requirements Process, Second Edition*, 2006).

A comprehensive survey was administered among a representative sample (Levy and Lemeshow, 2013). A survey was selected as a requirement elicitation method to get a biased result from every exporter. Incorporating their diverse needs into the application design is critical for ensuring the successful user adoption of the final solution.

2.2.1 Requirement elicitation plan

Techniques	Subject	Objective
Background Research	Books and Journal Articles	To gather background knowledge on the problem and analyse the findings of previous research. Understand the effectiveness of services provided to Sri Lankan exporters by existing systems.
Interview	Researcher	To find areas that require more research. To get an overview about the knowledge gathered by researchers and the availability of the data resources.
	Export promotion officer (EDB)	Study the tools and resources provided to exporters by government bodies and identify the issues currently tackled by the Export Promotion Board as the official government organization appointed by the government. This interview helped to gain more knowledge about issues related to failures of new exporters and gain insights that can help to create a successful and promising digital solution.

	Private business advisor	To understand solutions proposed by advisors to solve the issues faced by new exporters and collect data about the reasons why new exporters are not capable of putting those solutions to work and gain their insights that can help to create a successful and promising digital solution.
--	--------------------------	--

	Established export business owner	To understand the approaches taken by successful exporters to overcome the issues that has affected to most of the exporters and gain their insights that can help to create a successful and promising digital solution.
	Former export business	To understand the major issues affected him throughout his business journey and identify what are the technical tools that could potentially benefit him to restart export business.
Survey	Small and Medium-scale exporters	To validate the knowledge gathered from other interviewees and gain their overall opinion about the proposed solution.

Table 2 Requirement elicitation plan

2.2.2 Analysis and findings

The actions taken to improve the system after analysing the interview findings and survey results are discussed in detail throughout this section. Initially comprehensive study of the stakeholders was done using interview techniques to identify the major issues that created the sub problems.

To begin with EDB export promotion officer was interviewed to gather knowledge about emerging concerns in the industry and to gain contact information of experienced exporters. Mr.K.M.V Sachithra was approached through email. The other two exporters were connected through personal contacts. Distribution of the survey was done in the exporter directory provided by the Export Development Board.

The sample population was included of small and medium-scale export-oriented agri-business from failed businesses, struggling businesses and successful businesses including entrepreneurs willing to enter the export business arena. Findings gathered from these two audience segments are analysed and briefly discussed in this section.

2.2.2.1 Sample descriptions

A questionnaire was shared amongst 145 exports, out of which 108 individuals participated in the study. Survey was conceptualized according to the SMART concept. (Specific, Measurable, Actionable, Relevant, Timely) The sample covered 50% males and 50% of females. Amongst the sample in which the questionnaire was shared 19.2% belonged to the 18-24 age category, 16.3% belonged to the 25 – 34 age category, 43.3% belonged to the 35 – 44 age category, 17.3% belonged to the 35 – 54 age category and 3.9% belonged to the 55 and above age category.

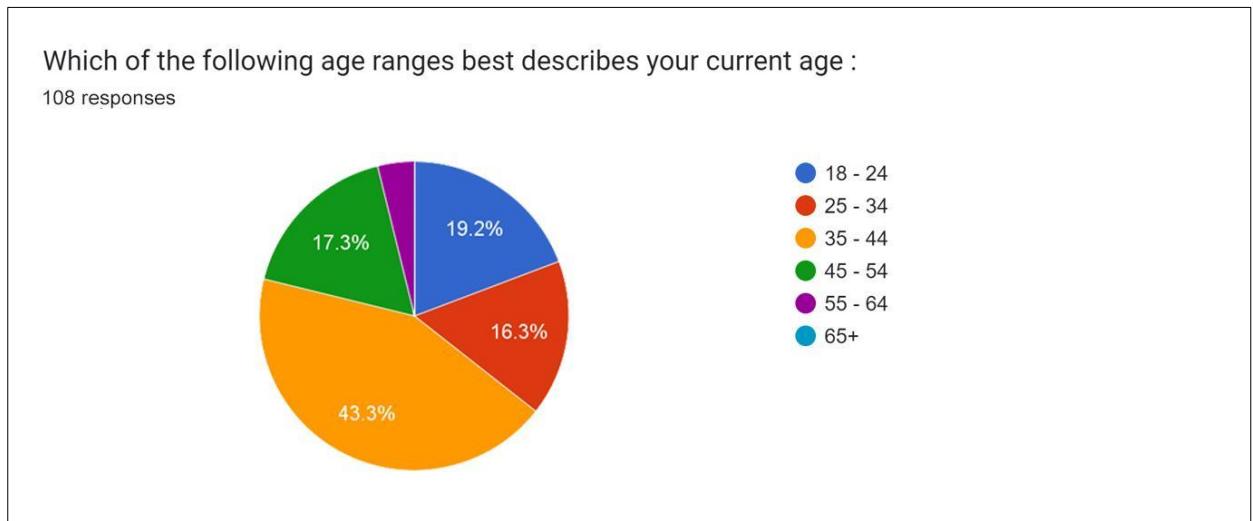


Figure 25 Age ranges of exporters

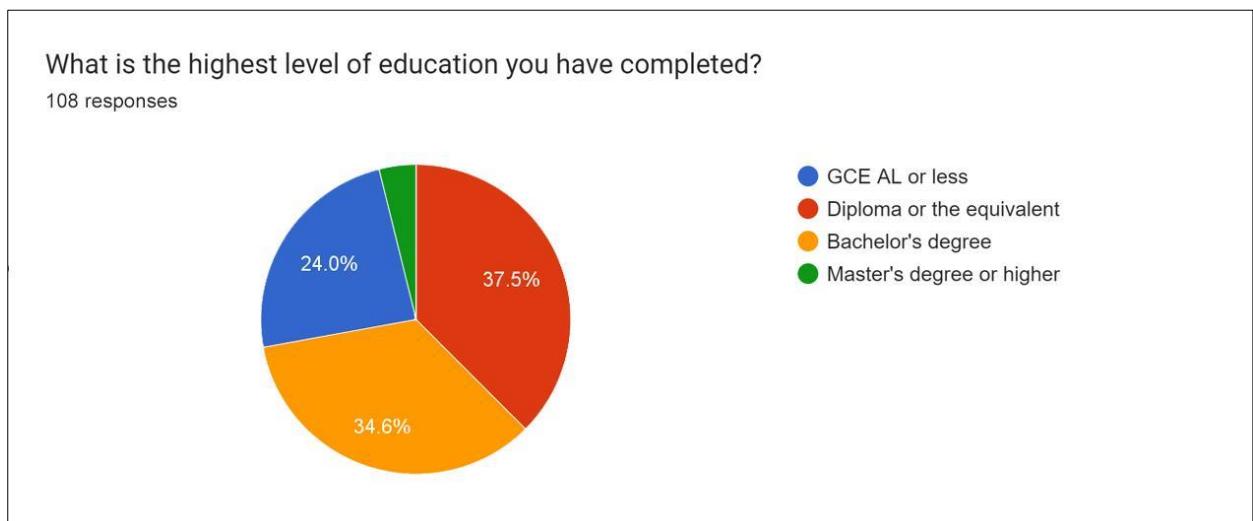


Figure 26 Education level of exporters

In addition to the quantitative data collected, qualitative insights were gathered through the interviews with domain experts (Table 4). Summaries of these interviews are provided in the Appendix.

Interviewee	Date and Time	Location or Platform
Dr.(Ms). K.M.V. Sachithra B.Com. (Special) (SJP); MSc. in Management (SJP); PhD in Business/Management (MSU, Malaysia), Researcher, Head of department Department of commerce	2023/11/7 6.00 PM to 6.30 Pm	Via zoom
Export Development Board Export promotion officer (requested to keep personal details disclosed)	2024/01/22 10.30 AM to 12.00PM	At Export Development Board office in navam mawatha
Export advisor (requested to keep personal details disclosed)	2024/01/15 3.30 AM to 4.10 PM	Via Zoom
Exporter 1 (fruit beverage) Ranjan T.Hanchapola Chairman Cap Group	2024/01/16 6.00 PM to to 6.40 PM	Via Zoom
Exporter 2 (coconut product) Mr.Karunasena subhasingha	2023/12/27 8.00 PM to 9.00 PM	Private plantation, Matara
Failed Exporter (requested keep personal details disclosed)	2023/ 12/ 26 4.00PM to 4.30 PM	Private café, Matara

Table 3 Interview details

2.2.2.1 Not being able to find new market opportunities.

2.2.2.1.1 Limitations of Market Analysis Without Technological Tools

Relevant questions were added in the questionnaire to identify the technological tools that are being used by exporters. The survey included a ‘None of the above’ option for participants who had not used any technological tools, in which 39.7% of the respondents stated that they have not used any technological tools.

Which of the following tools do you currently use to identify potential export markets for your products? (Please select all that apply):

108 responses

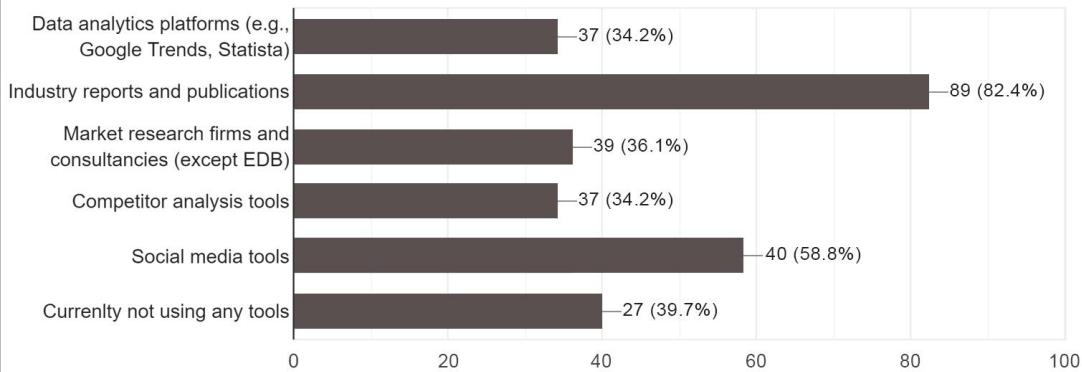


Figure 27 tools used to analyse and find markets

Buyers not being approached by the exporters with the expected supply capabilities is a major issue as per EDB export development officer who is responsible for connecting Sri Lankan exporters with foreign buyers stated,

“But actually, they are not replying because they don’t want to start business with low capacity exporters because its costly for them but there is a possibility that they contact Sri Lankan exporters when they lose their existing suppliers.”

Above data depicts that the primary obstacle hindering exporters’ success in finding buyers is insufficient market analysis and identification of markets best suited to their value proposition.

2.2.2.1.2 Limited awareness of emerging market trends and disruptions.

When questioned on the usage of the international news 94.7% of the respondents stated that they are using international news sources insights business decisions. Yet only 42.1% of respondents were leveraging these sources to gain the maximum advantage in international business setting.

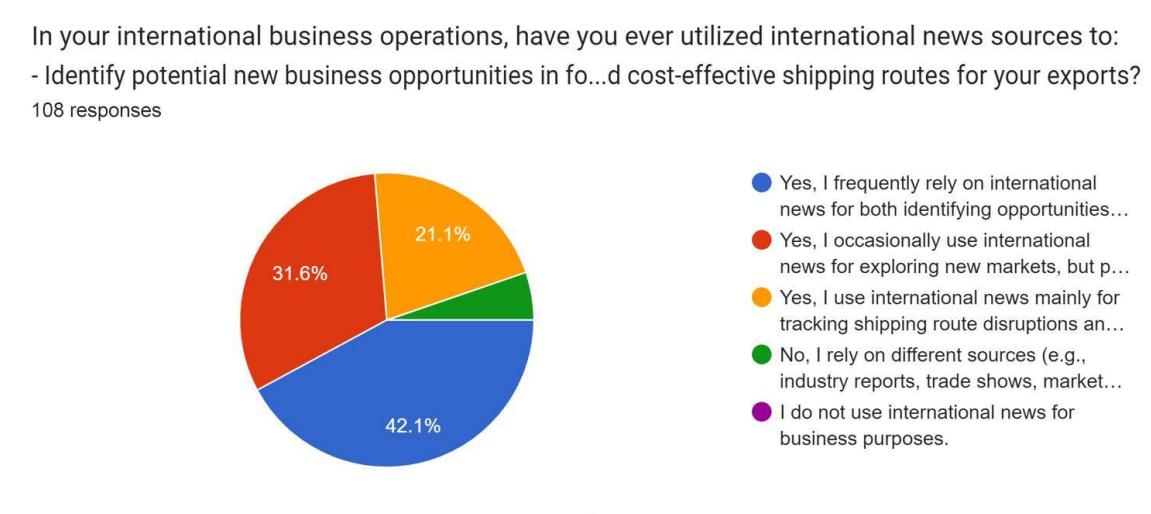


Figure 28 International news source usage of exporters

The questionnaire was incorporated with multiple sections to comprehensively assess the consequences faced by exporters lacking essential knowledge of international business procedures and regulations.

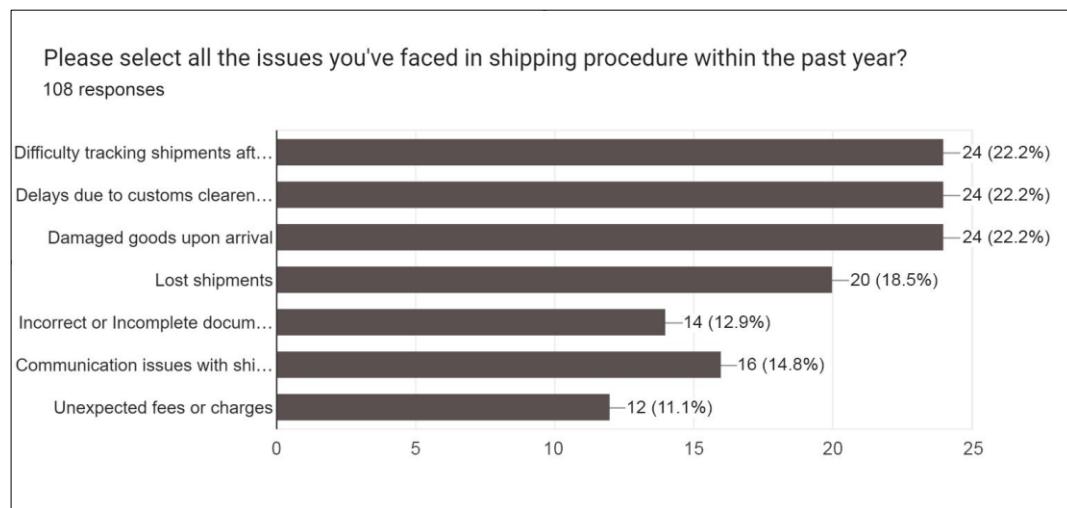


Figure 29 Issues in shipping procedure

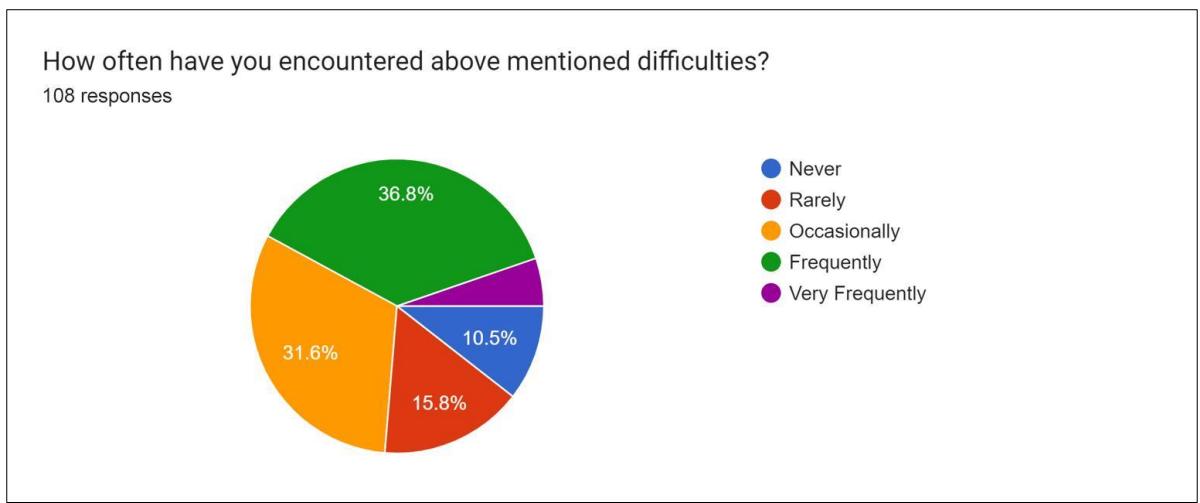


Figure 30 Frequency of shipping issues

As per the figure 12, it is highly likely that every exporter has encountered at least one of the listed challenges in the past year. As per the figure 13, 73.7% respondents have encountered listed challenges either occasionally, frequently or very frequently. This finding was important in concluding the statement of the EDB export promotion officer, “Exporters have to be aware about the global news to take critical business decisions”

2.2.2.2 Can't survive in existing export markets because of the inflation issues.

2.2.2.2.1 High Initial Capital Investment Barrier.

Export business advisor stated that export business might be highest profitable in Sri Lanka’s current economic climate, citing (Madurapperuma, 2016) inflation as a potential contributing factor.

“Export business is the most profitable business because of the current exchange rate of dollar within Sri Lanka”

Mr. Hanchapola stated that there are certain aspects every exporter have to look in to before start finding buyers for a product,

“Recently I found that there are pre-made bio-degradable boxes. It was marvellous. We have to think different. If we think like everyone else we cant be successful.”

Newly established exporters must navigate over 5 mandatory government requirements, primarily focused on administrative aspects. (Premaratne, Jayaratne and de Mel, 2011). This focus excludes crucial considerations like packaging and branding, which can potentially hinder their export success. These findings and the above discussed challenges that exporters have to face depicts the low possibility of a

exporter's becoming successful which mainly depends on the new exporters ability to launch a successful product after initial investments.

These findings, coupled with the above-mentioned challenges faced by exporters, depicts the limited probability of success for new exporters heavily reliant on launching a product after initial investments.

2.2.2.2 Challenges posed by fraudulent buyers in the export markets.

Relevant questions were added in the questionnaire to identify the frequency of exporters meeting fraudulent buyers.

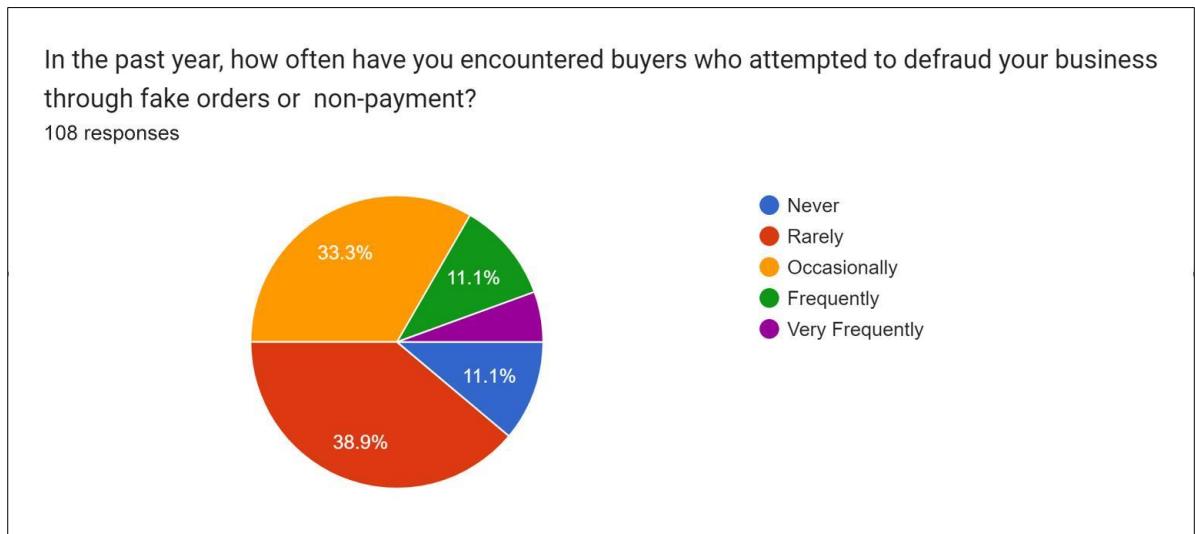


Figure 31 Frequency of encountering fraud buyers in last year

As per the figure, it is evident that majority of exporters have encountered fraudulent buyers. 50% of the buyers have encountered fraudulent buyers occasionally. Fraudulent buyers undermine the exporter's resilience throughout the challenging periods, which is a crucial factor for long-term success according to Mr.Hanchapola.

"I strengthen my relationship with the buyer. Actually its wasn't profitable for me but I know he will continue business with because of the credibility I have built throughout the years."

Mr.Hanchapola prioritized long-term potential over immediate profit for that specific shipment, recognizing the significant growth potential in the international coconut water market. (Burns, Johnston and Walker, 2020)

Exporters lacking a robust business profile face increased vulnerability to scammers, as highlighted by (Guo *et al.*, 2018). According to EDB export promotion officer, such scammers actively seek out potential targets,

“I usually get hundreds of emails. I am not even bothered to go response them. With my experience I can understand whether it is legit or not by just seeing the email”. Above discussed data proves that fraudulent buyers are major threat for exporters which can be very challenging for new exporters.

The data suggests that fraudulent buyers pose a significant threat to exporters, particularly challenging for new entrants.

2.2.2.3 Not being able to meet current market demands

2.2.2.3.1 Limited product differentiation to meet customer expectations

In order to understand the approaches taken by exporters when entering market, several queries were included in the questionnaire.

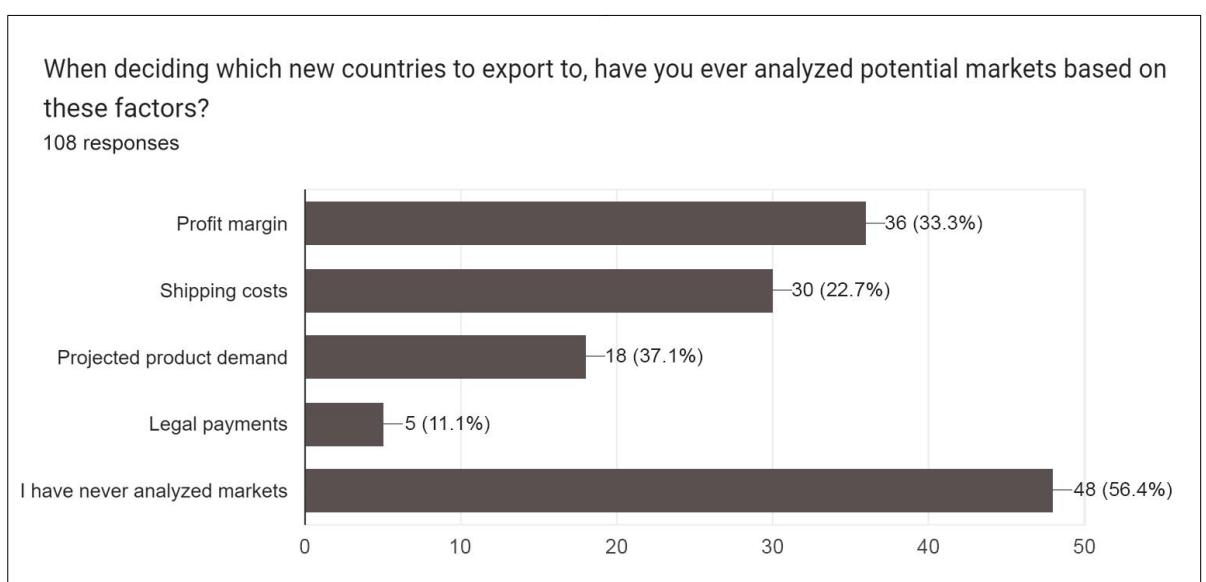


Figure 32 Factors considered when analysing markets

As per the figure 4, 50% exporters have not considered about the key factors when entering new markets. (Andersson and Shyamali Kekunawela Pathirana, 2022) The success of export businesses hinges on their products' ability to compete with offerings from domestic manufacturers. Also export business advisor stated that exporters need to focus on niche market requirements when entering certain market,

“niche market requirement this is about the expectations of the customers in niche market area you target.”

Miss hanchapola stated that exporters need to focus on current worlds trends to launch successful products to foreign markets.

“You have to focus more about these categories like healthy, sugar free and meat replacements. This is the way world is moving and these products have more demand.”

According to EDB export promotion office identified potential shortcomings in amabalagoda masks, adapting to foreign market demands, stating

“foreigners don’t want masks like that. They want masks with a modern touch.” (Sorenson and Bogue, 2005) highlights that Product quality is not the main factor, exporters have to consider the price range, packaging, market trends, etc. Above discussed findings depict that Sri Lankan exporters must improve their techniques to cater their products to match foreign markets.

2.2.2.3.2 Limited knowledge sharing

When questioned on the knowledge on rules and regulations, 94.7% respondents stated that they have encountered issues because they were not aware about rules and regulations.

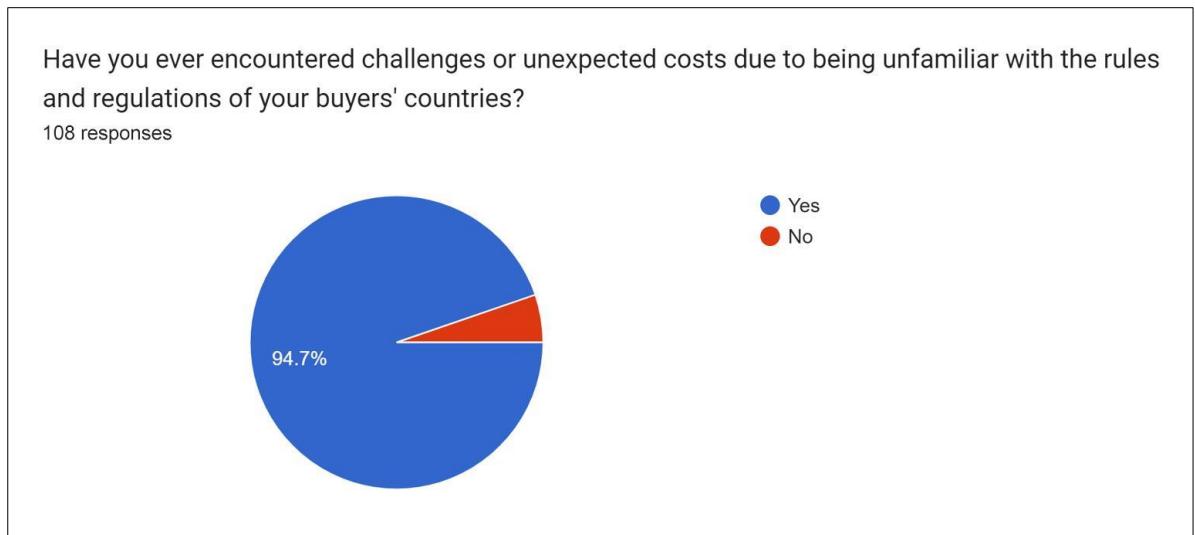


Figure 33 Familiarity with rules and regulations.

Mr.Hanchapola stated that using 100% raw materials available in Sri Lanka can increase the exporters profit margin even though they are ready to alter their products,

“You need to make sure raw materials are 100% available in Sri Lanka. It increases the possibility of your product become successful.”

Furthermore, he mentioned trying to find world trends such as organic, healthy, environment friendly, etc. (*A review on alternative raw materials for sustainable production: novel plant fibres | Cellulose*, 2022). The data suggests a potential lack of communication among Sri Lankan exporters, despite its potential efficacy in mitigating daily business challenges and adapting to dynamic markets.

2.2.2.3.1 Delays in responses to buyer inquiries.

Mr. Hanchapola identifies prompt responsiveness as a crucial factor in securing buyers, stating:

“Buyers expect responses to inquiries within an hour; delays often lead to lost opportunities. Most Sri Lankan exporters, however, take at least 3 days to respond.”

Survey results also show that approximately 40% of exporters don’t use any technological tools in their business processes. This is the root cause of issues where exporters have a poor first impression.

Furthermore, survey participants have responded that technical features to gather important news leads, market trends data, analyse data and get details about rules and regulations as most important features.

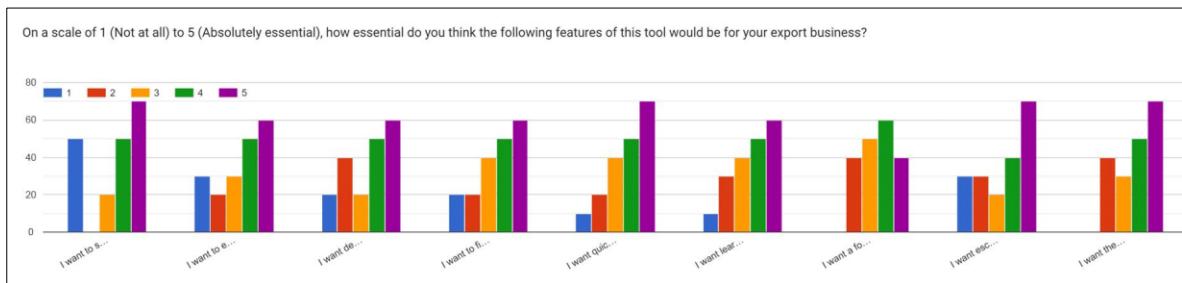


Figure 34 Feature rating according to exporters.

The data identifies a correlation between technological skills and exporters’ ability to provide competitive pricing, potentially impacting their success in securing business opportunities.

2.2.2.4 Not getting compelling support from government institutions

(Ramasamy, 2020) The Sri Lankan Agri export industry operates within a complex government landscape. However, individual perspectives on government effectiveness vary widely, making assessments complex. Despite this, the Sri Lankan Export Development Board (EDB) plays a crucial role in providing valuable assistance to exporters.

(Upulwehera *et al.*, 2022) examine Sri Lankan government institutions' support for exporters through case study with 10 entrepreneurs, offering valuable insights into this specific aspect of the export ecosystem.

*An interviewee within the study by (Upulwehera *et al.*, 2022) representing a small and medium-sized exporter stated,*

"As far as I experienced, most of the government officers are having negative views towards SMEs like us who operate in exportation. They however try to put barriers, not try to encourage, or support us for our innovations. I think this system should be changed first".

The findings suggest a potential knowledge gap between some ground-level officials and the needs of highly motivated entrepreneurs, which could impact service effectiveness of local government officials.

2.2.2 summary of outputs

Table 8 summarizes the modifications made to requirements and system design adjustments based on survey and interview insights, paired with corresponding problem they address.

Sub problem	Outputs
2.2.2.1.1 Limitations of Market Analysis Without Technological Tools	<ul style="list-style-type: none">- giving users ability to compare statistics of different markets will enhance their understanding and decision-making capabilities.- tariff data needs to be displayed alongside market statistics to provide exporters with a holistic perspective
2.2.2.1.2 Limited awareness of emerging market trends and disruptions	<ul style="list-style-type: none">- The development of an automated process to gather and display relevant news from established global business websites is a key requirement, as users expressed a need to stay informed about the dynamic business environment.- Presenting market trends statistics through effective visualizations, can potentially assist exporters in identifying key market trends

2.2.2.2.1 High Initial Capital Investment Barrier	<ul style="list-style-type: none"> - By equipping exporters with relevant knowledge on Agri-product markets, might enhances their chances of achieving successful product launches.
2.2.2.2 Challenges posed by fraudulent buyers in the export markets	<ul style="list-style-type: none"> - Exporters need to be given knowledge to find legitimate buyers - Use of relevant technological tools can contribute to smoother buyer identification process and potentially improve exporters' bargaining positions. - Successfully securing international buyers involves factors beyond the scope of any single firm. Exporters should carefully consider market research, due diligence and contractual terms when engaging with potential buyers.
2.2.2.3.1 Limited product differentiation to meet customer expectations	<ul style="list-style-type: none"> - Identifying special requirements of different markets can assist exporters modify their products.
2.2.2.3.2 Limited knowledge sharing	<ul style="list-style-type: none"> - Communicating with other exporters give exporters opportunity to create more sophisticated products. - Experienced exporters are willing to help new exporters to avoid beginner mistakes
2.2.2.3.1 Delays in responses to buyer inquiries	<ul style="list-style-type: none"> - Exporters need to able to use given tools effectively to respond buyer in short time period.
2.2.2.4 Not getting compelling support from government institutions	<ul style="list-style-type: none"> - Acting as a portal to share government announcements can help exporters while adding additional value to the system.

Table 4 Summary of outputs

Finally, Survey participants were given the option to rate the features of the proposed solution. Majority of the participants responded 'I want to stay updated on global events that could affect my exports or target markets.', 'I want quick summaries of each

country's import regulations, duties and document requirements.', 'I want escrow payment system so I don't get ripped off by fake overseas buyers.', 'I want the platform translated into my native language so I can fully understand it.' As most important features. This data was used to define the priority level of different requirements.

Additional findings were used to make necessary changes to the system including major changes to the user interface. Detailed list of all functional and non-functional requirements can be found in the following section.

B.2 Gant chart

	Task	Start...	Due D...
1	Background Research and Create Fishbone Diagram [Project Initiation]	10/24/2023	10/26/2023
2	Project Timeline [Project Initiation]	10/26/2023	11/04/2023
3	Literature review [Project Initiation]	10/26/2023	11/01/2023
4	Project Initiation plan [Market Research]	10/27/2023	11/06/2023
5	Data source identification and collection [Market Research]	10/31/2023	11/03/2023
6	Data source identification and collection [Market Research]	11/01/2023	11/03/2023
7	SRS [Market Research]	11/01/2023	11/05/2023
8	Data quality assessment [Market Research]	11/03/2023	11/05/2023
9	Gap Analysis Table [Market Research]	11/05/2023	11/09/2023
10	User Stories [Design Phase]	11/09/2023	11/23/2023
11	Data Flow Diagram [Design Phase]	11/13/2023	11/28/2023
12	Work Breakdown Structure [Design phase]	12/06/2023	12/14/2023
13	UI/Ux Design Diagram [Design Phase]	11/23/2023	12/09/2023
14	Front-end development [Development]	12/09/2023	12/23/2023
15	Back-end development [Development]	11/24/2023	12/28/2023
16	Integration of data sources [Development]	11/29/2023	01/14/2024
17	Implementing predictive models [Development]	12/22/2023	01/31/2024
18	Geospatial data integration [Development]	01/19/2024	02/09/2024
19	Unit testing [Testing and QA]	02/14/2024	02/16/2024
20	Integration testing [Testing and QA]	02/09/2024	02/27/2024
21	User acceptance testing [Testing and QA]	02/21/2024	03/06/2024
22	User guides [Documentation]	01/30/2024	02/16/2024
23	Technical documentation [Documentation]	02/14/2024	03/06/2024
24	Training materials [Documentation]	02/28/2024	03/12/2024
25	User acceptance Testing Plan [Testing and QA]	03/06/2024	03/11/2024
26	Deploying the web application [Deployment and Training]	03/06/2024	03/20/2024
27	User training and onboarding [Deployment and Training]	03/20/2024	04/01/2024
28	Post-launch monitoring and feedback collection [Continuous Improvement]	04/01/2024	04/30/2024
29	Iterative development and updates [Continuous Improvement]	04/05/2024	04/30/2024
30	Final documentation and reporting	04/15/2024	05/09/2024
31	Project review	05/02/2024	05/15/2024

Figure 10.35 Gant chart task list

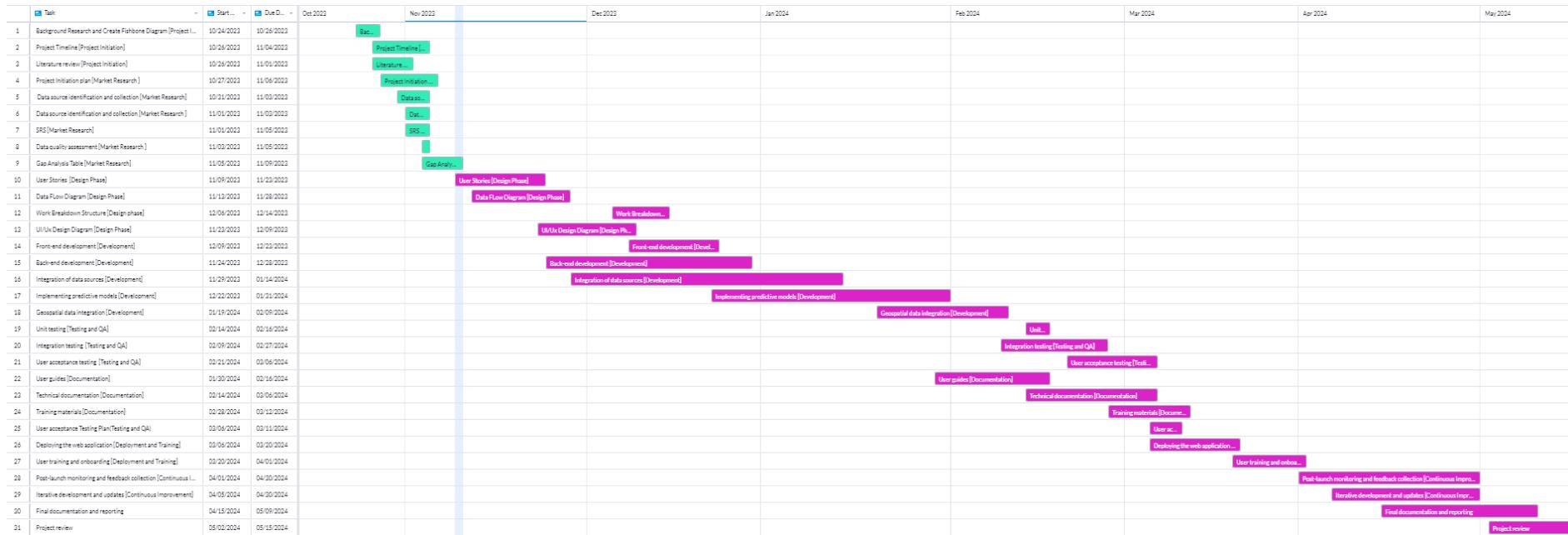


Figure 10.36 Gantt Chart

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B.3 Log Book

1	Name of the Supervisee	Wishwa Jayanath						
2	Student ID	2017087						
3	Project Title	Ceylon2World						
4								
5	Meeting #	Date	Time	Discussion/Guidance given	Tasks to complete before next meeting	Next Meeting Date	Next Meeting Time	Comments on previously assigned work
6				All the basic thing we should know in order to find a solution or opportunity to develop a project which is practical and deliverable. Also the sources we should use when we are finalizing our project idea. whatsapp group was created where we can get instructions on how to contact supervisor in the process of figuring out how we are going to finalize our idea.				
	1	2023/09/25	9:00 p.m to 8:00 pm	Comeup with solid idea which has a value in business context and can be delivered with results.	2023/09/26	05.00 p.m.	Idea is yet to be generated	Signed Off
7				Discussed about the different segments in project proposal and what are the work we have to get done in order to finalize those segments. Every supervisee presented their update about the current state of the FYP idea. Everybody was given advice on what are the areas we need to be focusing when selecting the final year project idea.				
	2	2023/10/09	5:00 pm to 6:00 pm	Finalizing FYP idea and working on project proposal	2023/10/23	05.00 p.m.	- Not filling log book on time	Signed Off
8				Further advice given to find a good idea which address a solid problem and has publicly available dataset. Also everybody was given advice on how they need to improve their research and what are the key points they need to be focusing. Discussing every supervisee ideas in group meeting was very helpful for everyone to understand how we need to change our thinking to find a problem with effective solution.				
	3	2023/10/23	5:00 pm to 6:00 pm	Finalizing Project proposal before next meeting to get it reviewed by thamal sir	2023/11/06	05.00 p.m.	- Finalized PP to be shared before the next meeting	Signed Off
9				review of the submitted project proposal draft were discussed. Areas for improvement were identified. Sir showed us example of past proposal and described why we need to add those components in the project proposal phase.				
	4	2023/11/08	5:00 pm to 6:00 pm	rewrite the proposal according to given review and submit it for final review before submission	2023/11/20	05.00 p.m.		Signed Off
10	5	2023/11/20	5:00 pm to 6:00 pm		2023/12/04	05.00 p.m.		Signed Off
11				Discussed about the literature review in detail. Discussed about scenarios where we cant find enough articles and how to include articles in world and south asian context.				
	6	2023/12/04	5:00 pm to 6:00 pm	Completing draft for the second chapter	2023/12/18	05.00 p.m.		Signed Off
12	7	2023/12/18	5:00 pm to 6:00 pm	Discussed Literature review	2023/1/01	05.00 p.m.		Signed Off
13	8	2023/01/01	5:00 pm to 6:00 pm	Discussed survey	2023/01/15	05.00 p.m.		Signed Off
14	9	2023/01/15	5:00 pm to 6:00 pm	Discussed PSPD	2023/01/29	05.00 p.m.	Feedback shared via Email	Signed Off
15	10	2023/01/29	5:00 pm to 6:00 pm	Discussed chapters in detail	2023/02/12	05.00 p.m.		Signed Off
16	11	2023/02/12	5:00 pm to 6:00 pm	Discussed Prototype demonstration	2023/02/26	05.00 p.m.		Signed Off
17	12	2023/02/26	5:00 pm to 6:00 pm	Discussed the progress of the final report and project		05.00 p.m.	- Needs to focus on completing the report - Incomplete log bog	Signed Off

Figure 10.27 Project Logbook

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B.4 Work Breakdown Structure

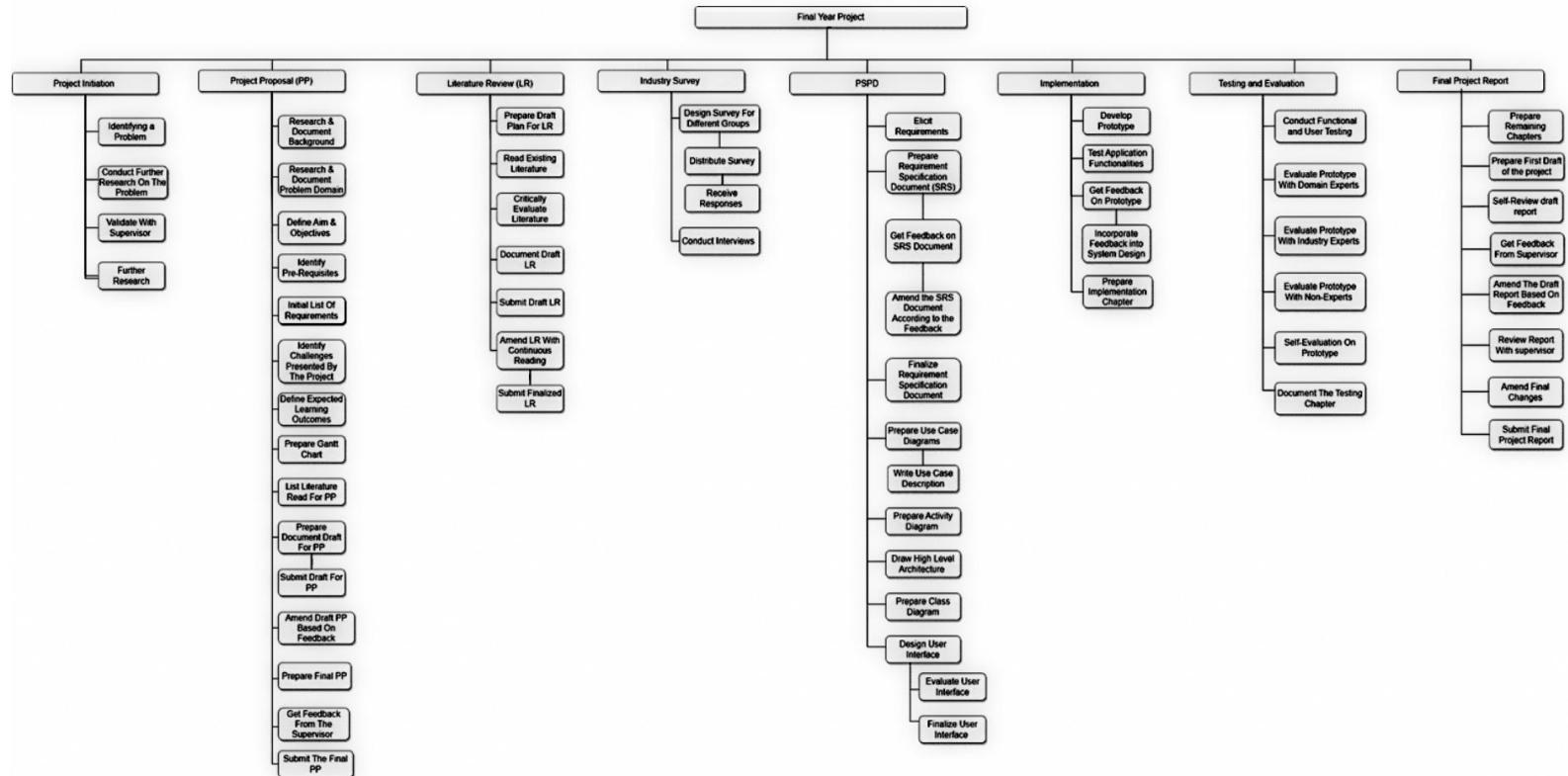


Figure 10.38 Work Breakdown Structure

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Appendix C – Revised Functional Requirement List

Req ID	User	Requirements	Priority	Use case
FR01	Registered user	Registered user should be able to view world wide news page	Must have	View news page
FR02	Registered user	Registered user should be able to use monthly sales forecast	Must have	Use annual sales forecast
FR03	Registered user	Registered user should be able view Q&A forum	Should have	View Q&A forum
FR04	Registered user	Registered user should be able to visit header links	Should have	Visit header links
FR05	Guest user	Guest user should be able to register to the system	Must have	Register user
FR06	Registered user	Registered user should be able to login to the system	Must have	Login user
FR07	Registered user	Registered user should be able verify their accounts with the business registration documents	Should have	Verify user
FR08	Registered user	Registered user should be able to bookmark, remove bookmark news card	Should have	Bookmark news cards
FR09	Registered user	Registered user should be able to view compare results	Should have	View compare results
FR10	Registered user	Registered user should be able to search buyers	Must have	Search buyers
FR11	Registered user	Registered user should be able to bookmark, remove bookmark report buyers	Should have	Bookmark buyers
FR12	Registered user	Registered user should be able to register as buyer	Must have	Register as buyer

FR13	Registered user	Registered user should be able to view transaction list	Should have	View transaction list
FR14	Registered user	Registered user should be able to invite buyers	Should have	Invite transaction users
FR15	Registered user	Registered user should be able to create transaction agreements	Must have	Do transactions
FR16	Buyer user	Buyer user should be able to view transaction list	Should have	View transaction list
FR17	Buyer user	Buyer user should be able accept transaction agreements	Should have	Do transactions
FR18	Registered user	Registered user should be able to get learning material suggestions	Must have	View learning materials
FR19	Registered user	Registered user should be to ask and delete questions	Should have	Ask and edit questions
FR20	Registered user	Registered user should be able to answer, up vote answers and down vote questions and answers	Should have	Answer and vote, report questions
FR21	System admin	System admin should be able to manage legal documents and learning materials	Must have	Manage documents & materials
FR22	System admin	System admin should be able to ban users involved in application rules and regulation violations	Must have	Ban users
FR23	System admin	System admin should be able to manage websites used to gather intel	Must have	Manage websites
FR24	System	System should be able to gather and filter news and display	Must have	Display news

FR25	System	System should be able to store bookmarked news and display when requested	Must have	Store and retrieve bookmarked news
FR26	System	System should be able to calculate and display profit margin, market demand	Must have	Calculate market demand and profit margin
FR27	System	System should be able to seasonal trends google trends API	Must have	Display seasonal trends
FR28	System	System should be gather, filter and display and buyer profile	Must have	Display buyer profiles
FR29	System	System should be able to find the education materials according to buyers profile	Could have	Suggest learning materials
FR30	System	System should be able to display rules and regulations for different markets	Must have	Display rules and regulations
FR31	System	System should be able to facilitate escrow services	Must have	Facilitate escrow services
FR32	System	System should be able to verify user	Must have	Verify user
FR33	System	System should be able auto detect unethical behaviour	Should have	Detect user behaviour

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Appendix D – User testing

Appendix D.1 Concept based User testing Questionnaire

1. Do you believe that this application capable of delivering the aim of the project?

2. From your perspective, does the prototype of the proposed solution meet the necessary requirements to effectively solve the problem?
3. According to your perspective, is this approach likely to increase the available options for users to find well aligned buyers with their portfolio ?
4. How would you rate the accessibility of the application?
5. How would you rate the user interface (UI) design of the application?
6. How would you rate the core features of the system?
7. Do you have any suggestions or feedback regarding the prototype of the proposed solution?

Appendix D.2 Design and Development based user testing questionnaire

1. Do you believe that this application is capable of delivering the aim of the project?
2. How would you rate the accessibility of the application?
3. Is user flow self-narrative and easily understandable?
4. How would you rate the user interface (UI) design of the application?
5. What is your thoughts on the quality of the codebase?
6. Do you find the technologies used in the development process efficient?
7. Do you have any suggestions or feedback regarding the prototype of the proposed solution?

Appendix E – Plagiarism Capture

The screenshot shows a plagiarism report generated by Feedback Studio. The report is titled "6BUIS020C – Final Project Report" and is submitted by Subhasingha Subhasingha. The report includes logos for INFORMATICS INSTITUTE OF TECHNOLOGY and UNIVERSITY OF WESTMINSTER. The main text of the report discusses "Ceylon2World (C2W): Empowering Agri-SME owners to discover lucrative export markets and navigate the exportation journey". The plagiarism overview on the right side of the interface shows 18 matches, with the top result being a self-plagiarism match from the university itself at 3%.

Rank	Source	Percentage
1	Submitted to University...	3%
2	www.mdpi.com	2%
3	mpra.ub.uni-muenchen...	1%
4	repo.lib.sab.ac.lk:8080	1%
5	www.statistics.gov.lk	1%
6	www.dive-portal.org	1%
7	www.journalajeba.com	1%
8	www.coursehero.com	1%
9	www.sdiarticle2.org	1%
10	www.researchgate.net	<1%
11	Submitted to CINEC Ca...	<1%
12	Submitted to University...	<1%

Appendix F – Video Link

<https://youtu.be/yZXUhqHpWd0>