APPLYING BEST VALUE APPROACH IN ESTABLISHING GUIDELINE FOR EDIBLE BIRD NEST CLEANING PROCESS

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By

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ABSTRACT

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Tan Kok Hong

Since 2009, Malaysia has become the world's second-largest producer of edible bird nests (EBN), following only Indonesia. With an estimated consumption of 5,654 tonnes in 2019, China is the most significant export market for edible bird nests. However, only 32 of Malaysia's 250 registered Edible Bird Nest (EBN) firms were granted an export license to China. This research aims to establish an alternative approach and guideline of the Edible Bird Nest cleaning process to assist stakeholders in obtaining a relative quality cleaning process. This is a mixed-method approach with qualitative and quantitative analytical processes. The semi-structured interview guide included questionnaires on challenges and the performance matrix of the industry. Subsequently, a survey was developed to accumulate sufficient data for analysing the performance of various practitioners. A total of thirty questions were prepared for questionnaires based on the Best Value Approach (BVA) concepts. BVA participants were identified using a Likert scale based on BVA characteristics. Participants who receive a total score of fifteen (15) out of thirty (30) will be classified as BVA practitioners. A score of 14 or less will be classified as Non BVA. BVA organisations in this research may not follow BVA processes, but they do have BVA company characteristics. A case study of selected cleaning facilities was closely examined to validate the

quality performance of the new improved cleaning process. A new enhanced cleaning method that can keep up to 19.09 per cent of nutrient concentration can preserve 50.25 per cent of crude protein, a 30 per cent increase in the likelihood of nutrients being maintained. The Best Value Approach (BVA) could narrow the gap between the top and lowest achievers from 10.8% to 3.6%. Practitioners of the BVA obtain a 15% improvement in work performance, according to the researchers. The implications of this research benefit not only the cleaning facilities but the entire ecosystem and supply chain. BVA has a greater impact on Small and Medium Enterprises (SMEs) as compared to larger and more established companies.

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This thesis entitled **"APPLYING BEST VALUE APPROACH IN ESTABLISHING GUIDELINE FOR EDIBLE BIRD NEST CLEANING PROCESS"** was prepared by TAN KOK HONG and submitted as partial fulfilment of the requirements for the degree of Doctor of Philosophy in Science at Universiti Tunku Abdul Rahman.

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SUBMISSION OF THESIS

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

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Date ________07/01/2022____________

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LIST OF ABBREVIATIONS/NOTATION/GLOSSARY OF TERMS

EBN	Edible Bird Nest
NKEA	National Key Economic Areas
CNCA	China National Certification and Accreditation Administration
PERHILITAN	Department of Wildlife and National Parks
UV	Ultra Violet
LOD	Limit Of Detection
PDCA	Plan Do Check Act
IMT	Information Measurement Theory
MDC	Manage, Direct and Control
TQM	Total Quality Management
BV	Best Value
BVA	Best Value Approach
DMAIC	Define, Measure, Analyze, Improve, and Control
CTQ	Critical To Quality
IS	Industrial Structure model
WRR	Weekly Risk Reports
PBSRG	Performance Based Studies Research Group
GT	Grounded Theory
SME	Small and Medium Enterprises
GNI	Gross National Income
MESTI	Makanan Selamat Tanggungjawab Industri (Food safety is responsibility of the industry)

HACCP	Hazard Analysis Critical Control Point
GHP	Good Hygienic Practices
GMP	Good Manufacturing Practices

CHAPTER ONE

INTRODUCTION

1.1 Introduction

This chapter provides an overview of the research. Section 1.2 establishes the study context, while Section 1.3 elaborates on the issue statement. Sections 1.3 to 1.8 define the study's research aim, objectives, method, scope, and limitations. Section 1.8 concludes the chapter by providing an outline of the chapters in this research.

1.2 Research Background

Edible bird's nest (EBN) is a valuable functional food and herbal medicine that has been consumed in China for hundreds of years (Wong, 2013). EBN is primarily a salivary gland secretion produced by many species of the Aerodramus genus swiftlet (Jamalluddin et al., 2019). Man-made swiftlet farming began to grow in the last few years, with an estimated 60,000 to 80,000 farms throughout Malaysia, since the native cave habitat grew too congested and incapable of tolerating swiftlet's population due to significant development. It has been selected as one of 16 entry point projects that would 'catalyse the formation of market-driven, industrial-scale, and integrated agriculture-related firms' as part of the National Key Economic Areas (NKEA) initiative (Hong et al., 2018). From their natural habitat in the dark and gloomy limestone caverns to the modern purpose-built swiftlet farms, the quality and number of bird nests have reached new heights. This accomplishment in moving swiftlet colonies' environment is one of the revolutions in the ease of gathering bird nests from dangerous settings to a safe and suitable setting (Hong et al., 2018).

Only five studies (Ma et al.,2012; Jong et al.,2013; Babji et al.,2015; Chua et al., 2016 and Dai et al.,2020) in the EBN cleaning technique literature research disclosed the EBN cleaning procedure. Brushing, soaking, picking, moulding, and drying are all common processes. The primary cleaning method entails removing feathers and frequently washing with water until the uncooked bird nest is clean. The majority of the article continues by stating that there is no uniform standard or guideline for cleaning bird nests and that the nutrients in the nests cannot be conserved throughout the cleaning operation.

Malaysia has been the world's second-largest producer of edible bird's nests since 2009, trailing only Indonesia. With an estimated consumption of 5,654 tonnes in 2019, China is the most significant export market for edible bird nests (Borneo Post,2020). The increase is exponential due to the high expanding economy of the Chinese market alone.

According to a list published by the People's Republic of China's Department of Certificate and Accreditation Administration (CNCA) in 2018, a total of 32 EBN enterprises in Malaysia obtained an export licence to China. It accounts for fewer than 10% of all registered EBN firms in Malaysia. As a result, the stiff defiance for industry players was acquiring a licence from CNCA China to export clean bird nests to China.

A study on the nutrition of edible bird nests found a significant difference in fat (0.01 per cent to 0.03 per cent) and ash (3.5 per cent to 6 per cent) content between dirty and clean nests. The report also said that the cleaning method increases the moisture content of a clean bird nest from 31% to 92% (Zainab et. al., 2013).

The real nutrients in bird nests, according to the research, cannot be preserved during the cleaning operation. The bulk of Malaysian processing plants fails to meet the CNCA of China.

Performance Based Studies Research Group (PBSRG) has 25 years of expertise in implementing the Best Value Approach, and multiple longitudinal studies utilising experts to generate transparency have identified purchasers/owners as the source of 90% of all project cost and time deviations. The claim was supported by case studies of the State of Minnesota, the initial $1 billion Dutch infrastructure fast track projects, the Arizona Department of Environment Quality study of professional services, the State of Hawaii three-year test (1998-2001), the University of Hawaii [One project manager completed 33 projects, with an average Project Manager load of three projects], the United Airlines tests, and the Saudi Arabian Classification endeavour. The total performance of testing resulted in a 50% reduction in procurement time and a project completion rate of 98 percent on time and on budget, with 98 percent customer satisfaction (PBSRG.com).

1.3 Problem Statement

In August 2011, China banned all bird nest from Malaysia due to an alarming situation in Zhejiang. According to China's industry and commerce bureau, the average nitrate level in 537 "blood nest" samples was 4,400 mg/kg, far above the national limit of 70 mg/kg. The bulk of the bird nests were assumed to have originated in Malaysia (Tho, 2014). The news devastated Malaysia's swiftlet industry, with raw bird nest prices falling by 60% from RM4,000 per kilogramme in 2010 to between RM1,200 and RM1,500 per kilogramme in 2013. (Lee, 2013).

Malaysia and China negotiated a treaty regulating the admission of bird's nests into China in September 2012, which included concerns such as inspection, quarantine, and cleanliness. In March 2013, fifteen Malaysian firms submitted applications to export their bird's nests to China. They were submitted to Chinese officials' scrutiny. In June, nine of them received provisional clearance, but only eight of them received final permission (Tho, 2014). The lifting of the embargo gave this long-suffering sector fresh hope. However, most downstream manufacturers appear to face a significant barrier in receiving final permission from Chinese regulators.

The key hurdles for Malaysia's EBN business are the export market and quality assurance. Malaysia is the world's second largest EBN exporter after Indonesia, with the primary export markets being Hong Kong and China. A total of 32 EBN firms in Malaysia secured an export license to China, accounting for less than 10% of all registered EBN companies in Malaysia. As a result, the stiff challenge for industry players was acquiring a license from CNCA China to export clean bird nests to China. However, the lack of consistency in their cleaning procedure jeopardizes their market share and product value.

The problems remain unsolved are:

1. Why could Malaysia's current edible bird nest cleaning process not meet the export requirement?

2. What is a relatively effective and efficient edible bird nest cleaning process?
3. What is the approach to obtain the best quality edible bird nest that meets the requirement?
4. How can the Best Value Approach improve the current performance of Malaysia's edible bird nest industry?

1.4 Research Aim

This research aims to establish an alternative approach and guideline for the Edible Bird Nest cleaning process to assist stakeholders in obtaining a relative quality cleaning process by CNCA standard.

1.5 Research Objectives

The difficulties of obtaining effective cleaning techniques arose often during the literature research, preliminary case study, and stakeholder interviews. To begin the inquiry, a small number of cleaning processing factories have been identified. One recurrent phenomenon that has emerged is the ongoing modification of the cleaning procedure to achieve higher quality. Due to the lack of procedures standards as a reference, most of the organization at a crossroads in the current circumstances.

According to the literature evaluations, few scholars are interested in expanding their study into cleaning techniques. This research deficit, however, has obscured the growth of EBN industries in expanding the market sectors. The goal of this research is to provide a structured approach to guiding future entrepreneurs and present stakeholders in boosting their output quality and capturing a larger market in the long term.

It is critical to examine the present cleaning process in order to comprehend the issues that the EBN cleaning sectors face. The cleaning technique may differ, but the difficulties may be the same for most of them. An investigation of the details handling procedure might aid in the development of a set of quality control assessment criteria. A new processing approach might be developed by studying each phase of the problems. The processes might be analysed using various laboratory tests, and so alterations to the present method could be applied.

Aside from the cleaning procedure, the research is looking into a systematic method to support new entrepreneurs in establishing cleaning facilities. The next phase would be to offer appropriate guidelines to aid the industry and serve as references.

In summary, the research has five objectives:

(i) to investigate the advantages and disadvantages of the current edible bird nest cleaning processes,

(ii) to develop evaluation criteria for quality assurance,

(iii) to seek an alternative, effective and efficient cleaning process to assist stakeholders in improving cleaning quality and productivity.

(iv) to validate the alternative cleaning process and the Best Value Approach as appropriate quality improvement processes, and

(v) to recommend a procedure for assisting stakeholders in the cleaning process.

1.6 Research Method

This was a mixed-method approach with qualitative and quantitative analytical processes. The semi-structure interview guide included questionnaires on challenges and the performance matrix of industry. The qualitative analytical procedure adopted was a five-phased cycle, which involves compiling, dissembling, reassembling, interpreting, and concluding. Subsequently, a survey was developed to accumulate sufficient data for analysing the performance of various practitioners based on the best value approach. The quantitative analytical procedure involves five steps descriptive analysis, inferential factors analysis, validation, interpretation, and conclusion. Each participant's BVA characteristics were graded on a Likert scale. BVA practitioners will be classified as having a total score of fifteen (15) out of thirty (30). Non BVA practitioners will be classed as having a score of 14 or lower. Lastly, a case study of selected cleaning facilities was closely examined to validate the quality performance of the new improved cleaning process.

The focus of this analysis was confined to enterprises based in West Malaysia, which was home to most of the processing plants. Chinese proprietors who were consultants, swiftlet farm owners, processing facility owners, and dealers were prospective respondents in this study.

In this investigation, most of the cleaning facilities impound to farm's nest or "house nest" rather than cave nest. Because the bulk of EBN sent to China was primarily composed of house nests, the study was focused on this niche market.

1.7 Significance of the Study

The supply chain benefits from the beginning of raw bird nests producers to the end customers because of this research. This research not only allows swiftlet farmers to focus on their farm management, but it also helps to maintain a long-term cooperation with local cleaning facilities, resulting in a win-win ecology. Swiftlet farmers optimise their swiftlet farm by altering humility, temperature, and even pest control concerns based on direct feedback from cleaning facility.

The cleaning facilities, without a doubt, will profit the most, as the entire study is targeted to address their problems. The proposed guidelines and new enhanced cleaning techniques not only boosted their production but also improved the work performance. It also established a basic checklist for each new entrepreneur in this industry. It develops a long-term strategy for doing additional research into the diversification of product applications and implementation in the medical and pharmaceutical industries in collaboration with local universities. A higher reputation not only increases customer trust, but also motivates research centres and institutions to invest in creating new products and applications.

Trust and authenticity of products are at the top of the list of consumer confidence levels in exotic farm items. A network of loyal clients is also built via consistent product quality and reputation. Customers benefit from decreased pricing because of implementing a loyalty programme or referral system.

New enterprises and job opportunities spring up all throughout the country as raw bird nest flows from upstream to downstream in the supply chain. Educational excursions to swiftlet farms, as well as cleaning and bottling companies, are among the other businesses that profit from the possibility. Experiencing a variety of tasty and nutritious bird nest delicacies also contributes to the country's image and branding.

1.8 Chapter Outline

This research consists of eight chapters, which are Introduction, Literature Reviews, Research Methodology, Result and Discussion on Qualitative Interview, Result and Discussion on Quantitative, Result and Discussion on Case Study, Conclusion and Recommendations.

Chapters 1 encompasses a brief introduction of this research, the background, and the problem statement. The aim and objectives of the research and overview of the research methodology are briefly introduced. The scope and limitations of this research are highlighted.

Chapter 2 critically reviews all the publications on the EBN industry related to cleaning facilities, process, or quality assurance. Firstly, the types and characteristics of swiftlets in Malaysia were examined. The detailed development in Malaysia is critically reviewing the swiftlet farm's determining criteria. A case study of a selected town was reviewed, and all findings were reported for further analysis of this research. All types of edible bird nests; including details cleaning processes are discussed and reviewed in this chapter. Lastly, the quality improvement system and summary of current challenges are illustrated for further research.

Chapter 3 explains the methodology to conduct the research. The rigour of this research is underpinned by the research philosophy of the post-positivism paradigm. This section explains the overall concept of research design and methodology; follow by research instrument and research sampling method. Lastly, the research flow and research design are illustrated.

Chapter 4 consists of a report on the semi-structured interviews conducted, analysing the transcripts of the interviews, and validating the transcripts. The contents of the transcripts are analysis and inferences the results for generalisation. Lastly, the summary of findings was tabulated in a diagram.

Chapter 5 contains the findings of the quantitative survey questions that were administered, as well as an analysis of the survey data. The contents of the survey are disassembled, and the results are examined for hypotheses. The discussion about the obstacles and concerns that local bird nest cleaning services encounter is tallied, and all inferential analysis is gathered. The results are rigorously validated by a panel of experts or consultants. Finally, a summary of the findings is shown.

Chapter 6 displays the findings of the interviews and analyses the case study done at a few selected cleaning facilities. The edible bird nest samples acquired during cleaning operations are tested in a laboratory. Finally, a table format summary of the test report's findings is displayed.

Chapter 7 discusses the issues that investors and swiftlet farmers face in urban swiftlet farming. As a result of the analysis, suggestions and recommendations were developed. The demand for uniform benchmarking and quality assurance processes was discussed, along with the establishment of a measurement criterion for the manufacturing process. The cleaning technique is outlined, and production planning for EBN cleaning facilities in Malaysia is advised. Finally, the application of the Best Value Approach resulted in a significant outcome, which was discussed in detail.

Chapter 8 concludes the overall investigation of this research. The study findings satisfy and justify the research goals. The contribution of this research work is discussed in-depth, and the research limits are highlighted. Finally, future research directions are recommended.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter report on the literature review that summarizes the studies about Edible bird nest. Section 2.2 briefly introduces the types and characteristics of swiftlet in Malaysia. The detailed development in Malaysia is provided in Section 2.2.5. Section 2.2.6 critically reviews the determining criteria of the swiftlet farm. All types of edible bird nest; including a details cleaning process are discussed and reviewed in Section 2.3. Section 2.3.3 depicts all the current issues of EBN cleaning processes and the research gap for this research study. Finally, numerous quality improvement strategies are examined in Sections 2.4 and Section 2.4.10 to provide the conclusion for the Best Value Approach selection.

2.2 Introduction to Swiftlet Farming Industry in Malaysia

2.2.1 Types of Swiftlets

Swiftlets are found in 24 different species across the world. *Hydrochousgigas, Collocalia Esculent* (white belly swifts), Asian Palm Swift, are the five species of swiftlets found in Malaysia and Borneo Island (*Cypsiurusbalasiensis*, *Aerodramus Maximus* and *Aerodramus fuciphagus*). *Aerodramus fuciphagus*, often known as swiftlets, are tiny insectivorous birds with drab plumage that echolocate. They weigh an average of 14 g and have a dull plumage (Ibrahim et al., 2009; Viruhpintu et al., 2002).

2.2.2 Natural Habitat

In general, edible-nest swiftlets are cave dwellers, and their nesting places are in dim to fully dark limestone caverns that are inaccessible to humans. They are found throughout the Indian Ocean, South and Southeast Asia, northern Australia, and the Pacific Islands (Thomassen et al., 2003), and are primarily harvested in Asian countries such as Malaysia, Indonesia, Thailand, Vietnam, the Philippines, and China (Marcone, 2005), with Indonesia being the largest resource and the Malaysia Borneo provinces of Sarawak and Sabah being the second largest (Hobbs, 2004).

2.2.3 Swiftlet Behaviour

Male swiftlets build edible bird nests mostly using saliva generated by the swiftlet's two sublingual glands. The swiftlet's sublingual salivary glands expand in size from 2.5 mg to 160 mg during the nesting and breeding season, and their secretary activity peaks (Medway, 1962). The nests are made of saliva and adhere to the vertical sides of caves on land or at sea (Kang, Hails, and Sigurdsson, 1991). Only the mother and nestlings may survive in the nests, which can weigh up to 1-2 times the bodyweight of swiftlets. The full building procedure may take 35 days (Marcone, 2005).

2.2.4 Property of Edible Bird Nest

Since the Tang era, edible bird's nest has been utilised in Chinese food and medicine (618 AD). The Chinese have ingested edible bird's nests in the form of "bird's nest soup" ever since around 1200 years ago. A recent scientific investigation revealed that EBN inhibited influenza virus haemagglutination and contains avian epidermal growth factor (Marcone, 2005; Lin et al., 2006).

The therapeutic effects of EBN, including replenishing essential nutrients and expelling phlegm, were recorded in an ancient Chinese literature published in 1695 (Zhang, 1959). Furthermore, edible bird's nest is valued for its high medicinal value, which includes its use in anti-ageing, anti-cancer, immunity-boosting, dissolving phlegm, alleviating asthma, suppressing cough, curing tuberculosis, improving the voice, stomach ulcers, hematemesis, general debility and asthenia, curing children who fail to thrive for no apparent reason, aphrodisiac, raising libido, aiding renal (Francis, 1987; Hobbs, 2004; Koon & Cranbrook, 2002; Leh, 1993; Wu et al., 2010; Zhang, 1959).

2.2.5 Edible Bird Nest Development in Malaysia

China is a major export market for edible bird nests, with a 2019 consumption forecast of 5,654 tonnes (Borneo Post, 2020). Given the rapidly expanding economy of the Chinese market alone, the growth is exponential.

Swiftlet farming is a new growing business in Malaysia that reached critical mass five years ago. The edible birds' nests business in Malaysia, on the other hand, has a considerably longer and more famous history, having been in intermittent operation for the previous 100 years or so. The business is mostly comprised of small-scale activities, with cave nests serving as the primary supply of bird nests. As the swiftlet farming sector expands and grows, more and more supplies of edible birds' nests obtained from purpose-built swiftlet farms enter the supply chain. Over the last eight years, Malaysia's swiftlet farming sector has grown by leaps and bounds. Prior to 1998, there were an estimated 900+ swiftlet farms around the country. By the end of 2006, the total number of swiftlet farms in the country had approached 36,000, with an annualized growth rate of 35% over the previous five years (Hameed, 2007). Malaysia is currently the second-largest producer of edible birds' nests in the world, behind Indonesia since 2009 (Borneo Post, 2020). The overall value of the bird nest market in Malaysia is still pretty much determined by the quality of raw bird nests. This is crucial to swiftlet farming as it has a direct impact on income.

Urban people in Indonesia, Malaysia, and Thailand realised that by converting the top floors of their shophouses, swiftlets would nest in this man-made habitat, as the original cave environment grew too congested to accommodate the swiftlet population development (Ibrahim et al., 2009). Swiftlet farming gained popularity in Malaysia only after the Asian Economic Crisis of 1997-1998. Numerous commercial buildings were left vacant at the time due to the failure of many small and medium-sized firms. Rather than leaving their abandoned retail buildings unoccupied, numerous landlords converted them into swiftlets farms, even though doing so was banned in several Malaysian states (Ibrahim et al., 2009).

a) Climatic Conditions

Malaysia is in a hot and humid region with high solar radiation. The mean monthly relative humidity ranges from 70% to 90%, varying from place to place and from month to month. This is a favourable range for swiftlet habitat.

b) Urban Versus Rural Area

Since swiftlet farms began during the Asian economic crisis in 1997-1998, the majority of swiftlet farms in Malaysia are located in urban or suburban areas. Another aspect that the farm owners anticipated is that town centres are highly populated with structures and automobiles, making it impossible for swiftlet predators such as eagles and owls to loom and hunt in the region. In contrast to lower temperatures in rural locations, heat island effects in urban and suburban areas provide more stable temperatures, particularly throughout the evening and night. In the survey, most swiftlet farm owners agreed that they preferred to invest in urban or suburban areas since they could rent out the ground floor of their facilities to generate money in the early phases. Another argument is that if the business fails, the buildings may be used as commercial properties. Investment in rural or agricultural land, on the other hand, will remain ample.

2.2.6 Criteria for Effective of Swiftlet Farming

Three essential characteristics may be the most critical elements determining the effectiveness of swiftlet farming. Swiftlet species, like every other animal, rely on food, security, and comfort to survive. The exterior environment is important for food sources, but the inside environment is important for reproduction.

a) Food Source

Swiftlet farms should be located within 20 kilometers of the sea and on low-lying terrain with moderate temperatures and humidity. Before establishing swiftlet farms, the owners should investigate the local environment for potential food supplies as well as any threats that might jeopardize the swiftlet farms' operation. Swiftlets are extremely sensitive to scent; thus, they should be maintained away from polluted areas such as major industrial zones or sewage treatment plants.

b) Security

When it comes to nesting places, swiftlets prioritize surviving prey of predators like owls and eagles over food supplies. Swiftlets could echolocate in deep and dismal limestone tunnels, which is one of their skills (Sia and Tan, 2008). As a result, while designing a swiftlet farm, such skills should be considered.

c) Predators and Threats

Swiftlet farming in urban and suburban areas continues to have higher population growth than in rural areas. Swiftlets are safer in human situations than they are in rural locations, where they are preyed upon by their predators.

Rats, geckos, and blood-sucking mites may potentially endanger the newly born chicks (Mardiatuti et al.,1997). As a result, consistency in maintenance or pest control is essential. When male swiftlets are comfortable and safe in their new surroundings, they begin to build their nest. A crucial component in agricultural success is the man-made farm, which replicates the natural habitat of the limestone caves.

d) Temperature, Relative Humidity & Lighting

Swiftlet reproduction needs an internal climate suitable for a swiftlet habitat, comparable to that of a limestone cave. The most essential factors are air temperature, mean radiant temperature, air velocity, relative humidity, and light intensity. The optimal temperature for swiftlet growth and reproduction is between 28°C and 30°C, with a humidity of around 90% and enough food (Kuan and Lee, 2005; Li, Zhang, Li, Xiao, Liu, Gu, and Zhang, 2018); if the temperature increases over 30°C, the saliva becomes dry, causing the nest to shrink. When the temperature falls below 25°C, the saliva does not harden, making nest construction difficult.

To produce a re-creation of a natural cave's micro-habitat condition suitable for breeding, relative humidity should be between 80 and 90%. When the relative humidity falls below 80%, the form of the nest changes, becoming drier, less sticky, thinner, and more readily broken. Aside from that, if the humidity is too high, the nest will become yellowish and sell for less money according to Kuan and Lee (2005) and Ibrahim et al. (2009) One thing to keep in mind while building swiftlet farms is that the illumination should not exceed 1 lux (Onn, 2008). Swiftlet farm's light intensity is critical since low light intensity means a darker environment. Because of the protection of their young offspring, most swiftlet predators are blind in the dark. Swiftlets, on the other hand, have a unique ability to use echolocation to navigate in absolute darkness and avoid predators (Sia and Tan, 2008).

Relative humidity should be between 80 and 90 percent to create a re-creation of a natural cave's micro-habitat condition suited for breeding. When the relative humidity goes below 80%, the nest's shape changes, becoming drier, less sticky, thinner, and more easily damaged. Aside from that, according to Kuan and Lee (2005) and Ibrahim et al., if the humidity is too high, the nest will become yellow and sell for less money (2009) One thing to remember while constructing swiftlet farms is that the lights should not surpass 1 lux (Onn, 2008). The light intensity of Swiftlet farm is crucial since low light intensity produces a darker habitat. Most swiftlet predators are blind in the dark. Swiftlets, on the other hand, have a unique ability to travel in complete darkness and evade predators by using echolocation (Sia and Tan, 2008).

e) Sound and Smell

Appropriate sound within the swiftlet farms might entice the swiftlet. When the young swiftlets feel at peace and safe in their new environment, they may return more frequently and eventually stay permanently there.

f) Reproduction & Breeding Process

After the three fundamental criteria of food, security, and comfort were met, male swiftlets would make nests using saliva and attach them to the vertical wooden batten created on the farm from "Melanti" wood species. The wooden batten intervals must be adequately spaced apart to offer ample nesting room for individual swiftlets. Farmers fear that failure to provide appropriate space may lead to violence inside the colony. Wider spacing may result in the loss of crucial space to allow for more nesting.

g) Management & Maintenance

Swiftlet farms, with regular maintenance and strict management, practices, would be able to sustain the natural increase of the swiftlet population. Because of the industry's immaturity, the bulk of the rules only apply to a single site and are overly broad in many ways. The following are some guidelines from various agencies and authorities:

1. Install the speaker to face the sky at an angle of at least 60 degrees from floor level.
2. Sound from the speaker produces not more than 40 decibels
3. Time to use sound only from 7.00 am until 7:00 pm.
4. Construct using waterproofing materials for floor and wall building (at the bottom).
5. Collect and regularly remove sewage of birds (guano) from the premise.

Ipoh City Council, in collaboration with the Ministry of Housing and Local Authority, refers to the standards for farming operations conducted in commercial buildings. Swiftlet nest farming is permitted in commercial buildings, except locations near restaurants and health care facilities.

The premise owners can only take the nest when the premises have produced at least 100 nests, according to the Department of Wildlife and National Parks' (PERHILITAN) standards.

Most swiftlet farms that are in urban or suburban areas are neither opposed nor resented by the surrounding community. The tweeting sound coming from the swiftlet farms is the sole obvious source of disruption. However, most of the farm owners disobeyed the above-mentioned guidelines, causing undue harm to the neighbouring population.

The odors of swiftlet guano are not detectable based on observations made at various places; most of the odors are confined within the farms due to the lack of openings or exposure to the outside.

2.2.7 Preliminary Study of Typical Swiftlet Town in Malaysia - Muar

A preliminary case study of "swiftlet town" was chosen to better understand the mechanisms that control the creation of swiftlet town and the obstacles that may arise to conduct in-depth research of the expansion of swiftlet farming in West Malaysia. Most of the literature research did not give comprehensive data that could be used to create a full profile. This section's data was gathered mostly by observation, onsite interviews, and measurements of sound velocity.

Muar, Johor, was chosen as the preliminary case study evaluation for the typical "swiftlet town" in West Malaysia since it represents the typical suburban town in Peninsular Malaysia. Muar, commonly known as Bandar Maharani, is a town in the Muar District of Johor, Malaysia (Figure 2.1). Muar district is the only one that encompasses the whole land that was once bordered to the north by Malacca. However, due to Ledang district's upgrading, Muar district now only covers the land south of Sungai Muar, with Ledang district occupying the northern portion beyond the river.

Figure 2.1: Maps of Muar Town

Muar Town View

Figure 2.2: Muar Town View

Muar is situated at 2° 3′ N 102° 34′ E, at the mouth of the Muar River. The town is around 150 kilometres southeast of Malaysia's capital, Kuala Lumpur, and 179 kilometres southeast of Singapore. It's 45 kilometres south of Malacca City. Muar district had a population of 328,695 people and covered 2,346.12 km2 (2000).

Muar Panorama View

Figure 2.3: Muar Panorama View

The flat terrain of Muar’s geographical ground and areas made the study easier with less obstruction in observing the flying path of swiftlets (**Figure 2.2 & 2.3**).

a) History of “Swiftlet Farms” Development

Most of the swiftlet farms began 10 to 16 years ago, during the Asian economic crisis of 1997–1998, and are housed in shophouses surrounding the town centre. They are all located near the Muar River and occupy the first and second floors; the ground floor is still occupied by businesses. The neighbouring neighbourhood is made up of both business and residential properties. In the early stages of the town centre’s development, a traditional arrangement with business premises on the ground floor and residential entities on the first floor was the standard. However, due to the vast spread of development, most inhabitants have relocated from the town centre to the outer ring of residential areas within 5 to 10 kilometres of the town centre. Most of the remaining areas are being turned into offices and company establishments. According to the poll, most swiftlet farm owners acknowledge that swiftlet farming is in the metropolitan town centre. Swiftlets' food supplies or hunting grounds are located northwestern of the town centre, along the course line of the mangrove swamp region.

b) Selection Criteria of Swiftlet Farms

This study's location was chosen based mostly on its proximity to the town centre and its surrounding business entities. Second, the farms must be well-established and profitable swiftlet farms. Finally, the neighbourhood should have a mix of business and residential properties. The swiftlet farms that meet the criteria outlined above have been identified and are depicted on the map below (**Figure 2.4 & 2.5**).

Figure 2.4: Boundary of Swiftlet Farms Study

Figure 2.5: Zoning and Subdivision of Study

c) Swiftlet Farms Listing

1) Zone A (**Figure 2.6**)- Swiftlet farms are bordered on the west by Jalan Sulaiman, on the east by Jalan Sayang, on the north by Jalan Maharani,

and on the south by Jalan Meriam. Swiftlet farms A1 through A11 are labelled as such.

Figure 2.6: Zone A

2) Zone B (**Figure 2.7**) - Swiftlet farms are bounded on the west by Jalan Sayang, on the east by Jalan Yahya, on the north by Jalan Maharani, and on the south by Jalan Meriam. Swiftlet farms are denoted by the letters B1 through B17.

Figure 2.7: Zone B

3) Zone C (**Figure 2.8**) - Swiftlet farm is bounded on the west by Jalan Sulaiman, on the east by Jalan Sayang, on the north by Jalan Meriam, and on the south by Jalan Arab. Swiftlet farms C1 to C3 are the names

of the swiftlet farms.

Figure 2.8: Zone C

4) Zone D (**Figure 2.9**) - Swiftlet farm is encircled by Jalan Sayang on the west, Jalan Yahya on the east, Jalan Meriam on the north and Jalan Arab on the south. The swiftlet farm is recognised as swiftlet farm D1.

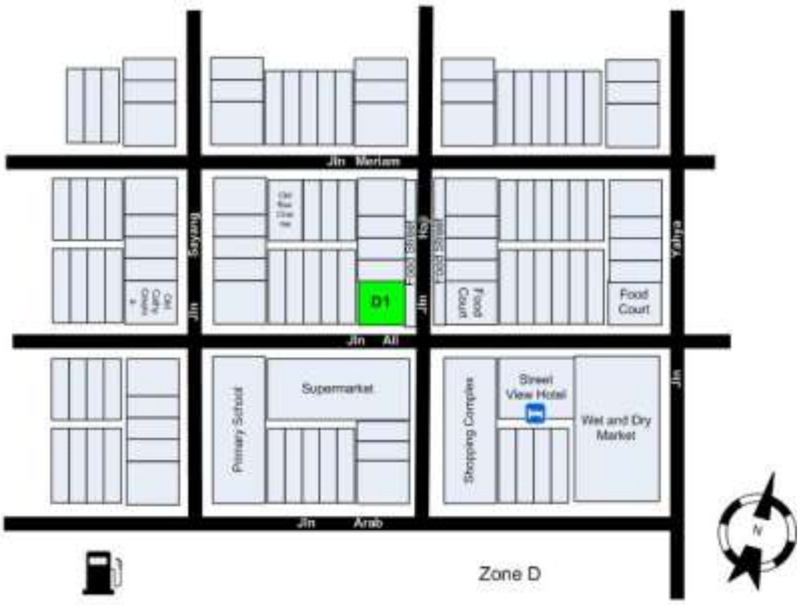

Figure 2.9: Zone D

d) Information of each Zone

i) Information on Zone A

Table 2.1: Data of Zone A

Swiftlet Farm	Location	Orientation	Building Typology	Surrounding	Noise Pollution	Smell Pollution
A1	Jln Sulaiman	West	Commercial	Mixture	69 dB	Unnoticeable
A2	Jln Maharani	North	Commercial	Office	69dB	Unnoticeable
A3	Jln Maharani	North	Commercial	Mixture	64dB	Unnoticeable
A4	Jln Maharani	North	Commercial	Mixture	64dB	Unnoticeable
A5	Jln Abdullah	South	Commercial	Sport	67dB	Unnoticeable
A6	Jln Abdullah	North	Commercial	Shoe	67dB	Unnoticeable
A7	Jln Abdullah	North	Commercial	Fashion	67dB	Unnoticeable
A8	Jln Abdullah	North	Commercial	Fashion	67dB	Unnoticeable
A9	Jln Meriam	South	Commercial	Food	72dB	Unnoticeable
A10	Jln Meriam	South	Commercial	Electrical	68dB	Unnoticeable
A11	Jln Sulaiman	East	Commercial	Bank	72dB	Unnoticeable

Figure 2.10: External Appearance of Zone A

Swiftlet farm A6 is one of the pioneer farms, hence the spread of swiftlet farms is more concentrated around zone A. According to the study, the noise level increases in the rear-lane region because the sound is generally aimed toward the back rather than the front façade. The flying path of the swiftlets is seen to be eastward when they leave the farms and westward when they return from the east. The odour from Swiftlet Farm is undetectable, owing to the small opening at the entry point and the lack of an opening on the opposite side of the wall. Another reason is that the entry is typically positioned at the top of the building in the shape of an air well or a high bay window.

ii) Information on Zone B

Table 2.2: Data of Zone B

Swiftlet Farm	Location	Orientation	Building Typology	Surrounding	Noise Pollution	Smell Pollution
B1	Jln Maharani	North	Commercial	Dry food	65 dB	Unnoticeable
B2	Jln Maharani	North	Commercial	Dry food	72dB	Unnoticeable
B3	Jln Maharani	North	Commercial	Dry food	68dB	Unnoticeable
B4	Jln Maharani	North	Commercial	Dry food	65dB	Unnoticeable
B5	Jln Sayang	West	Commercial	Mixture	73dB	Unnoticeable
B6	Jln Abdullah	South	Commercial	Mixture	72dB	Unnoticeable
B7	Jln Abdullah	South	Commercial	Mixture	68dB	Unnoticeable
B8	Jln Abdullah	South	Commercial	Bank	68dB	Unnoticeable
B9	Jln Abdullah	South	Commercial	Mixture	65dB	Unnoticeable
B10	Jln Abdullah	South	Commercial	Mixture	72dB	Unnoticeable
B11	Jln Abdullah	South	Commercial	TCM store	68dB	Unnoticeable
B12	Jln Abdullah	South	Commercial	TCM store	65dB	Unnoticeable
B13	Jln Abdullah	North	Commercial	Fabric Store	60dB	Unnoticeable
B14	Jln Abdullah	North	Commercial	Hardware	69dB	Unnoticeable
B15	Jln Haji	West	Commercial	Mixture	67dB	Unnoticeable
B16	Jln Meriam	South	Commercial	Mixture	72dB	Unnoticeable
B17	Jln Yahya	South	Commercial	Fashion	68dB	Unnoticeable

Figure 2.11: External appearance of Zone B

Swiftlet farm distribution might be divided into three pockets. As shown in Zone A, each subdivision tends to focus inward to the rear lane. The noise level appears to be significantly higher in Zone B due to the high concentration. It is also because there are fewer new buildings in the region, which is less likely to harm the swiftlet's environment.

Over the three zones, Zone B contains the most swiftlet farms. Because this zone contains the most numerous premises at the upper level, it is one of the most popular alternatives for converting existing premises into swiftlet farms. The noise level is maximum among the lowest in high density and approximate position from one another, providing an uncomfortable environment for human existence. Similarly, the odour from Swiftlet Farm was not detectable due to the large opening from the street level and the small opening on the frontage.

iii) Information on Zone C

Table 2.3: Data of Zone C

Swiftlet Farm	Location	Orientation	Building Typology	Surrounding	Noise Pollution	Smell Pollution
C1	Jln Ali	South	Commercial	Fashion	67 dB	Unnoticeable
C2	Jln Ali	North	Commercial	Mixture	66 dB	Unnoticeable
C3	Jln Sisi	West	Commercial	Office	65 dB	Unnoticeable

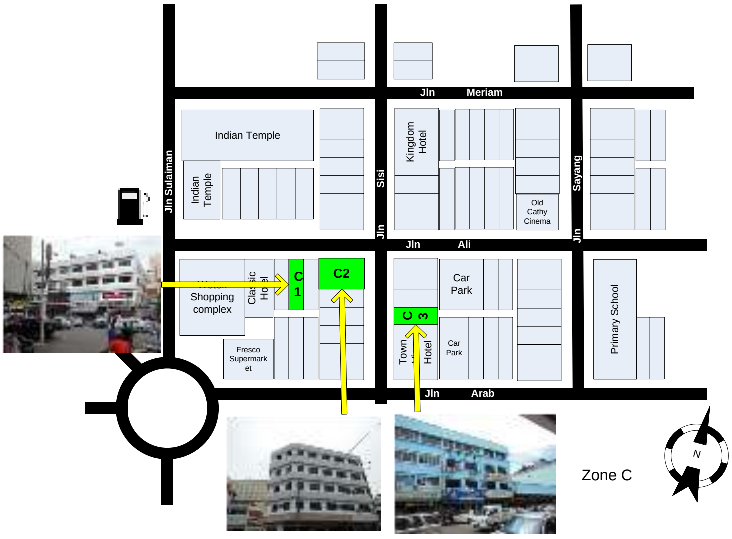

Figure 2.12: External appearance of Zone C

The spread of swiftlet farms may be identified in one corner of the retail area. The noise from the fields appears imperceptible due to the heavy traffic and human mobility. All three swiftlet farms, on the other hand, are quite young, having been developed within the previous few years. As a result, the swiftlet farms' success rate has yet to be determined. In comparison to the previous two zones, the cost of converting a new building to a swiftlet farm appears to be higher than the cost of converting an old and abundant structure. The benefits might include a reduced floor-to-ceiling height and the ease of collecting bird nests. Concrete flooring is much easier to maintain and clean than timber flooring in older buildings. The downsides are that new buildings usually have a lot of openings and windows that need to be sealed off, and the thinness of the walls makes the room warmer than an old structure with thick walls.

iv) Information on Zone D

Table 2.4: Data of Zone D

Swiftlet Farm	Location	Orientation	Building Typology	Surrounding	Noise Pollution	Smell Pollution
C1	Jln Ali	South	Commercial	Food Street	72 dB	Unnoticeable

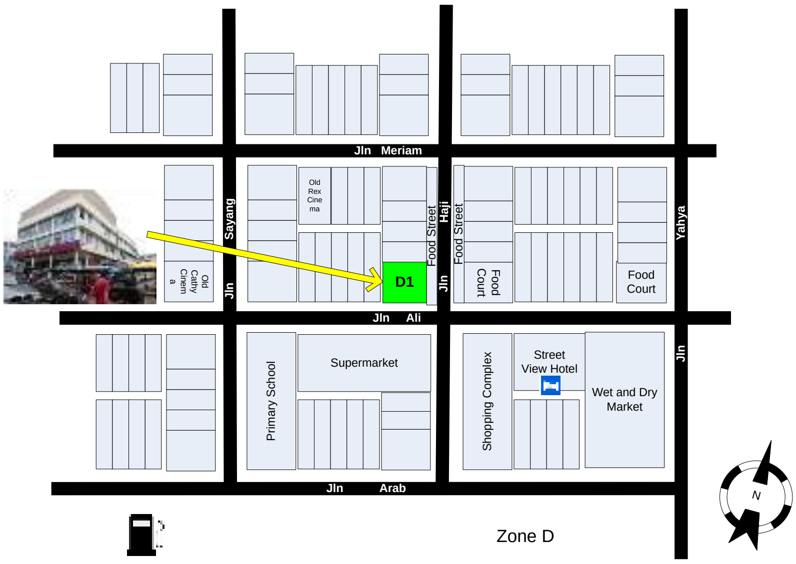

Figure 2.13: External appearance of Zone D

This zone has just one swiftlet farm, and the establishment may be owing to stringent regulation by the local administration, as there are no swiftlet farms near food outlets. Another cause might be the odour from the wet market, which keeps the swiftlets away from the area. Because of the heavy movement, the noise is undetectable, as it is in zone C.

j) Economic Impact

Swiftlet farms have no impact on nearby property values, neither boosting nor reducing them. On the other hand, the value given by successful swiftlet farms is substantial. Every successful swiftlet farm, according to the proprietor, is worth RM 1,000 for each edible bird nest in the farm (Excluding the value of the property).A simple calculation example is shown below (**Table 2.5**).

Table 2.5: Costing of Swiftlet Farm

Description	Amount	Total
Farm A (Investment)		**RM 620,000.00**
Renovation cost	RM 120,000.00	
Premises Value	RM 500,000.00	
Farm A (Sale)		**RM 1,050,000.00**
RM 1,000 x 500 nests (After 2 years)	RM 500,000.00	
Market value (10% appreciate)	RM 550,000.00	
	Total investment gain	**RM 430,000.00**

The estimation above was based on the value of raw bird nest pricing at RM 2,800 to RM 3,500 per kilogram during the time of research (the year 2010).

k) Societal and Environmental Impact

The survey investigation found no indication of a substantial influence on the environment since all swiftlet farms are completely enclosed, with just a small opening on the entry and ventilation openings (**Figure 2.14**). According to conversations with residents, there is no discernible odour from swiftlet farms.

Entrance Opening Ventilation Holes

Figure 2.14: Penetration of Swiftlet Farm

The recorded sound or noise from swiftlet farms ranged from 65 dB to 72 dB, with an average of 68 dB. The majority of neighbourhoods stated that the sound is too loud, except places facing high traffic and cloudy commercial districts, which have a steady masking sound of 72dB to 75dB. According to interviews conducted in surrounding residential areas, the noise from swiftlet farms is a nuisance in their everyday lives and sometimes serves as a masking sound for their conversations. Between 7 and 8 p.m., the majority of swiftlet farms switch off their exterior sound. According to the findings of this study, the majority of swiftlet farms should reduce their level to less than 60 decibels. In reality, the majority of swiftlet farms' exterior speakers point in the same direction or reflect, eliminating or overlapping each other. As a result, a careful examination of the sound wavelength or frequency should be carefully coordinated to minimise competition and undue annoyance to nearby neighbourhoods.

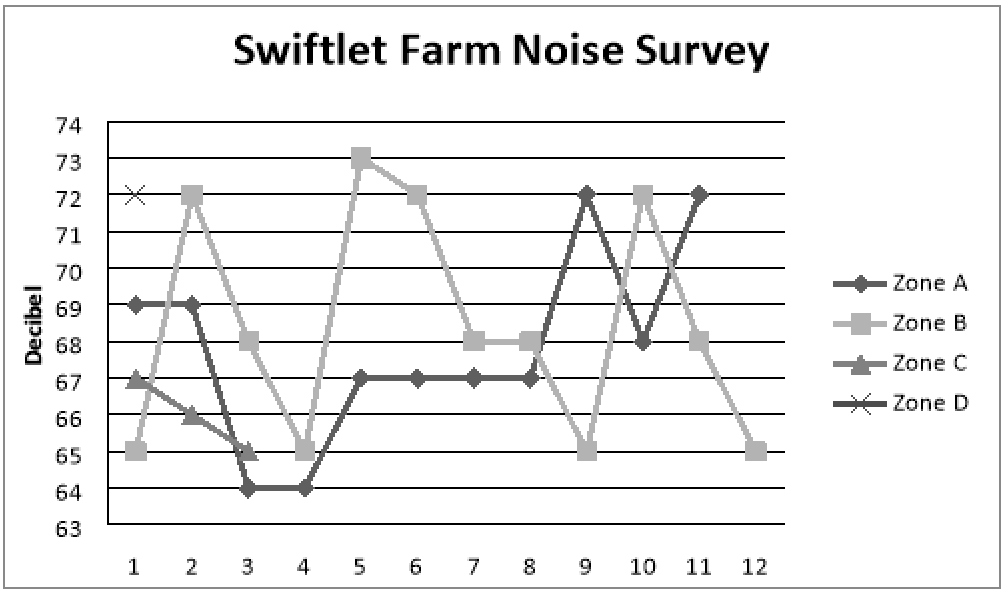

Figure 2.15: Noise Measurement Tabulation

l) Planning Control

Due to the proximity of farming locations, not all swiftlet farms achieve desired results, according to typical observations of swiftlet farms surrounding urban and suburban areas. This has prompted more research into the influence of swiftlet farming concentration on agricultural growth due to rivalry among them and delayed development due to food source scarcity. To minimise avoidable failure and species survival, a guideline for urban agricultural design and control should be proposed. Swiftlet farms in residential or mixed-use areas shall reduce their exterior sound level to an acceptable level, and their scheduling should adhere to the Ministry of Housing's standard of 7 a.m. to 7 p.m.

m) Finding

The study suggests that the decisive criteria for successful swiftlet farms are primarily the premises' capacity to meet and satisfy the needs of species. More research on the influence of each component on the success of swiftlet farms is needed. However, additional research on the environmental effect should be conducted as soon as possible to assess the viability of this sector and assure the healthy expansion of swiftlet species. The findings of a study of a typical town centre revealed that swiftlet farms located in a certain place would cause persistent noise pollution. It is recommended that the sound level be reduced to 50 decibels (dB) and that external speakers be avoided when facing a solid wall or structure. A planning guideline is required in the given site to guarantee the healthy proliferation of swiftlet species.

Several swiftlet farm owners urged that swiftlet farming be commercialised since it may provide a high return with a huge market. Swiftlet farming is an issue that demands a large amount of capital to begin, and not all of this activity is successful. As a result, the goal of this study was to summarise all of the components by analysing the data into more scientific and prioritised sequences of swiftlet natural habitat. Priority should be given to additional research into finding effective elements to reduce the failure rate. One of the remaining unanswered issues should be whether swiftlet farms should be placed in urban or rural areas. With the present development trend, most investors or swiftlet farm owners choose to establish their premises in metropolitan areas; it provides a stronger cushion to recoup their partial investment in the event of failure. It is a promising subject for additional research in two directions: lowering the failure rate in rural swiftlet farms and reducing the environmental effect of swiftlet farms in urban areas.

According to the findings, local governments should look into effective swiftlet agricultural planning. The building technique and requirements should be examined to meet the needs of swiftlet habitation and EBN harvesting ease. More consideration should be used while allocating swiftlet farming to eliminate competition and reduce failure rates.

2.3 Edible Bird Nest Production Process Theory

Edible bird nests are classified into three types: half-cup shape, strips, and biscuits. The price ranges from the most in half-cup shape to the lowest in biscuit shape. Aside from its appearance, the size, cleanliness, and colour all contribute to its value. The most expensive edible bird nests are those that have been preserved in their original shape, followed by those that are large and clean.

Due to the high value of raw bird nests, extra materials were discovered to be added before the sale to raise the net weight of the nests. Tremella fungus, karaya gum, red seaweed, hog skin, and egg white were among the ingredients used (Wu et al., 2007). These adulterants were often added at 10% levels and were exceedingly difficult to detect due to their comparable colour, appearance, taste, and texture to the actual salivary nest cement (Marcone, 2005).

2.3.1 Value of Raw Bird Nest

In general, the shape, cleanliness, size, and colour of raw bird nests influence their value. Because raw bird nests are normally traded through negotiation, determining the value is exceedingly challenging. Most swiftlet farmers harvest their nest at different times, and the mixing of different grades of bird nest makes determining a standard value difficult. Because of the nature of the industry, most trade involves lump-sum tenders, similar to those used in live fish selling. As a result, it is dependent on the dealers' experience to give a suitable value acceptable to the farmers.

a) Shape

The most popular shape is a perfect half cup, which is big but not too thick and is free of holes. Jordan (2004)

The majority of uncooked bird nests are classified into three types. They are divided into three grades: A, B, and C. When put on a horizontal surface, grade A nests have the shape of a half-cup with a 180-degree or even surface. The form of Grade B nests is identical to that of Grade A nests; however, it is 135 degrees when put on a level surface. When placed on a level surface, grade C is half the size of grade A and has a 90-degree angle (**Figure 2.16**) (Tan et al.,2014).

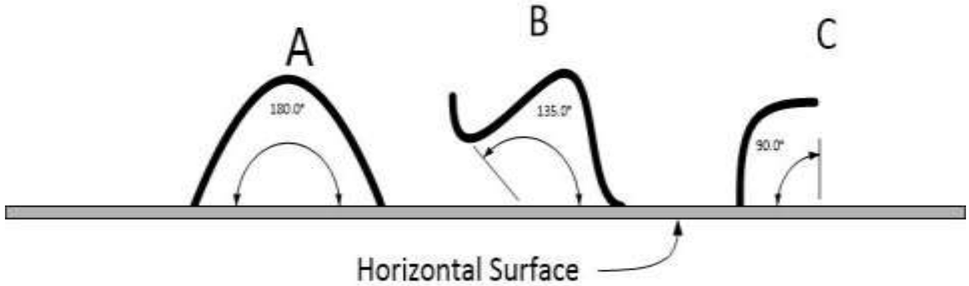

Figure 2.16: Grading of Raw Bird Nests

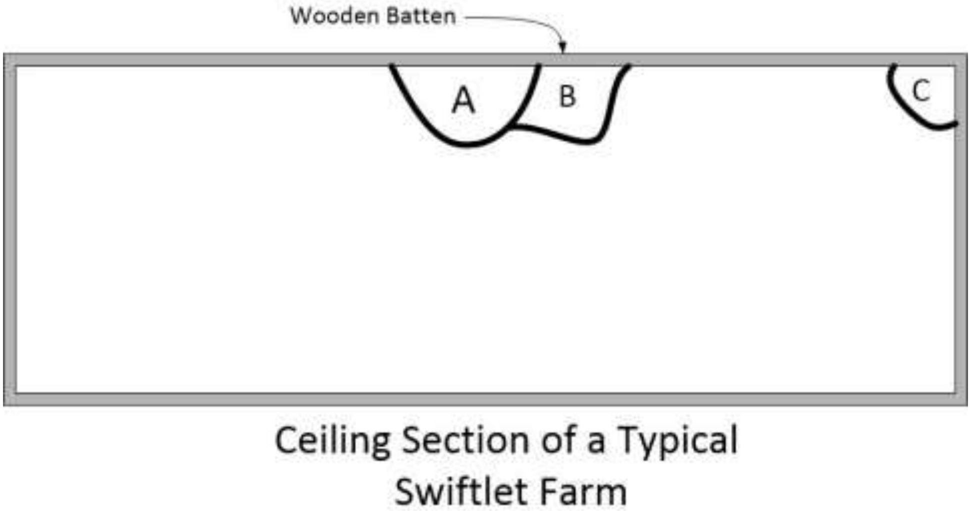

Figure 2.17: Formation of Raw Bird Nest in Swiftlet farm

Figure 2.17 depicts the creation of several grades as swiftlets establish their nests on the wooden batten. The swiftlet would occupy the four corners of the wooden batten as a nesting location in the majority of the new swiftlet farm. It is because the place is easier to build with fewer resources. As a result, the grade C ratio will be larger than the grade A and grade B ratios. (Tan et al., 2014)

Grade A and B **Grade C**

Figure 2.18: Photo of Raw Bird Nest Grading

b) Cleanliness

One of the influencing aspects of the value is cleanliness. Any contaminant on the bird nests would increase cleaning costs. Cleaning takes time, and thus increases the amount of bird nest waste. If swiftlet farm owners want to sell their nests for a greater price, they must remove all signs of feathers and impurities. White nests are often cleaned by hand to maintain the shapes. However, the technique may result in holes, lowering their value (Jordan 2004).

The cleanliness of bird nests is directly determined by swiftlet farm upkeep. Regular guano removal from swiftlet farms may limit the quantity of pollution on bird nests. However, the moult seasons of swiftlets from May to August have had a significant impact on the cleanliness of bird nests due to the presence of more shredded feathers in raw bird nests.

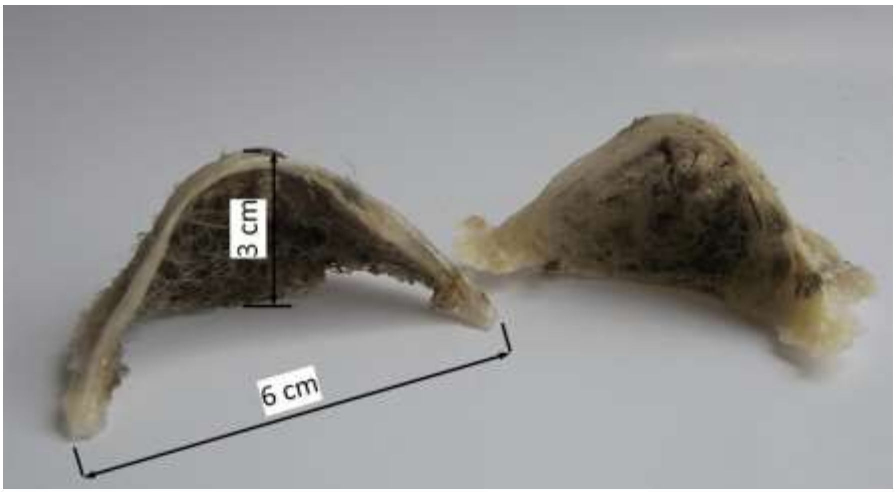

Figure 2.19: Measurement of Raw Bird Nests (Tan et al., 2014)

The size of bird nests was traditionally judged by the number of fingers (width of adult fingers). It was incorrect since the size of various people fluctuates. The height and length of the bird nest were used to determine the more scientific way, as illustrated in **Figure 2.19**. A Grade A nest would be 3 cm × 6 cm in size, whereas a Grade B nest would be 2.5 cm x 5 cm. Alternatively, it might be calculated by the number of parts in one kilogramme. In one kilogramme, Grade A would have 100 to 110 pieces while Grade B would have 120 pieces (Tan et al., 2014).

c) Colour

Edible bird nests are often drab white to slightly yellowish. Several examples are partially or fully dull orange-red to brownish red (Lim and Cranbrook, 2002).

The majority of the uncooked edible bird nests formed by swiftlets are white. Some of the many-coloured bird nests on the market are not their original colours. It might be owing to inadequate swiftlet farm care, or it could be due to the addition of materials or compounds to the original raw bird nests. Because of the "blood nest" event, which exposed the whole industry to adulterants, white birds nest has become the market's most known bird nest colour.

The highest grade has been assigned to white nests, followed by a combination of more yellowish nests. The yellowish colour tone may be caused by the high moisture level inside the swiftlet farms as well as the high quantity of guano, which includes nitrate components.

d) Moisture Contents

Hong Kong's major export market requires a moisture level of 10%, while certain nations, such as Taiwan, allow for greater moisture percentages. This has become so contentious that some owners have sought to increase the total weight of the nests by spraying them with more water (Jordan 2004). More water may be sprayed to maintain the shape and prevent the bird nest from shattering during travel. However, the guideline only allows for a moisture level of 10%. Any increased moisture level reduces the value or necessitates drying out the bird nests before weighing.

e) Wastage

Most swiftlet farm owners understand that raw nest prices will be much lower during the dry seasons than during the regular seasons. When compared to ordinary seasons, the raw bird nests obtained contain more feathers. Because of the swiftlet's life cycle's moulting seasons.

The seasons would last two to three months and would coexist with the dry seasons, which would last from May to July. Swiftlets would use their shedding feathers to build nests during this period. As a result, the higher the feather content, the more trash and the higher the cleaning costs.

Samples of raw bird nests Feathers and impurity

Figures 2.20: Sample of Raw Bird Nests and Wastages during Moulting Seasons

2.3.2 Cleaning Process and alternate cleaning method

Only five papers referenced the EBN cleaning approach throughout the bird nest cleaning process literature review. Washing with brushes, softening with water, cleaning with pincers, moulding or binding with thread, drying with a fan, and heating with an incandescent light bulb comprise the entire technique (Jong et al., 2013).

Uncooked edible bird's nests should soak in water for 6 to 48 hours to absorb water and expand before the feathers are removed, according to Ma and Liu (2012). Tweezers are used to remove all big feathers, while little feathers can be removed by soaking in vegetable oil and floating. This cleaning procedure consists of three steps: soaking, picking, and drying.

Jong, Tay, and Lim (2013) detailed the cleaning method. The raw EBN is first scrubbed with brushes before being softened by soaking in water, and the softened raw bird nest is cleaned using a pincer. Picking and spraying with water are repeated during the cleaning procedure until the raw bird nest is clean. Brushing, soaking, picking, moulding, and drying are the phases of the procedure.

Babji, Nurfatin, Syarmila, and Masitah (2015) documented the industry procedure of cleaning nests by soaking them in water until the nest is softened and loosened. Small and fine feathers are then painstakingly extracted using tweezers. The cleaned strands of bird nest are then rearranged and shaped into different forms before being air-dried and packed for sale. Soaking, picking, moulding, and drying are the four processes in the process.

Chua and Zukefli (2016) observed the cleaning procedure as raw EBN is first soaked in clean water for 1 to 2 hours till the soft and sticky material is partially free. Impurities such as dirt and feathers will float and be eliminated at this time. The remaining feathers and dirt are painstakingly removed using tweezers. The cleaned EBN is then formed using a plastic mould. Following shape, EBN is dried in an oven or with a fan before being packed for sale. Soaking, selecting, moulding, and drying were additional needed processes in the process.

Dai, Cao, Wang, Chen, and Jiang (2020), reinforced the cleaning procedure, stating that the raw bird nest would be cleaned with water to eliminate contaminants such as swiftlet droppings and dirt, which are also components of nitrite content. Small feathers in EBN will then be carefully picked out. The clean EBN will be moulded using a half-bowl mould and dried in the air-drying chamber with fans. UV irradiation, ozone, or high temperatures will be used to sterilise the finished items. The procedure, as described by earlier writers, consists of four steps: soaking, picking, moulding, and drying.

Between 2014 and 2017, three papers offered alternative cleaning technology to replace human labour. Utomo et al. (2014) proposed keratinase enzyme applications as one option for cleaning bird's nests. The authors emphasised that keratinase enzyme washing does not need immersion, therefore no glycoprotein is dissolved in water, and most feathers do not need to be retrieved one by one since they have been destroyed or separated from the bird's nest by the enzyme keratinase's activity (Utomo et al, 2014).

Subramaniam et al., 2015 underlined the need for a better and more efficient automated system to lower manufacturing costs and boost production rate to meet demand. For continuous manufacturing, a system with little human interference and a high-efficiency rate is being designed. However, the current established system has several drawbacks. According to the authors, the developed machine vision system can only acquire and analyse twodimensional picture data. As a result, the raw bird nest must be flattened to a thickness of less than 2mm. Furthermore, this cleaning process was unable to keep the original form of the bird nest.

Table 2.6: Cleaning Process Review by Researchers

Journal Publication	Cleaning process					Year
	Brushing	Soaking	Picking	Moulding	Drying	
Sketch of the edible bird's nest and its important bioactivities	No	Yes	Yes	No	Yes	2012
Application of the fuzzy Failure Mode and Effect Analysis methodology to edible bird nest processing	Yes	Yes	Yes	Yes	Yes	2013
Secrets of edible bird nest	No	Yes	Yes	Yes	Yes	2015
A comprehensive review of edible bird nests and swiftlet farming	No	Yes	Yes	Yes	Yes	2016
A comprehensive review of edible bird's nest	No	Yes	Yes	Yes	Yes	2020

According to guidelines published by the Ministry of Health Malaysia, Food Safety and Quality Division on 8 April 2013, Section 4.3 stated that the level of nitrite in EBN could be significantly reduced through appropriate softening (soaking) and cleaning process.

Therefore, Section 5.0 Softening and Cleaning recommended the following process:

1) The raw EBN could be softened using clean water such as filter, alkaline water, etc. to ease the removal of impurities. The duration and temperature of the soaking process should be properly recorded.

2) The softened raw EBN will be cleaned by tweezers, brush or appropriate cleaning tools.

3) Two bowls of clean water will be prepared for each worker, one bowl for cleaning of tools and another bowl for rinsing of raw bird nest.

4) The clean water should be changed regularly and the frequency of rinsing and softening of raw EBN will be recorded during the entire cleaning process.

5) The final clean EBN should be sent to laboratories for nitrite test by using the ion chromatography method with the limit of detection (LOD) 2 mg/kg and below.

a) Brushing Process

The raw EBN should be brushed with clean water as the first stage in the cleaning procedure. Jong, Tay, and Lim (2013) exclusively suggest this procedure. The procedure is scrubbing raw EBN with filter tap water or clean water to remove any contaminants before soaking in clean water. Most procedures skip this step since soaking raw EBN may eliminate all contaminants.

b) Soaking or Softening Process

Soaking and softening methods differ from one another. According to Ma and Liu (2013), the soaking technique is immersing the entire raw EBN in water for 6 to 48 hours. Chua and Zukefli (2016) stated that the soaking time should be between 1 and 2 hours, or until the gelatinous components are partially released.

Dai, Cao, Wang, Chen, and Jiang (2020) proposed another method of removing contaminants from raw bird nests by washing them in water. The formal technique takes several hours of soaking, whilst the latter may be accomplished simply by washing or rinsing. The Malaysian Ministry of Health's recommendation does not specify the length of the softening process. The actual soaking procedure could not be examined or completed.

c) Picking Process

The most important aspect of EBN cleaning should be the removal of feathers and impurities after soaking. All techniques need the use of tweezers or pincers to remove feathers and contaminants. Jong, Tay, and Lim (2013) reaffirmed the spraying of water throughout the plucking process to soften the EBN; similarly, the Ministry of Health and Chua and Zukefli (2016) guidelines echo the practice of washing under clean water to loosen the raw EBN. Ma and Liu (2012) documented a further procedure employing vegetable oil and flotation techniques to eliminate contaminants. Even though this is the main cleaning procedure, the specific cleaning processes are not available for further assessment and inquiry.

d) Moulding Process

Clean bird nests are subjected to a moulding process based on client or market criteria. Most of the processes advised shaping the cleaning bird nest with a plastic mould or other equipment to form it into a half bowl or other shapes. Moulding is a time-consuming operation that necessitates the use of skilled or experienced employees.

e) Drying Process

According to Deng et al. (2017), one of the critical phases is drying. The author said that sialic acid and antioxidants might be thermosensitive and unstable in high temperatures. The results show that sialic acid and antioxidant retentions are 83.9 per cent and 96.6 per cent, respectively, at 25°C, and 78.7 per cent and 91.5 per cent, respectively, at 40°C, by low temperature drying, and 42.5 per cent and 38.7 per cent, respectively, at 70°C, by conventional hot air-drying (Deng et al. 2017).

2.3.3 Overview of Research Topics on Cleaning Process

Table 2.7 examined the scientific interests since 1885. During the previous two decades, most researchers focused on EBN-related subjects. Papers investigate the contents of EBN as well as the changes in EBN properties based on kind and location.

Most of the research articles were on the functional, quality, and safety issues that were gaining traction around the turn of the century. The explanation has been the rising demand and popularity of EBN throughout the world, notably with China's robust economic growth. Many businesses are drawn to the vast market sectors and expanding demand.

As adulterants EBN products flood the market, quality and authenticity have become the most debated subjects. The "Blood Nest" incident has resulted in the closing of the Chinese market to Malaysian EBN exports. As a result, the fundamentals of EBN functionality and quality have sparked the interest of all stakeholders. The export licence requirement places a strong focus on the safety of EBN to guarantee that it is safe for human consumption.

Table 2.7: Research Topics Relevant to Cleaning Process

Topics or Areas of research	No.	Year of Publication (Range)	
Property	34	1885	2017
Quality	20	1998	2017
Functionality	8	2012	2015
Safety	8	2004	2015
Processing	10	2012	2020
Framing	2	2012	2014
Marketing	1	2014	
Nutritional	1	2014	

2.3.4 Overview of Current/Traditional Cleaning Process

The traditional cleaning process has been implemented for more than half a century. It has been passed on from generation to generation without much improvement. This process is time-consuming and without scientific proof or analysis. The following data collection conducted through site visit and onsite interviews of few selected cleaning processing plants at Kelantan, Pahang, Selangor and Johor.

a) Sorting

As shown in **Figure 2.21**, the raw bird nests harvested from the swiftlet farms or limestone caves go through the process of sorting according to their grade. This is to facilitate what type of products are used to produce. The fewer feathers or impurities will be preserved for the premium grade bird nests followed by normal grade. Those bird nests which are hard to clean will be placed as low-grade products such as biscuits or bird nest strips.

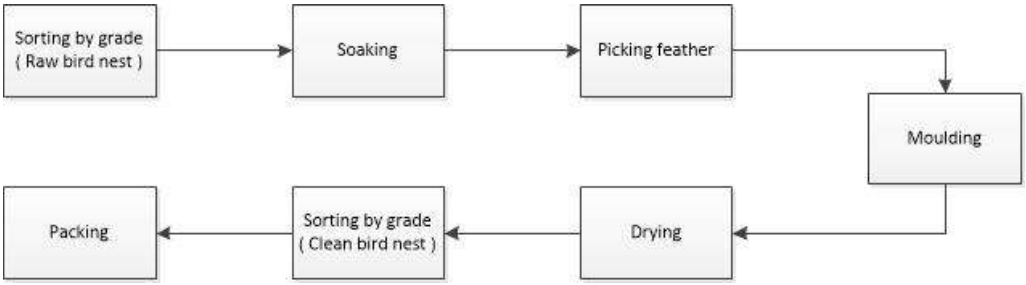

Figure 2.21: Traditional Cleaning Process Flow Chart

Table 2.8: Overview on Methods of Storage

	Methods of Storage	Advantage	Disadvantage
1	Open shelf under normal temperature	Low cost and low maintenance	Subject to external pollutants and climate change
2	Open shelving under air-conditional room	Better control of raw materials	High operational cost
3	Storage in fridge	Cost-saving in operational	Limitation of storage space

The entire process is conducted in an enclosed space labelled as a storage room or holding room. Most of the raw bird nest are stored in dry conditions free from dust and moisture. They are either stored in plastic containers or polyurethane form boxes and kept on open shelves. Some operators may choose to keep it in the fridge at a cool temperature (**Table 2.8**).

b) Soaking

After the sorting, the raw bird nests will be soaked in clean water for further cleaning (Ma et al.,2013 and Chua, 2016). During the process, most of the dust or surface impurities float up. Whilst, the bird nest starts to absorb the water and expands its size by 20% to 30% with an increase of 5 times its original weight.

This process will take up between 1 to 2 hours depending on the size of the bird nest. The condition of the nest appears to be soft and sticky. Therefore, it is easier for the workers to pick the feathers with forceps or tweezers (**Table 2.9**).

Table 2.9: Overview of Soaking Methods

	Methods of Soaking	**Advantage**	**Disadvantage**
1	Soaking under the individual container	The expansion of bird nest size makes it easy for picking up feathers at later stage	The period of soaking may cause the bird nest nutrient to breach into the water
2	Soaking under one big container	Reduce the working process	The pollutant may spread among all the bird nest
3	Cleaning under high-pressure water jet	The process may clean partial impurity	The bird nest structure may be broken and nutrient losses through water spread

b) Picking

This process may take 20 to 30 minutes for a skilled worker and it depends on the cleanliness of the raw bird nest (Jong et al.,2013). Due to the over-expansion of the bird nest, the bird nest will be placed on the plate or plastic mould. Most of the bird nests are too soft to be held in the palm. The workers may need to work under a constraint position for a long hour which may cause pain to their neck and spiral (**Table 2.10**).

Table 2.10: Overview on Picking Methods

	Methods of Picking	Advantage	Disadvantage
1	Place on top of the plate	Could spread out into the bigger size	Difficult for moulding base to original shape
2	Place inside a plastic mould	Easy to handle and could bring closer for detailed inspection	It May is not flexible to flip over
3	Place on the palm	Easy to handle and could bring closer for detailed inspection	Easily tearing apart

d) Moulding

Table 2.11: Overview on Moulding Methods

	Methods of Moulding	Advantage	Disadvantage
1	Using stainless steel mould	Easier to dry	Difficult to mould as the birds nest may stick to the nest
2	Using plastic mould	Easy to mould back into shape	Taking a longer time to dry
3	Using moulding tray	Increase productivity	Different bird nest drying at different time

The process of moulding requires a set of stainless-steel netting shapes like half cups or plastic moulds as shown in **Figure 2.22**. Placing of moist bird nest into the plastic mould, it is to assist~~s~~ the cleaned bird nest to be obtained its original shape upon completely drying up (**Table 2.11**).

e) Drying

The plastic mould also requires some clips or tools to hold the bird nest in place during the drying process (Figure 2.22). Most of the bird nests will be dried under a low heat cabinet with the assistance of a direct fan blowing (Deng et al., 2017).

Figure 2.22: Plastic Mould

Table 2.12: Overview on Dying Methods

	Methods of Drying	Advantage	Disadvantage
1	Using fan and heater	Low cost and low maintenance	May cause the bird nest to turn yellowish
2	Using fan only	Low cost and low maintenance	Taking a longer time to dry
3	Using fan under air-conditional room	Better control and result	High operational cost

One of the weaknesses of this process is that the moulding and drying process is time-consuming. Due to the full expansion of the bird nest during the soaking process, the shape is hard to resume its original size. The quality will be downgraded, and the nutrients contained will reduce quite substantially (**Table 2.12**).

2.4 Information Measurement Theory – Foundation of Best Value Approach

The Best Value Approach is a procurement system, project management system, and risk management system all rolled into one. The approach satisfies the needs of the edible bird nest sector by shifting the focus from the owner to the provider or expert. It is also a commercial strategy for reducing effort and expense, increasing vendor profit, and improving project quality. Information Measurement Theory (IMT) is the theoretical underpinning for the Best Value Approach (BVA).

Information Measurement Theory is a theory of mind that allows individuals with no specialized knowledge to understand. IMT considers the following concepts: the laws of physics, the definition of information, events with initial and final conditions, and the process of learning in people.

The first concept is the laws of physics, which determine the physical world. The number of laws of physics stays consistent over time. Science may unknowingly incorrectly identify a law at one period of time and find out at a later period that the law was defined incorrectly or incompletely. Laws are not created but discovered - this notion is employed in Hawking's "no boundary theory" (1988).

The second concept is information. It is described as "the combination of laws and data (condition measurements) that depicts the existing conditions and may be utilised to reliably forecast a future event" (Kashiwagi 2001). As a result, information is not what a person perceives, but rather an explanation of what truly exists. Therefore, the amount of information perceived and their respective capacity to effectively forecast the future event would be a difference between two people. The limitation is not that the information does not exist, but that it must be perceived. (Kashiwagi 2002)

An event is defined by IMT as "something that happens throughout time" (Kashiwagi 2001). Throughout the event, there are beginning conditions, end conditions, and shifting conditions. And the number of laws remains constant throughout the events. The following are event characteristics:

1. Every event has a distinct set of starting conditions as well as a distinct set of concluding conditions. However, the number of physical laws remains constant throughout the event.
2. When two people with different degrees of perception gaze at the same event, they may see it differently. However, the event remains a single event with a single conclusion.
3. Cause and effect connect all occurrences and portions of events. Every event is bound by beginning conditions and rules, and its result or end state may be predicted if all information is perceived.
4. The change in the event's circumstances can be determined using differential. When there is a lack of information regarding the beginning circumstances and rules, randomness and probability are just strategies for estimating the end outcome.

The ideas of the first two concepts are applied in the Cycle of Learning (**Figure 2.23**). It is assumed that everyone begins with some amount of awareness or perspective of reality. Every individual will, at some time, become aware of a law that they were previously unaware of and will attempt to process the law's execution. Once a person understands the rule or concept, he or she may apply it. A person has transformed if they have implemented a freshly perceived principle. This shift in perception invariably results in the perception of more rules or principles (Kashiwagi, 2004).

Figure 2.23: Cycle of Learning (Kashiwagi,2004)

The following deductive logic applies to the model's comprehension and operation:

1. The faster the cycle, the more times a person cycles through the procedure (**Figure 2.23**).
2. There are several perspectives of how efficiently and effectively people perceive and process information. A lack of quantitative knowledge is the source of disagreement.
3. If the process is cyclical, the pace of change and application of concepts that may be assessed are relative to the individual's perceptual and processing capabilities.
4. People who perceive more, processes more quickly, apply more right concepts and change more quickly. People who are open to change are more likely to be imaginative, intuitive, efficient, and effective.

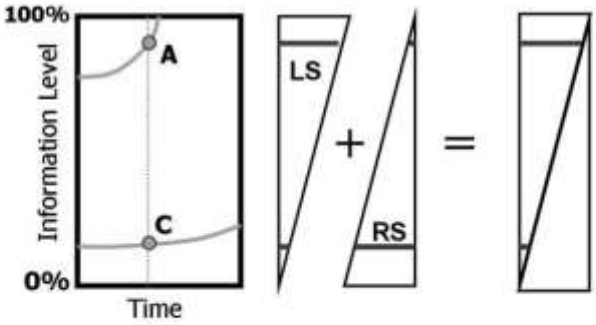

Figure 2.24: Rate of Change/KSM (Kashiwagi,2004)

IMT classifies these as "Type A" persons, or those who are more prone to demonstrate leadership traits. IMT indicates fewer observant persons, digest information at a slower rate, are less likely to apply new concepts and are less likely to be comfortable with change. "Type C" persons are more concerned with management and control (**Figure 2.24**).

According to IMT, it is more difficult to use an expert vendor's skills when an owner seeks to manage, direct, and control (MDC) them. The expert, on the other hand, may examine the existing condition without intervention from the owner and determine what has to be done to meet the objectives. Those suppliers that lack experience will try to follow the instructions of the non-expert proprietors. This raises the project's risk and operating costs.

Experts in the BVA must back up their bids with dominant performance data (van de Rijt & Santema, 2013). Dominating information is derived from information measurement theory and is characterised as "a deductive, logical, and dominant observation or explanation of an occurrence." It entails using relative and related facts to forecast the future result of an event." (Kashiwagi, 2016). According to van de Rijt and Santema (2013), dominating knowledge is verifiable, accurate, quantifiable, and irrefutable. This is a critical beginning point since the expert, according to the BV concept, is someone who can describe the problem simply. One significant benefit of knowing this prevailing knowledge is that it is simpler to forecast what will happen (Kashiwagi, 2016). Uncertainties are minimised, and project risks are lowered as a result (Wenselaar, 2011). Dominant information is documented in so-called "performance measures," or "metrics," which are simple to grasp and facilitate consensus (Kashiwagi, 2016). It is vital to note that the measurements do not have to be provided by the contractor. Metrics may also be obtained from partner suppliers, allowing for collaboration with the whole supply chain (Rijkswaterstaat, 2013). BVA welcomes suppliers for who they are, finds the vendor with the highest knowledge, and lets that vendor use that experience to enhance the project's value while lowering its cost (Kashiwagi, 2018).

The characteristics of the value-based quadrant are (Kashiwagi, 2013):

1. Utilising Expert,
2. Preplan to Identify Risk,
3. Measure Performance,
4. Create Accountability,
5. Motivation for Improvement, and
6. Customer Expectation.

According to Kashiwagi (2017), the BVA procurement commencement points are as follows:

1. The use of metrics to reduce and simplify risk.
2. In addition to pricing, choose based on level of experience, risk management, and value-added.
3. Scope clarification by the best value contractor
4. Use transparency to track project cost and time variances and reduce risk.

The technique focuses on locating and exploiting specialists' knowledge. Experts may look into the future and anticipate the outcome of a work based on natural law.

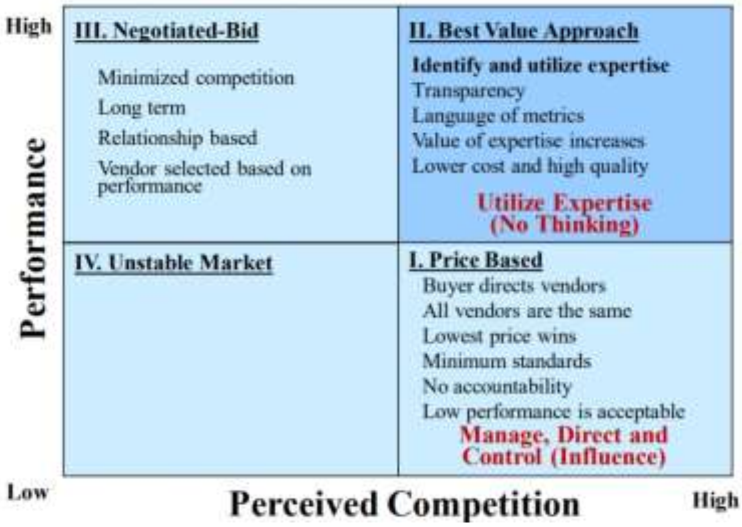

Figure 2.25: Industrial Structure Model adopted from Kashiwagi,2019

The industrial structure model (IS) was used to develop the Best Value Approach (BVA) (**Figure 2.25**). The IS model divides the industry into two major quadrants: the Value-Based quadrant (high competitiveness and performance) and the Price Based quadrant (poor competition and performance). The model detects poor performance as a result of buyers attempting to manage, direct, and control (MDC) vendors. The only way to advance to the Value-Based quadrant is to use the vendor's knowledge by delegating project management and control to the expert vendor (Kashiwagi, 2017).

(i) **Quadrant I: Price based or Lowest Price**

The price-based environment has the following characteristics:

• The client serves as the expert, telling everyone what has to be done and how (performance, scope of work and conditions are laid down for the supplier). The clients' primary focus is on analysis, thought, and decision making.

• The instruments used by the client to impose minimum requirements and limit risks include instruction, inspection, and control. • In such a situation, the customer is the primary driver of budget and time overruns. The more training, inspection, and control there is, the more meetings and communication there will be.

• The fundamental assumption is that all suppliers are the same and can perform the same functions.

• Instructions, inspections, and control mechanisms are outlined in a contract that holds the vendor liable for any risks. By relocating

• Instructions, inspections, and control mechanisms are outlined in a contract that holds the vendor liable for any risks. The contract becomes the most significant tool by passing risks to suppliers in this manner. In truth, the customer is the most significant source of project risk. If issues emerge, the vendor's sole option is to maintain a positive connection with the consumer.

The exercise of influence and control (through the contract) is wasteful and ineffectual, resulting in problems that are difficult to overcome [typically through legal actions]. It is a complicated and complex environment. Everyone in such a setting exhibits the same behaviour (influence and control). Clients who have seen the consequences of legal action (cost increases for everyone) will understand that they have no influence or control over vendors. To reduce risk, such clients shift their focus to developing a positive connection by entering into agreements designed to manage the relationship, such as partnership and collaboration contracts.

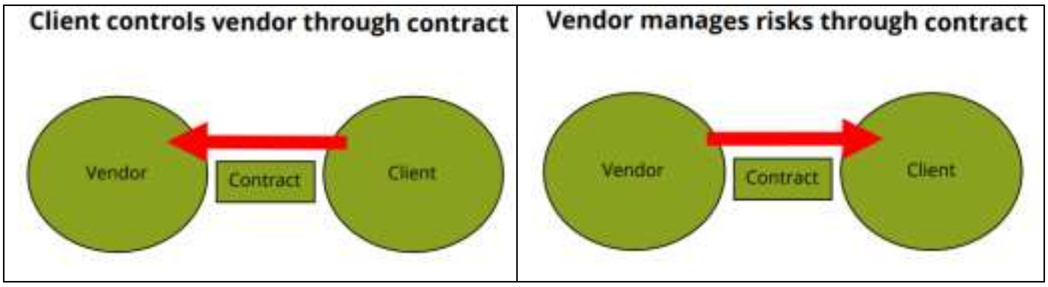

Figure 2.26: Client & Vendor (Source: Best Value Approach 2016 book – Dean T. Kashiwagi)

When the client utilises the contract to manage and control the vendor (the contract mandates performance, scope of work, and conditions for job execution), the relationship becomes the most essential means of issue solving. Making deals and cooperating reduces the relevance of the contract. This might explain why the customer is the primary driver of time and budget variances (more than 90 percent of project deviations are caused by the client) (**Figure 2.26**).

The Lowest Price Quadrant is the most expensive way for service delivery because to its complexity, lack of transparency, and huge number of stakeholders.

(ii) Quadrant II: Best Value Approach

This approach has the following characteristics:

• The customer sets his expectations (what he believes he needs), but the ultimate scope and conditions are defined by the vendor, who is chosen based on competence and cost.

• Vendors compete by giving a solution that satisfies the customer's genuine demands based on the vendor's knowledge.

• The customer, who is not an expert, leverages transparency and dominating information (numbers and statistics) to reduce the need for thinking or making judgments when selecting the best vendor for the project.

• The client employs the best vendor's skills to simplify, provide transparency, limit risks, and offer the maximum value at the lowest practical costs [as confirmed by the vendor].

This method decreases the need for thinking, making choices, and holding meetings, as well as communication and the possibility of misunderstanding. It boosts competitiveness by utilising transparency. This attracts competent vendors and provides greater value and performance.

The use of relationships, the employment of non-experts, and the number of personnel required to execute the project are all reduced, as is the participation of individuals who offer little value.

The participation of those who are necessary to carry out the project is maximised by reducing their efforts. This is analogous to advancements in automation and robotics, where risks are reduced by reducing human thinking, acting, and decision making. It lowers expenses, improves performance, and adds value.

The Best Value Approach focuses on observation, simplicity, value maximisation, transparency, and efficiency, while reducing communication and the usage of "technical" information.

(iii) Quadrant III: Negotiate

This is the setting in which the customer pre-qualifies suppliers before selecting one and establishing a long-term partnership. The most recent phrase for this is "vested": the contract includes both the customer and the vendor as parties participating in the delivery, and both share in the outcomes. Vested is a business strategy or approach that aims for high-quality cooperation across chain partners and is founded on the belief that all parties are totally dedicated to joint success.

This relationship-based collaboration appears to be centred on the assumption that both partners are totally dedicated to shared success. This setting lacks the use of dominating verifiable (performance) information yet competes on performance, reinforcing the inclination to make hollow gold-plated promises in order to "score" the assignment. It also reduces responsibility and the differentiation based on knowledge and value. Although it in the model stands for "high performance," it has many features of the price-based environment.

(iv) Quadrant IV: unstable market

This sector cannot be sustained. This industry's vendors do not differentiate themselves by competence and performance. When the slightest inkling of competition comes, these sellers vanish. This quadrant provides services to potentially indifferent clientele who do not rely on knowledge.

2.4.1 Communicating Expectations

Communication is founded on the capacity to comprehend; communicating expectations from one person to another is wasteful and unproductive. Stakeholders frequently modify communication objectives based on their assessment of the reality in which the communication occurs.

A client, for example, who tells a vendor what to do and how to accomplish it is not a visionary or informed individual. He believes he is an expert based on observation, employs thorough knowledge, and fears being tricked.

On the assumption that he has control over the vendor, he determines the minimum acceptable standard of work.

To be as competitive as feasible (price!) and to decrease their own risks, suppliers shift from a minimum standard to a maximum standard, lowering the amount of performance and value that can be given (**Figure 2.27**).

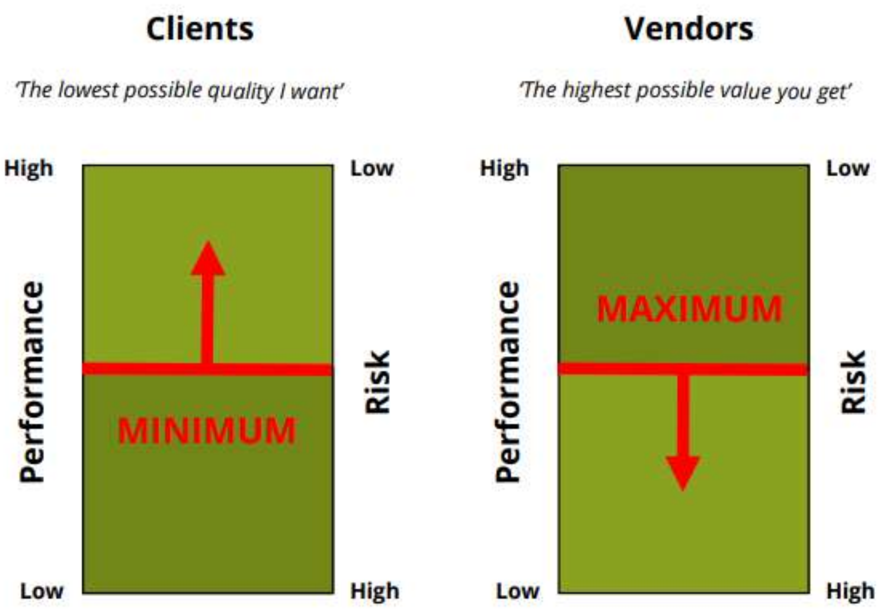

Figure 2.27- Impact of Using Minimum Standards (Source: "How to Know Everything Without Knowing Anything" – Dean T. Kashiwagi)

Industries and vendors rationally obey fundamental business economic principles, such as: 1. Experts with greater expertise and knowledge are paid more.

2. More knowledgeable experts provide better work faster and at a cheaper cost.

3. If experts' expertise is not used [client directs, inspects, and controls], the experts' performance suffers [higher costs and lower production] and the value for both the client and the vendor suffers.

4. When an industry's competence is reduced, the expenses rise. The client is the primary reason of rising project expenses.

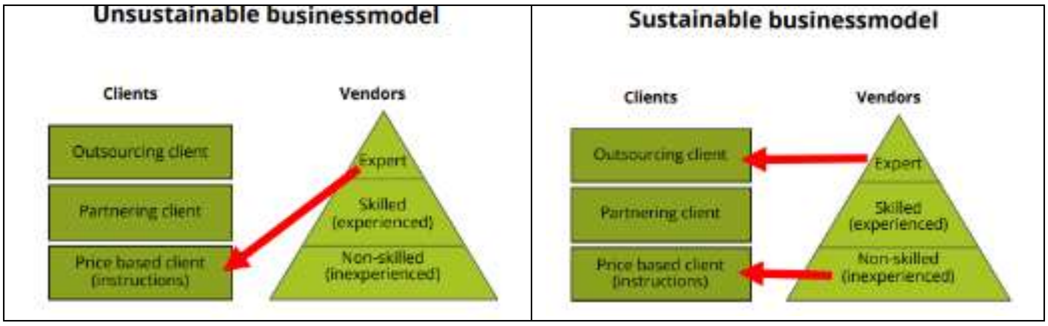

Figure 2. 28 - Expertise Deployment is Highest with the Outsourcing Customer (Source: "How to Know Everything Without Knowing Anything" – Dean T. Kashiwagi)

Figure 2.28 depicts a vendor's staff as having limited, experienced, or expert knowledge. Clients on the left are categorised as outsourcing [use the supplier's skills], partner-client [collaborate], and customer in the lowest pricing environment [Dictate].

If the vendor sends his most experienced and expert employees to the client in the lowest-cost environment, where the expert is instructed, inspected, and controlled by the client, the expert will oppose the incompetent client, the project will be delayed, the costs will rise, and the profit will fall.

Vendors will quickly realise that it is better to assign inexperienced personnel to the lowest-paying clientele. They are less expensive, and since they lack experience and skill, they satisfy the lowest-priced clientele by listening to and obeying their directions. Vendors face no danger if they follow the instructions. Even if the outcomes are unsatisfactory, the customer is accountable for them as long as the vendor performed what the client instructed him to do.

The only way for successful vendors to make the most use of specialists in their own organisation is to deploy those experts to outsourced customers. The professionals are paid more, but they will lower project costs owing to their superior planning, risk management, and knowledge. This is the only way to keep industry expertise.

Most customers are low-cost customers. Because of their "blindness," they are lowering industrial performance and competence. There is little incentive for highly competent project managers, CEOs, highly educated technicians, and other professionals to expand their competence [to shift their paradigm, pursue further training and education, and be proactive in project leadership] (Kashiwagi, 2017).

The IS model also recognises the following actions as allowing purchasers to use vendor expertise:

1. Minimize engagement with service technical specifics.
2. Shift buyer operations from quality control to quality assurance (ensuring the vendor has produced a strategy and is assessing their success using non-technical measures) (ensuring the vendor is performing all of their technical work correctly).
3. Require vendors to inform the customer of the technical specifications and needs.
4. Make use of internal buying people to assist and defend the vendor.

2.4.2 BVA Process

The BVA was created to assist buyers in understanding and moving to the Value-Based quadrant, as well as performing actions that allow them to leverage vendor knowledge. A project is divided into three primary phases by the BVA (selection, clarification, and execution) (**Figure 2.29**):

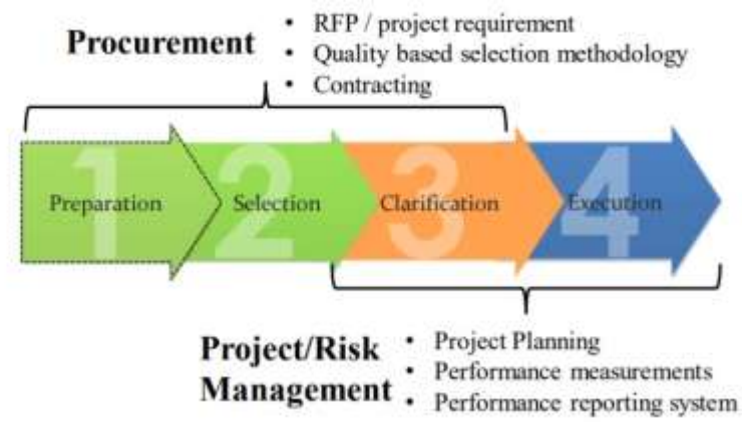

Figure 2.29: BVA Process Model adopted from Kashiwagi,2019

i) Phase of Selection

Vendors will compete based on their degree of experience rather than their technical scope of work. During this phase, vendors are provided with a list of expectations and an explanation of "what the customer believes they want," rather than technical needs or specifications. They are chosen based on their prior performance metrics, ability to recognise risk, and critical personnel competency. The vendor with the highest score proceeds into the second phase.

ii) Clarification Phase

This is the most critical phase, as the vendor with the most experience is now required to develop their scope of work and technical requirements. They must also describe how they plan to do the task efficiently and with great client satisfaction. They must identify their strategy from start to finish, all-hazards over which they have no control, all important milestones, how they will assess their success, and justify their expenses. The client will communicate their issues and feedback on the contractor's plan during clarification, and the contractor must address those concerns in their plan. Regardless of whether the client's issues are technical or non-technical, the vendor must answer the issue in non-technical terminology. The contract is only signed when the customer is completely satisfied with the contractor's plan; otherwise, the contractor is removed from the clarification process and the next in line vendor is called.

iii) Phase of Execution

After signing the contract, the contractor can begin work on their plan. Because the vendor created the strategy and the measurements, they now have complete control over the project. Each contractor's performance will be recorded and reported online via Weekly Risk Reports (WRR), which the contractor will submit every Friday. If another stakeholder attempts to control the expert, it is likewise recorded on the WRR, and the vendor determines the impact of that control on the project's performance.

2.4.3 BVA Implementation Criteria

Although the BVA may be used for a wide range of projects, several parameters must be met for it to be effective.

i) Characteristic of Project

The first criteria concern the characteristics of the project to be acquired with the BVA. First and foremost, the project should be sophisticated enough that contractors may submit a distinct proposal based on the risk's criterion. Furthermore, according to the BVA concept, the project should be acceptable for capture in functional requirements; the fewer specifications, the better (Rijkswaterstaat, 2013). As a result, the project scope should leave enough flexibility for contractors to develop unique creative solutions. Furthermore, the contracting authority should provide for this flexibility. This brings us to the second criterion.

ii) Role of Contracting Authority

Even though BVA could be implemented in the EBN processes industry, it requires a specific function from the contracting authority to be used properly. Because the contractor is seen as the expert, he should be allowed to demonstrate his knowledge. This necessitates the contracting authority relinquishing control and becoming more accommodating (PIANOo, 2017). The winning contractor should be recognised as an expert and should be assisted throughout the project's execution (Wenselaar, 2011). This does not, however, imply that the contracting authority can relax. In actuality, the contracting authority possesses a wealth of knowledge in a variety of sectors. The contracting authority must take the initiative in these areas (van de Rijt et al., 2016).

iii) Role of Contractor

It was discovered that adequate market competitors are required for the successful use of the BVA; otherwise, the expert cannot differentiate himself from others. If the method is restricted, at least five professional contractors should be available to make a bid. Furthermore, contractors must be able to demonstrate their knowledge (through dominating information) and make their performance visible (Rijkswaterstaat, 2013; PIANOo, 2017).

2.4.4 Performance of Best Value Approach

BVA's goal is to eliminate inefficiencies between the client and the consultant. The decrease of effort and issues might be increased if the client and consultant's skills were more aligned. The Performance-based Studies Research Group (PBSRG) has identified several advantages of the method, including:

1) Requires minimal to no knowledge of the services
2) Simplify or reduce the number of difficult project requirements.
3) Simplified assessment procedure
4) Complete scope/plan from a consultant before engagement
5) Reduces project cost by up to 30% with on-time/on-budget completion
6) Tracking system for project performance that is semi-automated

2.4.5 Proven Success of Best Value Approach

Over the last 30 years, Dr. Dean has created the Best Value Approach (BVA), a project delivery methodology that has automated many aspects of the project delivery process, allowing customers to save money and time while improving the quality of their projects and services. Previously, it was thought that the client was the key to a successful project delivery model; however, the BVA has revealed that the contrary is true, and the expert vendor is the key to delivering high-performing projects. The BVA is the only delivery model that shifts from a "client-centric" to a "vendor-centric" mindset. BVA has had a long history of success in aiding and delivering services such as construction, information technology, and other services such as food, cleaning, health, financial, and insurance.

Some of the indicative projects are mentioned below, according to the PBSRG websites:

1. Arizona State University — 13 projects, $1.7 billion in value, and complete satisfaction. Food services were obtained with a 23% rise in commissions/returns. IT networking services with a $2.75 million yearly savings.
2. Harvard University - 8 construction projects totalling $13 million; all bids were 25% lower than the average bid. The Cornet Global Innovators Award was bestowed on us.
3. University of Minnesota - 355 construction projects totalling $322 million, a 0% contractor change order rate, and a 9.5 out of 10 customer satisfaction rating. State of Oklahoma – 30 projects, $141M value, 13 different services procured including, $71.8M in cost avoidance.

4. State of Utah - 5 construction projects totalling \$85.8 million were awarded 7% under budget, with 88 per cent of participants preferring the BVA over traditional methods.
5. Arizona Department of Environmental Quality — 60 engineering services projects totalling \$5.8 million, 94 per cent more work completed in 33 per cent less time, and a 140 per cent increase in PM work capacity.
6. US Army Medical Command - 600+ construction projects, project management tracking system, \$1 billion in value, 0% contractor change order rate, and 1.5 per cent contractor schedule delay.
7. Rijskwaterstaat (Dutch Ministry of Infrastructure) - 16 road projects, \$1 billion in value, 25% faster delivery time, 50% lower transaction costs for client/vendor, earned the Dutch sourcing prize.

2.5 Quality Improvement Review

The EBN industries have been forced to seek better ways to fulfil their customers' needs, decrease costs, and enhance efficiency because of global competition pressure. Continuous improvement has become an important component of business strategy and a must for existence. According to the authors, the method was to make a change by closely examining the current system for defects and opportunities for improvement. Alternatively, create a new system that is not based on current practice. Learning and extensive study were required to ensure that the improvements were good and improving. Tests and experiments are also required to verify the changes.

Every change necessitated knowledge. "Knowledge gained by study or practise" is how knowledge is defined. W. Edwards Deming (1994) suggested a "System profound knowledge" framework to show how subject matter knowledge and deep knowledge intersect.

According to Deming (1995), there are five different methods to change:

1. Development of a new product or service,
2. Redesigning an existing product or service
3. Development of a new process,
4. Redesign of an existing process, as well as
5. Enhance the overall system.

The understanding of the relevance of variation, according to Deming, is the key to quality. He asserted that managers must be able to discern between unique and common causes of variance. He established a theory of variation in which specific causes of variation are typically clearly attributed to easily identifiable variables such as changes in technique, shift or operator changes, and so on, but common causes will persist after special causes are eliminated (normally due to design, process or system).

Workers are typically aware of these prevalent reasons, but only managers have the authority to modify them to prevent the problem from recurring. Management, according to Deming, was responsible for more than 85% of the causes of variance. Deming proposed 14 principles that may be utilised to drive long-term organisational plans and goals, as well as provide a framework for knowledge creation in the workplace. The points provide a guideline for management to setting up better management philosophy than an action method. The 14 points could be summarised as **Table 2.13** below.

Table 2.13: Interpretation of Deming 14 points

	Deming 14 Points	Interpretation
1	Establish a consistent goal of improving product and service to become competitive, stay in business, and provide jobs.	Create constant improvement
2	Adhere to the new philosophy. Western management must face the issue, learn their duties, and take the lead in effecting change.	Adaptability to change
3	Reduce reliance on mass inspection. Quality should be built into the product from the beginning.	Eliminate mass inspection
4	Put an end to the practice of awarding business only based on pricing. Instead, aim to reduce total cost. Move toward a single provider for any item, based on long-term loyalty and trust relationship.	Ending price awarding but building trust
5	Constantly and indefinitely enhance the manufacturing and service systems to increase quality and eliminate waste.	Improve constantly
6	Institute education and re-education.	Training and retraining
7	Institute management. The goal of supervision should be to guide and assist others in doing a better job.	Supervision and leadership
8	Remove fear from the workplace so that everyone can work efficiently for the organisation.	Drive out fear
9	Breakthrough departmental borders. People in research, design, sales, and manufacturing must work together to anticipate and solve production challenges.	Breakdown barrier between staff
10	Remove slogans, exhortations, and worker objectives because they do not always achieve their goals.	Eliminate slogan
11	Remove numerical quotas to consider quality and techniques rather than just numbers.	Eliminate numerical quotas
12	Remove impediments to pride in one's job.	Remove barrier to the pride of workmanship
13	Implement a robust education and re-training programme for both management and the workers.	Programme of education and retraining
14	Take action to bring about the transition. Management and the employees must collaborate.	Take action to accomplish the transformation

When applying Deming’s 14 points to the EBN cleaning process, the 14 points can be divided into three major domains: management, employees, and facilities or processes. In terms of management, the company should envision continuous quality improvement as part of its missions, the management should be adaptable to changes, and the management should be resilient to current issues.

Deming believes that management should foster trust and eliminate fear among employees to nurture loyalty and pride in their daily tasks. Thus, job satisfaction could be obtained, and by removing slogans or exhortations, employees could be set free and motivated by their accomplishments. Finally, management should work with employees to improve transition and teamwork among all employees.

Employees should be subjected to individual accountability rather than mass quality control to ensure their quality output. It is critical to engage an expert or consultancy to educate and supervise employees to instil a culture of lifelong learning. It should be encouraged for different divisions or departments to work together as a cohesive team. The barrier between the two domains could be removed through a re-education programme for both managers and employees.

Suppliers of raw materials and tools for facility management should be based on trust and loyalty rather than price. To improve quality and eliminate waste, the process procedure and system should be reviewed regularly. Quality improvement should be based on techniques rather than a numerical score. More planning ideas for improving quality could be generated by applying Deming principles.

2.5.1 Deming's Theory of Profound Knowledge

Deming's 'System of Profound Knowledge' is based on the principle that every business is made up of related people and processes that work together, and that the system's success is dependent on the ability to successfully manage those components. He theorised that there were four elements to comprehend to improve a business's effectiveness:

1) Appreciation of a system

2) Knowledge of variation

3) Theory of knowledge

4) Knowledge of psychology

1) Appreciation of System

A leader must have a thorough understanding of the system he or she is attempting to manage. The system cannot be managed or improved without this understanding. A system cannot comprehend or manage itself. The optimization of the parts does not result in the optimization of the whole. System optimization necessitates coordination and cooperation among the various components, which usually requires leadership.

2) Knowledge about Variation

There are two types of causes for variation:

i. Common Cause - Common causes of variation are caused by within-system structures and can be predicted using probabilities. When looking at variation with a common cause, it is most likely something consistent that does not have statistically significant value that can be traced back to a specific historical event.

ii. Special Cause - Variation with a special cause occurs unexpectedly. Variation due to a special cause can occur after a change in the system (with or without awareness of the change), and special cause variation cannot be predicted.

3) Theory of Knowledge

Good leaders in Deming's System of Profound Knowledge can identify which theory of knowledge is being used. When approach phenomena with certainty and think of "fixes" as a one-time event rather than a continuous process, it will end with failure. Improvement thru the Deming-Shewhart plan-do-check or study-action (PDCA) cycle is required.

4) Knowledge of Psychology

Leaders must understand human behaviour to motivate, coordinate and manage people to optimize the system. These are the things that can make or break the ability to manage a project effectively. Working well with others is an important aspect of successful project management.

2.5.2 Juran Trilogy

Dr Joseph M. Juran is a prominent figure in quality management after Dr Deming. Dr Juran's Juran Trilogy consists of three components: planning, control, and improvement (Juran, 1986).

1) Planning

The planning phase begins with the identification of the customer. Once the customers have been identified, the needs of the customers are discovered. Customer needs are mostly expressed from their perspective; thus, they must be translated into requirements that the organisation can understand.

The next step will be to plan the process or services that will meet the needs. The final step in the planning process is to put plans into action.

2) Control

Control is used by operation forces to ensure that the requirements for products, processes, and services are met. It consists of three steps: evaluate current operating performance, compare current performance to goals, and act on the difference.

3) Improvement

The third component of the trilogy aims to improve performance beyond the current level. The establishment of infrastructure teams required to ensure annual quality performance is the first step in process improvement. The teams' responsibilities include identifying improvement projects and project teams with a project owner. The teams will need resources, motivation, and training, which will be provided.

Juran Trilogy could be summarised as the list below:

1) Planning

    1a. Establish quality goals

    1b. Identify customers

    1c. Determine customers’ needs

1d. Develop services corresponding to customers' needs

1e. Develop a process that can create those services

1f. Establish process control

2) Control

2a. Evaluate actual quality performance

2b. Compare performance to quality goals

2c. Act on the difference.

3) Improvement

3a. Establish infrastructure needed to secure annual quality improvement

3b. Identify improvement projects

3c. Establish teams to effect improvement projects

3d. Provide resources, motivation and training to teams

2.5.3 Zero Defects by Philip Cosby

Phillip Cosby's greater contribution to quality history was the 'zero defects' idea. According to Cosby, the cost of quality is the expense of doing things wrong and we must define quality as conforming to requirements (Cosby, 1980).

Cosby defined quality system involves 14 steps.

1) Management commitment
2) The quality improvement teams
3) Quality measurement
4) The cost of quality
5) Quality awareness

6) Corrective action

7) Zero defects planning

8) Supervisor training

9) Zero Defect Day

10) Goal setting

11) Error cause removal

12) Recognition

13) Quality council

14) Do it over again.

2.5.4. Comparison of Best Value Approach with Deming, Juran and Cosby TQM system

Looking at **Table 2.14**, all three quality gurus emphasise the importance of training and education, which is consistent with the BV principle of utilising experts. When most EBN companies do not know the industry, they engage an external expert to conduct training for their employees.

The second BV principle of pre-planning to identify risk corresponds to Deming's creating improvement, Juran's setting quality goals, and Cosby's quality improvement or management commitment. To deploy the entire process, all planning required the expertise of consultants.

On the third BV principle of measure performance. We could interpret Deming's principle of eliminating mass inspection, Juran's evaluating actual quality performance, and Cosby's quality measurement in the same way.

Next, in terms of accountability, it is similar to Deming's concept of driving out fear and removing barriers to pride of workmanship. It is especially important in the EBN industry, where all cleaning is done by hand.

The Juran trilogy of providing support and motivation to the workforce could boost employee morale, and Cosby's ideas of recognition echo the same point.

Table 2.14: Comparison of BVA, Deming, Juran and Cosby

BVA	Deming 14-point system	Juran Trilogy	Cosby 14 steps
Utilising Expert	6. Training and retraining 13. programme of education and retraining	3d. Provide resources, motivation and training to teams	8. Supervisor training
Pre-Planning to identify Risk	1. Create constant improvement 2. Adopted to change 14. Take action to accomplish the transformation	1a. Establish quality goals	1. Management commitment 2. Quality improvement teams 5. Quality Awareness
Measure Performance	3. Eliminate mass inspection	2a Evaluate actual quality performance 2b Compare performance to quality goals 2c. Act on the difference 1e. Develop a process which can create those services 1f. Establish process controls	3. Quality measurement 7. Zero defect planning
Create Accountability	8. Drive out fear 9. Breakdown barrier between staff 10. Eliminate slogan 12. Remove barrier to the pride of workmanship	3d. Provide resources, motivation and training to teams	9. Zero Defect Day 10. Goal setting 11. Error cause removal 12. Recognition 13. Quality councils
Motivate for Improvement	5. Improve constantly	3a. Establish infrastructure needed to secure annual quality improvement 3b. Identify improvement project 3c. Establish teams to effect improvement projects	4. The cost of quality 6. Corrective action 11. Error-cause removal 14. Do it over again
Customer Expectation		1b identify customer 1c Determine customer's need 1d Develop service corresponding to customers;' need	

The next step in aggregating employees' attitudes toward quality improvement should be motivation for improvement. Deming's suggestion for continuous improvement is consistent with Juran's identify improvement project and Cosby's corrective action. The long hours of manual labour in the EBN cleaning process necessitate motivation from the supervisor and top management.

Finally, the centre of this process is customer expectation, as suggested by Juran, to identify, determine, and develop services corresponding to customers' needs. Identification of target customers should be at the heart of all businesses to capture a new market or venture into a new industry sector. Products and services that can meet the needs of customers are highly competitive. The EBN industry still has a lot of room to grow beyond health and beauty products and into medical applications.

2.6 Continuous Improvement

Aside from quality improvement, the next section will cover a variety of continuous improvement methodologies and concepts. This is critical to ensuring that the quality of edible bird nest end products meets the stringent requirements of food safety while also creating a reputation among rivals. The sections that follow will go through Lean management, Kaizen, the PDCA cycle, and Six Sigma methodologies.

2.6.1 Lean Management

Lean manufacturing is a production technique invented by Toyota in Japan in the 1950s that has continued to make the company more successful to this day. It is also known as "Lean Management" (Drew et al., 2004) and was a popular idea in the United States in the 1980s (Liker., 2004). The literature has several definitions of Lean that varies based on the perception of certain authors and corporations (Liker., 2004; Womack & Jones., 2005).

"Lean is a whole combining multiple concepts, tools, and methodologies whose purpose is to reduce all sources of value chain inefficiencies while bridging the gaps between current performance and customer expectations," describe Drew et al. (2004).

Lyonnet (2010) outlines Lean using six key concepts:

1. Waste elimination: To produce effective value, waste must be identified and any action that does not provide value for consumers must be eliminated. As a result, eight types of waste (MUDA in Japanese) were identified: overproduction, waiting times, unnecessary transportation, steps with no added value (over-processing), excessive inventories, unnecessary human movements, defective part production (quality defects), and under-utilization of human potential.
2. The just-in-time operating mode entails "delivering the correct part at the right place at the right time and in the right amount."
3. Quality: The industry strives to provide the best ways for improving quality, ranging from the Quality Control concept to Total Quality Management. The primary purpose of promoting excellent quality is to

create a product that satisfies the expectations of customers (Lyonnet, 2010).

4. Continuous improvement (Kaizen in Japanese): it is a method that is built on a set of efficient activities, productivity, procedures, and so on. Kaizen is a state of mind and a work culture, but it is most importantly a management strategy that employs tools and resources. Methods like as 5S, Kanban, SMED, and TPM are examples of kaizen.
5. Visual management discloses the condition of production with visual methods such as billboards that display a set of indications. The primary visual management strategies include the 5S method, Kanban, and Andon systems. Employee management encompasses all aspects of teamwork, multifunctional teams, adaptability, and employee participation.

Kaizen is the essence of Lean Management, which focuses on continual improvement. This will be embraced and further studied in this section. Workplaces may be classified into two kinds when it comes to the continuous improvement strategy. Type A workplaces, such as processing lines are mostly people (labour) intensive, whereas Type B workplaces, such as receiving or packaging, are primarily machinery and facility demanding. Productivity improvement, an increase of production capacity, or adaption of production for various goods in small quantities might all be suitable improvement targets in any instance.

This section illustrates examples of hidden losses (waste) and presents a collection of improvement checkpoints (improvement rules) based on each of these objectives under the idea of continuous improvement, or kaizen in

Japanese. The following **Table 2.15** is a ten-point summary by Miller,2019 and interpreted for EBN processing.

Table 2.15: Interpretation of Kaizen Improvement

	10 points of Kaizen Improvement	**Interpretation**
1	Although Kaizen is built on little daily achievements, it must be approached with a long-term goal in mind. What exactly does it mean to be "good"? We sketch out a picture of what a perfect state may look like and try to handle each situation one step at a time.	Having clear vision
2	Being able to move quickly when necessary is not a bad thing. The lesson is that we can win in the long run by making small improvements every day.	Making small improvements daily
3	When we focus on little changes, our anxiety decreases. As we achieve small successes, our faith and confidence expand. This raises the chances of perseverance in the face of hardship. After a year, a weekly improvement of 1% leads to a compounded improvement of 65%.	Small achievement boosts the morale
4	When we face a problem, our first objective is to contain it, provide relief and keep it from escalating. A quick-and-dirty improvement that we can test, learn from is more essential than a faultless answer. So-called perfect solutions rarely perform as intended, cost more, and delay	Don’t be afraid to make a mistake
5	A continuous improvement culture encourages the visibility of issues so that they may be discovered as soon as possible, while they are still small. Problems can grow in magnitude as they go unaddressed if they are not dealt with now rather than when they are too late.	The mindset of continued improvement could save the big problem
6	When the human mind isn't bombarded with options, it makes better decisions. When we are limited in time or resources, we examine the situation more closely and think more critically. Even when we develop, we must impose clear limitations on ourselves to keep coming up with new techniques.	Understand the limitation and work with available resources
7	The spot where we can observe the true situation and acquire information is crucial to the kaizen technique. Humans are prone to having strong opinions, jumping to conclusions, and arguing for preferred solutions regardless of whether they are appropriate for the situation.	Inspect and observe the situation instead of report
8	We spend money and effort on symptoms when problem-solving isn't based on facts, providing temporary relief but seldom a long-term solution. The only approach to research root causes is to get to the base of the problem and create a blame-free environment.	In-depth study of the main root cause
9	Continuous improvement is not something that occurs by chance. We can get good outcomes by adhering to a good approach based on well-established notions. When we don't follow a proper technique yet receive good results by coincidence, we must adjust our strategy.	Continues improvement need proper planning and techniques
10	Many of these ideas are based on natural laws, such as cause-and-effect, the power of little changes compounding over time, and the advantage of faster feedback cycles from small acts. These, like gravity, have stood the test of time. It is not a good idea to breach these laws regularly. Many of these principles also work in concert with, rather than against, the best qualities of human nature.	Perseverance to seek improvement should be the key to quality improvement

The kaizen method emphasises "go see," recognising that people are intelligent and will arrive at solutions on their own.

Instead of undertaking a large project and aiming for perfection, kaizen encourages us to try a "good enough" solution. It is now widely used in fields such as business, healthcare, government, education, psychotherapy, and others. According to the summary of Kaizen improvement, the main approach should be for management to have a clear vision in driving quality improvement. Having a mindset of small daily improvements is preferable to preparing for huge changes with little success. Workers should be trusted to make small improvements without fear, and they should be able to improve their quality despite limited resources.

Finally, rather than relying on reports and making assumptions, senior management should physically visit the production or facilities to undertake an in-depth analysis of the underlying cause. Planning and direction are required for continuous progress. Persistence in seeking quality improvement should be instilled in both management and personnel.

In Kaizen, the mindset and attitude of both management and employees are important. A leader must have a clear vision for the organisation, an in-depth understanding of their limitation and resource as well as a total understanding of the root cause. To achieve the kaizen principles, the leader could rely on the expertise of consultants (**Table 2.16**).

Secondly, the continuous improvement required proper planning and techniques from the expert and complete planning before the implementation of the improvement process.

Table 2.16: Comparison of BVA to Kaizen

BVA	Kaizen
Utilising expert	Having clear vision Understand the limitation and work with available resources In-depth study of the main root cause
Pre-planning to identify risk	Continues improvement need proper planning and techniques
Measure performance	Inspect and observe the situation instead of report
Create accountability	The mindset of continued improvement could save the big problem
Motivation for improvement	Small achievement boosts the morale Making small improvements daily Don’t be afraid to make a mistake
Customer expectation	Perseverance to seek improvement should be the key to quality improvement

Thirdly, the leaders need to inspect the real situation instead of depending on the report. The outcome requires proper measurement and performance to be observed for further investigation.

Fourthly, all employees need to impress by the mindset of continuous improvement could save the big problem, they are entrusted with the task assigned and accountable to their output quality.

Fifthly, it is adequate to focus on small achievements daily than huge achievements. The motivation and encouragement to employees could boost their morale and fear of making mistakes should be removed among all the employees. Lastly, all improvement needs perseverance to conform to customer requirements or expectations.

2.6.2 PDCA Cycle

The PDCA cycle (**Figures 2.30**) was invented by Walter Shewhart and introduced to Deming by him. In the 1950s, Deming popularised the concept, which became known as the Deming Wheel or the Deming Cycle.

The PDCA (Plan-Do-Check-Act) cycle has four phases or stages that must be completed to move from "problem-faced" to "problem-solved." The repetition of these stages creates a cycle of improvement:

Plan for changes to bring about improvement.
Do changes on a small scale first to trial them.
Check to see if changes are working and to investigate selected processes.
Act to get the greatest benefit from the change.

Figures 2.30: PDCA Cycle
(Source: www.creativesafetysupply.com/glossary/pdca-cycle/)

2.6.3 Six Sigma Methodology

In 1986, Motorola developed the Six Sigma quality concept in an attempt to achieve 6-sigma capability and reduce the number of defects and mistakes to fewer than 3.4 per million possibilities. It all started in the mid to late 1980s, when Bill Smith, a Motorola engineer, recognised a correlation between market product performance and the number of adjustments required at manufacturing locations.

Six Sigma is now a business improvement process intended at identifying and minimising errors and defects in various parts of manufacturing and service businesses, such as product development, marketing, finance, accounting, and operations. It's used in finance and accounting departments, for example, to reduce or eliminate costly errors and minimise the time it takes to close the books. Six Sigma is a methodology that focuses on understanding customer expectations and improving process performance via the use of data-driven methodologies and rigorous statistical tools (e.g., process control charts).

Six Sigma approaches have increased firm profitability by lowering costs, increasing productivity, improving quality, increasing customer satisfaction, and promoting employee morale. Motorola owns the trademark "Six Sigma," which contains two capital Ss. What exactly is Six Sigma, and how does it assist firms in making such a large profit? The three main pillars of Six Sigma are striving for 6-sigma competency, the Six Sigma improvement cycle, and organisational engagement.

Six Sigma is a problem-solving strategy that focuses on data analysis through the use of quantitative techniques and statistical analysis, with a strong emphasis on continuous improvement. DMAIC, a systematic problem-solving process, is the cornerstone of Six Sigma quality improvement (improvement cycle). The acronyms Define, Measure, Analyze, Improve, and Control (DMAIC) stand for Define, Measure, Analyze, Improve, and Control (**Figures 2.31**). Using the DMAIC improvement cycle, organisations may systematically monitor and improve processes in virtually every aspect of their company.

Figures 2.31: DMAIC Cycle
(Source: www.qualitymag.com/articles/94429-back-to-basics-six-sigma)

a) DEFINE

The essential to quality (CTQ) feature of a process output that is significant to consumers must be defined. CTQ is the difference between the process output and CTQ measurements. Process mapping tools such as Process-Flow Chart and Value Stream Mapping can help you better understand the process.

b) MEASURE

The measure aims to assess the present performance of the DMAIC process. Data on numerous performance metrics, as well as crucial input and output variables, must be obtained before an improvement can be made in the process's quality or cost per tonne.

c) ANALYSE

The "Analyze" phase of the DMAIC involves analysing the data collected in the "Measure" step. The Cause-and-Effect Diagram is an important tool that is frequently used by Six Sigma teams to help them identify the root causes of problems.

d) IMPROVE

Increasing process capability usually correlates to an improvement in quality. The team must weigh the pros and cons of each option before deciding on the best one for the problem at hand. Some elements may need to be modified, redesigned or re-engineered.

e) CONTROL

The DMAIC's "Control" phase requires the Six Sigma team to pass off the project to the process manager. This involves giving statistics on important process metrics both before and after the solution is implemented. The major goal is to create a mechanism that assures that the solution's improvement is sustained.

2.6.4 Selection of Best Value Approach

The most significant distinction between the BV and the first two approaches (Six Sigma and Continue Improvement - Kaizen) is that the BV strategy necessitates the involvement of an experienced consultant who can oversee the entire project from start to finish before it begins. Using the experience of the expert consultant, the BV method maximises pre-planning and planning. The professional consultant must also oversee the whole project and ensure transparency, reducing the need for the owner to comprehend the project's technical needs. The BV method also has a structure that requires the selection of an expert (Figures 2.29) The structure contains a selection step and a clarification phase, which compel the expert consultant to take the following actions:

1) The expert begins by identifying the project deliverable and obtaining consensus from all stakeholders.

2) The expert has a comprehensive strategy [which contains a thorough timeline, cost, and milestone schedule].

3) The expert must identify, minimise, and track risk [over which they have no control], including unanticipated situations.

4) The expert works backwards from the deliverable to discover all additional project needs.

5) The expert keeps note of any deviations from the project plan.

6) The expert creates clarity, allowing the owner/client to see clearly into the future until the conclusion of the project, reducing the need for the owner to become active in project management.

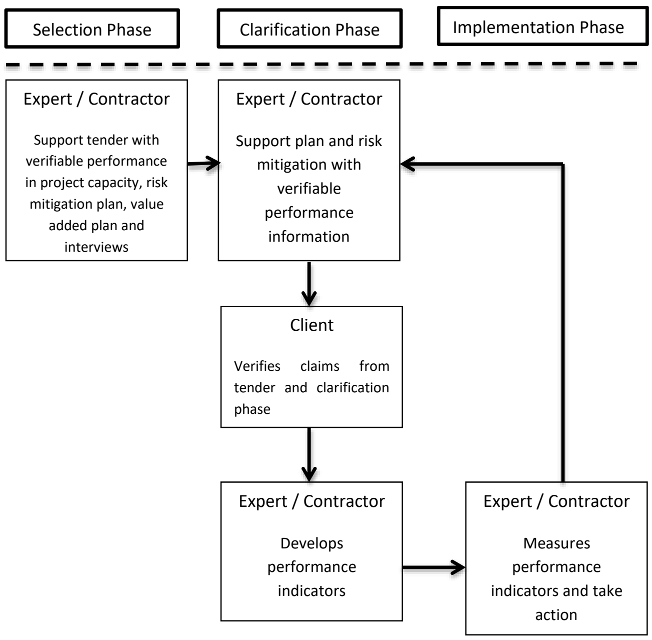

Figure 2.32: Best Value Approach in Selection Process adopted from Horstman, 2013

The owner must identify what they "think they want" under the BV method, but because they are not experts, the Best Value expert provider is necessary to set the project scope. The owner must agree to the scope recommended by the expert.

The BV approach has the following advantages:

1) Reduces the need for specialist consultants to be managed, directed, and controlled.
2) Increases the expert consultants' accountability.
3) Increases the client's/accountability owners to understand their business and how the apps will contribute to their business goals.
4) Increases the expert's and their expertise's worth.
5) Promotes transparency, allowing everyone to comprehend the project with less information and communication.
6) Increases the industry's strength and performance to achieve high performance.

The difference between the first two approaches and the third approach is that the BV approach uses expertise to resolve complexity, whereas the other two approaches attack complexity by reducing scope by making the project smaller or breaking it down into smaller components and working on one at a time. The BV method experts work backwards from the well-defined deliverable to the original circumstances, whereas the other two techniques work from beginning to conclusion.

2.6.5 Application of BVA in Responding to PDCA and DMAIC Process

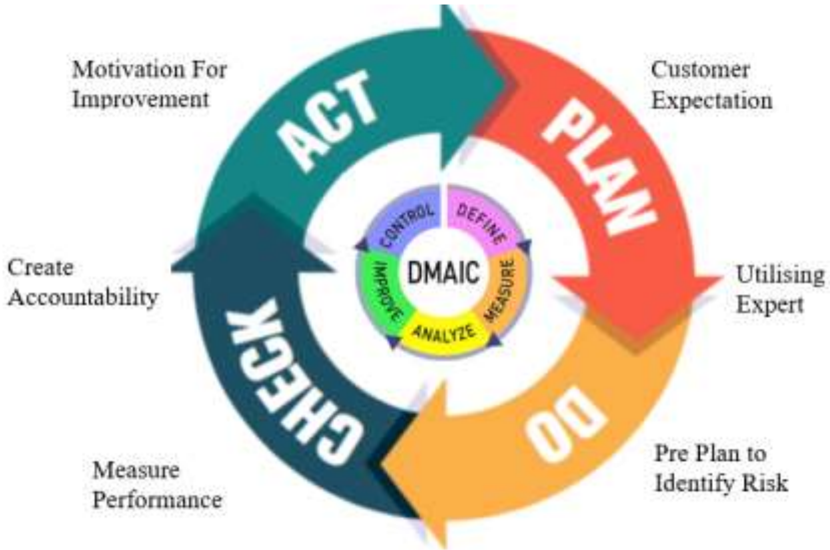

Figure 2.33: Application of BVA according to PDCA & DMAIC Cycle

The six Best Value principles can be read in parallel with the PDCA cycle (**Figure 2.33**). It all starts with the customer's expectations; the cleaning process must be modified to meet those expectations. If internal expertise is unable to meet the requirements, an external consultant will be recruited.

Following this, the entire process is pre-planned to identify potential risks and mitigation actions. All performance will be measured during the checking stage to ensure process efficiency. Simultaneously, all workers' output will be recorded, and individual quality checks will be performed to ensure accountability. Finally, all employees will be entrusted with improving their processes through supervisory and management motivation.

When compared to the Six Sigma – DMAIC process, BVA principles could be interpreted as defining customer needs or conforming to requirements at the defined stage (**Figure 2.30**).

According to Six Sigma, the measuring stage is to collect data for subsequent measurement and analysis. The performance metric should be determined before measuring performance. As a result, before the measurement stage, the use of an expert or the engagement of a consultant is essential.

Once the performance has been measured, the data will be analysed to develop an improvement strategy. This is similar to the BV principle of pre-planning to identify and mitigate risk.

The Six Sigma improvement plan would be passed on to production, but more importantly, all employees should be motivated to improve their output and quality.

This brings us to the final stage of control. Six Sigma defines control as the delegation of responsibility to production rather than the management team. As a result, the BV principle emphasised the importance of instilling accountability in all employees. Management's trust and dedication should be passed on to the employees, and all management, direct, and control should be avoided in the process.

2.7 Main Challenges or Research Gap of Edible Bird Nest Industry in Malaysia

Malaysia produces around 350 metric tonnes of EBN per year, with approximately 105 tonnes exported in 2015. More than 50,000 EBN sites were expected to exist across the country in 2015. However, as of October 2016, just 21,000 swiftlet facilities and 250 processing companies were registered with the Department of Veterinary Services. The EBN sector is recognised as a high-value business since it provides greater cash for entrepreneurs (Ramlan et al., 2018).

Several concerns have been noted during discussions with EBN industry stakeholders, including authenticity, high nitrite/nitrate content, over-exploitation of EBN, and issues relating to legislation and policy. Many EBN products on the market have been found to include adulterants to lower costs and boost business margins. It is difficult to discover adulterated or contaminated items throughout the manufacturing process (Ramlan et al., 2018).

Tabulated in **Table 2.17**, a systematic processing mechanism, in addition to manufacture, should be in place to ensure the authenticity and quality of the produced in Malaysia EBN.

Table 2.17: Research Gap Compilation

	Research Gap	Literature Review	Citation
1	**Systematic processing system**	" ……a systematic processing system should be in place to guarantee the authenticity and quality of the made in Malaysia EBN. "	Kamarudin & Aziz, 2011
2	**Strict processes and product authenticity**	"EBN is produced and processed under the strictest conditions so that EBN that reaches the consumers is authentic and safe for consumption to achieve its health-promoting effects."	Wong, 2013
3	**Quality assurance practices**	"……need to establish a standardised benchmarking and quality assurance practices from regulatory authorities, which ensure the EBN products from Malaysia are safe for human consumption." -	Babji et.al, 2015 & Dai et.al,2020
4	**Quality assurance regulation**	"The establishment and implementation of stringent regulations for the standards of EBNs should be regularly updated and monitored to improve the quality of the EBNs and consumer safety." -	Lee et.al, 2017
5	**Study of processing to eliminate contamination**	"A comparative study of different processing (including cleaning, drying and sterilization) methods (from Raw EBN to Cleaned EBN) in removing and mitigating the contaminants should be further investigated." -	Yeo et.al, 2021

Existing and prospective processors must be exposed to aspects of quality assurance, proper processing practice, and the certificate of conformity issued must be monitored regularly throughout this interaction (Kamarudin & Aziz 2011). It is also critical to guarantee that EBN is manufactured and processed under the most stringent circumstances so that the EBN that reaches customers is legitimate and safe to eat to accomplish its health-promoting effects (Wong, 2013).

There is currently a growing need for regulatory bodies to adopt uniform benchmarking and quality assurance processes to guarantee Malaysian EBN products are safe for human consumption (Babji et al., 2015; Dai et al., 2020). To increase the quality of EBNs and consumer safety, strong rules for EBN standards should be established and implemented regularly (Lee et al., 2017). Furthermore, comparative research of various processing (including cleaning, drying, and sterilising) procedures (from Raw EBN to Cleaned EBN) in eliminating and mitigating pollutants should be conducted (Yeo et al., 2021).

Indeed, establishing a quality assurance system and a structured process guideline is a top priority for this sector.

CHAPTER THREE

METHODOLOGY

3.1 Chapter Overview

This chapter explains the methodology to conduct the research. The rigorous research is underpinned by the philosophy of the post-positivism paradigm. Section 3.2 explains the post-positivism philosophy stance adopted in this study. Section 3.3 elucidates the deductive approach and exploratory design method as research strategy adopted. Section 3.4 clarifies the research instrument and how it is conceptually underpinning with the Theory of Best value approach. Section 3.5 explained the sampling method of non-probability sampling method adopted for an interview and random sampling method for online survey. In Section 3.6, statistical analysis methods comprised of descriptive and inferential statistical analysis including Kruskal Wallis test, Spearman correlation, Mann Whitney U Test and Cronbach's Alpha reliability test are reviewed and justified. Lastly, the overall flow chart and research design are presented in the final part of this chapter.

3.2 Philosophy Stances

Research Onion as described by Sauders (2003) consists of three main philosophical assumptions. The outer layer of Research Onion consists of three main philosophical stances which are ontology, epistemology and axiology.

Ontology is the study of reality and assumptions about the nature of reality. In any given phenomenon, different people may perceive the situation from a different perspective. Therefore, one's ontological assumption could shape the way one views the world, thus affect one's choice of what to research for the research project.

Epistemology refers to assumptions about knowledge. The epistemology constitutes what is valid, acceptable, and legitimate knowledge in the research. And how we communicate to others (Burrell and Morgan, 2016). As compared to an ontology that seems abstract, epistemology is more explicit based on the facts and numerical data.

Axiology refers to a role of value and ethics. One of the challenges in axiological choices is how to keep away personal beliefs and values from the research. The research philosophy is a reflection of personal value, and it shapes the choice of data collection techniques.

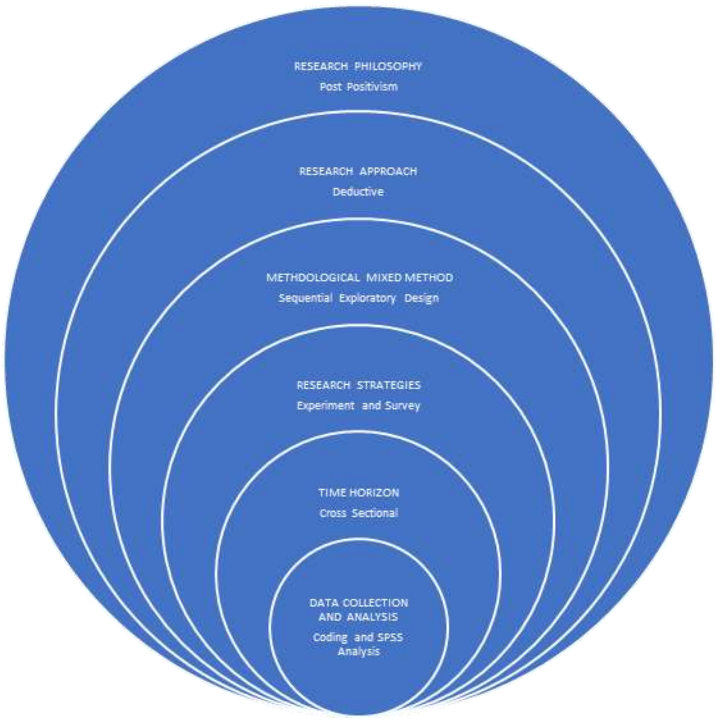

Figure 3.1: Layer of Research Reference to Research Onion (Sauders, 2003)

Model of Research Onion Process (Sauders, 2003) (**Figure 3.1**) has been adopted to illustrate all steps involved in the research process. The model sets a comprehensive framework by giving options for the research process in every stage. The illustration indeed provides ease of approach to each layer of the research process. The outermost layer of this research philosophy is post positivism, which is followed by the research approach of deductive and sequential exploratory design. Experiment and survey are used as research strategies, including cross-sectional sampling and coding and inferential statistical analysis techniques.

3.2.1 Research Philosophy

The first layer of Research Onion has the option of selecting research philosophies namely interpretivism, positivism (Post positivism), critical realism and pragmatism. The philosophy of interpretivism works on the principle that nature and society are two different objects (Martin and Guerin, 2006). It states that there can be many approaches to deal with a specific issue. On the other hand, the philosophy of positivism states that a logical survey is the best method of gathering the desired information. It is also known as scientific philosophy and is based on facts. In this study, post-positivism philosophy would be adopted to emphasize the connection between thought and action, by emphasizing the practical application of ideas via acting on them to test them in human experiences.

a) Post Positivism

Post Positivists believe in the determinism of the consequences or outcomes of certain occurrences that might (probably) be caused by specific causes (Creswell,2009). Post Positivists also focus on the reductionistic principle, with the goal of condensing concepts into a tiny variable, which includes hypotheses and research questions to be investigated. Finally, a hypothesis is established through data collecting that either supports or refutes the theory, and required revisions are made before further tests are conducted.

According to Philips and Burbules (2000), the central assumption of post-positivism is that knowledge is conjectural, and that absolute truth can never be achieved. The evidence gathered via study is always flawed and faulty. Similarly, research is the act of developing assertions and then refining or discarding them when another claim gains strength. In practise, data is gathered based on facts and observable evidence to explain the causal link of interest. To maintain the validity and reliability of quantitative research, procedures and findings must be evaluated for bias.

According to ontology, 'Organisation' is a flow of communal activities and practises rather than a concrete and unchanging substance. A clearer framework of study might be developed by examining the existing phenomena and difficulties confronting the edible bird nest business using a literature review, interviews with stakeholders, and media resources.

In epistemology assumption, what is generally counted as ‘real’, ‘true’ and ‘valid’ is determined by politically dominant points of view. In this research, the interview would be conducted through semi-structured interviews to collect the opinions of respective stakeholders. Subsequently, with an online survey to measure the measurable facts.

Finally, on axiology assumption, researchers should openly and critically discuss their values and beliefs. In this research, the researcher believes that the current phenomenon is greatly affected by political and market demand; however, the quality of edible bird nest remains a key factor in any given situation. **Table 3.1** summarises the research philosophy as mentioned above.

Table 3.1: Research Philosophy

Philosophy Stances	Post-Positivism	Research Philosophy
Ontology (nature of reality or being)	'Organisation' is not a solid and static thing but a flux of collective processes and practices.	By researching the current phenomenon and issues that facing the edible bird nest industry through literature review and interviews of stakeholders.
Epistemology (what constitutes acceptable knowledge)	What generally count as 'real', 'true' and 'valid' is determined by politically dominant points of view.	Semi-structured interview has been conducted to understand the current challenges and subsequently with an online survey to measure the measurable facts.
Axiology (role of values)	Researchers should openly and critically discuss their values and beliefs.	The researcher believes that the current phenomenon is affected by political and market demand; however, quality remains a key fact in any situation.
Purpose of research	The purpose of research is to examine and question the power relations that sustain conventional thinking and practices.	Based on the observation and research, the main challenges of this industry will be to obtain export permits overseas (especially in China).
Meaningful data	Absences and silences in the world around us are at least as important as what is prominent and obvious.	Semi structure interviews and case studies tend to capture all “silences” voices within the industry.
Structure and agency	Structure, order and form are human constructions.	A systematic structure framework guides the research in reaching the desired results.

Source: Adopted from Saunders et al. (2019)

The purpose of this research encompasses examining and questioning the power relations that sustain conventional thinking and practices. Based on the observation and research, the main challenges of this industry would be to obtain an export permit overseas (especially China) despite all the hindrances. The structure, order and form are human constructions, on this remark, a systematic framework would guide the research in reaching the desired results.

3.3 Research Approach

There are two approaches namely inductive and deductive. For the following study deductive approach would be applied. The deductive approach is also known as the top-down approach. Firstly, the general information would be identified, then driving towards specific findings of the results. The report does aim to create a hypothesis and work with the theory presented.

Table 3.2 summarises the research approach. The logic of the deductive approach is based on assumption when the premises are true, hence the conclusion must also be true. The results of the interviews, as demonstrated in Chapter 4 Section 4.2, are used to create survey questionnaires to support the hypothesis. The data might be further analysed to uncover the fundamental cause and provide performance measures by capturing the major problems of the present scenario. The following hypothesis was produced because of the findings analysis:

1) Most of the edible bird nest cleaning facilities are not able to comply with requirements;
2) Reasons of non-compliance due to quality of EBN;
3) Quality of EBN depending on effectiveness of cleaning process;
4) Quality of cleaning process depending on worker skills;
5) Quality of worker skills depending on training provided; and

6) Quality of training depend on the expertise of trainer.

Table 3.2: Research Approach

Characteristics	Deduction	Research approach
Logic	In deductive inference, when the premises are true, the conclusion must also be true.	The premises areas: 1) Most Edible bird nest (EBN) cleaning facilities are not able to comply with requirements. 2) Reasons of non-compliance due to quality of EBN 3) Quality of EBN depending on effectiveness of cleaning process. 4) Quality of cleaning process depending on worker skills. 5) Quality of worker skills depending on training provided. 6) Quality of training depend on the expertise of trainer.
Generalisability	Generalising from the general to the specific.	From the hypothesis above, a conclusion could be drawn by providing effective cleaning process training through experts, the quality of EBN can be improved and compliance for export be achieved.
Use of data	Data collection is used to evaluate propositions or hypotheses related to an existing theory.	Data collection through an online survey will be analysed to justify and sustained the hypothesis.
Theory	Theory falsification or Verification.	The best value approach theory will be adopted to justify the above hypothesis.

Source: Adopted from Saunders et al. (2019)

The EBN cleaning facilities' key issues are export required compliances. And the major cause of non-compliance difficulties is poor product output quality. As a result, the hypothesis will be based on the primary goal of producing higher-quality product. Throughout the examination of literature, most authors emphasised the efficacy of the cleaning method. It is difficult to evaluate the outcome without the right guidelines and standard operating procedures. The next hypothesis will be the cleaning process's quality, which is heavily dependent on worker capabilities. Skilled employees will produce higher-quality goods. This would be related to the next premise of employees receiving training to improve their abilities. Constantly improve via excellent training capable of enhancing workers' skills. Finally, the final premise of excellent training should be offered by experienced trainers and field experts.

To generalise the above statement into a specified hypothesis, the specified hypothesis could be concluded by providing effective cleaning process training through experts; the quality of EBN can be improved and compliance for export to be achieved. With all the data collected through an online survey, the formulated hypothesis could be evaluated and justified. Finally, the best value approach theory would be adopted to justify the above hypothesis.

3.3.1 Research Strategy

In considering the research method, a mixed-method design is chosen. There are four major mixed-method designs namely, triangulation design, explanatory design, exploratory design and embedded design identified by Creswell and Plano Clark (2007).

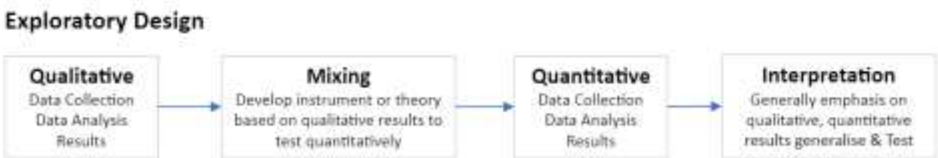

Figure 3.2: Mixed Method Design (Source: Adopted from Clark et al., 2008)

This research is based on an exploratory design method with qualitative data collection and analysis followed by quantitative data collection and analysis. This design is best suited when there is little empirical knowledge about a particular research area, a lack of a theoretical framework, instruments, or variables. (Creswell & Plano Clark, 2007). As shown in **Figure 3.2**, exploratory designs begin with qualitative, in-depth exploration and then build to a secondary quantitative phase that is connected to the initial qualitative results.

A qualitative interview survey is to explore the phenomena of edible bird nest challenges faced by stakeholders (**Table 3.3**). The finding and analysis from the qualitative survey would be generalised to determine and evaluate elements of emergent theory by quantitative survey within a chosen population.

Table 3.3: Research Strategy

Strategy	Method	Objectives
Qualitative	Interview	To explore the challenges face by stakeholders
Mixing	Performance Matrix & Survey Questionnaires	To generate performance criteria and survey questionnaires in relation to Best Value Approach
Quantitative	Survey	To collect the data on performance of various stakeholders
Interpretation	Analysis Descriptive & Inferential Statistic	To analysis and evaluate the performance of BVA practitioners

A combination of qualitative interview, and quantitative survey would be used for this research. The survey is one of the most popular methods of collecting data for research. A series of relevant questions would be asked, and the recorded responses will be used for analysis.

The quantitative survey is a procedure carried out to justify and validate a hypothesis. These two methods would aid the understanding of edible bird nest market challenges and ways of overcoming the challenges.

3.3.2 Data Collection Method

To make the findings of the report more conclusive, a combination of different methods including sampling, secondary data, interview, and questionnaire would be used. Since the research explores to uncover current challenges faced by stakeholders, therefore, a questionnaire survey would help to achieve accuracy. To collate and analyse secondary data, relevant books, journals, and online sources would be referred to (Dey, 2002). This would help the respondents in answering sensitive questions with ease.

3.4 Research Instrument

In an exploratory design, qualitative data is first collected and analyzed, and themes are used to drive the development of a quantitative instrument to further explore the research problem (Creswell and Plano Clark 2011; Teddlie and Tashakkori 2008; Onwuegbuzie, Bustamante, and Nelson 2010). As a result of this design, three stages of analyses are conducted: after the primary qualitative phase, after the second quantitative phase, and at the integration phase that connects the two strands of data and extends the initial qualitative exploratory findings (Creswell and Plano Clark 2011).

3.4.1 Theoretical Framework Development

The researcher selects participants for a grounded theory study who can contribute to the theory's development. Theoretical sampling, as defined by

Strauss and Corbin (1998), is a method of selecting persons who can help develop the theory's opening and axial coding. Grounded theory starts with a broad area of interest rather than a specific set of research questions (Parry, 1998). The method of not developing specific research questions before the study does not imply that there is no problem in this research (Glaser,1998 Moghaddam, 2006). It does provide the opportunity to capture the main concerns of the target audience at an early stage (Glaser,1992).

The Grounded theory (GT) approach to research begins with a brief review of the literature. GT researchers collect, code, and analyse data using theoretical simulations. They then decide on subsequent data collection as well as the data source, building a theory as it emerges (Glaser, 1978). Open coding is at the heart of data analysis. In GT, each script was examined sentence by sentence and line by line to gain conceptual understanding. When key points were identified, they were given a code (Glaser, 1978). The emergent codes were then compared to the same open codes in the same and previous transcripts.

In GT research, issues and challenges are identified and tabulated into factors to form the fundamental data. The core category is centred on several other related categories and their properties. To prepare for future interview sessions, the type of questions to be directed at the participants must be determined. It identifies the connections and relationships between the core category and other emerged categories, forming hypotheses to explain the theory (Glaser and Strauss, 1967 ; Glaser, 1992). During this stage, the factors were combined, grouped, and sorted to form the foundation of the hypotheses and the resulting theory.

This approach begins with the selection and research of a homogenous sample of persons (e.g., all firms participating in the edible bird nest cleaning process), followed by the selection and study of a heterogeneous sample of individuals once the theory has been developed (e.g., company that is related or involved in the supply chain of edible bird nest cleaning). The goal of analysing this diverse sample is to validate or disprove the model's validity under various situations, both contextual and intervening. (**Figures 3.3 and 3.4**).

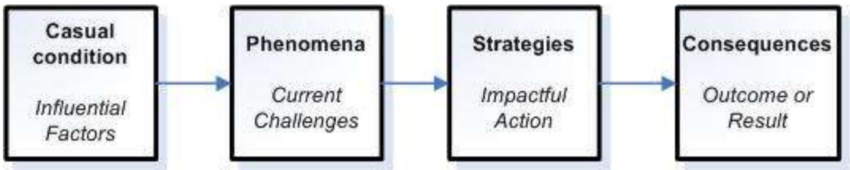

Figure 3.3: Model of Theoretical Framework

Table 3.4: Samples of Questionnaires for First Initial Interview

Theme	Questions of interview
Current challenges	*What is the current challenge faced by Bird nest cleaning industry?*
Influences factors	*What is the cause of such a challenge?*
Impactful action	*What are the possible steps or approaches to overcome?*
Outcome or result	*What will be the outcome of those steps or approaches?*

The interview conducted on initial stage was to formulate the coding and categorise the data into four different frameworks of casual condition, Phenomena, Strategies and Consequences.

Through the data analysis, the second set of interviews would be conducted through a wider group to validate the initial set of data collection. The second set of theoretical frameworks is shown in **Figure 3.4**.

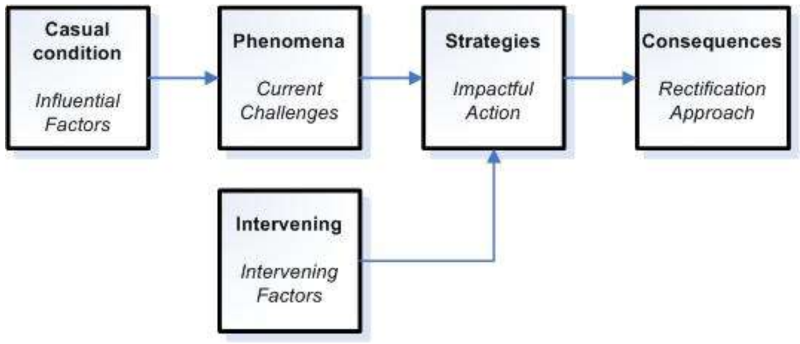

Figure 3.4: Model of Theoretical Framework at Second Stage

Table 3.5: Samples of Questionnaires for Second Stage Interview

Theme	Questions of interview
Current Challenges	*What is the bigger challenge in the cleaning process?*
Influences factors	*What is the most important factor in cleaning process?*
Impactful action	*What is the most important value or quality cleaning process?*
Intervening factors	*How can the government assist in this industry?*
Rectification approach	*What will be the prospect of this industry?*

3.4.2 Interview Data Collection & Analysis

In the first phase of this research, data is collected from a random sample of existing stakeholders. An interview guide is prepared to guide the interview order in the semi-structured interview (**Table 3.6**).

The themes are developed through literature review and ten potential questions are listed to address the research questions. The interview is conducted by phone and data is captured in both sound recording and note-taking.

Table 3.6: Details in Interview Guide

S/N	Potential Question	Theme
Q1	*When did your company involve in the Edible bird nest industry?*	Year of establishment
Q2	*How do you acquire the knowledge of cleaning process?*	Origin of processing skill
Q3	*What is the most important factor in the cleaning process?*	An important factor in processing
Q4	*Do you have your swiftlet farm?*	Source of raw materials
Q5	*What is the basic step in the cleaning process?*	Processing procedure
Q6	*What is the most important value or quality cleaning process?*	Quality factors
Q7	*What is the bigger challenge in the cleaning process?*	Current threat
Q8	*How can the government assist in this industry?*	Current obstruction
Q9	*What will be the prospect of this industry?*	Perception of the industry toward current market
Q10	*Would you encourage a newcomer in this industry? What will be the advice?*	Prospect of Edible bird nest industry

One key benefit of the semi-structured interview is flexibility to change when no new data or new insight occurred during the interview stages. The subsequent quantitative survey relies on the quality of contribution from the interviewee's respondents.

3.4.3 Validation of First Interview

The theme of the second interview consists of market requirement on quality; government requirements on export; company requirements; quality control and quality assurance procedures as shown in **Table 3.7** below.

Table 3.7: Validation Questionnaires on Quality Requirement

Theme	Validity Questions
Market Requirement on quality	*What are the markets or your customer's requirements on the quality of bird nest?*
Government requirement on quality	*What are the government requirements on quality for export?*
Company requirement on quality	*What is your operation requirement apart from the above requirement?*
Quality control	*How do you control or determine the quality? Centralize quality control or individual control?*
Quality assurance or procedure	*Who is responsible to rectify? Operator or special team?*

3.4.4 Survey Data Collection & Analysis

Data from the interview are used to develop a survey questionnaire for the second phase of this research. (**Figure 3.5**)

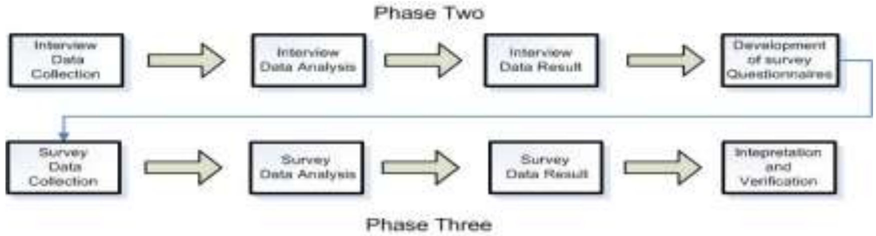

Figure 3.5: Process Flow

The survey measures the following dimensions: utilizing expert; pre-plan to identify risk; measure performance; create accountability; motivate for improvement; customer satisfaction and demographics (**Figure 3.6**).

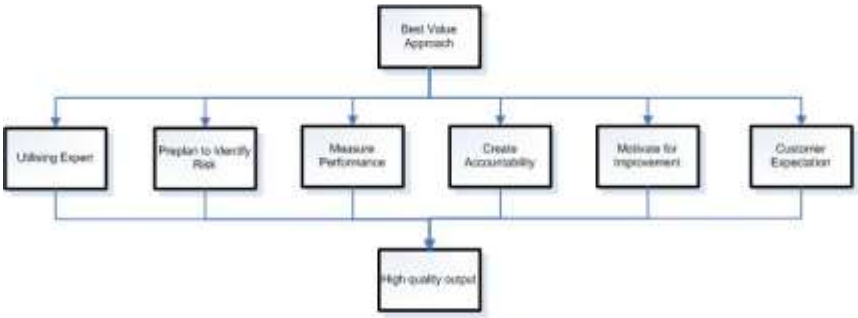

Figure 3.6: Best Value Principles

Questions are built from the salient themes emerging from the interview data analysis and used the theory of the Best Value Approach (BVA) (Kashiwagi, 2011) as a conceptual underpinning to evaluate the effectiveness and quality of cleaning facilities. (Table 3.8) The survey is deployed to all current stakeholders and vendors to generalize the findings from the initial qualitative research and to focus only on the challenges and value of the edible bird nest industry.

Table 3.8: Details in Survey Questionnaires

Best Value Key Performance Matrix	Questionnaires
Utilizing expert	***1.*** *attending training course able to improve on the quality of cleaning process.*
	2. *Engaging consultant/expert able to improve production process is essential.*
	3. *Seeking help from expert able to resolve difficulty or challenges faced.*
	4. *Training course for workers or supervisors could help to improve the quality of final products.*
	5. *consultant/expert could help to achieve export requirements.*
Pre plan to identify risk	***6.*** *Plan production flow is important before starting operation.*
	7. *Identifying the risk factors before production help to mitigate the risk.*
	8. *Seeking consultant/expert to assist in production planning is important.*
	9. *Proper planning with consultant/expert before production is important.*
	10. *Considering potential risk before starting production is important.*
Measure Performance	***11.*** *Setting measure criteria or requirements is important.*
	12. *Proper guideline for your workers on quality is essential.*
	13. *Require workers to record their output each day help to control performance.*
	14. *All workers understand the quality requirement is a must.*
	15. *All workers should know how to check on their own output.*
Create accountability	***16.*** *All workers should know how to determine the quality required by company.*
	17. *All workers should be responsible and rectify their own rejected products.*
	18. *All workers should know how to rectify the problem.*
	19. *All workers know how to record their output every day.*
	20. *All workers should be accountable for their own work.*
Motivation for improvement	***21.*** *Having incentive to motivate workers' productivity is important.*
	22. *All workers should be paid according to output / pieces rate.*
	23. *Workers would be rewarded when achieve higher output.*
	24. *Workers would be rewarded when achieve better quality.*
	25. *Supervisor should be able to motivate the workers to increase productivity.*
Customer expectation	***26.*** *All the workers should understand the customer requirement.*
	27. *When workers not able to achieve the customer requirement, seeking help from consultants/experts is important.*
	28. *Production process should change according to customer need.*
	29. *Constantly upgrading the quality to meet customer expectation/ market demand is essential.*
	30. *Supervisor should be able to train the workers according to customer expectation.*

3.4.5 Development of Performance Matrix

The rating scales of the performance matrix are compiled through literature review and interviews of stakeholders. Each set of matrices can measure the performance of participants.

The raw data of the survey were analysed and segregated into the grouping. The rating of each participant was given according to their responses to questionnaires of BVA characteristics. On the Likert scale of six (6) and seven (7) will be given the score of one (1); whereas five (5) and below will be zero (0). The total scores of fifteen (15) out of thirty (30) and above will be identified as BVA practitioners. Scores of 14 and lower, on the other hand, will be classified as Non BVA practitioners.

The result of both BVA practitioners and non-BVA practitioners are tabulated and compared on their performance matric.

The survey questions are abstract and unstructured due to their design. The data is then converted via coding and re-tabulated for further analysis (**Table 3.9**). The first set of statistics includes monthly production capacity and distribution percentages for the three primary goods. Because the rating scale was based on a range, the mean between the ranges will be used for the calculation. Similarly, in the percentage of three products range, the sum of the three production percentages should be 100%. (100 percent). More data, however, could not be added up to the total number. To determine the closest possible percentage, the prorate technique of three products is used.

The second set of statistics includes the number of workers and their productivity. The range is used to calculate the mean once again. The ultimate worker's productivity might be assessed by comparing groups one and two.

The third type of data is waste produced during processing. For example, a waste range of 16 percent to 25% would be graded as 23.5 percent, the mean value between two percentages. The final percentage might be calculated by taking the mean of the range and dividing it by the number of workers.

Table 3.9: Coding of Raw Data

Matrix	Data range	Mean / Value
Monthly Production Capacity	1 = Less than 20 kg 2 = 21 – 40 kg 3 = 41 – 60 kg 4= 61 – 80 kg 5 = More than 80 kg	1 = 10 kg 2 = 30 kg 3 = 50kg 4 = 70 kg 5 = 90 kg
Total number of workers	1 = Up to 20 pax 2 = 21 – 40 3 = 41 -60 4 = 61 – 80 & 5 = > 80 pax	1 = 10 pax 2 = 30 pax 3 = 50 pax 4 = 70 pax 5 = 90 pax.
Wastage	1=<15% 2 = 16%-20% 3 = 21%-25% 4 = 26%-30% & 5 = >30%.	1 = 12.5%, 2 = 18.5% 3 = 23.5%, 4 = 28.5% 5 = 32.5%.

The raw data of monthly output, number of employees, total waste percentage, and real value of edible bird nest may be converted to monetary worth per worker. The formulae of Actual Value per Worker,

$$\frac{x\,(a-c)}{b}$$

x = Actual Market Value of Edible Bird Nest (RM)
a = Total Monthly Output (kg)
b = Total Number of Workers (pax)
c = Losses Per Month (kg)

3.4.6 Mixed Methods Data Analysis

The use of both interview and survey data collection methods in a single study is not sufficient to categorize a study as 'mixed-methods.' It is the integration or linking of the two strands of data that defines mixed methods research and highlights its value. Integration can happen at multiple levels of a study design-level, methods-level, or interpretation-level and can happen in a variety of different ways connecting, building, merging, or embedding (Fetters, Curry, and Creswell 2013; Creswell and Plano Clark 2011). In this study, the first linking of data happened at the design level with the use of a sequential design, where the results from the first phase of the research were used to build the second stage of the research design.

3.5 Sampling Method

The sampling method falls into two categories, probability, and non-probability samples. With probability sampling, each population has a known (non-zero) chance of being chosen for the sample. Whereas, in non-probability sampling methods, the probability of each population element chosen will be unknown.

The sampling method adopted in an interview is the non-probability sampling method. The advantages of the non-probability method are convenience and lower cost; however, the main disadvantage is that this sampling method does not allow to estimate the extent to which sample statistics are likely to differ from population parameters.

A random sampling method would be chosen for the online survey following the interview; a sample group of observations would be selected from the population to make inferences about the population.

3.5.1 Sample Size

In most situations, qualitative interviews have a smaller sample size than quantitative research methods. This is because qualitative research methods are usually concerned with gaining a comprehensive knowledge of a phenomenon and are frequently focused on the how and why of a certain issue, process, situation, subculture, scene, or set of social interactions. Saturation is commonly defined as the point at which the data collection process stops providing new or relevant data. Another way to show saturation is when obtaining new data no longer sparks fresh theoretical discoveries or reveals new aspects of your core theoretical categories (Charmaz, 2006, p. 113).

The interviewers were chosen at random from a list of Malaysian EBN firms. All data and classifications would be recorded until the saturation point was reached, at which point no new or fresh data would be collected.

The determination of the smallest/most appropriate sample size for a quantitative survey requires meticulous preparation at all stages of the study, from the paradigm through data collecting materials and data processing procedures. According to Bailey (1978), competent researchers identify the population first, then define the study group to work with; novice researchers, on the other hand, begin by determining the smallest study group size and work their way up towards the population (Cohen et al., 2000).

The sample size is influenced by the size of the population (Cohen et al., 2000; Lodico, Spaulding & Voegtle, 2006). Tables provided by Cochran (1977) and Krejcie & Morgan (1970) show the sample size about the degree of dependability and population size. Many scholars (for example, Yldrm & imşek, 2006; Baykul, 1999; Ross, 2004) believe that if parametric tests are to be performed, a sample size of 30-500 individuals is required; otherwise, non-parametric analytic approaches should be used. These figures are accurate when utilising random sampling procedures to choose a sample.

Table 3.10: Sample Size

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	1000000	384

(Source: Adopted from Krejcie & Morgan,1970)

A total of 250 cleaning processing plants were registered with the Department of Veterinary Service in 2016, according to a journal article by Ramlan et al. The sample size should be 152 samples, according to Table 3.8. The overall number of firms who got CNCA certification was 33 (as shown on the CNCA.org.cn website in 2021), and according to **Table 3.10**, the total sample requirement should be 30 samples.

3.6 Statistical Analysis Method

3.6.1 Descriptive Statistical Analysis

In general, descriptive statistical analysis entails several steps, including tabulation, interpretation using measures of central tendency (mean, median, mode), and measure of variance dispersion (range, variation and standard deviation). All the information is organised in tabular format and shown in charts and graphs. It also aids in the extraction of different data properties and the explanation of key data aspects.

3.6.2 Inferential Statistical Analysis

The inferential statistical analysis looked at a hypothesis based on a sample of data and made generalisations about the entire dataset. It can also conclude future events based on the facts supplied. As a result, this approach entails sampling theory, different significance tests, statistical control, and so on.

Table 3.11: Schematic diagram showing the purpose and types of statistics used in this research

General Purpose	Explore **Relationship** between variables		**Description** Only
Specific Purpose	Compare group	Find Strength of association, related variables	Summarise Data
Type of Question/Hypothesis	**Differences**	**Associational**	**Descriptive**
Types of statistics	**Difference Inferential Statistics**	**Associational Inferential Statistics**	**Descriptive Statistic**
Types of statistics techniques adopted	Kruskal Wallis, Mann Whitney	Spearman, Cronbach's Alpha	Mean, Median, percentage

Source: Adopted from Morgan et al, 2019

Table 3.12: Selection of Appropriate Inferential Statistics

The scale of Measurement of Dependent Variables	**Compare**	**One Factor or Independent variables**	
		Two-level or categories/group/samples	**Three or more levels/groups**
Dependent Variables ordinal	***Mean Rank***	Mann Whitney	Kruskal Wallis, Spearman, Cronbach's Alpha
Types of tests		Comparing Best Value and Non Best Value performance	Best Value practitioner on performance matrix
		Analysis of Best Value Approach on company size	Reliability test on Best Value practitioners
		Comparing CNCA & NCNCA practitioner on the performance matrix	

Source: Adopted from Morgan et al, 2019

Table 3.11 tabulated various statistical analysis methods adopted by this research and **Table 3.12** listed the various inferential statistics adopted for this research.

The Kruskal–Wallis test is adopted to compare the significance of different groups to the performance matrix. Similarly, the Spearman test measures the strength and direction of association between two ranked variables.

The Mann-Whitney U test is the nonparametric equivalent of the two-sample t-test based on mean rank. The test compares two groups of Best Value and Non Best Value practitioners, Small and Medium Enterprises (SME) with an established company, CNCA practitioner versus Non-CNCA practitioners." is another name for consistency.

Finally, Cronbach's alpha tests are adopted to see if multiple-question Likert scale surveys are reliable.

3.6.3 Case study and experiment on selected facility

The case study methodology is useful not only for the evaluation of development methods, but also to observe, explain, and explore other phenomena within their real-life setting (Yin, 2003). Thus, we gain a greater understanding of why something happened as it did, and what else might be important for further investigation. Case study research involves an in-depth examination of a single case or a small number of cases. The methodology provides us with a systematic way of looking at events, collecting data, analyzing information, and reporting results. The methodology includes six phases: preplanning, design, implementation, data collection, data analysis and reporting.

A novel enhanced cleaning technique has been created to increase the quality of EBN output based on a literature research, onsite interviews, and observation of chosen cleaning facilities.

Initially, the cleaning procedure is carried out in a laboratory setting. The technique and approach are refined further until the desired outcome is obtained. The findings are submitted to a possible partner. Following an agreement of adaption from facility management, the cleaning method is deployed on production. Interviews and data are collected for further study during the deployment. Lastly, laboratory tests on the EBN property are performed to justify and confirm the significant improvement of the new enhanced cleaning technique.

3.7 Research Flow

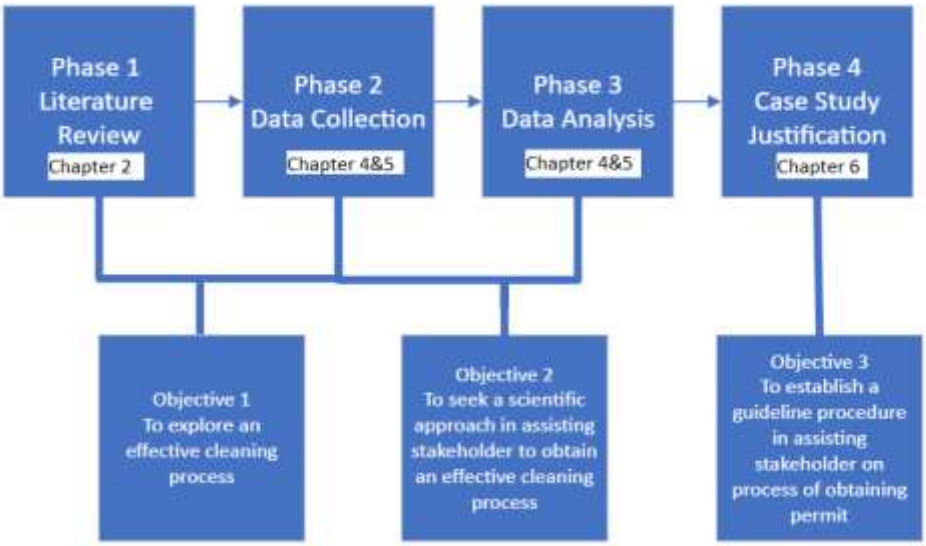

Figure 3.7: Research Flow

The research flow, as seen in **Figure 3.7**, is divided into four stages. To begin, thorough literature research will be undertaken to investigate the most effective cleaning procedure in Malaysia. The second phase is gathering data through semi-structured interviews to create survey instruments. The acquired data would then be analysed and discussed in the result and discussion. The last phase would consist of a case study of selected facilities to justify the discovery and achieve the goal.

3.8 Summary

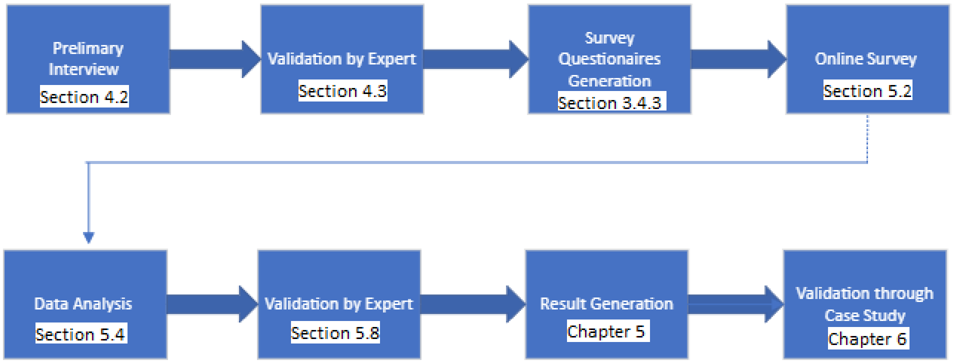

Figure 3.8: Research Design

Figure 3.8 summarises the entire research design. The research method begins with an interview with a group of industry representatives. After all of the data has been coded and classified, it will be organised into separate themes and subthemes.

Following the completion of the analysis, all data will be reviewed by industry specialists before being converted into questionnaires. The survey was sent via multi-media to all relevant participants. All raw data collected has been processed and analysed using descriptive and inferential statistics. The tabular data has been double-checked by industry experts. The final output will be the result of several analyses and conclusions. The case study was used to validate the findings.

CHAPTER FOUR

RESULT AND DISSCUSSION ON INTERVIEW

4.1 Introduction

This chapter includes Section 4.2 to report the results of the interviews conducted during the interview session. All the key factors have been abstracted to formulate into 6 main themes with 15 subthemes. The six main themes are material resources, product quality, human resources, processing procedure, market and government policy. The key finding from the interview is utilised to set the foundation for the next phase of the survey. In Section 4.3, the transcripts of the interviews are analysed and validated by the experts of this industry. Through the validation, all the key findings further construct the performance matrix of 6 attributes for the next phase's evaluation. The contents of the transcripts are dissembled in Section 4.4 and the results were inferred for generalisation. Lastly, the summary of findings is illustrated in Section 4.5.

4.2 Results of Interview

Ten interviews were conducted, with seven of them learning their expertise locally in Malaysia and three learning it abroad Indonesia. **Table 4.1** highlights the 10 respondents' company type, year of establishment, and country of origin. According to the data from the interviews, the majority of the firm (7 out of 10) acquired their cleaning abilities from expert or training courses. Only three businesses were obtained by self-study or inquiry. In this business, the notion of utilising expertise or engaging an expert is common practise.

Most of the interviewees have 5 years or more in terms of experience in this industry and they are the members of the committee members of the Bird Nest Association in Malaysia.

Table 4.1: Interviewee Profile

Interview	**Year of establishment**	**Year of Experience**	**Acquired skill through**	**Acquired skill from**
A	2008	12	Course	Malaysia
B	2015	5	Expert	Malaysia
C	2011	9	Self	Malaysia
D	2018	2	Self	Malaysia
E	2016	4	Course	Malaysia
F	2005	15	Course	Indonesia
G	2015	5	Course	Malaysia
H	2015	5	Self	Malaysia
I	2014	6	Course	Indonesia
J	2011	9	Course	Indonesia

The transcriptions of the interview contents are prepared in the compiling phase. Five copies of interview transcripts samples are attached in Appendix A. The interview transcripts are then dissembled into subthemes. The selected quotes are then re-examined and reassembled according to the themes. The recombination of data is facilitated by using tabular arrangement and attached in Appendix B.

Table 4.2 compile all the important factors and criteria through phone interviews. The saturation reaches at interviewee G, in which a total of 15 subthemes has been tabulated. **Table 4.3** shows the six (6) themes and fifteen (15) sub-themes identified.

Table 4.2: Subtheme Abstract from Interviews

Subtheme	Interviewee									
	A	B	C	D	E	F	G	H	I	J
Raw Material Quality	1									1
Raw Material Availability			1		1					
Water Quality							1	1		
Cleanliness	1	1		1		1	1	1		1
Worker Skill			1	1			1	1		
Worker Availability	1			1					1	
Processing Time / Speed			1			1	1			
Sterilization		1								
Standard Cleaning process							1			
Newmarket	1	1			1		1	1		
Export permit					1	1		1		
Lower Export Requirement			1							1
Worker Permit	1			1					1	
Raw Material Export						1			1	
SST Exemption				1						

Table 4.3: Theme and Sub-theme of Transcript Analyzed

Theme	Subtheme
Material Resources	Raw Material Quality
	Raw Material Availability
Product Quality	Water Quality
	Cleanliness
Human Resources	Worker Skill
	Worker Availability
Processing Procedure	Processing Time / Speed
	Sterilization
	Standard Cleaning process
Market	New market
Government Policy	Export permit
	Lower Export Requirement
	Worker Permit
	Raw Material Export
	SST Exemption

4.2.1 Material Resources

The main resources in the edible bird nest industry as the raw bird nest have a direct impact on the quality of edible bird nest. Interviewee A reiterated that "*I* *will (be) said it should be raw bird nest. We choose those with fewer feathers and cleaner source.”.*

Interviewee J elaborated with the statement as *“Raw materials quality is very important; we control the wastage below 20%”* and Interviewee C explained further *“………With the government allowed the raw bird nest to export. We may have a shortage of resources. Malaysia has a total of 20,000 companies which require huge amount.”* Therefore, the management of raw materials resources becomes one of the challenges in this industry.

From the above interviews, it is noted the impact of raw bird nest shortage if the export of raw bird nest was permitted without any control from the government. As indicated by Interviewee C and E, the stakeholders could be facing a shortage of raw bird nest to sustain their operation or increase in operation costs due to fluctuation in raw materials pricing. At the end of the last century, most of the raw bird nest were processed and cleaned in Indonesia. Traders from Indonesia would travel from place to place to purchase the harvested raw bird nest and brought back to Indonesia for processing. However, in the last 10 years, Malaysia’s cleaning processing industries have grown in numbers with the permission of direct export to the China market being granted. The demand for raw bird nest becomes the determining factor in terms of pricing and quality of end products. The concern of scarce commodity of a raw bird nest could become a challenge in the growth of this industries.

4.2.2 Product Quality

Edible bird nest cleaning production is an extremely labour intensive and dependent industry. Interviewee H explained that “*Water sources is the most* *important. This process required a lot of labour and manual work; therefore, if the water is not clean, it will easily contaminate."*

And supported by Interviewee G,

> *"The water must be clean and (in) good quality."*

Both interviewees raised concerns of water quality. The process of cleaning involves water as main source of cleaning agents; therefore, water quality should be the top priority to look into during the cleaning process.

Interviewee J made a strong statement,

> "*Cleanliness will be the most important factor.*"

and supported by another Interviewee A,

> *"I will say the cleanliness. We check one by one under the magnifying glass or by visual."*

Interviewee D also claimed,

> *"The other (factor) will be cleanliness and originality of bird nest."*

Interviewee F explained that other than cleanliness, the storage of bird nest needs to look into as well.

> *"Storage of Bird nest and cleanliness"*

Interviewee H has a similar view on the air quality and environment by saying,

> *"Worker hygiene and air quality or environmental quality are the most important factor."*

From the small cottage industry to cleanroom production, the challenges in maintaining of facility environment are not only subject to the equipment and space but also the worker hygiene and attitude toward the production requirement. Since this industry is labour intensive and production quality highly depended upon the facility standard, it is the best practise to provide clean water and a good quality environment. Even though the end products are subjected to further process before ready for human consumption, the hygiene and cleanliness of production can determine the product's shelf life.

4.2.3 Human Resources

Since the bird nest cleaning process requires long hours of manual cleaning, human resources become one of the key factors or contributors that impact the success of the business. It was elaborated by Interviewee A,

> "*The biggest challenge in last time will be raw materials since last time the sources are limited but now it will be workers. We are very difficult to obtain local workers and most of the time they resigned after acquiring the skills or find it too difficult (to continue)"*

and the supported by Interviewee C,

> *"Workers are the most important factor. The way how they clean and their emotion. The skills are also important."*

In the interview with Interviewee D, he claimed that

> *"Malaysian workers did not like the picking work; they think it is boring."*
>
> And he added another factor,
>
> *"It is hard to find good workers."*

On the worker factor, Interviewee H felt that,

> *"…… if the workers don't have good skill, they could jeopardize the final quality."*

Interviewee I concluded that,

> *"Worker's shortage. We are facing the control of foreign workers."*

Worker shortage will also be the challenge of these industries. As it is labour intensive and the process requires a high concentration of observation, most of the workers cannot focus easily in this monotonous work environment. In

Malaysia, most of the manual operation or labour work is highly dependent on foreign labours. The scenario of workers shortage can be a hindrance to the growth of these industries. Without the support from government policy on the worker permit, the industries may face the challenge of obtaining their production workforce.

4.2.4 Processing Procedure

Further exploring into the processing procedure, Interviewee C explained that,

> *"Processing time is the most important. The duration should not be more than 1 day."*

Interviewee G supported that,

> *"Our speed is still too slow. As compared to Indonesia using chemicals to breach, we don't use chemicals but manually picking. Often time, we are still slow and resulting in higher labour costs."*

As Interviewees C and G pointed out, the crucial time factors can be the reasons for high labour costs due to less efficiency of production. Often time the long production can cause other issues as explained by Interviewee F,

> *"Must control the timing. Not to expose too long."*

Statement by Interviewee B, stated the importance of sterilization,

> *"Sterilization. When the outbreak of Avian diseases happens, this process becomes very important."*

Due to the long exposure, the process bird nest can easily be contaminated through bacteria, which downgrade the quality of the product.

Interviewee G concluded,

> *"The government can look into how to improve the cleaning process to be more effective and increase the speed."*

Indeed, government and researchers should focus to improve the process to be more effective and finding ways to increase the speed of production. The process of cleaning can also be improved through the aid of technologies and better equipment. This effort should be top-down instruction from governments through research funding and collaboration with research institutions.

4.2.5 Market

Apart from the material & human resources, product quality and production procedure, market demand is important as well. Currently, the biggest market demands remain in China and Hong Kong.

Interviewee A suggested,

> *"Our government can give us more quota and support in a research project to diversify the product range of EBN. Like China, they have a lot of new products such as cosmetic applications, instant bird nest or even capsules. Government can encourage more collaboration between universities."*

and similar statement by Interviewee B,

> *"It has become common consuming item among China peoples, not only for health purpose but also for the beauty."*

The new market or new application of edible bird nest are yet to be explored. Any form of research involves lengthy research works and substantial funding. Given the research development of private sectors, very minimum funding has been channelled into the development of new products but rather on the packaging and advertising instead.

Interviewee E elaborated to expand the market share, *"They (government) must start to find the buyer. China markets still have a lot of room for expansion. Currently, only a small group of China people know and consume bird nests. We need to educate them."*

Supported by Interviewee G,

"……… can help us to expand to a market other than China. Still many countries do not know what is bird nest."

Lastly, Interviewee H suggested,

"Not only to China but other countries as well."

Due to the ineffectiveness of research, the products range of edible bird nest remains as direct consuming products. Other than China and Hong Kong market, the market share could not even breakthrough to another part of the world.

4.2.6 Government Policy

One of the challenges for the stakeholders Is the export permit to China, Interviewee C explained,

"We have only 19 companies with CNCA approval. The requirement is too high like the pharmaceutical industry. Government should reduce the requirement to food grade."

Supported by Interviewee J,

"………..to help on the export permit or license to China. Since most of the buyers are from China, hopefully, can be easier on the requirement."

Interviewee E suggested,

"In terms of export, it is to loosen the export procedure. Also, it is to help us to stabilize raw bird nest price."

Interviewee I suggested that government could assist in two areas, *"First, it is the worker's permit to allow for more quota. And second, it will be control on the raw bird nest export. Otherwise, in future, we may need to import raw bird nest from China."*

Interviewee A explained that local workers were hard to obtain,

"Therefore, we have to depend on the foreign workers. And the government did not give us enough of quota for workers permit."

Interviewee D also has a similar view,

"We have a shortage of workers since the government does not allow foreign workers."

Lastly, Interviewee F recommended that government should support in,

"The export permit to China and SST exemption."

In summary of the above interviews, government policy could be the determining factor that assist the industries to expand and grow in future. Our government can assist in:

1) To encourage more research on the exploration of new products;
2) To allocate more research funds to explore more effective cleaning processes;
3) To release more foreign worker permits to cleaning process industries;
4) To explore more new market;
5) To reduce the requirement for export; and
6) To control on the export of raw bird nest.

Table 4.4 summarised all the key comments from the interviewee and further analysis at section 4.2.7

Table 4.4: Summary of Key Comments

Theme	Summary of key comments
Material Resources	Raw bird nest should be controlled with good quality
	Ensure availability of raw bird nest
Product Quality	To ensure good quality of water source to avoid contamination To ensure cleanliness and hygiene of process
Human Resources	To enhance the worker skills and attitude
	To allow more foreign workers for this industry
Processing Procedure	Processing time should be shortened to ensure less contamination Sterilization should be instilled during the processing
	A standard cleaning process should be in place to enhance quality and improve productivity
Market	More new markets should be explored to expand the market share
Government Policy	To reduce the process for an export permit
	To reduce export requirement
	To allow more worker permits for this industry
	To controlled on raw bird nest export
	To exempted from SST taxation

4.2.7 Core Category of Interview

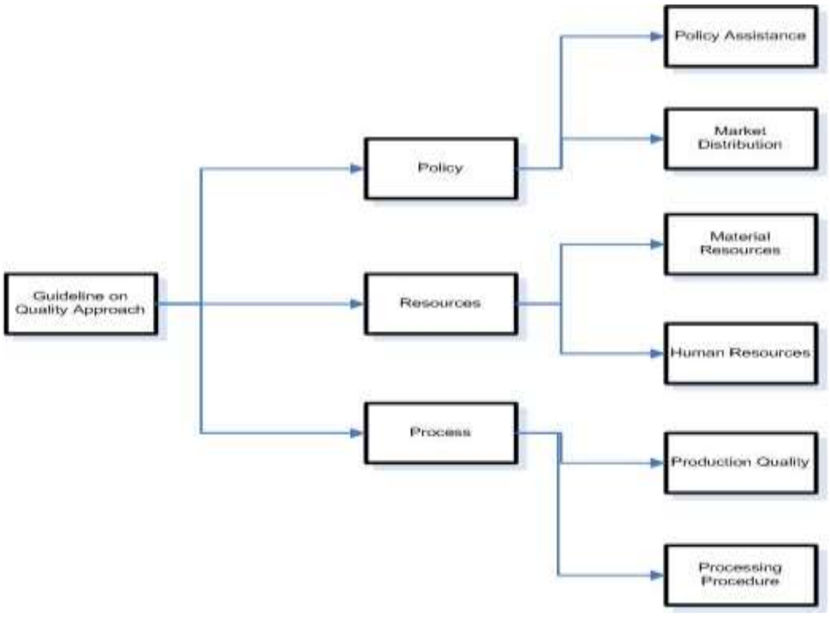

Figure 4.1: Core Category and Property of Data

As indicated in **Figure 4.1**, we may summarise the above into three primary categories: policy, resources, and procedures. All three categories share quality features in certain manner, pointing toward the core category of quality approach to controlling and increasing the final quality in fulfilling the export need as well as the customer's demand.

The policy category also classifying external factors on the impact on industry. According to Babji et al (2015), Lee et al (2017), and Dai et al (2020), regulatory agencies must adopt a uniform benchmarking methodology to ensure that Malaysian EBN products are safe for human consumption. The other two resource and process categories can be controlled internally. According to Kamarudin et al (2011), Wong (2013), and Yeo et al (2021), a systematic processing mechanism should be in place to ensure the quality of EBN reaching customers is legitimate and safe for human consumption.

4.3 Validity on Quality Requirement

Table 4.5: Number of Interviewee Agreement to Subtheme Tabulated

Subtheme	**Interviewee**						**Percentage***	**Ranking**
	I	II	III	IV	V	VI		
No visible dust or impurity	1	1	1	1	1	1	100%	1
Achieving target set by the company		1	1	1	1	1	83%	2
No Chemical	1	1			1	1	66%	3
Wastage less than 20%	1	1	1			1	66%	
Shape			1	1		1	50%	4
Manual Cleaning	1				1	1	50%	
Follow Standard Operation Procedure			1	1		1	50%	
Nitrite contain within allowable	1					1	33%	5
Colour		1	1				33%	
Competitive price		1	1				33%	

* *Percentage represent total agreement from all 6 interviewees*

To justify and validate the interview, another set of interviews was conducted to determine the quality factors gathered during the first interview. **Table 4.5** revealed that all the interviewers agreed that the quality requirement should come first, followed by appearance and worker skills.

As shown in **Table 4.6**, the results were further analysed and generalised into a performance matrix. The subthemes of colour and shape were tied to the uniqueness of materials in connection to the main theme of material resources. The basic ingredients from the swiftlet farms determined both factors. On the matrix, it was coded as an appearance.

Table 4.6: The Six (6) Themes and Nine (9) Sub-themes Identified

Main Theme	Subtheme	Matrix
Material Resources	Colour	**Appearance**
	Shape	
Product Quality	No visible dust or impurity	**Cleanliness**
	No chemical	
Human Resources	Manual Cleaning	**Worker Skills**
	Achieving target set by company	
Processing Procedure	Less than 20% wastage	**Wastage**
Market	Competitive price	**Price**
Government Policy	Nitrites contain within allowable	**Safety**
	Follow Standard Operation Procedure	

The second theme was product quality, which included no apparent of dust or impurities, as well as no chemical residue on EBN. Both variables have to do with the cleanliness of the products on the matrix. The third theme human resources were manual cleaning and meeting the company's goals. Both subthemes emphasised the significance of worker skills as matrix indicators. On the theme of the processing procedure, waste of less than 20% was used as a measurement to assess the cleaning process' performance. Matrix coding was wastage. The main theme – market – was linked to a competitive pricing. The matrix's coding was price. Finally, the government policy focused on keeping nitrite levels below acceptable limits and adhering to normal operating procedures. In matrix coding, both variables were connected to safety.

4.3.1 Cleanliness

During the interview, all interviewees reiterated that the most important quality was cleanliness of edible bird nest with no visible dust or impurity to be detected by naked eyes. It has become an important factor as 3 out of 6 interviewees agree that most of the cleaning process was manual cleaning being free from chemical exposure.

4.3.2 Safety

According to more than half of the interviewees, all cleaned bird nest should be free of chemical contents and also passing the nitrite level. Both factors are the export requirement to China or another country.

In 2011, China authority has banned Malaysia's edible bird nest to be exported to China due to the excessive level of nitrite contents. This ban has caused a sharp drop in edible bird nest pricing in Malaysia. Therefore, the safety factors of free from any chemical is important to this industry.

4.3.3 Appearance

The appearance of edible bird nest also affects the pricing. The market demands edible bird nest that are white and shaped like a half cup as it is during the raw material state. The colour may be affected by the ecosystem of swiftlet and the environment of swiftlet farms. To maintain the shape in its original state will greatly depend on cleaning process and worker's skill.

4.3.4 Wastage

One of the performance criteria or indicators on workers' performance is the control of processing wastage. This factor is closely related to the profit and quality of edible bird nest. More than half of the interviewees felt that the wastage should be controlled to less than 20%. However, the wastage also relates to the quality of raw bird nest. During the moult season, the wastage may increase substantially.

4.3.5 Price

To remain competitive and low prices, there are two main factors to be looked into. Firstly, the wastage of bird nest during the process should be lower, and secondly, it is the efficiency of the workers in cleaning the bird nest. The source of raw bird nest could be another decisive factor but with the more transparent market, the price should be quite stable throughout Malaysia.

4.3.6 Worker Skills

All the above factors can be summarised into the cleaning process procedure and workers' skills. With a proper and effective cleaning process, the productivity can be improved along with the quality. Finally, the decisive factors can be the worker's skills and attitude toward their work performance. More of the interviewees will agree that workers need to achieve the target set by the company and strictly follow the standard operation procedure given. One of the dilemmas faced by the industry is lack of skills workers and difficulty to obtain the workers.

4.4 Summary of Finding

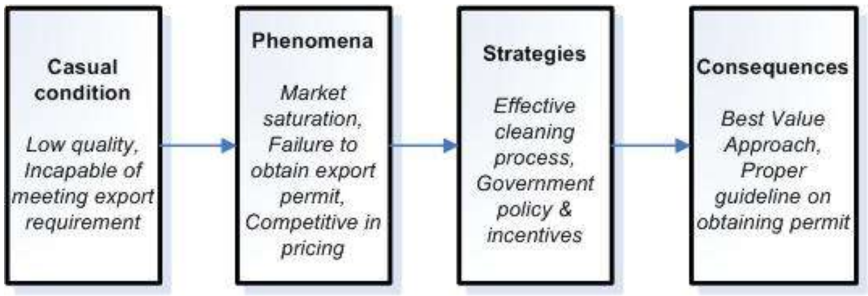

Figure 4.2: Conceptual Framework of Effective Cleaning Process

In brief, the first phase of the research finding is illustrated by **Figure 4.2** conceptual framework. The casual condition of the current industry is the low quality of EBN which lead to the incompetence of meeting export specification. The direct phenomena would be market saturation caused by a decline in attaining export permits and competition in pricing with inferior quality. This compels two possible strategies of effective cleaning process that elevate the quality and productivity, concurrently government policy and incentives would assist on a venture to new market and competitiveness in price. The final consequences could be established of effective approach in the cleaning process and proper guideline on attaining the export permit.

CHAPTER FIVE

RESULT AND DISCUSSION OF SURVEY

5.1 Introduction

This chapter includes Section 5.2 to report the results of the survey questionnaires conducted and Section 5.3 to interpret the survey data. Section 5.4 summarised the finding with Best Value Principles implementation, the productivity improves on the lowest performance (0.97 kg) with 10.3% to highest productivity (1.07 kg). Similarly, the percentage of differences reduces from 9.9% to 4.1%. Section 5.5 demonstrated how having a suitable measurement criterion becomes the top concern in the production process. Pre-production planning not only reduces risk, but also increases productivity and workforce growth. Expert or consultant input will be used to design a strategic production strategy that will elevate the firm in a shorter period. Lastly, the summary of findings is concluded in Section 5.9. Best Value Approach has accomplished the objectives of an effective approach in elevating end products quality and raising productivity. Through the descriptive analysis, there is a clear demarcation between the best value partitioners and non-best value partitioners. The finding justifies the objectives and substantial on the new finding of Best Value having greater repercussion over the established company and CNCA achievers.

5.2 Results of Survey

There is a total of 170 surveys collected through Google form and Microsoft form. **Table 5.1** summarizes the gender, position, nature of business and year of establishment of the survey data.

The raw data of the survey were analysed and segregated into the grouping. The rating of each participant was given according to their responses to questionnaires of BVA characteristics. On the Likert scale of six (6) and seven (7) will be given the score of one (1); whereas five (5) and below will be zero (0). The total scores of fifteen (15) out of thirty (30) and above will be identified as BVA practitioners. Scores of 14 and lower, on the other hand, will be classified as Non BVA practitioners.

The result of both BVA practitioners and Non-BVA practitioners are tabulated and compared on their performance matric.

Table 5.1: Survey Participants Profile

		Frequency	Percentages
Gender	Female	62	36.5
	Male	108	63.5
Position	Director	70	41.2
	Manager	30	17.6
	Production Manager	12	7.1
	Supervisor	14	8.2
	Other	44	25.9
Nature of Company	Bird nest supplier	14	8.2
	Raw bird nest supplier	16	9.4
	Bird nest cleaning and supplier	92	54.1
	Bird nest exporter	32	18.8
	Bird nest cleaning provider	16	9.4
Year of establishing	1 - 4	62	36.5
	5 - 9	44	25.9
	10 - 14	42	24.7
	>15	22	12.9

5.2.1 Comparison between Best Value and Non-Best Value Practitioners

Table 5.2: Value Output Comparison

Value Comparison	**Value per kilogramme (RM)**	**Value per Worker (RM)**	**Losses per Worker (RM)**	**Actual Value per Worker (RM)**
Best Value Practitioners	**4,967**	**7,512**	**1,846**	**5,666**
Non Best Value Practitioners	**4,983**	**6,852**	**1,962**	**4,890**

The formulae of Actual Value per Worker,

$$\frac{x\,(a-c)}{b}$$

x = Actual Market Value of Edible Bird Nest (RM)
a = Total Monthly Output (kg)
b = Total Number of Workers (pax)
c = Losses Per Month (kg)

The value output generated by the BVA practitioners indicates better performance to Non-BVA practitioners. **Table 5.2** shows the workers of BVA practitioners having a higher value and lower losses during processing. The value generated by BVA practitioners is 9.6% higher than Non-BVA practitioners. While the losses per worker during production is 6.2% lower. Thus, the final value per worker (BVA) increases by 15% over Non-BVA practitioners.

Figure 5.1: Value Comparison between Best Value and Non-Best Value

On the production output, **Table 5.3** shows the workers of BVA practitioners produced higher productivity and lower wastage. The final result is 15% more productive than workers of Non-BVA practitioners.

Table 5.3: Production Comparison

Value Comparison	Kilogramme Per Worker	Percentage of wastage (%)	Losses per Worker in Kilogramme	Actual Kilogramme per Worker
Best Value Practitioners	1.51	24.5	0.37	1.14
Non-Best Value Practitioners	1.38	28.4	0.39	0.99

Figure 5.2: Productivity Comparison between Best Value and Non-Best Value

5.2.2 Performance of individual Best Value Principle

The data obtained through the survey is further classified according to their performance of six (6) individual Best Value Principles. The result in **Table 5.4** shows that the highest achiever would be the Utilising Expert, followed by the Measure Performance and Customer Expectation.

The average value generated (worker) as shown in **Table 5.4** was RM 6,692.00 and average losses through the processing of RM 1,614.00 with the final average net value of RM 5,077.00 per worker.

Utilising expert factors has an outstanding impact on the value of edible bird nest process of RM 5,222.00. It is around 2.85% more than average value generated by other factors. Similarly, on the value generated by each worker, utilising expert factor has 3.12% more than the average value generated.

The next stage would be further analysis the data by grouping the indicators in pairs.

Table 5.4: Performance of Best Value Principle

Best Value Principle	**Value per kilogramme (RM)**	**Value per Worker (RM)**	**Losses per Worker (RM)**	**Actual Value per Worker (RM)**
Utilising Expert	4,969	6,901	1,679	5,222
Preplan to identify risk	4,979	6,489	1,622	4,867
Measure Performance	4,974	6,727	1,551	5,176
Create Accountability	4,962	6,602	1,570	5,032
Motivation for Improvement	5,007	6,661	1,588	5,073
Customer Expectation	4,980	6,774	1,678	5,096
Average		6,692	1,614	5,077

Table 5.5 records the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

The average productivity per worker (kg) is 1.34 kilogramme per month, average wastage of 24.13% and average losses of 0.33 kilogramme. The total net productivity is 1.02 kilogramme. On the losses by each worker, utilising expert factor able to increase the worker's productivity by 3.73% above average. The final net productivity of 1.05 kilogramme is 2.9% higher than the average performance by the entire group.

The indicators performance of utilising expert concluded by a utilised expert at the beginning of productivity being able to generate higher performance. The skills of workers need to be polished and trained by an experienced expert or consultant. This is a secure and reliable approach with minimum error and avoiding the risk of failure at the initial stage of production.

It is obvious that when the performance of workers is measured and monitored during production. Throughout the entire survey, most of the participants would agree to the importance of workers' performance being measured and rewarded according to their output and efforts.

Another indicator to monitor is Customer Expectation. The achievement clearly shows that customer expectation could make a significant effect on the entire production. All three indicators reveal the best value principles do bring impact to the productivity of workers as well as the profitability.

The difference between the highest and the lowest performance are 7.3% incremental.

Table 5.5: Productivity performance of Best Value Principle

Best Value Principle	Kilogramme Per Worker	Percentage of wastage	Losses per Worker in Kilogramme	Actual Kilogramme per Worker
Utilising Expert	1.39	24.40%	0.34	1.05
Pre plan to identify risk	1.3	25.00%	0.33	0.97
Measure Performance	1.35	23.10%	0.31	1.04
Create Accountability	1.33	23.80%	0.32	1.01
Motivation for Improvement	1.33	23.80%	0.32	1.01
Customer Expectation	1.36	24.70%	0.34	1.02
Average		24.13%	0.33	1.02

5.2.3 Performance of Combine Best Value Principle in Pair

In the second stage of analysis, a combination of the two best-value principles is tabulated in **Tables 5.6 and 5.7**.

The average value generated (worker) as shown in **Table 5.6** is RM 6,816.00 and the average losses through the processing of RM 1,643.00 with the final average net value of RM 5,173.00 per worker. During the analysis of two combinations of the best value principles, the gap of performance between each group is reduced further. However, the outstanding performance factor is still clearly identified as utilising expert and customer expectation (RM 5,384.00) with a 4.0% edge over average performers on net value generated. When comparing on value generated by the worker, a combination of utilising expert and customer expectation performs at 4.3% better than the average of the entire group.

The performance improves when the combination of both indicators results in outstanding performance. Another observation is the gap of the performance becomes narrow in the combination of both indicators. The average means also improves from a single indicator to combine indicators of any two best value principles. The difference between the highest and the lowest are 8.5%.

Table 5.6: Performance of Best Value Principle (Group of 2)

Best Value Principle	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
Utilising Expert & Pre plan to identify Risk	4,979	6,877	1,685	5,192
Utilising Expert & Measure Performance	4,964	6,914	1,695	5,219
Utilising Expert & Create Accountability	4,963	6,960	1,705	5,255
Utilising Expert & Motivation for Improvement	4,974	6,794	1,624	5,170
Utilising Expert & Customer Expectation	4,970	7,124	1,740	5,384
Pre plan to identify Risk & Measure Performance	4,975	6,840	1,687	5,153
Pre plan to identify Risk & Create Accountability	4,964	6,583	1,622	4,961
Pre plan to identify Risk & Motivation for Improvement	4,983	6,739	1,624	5,115
Pre plan to identify Risk & Customer Expectation	4,977	6,983	1,726	5,257
Measure Performance & Create Accountability	4,969	6,726	1,601	5,125
Measure Performance & Motivation for Improvement	4,976	6,569	1,520	5,049
Measure Performance & Customer Expectation	4,971	6,819	1,608	5,211
Create Accountability & Motivation for Improvement	4,984	6,695	1,555	5,140
Create Accountability & Customer Expectation	4,969	6,836	1,640	5,196
Motivation for Improvement & Customer Expectation	4,965	6,794	1,620	5,174
Average		6,817	1,643	5,173

Table 5.7 records the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

Table 5.7: Productivity Performance of Best Value Principle (Group of 2)

Best Value Principle	**Kilogramme Per Worker**	**Percentage of wastage**	**Losses per Worker in Kilogramme**	**Actual Kilogramme per Worker**
Utilising Expert & Pre plan to identify Risk	1.38	24.50%	0.34	1.04
Utilising Expert & Measure Performance	1.39	24.50%	0.34	1.05
Utilising Expert & Create Accountability	1.4	24.50%	0.34	1.06
Utilising Expert & Motivation for Improvement	1.37	23.90%	0.33	1.04
Utilising Expert & Customer Expectation	1.43	24.40%	0.35	1.08
Preplan to identify Risk & Measure Performance	1.38	24.60%	0.34	1.04
Preplan to identify Risk & Create Accountability	1.33	24.60%	0.33	1
Preplan to identify Risk & Motivation for Improvement	1.35	24.10%	0.33	1.02
Preplan to identify Risk & Customer Expectation	1.4	24.70%	0.35	1.05
Measure Performance & Create Accountability	1.35	23.80%	0.32	1.03
Measure Performance & Motivation for Improvement	1.32	23.10%	0.31	1.01
Measure Performance & Customer Expectation	1.37	23.50%	0.35	1.02
Create Accountability & Motivation for Improvement	1.34	23.20%	0.31	1.03
Create Accountability & Customer Expectation	1.38	23.90%	0.33	1.05
Motivation for Improvement & Customer Expectation	1.37	23.80%	0.33	1.04
Average	1.37	24.07%	0.33	1.04

The average productivity per worker (kg) is 1.37 kilogramme per month, average wastage of 24.07% and average losses of 0.33 kilogramme. The total net productivity is 1.04 kilogramme.

On the losses by each worker, utilising expert and customer expectation factors can increase the worker's productivity by 4.37% above average. The final net productivity of 1.08 kilogramme is 3.84% higher than an average performance by the entire group.

The combined indicator of utilising expert and customers expectation shows that stage two of productivity indeed focuses on customer expectation. To capture the market, it is to fine tune production according to market demand. The effective market research and analysis will reduce the risk of frequent changes in production and minimum on the wastage in long term.

5.2.4 Performance of Three Combine Best Value Principle

In third stage of analysis, combination of three best value principles were tabulated in **Table 5.8 and 5.9**.

Table 5.8: Performance of Best Value Principle (Group of 3)

Best Value Principle	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
Utilising Expert, Pre plan to identify risk &Measure Performance	4,968	6,956	1,700	5,256
Utilising Expert, Pre plan to identify risk & Create Accountability	4,963	6,948	1,698	5,250
Utilising Expert, Pre plan to identify risk & Motivation for improvement	4,984	6,862	1,615	5,247
Utilising Expert, Pre plan to identify risk & Customer Expectation	4,907	7,124	1,740	5,384
Utilising Expert, Measure Performance &Create Accountability	4,988	7,336	1,788	5,548
Utilising Expert, Measure Performance & Motivation for improvement	4,977	6,886	1,633	5,253
Utilising Expert, Measure Performance & Customer Expectation	4,974	7,148	1,737	5,411
Utilising Expert, Create Accountability & Motivation for Improvement	4,969	6,905	1,656	5,249
Utilising Expert, Create Accountability & Customer Expectation	4,973	7,080	1,734	5,346
Utilising Expert, Motivation for Improvement & Customer Expectation	4,970	7,075	1,732	5,343
Pre plan to identify risk, Measure Performance & Create Accountability	4,963	6,877	1,711	5,166
Pre plan to identify risk, Measure Performance & Motivation for improvement	4,987	6,817	1,632	5,185
Pre plan to identify risk, Measure Performance & Customer Expectation	4,981	7,,004	1,724	5,280
Pre plan to identify risk, Create Accountability & Motivation for Improvement	4,976	6,603	1,596	5,007
Pre plan to identify risk, Create Accountability & Customer Expectation	4,980	6,942	1,721	5,221
Pre plan to identify risk, Motivation for Improvement & Customer Expectation	4,977	6,938	1,719	5,219
Measure Performance, Create Accountability & Motivation for Improvement	4,971	6,637	1,551	5,086
Measure Performance, Create Accountability & Customer Expectation	4,965	6,776	1,627	5,149
Measure Performance, Motivation for Improvement & Customer Expectation	4,975	6,858	1,622	5,236
Create Accountability, Motivation for Improvement & Customer Expectation	4,969	6,836	1,640	5,196
Average		6,930	1,679	5,252

The average value generated (worker) as shown in **Table 5.8** is RM 6,930.00, average loses through processing of RM 1,679.00., and the final average net value of RM 5,252.00 per workers. Among the outstanding performance factors are utilising expert, measure performance and create accountability (RM 5,548.00) with 10.6% edge over average performers on net value generation. When comparing on value generated by worker, combination of utilising expert, measure performance and create accountability is performing 5.8% better than the average of entire group. From the observation of above three performance analysis, the gap of performance becomes closer when more best value principles appear. The average means also improves from single indicator to three indicators combined. The difference between the highest and the lowest is 10.8%.

Table 5.9: Productivity Performance of Best Value Principle (Group of 3)

Best Value Principle	**Kilogramme Per Worker**	**Percentage of wastage**	**Losses per Worker in Kilogramme**	**Actual Kilogramme per Worker**
Utilising Expert, Preplan to identify risk &Measure Performance	1.35	25.0%	0.34	1.01
Utilising Expert, Preplan to identify risk & Create Accountability	1.40	24.4%	0.34	1.06
Utilising Expert, Pre plan to identify risk & Motivation for improvement	1.38	23.5%	0.32	1.06
Utilising Expert, Pre plan to identify risk & Customer Expectation	1.43	24.4%	0.35	1.08
Utilising Expert, Measure Performance &Create Accountability	1.47	24.3%	0.36	1.11
Utilising Expert, Measure Performance & Motivation for improvement	1.38	23.7%	0.33	1.05
Utilising Expert, Measure Performance & Customer Expectation	1.44	24.3%	0.35	1.09
Utilising Expert, Create Accountability & Motivation for Improvement	1.39	24.0%	0.33	1.06
Utilising Expert, Create Accountability & Customer Expectation	1.42	24.4%	0.35	1.07
Utilising Expert, Motivation for Improvement & Customer Expectation	1.42	24.4%	0.35	1.07
Pre plan to identify risk, Measure Performance & Create Accountability	1.39	24.9%	0.34	1.05
Pre plan to identify risk, Measure Performance & Motivation for improvement	1.37	23.9%	0.33	1.04
Pre plan to identify risk, Measure Performance & Customer Expectation	1.41	24.6%	0.35	1.06
Pre plan to identify risk, Create Accountability & Motivation for Improvement	1.33	24.2%	0.32	1.01
Pre plan to identify risk, Create Accountability & Customer Expectation	1.39	24.8%	0.35	1.04
Pre plan to identify risk, Motivation for Improvement & Customer Expectation	1.39	24.8%	0.35	1.04
Measure Performance, Create Accountability & Motivation for Improvement	1.34	23.4%	0.31	1.03
Measure Performance, Create Accountability & Customer Expectation	1.36	24.0%	0.33	1.03
Measure Performance, Motivation for Improvement & Customer Expectation	1.38	23.6%	0.33	1.05
Create Accountability, Motivation for Improvement & Customer Expectation	1.38	24.0%	0.33	1.05
Average	1.39	24.23%	0.34	1.05

Table 5.9 recorded the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

The average productivity per workers (kg) is 1.39 kilogramme per month, average wastage of 24.23% and average losses of 0.34 kilogramme. The total net productivity is 1.05 kilogramme.

The combination group (Utilising Expert, Measure Performance and Create Accountability) has recorded net productivity of 1.11 kilogramme, 5.71% better than average and higher output per worker of 1.47 kilogramme.

At this stage, workers performance has become extremely important. It is required proper recording for production flow and operation to create accountability and measure of individual workers performance. It is also to motivate the workers to improve on their work quality and quantity, depending on the accountability of the workers themselves. The other factor is highly related to the methodology of performance being measured and rewarded. By establishment of rewarding system, workers would be motivated to excel in their work scope and accountability habit could be developed through training and proper tracking system. Finally, with proper recording system, the performance could be measured, and reward system could be executed eventually.

5.2.5 Performance of Four Combined Best Value Principle

In stage four of analysis, combination of four best value principles is tabulated in **Table 5.10 and 5.11**.

Table 5.10: Performance of Best Value Principle (Group of 4)

Best Value Principle	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
Utilising Expert, Pre plan to identify risk, Measure Performance & Create Accountability	4,945	6,991	1,730	5,261
Utilising Expert, Pre plan to identify risk, Create Accountability & Motivation for improvement	4,975	6,923	1,635	5,288
Utilising Expert, Pre plan to identify risk, Motivation for improvement & Customer Expectation	4,972	7,051	1,704	5,347
Utilising Expert, Pre plan to identify risk, Measure Performance & Motivation for improvement	4,975	6,899	1,650	5,249
Utilising Expert, Pre plan to identify risk, Measure Performance & Customer Expectation	4,974	7,148	1,737	5,411
Utilising Expert, Measure Performance, Create Accountability & Motivation for improvement	4,951	6,917	1,658	5,259
Utilising Expert, Create Accountability, Motivation for Improvement & Customer Expectation	4,961	7,068	1,736	5,332
Pre plan to identify risk, Measure Performance, Create Accountability & Motivation for improvement	4,968	6,839	1,670	5,169
Pre plan to identify risk, Create Accountability, Motivation for Improvement & Customer Expectation	4,969	6,956	1,726	5,230
Measure Performance, Create Accountability, Motivation for Improvement & Customer Expectation	4,969	6,836	1,640	5,196
Utilising Expert, Pre plan to identify risk, Measure Performance & Create Accountability	4,945	6,991	1,730	5,261
Utilising Expert, Pre plan to identify risk, Create Accountability & Motivation for improvement	4,975	6,923	1,635	5,288
Average		7,013	1,710	5,302

The average value generated (worker) as shown in **Table 5.10** is RM 7,013.00, average losses through processing of RM 1,710.00 and the final average net value of RM 5,302.00 per workers. Among the outstanding performance factor are utilising expert, pre-plan to identify risk, measure Performance & customer Expectation (RM 5,411.00) with 2.06% edge over average performers on net value generation. When comparing on value generated by worker, combination of utilising expert, pre-plan to identify risk, measure Performance & customer Expectation perform 1.92% better than the average of entire group.

Table 5.11: Productivity Performance of Best Value Principle (Group of 4)

Best Value Principle	Kilogramme Per Worker	Percentage of wastage	Losses per Worker in Kilogramme	Actual Kilogramme per Worker
Utilising Expert, Pre plan to identify risk, Measure Performance & Create Accountability	1.41	24.7%	0.35	1.06
Utilising Expert, Pre plan to identify risk, Create Accountability & Motivation for improvement	1.39	23.6%	0.33	1.06
Utilising Expert, Pre plan to identify risk, Motivation for improvement & Customer Expectation	1.42	24.1%	0.34	1.08
Utilising Expert, Pre plan to identify risk, Measure Performance & Motivation for improvement	1.39	23.9%	0.33	1.06
Utilising Expert, Pre plan to identify risk, Measure Performance & Customer Expactation	1.44	24.3%	0.35	1.09
Utilising Expert, Measure Performance, Create Accountability & Motivation for improvement	1.40	23.9%	0.33	1.07
Utilising Expert, Create Accountability, Motivation for Improvement & Customer Expectation	1.42	24.5%	0.35	1.07
Pre plan to identify risk, Measure Performance, Create Accountability & Motivation for improvement	1.38	24.4%	0.34	1.04
Pre plan to identify risk, Create Accountability, Motivation for Improvement & Customer Expectation	1.40	24.8%	0.35	1.05
Measure Performance, Create Accountability, Motivation for Improvement & Customer Expectation	1.38	24.0%	0.33	1.05
Utilising Expert, Pre plan to identify risk, Measure Performance & Create Accountability	1.41	24.7%	0.35	1.06
Utilising Expert, Pre plan to identify risk, Create Accountability & Motivation for improvement	1.39	23.6%	0.33	1.06
Average	1.40	24.22%	0.34	1.06

Table 5.11 recorded the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

The average productivity per workers (kg) will be 1.4 kilogramme per month, average wastage of 24.22% and average losses of 0.34 kilogramme. The total net productivity is 1.06 kilogramme.

Coming to this stage of production, the production planning has become one of important factors. As the production expand, pre-planning could mitigate or reduce the risk in production losses. This risk could be avoided by utilising the expertise of consultant or advisor.

5.2.6 Performance of Five Combine Best Value Principle

In stage five of analysis, combination of four best value principles is tabulated as **Table 5.12 and 5.13**.

Table 5.12: Performance of Best Value Principle (Group of 5)

Best Value Principle	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability& Motivation for improvement	4,956	6,970	1,663	5,307
Utilising Expert, Pre plan to identify risk, Create Accountability, Motivation for improvement & Customer Expectation	4,981	7,083	1,714	5,369
Utilising Expert, Pre plan to identify risk, Measure Performance, Motivation for improvement & Customer Expectation	4,969	7,025	1,714	5,311
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability& Customer Expectation	4,972	7,032	1,741	5,291
Utilising Expert, Measure Performance, Create Accountability, Motivation for improvement & Customer Expectation	4,968	7,070	1,716	5,354
Pre plan to identify risk, Measure Performance, Create Accountability, Motivation for improvement, Customer Expectation	4,980	6,895	1,713	5,182
Average		7,013	1,710	5,302

The average value generated (worker) as shown in **Table 5.12** is RM 7,013.00, average losses through processing of RM 1,710.00, and the final average net value of RM 5,302.00 per workers. Among the outstanding performance factors are Utilising Expert, Preplan to identify risk, Create Accountability, Motivation for Improvement & Customer Expectation (RM 5,369.00) with 1.2% edge over average performers on net value generation. When comparing on value generated by worker, combination of Utilising Expert, Pre plan to identify risk, Create Accountability, Motivation for

Improvement & Customer Expectation perform 1.0% better than the average of entire group.

Table 5.13: Productivity performance of Best Value Principle (Group of 5)

Best Value Principle	Kilogramme Per Worker	Percentage of wastage	Losses per Worker in Kilogramme	Actual Kilogramme per Worker
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability& Motivation for improvement	1.41	23.8%	0.33	1.08
Utilising Expert, Pre plan to identify risk, Create Accountability, Motivation for improvement & Customer Expectation	1.42	24.1%	0.34	1.08
Utilising Expert, Pre plan to identify risk, Measure Performance, Motivation for improvement & Customer Expectation	1.41	24.3%	0.34	1.07
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability& Customer Expectation	1.41	24.7%	0.35	1.06
Utilising Expert, Measure Performance, Create Accountability, Motivation for improvement & Customer Expectation	1.42	24.2%	0.34	1.08
Pre plan to identify risk, Measure Performance, Create Accountability, Motivation for improvement, Customer Expectation	1.38	24.8%	0.34	1.04
Average	1.41	24.32%	0.34	1.07

Table 5.13 records the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

The average productivity per workers (kg) is 1.41 kilogramme per month, average wastage of 24.32% and average losses of 0.34 kilogramme. The total net productivity is 1.07 kilogramme.

5.2.7 Performance of Six Combine Best Value Principle

Table 5.14: Performance of Best Value Principle (Group of 6)

Best Value Principle	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability, Motivation for improvement & Customer Expectation	4,970	6,997	1,701	5,296

In stage six of analysis, combination of six best value principles is tabulated in **Table 5.14 and 5.15**.

The average value generated (worker) as shown in **Table 5.14** is RM 6,997.00, average loses through processing of RM 1,701.00, and the final average net value of RM 5,296.00 per workers.

Table 5.15: Productivity performance of Best Value Principle (Group of 6)

Best Value Principle	Kilogramme Per Worker	Percentage of wastage	Losses per Worker in Kilogramme	Actual Kilogramme per Worker
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability, Motivation for improvement & Customer Expectation	1.41	24.2%	0.34	1.07

Table 5.15 records the total productivity of each worker in weight, percentage of wastage during production, losses in weight by each worker and net productivity by each worker.

The average productivity per workers (kg) is 1.41 kilogramme per month, average wastage of 24.2% and average losses of 0.34 kilogramme. The total net productivity is 1.07 kilogramme.

5.2.8 Overall Performance of Best Value Principle

Table 5.16: Productivity performance of Best Value Principle (Overall)

Best Value Principle	Productivity per worker (RM)	Average in the group (RM)	Percentage increase (%)
Utilised Expect	5,222	5,077	3
Utilising Expert & Customer Expectation	5,384	5,173	4
Utilising Expert, Measure Performance &Create Accountability	5,548	5,252	6
Utilising Expert, Create Accountability, Motivation for Improvement & Customer Expectation	5,411	5,274	3
Utilising Expert, Pre plan to identify risk, Create Accountability, Motivation for improvement & Customer Expectation	5,369	5,302	1
Utilising Expert, Pre plan to identify risk, Measure Performance, Create Accountability, Motivation for improvement & Customer Expectation	5,296	5,296	0

The overall summary of different analysis stages is illustrated in **Table 5.16**. The most outstanding best value principles is utilising of expert which appears throughout all the combination group, followed by customer expectation, create accountability, motivation for improvement, measure performance and pre-plan to reduce risk.

Therefore, it is recommended to start with engaging the experience consultant by utilising their expertise in setting up of all production flow and training of workers. The target market requirement and customer expectation should also take into consideration in determine the company goals and market strategy.

Figure 5.3: Productivity Performance of Best Value Principle (Overall)

During the production stage, beside utilising the expert in training the workers, a comprehensive recording and measurement of performance need to be in place to create accountability of individual workers. It is clearly indicated from **Figure 5.3**, combination of utilising expert, measure performance and create accountability could achieve the higher output and performance. It is 6.24% higher value generated (RM 5,548) than the lowest value output (RM 5,222).

Table 5.17: Productivity performance of Best Value Principle (Differences)

Best Value Principle	Highest Performance per workers (RM)	Lowest Performance per workers (RM)	Percentage increase (%)
Single Best Value	5,222	4,867	7.3
Group of 2 Best Value	5,384	4,961	8.5
Group of 3 Best Value	5,548	5,007	10.8
Group of 4 Best Value	5,411	5,169	4.7
Group of 5 Best Value	5,369	5,182	3.6
Group of 6 Best Value	5,296	5,296	0.0

In summary, the gap between the highest achiever to the lowest getting narrow from 10.8% to 3.6% (**Table 5.17**). This trend means that Best Value Approach being able to close the gap and improve the performance.

With Best Value Principles implementation, the productivity improves on the lowest performance (0.97 kg) with 10.3% to highest productivity (1.07 kg). Similarly, the percentage of differences reduces from 9.9% to 4.1% (**Table 5.18**).

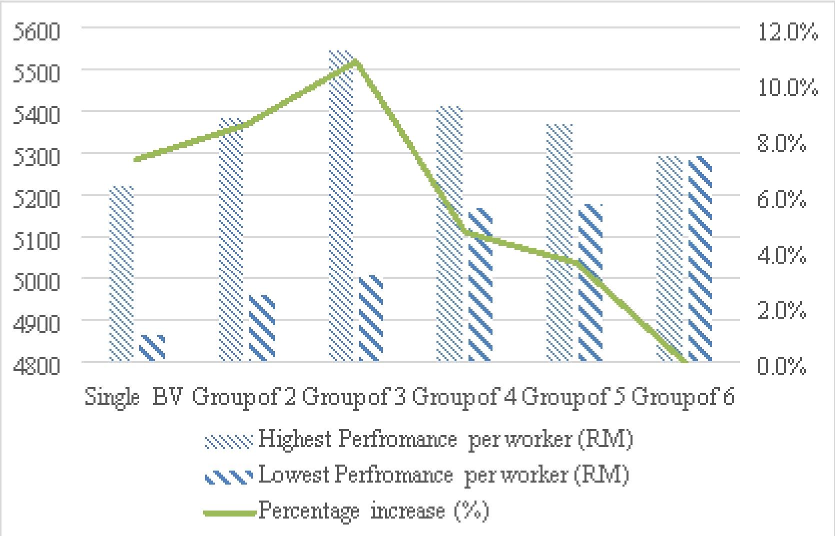

Figure 5.4: Productivity Performance of Best Value Principle (Differences)

Table 5.18: Productivity performance of Best Value Principle (Differences)

Best Value Principle	Highest Productivity per workers (Kg)	Lowest Productivity per workers (Kg)	Percentage increase (%)
Single Best Value	1.05	0.97	8.2
Group of 2 Best Value	1.08	1	8.0
Group of 3 Best Value	1.11	1.01	9.9
Group of 4 Best Value	1.09	1.04	4.8
Group of 5 Best Value	1.08	1.04	4.1
Group of 6 Best Value	1.07	1.07	0.0

5.3 Descriptive Evaluation of Performance Matrix

The performance of matrix measurement is tabulated based on the percentage of participants in each category. Through the detailed evaluation, each grouping performance can be identified, and recommendation can made in the final conclusion section.

5.3.1 Performance on Production Wastage

One of the important indicators is total wastage during production. The least percentile of wastage is the category with less than 15% of wastage, while the highest is more than 30%. **Table 5.19** shows the result of each category with percentage of participating in each Best Value Principle. The best performance of less than 15% wastage stipulates all principles to be above average. In contrast, the highest wastage category exhibits full partaking in three principles but remaining three principles are below average mark. This reveals the predominant of balancing in performance of each principle. The outcome of selective partaking could be devastating.

Table 5.19: Participation of Best Value Principle by each Category (Wastage)

Performance Category	Utilising Expert	Preplan to identify risk	Measure Performance	Create Accountability	Motivation for Improvement	Customer Expectation
Less than 15%	90%	90%	100%	100%	90%	90%
16% - 20%	62%	86%	100%	95%	100%	86%
21% - 25%	67%	83%	100%	100%	83%	83%
26% - 30%	0%	100%	100%	0%	100%	50%
More than 30%	100%	100%	100%	50%	100%	100%
Average	64%	92%	100%	69%	95%	82%

5.3.2 Performance on Worker Productivity

Second indicators are worker's productivity. The least percentiles of the category with worker's monthly productivity are less than 2 kilogrammes. The highest is more than 5 kilogrammes. **Table 5.20** reveals the result of each category with percentage of participating in each Best Value Principle. The best performance of more than 5 kilogrammes stipulated all principles are above 90% participants. In contrast, the highest wastage category exhibited full partaking in all 5 principles but one principle with 50% mark. This reveals the predominant of balancing in performance of each principle.

Table 5.20: Participation of Best Value Principle by each Category (Worker Productivity)

Performance Category	Utilising Expert	Preplan to identify risk	Measure Performance	Create Accountability	Motivation for Improvement	Customer Expectation
Less than 2kg	70%	90%	100%	88%	100%	94%
3 kg	71%	86%	100%	100%	93%	86%
4 kg	0%	100%	100%	50%	50%	50%
5 kg	100%	50%	100%	100%	100%	50%
More than 5 kg	50%	83%	100%	83%	100%	83%
Average	58%	82%	100%	84%	89%	73%

5.3.3 Performance on Fulfilment

Fulfilment of requirement either locally or overseas establishes the capability of any given cleaning facilities. One of the clear indications is the ability to fulfil local authorities' requirement. As shown on **Table 5.21**, the participants who fulfil all the local requirements will achieve all the best value practices. However, fulfilment of export requirements varies from one country to another, hence hard to measure and collate.

Table 5.21: Participation of Best Value Principle by each Category (Fulfilment)

Performance Category	Utilising Expert	Preplan to identify risk	Measure Performance	Create Accountability	Motivation for Improvement	Customer Expectation
Not fulfilled	83%	100%	100%	83%	100%	100%
Partially fulfilled local requirement	**33%**	**83%**	**100%**	**100%**	**100%**	**100%**
Fulfilled local requirement	100%	100%	100%	100%	100%	100%
Partially fulfilled export requirement	**80%**	**70%**	**100%**	**90%**	**100%**	**90%**
All fulfilled export requirement	67%	94%	100%	89%	89%	72%
Average	73%	89%	100%	92%	98%	92%

5.3.4 Performance on Market Distribution

Market distribution has become predominant yardstick. As shown on **Table 5.22**, the participants who capture 100% local market or overseas market may not be the most optimistic winners. The participants who are able to balance in their market distribution would not be affected by the off-peak session of overseas market. Nevertheless, those who focus on certain market could endured a period of slow in production.

Table 5.22: Participation of Best Value Principle by each Category (Market Distribution)

Performance Category	Utilising Expert	Preplan to identify risk	Measure Performance	Create Accountability	Motivation for Improvement	Customer Expectation
100% local market	50%	67%	100%	83%	100%	100%
More than 50% local market	0%	100%	100%	100%	100%	100%
50% local and 50% overseas	73%	91%	100%	91%	100%	91%
More than 50% overseas	77%	85%	100%	92%	100%	92%
100% overseas	70%	100%	100%	90%	80%	60%
Average	54%	89%	100%	91%	96%	89%

5.4 Inferential Statistics Analysis

The Kruskal-Wallis H test (also known as the "one-way ANOVA on ranks") is a nonparametric rank-based test that may be used to evaluate if there are statistically significant differences between two or more groups of an independent variable on a continuous or ordinal dependent variable (Morgan et al, 2019). The Kruskal Wallis H test is adopted to compare the significant of difference grouping to performance matrix.

The Spearman rank-order correlation coefficient (also known as Spearman's correlation) is a nonparametric measure of the degree and direction of relationship between two variables assessed on at least an ordinal scale (Morgan et al, 2019). It is to measure the correlation variable on the direction of performance matrix.

The Mann-Whitney U test is the nonparametric counterpart of the t-test for two samples. (Morgan et al, 2019). The test compares between various groups in pair between the Best Value Practitioners and Non Best Value Practitioners, SME and Establish Company and CNCA Practitioner versus Non CNCA Practitioners.

5.4.1 Impact on Production Wastage

Table 5.23: Best Value Principles on Performance Matrix (Wastage)

				Wastage		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.851	1.303	0.001	-.299**	0.000
15	All workers should know how to check on their own output	6.292	0.956	0.000	-.264**	0.001
29	Constantly upgrade the quality to meet customer expectation/ market demand is essential	6.422	0.877	0.046	.195*	0.016

All variables are assessed under Kruskal Wallis test on significant (**Table 5.23**). The result shows significant consequence when attending training course by the supervisor, and workers are able to improve the quality and decrease the wastage during production ($p < 0.001$).

The similar variable further exhibits a correlation coefficient of ($c = -0.299$). The negative correlation indicates that the higher rating on the training of supervisor and workers, the rating of wastage reduces (negative). The result under spearman test also manifests the significant of ($p<0.000$).

The variable of Measure performance examined under Kruskal Wallis indicates a significant effects on wastage ($p<0.000$) when all workers know how to check their own output quality.

The result of correlation coefficient and spearmen test appears that workers' ability to inspect and control their own output to be able to lower the wastage percentiles. ($c=-0.264$ and $p<0.001$).

Controversially, constantly upgrading the quality to meet customer expectation or market demand has positive influence to wastage. Obviously, when the production process keeps changing according to market or customer demand, the efficiency of productivity will be diminished; thus, wastage increased. Therefore, the significant test of Kruskal Wallis ($p<0.046$) and Spearman test ($p<0.016$) reveal strong corelation coefficient of $c = 0.195$.

The result affirms both Utilising Expert and Measure of Performance (Best Value principle) have direct and significant value in lessening the wastage during production. From the mean of 5.851 and 6.292, most of the participants do concur with engaging expert on training the workers, and proper record to measure the performance of workers is most predominant variables for this matrix indicator.

5.4.2 Impact on Worker Productivity

Table 5.24: Best Value Principles on Performance Matrix (Worker productivity)

				Worker Productivity		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
5	Consultant/expert could help to achieve export requirements.	5.539	1.734	0.001	-.316**	0.000
26	All the workers should understand the customer requirement	5.805	1.495	0.022	-.206*	0.010
27	When workers not able to achieve the customer requirement, seeking help from consultants/experts is important	5.390	1.823	0.009	-.221**	0.006

Under the Kruskal Wallis test (**Table 5.24**), seeking help from expert is able to resolve difficulty and challenges faces significant impact on workers productivity (p <0.001). However, the correlation result shows the negative sign (c= -0.316), meaning more engagement of expert to assist on export requirement, causing the depletion in worker productivity. The result on spearman test further stipulates the significant impact (p<0.000). From the observation, when the workers are required to adapt to new cleaning method or processes. It will cause a setback in productivity until he or she masters the skills.

Similarly, two other variables relate to customer requirement; workers understanding of customer requirement (c=-0.206) and seeking help from consultants or expert to achieve customer requirement (c=-0.221) has manifested the negative significant in correlation coefficient. Both variables having the significant value of p<0.022 and p<0.009 in Kruskal Wallis test, and p<0.010 and p<0.006 in Spearman test.

The above result concludes that Best Value Principle – Utilising Expert and Customer Expectation having undeviating and negative consequence resulting the lower productivity. By engaging expert to fine tune, the production process in meeting the export and customer requirement could have a setback on production efficiency.

5.4.3 Impact on Number of Workers

Table 5.25: Best Value Principles on Performance Matrix (Number of worker)

				Number of Worker		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
6	Plan production flow is important before start operation.	6.344	1.006	0.001	.207*	0.010
11	Setting measure criteria or requirement is important	6.344	1.025	0.014	.239**	0.003
25	Supervisor should be able to motivate the workers to increase productivity	6.247	1.074	0.011	.168*	0.038

Table 5.25 above illustrates the outcome of variable on production planning before the operation has significant effect on number of workers through Kruskal Wallis test (p<0.000). The test outcome on correlation and Spearman resulting the positive relationship; whereby, the pre- production planning could have positive impact on production grow indicated by incremental of worker number (c=0.231, p<0.002).

Another variable on the setting of measure criteria or requirement has positive correlation on worker's growth (c=0.215, p<0.005). The outcome concurs by Kruskal Wallis test of p<0. 018. Interesting finding on the variable of motivation from supervisor to workers able to expand the workers number

(Corelation c= 0.168 and Spearman p<0.038). The analysis outcome explained that when supervisor able to motivate on workers, the increment on productivity will assist to retain the workers and attract more workers to join the company. The significant test outcome from Kruskal Wallis echoes the same finding (p<0.011).

In summary, Pre-planning to reduce risk, measure performance and motivation for improvement have distinctive influence on number of workers either on the production growth or scale of production.

5.4.4 Impact on Market Distribution

Table 5.26: Best Value Principles on Performance Matrix (Market distribution)

Variables	Questionnaires	Mean	Std. Deviation	Market Distribution Kruskal Wallis	Correlation	Spearmen
22	All workers should be paid according to output / pieces rate	5.948	1.520	0.002	-.278**	0.000

The variable of all workers being paid according to output quantities or pieces rate resulting in a significant repercussion on market share of company. According to Kruskal Wallis test in **Table 5.26**, the p value of 0.002 with negative correlation of -0.278 and significant value of 0.000 on Spearman test, expressing the impact of pieces rate methods has directly caused the market share to shift toward local market instead of overseas market. This is the only variable that has effect on market share.

5.4.5 Impact on Fulfilment of Requirement

Table 5.27: Best Value Principles on Performance Matrix (Fulfilment)

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Fulfilment Correlation	Spearmen
14	All workers understand the quality requirement is a must	6.442	1.066	0.004	.279**	0.000
20	All workers should be accountable for their own work	6.370	1.090	0.002	.245**	0.002

In **Table 5.27**, a total of two variables exhibits a positive significant to fulfilment of local and overseas requirement. First variable on worker's understanding of quality requirement value at p<0.004 on Kruskal Wallis and correlation of c=0.279, and p<0.000 on Spearman test. Second variable on the worker's accountability of their own output, the significant value of p<0.002 and correlation rating c=0.245, and p<0.002 of Spearman test indicate that both variables directly related to workers ability.

It is important to measure the performance and create accountability among the workers. Both variables have reiterated the attitude of the workers toward fulfilment of local or overseas requirement. The right attitude will be able to achieve and meet stringent requirement.

5.4.6 Impact on Obtaining of License

In obtaining license, worker's ability to understand the requirement is extremely important; the output convey the significant value in Kruskal Wallis test of p<0.006 and correlation c=0.220 and p<0.006 on Spearman test (**Table 5.28**).

Table 5.28: Best Value Principles on Performance Matrix (License)

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	License Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.851	1.303	0.001	-.265**	0.001
14	All workers understand the quality requirement is a must	6.442	1.066	0.006	.220**	0.006
19	All workers know how to record their output everyday	6.058	1.344	0.025	.182*	0.024
20	All workers should be accountable for their own work	6.370	1.090	0.003	.239**	0.003

One of the requirements by respective authorities is the worker's ability to record their output during production. The impact factor of $p<0.025$ on Kruskal Wallis and correlation $c=0.182$, and $p<0.024$ on Spearman test. The production record further enhances the workers accountability toward their own output. The result shows $p<0.003$ Kruskal Wallis, $c=0.239$ and $p<0.003$ Spearman.

The variable on attending the training course has negative impact on obtaining the license. The outcome expresses that $p<0.001$ on Kruskal Wallis test, correlation $c=-0.265$ and $p<0.001$ Spearman test. It is due to most training course not attuned to requirement of specific authorities. Therefore, by attending the training course in general does not produce a positive result but instead creates confusion to the production flow.

5.4.7 Impact on Monthly Productivity

Table 5.29 shows three variables having significant and positive corelation to monthly productivity. Unlike the analysis above on individual worker productivity, early planning of production flow significantly ameliorates on productivity (p<0.000 Kruskal Wallis, c=0.204 and p<0.011 Spearman).

Table 5.29: Best Value Principles on Performance Matrix (Monthly productivity)

					Monthly Productivity	
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
6	Plan production flow is important before start operation.	6.344	1.006	0.000	.204*	0.011
14	All workers understand the quality requirement is a must	6.442	1.066	0.022	.242**	0.003
20	All workers should be accountable for their own work	6.370	1.090	0.043	.224**	0.005

Another two variables on worker's attitude whereby the workers acknowledge of quality requirement (p<0.022 Kruskal Wallis, c=0.242 and p<0.003 Spearman) and accountability of their own work (p<0.043 Kruskal Wallis, c=0.224 and p<0.005 Spearman), are the most influential factors from the survey.

Having a good planning and right attitude of workers by measure their performance and create accountability produce good productivity result.

5.4.8 Impact on Export to China Market

Table 5.30: Best Value Principles on Performance Matrix (China market)

					China Market	
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
14	All workers understand the quality requirement is a must	6.442	1.066	0.005	.242**	0.003

Table 5.30 indicates variable that generating positive correlation to China market export is having workers that recognise the quality requirement. This

variable not only influences the ability of company in fulfilment of local or overseas requirement, but also on obtaining license, monthly productivity and exporting to China market.

Form the significant value of p<0.005 on Kruskal Wallis and having correlation c=0.242, p<0.003 of Spearman; the training of workers skills and self-quality control is foremost needed.

5.4.9 Impact on Cleanroom Facility

Table 5.31: Best Value Principles on Performance Matrix (Worker productivity)

				Cleanroom Facility		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.851	1.303	0.039	-.167*	0.038
4	Training course for workers or supervisors could help to improve quality of final products.	6.169	1.047	0.046	.161*	0.045
11	Setting measure criteria or requirement is important	6.344	1.025	0.019	.190*	0.019
22	All workers should be paid according to output / pieces rate	5.948	1.520	0.018	.191*	0.018
23	Workers would be rewarded when achieve higher output	6.162	1.311	0.034	.171*	0.034
25	Supervisor should be able to motivate the workers to increase productivity	6.247	1.074	0.006	.224**	0.005
29	Constantly upgrade the quality to meet customer expectation/ market demand is essential	6.422	0.877	0.014	.198*	0.014
30	Supervisor should be able to train the workers according to customer expectation	6.266	1.054	0.022	.185*	0.022

Having the most variables that reveals significant result, with cleanroom facility representing the strength and ability of the company in obtaining CNCA permit (**Table 5.31**).

The only variable having negative impact is attending training course ($p<0.039$ Kruskal Wallis, $c=-0.167$ and $p<0.038$ Spearman). Most of participants attending training course conducted by outside consultant, have not able to assist to improve company status. However, they acknowledged that providing training course to workers and supervisor do assist on the company growth. ($p<0.046$ Kruskal Wallis, $c=0.161$ and $p<0.045$ Spearman).

Setting a good measurement criterion could also boost the morale of workers ($p<0.019$ Kruskal Wallis, $c=0.190$ and $p<0.019$ Spearman). Following by the piece rate system that rewarded the workers according to their output ($p<0.018$ Kruskal Wallis, $c=0.191$ and $p<0.018$ Spearman) motivate them with proper bonus scheme when achieving higher output. ($p<0.034$ Kruskal Wallis, $c=0.171$) and $p<0.034$ Spearman). On top of that, supervisor motivation could boost the workers morality according to survey. ($p<0.006$ Kruskal Wallis, $c=0.224$ and $p<0.005$ Spearman).

Lastly, constantly upgrading to customer requirement or market demand ($p<0.014$ Kruskal Wallis, $c=0.198$ and $p<0.014$ Spearman) and supervisor's training of workers to comply with customer requirement ($p<0.022$ Kruskal Wallis, $c=0.185$ and $p<0.022$ Spearman) strongly contributed to production growth.

5.4.10 Summary

Table 5.32 summarises the Best Value Principles that influence the outcome of nine measurement criteria.

Table 5.32: Summary of Impact of Best Value Principles on Performance Matrix

Measurement Criteria	**Utilising Expert**	**Pre-Plan to Reduce Risk**	**Measure Performance**	**Create Accountability**	**Motivation for Improvement**	**Customer Expectation**
Wastage	√		√			X
Worker productivity	X					X
Number of Worker		√	√		√	
Market distribution					X	
Fulfilment			√	√		
License	X		√	√		
Monthly productivity		√	√	√		
China market			√			
Cleanroom	√		√		√	√

The most influential Best Value Principles are Measure Performance. It effected almost all the measurement criteria except worker productivity and market distribution. This principle highlights the need of setting a good measurement criterion and also the workers attitude toward the quality and understanding of their own responsibility. According to Best Value Approach, the performance matrix is the key components for evaluation. Therefore, having good measurement criterion becomes the top priority in production process.

The second variable is relevant to measurement of performance. It is creating accountability among all workers. When all the workers acknowledge the quality requirement and their accountability toward their own output, the responsibility and attitude will change.

Pre-production planning not only mitigate the risk, but it also contributes to productivity and growing of work force. Input from expert or consultant will develop strategic production plan that elevates the company in shorter period.

Table 5.33: Reliability Test on Best Value Principles

Reliability Test	Measure Performance	Preplan to identify risk	Create Accountability	Motivation for Improvement	Utilising Expert	Customer Expectation
Cronbach Alpha	0.859	0.842	0.835	0.815	0.767	0.759
Ranking	1	2	3	4	5	6

Similar output from Cronbach Alpha test (Table 5.33), testifies the ranking of reliability according to score. All the score above 0.7 conveys the reliability of outcome. The highest score of measure performance similar to the analysis earlier, follow by the pre-planning to identify risk and create accountability.

5.5 Result of Comparison between Best Value and Non-Best Value Group

5.5.1 Result Performance of Best Value Group

Table 5.34: Result Performance of Best Value Group on Production Wastage

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Wastage Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.971	1.224	0.008	-.365**	0.002
15	All workers should know how to check on their own output	6.434	0.737	0.024	-.326**	0.006

The results in **Table 5.34** show that both using an expert and measuring performance variables have a direct and significant impact on reducing production waste. With a mean of 5.971 and 6.434, the majority of participants agree that hiring an expert to educate workers and keeping a thorough record to assess worker performance are the most important variables for this matrix indication.

Table 5.35: Result Performance of Best Value Group on Fulfilment of Requirement

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	**Fulfilment** Correlation	Spearmen
14	All workers understand the quality requirement is a must	6.579	0.881	0.029	.315**	0.008
20	All workers should be accountable for their own work	6.420	1.020	0.048	.249*	0.039

Table 5.35 above indicates that it is critical to assess performance and establish accountability among employees. Both variables have reaffirmed the workers' attitude toward meeting local or international requirements. With the correct mindset, you'll be able to attain and satisfy even the most demanding requirements.

Table 5.36: Result Performance of Best Value Group on Obtaining of License

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	**License** Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.971	1.224	0.025	-.272*	0.024
14	All workers understand the quality requirement is a must	6.579	0.881	0.006	.334**	0.005
19	All workers know how to record their output everyday	6.188	1.263	0.046	.242*	0.045
20	All workers should be accountable for their own work	6.420	1.020	0.028	.266*	0.027

The capacity of the worker to comprehend the requirements is critical in getting a licence; one of the conditions set out by the relevant authorities is the worker's ability to record their output during production. The workers' accountability toward their own productivity is further emphasized by the production record (**Table 5.36**).

Attending at the training session has a negative influence on obtaining a licence. It's because most training courses aren't tailored to the needs of authorities. As a result, taking a training session in general does not result in a beneficial outcome, but rather causes complexity in the production flow.

Table 5.37: Summary of Impact of Best Value Group on Performance Matrix

Measurement Criteria	**Utilising Expert**	**Pre-Plan to Reduce Risk**	**Measure Performance**	**Create Accountability**	**Motivation for Improvement**	**Customer Expectation**
Wastage	√		√			
Fulfilment			√	√		
License	X		√	√		

Table 5.37 summarises the Best Value Principles that influence the outcome of three performance matrix.

Measure Performance is one of the most significant Best Value Principles. It had an impact on all three measuring criteria. This concept emphasises the need of establishing a proper measuring standard, as well as the workers' attitude toward quality and awareness of their own accountability. The performance matrix, according to the Best Value Approach, is one of the most important components for evaluation. As a result, having a suitable measuring criterion becomes the most important aspect of the manufacturing process.

The second variable is important for performance evaluation. It instils accountability in all employees. The responsibility and attitude will change if all of the workers understand the quality demand and their own accountability for their own production.

Finally, while hiring an expert may enhance waste reduction, however, changing the process technique may have a detrimental influence on meeting the authorities' requirements for acquiring various licences.

5.5.2 Result performance of Non-Best Value Group

Table 5.38: Result Performance of Non-Best Value Group on Obtaining of License

				License		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
4	Training course for workers or supervisors could help to improve quality of final products.	4.625	1.310	0.025	-.272*	0.024

Table 5.38 showing the only variable that indicate a significant score toward obtaining of license is the utilise of expert. The mean rank of 4.625 suggested that low agreement among the Non-Best Value participants on training of workers or supervisors could improve on final product quality.

The negative correlation results confirmed that taking the training session did not result in acquiring the licence for the Non-Best Value group. It may due to generic training course that focuses on quality but does not meet with the authority's requirements and lacks other aspects such as performance monitoring and responsibility. The company's ability to maintain quality has become an issue.

Table 5.39: Result Performance of Non-Best Value Group on Monthly Productivity

				Month Productivity		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
6	Plan production flow is important before start operation.	4.937	1.569	0.042	.614*	0.011

Pre-planning to decrease risk is the only variable that has a positive impact on the performance matrix. The majority of Non-Best Value group members feel that planning production flow prior to actual production is critical, and that it has a positive impact on monthly productivity.

It is self-evident that identifying a solid planning flow may help companies prevent costly mistakes and redo. As a result, improve efficiency and production.

Table 5.40: Result performance of Non-Best Value Group on Cleanroom Facility

Variables	Questionnaires	Mean	Std. Deviation	**Cleanroom Facility** Kruskal Wallis	Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	4.812	1.558	0.018	-.610*	0.012

Attending a training session alone may not be enough to enhance corporate efficiency and product quality. As a result, it's critical to maintain employee efficiency and inspire them to flourish and take responsibility for their own job.

Table 5.41: Summary of Impact of Non-Best Value Group on Performance Matrix

Measurement Criteria	**Utilising Expert**	**Pre-Plan to Reduce Risk**	**Measure Performance**	**Create Accountability**	**Motivation for Improvement**	**Customer Expectation**
License	x					
Monthly Productivity		√				
Cleanroom Facility	x					

Obviously, the Pre-plan to reduce risk is the only element that has a substantial influence on the Non-Best Value group. However, a lack of understanding about how to use or engage an expert can lead to several other problems. This group of companies will face a significant difficulty without long-term planning and a sustainable programme.

Table 5.42: Result Performance between Best Value and Non Best Value Group

Variables	Questionnaires	Mann-Whitney U Test	Mean Rank		Best Value principle
		Significant	BV	NBV	
1	Attending training course able to improve on quality of cleaning process	0.003	46.65	27.25	UTILISING EXPERT
2	Engaging consultant/expert able to improve production process is essential	0.000	47.54	23.44	UTILISING EXPERT
3	Seeking help from expert able to resolve difficulty or challenges faced.	0.000	47.44	23.84	UTILISING EXPERT
4	Training course for workers or supervisors could help to improve quality of final products.	0.000	49.21	16.22	UTILISING EXPERT
5	Consultant/expert could help to achieve export requirements.	0.002	46.87	26.31	UTILISING EXPERT
6	Plan production flow is important before start operation.	0.000	48.52	19.19	PRE PLAN TO REDUCE RISK
7	Identifying the risk factors before production help to mitigate the risk.	0.000	49.2	16.25	PRE PLAN TO REDUCE RISK
8	Seeking consultant/expert to assist in production planning is important	0.000	47.96	21.59	PRE PLAN TO REDUCE RISK
9	Proper planning with consultant/expert before production is important	0.000	47.39	21.06	PRE PLAN TO REDUCE RISK
10	Considering potential risk before starting production is important.	0.000	48.75	18.19	PRE PLAN TO REDUCE RISK
11	Setting measure criteria or requirement is important	0.000	49.54	14.81	MEASURE PERFORMANCE
12	Proper guideline for your workers on quality is essential	0.000	49.07	16.84	MEASURE PERFORMANCE
13	Require workers to record their output each day help to control on performance	0.000	48.85	17.78	MEASURE PERFORMANCE
14	All workers understand the quality requirement is a must	0.000	47.77	22.44	MEASURE PERFORMANCE
15	All workers should know how to check on their own output	0.000	47.79	22.34	MEASURE PERFORMANCE
16	All workers should know how to determine the quality required by company	0.000	48.4	19.72	CREATE ACCOUNTABILITY
17	All workers should responsible and rectify their own rejected products	0.000	47.78	22.41	CREATE ACCOUNTABILITY
18	All workers should know how to rectify the problem	0.003	46.68	27.13	CREATE ACCOUNTABILITY
19	All workers know how to record their output everyday	0.001	47.15	25.09	CREATE ACCOUNTABILITY
20	All workers should be accountable for their own work	0.199	44.45	36.75	CREATE ACCOUNTABILITY
21	Having incentive to motivate workers’ productivity is important	0.000	48.06	21.19	MOTIVATION FOR IMPROVEMENT
22	All workers should be paid according to output / pieces rate	0.000	47.99	21.5	MOTIVATION FOR IMPROVEMENT
23	Workers would be rewarded when achieve higher output	0.000	48.31	20.09	MOTIVATION FOR IMPROVEMENT
24	Workers would be rewarded when achieve better quality	0.000	48.21	20.94	MOTIVATION FOR IMPROVEMENT
25	Supervisor should be able to motivate the workers to increase productivity	0.000	48.09	21.06	MOTIVATION FOR IMPROVEMENT
26	All the workers should understand the customer requirement	0.005	46.61	28.31	CUSTOMER EXPECTATION
27	When workers not able to achieve the customer requirement, seeking help from consultants/experts is important	0.000	47.71	22.69	CUSTOMER EXPECTATION
28	Production process should change according to customer need	0.006	46.43	28.19	CUSTOMER EXPECTATION

29	Constantly upgrade the quality to meet customer expectation/ market demand is essential	0.000	47.1	25.31	CUSTOMER EXPECTATION
30	Supervisor should be able to train the workers according to customer expectation	0.000	47.41	24	CUSTOMER EXPECTATION

The performance of Best Value practitioners and Non-Best Value practitioners is shown in **Table 5.42**. The mean rank of Best Value practitioners firm looks to be greater than that of Non-Best Value practitioners, implying that the implementation of Best Value Principles produces much better results for company performance.

5.6 Impact on Company Size or Scale

Table 5.43: Value Performance of Company by Size or Scale

NUMBER OF WORKER	UTILISING EXPERT	PRE PLAN TO REDUCE RISK	MEASURE PERFORMANCE	CREATE ACCOUNTABILITY	MOTIVATION FOR IMPROVEMENT	CUSTOMER EXPECTATION
BELOW 20 WORKERS	RM 10,198.77	RM 8,121.28	RM7,469.61	RM 7,644.30	RM 7,828.88	RM 18,206.39
21 - 40	RM 7,639.29	RM 7,904.84	RM6,864.38	RM 7,644.30	RM 7,023.46	RM 6,522.16
41 - 60	RM 5,046.63	RM 4,618.36	RM4,687.54	RM 4,508.80	RM 4,580.04	RM 4,336.54
61 - 80	RM 4,304.69	RM 4,304.69	RM4,304.69	RM 4,023.07	RM 4,304.69	RM 4,542.10
80 AND ABOVE	RM 3,362.48	RM 3,121.67	RM3,546.75	RM 3,296.43	RM 3,992.14	RM 3,255.74
AVERAGE	RM 6,110.37	RM 5,614.17	RM5,374.59	RM 5,423.38	RM 5,545.84	RM 7,372.59

The finding shown on **Table 5.43** elucidate the theory of entropy as the production grow, entropy increases. The biggest gap between the entire group performance is the result performance on Customer Expectation of company with less than 20 workers and company with 80 workers and above. The rationale could be the flexibility of small entrepreneurs to achieve customer expectation in shorter time.

This advantage could also reflect in the company culture of small enterprises, where most of the workers sharing the same value of company. They are more endurance to any occasion and willing to sacrifice for the growth of company.

As the company grows, the enterprise becomes more compartmentalised and bureaucratic. As a result, big companies are not nearly as agile as small businesses or as able to quickly change.

On the second note, the result of utilising expert indicates a significant difference despite both small and large enterprises practising engagement of consultants. When the expert recommended a certain change to existing system, the suggestion has to be filtered through multiple layers of leadership across different department in large enterprises. Small businesses, in contrast, can make big changes much more quickly. Similarly, smaller companies can respond quickly by identifying and reacting to problems. The lack of complex chain-of-command allows employees to have direct access to the owner, who can quickly address whatever problem a worker encounter.

The third notable outcome is the pre plan to reduce risk. Similar to utilising expert, the vitality comes from external force. May it be direct market demand, authority requirement or customer need, the small enterprises could have quick respond with new plan and strategy.

5.6.1 Comparison of Small and Medium Enterprise (SME) and Large company

Table 5.44: Value Performance of SME and Large Company

TYPE OF COMPANY	UTILISING EXPERT	PRE PLAN TO REDUCE RISK	MEASURE PERFORMANCE	CREATE ACCOUNTABILITY	MOTIVATION FOR IMPROVEMENT	CUSTOMER EXPECTATION
SME	RM 10,198.77	RM 8,121.28	RM 7,469.61	RM 8,039.44	RM 7,828.88	RM 8,091.73
LARGE	RM 4,471.85	RM 4,198.89	RM 4,602.26	RM 4,363.04	RM 4,418.88	RM 4,392.16
AVERAGE	RM 7,335.31	RM 6,160.09	RM 6,035.93	RM 6,201.24	RM 6,123.88	RM 6,241.95

Further analysis on company scale has been conducted and tabulated in **Table 5.44**. Companies that are small in size are often referring as small and medium enterprise (SME).

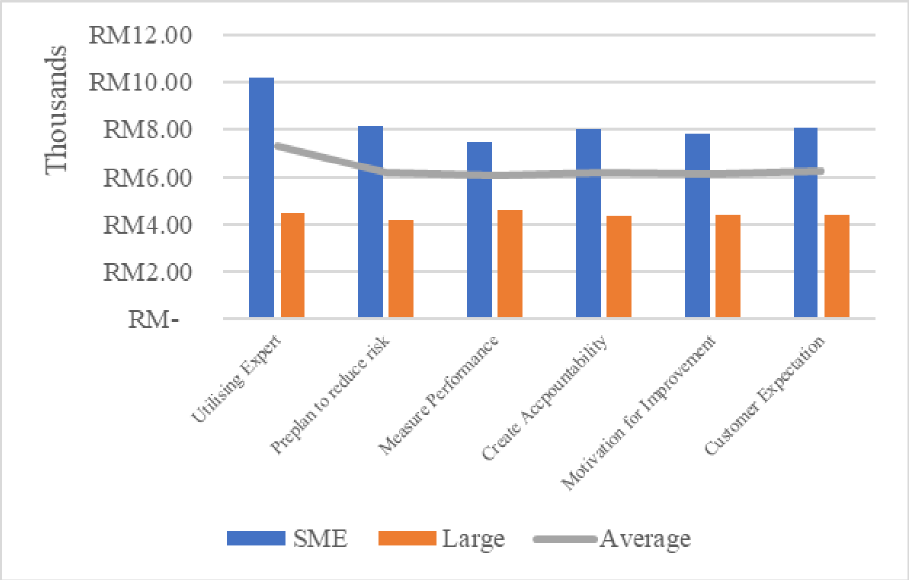

Figure 5.5: Value Performance of SME and Large Company

Figure 5.5 exhibits a distinguishing comparison between SME and large company. The value performance of SME almost doubles the performance of large company.

Table 5.45: Result Performance between SME and Large Company

Variables	**Questionnaires**	**Mann-Whitney U Test**	**Mean Rank**		**Best Value principle**
		Significant	SME	Large	
1	Attending training course able to improve on quality of cleaning process	0.028	93.52	77.65	Utilising Expert
8	Seeking consultant/expert to assist in production planning is important	0.022	89.40	81.69	Pre plan to reduce risk
27	When workers not able to achieve the customer requirement, seeking help from consultants/experts is important	0.015	94.45	76.76	Customer Expectation
28	Production process should change according to customer need	0.022	93.93	77.27	Customer Expectation

Table 5.45 above indicates the result performance between the small and medium enterprises (SME) and large companies. The mean rank of the SME appears to be higher comparative to large company, hence, stipulating the application of Best Value Principles resulting in better performance in SME rather than large companies.

The analysis outcome suggests three main Best Value Principles that perform well with SME. They are utilising the expert, preplan to reduce risk and customer expectation. All the three principles show a similar interrelationship of external influences.

Justification of best value approach having greater impact on SME as compared to large company of organisation could be summarised below:

1. SME is more flexible in adopting to changes.
2. Most of the workers in SME are multi-tasking and require more talents or skills in performing their routine duty.
3. SME could easily identify individual output, thus accountability enhanced.
4. Less communication needed in SME due to its slim organisation.
5. In SME, it is able to explore and expand individual adaptation or problem-solving skills during daily production.
6. SME is quick on responding to external input and transform into part of internal process.
7. Job satisfactory and sense of belonging are the key factors in SME.
8. Large companies are too rigid in accommodating customer or market input.

9. Large companies do not value individual input but rather a corporate agreement.

10. Large companies prefer to minimise frequent change of production flow.

11. Large companies prefer to stay at comfort zone as long as possible.

12. Large companies value the group output instead of individual performance.

5.6.2 Comparison of New Start up and Established Company

Table 5.46: Result Performance between New Start-up & Established Company

Variables	Questionnaires	Mann-Whitney U Test Significant	Mean Rank New Start Up	Mean Rank Established Company	Best Value principle
1	Attending training course able to improve on quality of cleaning process	0.047	94.98	80.06	Utilising Expert
4	Training course for workers or supervisors could help to improve quality of final products.	0.049	94.69	80.22	Utilising Expert
5	Consultant/expert could help to achieve export requirements.	0.026	96.21	79.35	Utilising Expert
7	Identifying the risk factors before production help to mitigate the risk.	0.017	96.53	79.17	Pre plan to reduce risk
8	Seeking consultant/expert to assist in production planning is important	0.003	99.85	77.26	Pre plan to reduce risk
10	Considering potential risk before starting production is important.	0.000	105.27	74.15	Pre plan to reduce risk
21	Having incentive to motivate workers' productivity is important	0.004	98.40	78.09	Motivation for Improvement
26	All the workers should understand the customer requirement	0.029	95.79	79.59	Customer Expectation
27	When workers not able to achieve the customer requirement, seeking help from consultants/experts is important	0.003	99.85	77.26	Customer Expectation
28	Production process should change according to customer need	0.026	96.18	79.37	Customer Expectation
29	Constantly upgrade the quality to meet customer expectation/ market demand is essential	0.029	95.21	79.93	Customer Expectation
30	Supervisor should be able to train the workers according to customer expectation	0.008	97.56	78.57	Customer Expectation

Table 5.47: Value Performance of New Start up and Established Company

TYPE OF COMPANY	UTILISING EXPERT	PRE PLAN TO REDUCE RISK	MEASURE PERFORMANCE	CREATE ACCOUNTABILITY	MOTIVATION FOR IMPROVEMENT	CUSTOMER EXPECTATION
NEW START UP	RM 4,990.05	RM 4,664.83	RM 4,883.06	RM 4,433.25	RM 4,725.37	RM 5,492.44
ESTABLISHED	RM 4,814.28	RM 4,513.46	RM 4,920.74	RM 4,929.81	RM 4,865.71	RM 4,525.01
AVERAGE	RM 4,902.17	RM 4,589.14	RM 4,901.90	RM 4,681.53	RM 4,795.54	RM 5,008.73

Table 5.46 above indicates the result performance between the newly start-up company and established companies. The mean rank of the newly start-up company appears to be higher comparative to established company, hence, concur the application of Best Value Principles generate much better performance for new start-up companies.

The outcome tabulated in **Table 5.47** suggests similar result as three main Best Value Principles that perform well with SME. They are utilising the expert, preplan to reduce risk and customer expectation. All the three principles show a similar interrelationship of external influences.

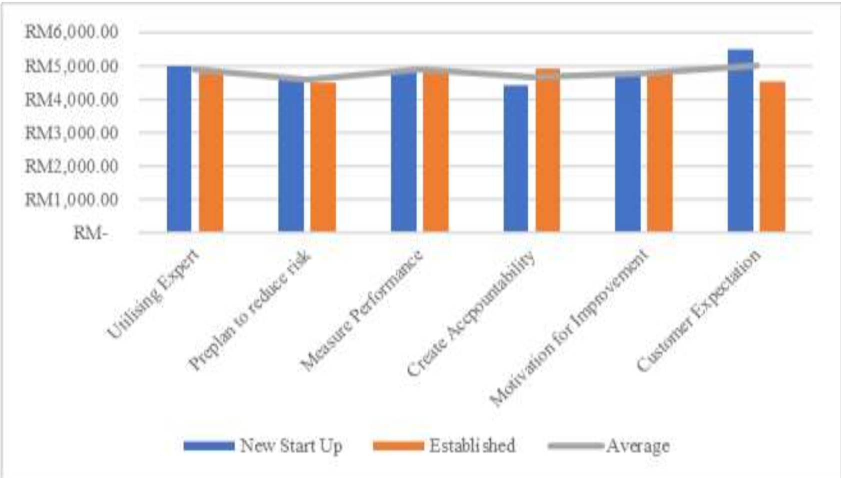

Figure 5.6: Value Performance of New Start up and Established Company

Figure 5.6 indicates the gaps of performance become slimer and closer between new start-up and established company.

5.7 Result of CNCA Practitioners

Table 5.48 exhibits descriptive analysis on value output of both CNCA and Non CNCA practitioners having direct consequences to productivity. CNCA practitioner is 2% higher value in every kilogramme of production and 1% higher value of actual worker output.

Table 5.48: Value Output Comparison (CNCA & NCNCA)

Value Comparison	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
CNCA Practitioner	5,035.92	6,598.79	1,543.56	5,055.23
Non CNCA Practitioners	4,947.55	6,645.96	1,647.51	4,998.45
Average	4,991.73	6,622.37	1,595.54	5,026.84

Table 5.49 reveals further CNCA achievers have enhanced 3% of value per kilogramme of product and overall, 5% improvement on workers output value.

Table 5.49: Value Output Comparison (CNCA & BVA)

Value Comparison	Value per kilogramme (RM)	Value per Worker (RM)	Losses per Worker (RM)	Actual Value per Worker (RM)
CNCA & BVA Practitioner	5,052	6,966	1,450	5,516
Non CNCA & BVA Practitioners	4,915	6,863	1,644	5,219
Average	5,012	6,299	1,724	4,575

Besides the Best Value Principles that distinguish the performance among EBN cleaning facilities, CNCA appears to be influential factors in determination of success in three main areas.

5.7.1 CNCA on Fulfilment of Requirement

Table 5.50: CNCA on Performance Matrix (Fulfilment)

Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Fulfilment	
					Correlation	Spearmen
15	All workers should know how to check on their own output	6.129	1.02443	0.047	.524**	0.002
16	All workers should know how to determine the quality required by company	6.129	1.175923	0.043	.496**	0.005

Table 5.50 exhibits two variables having positive significance to fulfilment of local and overseas requirement. First variable on worker’s knowing how to inspect on their own output value is at P<0.047 on Kruskal Wallis and correlation of c=0.524 and p<0.002 on Spearman test. Second variable on the worker’s ability to determine the quality requirement of the company, the significant value of P<0.043 and correlation rating c=0.496 and P<0.005 of Spearman test indicate that both variables directly relate~~d~~ to workers ability.

It is important to measure the performance and create accountability among the workers. Both variables have reiterated the attitude of the workers toward fulfilment of local or overseas requirement. This result enhances the early analysis; whereby, the fulfilment of requirement is depending upon the soft skill of human workforce rather than hardware facilities.

5.7.2 CNCA on Monthly Productivity

Table 5.51 shows four variables having significant and positive correlation to monthly productivity. CNCA achievers believe that utilise expert by attending training course is able to improve on the quality of cleaning process, thus increases productivity (p<0.038 Kruskal Wallis, c=0.571 and p<0.001 Spearman).

Table 5.51: CNCA on Performance Matrix (Monthly productivity)

				Monthly Productivity		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
1	Attending training course able to improve on quality of cleaning process	5.7419	1.26406	0.038	.571**	0.001
6	Plan production flow is important before start operation.	6.3871	1.11587	0.003	.650**	0.000
7	Identifying the risk factors before production help to mitigate the risk.	6.3548	0.87744	0.007	.603**	0.000
10	Considering potential risk before starting production is important.	5.9677	1.1397	0.019	.615**	0.000

Another three variables on pre plan to reduce risk, firstly they agreed that planning of production flow prior to operation shown a significant p<0.022 on Kruskal Wallis, Correlation of c=0.242 and p<0.003 on Spearman. Secondly, by identify the risk factors before production able to mitigate the risk (p<0.007 Kruskal Wallis, c=0.603 and p<0.000 Spearman), and finally to consider potential risk before the production (p<0.019 Kruskal Wallis, c=0.615 and p<0.000 Spearman) are the most influential factors from the survey.

All the above results, clearly designate utilising of expert and having pre planning on reducing risk ameliorate monthly productivity.

5.7.3 CNCA on Cleanroom Facility

Table 5.52: CNCA on Performance Matrix (Cleanroom facility)

				Cleanroom Facility		
Variables	Questionnaires	Mean	Std. Deviation	Kruskal Wallis	Correlation	Spearmen
11	Setting measure criteria or requirement is important	6.2581	1.12451	0.022	.419*	0.019
29	Constantly upgrade the quality to meet customer expectation/ market demand is essential	6.3548	0.83859	0.013	.454*	0.010

Apart from having a good cleanroom facility, there are two variables factors that determine the success of facility (**Table 5.52**).

CNCA practitioners concur that setting measure criteria to show a significant $p<0.022$ on Kruskal Wallis, Correlation of $c=0.419$ and $p<0.019$ on Spearman. They also consent on constantly upgrading the quality in meeting customer expectation is essential ($p<0.013$ Kruskal Wallis, $c=0.454$ and $p<0.010$ Spearman).

Measure performance and customer expectation are the two most significant impactful variables on cleanroom facility management.

5.7.4 Summary on CNCA

Table 5.53: Summary of CNCA on Performance Matrix

Measurement Criteria	**Utilising Expert**	**Pre-Plan to Reduce Risk**	**Measure Performance**	**Create Account ability**	**Motivati on for Improve ment**	**Customer Expectation**
Fulfilment			√	√		
Monthly productivity	√	√				
Cleanroom			√			√

The **Table 5.53** summarised the CNCA that influent the outcome of three measurement criteria.

The most influential Best Value Principle is Measure performance as concurred by CNCA practitioners. It greatly impacts on fulfilment and cleanroom facilities. This principle highlights the need of setting a good measurement criterion and also the workers' attitude toward the quality and understanding of their own responsibility. According to Best Value Approach, the performance matrix is the key components for evaluation. Therefore, having good measurement criterion become the top priority in production process.

The second variable is relevant to measurement of performance. It is creating accountability among all workers. When all the workers acknowledge the quality requirement and their accountability toward their own output, the responsibility and attitude will change.

One of the interesting facts through this survey is the missing of motivation for improvement. This could be explained by the earlier analysis on establish company; whereby, the management focuses more on group or corporate performance rather than individual output.

5.7.5 Comparison of CNCA and Non CNCA on Best Value principles

Table 5.54: Result Performance between CNCA and Non CNCA

Variables	**Questionnaires**	**Mann-Whitney U Test**	**Mean Rank**		**Best Value principle**
		Significant	CNCA	Non CNCA	
2	Engaging consultant/expert able to improve production process is essential	0.022	96.50	79.19	Utilising Expert
6	Plan production flow is important before start operation.	0.027	89.98	84.65	Pre plan to reduce risk

Table 5.54 stipulates data of CNCA and Non CNCA practitioners under Mann-Whitney U test. The p value of 0.022 on utilising expert concurs the earlier Kruskal Wallis and Spearman test by engaging consultant or expert being able to improve on production process. The mean of CNCA is higher than Non CNCA, indicating the CNCA practitioners agreeing on best value practise.

The second indicators are pre plan to reduce risk, the significant value p = 0.027; whilst, the mean value of CNCA practitioner concur pre plan production flow is essential to production.

5.7.6 Comparison of CNCA and Non CNCA on Performance Matrix

Table 5.55: Result Performance of CNCA & NCNCA on Performance Matrix

Variables	Performance Factors	Mann-Whitney U Test	Mean Rank	
		Significant	CNCA	Non CNCA
1	Production Wastage	0.035	95.47	79.78
2	Number of workers	0.000	122.08	64.50
3	Market Share	0.000	105.60	73.96
4	Fulfilment of requirement	0.000	121.11	65.06
5	Obtaining of License	0.000	112.76	69.85
6	Monthly production	0.000	123.05	63.94
7	China Share	0.000	115.44	68.31

The comparison of CNCA and Non CNCA participants over performance matrix in Table 5.55 elucidates–significant value in Mann-Whitney U test; whilst, the mean value of CNCA participants suggests the impact of CNCA certification over all the performance criteria. When obtained CNCA certificate, the company is able to capture the market share and improve on productivity, thus fulfilled all the requirement either local or overseas.

5.8 Validation on Survey

Validation survey was conducted upon the established of influential factor analysis. A total of 10 validation surveys were collected from the expert or the leaders of industry. Most of them are the committee members of Malaysia Bird Nest Association or organisation (**Table 5.56**).

The surveys collected constitute a fair distribution in nature of company and year of establishment. All the interviewees holding the position of director truly reflect the reliability of survey data.

Table 5.56: Biodata of Interviewees

		Frequency	Percentages
Gender	Female	2	20%
	Male	8	80%
Position	Director	10	100%
Nature of Company	Bird nest supplier	1	10%
	Raw bird nest supplier	2	20%
	Bird nest cleaning and supplier	2	20%
	Bird nest exporter	3	30%
	Bird nest cleaning provider	2	20%
Year of establish	5 - 9	3	30%
	10 - 14	5	50%
	>15	2	20%

5.8.1 Factors that Able to Improve on Wastage

Table 5.57: Validation on Factors that Improve on Wastage

		Agree	Neutral	Disagree
1	56% agreed by attending training course able to improve on quality of cleaning process.	50%	50%	0%
2	78% agreed all workers should know how to check on their own output	90%	0%	10%

On the factor of attending training course being able to improve on quality of cleaning process, only half of the expert agreed on this factor (**Table 5.57**).

According to further clarification, some of the expert felt that attending of training may not immediately improve wastage reduction. It is due to the changes of cleaning process may not be executed from the top to bottom level of common workers.

However, almost 90% of experts agreed that workers should know how to check on their own output. This factor not only creates accountability and responsibility, but it also indirectly reduces the wastage and improved quality.

5.8.2 Factors that Able to Expand Workforce

Table 5.58: Validation of Factors that Expand on Number of Workers

		Agree	Neutral	Disagree
1	76% agreed that planning production flow is important before start operation.	100%	0%	0%
2	89% agreed that setting measure criteria or requirement is important	100%	0%	0%
3	84% agreed that Supervisor should be able to motivate the workers to increase productivity	100%	0%	0%

All experts agreed on the factors that impact the expansion of the workforce (**Table 5.58**). The feedback on the planning of production flow is important before the operation. This sets an initial process strategy, follow by the measure criteria and requirement for each worker. The third factor will be the supervisor's motivation on the workers productivity. When the supervisor raises up to lead the workers or subordinate, the morale of workers arises, thus repercussion on workforce growth.

5.8.3 Factors that Able to Assist on Fulfilment of Requirement

Table 5.59: Validation of Factors that Assist on Fulfilment

		Agree	Neutral	Disagree
1	85% agreed all workers understand the quality requirement is a must	100%	0%	0%
2	85% agreed all workers should be accountable for their own work	100%	0%	0%

Table 5.59 illustrates two factors that assist in the fulfilment of either local or overseas requirement, all workers' understanding of quality requirements and accountability toward their own output, are enormously agreed by the experts. Both factors shown a high significant result and workers need to be educated besides acquiring the right skills but also on their responsibility toward their own produces.

5.8.4 Factors that Influence the Obtaining of License

Table 5.60: Validation on Factors that Influence the Obtaining of License

		Agree	Neutral	Disagree
1	86% agreed all workers understand the quality requirement is a must	100%	0%	0%
2	86% agreed all workers know how to record their output everyday	80%	20%	0%
3	83% agreed all workers should be accountable for their own work	100%	0%	0%

Obtaining of a license is hinged on the compliance with local requirement (**Table 5.60**). Therefore, both factors that influence the fulfilment also appear to be impactful factors on obtaining a license. Similarly, all expert agreed on the finding except 80% expert agreed on the workers knowing how to record their output that could have to affect the obtaining of license. Sometimes, the well organised production, the record of production output was executed by production administrative staffs instead of workers themselves.

5.8.5 Factors that Increase Productivity

Table 5.61: Validation of Factors that Increase Productivity

		Agree	Neutral	Disagree
1	75% agreed plan production flow is important before start operation	100%	0%	0%
2	85% agreed all workers understand the quality requirement is a must	100%	0%	0%
3	82% agreed all workers should be accountable for their own work	100%	0%	0%

A worker's attitude toward his or her own work or duty do result in various aspect of production. On the factors that increase productivity, workers' understanding of the quality requirement and accountability shows a positive correlation in **Table 5.61**. All agreed that workers having the right attitude eradicate laziness and sloppy. They also agreed having good planning of production flow is extremely important in boosting productivity.

5.8.6 Factors that Attain Export to China

Table 5.62: Validation on Factors that Attain Export to China

		Agree	Neutral	Disagree
1	84% agreed all workers understand the quality requirement is a must	100%	0%	0%

Table 5.62 exhibits all expert agreed the only factors that determine the export to overseas, especially China was the worker's understanding of quality requirement during processing. This is the top priority governing the success of the application and meeting the market demand.

5.8.7 Factors that Govern the Success of Cleanroom Facilities

Table 5.63: Validation on Factors that Govern the Success of Cleanroom Facilities

		Agree	Neutral	Disagree
1	59% agreed that training courses for workers or supervisors could help to improve quality of final products.	90%	10%	0%
2	87% agreed that setting measure criteria or requirement is important	100%	0%	0%
3	81% agreed all workers should be paid according to output / pieces rate	90%	10%	0%
4	81% agreed workers would be rewarded when achieving higher output	100%	0%	0%
5	81% agreed supervisor should be able to motivate the workers to increase productivity	100%	0%	0%
6	62% agreed constantly upgrade the quality to meet customer expectation/ market demand is essential	80%	20%	0%
7	62% agreed supervisor should be able to train the workers according to customer expectation	80%	20%	0%

Three out of seven factors, that govern the success of cleanroom facilities, are setting of measure criteria or requirement, following by rewarding system that reimburses based on performance and supervisors who can motivate the workers to enhance on productivity (**Table 5.63**).

90% of experts do agree that training courses for workers and supervisors could assist on quality and workers paid according to output or pieces rate could influence on the success of cleanroom facilities.

Finally, 80% of experts agreed that constantly upgrading the quality in meeting customer expectation and training of workers to achieve customer demand are essential. However, few of them felt that constantly upgrading or converting of cleaning process may cause a drop in productivity, which reflected upon the 62% of overall survey agreement result.

5.9 Summary of Finding

To conclude the phase two research finding, it is proven that Best Value Approach has accomplished the objectives of effective approach in elevating end products quality and raising productivity. Through the descriptive analysis, there is a clear demarcation between the best value partitioners and non-best value partitioners.

In contrary, inferential analysis of the same data has concurred the finding to further pinpoint toward the specific significant variables. All the performance matrix is resolved by the set of variables to achieve the six fundamental Best Value Principles.

The final analysis on the CNCA achievers designate the highly significant relationship with all performance matrix indicators. All the finding in this chapter justifies the objectives and substantial on the new finding of Best Value having greater repercussion over established company and CNCA achievers dominated in all aspects of performance.

CHAPTER SIX

PROPOSED CLEANING PROCESS AND VALIDATION

6.1 Introduction

Section 6.2 compares, and analyses observation data collected from a few selected cleaning facilities in West Malaysia, including Kota Bahru, Mentakap, Shah Alam, and Johor Bahru. All cleaning techniques are compared and analysed to validate the proposed new enhanced cleaning procedure. The conventional cleaning procedures are outlined in Chapter 2 Section 2.3.5. As described in Sections 6.2.2 and 6.2.3, EBN samples taken from both cleaning techniques (Traditional and New Improved) are tested in a laboratory. The results of the expansion test and crude protein test are presented in Table 6.7 and summarised in Section 6.2.4.

Section 6.3 contains the validation findings of the Experts interviews, and Section 6.3.1 summarises the validation survey results performed by industry experts. Section 6.4 summarised all of the chapter's findings.

6.2 Data Collection Process

All of the data were documented and gathered at the facilities from Kota Bahru (Kelantan), Mentakap (Pahang), Johor Bahru (Johor) and Shah Alam (Selangor). All of the information was gathered through observation and interviews with owners, supervisors, and workers from diverse operations. Data collected includes production reports, test findings, and customer comments. SWOT analysis was used to compare and analyse the outcomes. To prove the consistency and legitimacy of the data, several months of repetitive data collecting were carried out.

6.2.1 New improved/Proposed Cleaning Process

As part of the case study, the facility's owner in Shah Alam, Selangor adopted and implemented this new cleaning approach. The new improved cleaning process (**Figure 6.1**) is developed through a scientific analysis of bird nest properties and its characteristics. The bird nest is built completely from salivary gland; it is sticky and contains high percentage of water. According to research, the moisture content is frequently used as an index of stability and quality of bird nest (Kok and Thrisingam, 2011). During the drying process, it is slowly hardened into a stable state to hold up the weight of the eggs and the chick.

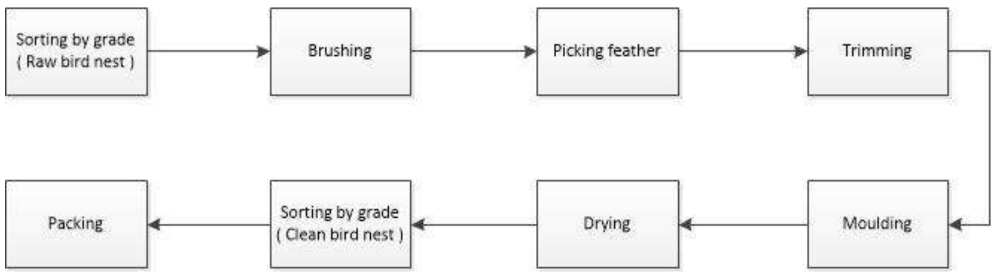

Figure 6.1: New Improve Cleaning Process Flow Chart

After the sorting process, the raw bird nest will be required to brush off any impurities or dusts that covering the surface. During this process, the raw bird nest is exposed to small amount of water, causing the bird nest to turn into a soft and rubberised condition. It will be placed in the container to allow the bird nest to expand slightly. The process of picking the feathers will be under a stage of semi-dry condition. This maintains the nutrients as well as the original shape of the bird nest. Cleaned bird nests will be trimmed away and any excessive edges are placed into the plastic mould. Due to the controlled expansion and moisture, the drying process does not require any heat. It is placed under a ventilated cabinet until the bird nest completely dries to its original shape. This approach shortens the time of moulding and drying. The nutrients and quality of bird nest are also preserved. The risk of contamination through water or air can be reduced or avoided.

6.2.2 SWOT Analysis

Prior to the implementation of the new cleaning method, an observation and interview session were held to better understand the challenges that the facilities encountered. The examination of the conventional cleaning technique, as well as the literature research, was described in Chapter 2 Section 2.3.5.

Table 6.1: SWOT Analysis of both Cleaning Process

	Traditional Cleaning Process	**New Improved Cleaning Process**
Strength	Easy to train the workers	Less wastages
	Easy to set up	Better quality
		Less contamination
Weakness	Higher wastage	Required more skill
	Low quality	More steps or process
	Higher chances of contamination	Longer training time
Opportunity	More area of improvement	More skilled improvement
	More saving on the wastage	Better control on worker mobility
Threat	Workers' reluctance to change	Require strict quality control
	More investment needed to improve the process	New workers may find it difficult to master the skill

The new cleaning procedure was introduced and incorporated to the current cleaning process with the approval of the management of the cleaning facility in Shah Alam, Selangor. After one month of implementation, a post-interview session was held.

The data gathered through observations and interviews at various sites might be best presented using the SWOT analysis approach. The SWOT analysis identifies the cleaning process parameter and significant areas for improvement. **Table 6.1** summarises both cleaning techniques.

As a point of strength, the conventional cleaning procedure has a reduced setup cost and steps to follow, making it much easier to adopt by most cleaning facilities. When compared to the current cleaning process, the increase in quality and waste management is far more convincing. Since the new technique is more regulated, it may easily prevent contamination.

Looking at the weaknesses, traditional cleaning processes exhibit substantial wastage owing to ineffective standard procedures, resulting in low quality and a high risk of contamination. Because of the greater quality need, the new cleaning procedure necessitated additional training hours, as well as more detailed stages and processes. As a result, higher skill levels are required of workers.

Most traditional cleaning techniques, according to the survey, remain unaltered due to current workers' unwillingness to adapt and the additional expense necessary for operators to improve their operations. The challenge to the new cleaning procedure was workers' adaptability to the high standards and quality. It may take longer to attain the desired results.

Because the potential for conventional cleaning will be the adaption of new cleaning processes for improvement and to overcome the barrier, training should start with senior management, then go down to supervisors, and eventually to employees. Top management may be able to see the benefits of such changes, and supervisors may enjoy the increased quality and productivity.

Similarly, the new cleaning method can keep their employees when they are taught to reap the benefits of improved quality and productivity through skill enhancement.

6.2.3 Expansion Test

The expansion test is adopted by many bird nest traders as the method to assess the quality of edible bird nest. The test measures the expansion ratio of edible bird nests after being soaked in warm water for certain duration. On both cleaning processes, a set of samples is collected at the end of cleaning process. Both edible bird nests are weighed before the experiment. The moisture content of sample bird nests is measured to ensure the equal dryness. Then, the sample bird nests are submerged into a cup of warm water (70°C) for 20 minutes (**Figure 6.2**). During this period, the bird nests start to soak up the water and slowly expand. When reaching the time allocated, the bird nests are drained and placed on scale to record the weight. The statistical data comparison of both cleaning processes in term of weight and expansion rate is tabulated in **Table 6.2.**

Figure 6.2: Detail Process of Expansion Test

Table 6.2: Expansion Test

S/N	**Edible Bird Nest**	**Original Weight (Gram)**	**Weight After Soaking (Gram)**	**Expansion Rate (Ratio)**	**Percentage of Expansion**
1	Raw Bird Nest (Unclean)	5.52	45.02	8.2	100%
2	Clean bird nest using Traditional Method	4.73	25.11	5.3	64%
3	Clean bird nest using New Improved Method	4.89	37.73	7.7	94%

6.2.4 Crude Protein Test on Edible Bird Nest

According to the paper by Marcone (2005), it was reported that the composition of EBN from both Malaysia and Indonesia being 62.0% crude protein, 27.3% carbohydrate, 7.5% moisture, 2.1% inorganic ash and 0.14% lipid. The major portion of the detected nutrient is crude protein and also comprising all the major sialic acid components. The research conducted by Tan (2018) indicates the cruel protein content ranging from 50-53% in raw bird nest collected from various regions in Malaysia.

To establish the nutritional content of the bird nest and to validate the allegation that nutrients are lost during the cleaning process, a crude protein test is performed to assess the effectiveness of the new cleaning procedure.

a) Biuret Method

Biuret Method was the method chosen in this study. The sample of clean bird nest is prepared as sample A and B (**Figure 6.3**). Biuret method involves the preparation of solution of bovine serum albumin as standard. Biuret reagent consists of copper sulphate pentahydrate CuSO4·5 H2O c = 13.0 mmol·l-1 , potassium sodium tartrate KNaC4H4O6·4 H2O c = 32·0 mmol·l-1 and NaOH c = 0.6 mol·l-1. Basically 0.5 ml of sample was diluted with 3 ml of Biuret reagent. The tubes are allowed to set for 30 minutes at room temperature. The absorbance is then measured at 540 nm (Coleland 1994).

Figure 6.3: Sample of Bottle Bird Nest

b) Preparation of the Standard and Sample

Approximately 0.4 gram of protein was diluted with 400ml of distilled water. A set of standard dilution for 2 mg/ml. 4 mg/ml, 6 mg/ml, 8 mg/ml and 10 mg/ml were prepared according to **Table 6.3** below:

Table 6.3: Dilution of Protein Standard

Mg/ml	Protein Standard	Distilled water
2	2 ml	8 ml
4	4 ml	6 ml
6	6 ml	4 ml
8	8 ml	2 ml
10	10 ml	-

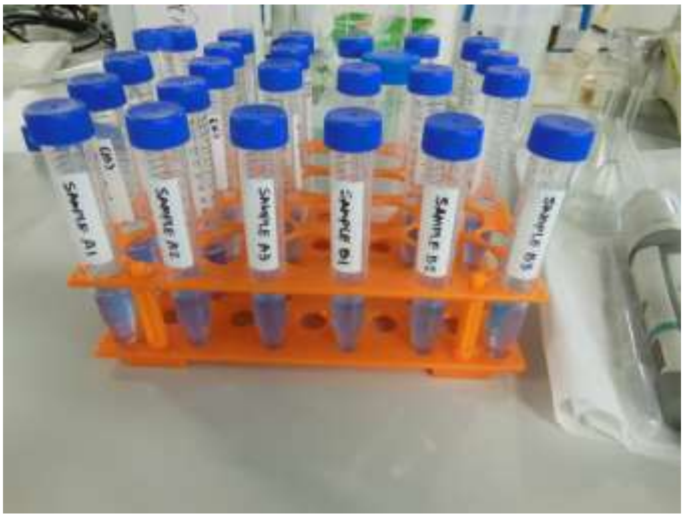

Figure 6.4: Triplicate Sample with Biuret Reagent

Two samples of cleaning bird nest are obtained and prepared with double boil for 45 min at 100℃. Sample A & B were filtered with a filter paper to separate the solid object. A total of 3 sets for each sample were prepared with 0.2 ml of bird nest and 0.3 ml of distilled water (**Figure 6.4**). Finally, 3 ml of biuret reagent was added to each standard and sample with the interval of 1 minute. The standard and sample mixture were allowed to set for 30 minutes.

c) Preparation of Spectrophotometer

The spectrophotometer was blank with distilled water at 540 nm and absorption reading for the standard as well as samples were read. (**Figure 6.5**)

Figure 6.5: Spectrophotometer

d) Result of Crude Protein Content

Table 6.4 shows the absorbance results from the biuret reagent test. Tubes 1–5 are the control standard with incremental concentration, and three sets of samples A – New cleaning technique and sample B – conventional cleaning procedure are investigated.

Table 6.4: Result of Absorbance

Tube	Concentration	Absorbance
1	2	0.08
2	4	0.122
3	6	0.152
4	8	0.185
5	10	0.231
Sample A1		0.152
Sample A2		0.152
Sample A3		0.160
Sample B1		0.115
Sample B2		0.109
Sample B3		0.114

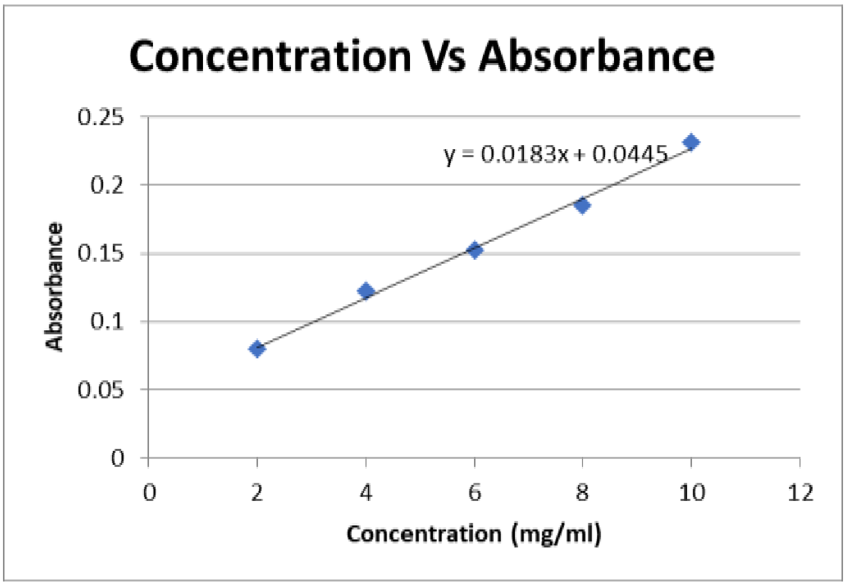

Figure 6.6: Crude Protein Concentration

The outcome of **Table 6.4** is seen in **Figure 6.6.** The graph demonstrates the remarkable accuracy of the samples gathered. As shown in **Table 6.5**, the formula derived from the graph may be used to compute the concentration of each sample.

Table 6.5: Result of the Sample A and Sample B

Tube	**Unknown Absorbance**	**Concentration (mg/ml)**
Sample A1	0.152	5.89
Sample A2	0.152	5.89
Sample A3	0.16	6.33
Sample B1	0.115	3.87
Sample B2	0.109	3.55
Sample B3	0.114	3.82

e) Result Finding

The result from the **Table 6.6** shows the percentage of protein concentration in the new improved method was at 50.25% and traditional method at 31.16%. It clearly indicates the difference of 19.09% nutrient losses between the new improved method and traditional cleaning method.

Table 6.6: Percentage of Protein Content

Sample	Protein (mg/ml)	Percentage
Sample A New Improved Method	6.03± 1	50.25%
Sample B Traditional Method	3.74±1	31.16%

6.2.5 Summary of Finding

A set of raw bird nests (unclean) has been used as a standard measurement for the test. The result shows that full expansion of raw bird nest to be 8.2, clean bird nest (Traditional) at 5.3 and clean bird nest (Improved) at 7.7. The experiment shows that current or traditional processing method may cause possible contamination through water and losing of nutrients by 36%, and new improved method could preserve the nutrients of up to 94%.

Table 6.7: Comparison Results of Expansion Test and Crude Protein Test

Sample	Expansion Rate	Percentage of losses	Percentage of Crude protein contain	Percentage of losses
Raw bird nest	100%	Nil	62% - (a) (Marcone,2005)	Nil
Traditional method	64%	36%	31.16% (b)	30.84% (a- b)
New improved method	94%	6%	50.25% (c)	11.75% (a – c)

The result from the **Table 6.7** shows the losses of protein concentration during new improved cleaning method at 11.75% and traditional method at 30.84%. It clearly indicates the differences of 19.09% nutrient losses between the new improved method and traditional cleaning method. When benchmark against research conducted by Halim et al, 2014, the crude protein obtained ranged from 56.2% to 61.5%. The crude protein losses by the newly improved cleaning methods were between 6% to 11%.

The Best Value Approach of analysing current cleaning process and re-engineering the process by engaging an expert from beginning produced much desirable result. The end results could easily justify through the fundamental matrix set from the beginning. This study conclude that Best Value Approach indeed has been adopted for a good performance of the process.

6.3 Validation Result through Interview of Expert

The validation survey was carried out to justify the survey findings from Chapter Five. Ten interviews were conducted, with seven respondents acquiring their skill locally in Malaysia and three acquiring it in Indonesia. All of the participants are industry leaders and specialists who are either members of the Bird Nest Association or members of another recognised organisation.

The interview transcripts data listed a total of ten processing steps. **Table 6.8** contains an overview of the findings. The sequences and operations are arranged in priority order. Sorting, soaking, plucking, moulding, drying, and packaging are the important processes, according to **Table 6.8**. The major operations were picking and moulding, both of which required a great deal of human labour. Other processes might be carried out in batches by a small number of personnel. As a result, the core process should emphasize on both activities to enhance efficiency and smooth process flow.

The remaining six steps of the procedure might be classified into two groups: early preparatory work and final inspection. Before moving on to the primary cleaning process, the group of employees in charge of sorting, soaking, and brushing may control the quality of raw bird nest. The last inspection of drying, quality checking, and packing, on the other hand, will be able to assure the ultimate quality of finished products.

Table 6.8: Number of Interviewee Agreement to Cleaning Process

Cleaning process (In sequences)	**Interviewee**										**Percentage***	**Step**
	A	B	C	D	E	F	G	H	I	J		
Sorting	1		1			1	1	1		1	60%	1
Soaking							1	1			20%	-
Brushing	1		1	1	1	1			1		60%	2
Trimming/ Grinding				1	1						20%	-
Sterilizing/ Heat treatment	1	1									20%	-
Picking	1	1	1	1	1	1	1	1	1	1	100%	3
Molding	1	1	1	1	1	1	1	1	1	1	100%	4
Drying	1		1	1	1	1	1	1	1	1	90%	5
QC Checking	1		1	1		1					40%	-
Packing	1	1	1	1	1	1	1	1	1		90%	6

* *Percentage represent total agreement from all 10 interviewees*

6.4 Summary of Finding

The results of the expansion test demonstrate that the new enhanced approach has a greater percentage of protein concentration, which was 50.25 percent, compared to the traditional method, which was 31.16 percent.

A crude protein test is done to analyse the performance of the new cleaning approach to measure the nutritional content of a bird nest and substantiate the allegations that nutrients are lost during the cleaning process.

A set of raw (unclean) bird nests was utilised as a benchmark measurement for the test. The results reveal that the new cleaning process proposed was able to keep the nutrients, form, and original properties. The existing or traditional processing procedure may result in water contamination and a 36 percent loss of nutrients.

Validation results of Experts interviews performed; the fundamental cleaning process could be classified as sorting, soaking, picking, moulding, drying, and packaging. The results of the validation survey conducted by industry experts. Ninety percent of experts believe that training courses for employees and supervisors may increase quality, and workers paid on a production or piece rate may have an influence on cleanroom facility performance. Eighty percent of respondents felt that it is vital to continually enhance quality in meeting consumer expectations and to train employees to fulfil customer demand.

CHAPTER SEVEN

DISCUSSION & RECOMMENDATION

7.1 Introduction

This chapter discusses the overall findings in this research. Section 7.2 discusses the issues of urban swiftlet farming. As highlighted by Ibrahim et al, (2009), swiftlet farming only became popular in Malaysia during the Asian Economic Crisis of 1997-1998. Regardless of the annoyances and possible risks that swiftlets and other urban animals might provide, humans should be able to reduce and tolerate such externalities (Connolly, 2016). Urban and suburban areas are ideal for swiftlet farming as they are less prone to predation by predators like eagles and owls. Heat island effects in urban areas also give more constant temperatures, particularly during the evening and night, as compared to lower temperatures in rural areas. The investment in agriculture land has higher return on investment as compared to urban or suburban farms, but the risk of investment is higher. Most investors would choose to invest in urban area as the cost recovery are much higher. The average duration of renovation at existing shophouse property is just 3 months. However, agriculture swiftlet farming offers a long-term sustainability advantage over urban farming in terms of community environmental effects. In Section 7.3, there is a growing need for regulatory bodies to adopt uniform benchmarking and quality assurance processes (Babji et al., 2015; Dai et al., 2020). Strong rules for EBN standards should be established and implemented on a regular basis. Research of various processing (including cleaning, drying, and sterilising) procedures should be conducted (Lee et al., 2017: Yeo et al, 2021). The current or traditional processing approach may cause contamination through water and nutritional loss of up to 36%, but the new improved method may maintain up to 94% of the nutrients in total. The crude protein losses caused by the new improved cleaning procedures ranged between 6% to 11%. Lastly, Section 7.4 discussed on implementation of the Best Value Approach. Best value practitioners increased 15% on both values generated per workers and total productivity of end products in weight per month. The incremental difference between the best and worst performance is 7.3 per cent. All three indicators clearly show that the best value principles have an impact on both worker productivity and profitability. Having a good measurement criterion becomes the top priority in the production process. Pre-production planning not only reduces risk, but also increases productivity and workforce growth. The largest gap between the overall group performance of companies with fewer than 20 workers and those with more than 80 workers is on Customer Expectation. Most SMEs began on a small scale, giving them the advantage of being adaptable and resilient to change. Because of their small size, most workers are multi-tasked in performing their duties to assist due to the urgency of the work requirement. Employees are held accountable for their performance and can be motivated to improve it.

7.2 Discussion on Swiftlet Farming

Swiftlet farming only became popular in Malaysia during the Asian Economic Crisis of 1997-1998. According to Ibrahim et el., (2009), commercial landlords chose to turn their unoccupied property into swiftlet farms even though doing so was prohibited in several Malaysian states. Regardless of the annoyances and possible risks that swiftlets and other urban animals might provide, Connolly (2016) illustrates that to establish more inclusive urban commons, we must be willing to reduce and tolerate such externalities. Thus, recognising that the evolution of urban policy must account for the agency of nonhumans and cannot be controlled by human interests. Considering that the Edible Bird Nest business is a significant agricultural entity, the discussion below aims to propose some suggestions to shine some light on the situation.

7.2.1 Urban versus Rural Area

Most swiftlet farms in Malaysia are in urban or suburban areas, because swiftlet farms began during the Asian economic crisis in 1997-1998, as previously indicated. Another factor, as predicted by the farm owners, is that the town centre is densely crowded with buildings and traffic, prohibiting swiftlet predators like eagles and owls from looming and hunting in the region.

Heat island effects in urban and suburban areas also give more constant temperatures, particularly during the evening and night, as compared to lower temperatures in rural areas. According to the report, the majority of swiftlet farm owners choose to invest in urban or suburban areas since they may rent out the bottom floor premise to generate income during the initial period. Another argument has been that in the event of failure, the premises might be transformed back into commercial entities. However, investment in rural or agricultural land will continue to be abundant.

7.2.2 Risk of Investment

Through the few interviews conducted among the swiftlet farm owners and consultants, one of the obvious risks in swiftlet farming was the low success rate (Estimated at 30%). To reduce the risk of investment, most of the investors would choose to invest in an urban area as the cost recovery are much higher as compared to suburban area. **Table 7.1** below shows the economic impact comparison between two swiftlet farms of the urban area and agricultural land at Mentakab, Pahang.

Table 7.1: Economy Impact Comparison between Urban and Agriculture land Swiftlet Farm

Criteria	Swiftlet farm at urban area	Swiftlet Farm at agricultural land
Type	20’ x 80‘ 2-storey shophouse	30’ x 80’ 3-storey freestanding farm
Area	3200 sq. ft.	7,200 sq. ft.
Construction cost	800,000 (Building) +80,000 (Renovation) = 880,000.00	400,000 (Building + Renovation) + 100,000 (1 acre of land) = 500,000.00
Unit price	RM 275/ sq. ft.	RM 69.50/ sq. ft.
Failure rate	70%	70%
Cost recovery	RM 800,000	RM 100,000.00
Total loss upon a failure	RM 80,000	RM 400,000

Even though the investment in agricultural land has a higher return on investment as compared to urban or suburban farms, the risk of investment is higher as compared to urban farms. **Table 7.2** shows the assumption of swiftlet farming values when it is assumed to have an equal growth rate after one year period. The valuation was based on the market value during the year 2010.

Table 7.2: Return of Investment upon the Sale of Swiftlet Farms (data collected in 2010)

Assumption of harvest after 1 year	Swiftlet farm at urban area	Swiftlet Farm at agricultural land
Number of bird nest	500 nests	500 nests
Estimated price	500 x RM 1,000/nest = RM 500,000.00	500 x RM 1,000/nest = RM 500,000.00
Property cost	RM 880,000.00	RM 500,000.00
Total firm value	RM 1,380,000.00	RM 1,000,000.00
Return on investment	56.8%	100%

7.2.3 Faster Completion

In comparison to agriculture farms, which can take up to 8 months to finish, the average duration of renovation at the existing shophouse property is just 3 months. Aside from the economic impact, it is necessary to consider long-term sustainability and environmental impact. Agriculture swiftlet farming offers a long-term sustainability advantage over urban farming in terms of community environmental effects.

7.2.4 Cost Effectiveness

Construction costs cannot be decreased to comply with building codes or regulations based on human usage in urban or suburban areas. Agriculture land is more cost-efficient since its use may be adapted to its function. (**Figure 7.1**)

	Urban Swiftlet Farm	Agriculture land Swiftlet Farm
External View		

Figure 7.1: External View and Environment of Urban and Agriculture land Swiftlet Farm

7.2.5 Environmental Impact

Another disadvantage of urban and suburban farming is the environmental effect, such as noise pollution caused by the tweeting sound that is continually disrupting the community's lifestyle. Agriculture production may not have a large impact since it is cushioned by plantations or greenery.

7.2.6 Sustainability and Growth Rate

Farming in cities or suburbs may reach its peak and begin to saturate. Because of their proximity, the farms may have to compete for existence, and growth rates may eventually decline.

7.2.7 Effective Use of Space and Ergonomic

Due to construction code requirements, some utility or service facilities in a shophouse property may be underutilised. Some of the high ceiling locations may be inaccessible for nest harvesting (**Figure 7.2**). As a result, waste of space may cut income even further.

Urban Swiftlet Farm | Agriculture land Swiftlet Farm

Internal View

Entry Design

Figure 7.2: Internal Design Layout and Usage

7.2.8 Flexibility in Design and Future Expansion

Most urban or suburban farms have reached their peak not just owing to the rate of growth, but also because of the overpopulation of swiftlets with little room for expansion. The agricultural farm, on the other hand, might simply be expanded to the surrounding open space. In agricultural land, the ability to alter or tolerate changes is advantageous.

7.2.9 Summary of Discussion on Swiftlet Farming

In summary, a comprehensive analysis of new buildings and designs should be in place to address construction costing challenges. Local governments should investigate efficient swiftlet agriculture planning. To suit the demands of swiftlet habitation and EBN harvesting ease, the building technique and specifications should be addressed. More thought should be given to swiftlet farming allotment to eliminate competition and reduce failure rates.

In terms of economics, the cost of a building must be modular. This modular design would shorten building time, eliminate waste, and lower labour costs. It might expand in response to future needs as the swiftlet colony grows. This module should be able to be disassembled and reassembled in a different place. This mobility may minimise investment risk and provide second chances to recoup or perhaps achieve a higher return. Materials chosen should be lightweight and durable to facilitate movement. The final objective should be a self-sufficient and self-contained module capable of establishing an appropriate environment.

7.2.10 Recommendation of Swiftlet Farming

The recommendation of swiftlet farming was supported by the result of case study and analysis of Section 7.2.

From the Rearing of Swiftlet and Manufacturing of Swiftlets' Nest By-Laws 2013, it is stated that all urban or suburban swiftlet farms are to be given a grace period of 3 years starting from 1st January 2014 (C.W. Lim, 2013).

Considering the difficulty, section 7.2.9's recommendation might be expanded and implemented into town planning to account for township development in the next 10 to 20 years.

The impacts of the sudden closure of all swiftlet farms in urban or suburban areas may results in a massive migration of swiftlets out of this country and eventually reduce the population of species within the country.

To lower the risk, it is recommended to shift the swiftlet farms that are closer to agricultural land as priorities (**Figure 7.3** in red arrow). Once the new swiftlet farms stabilize, the next stage is to shift the urban area swiftlet farms. (**Figure 7.3** in yellow arrow).

The location of newly constructed swiftlet farms also needs to be in line with the Master Plan of city or township planning. This prevents agricultural land earmarked for swiftlet farms not being encroached by the expansion of township in future.

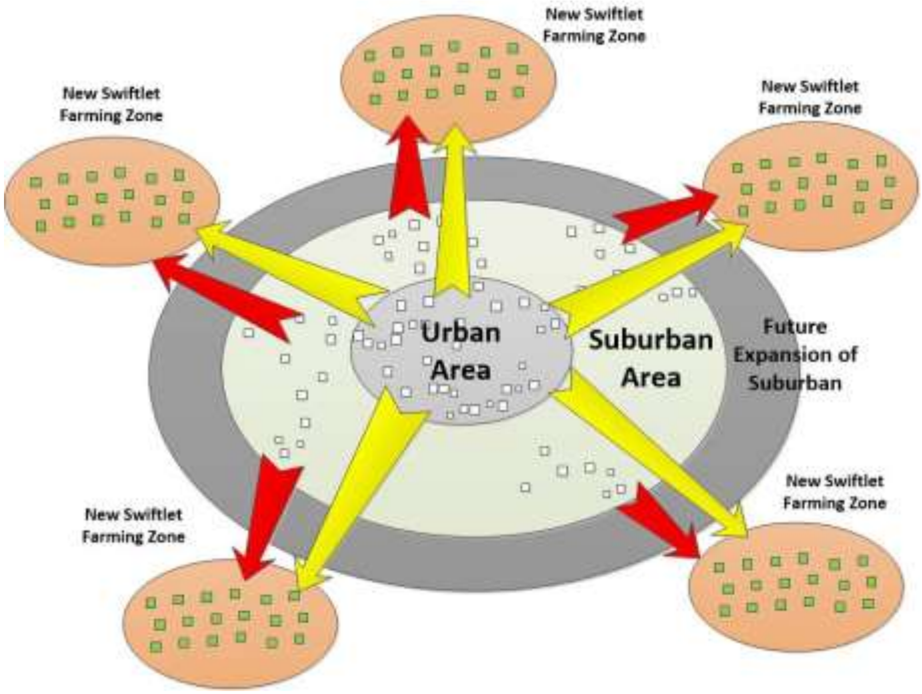

Figure 7.3: Migration of Existing Swiftlet Farms from Urban and Suburban area to Agriculture land

The local authorities also need to assist in controlling the proximity and concentration of swiftlet farms in particular areas. Due to proximity, the swiftlet colony tends to loom in and out of different farms. And this creates direct competition between the farm's owners to increase louder their tweeting sound speakers and unnecessarily generate noise pollution.

To ensure the long-term sustainability of swiftlet farming, a new bylaw needs to protect the natural resources in the food sources of these species. Any polluted industry needs to be avoided within the zone earmarked for swiftlet farms.

The design of module swiftlet farms should be incorporated into this planning. The owner's flexibility of growth and mobility may allow it to relocate in the future to accommodate other land uses. New forms of swiftlet farms might lessen the probability of failure owing to environmental challenges while also eliminating building material waste.

7.3 Discussion on Edible Bird Nest Cleaning Process

Many EBN products on the market have been found to include adulterants to reduce costs and increase profit margins. Throughout the production process, it is difficult to detect adulterated or contaminated commodities (Ramlan et al., 2018). There is a growing need for regulatory bodies to adopt uniform benchmarking and quality assurance processes (Babji et al., 2015; Dai et al., 2020). Strong rules for EBN standards should be established and implemented regularly (Lee et al., 2017). Research of various processing (including cleaning, drying, and sterilising) procedures should be conducted. (Yeo et al., 2021).

7.3.1 Traditional or Current Cleaning Process

In Malaysia, birds nest cleaning has only been practised for around 20 years. There were not many acknowledged experts or trainers throughout the early days. As a result, every business owner or investor would look for a reliable expert by attending their seminar or training. Most of them would begin with the fundamental skills they learned in a few days of training. They attended a couple of rounds of seminars to develop their skills before training their workers.

According to our observations, the procedure may be summed up in a few phases (**Figure 7.4**). The initial phase of searching for the best cleaning procedure may be time consuming and unpredictable in terms of the result. Due to unanticipated circumstances, the owner may encounter a new condition that necessitates a change in the cleaning technique. This would result in unstable quality control and a lack of proper procedure.

The facilities planning has become unproductive since the cleaning technique has changed regularly. As a result, there was an overlapping in the handling procedure. The complexity may have increased the possibility of contamination, and as a result, the final quality was degraded. This is the constant occurrence of traditional process owners to modify or upgrade their facility when the customer demands better quality.

Figure 7.4: Phases of Setting Traditional Cleaning Process

7.3.2 Best Value Approach to Establish Cleaning Process Facility

Figure 7.5: Phases of Setting Cleaning Facility through Best Value Approach

The new method to establish the cleaning process most efficiently will be the Best Value Approach (Kashiwagi, 2017). The assumption behind this strategy is that it does not rely on the client's knowledge or skill, but rather on the competence of vendors (**Figure 7.5**).

The customer would be out of the picture if the expert was entirely in command of the entire endeavour. Before establishing the facility, it is now up to the expert to create a performance matrix or indicator. Without the client's intervention, the expert might make a quick decision to save time and boost efficiency.

When the facility is completely operational, the expert will assess it with the actual operation and involve workers. When the facility is completely operational, the expert will assess it with real operation while also engaging workers in training. This would allow the expert to completely analyse the facility's efficiency and make minor adjustments if necessary.

7.3.3 New Improved/ Proposed Cleaning Process

A scientific analysis of bird nest properties and characteristics resulted in the development of a new improved cleaning process. Understanding that the bird nest is made entirely of salivary glands, it is sticky and contains a high amount of water. According to a study, the moisture level of a bird nest is widely utilised as an indicator of its stability and quality. (Kok and Thrisingam, 2011). During the drying process, it gradually hardens into a solid form capable of supporting the weight of the eggs and the chick.

The expert's procedure begins with a meticulous separation of raw bird nests to minimise contamination due to bacteria growth among filthy nests. Following the sorting procedure, the raw bird nest would need to be brushed to remove any impurities or dust that have accumulated on the surface. During this procedure, the raw bird nest is exposed to little quantities of water, causing the bird nest to soften and rubberize. According to experts, the moisture contained at this step should be controlled between 30% to 40%; any extra moisture should be dried off using a clean towel or sponge.

It would be placed in the container to allow the bird nest to slightly expand. The feather picking operation will take place in a semi-dry environment. This would preserve both the nutrients and the natural form of the bird nest. According to the expert, cleaning EBN in semi-dry conditions necessitates specialised skills and procedures; nonetheless, trained employees may generate higher-quality EBN with less waste.

Following quality control, cleaned EBN would be trimmed to remove any surplus edges before being placed into the plastic mould. The drying process does not require heat because of the regulated expansion and dampness. It is put beneath a ventilated cabinet until the bird nest dries entirely to its original shape. According to Gan SH's research, drying at high temperatures (70 – 90 C) and over a longer period greatly reduces sialic acid concentration (Gan et al, 2017). This method has reduced the time required for moulding and drying. It also keeps the nutrition and quality of the bird nest intact. Contamination by water or air might be limited or prevented

7.3.4 Discussion on New Improved Cleaning Process

The analysis and expansion experiment reveal that the new cleaning method presented can preserve the nutrients, form, and original features. In compared to traditional soaking approaches, Ma and Liu (2013) and Chua and Zukefli (2016) claimed that the soaking period ranged from 1 to 48 hours. The conventional processing method may produce contamination through water and nutritional loss of up to 36%, but the new improved technique may retain up to 94% of the total nutrients.

The finding also demonstrates that the new enhanced cleaning procedure loses 11.75 percent of its protein content whereas the conventional approach loses 30.84 percent. According to Jong, Tay, and Lim (2013), the approaches of repetitive water spraying during the plucking stage process to soften the EBN may result in nutritional losses due to continual washing with water. The difference in nutrient losses between the new enhanced approach and the previous cleaning method is readily visible. In comparison to Halim et al., 2014, the crude protein obtained varied from 56.2 percent to 61.5 percent. The crude protein losses induced by the new enhanced cleaning processes varied from 6% to 11%. Another study, Hamzah et al, 2015, revealed that cleaning techniques generated roughly 30% of waste. The waste residue exhibited a high protein content ranging from 44.24 to 50.42 percent. As a result, the new enhanced approach might boost protein content by 73 to 76 percent.

The Best Value Approach of analysing the present cleaning process and re-engineering it by involving an expert from the beginning yielded substantially better outcomes. The ultimate findings may easily be justified using the fundamental matrix established at the beginning.

7.3.5 Recommendation on Edible Bird Nest Cleaning Process

The following recommendation supported by result finding of case study and interview conducted in Section 7.3.

Malaysia as the second-largest exporter of edible bird nest after Indonesia contributes around RM 5.2 billion to the Gross National Income (GNI) in 2020 (Rabu & Nazmi, 2015). The supply chain of edible bird nest in Malaysia is illustrated in **Figure 7.6** below.

Figure 7.6 Supply Chain of Edible Bird Nest in Malaysia

Raw bird nest as harvested by the swiftlet farmers throughout Malaysia is channelled by two main routes to reach the end users. The main channel of distribution in Malaysia, all raw bird nest is sold to local middleman; and with sorting of grade, they are cleaned by the local cleaning facilities. The raw cleaned bird nest is packed and exported to an overseas market or distributed to the local market by the local wholesaler or exporter. The second channel is established after the trade agreement between China and Malaysia to export raw bird nest directly to China. This channel is conducted by the middleman or overseas exporters sourcing the raw bird nest directly from swiftlet farmers. Similarly, after grading and packing, the raw bird nest is shipped to overseas cleaning facilities for further processed and finally reaching the consumer through distributors or retailers.

This study's contribution is to support local cleaning facilities process raw bird nest locally, increasing their quality and productivity. As a result of the processing, there will be more job opportunities and higher revenue. Long term, it will improve the country's reputation and economy.

In response to Kamarudin and Aziz (2011)'s request for a systematic processing mechanism to be in place to assure the validity and quality of Malaysian EBN, a new guideline for EBN facility setup has been created and included at APPENDIX III. The new guideline also serves as standard operation provide a new reference to existing and prospective processors on their exposure to aspects of quality assurance, proper processing practice, and the certificate of conformity as highlighted by Kamarudin & Aziz 2011. Similarly, the guideline capable of ensuring that EBN is created and processed under the most severe conditions so that the EBN that reaches customers is authentic and safe to ingest to achieve the health-promoting effects mentioned by Wong (2013).

An appeal to regulatory bodies by Babji et al (2015) and Dai et al (2020) to establish consistent benchmarking and quality assurance techniques to ensure Malaysian EBN products are safe for human consumption. The new guidelines might serve as a point of reference for the regulatory agency as part of their benchmarking process. Lee et al. (2017) reiterated the important of quality enhancement of EBNs and consumer safety and Yeo et al (2021) called for comparative research of various processing (including cleaning, drying, and sterilising) procedures (from Raw EBN to Cleaned EBN) in eliminating pollutants has been answered through the expansion and nutrients test result reported previously.

7.4 Result Justification on Hypothesis

The survey and case study results validated all of the requirements of the hypothesis produced during the interview, as shown in **Figure 7.7**.

The hypothesis was created using a deductive approach, using the following assumptions:

1. Quality of EBN depending on effectiveness of cleaning process;
2. Quality of cleaning process depending on worker skills;
3. Quality of worker skills depending on training provided; and
4. Quality of training depend on the expertise of trainer.

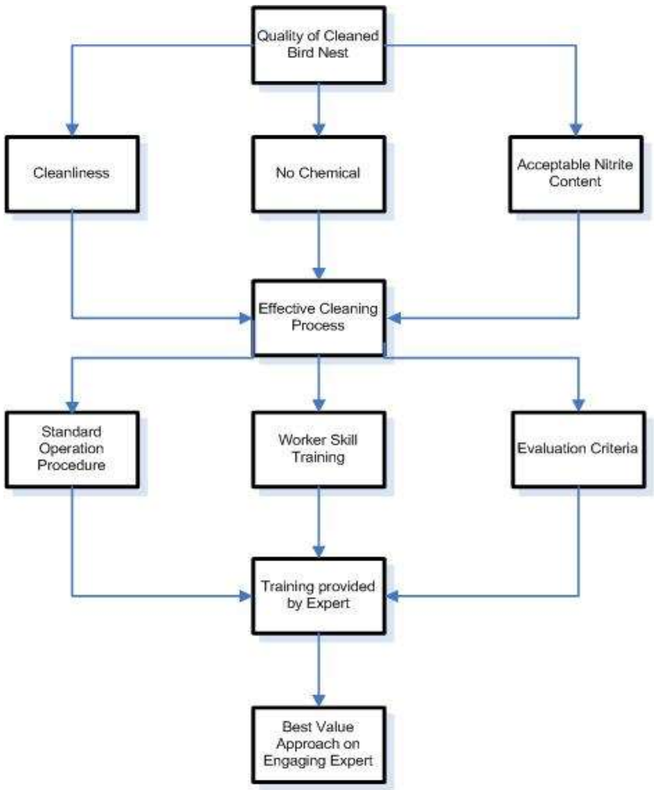

Figure 7.7: Hypothesis Developed through Interview

7.4.1 Justification of H1: Quality of cleaned EBN depend on effectiveness of cleaning process

Hypothesis 1 state that quality of cleaned EBN depend on effectiveness of cleaning process. The results in Chapter 7 illustrated the new improved cleaning method produce higher protein concentration than traditional method. It clearly indicates the differences of 19.09% nutrient differences between the new improved method and traditional cleaning method.

The expansion rate of 30% improvement by new improved cleaning method given the indication of nutrients preservation.

7.4.2 Justification of H2: Quality of cleaning process depend on the worker skills

This hypothesis was transcribed into survey questionnaires. The result of Kruskal Wallis and Spearmen correlation test indicated all workers understand the quality requirement and knowing how to check their own quality having strong correlation between performance criteria of wastage, fulfilment of requirement, obtaining of license and China market distribution.

Among all the participants who agree with above statement justify with their performance in lower wastage, high fulfilment to authority requirements, ability to obtaining license and high performance in China market distribution. The outcome justifies the workers skills able to influence the quality of cleaning process.

7.4.3 Justification of H3: Quality of worker skills depend on the training provided

Similarly, hypothesis 3 was built upon the hypothesis 2; in which, quality of worker skills depends on the training provided. The result shows that by providing training course to both workers and supervisors able to reduce wastage and success operation of cleanroom facilities. Participants who agreed to the statements proven to have better performance in both indicators. The output justify quality of workers skills could ameliorate through attending training course.

7.4.4 Justification of H4: Quality of training depend on the expertise of trainer

The result enumerates all the attribute on utilising of expect to improve on quality of cleaning process, to train the workers to boost their cleaning skills, to assist in achievement of export quality, meeting the customers need and mitigate the production risk. All the above attribute shows a high significant on those participants with top achievement in performance matrix.

The outcome testifies quality of training provided by the expect could greatly impact the output of the company and performance. In conclusion, all 4 hypotheses are achieved through survey questionnaires and the results are aligned with interview finding (**Table 7.3**).

Table 7.3: Result Achievement of Hypothesis

	Hypothesis	Result
1	Quality of cleaned EBN depend on effectiveness of cleaning process	Achieved
2	Quality of cleaning process depend on the worker skills	Achieved
3	Quality of worker skills depend on the training provided	Achieved
4	Quality of training depend on the expertise of trainer	Achieved

Likewise, by analysing the BVA practitioners from single to six Best Value Principles; the gap between the highest achiever to the lowest getting narrow from 10.8% to 3.6%. This trend means that BVA able to close the gap and improve the performance in production value.

7.5 Discussion on Implementation of Best Value Approach

The Best Value Approach (BVA) is a strategy for improving project delivery, project management, risk management, and processes efficiency and performance. BVA is not just useful in the building sector; it has also been shown to be useful in the industrial environment.

BVA is based on an idea developed by Professor Dean Kashiwagi of Arizona State University's Performance Based Studies Research Group. The

BVA is a procurement strategy that focuses on obtaining the most value for the least amount of money (Snippert, Witteveen, Boes, & Voordijk, 2015). It seeks to discover and use supply chain knowledge to pick the "expert contractor" for contract execution (PIANOo, 2017). This expert is discovered through dominating information (metrics) that demonstrate his qualities. By focusing on the expert, who is aware of the contracting authority's risks and opportunities and can mitigate these issues (Rijkswaterstaat, 2013).

The finding from the survey reviewed that best value practitioners increased 15% on both values generated per worker and total productivity of end products in weight per month (**Table 7.4**).

Table 7.4: Performance Result of Best Value Practitioners

Value Comparison	**Value per Worker (RM)**	**Differences**	**Kilogramme per Worker (Kg)**	**Differences**
Best Value Practitioners	5,666		1.14	
Non-Best Value Practitioners	4,890	15.8%	0.99	15.1%

Table 7.5 demonstrated the performance of utilising experts, which was concluded by utilising experts at the start of productivity being able to generate higher performance.

Table 7.5: Performance Result of Best Value Principles

Best Value Principle	**Value per Worker (RM)**	**Ranking**	**Kilogramme per Worker (Kg)**	**Ranking**
Utilising Expert	5,222	1	1.05	1
Preplan to identify risk	4,867	6	0.97	6
Measure Performance	5,176	2	1.04	2
Create Accountability	5,032	5	1.01	5
Motivation for Improvement	5,073	4	1.01	4
Customer Expectation	5,096	3	1.02	3

Workers' skills must be polished and trained by an experienced expert or consultant. This is the safest and most dependable approach, with the least amount of error and the lowest risk of failure at the start of production.

It is obvious that when worker performance is measured and monitored during production. Throughout the survey, most participants agreed on the importance of workers' performance is measured and rewarded based on their output and efforts.

Customer Expectation is another important metric to keep an eye on. The accomplishment demonstrates that customer expectations can have a significant impact on the entire production. All three indicators clearly show that the best value principles have an impact on both worker productivity and profitability.

The incremental difference between the best and worst performance is 7.3 per cent.

Table 7.6: Summary of Impact of Best Value Principles on Performance Matrix

Measurement Criteria	**Utilising Expert**	**Pre-Plan to Reduce Risk**	**Measure Performance**	**Create Accountability**	**Motivation for Improvement**	**Customer Expectation**
Wastage	√		√			X
Worker productivity	X					X
Number of Workers		√	√		√	
Market distribution					X	
Fulfilment			√	√		
License	X		√	√		
Monthly productivity		√	√	√		
China market			√			
Cleanroom	√		√		√	√

According to Kashiwagi (2016), a performance matrix is a measuring instrument for the Best Value Approach that is easy to understand and facilitates consensus. The most influential Best Value Principles are Measure Performance as indicated in **Table 7.6**. It affected almost all the measurement criteria except worker productivity and market distribution. This principle highlights the need for setting a good measurement criterion and the worker’s attitude toward the quality and understanding of their responsibility. The performance matrix is the primary component for evaluation, according to the Best Value Approach. As a result, having a reliable measuring criterion becomes the top concern in the manufacturing process.

The second variable is important for measuring performance. It instils accountability in all employees. When all employees recognise the need for quality and accept responsibility for their output, responsibility and attitude will shift.

Pre-production planning not only reduces risk, but also increases productivity and workforce growth. Expert or consultant input will be used to develop a strategic production plan that will elevate the company in a shorter period.

7.5.1 Application of Best Value Approach on Company Size

The results in Chapter 5, Section 5.6 Table 5.43 show that the largest gap between the overall group performance is the result performance on Customer Expectation of companies with fewer than 20 workers and companies with more than 80 workers. The rationale could be small entrepreneurs' ability to meet customer expectations in a shorter period. As stated by Kashiwagi (2004) “If a person implements a newly perceived principle, they will transform. This shift in perspective always leads to the perception of more rules or principles. People who perceive more, process faster, apply more correct notions, and change faster. Open to change individuals are more likely to be inventive, intuitive, efficient, and effective."

This advantage may also be reflected in the company culture of small businesses, where most employees share the same company values. They are more resilient in the face of adversity and are willing to make sacrifices for the sake of the company's growth. As the company expands, it becomes more compartmentalised and bureaucratic. As a result, large corporations are not nearly as agile or adaptable as small businesses.

On the second note, even though both small and large businesses use consultants, the results of using experts show a significant difference. In large enterprises, when an expert recommends a change to an existing system, the suggestion must be filtered through multiple layers of leadership across various departments. Small businesses, on the other hand, can implement major changes much more quickly. Smaller businesses, on the other hand, can respond quickly by identifying and reacting to problems. Because there is no complicated chain of command, employees have direct access to the owner, who can quickly address any problem that arises.

The third notable outcome is the risk-reduction strategy. The vitality, like using an expert, comes from an outside force. Whether it is direct market demand, an authority requirement, or a customer need, small businesses can respond quickly with a new plan and strategy.

7.5.2 Application of Best Value Approach on Year of Establishment

Chapter 5, Section 5.6.1 suggests three main Best Value Principles that perform well with SMEs. They are utilising the expert, preplan to reduce risk and customer expectation. All three principles show a similar interrelationship of external influences.

Justification for the best value approach has a greater impact on SMEs than on large corporations. Most SMEs began on a small scale, giving them the advantage of being adaptable and resilient to change. In comparison to a well-established large corporation, any changes requested by customers will take time to implement. Because of their small size, most workers are multi-tasked in performing their duties to assist due to the urgency of the work requirement. This working environment is compatible with the Best Value Approach, in which all employees are held accountable for their performance and can be motivated to improve it. Expertise could be utilised with less management, control, and direct.

Other differences include the fact that individual workers' input could reach management much more easily due to the organization's slimness. As a result, job satisfaction and achievement may improve, whereas a large organisation may value collective group agreement rather than individual opinion.

A small company's ability to internalise any challenges may be much faster than a large organisation with too many layers of process. The workforce in large organisations is content with stable and routine work processes; thus, minimising changes and remaining in their comfort zone has become their attitude toward any external influences.

7.5.3 Recommendation on Implementation of Best Value Approach

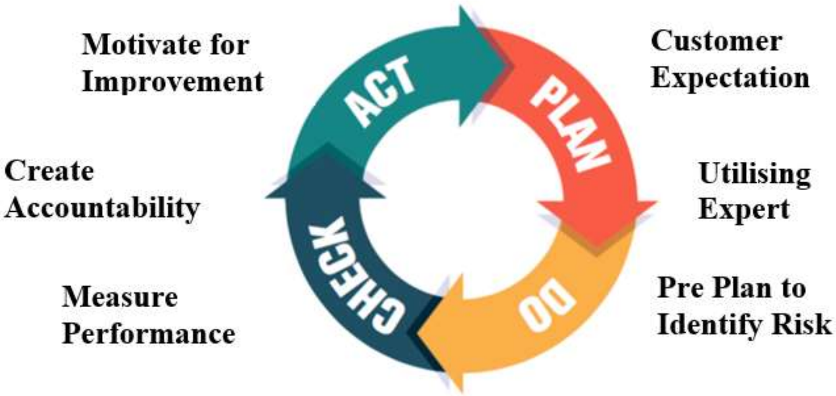

Figure 7.8: Implementation of Best Value Principle on PDCA cycle

The Best Value Approach is appropriate for the EBN industry. **Figure 7.8** showed how the BV principles correlated with the PDCA cycles.

Plan

Most EBN cleaning facilities will begin by determining their customer demand or market need. During the initial planning stage, the company must rely on its internal expertise to meet the customer's expectations. If internal expertise is unable to meet the requirement, external expertise will be commissioned to train and set up the cleaning process procedure. **Figure 7.9** depicts the start of the BVA engagement process.

The owners must pre-select the available experts or consultants during the selection phase. The tender process would start by inviting the shortlisted experts to demonstrate their verifiable project performance, risk mitigation plan, and value-added plan from previous successes. Before the interview, the shortlisted experts will be given the customer's expected demand and will be required to prepare a workable cleaning process.

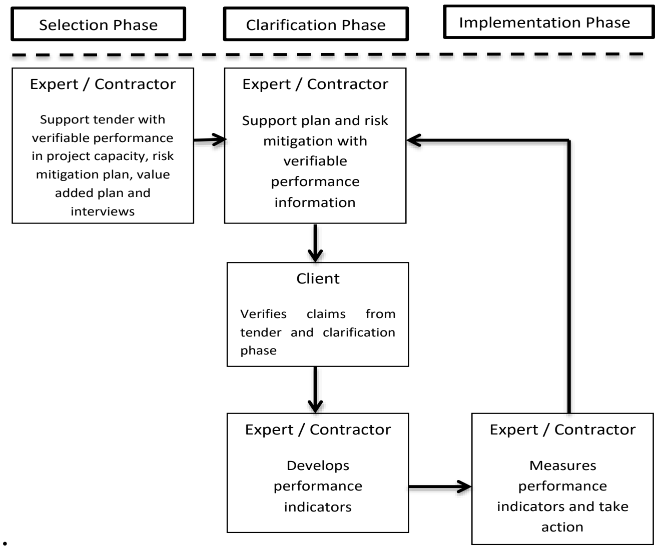

Figure 7.9: Best Value Approach in Selection Process
(Horstman, 2013)

Following score verification, the final shortlisted experts will be contacted to clarify their supporting plan and risk mitigation with verifiable performance indicators. The owners would investigate all of the claims raised by the experts before making a final decision based on merit. Following the expert's engagement, the expert would create performance indicators or a matrix and submit it to the owners.

Do

During implementation, all output would be measured using performance indicators, and any verification actions would be reported to owners as part of the risk mitigation plan's ongoing improvement.

Check

Individual worker performance measurement should also be implemented to re-delicate the quality checking responsibility to each worker. All employees are not only entrusted with ensuring the quality of their output but also with creating accountability for the tasks they complete. This process will cultivate their attitude toward excellent quality, resulting in loyalty and job satisfaction at work.

Action

The right attitude toward quality improvement will motivate them to seek improvement in their work and duties. This fulfilled the Best Value principle whereas when all employees have the right mindset of seeking improvement, management does not have to manage, direct, and control the workers. Instead, encourage and motivate them to produce higher-quality results.

7.5.4 Summary of contribution to Edible Bird Nest Industry

Table 7.7 Contribution of Research in Respond to Research Gap

	Research Gap	Contribution of research
1	Systematic processing system	New Improved Process has been proposed and verified.
2	Strict processes and product authenticity	New Improved Process has been proposed and verified.
3	Quality assurance practices	A new guideline has been proposed based on research finding.
4	Quality assurance regulation	Standard operational procedure has been suggested.
5	Study of processing to eliminate contamination	Standard operational procedure has been suggested.

This research finding contributes to the entire supply chain of edible bird nest. Swiftlet farming includes recommendations in both design consideration and municipal planning proposal to solve the problems of acquiring the swiftlet farms licence.

The new enhanced cleaning process guidelines will serve as a key reference for those cleaning facilities that must comply with export requirements (**Table 7.7**). According to Babji et al (2015), Lee et al (2017), and Dai et al (2020), regulatory agencies must adopt a uniform benchmarking methodology to ensure that Malaysian EBN products are safe for human consumption. The suggested guideline and standard operation procedure might help the owners correct any non-compliance issues and improve or enhance their products' quality.

Kamarudin et al (2011), Wong (2013), and Yeo et al (2021), reiterated a systematic processing mechanism should be in place to ensure the quality of EBN reaching customers is legitimate and safe for human consumption. Best Value Approach was proven as among the most successful technique for any new start-up or SME company to use when establishing their facilities. According to the study and interviews, most stakeholders in the edible bird nest sector do not necessarily adhere to the Best Value approach, but they do have the same characteristics as Best Value companies. By establishing the correct technique, Best Value Approach established a systematic procedure that any start-up company could readily adopt and apply.

CHAPTER EIGHT

CONCLUSION

8.1 Introduction

This chapter concludes the overall findings of this study. The research objectives are fulfilled and justified by the research findings as described in Section 8.2. Best Value Approach or BVA is a better approach in assisting an expansion of cleaning facilities, in achieving a better quality of all aspects of performance criteria. Research discovers BVA implicit in Small and Medium Enterprises (SME) as compared to an established company. Section 8.3 justifies all hypothesis generated through interviews, and Section 8.4 responds to all performance indicator variables raised by interviewers. Section 8.5 discusses the recommendation toward the swiftlet farm in Malaysia. All the suggestions and guidelines toward the edible bird nest cleaning process and facilities are proposed in Section 8.5 through Section 8.9. The contribution of this research study is explained in Sections 8.10 and 8.11. As the raw bird nest moves from upstream to downstream of the supply chain, job placement and new entrepreneurship sprout throughout the country. The opportunity also spreads to other industries like the educational tours to swiftlet farms, cleaning and bottling facilities. Experiencing a variety of edible bird nest products also build the reputation and branding of the nation. Finally, the proposed future study is highlighted in section 8.12 and the limitation of the research is tabled in Section 8.13.

8.2 Research Process and Achievement

The research approach could be summarised as the initial research review through literature and case study uncovers the newly improved method of the cleaning process which can enhance the current traditional process.

The data through primarily and secondary sources formulate the interview questions. Interviews session was conducted through random samples till saturation of data. After all the data has been coded and classified, it will be organised into separate themes and subthemes.

Following the completion of the analysis, all data will be reviewed by industry specialists before being converted into questions. The survey was sent via multi-media to all relevant participants. All raw data collected has been processed and analysed using descriptive and inferential statistics. The tabular data has been double-checked by industry specialists. The final output will be the result of several analyses and conclusions. To validate the results, a case study of existing and new enhanced processes will be performed to establish the validity of the findings.

The results justified and fulfilled the objective of unearthing a relative effective cleaning process. The results showed an improvement in obtaining 19.09% of nutrients during the cleaning process as highlighted and discussed in Chapter 7, Section 7.3.4.

The second objective of seek an alternative approach in assisting stakeholders to improve cleaning quality and productivity. The research discovers BVA implicit in Small and Medium Enterprises (SME) as compared to established company in Chapter 5, Section 5.6.1. Finally on the guideline to assist current cleaning facilities, case study and analysis of Chapter 4, 5 and 6 responded to provide a complete picture from initial set up to the details process of every steps. The complete guideline could be found at Appendix III.

8.3 Contribution of Best Value Approach to EBN Cleaning Industry

All the factors that raised by the stakeholders during qualitative interview were resolved by the quantitative survey questionnaires and could be achieved by the 6 principles of Best Value Approach (**Figure 8.1**). The descriptive analysis in Chapter 5, Section 5.2.1 exhibits value per workers generated by Best Value practitioners is 9.6% higher than Non BVA practitioners. While the losses per workers during production is 6.2% lower. Thus, the final value per workers (BVA) increase**s** by 15% over Non BVA practitioners. The results demonstrated that by implementing BVA principles, the organisation could increase worker productivity while reducing waste throughout manufacturing. This indicator suggests the possibility of cost savings. The full impact of BVA on the business has yet to be discovered until the sector completely implements and adopts BVA.

Similarly, when analysing BVA practitioners from one to six Best Value Principles, the difference between the greatest and lowest achievers narrows from 10.8 percent to 3.6 percent as shown in Chapter 5, Section 5.2.8. This trend indicates that BVA can close the gap and increase its production value performance. The performance matrix might be achieved by BVA procedures based on the finding of inferential statistics. The full implementation of BVA might lead and steer the organisation to meeting requirements while also achieving higher quality.

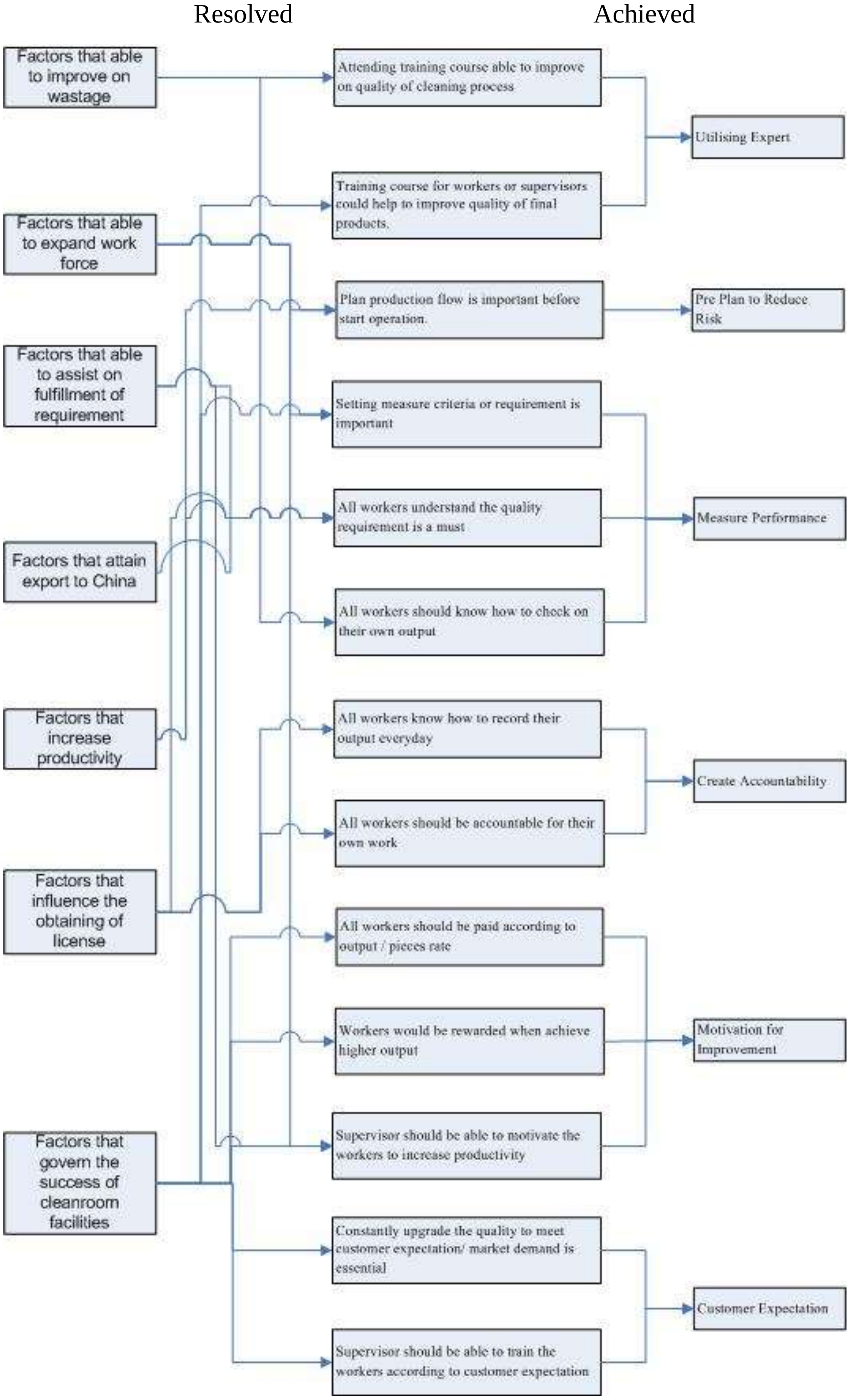

Figure 8.1: Relationship of Performance Factors with BVA

In summary, the Best Value Approach provides a scientific and established approach that all stakeholders may use. The first step is to discover a client demand or market segment. It is difficult to keep up with market demand as it changes with time and the market economy. However, without the ability to alter, the market sector may suffer over time. As a result, the BVA strategy prioritises customer demand.

The second step is to hire professional consultants or experts to educate employees and set up the production flow. The expert should be allowed complete freedom to carry out his strategy without intervention from the owner or management. According to Kashiwagi (2004), all direct, manage, and control actions should be removed.

Third, the expert must support their offer with the prevailing performance data suggested by Van de Rijt and Santema (2013). They will be planning the production flow and identifying production risks to develop an appropriate mitigation strategy. Dominating knowledge can reduce production risk and minimize uncertainty (Wenselaar, 2011).

Fourth, a comprehensive tracking and recording system must be established to generate accountability for each worker. All dominating information is captured in performance matrices that are easy to understand and monitor (Kashiwagi, 2016).

Fifth, every worker performance will be assessed and rewarded properly. This method has the potential to motivate employees to strive for higher levels of performance and efficiency in their work.

Finally, it is the rewarding system or incentives that push all workers to develop. Workers' morale is critical to the efficiency of production flow;

with the proper incentive system in place, it establishes goals for all workers to drive their enthusiasm and energy.

Following completion of the Best Value Approach cycle, the next goal would be CNCA accreditation. During this phase, facility productivity and quality assurance must be developed and constant. During the assessment, all manufacturing procedures and records should be provided.

Figure 8.2: Flow Chart for New Start up

Figure 8.2 summarises the approach in steps in diagram format. The steps of identify market niche is a priority in cleaning facilities. The decision from the marketing and management input will determine the future set up and end products of the company. Vigorous assessment of the pro and con of each products strength and future development is essential. Upon firm decision and target end products, the following steps are to identify experience consultant to construct the right production plan. Again, all the consultants should be assessed through 3 phases of process as highted in Chapter 2 (Figure 2.25).

During the selection phase, the expert or contractor are called for supporting documents on previous track record; the documents are performance result, mitigation plan and value-added plan in previous projects during the interview.

During clarification phase, the expert or contractor will provide support plan in lieu of risk mitigation plan and verifiable performance information. As the client, it is important to verify all the claims during clarification stage. Upon satisfying all explanation and verification, a contact will be awarded, and expert or contactor will prepare the performance indicators like performance matrix to company as key performance guideline.

Finally, when coming to implementation phase, expert or contractor will provide a weekly performance report against the performance indicators. Any underperforming result, a mitigation plan or action will be taken by the expert or contractor, and the continual quality improvement process will be implemented until all indicators are achieved.

8.4 Organisation Structure of EBN Cleaning Facility

The bird nest cleaning industry first appeared in Malaysia in the early twentieth century. The nature of this enterprise manifested itself in the form of a cottage industry, founded by swiftlet farmers to process their excess raw bird nest during painfully slow demand periods. The endeavour not only extended their market sector and earned profitable income, but it also resulted in more business ventures into the industry. As a result, the bird nest cleaning industry evolved as part of Malaysia's supply chain.

From a modest cottage business with fewer than 20 people to a huge corporation with more than 80 employees, the firm has grown. More handling processes and controls have been introduced as the work organisation has grown compartmentalised. As a result, productivity is low and profit margins are low. This problem was generated by an increase in authority and a compartmentalised working environment, which hindered the overall workforce's flexibility. The evident may be discovered from the explicit result in Chapter 5, Section 5.6.1.

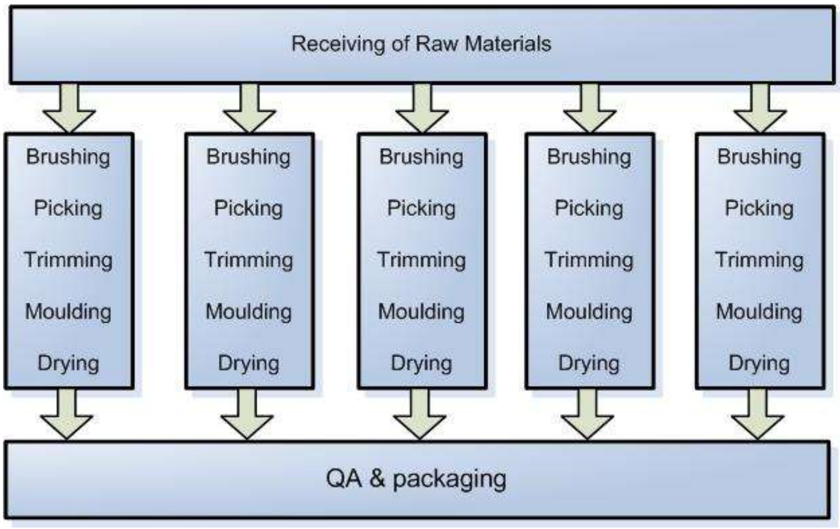

Figure 8.3 Unit Approach

Figure 8.3 depicted an organisational structure that combined the flexibility and agility of a small worker grouping. The notion of dissipative structure must be ingrained in the business structure. To ensure the long-term viability of the system, businesses required to establish responsibility to instil ownership in each worker's role. Each unit should be accountable for their performance, and unit supervisors should be able to resolve any problems that arise throughout production. This technique enabled supervisors to inspire employees to improve current processes and increase quality or productivity. To assure the quality of edible bird nest incoming and outgoing, two divisions must be centralised: receiving raw bird nest checking and quality assurance checking prior to exiting finished products.

8.5 Implication to EBN Industry

Malaysia as the second largest exporter of edible bird nest after Indonesia, contribute**s** around RM 5.2 billion to the Gross National Income (GNI) in 2020 (Rabu & Nazmi, 2015). The supply chain of edible bird nest in Malaysia is illustrated in **Figure 8.4** below. Raw bird nest as harvested by the swiftlet farmers throughout Malaysia is channelled by two main routes to reach the send users. The main channel of distribution in Malaysia, all raw bird nest is sold to local middleman; and with sorting of grade, they are cleaned by the local cleaning facilities. The raw cleaned bird nest is packed and exported to overseas market or distributed to local market by the local wholesaler or exporter. Second channel is established after the trade agreement between China and Malaysia to export raw bird nest directly to China. This channel is conducted by the middleman or overseas exporters sourcing the raw bird nest directly from swiftlet farmers. Similarly, after grading and packing, the raw bird nest is shipped to overseas cleaning facilities for further processed and finally reaching the consumer through distributors or retailers.

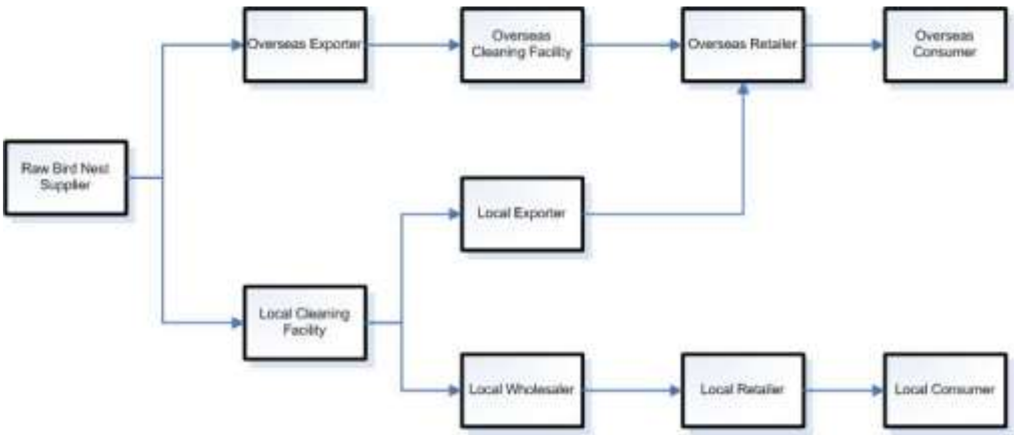

Figure 8.4: Supply Chain of Edible Bird Nest industry in Malaysia

8.5.1 Impact to Raw Bird Nest Supplier

The implication of this research benefits the supply chain from the beginning of swiftlet farmers down to the end consumers.

The moult seasons of swiftlet greatly affect the cleanliness of raw bird nest. The overseas exporters or buyers choose to purchase the raw bird nest with less feathers during the seasons between September to May. The demand reaches peak by the month of December to January due to high trading volume from the sales of lunar Chinese New Year.

Therefore, the local swiftlet farmers can suffer a great loss with more mouldy raw bird nest when no demand between June to August. The fluctuation of pricing has also caused the local cleaning facilities fighting to secure the supply of raw materials at the higher cost with the oversupply of dirty and mouldy bird nest during the peak seasons and off-peak seasons.

The implementation of this research not only assists the swiftlet farmers to focus on their management of swiftlet farm but also sustains the long-term partnership with the local cleaning facilities to achieve the win-win ecosystem. Through the direct feedback from cleaning facilities, swiftlet farmers improve on their swiftlet farm by adjusting of humility, temperature and even the insect control issues through the instant information from partners.

8.5.2 Impact to Middleman or Traders

According to R Kamaruddin's (2019) research, the author reaffirmed that the function of the middleman has a favourable influence on the long-term production of swiftlet nests. Most middlemen are bulk purchasers who are responsible for sorting and gathering all raw bird nest to grade and market to various end customers or fulfil varying demand.

The application to middlemen enables them to secure their sources without having to compete with international exporters or middlemen. Similarly, using the direct feedback method, people contribute to swiftlet farmers' suggestions for swiftlet farm management. This long-term cycle also offers intermediaries the confidence to seek out new markets and address new demands.

8.5.3 Impact to Cleaning Facilities

Without a doubt, the cleaning facilities will benefit the most because the entire study is geared around resolving their issues. First and foremost, the facilities assure a steady supply of raw bird nest because swiftlet farmers profit from quality improvements to their facilities. Long-term sustainability goals may be guaranteed with the predicted rise of swiftlet farms. This results in a long-term strategy for research and development as more stakeholders participate in product diversification, application, and implementation in the medical or pharmaceutical fields.

Second, Malaysia edible bird nest's international reputation may be developed. This broadens the market beyond Asia to other parts of the world. Higher reputation not only gains customer confidence, but also more research centres or institutes are prepared to channel resources into product and application diversification.

8.5.4 Impact to Exporter

Their duty, such as middlemen, will be to connect local bird nest providers with international wholesalers or merchants. Branding and reputation building may have an influence on exporters. As quality increases, a new market may be formed, or new demand can be met confidently. Long-term brand strategy, built without fear of imperial products, leads to the implementation of a quality assurance system.

8.5.5 Impact to Overseas Retailer

The stability of supply and quality assurance benefits the overseas partners with enjoyment of loyal customers and returning sales. Long term growth can also be established through campaign and loyal customer programme in capturing market share. Similarly, the profit can be guaranteed with the constant and stable pricing.

8.5.6 Impact to Overseas Consumer

In consumers point of view, trust and authenticity of the products top the list of confidence level in the exotic agriculture products like edible bird nest. This implication does build the trusted brand among the consumers. Consistent products quality and reputation also build the network of loyal customers; these customers advocate for the products and news spreads through multimedia or via word of mouth. By establishing loyalty programme or referral system, consumers also enjoy lower price as the result.

8.5.7 Impact to Government

The greatest beneficial of entire supply chain should be the government. Not only export revenue increases but also the tax revenue is derived from the trading companies. As the raw bird nest moves from upstream to downstream of supply chain, job placement and new entrepreneurship sprout throughout the country. The opportunity also spreads to other industry like tourism by educational tour to swiftlet farms, cleaning, and bottling facilities. Experiencing a variety of edible bird nest products also build reputation and branding of the nation. Since the nation enjoys great contribution from edible bird nest, more research and development should be allocated to this sector in exploring the hidden benefit of edible bird nest.

8.5.8 Summary

The implication of this research not only assists the cleaning facilities alone but also benefits entire ecosystem and supply chain (**Table 8.1**). The ripple effect could spread across the entire business world and provide nutrients to nourish the business that depending upon each other to survive.

Table 8.1: Impact of Implementation to Stakeholder

Stakeholder	Impact
Swiftlet farmer	Stable pricing Better security for long term growth
Middleman	More secure source Ensure better quality and sustainability
Cleaning facility	Stable supply Better quality and sustainable Establish good reputation Opportunity for research and development
Exporter	Establish brand and reputation Brand building Expansion to new market
Overseas retailer	Stable supply and growth Better quality
Consumer	Lower pricing Authenticity of product Quality assurance
Government	Higher export revenue Long term sustainable growth More entrepreneurs More research and development

8.6 Limitation and Future Research Study

The scope of this study is limited to the companies located in West Malaysia, where most of the processing plants are located. The potential respondents in this research are Chinese owners, who are consultant, swiftlet farm owners, processing plant owner and traders.

Most of the cleaning facilities in this study impound to farm's nest or "house nest" instead of cave nest. The majority export EBN to China is strictly compose of house nest, therefore, the research pivot toward this niche market. The ideas and suggestions given on the cleaning process in Section 7.7 impounded toward house nest from swiftlet farms. The results may be various on cleaning process toward cave nest. Due to the limited access to cave nest in West Malaysia, the scope of research could not cover the entire spectrum of edible bird nest. Likewise, the recommended process in setting up the cleaning facilities may differ from different state or local authorities' requirement. The steps and details processes aim to provide a fundamental guideline on initial production planning. It is advocated to follow the suggestion of Best Value Approach by engaging qualify experts and consultants.

It is difficult to automate and mass manufacture in this labor-intensive industry. However, by isolating the vital amino acid as an ingredient in health care supplements, nutrient extraction research and development may be developed.

Future research should investigate the cleaning technique for "cave nests," which was not included in this study. Cleaning "cave nests" produces more trash than cleaning "house nests," which is a common occurrence. New cleaning processes or approaches, on the other hand, are worthwhile investments to cover this research topic.

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APPENDIX I : LIST OF PUBLICATION

1) Tan, K.H., Chia, F.C. and Alan, H.K., **2014**. Impact of swiftlet's moult season on the value of edible bird nests. *International Proceedings of Chemical, Biological & Environmental Engineering*, *63*, p.17. (Published)

2) Hong, T.K., Fah, C.C. and Han, A.K.O., **2018**. Approach to Improve Edible Bird Nest Quality & Establishing Better Bird Nest Cleaning Process Facility through Best Value Approach. *Journal for the Advancement of Performance Information and Value*, 10(1), pp.38-50. (Published)

APPENDIX II

List of Literature Review on EBN

Literature Publication	Author	Year	Property	Quality	Functional	Safety	Processing	Framing	Marketing	Nutritional
			Topics or Area of research							
The edible bird's-nest, or nest of the Java swift (Collocalia nidifica).	Green, J. R.	1885	1							
The haemagglutination inhibitor in edible bird-nest: its biological and physical properties.	Biddle et al	1963	1							
Saccharides and amino acids of the mucoid in an edible bird's nest.	Oda, M.	1983	1							
Potentiation of mitogenic response by extracts of the swiftlet's (Collocalia) nest	Ng et al	.	1							
4, 8-Anhydro-N-acetylneuraminic acid: Isolation from edible bird's nest and structure determination.	POZSGAY et al.	1987	1							
Potentiation of mitogenic response by extracts of the swiftlet's (Apus) nest collected from Huai-Ji.	Kong et al.	1989	1							
Study on food components: the structure of N-linked asiago carbohydrate from the edible bird's nest built by Collocalia fuciphaga.	Oda et al.	1998	1	1						
Edible "bird's nest"–induced anaphylaxis: An under-recognized entity?.	Goh et al.	2000	1							
Determination of edible bird's nest and its products by gas chromatography	Yu et al.	2000	1							
Immunochemical characterization of edible bird's nest allergens.	Goh et al.	2001	1							
Determination of content of birds nest by spectrophotometer	Huang et al.	2003	1							
Problems in the harvest of edible birds' nests in Sarawak and Sabah, Malaysian Borneo	Hobbs, J.J.	2004				1				
Characterization of the edible bird's nest the "Caviar of the East".	Marcone, M. F.	2005	1							
The expression of sialylated high-antennary N-glycans in edible bird's nest.	Yagi et al.	2006	1							
Occurrence of a nonsulfated chondroitin proteoglycan in the dried saliva of Collocalia swiftlets (edible bird's-nest)	Nakagawa et al.	2006	1							
Edible bird's nest extract inhibits influenza virus infection.	Guo et al.	2006				1				
Methods to Identify True Edible Bird's Nest [J].	ZHU et al.	2007		1						
Authentic Determination of Bird's Nests by Saccharides Profile.	Tung et al.	2008		1						
Genetic identification of edible birds' nest based on mitochondrial DNA sequences.	Lin et al.	2009		1						
Preliminary Study of the Nutritional Content of Malaysian Edible Bird's Nest.	Norhayati et al.	2010	1							
Effect of edible bird's nest on Caco-2 cell proliferation.	Rashed et al.	2010	1							
Determination of sialic acid in edible birds nest using pre-column derivatization reversed-phase high performance liquid chromatography with photodiode array or fluorescence detection.	Feng et al.	2010	1							
Application of SYBRgreen PCR and 2DGE methods to authenticate edible bird's nest food.	Wu et al.	2010		1						

Minimizing colour change of cleaned edible bird’s nest by applying appropriate processing strategy	Law et al.	2011				1		
Improvement of bone strength and dermal thickness due to dietary edible bird’s nest extract in ovariectomized rats.	Matsukawa et al.	2011	1					
Effects of edible bird's nest (EBN) on cultured rabbit corneal keratocytes.	Abidin et al.	2011	1					
The theoretical framework study of artificial walet nest template from stoneware body.	Rahim et al.	2012						1
Effects of edible bird's nest on tumour necrosis factor-alpha secretion, nitric oxide production and cell viability of lipopolysaccharide-stimulated RAW 264.7 macrophages.	Oda et al.	2012			1			
Water extract of edible bird’s nest attenuated the oxidative stress-induced matrix metalloproteinase-1 by regulating the mitogen-activated protein kinase and activator protein-1 pathway in human keratinocytes.	Kim et al.	2012			1			
Food safety governance: standard operating procedure on controlling of nitrite level, handling and processing of Edible Bird's Nest.	Ramli et al.	2012					1	
Competitive enzyme-linked immunoassay for sialoglycoprotein of edible bird’s nest in food and cosmetics.	Zhang at al.	2012	1					
Mechanisms of edible bird's nest extract-induced proliferation of human adipose-derived stem cells	Roh et al.	2012	1					
Sketch of the edible bird's nest and its important bioactivities.	Ma et al.	2012					1	
Fast, effective evaluation of edible bird nests using the handheld Agilent 4100 ExoScan FTIR.	Set, J.	2012		1				
Proteomic profile of edible bird’s nest proteins.	Liu et al.	2012		1				
Edible bird nest shape quality assessment using machine vision system	Saad at al.	2012		1				
A preliminary report on the surveillance of highly pathogenic avian influenza (H5N1) and Newcastle disease (ND) viruses in edible bird nest swiftlet (Aerodramus fuciphagus and Aerodramus Maximus).	KH et al.	2012				1		
Risk assessment of nitrite in edible birdnest	Dun-Ming et al.	2012				1		
Nutritional properties of edible bird nest	Hamzah at al.	2013	1					
Edible bird’s nest: food or medicine?	Wong et al.	2013	1					
Nutritional composition of the farmed edible bird's nest (Collocalia fuciphaga) in Thailand.	Saengkrajang et al.	2013	1					
Edible Bird’s nest extract as a chondro-protective agent for human chondrocytes isolated from osteoarthritic knee: in vitro study	Chua et al.	2013	1					
Application of the fuzzy failure mode and effect analysis methodology to edible bird nest processing.	Jong et al.	2013					1	
A rapid technique to determine purity of edible bird nest.	Hamzah et al.	2013		1				
Determination of free N-acetylneuraminic acid in edible bird nest: development of a chemical marker for quality control.	Chan et al.	2013		1				
Edible bird's nests—How do the red ones get red?	But at al.	2013				1		
Prevalence of nitrite and nitrate contents and its effect on edible bird nest's color.	Paydar et al.	2013				1		

An overview of the study of the right habitat and suitable environmental factors that influence the success of edible bird nest production in Malaysia.	Idris et al.	2014						1		
Edible bird’s nest ameliorates oxidative stress-induced apoptosis in SH-SY5Y human neuroblastoma cells.	Yew et al.	2014			1					
In vitro bioaccessibility and antioxidant properties of edible bird’s nest following simulated human gastro-intestinal digestion	Yida et al.	2014			1					
Factors affecting intention to purchase edible bird’s nest products: the case of Malaysian consumers	Sharifuddin et al.	2014							1	
Nutritional composition and solubility of edible bird nest (Aerodramus fuchiphagus).	Halimi et al.	2014								1
Cleaning method by keratinase enzyme for improving quality edible bird nest.	Utomo et al.	2014					1			
Preliminary study on free sialic acid content of edible bird nest from Johor and Kelantan.	Marni et al.	2014	1							
Characterization and standardization of edible birds Nest (EBN)-determination of sialic acid	Thavamanithevi ett al	2014	1							
Impact of swiftlet’s moult season on the value of edible bird nests	Tan at al.	2014		1						
Establishment of a holistic and scientific protocol for the authentication and quality assurance of edible bird’s nest.	Yang et al.	2014		1						
A single input rule modules connected fuzzy FMEA methodology for edible bird nest processing.	Jong et al.	2014		1						
Authentication of Edible Bird's nests by TaqMan-based real-time PCR	Guo et al.	2014		1						
Identification of edible bird’s nest with amino acid and monosaccharide analysis.	Chua et al.	2014		1						
Effects of edible bird's nest on hippocampal and cortical neurodegeneration in ovariectomized rats.	Zhiping, et al.	2015			1					
Edible bird’s nest prevents high fat diet-induced insulin resistance in rats.	Yida et al.	2015			1					
Edible bird’s nest attenuates high fat diet-induced oxidative stress and inflammation via regulation of hepatic antioxidant and inflammatory genes.	Yida et al.	2015			1					
Lactoferrin and Ovo transferrin contribute toward antioxidative effects of Edible Bird’s Nest against hydrogen peroxide-induced oxidative stress in human SH-SY5Y cells.	Hou et al.	2015			1					
Secrets of edible bird nest.	Babji et al.	2015					1			
Edible bird nest processing using machine vision and robotic arm	Subramaniam et al.	2015					1			
Metabolite profiling of edible bird's nest using gas chromatography/mass spectrometry and liquid chromatography/mass spectrometry.	Chua et al.	2015	1							
Enzyme immunoassay for the detection of porcine gelatine in edible bird’s nests.	Tukiran et al.	2015	1							
Culture and molecular identification of fungal contaminants in edible bird nests.	Chen et al.	2015		1						
Waste to Wealth for the Edible Bird Nest Industry. In Applied Mechanics and Materials	Hamzah et al.	2015		1						
Preliminary nitrite, nitrate and colour analysis of Malaysian edible bird’s nest.	Quek et al.	2015				1				
Characterization of swiftlet edible bird nest, a mucin glycoprotein, and its adulterants by Raman microspectroscopy.	Shim et al.	2016	1							

A comprehensive review of edible bird nests and swiftlet farming.	Chua et al.	2016					1			
Differentiation between house and cave edible bird's nests by chemometric analysis of amino acid composition data.	Seow et al.	2016	1							
A perceptual computing-based method to prioritize failure modes in failure mode and effect analysis and its application to edible bird nest farming.	Chai et al.	2016		1						
A comparative quality study and energy saving on intermittent heat pump drying of Malaysian edible bird's nest.	Gan et al.	2017					1			
Identification of two novel antioxidant peptides from edible bird's nest (Aerodramus fuciphagus) protein hydrolysates	Ghassem et al.	2017	1							
A rapid and nondestructive method to determine the distribution map of protein, carbohydrate and sialic acid on Edible bird's nest by hyper-spectral imaging and chemometrics	Shi et al.	2017	1							
Inspection for Edible Bird-Nest Cleaning System Using Machine Vision Algorithm	Ting, P. H.	2017		1						
Thermal analysis methods for the rapid identification and authentication of swiftlet (Aerodramus fuciphagus) edible bird's nest–A mucin glycoprotein	Shim et al.	2017		1						
Formulation of Crude Enzymes from Bacillus sp. MTS for Cleaning Solution.	Rahaya et al.	2017					1			
Automated Grading of Edible Bird Nest	Koay, M. Y.	2018	1							
A comprehensive review of edible bird's nest	Dai et al.	2020					**1**			
		Total	**34**	**20**	**8**	**8**	**10**	**2**	**1**	**1**

APPENDIX III

GUIDELINE FOR EBN CLEANING FACILITY

I. EBN Cleaning Process Flow

The first step to setting up the cleaning facilities is the process flow. Each area or division must be properly located within the given premise. **Figure I** below show an example of cleaning facilities in operation.

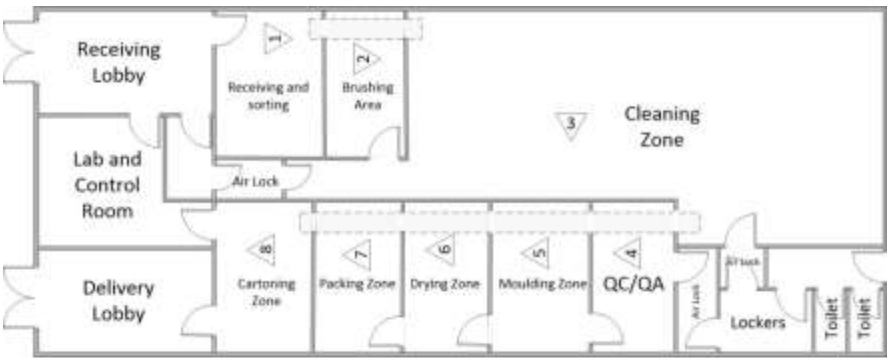

Figure I: Example of cleaning facilities

i) Receiving Station

When the raw bird nests arrive at the facilities, they are weighed and recorded according to grade and stored under a controlled environment. During the transfer of raw bird nests, all recorded bird nests will be placed in a clean container, sealed with a plastic bag or plastic wrap, to ensure no the possibility of contamination.

During transporting raw bird nests to the processing zone, the worker has to pass the container through the pass over the window; and he or she should go through the sterilisation process by airlock compartment.

The raw bird nests once removed from the container will be delivered to station one.

ii) Brushing Station

The worker who handles the raw bird nest has to ensure that raw bird nests are not broken or with any crack. The selected bird nest will be brushed off all the dust or impurity with a medium soft toothbrush. The process starts from the base and slowly moves toward the lip of the nest. During the process, a small amount of water is required. However, it is crucial not to soak up the bird nest. Moisture control is very important at this station.

The entire brushed bird nest will be placed in the container for at least 30 minutes on top of the clean tower until becoming slightly soft and elastic.

iii) Soft Take Station

Before any operation, all the tools and equipment will be sterilised to ensure cleanliness of any contaminations. The workers must wear proper attire including a hand glove, mask and hair cap.

The first step is to remove the entire fine nest near the base and keep the nest separate in another small container.

When picking and removing the feathers from the bird nest, it is to start~~s~~ at one area and slowly moves to another. A small amount of clean water can be applied to the area where feathers are hard and difficult to remove. The clean water can be sprayed toward the area but not the entire bird nest. Let the water be absorbed into the bird nest glands. Do not remove the feather immediately.

Once all impurities or feathers are removed, the processed nest will be placed into another clean container and moved to the second station.

iv) Major Pick Station

At this station (**Figure II**), workers will be equipped with a magnifying glass either with a goggle or table stand. It is extremely slow in picking up all the small dust particles and feathers from the bird nest.

It is not recommended to spray any water during this stage; instead, the skill of the workers is foremost important in this operation. Workers should start with the internal surface before approaching the external surface.

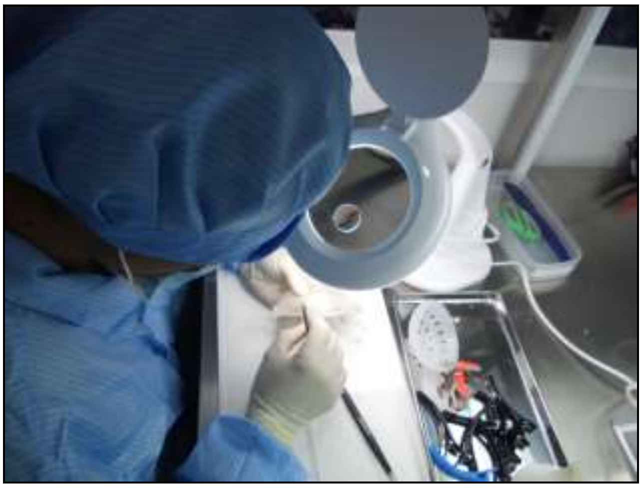

Figure II: Removing of dust particles or feathers at major picking Station

v) Quality Checking Station

All cleaned bird nests will go through checking and final inspections (Figure 7.9) to ensure the level of cleanliness achieved. At this stage, the supervisor also needs to make sure that all major whole is patched back or properly concealed.

Figure III: Inspection and patching of bird nest at QC Station

vi) Moulding Station

The entire cleaned bird nest will be placed in the plastic mould and firmly pressed down to maintain the desired shape (**Figure IV**). Once the shape is achieved, a few numbers of the plastic clips will be applied to firmly hold the bird nest to the mould (**Figure V and VI**)

Figure IV: Firmly pressed the bird nest to shape with plastic mould

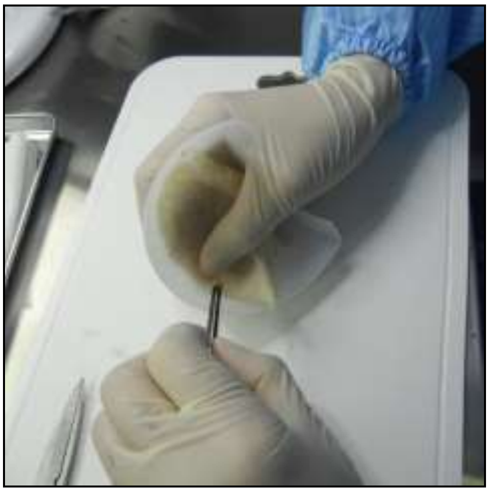

Figure V: Clip to hold the bird nest to position

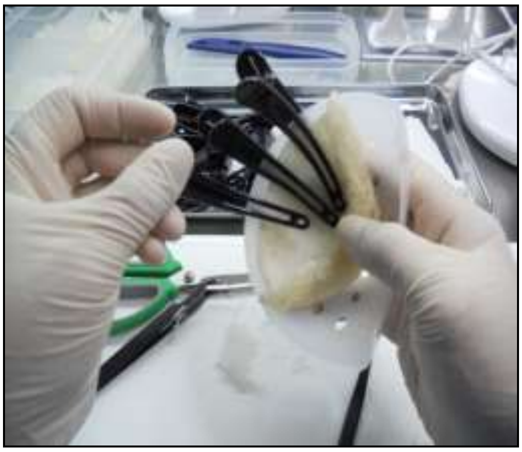

Figure VI: Number of clips apply according to situation

vii) Drying Station

The finished bird nest will be placed in the air-drying chamber (**Figure VII**) for 4 hours until completely dry. At the first 1 hour, each bird nest has to be removed from the chamber at the interval of 15 minutes to ensure the shape is firmly pressed against the mould. This process will ensure the smooth surface of the bird nest is achieved.

Figure VII: Bird nest to be placed under air drying chamber position

viii) Final Inspection

The dry bird nest will be removed from the mould and placed in the container for final quality inspection and sorting. All cleaned bird nests will go through a rigorous quality inspection and be sorted according to size, shape and colour (**Figure VIII & IX**).

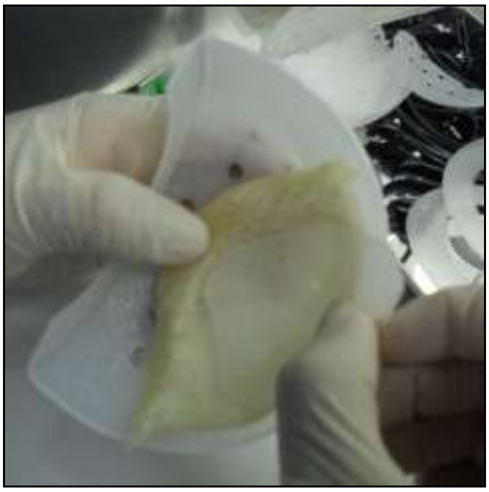

Figure VIII: Dry bird nest to be removed from the mould position

Figure IX: Inspection and sorting of grade position

II. Suggested Zoning and Specification

In general, there are three zone types in all production areas (**Figure X**). The first zone is called the Grey Zone or Grey Area. The specification for this zone is the common area, similar to office space (**Figure XI**). It consists of Receiving Lobby, Laboratory, Toilet, Utility and Delivery Lobby.

Figure X: Classification of Zoning

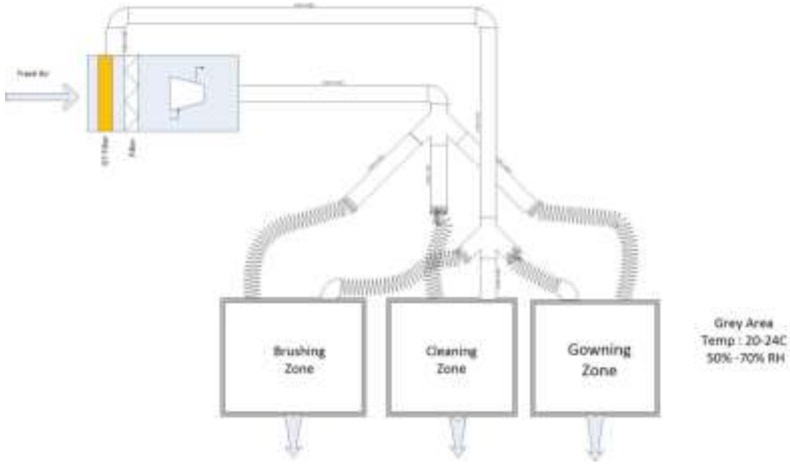

Figure XI: Specification Requirement of Grey Area position

The second zone is the Clean zone or Clean Area. The majority of the production area is classified under this zone. It is required a transition area called an air lock chamber to sterilise any object before entering into this zone. The specification for this area is classified under Class 100. (**Figure XII**) The temperature requirement of 20 to 24 degrees with relative humidity ranges from 50% to 70%.

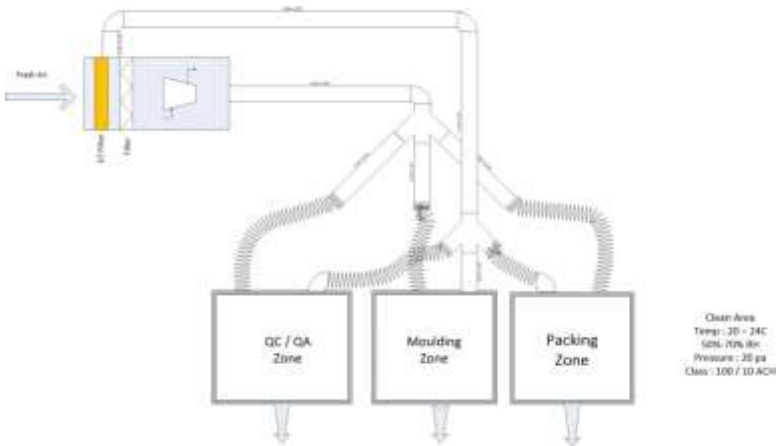

Figure XII: Specification Requirement of Clean Area position

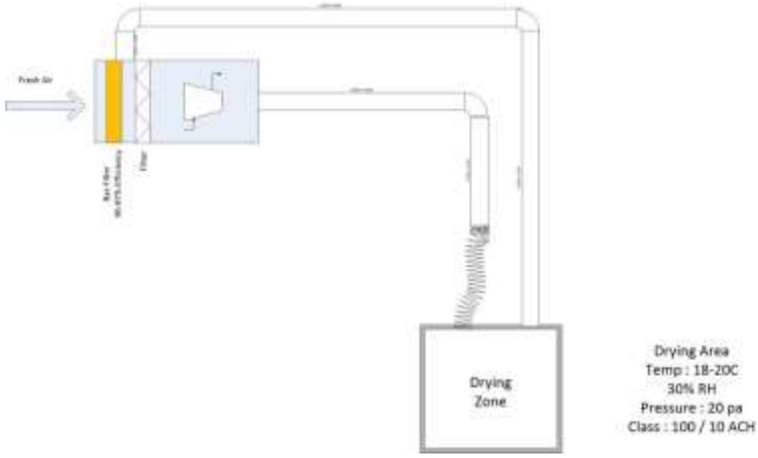

Figure XIII: Specification Requirement of Drying Area position

The transaction zone is called the Gowning or De-gowning area, this serves as a checkpoint to ensure all objects or personally comply with the requirement before proceeding to the Clean Area. It also acts as a segregation area between the grey and clean area.

The specification on drying area dictates a slightly lower temperature requirement of 18 to 20 degrees and relative humidity of 30% (**Figure XIII**).

A. Standard Operation Procedure

The processing plant is divided into three zones comprising the Preliminary, Cleaning and Packaging zones.

Each zone contains various processes as shown in **Figure XIV** below:

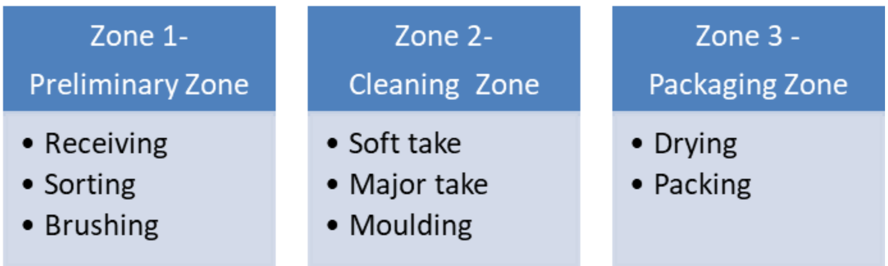

Figure XIV: Zoning and function

B. Zone 1 – Preliminary Zone

I. Receiving Station

i. Upon receiving of raw bird nest, ensure the bird nests are dry and without mould (Test with a moisture meter).
ii. Keep the bird nests inside the freezer for 20 minutes.
iii. Check the moisture content. If above 10%, spread out and dry under a fan or ventilated room.
iv. Weigh~~t~~ the bird nests and record the quantity according to grading and cleanliness.

II. Sorting Station

i. Sort out the birds nests according to size and grade.
ii. Sort out according to cleanliness; make sure all bird nests with mould are separated from the lot.
iii. Sort out according to colour: white, yellow or grey.

III. Brushing Station

i. Ensure the sink area and workstation are clean at all times.
ii. Prepare the clean container for bird nests after brushing.
iii. Ensure raw bird nests, tools and containers are ready before brushing.
iv. Follow the SOP on the brushing procedure.
v. Upon the completion, ensure the containers are properly covered before leaving to Zone 2.

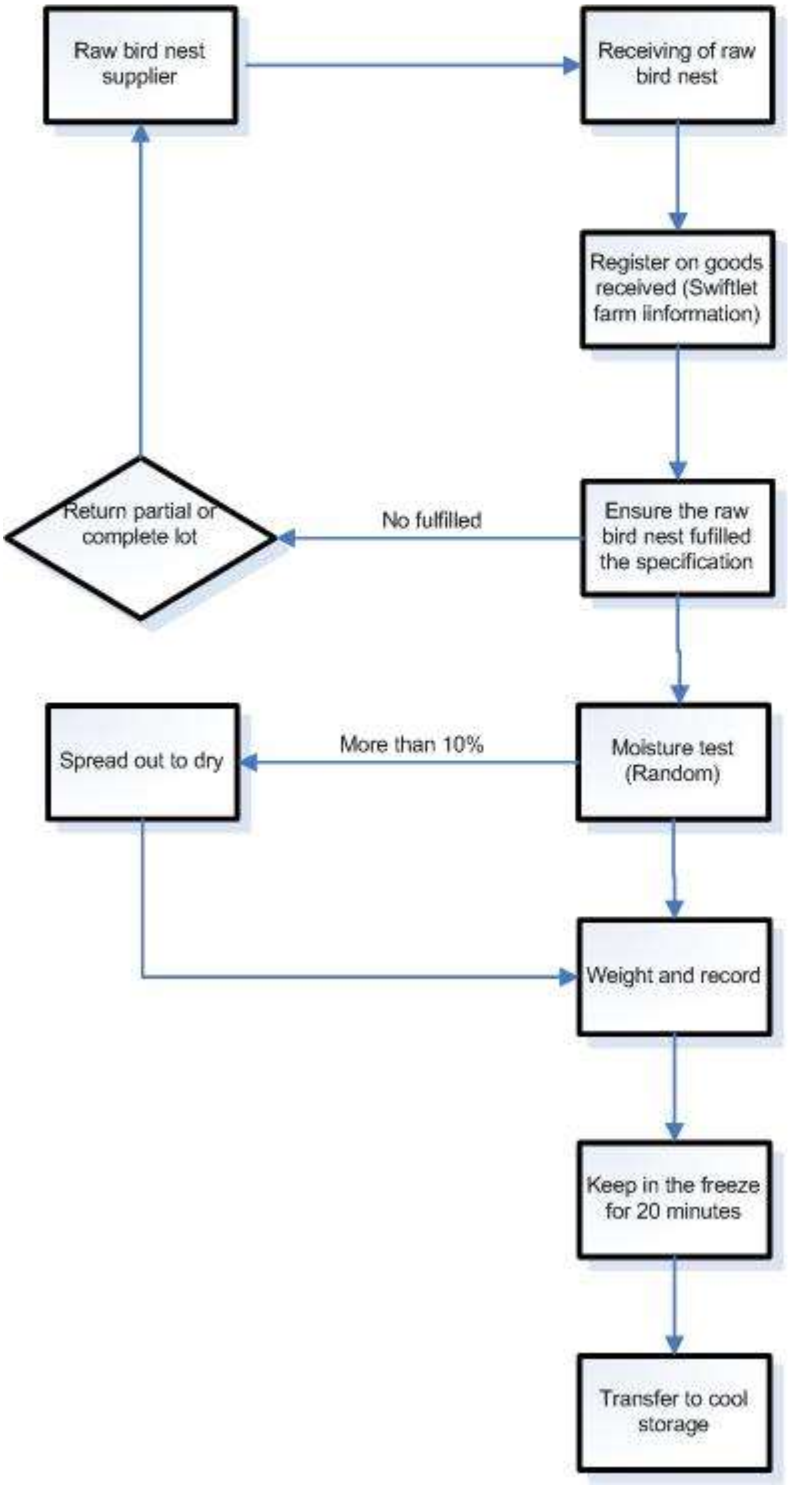

Figure XV: Process Flow Chart for Zone 1

C. Zone 2 – Cleaning Zone

1) Soft Take Station

i. Upon receiving of containers, ensure that the external surface of containers is sterilised before entering.
ii. Transfer the raw bird nests to small/individual containers for each cleaning staff.
iii. Ensure the workstation surface is properly sterilised before cleaning.
iv. Ensure all tools and equipment are ready and in order.
v. Clean the bird nest according to SOP.
vi. Keep the semi finished bird nests in the container before proceeding to the next station.

2) Major Take Station

i. Ensure the workstation surface is properly sterilised before cleaning.
ii. Ensure all tools and magnifying glass are functional and in order.
iii. Clean the bird nests according to SOP.
iv. Keep the clean bird nests in plastic mould and container before proceeding to the next station.

3) Moulding Station

i. Ensure the workstation surface is properly sterilised before cleaning.
ii. Ensure all tools and drying machines functional and in order.
iii. Mould the bird nests according to SOP.

iv. Ensure the bird nests are securely placed in plastic mould and container before proceeding to the next station.

D. Zone 3 – Packaging Zone

1) Drying Station

i. Ensure all drying machines are functional and operational.

ii. Place the bird nests into the drying machines according to SOP.

iii. Keep track of the time upon placement of bird nests into machines.

iv. Keep the dry bird nests into the containers according to grade and tightly covered.

2) Packing Station

i. Ensure the workstations are properly sterilised and cleaned.

ii. Ensure all packing materials ready and in order.

iii. Pack the bird nests according to SOP.

iv. Record the pack bird nests before sending them into stock.

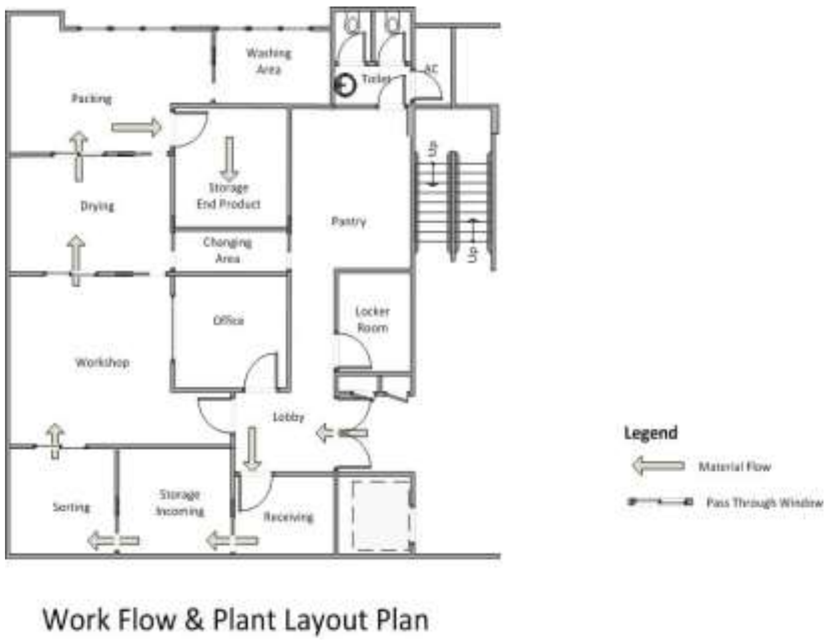

Figure XVI: Sample layouts for MESTI

Steps in Setting Up EBN Cleaning Facilities

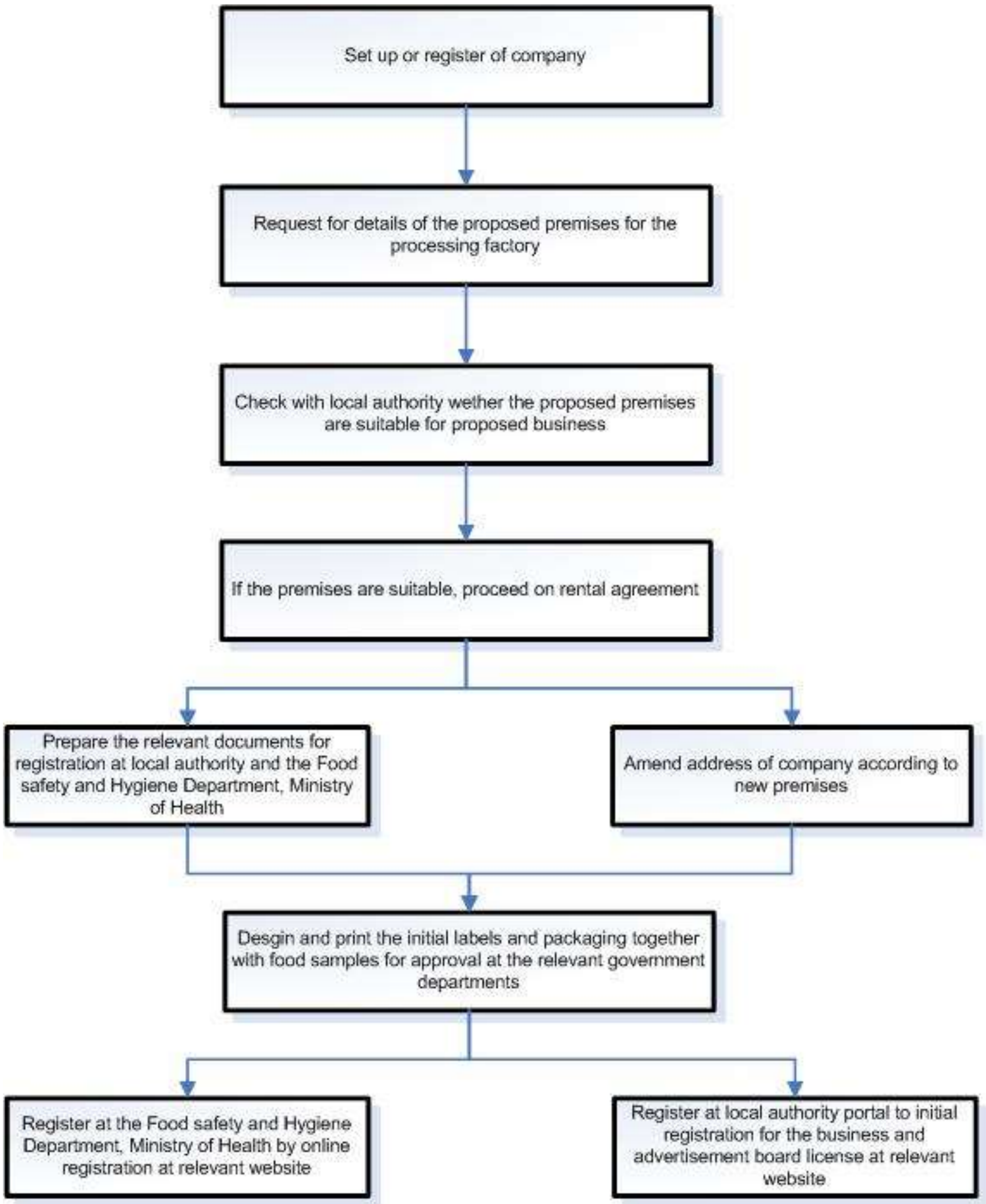

Figure XVII: Flow charts of Setting up cleaning facilities

Figure XVII shows the sample step of setting up cleaning facilities in Malaysia. The details may vary according to local authorities' requirements.

C. Governance Law in Malaysia

The laws applicable for the setting up of the processing facilities areas listed below:

1) The Food Act 1983
2) Food Hygiene Regulations 2009
3) Food Regulation 1985
4) Guidelines for Food safety is responsibility of the industry (MESTI) certification scheme
5) Food (Food Analysis Fee) Regulations 2016
6) Food (Compounding of Offences) Regulations 2017
7) Food Analyst Act 2011
8) Animal Act 1953
9) S.107 of Local Government Act 1976

D. Requirement by Food Act 1983

The Food Act 1983 provides for the regulation of food, food hygiene and issuance of the health compliance certificate in Malaysia. According to this act, amongst other things:

Any authorized officer authorized by the health minister may, in discharging his duties under the Food Act, enter your premises where the processing of the bird nests is conducted to, amongst other things:

Examine any food, take samples of food, examine anything that he believes is used or capable of being used for the preparation, preservation, packaging, storage, conveyance, distribution or sale of the food (Food Act 1983);

I. Open and examine any packaging including the company's products used or found in the company's business (Food Act 1983);

II. Examine any books, documents or other records found in any food premises that he believes contain any information relevant to the enforcement of this Food Act and make copies thereof (Food Act 1983);

III. Demand for the production of any national identity card, business registration certificate or any relevant document that the authorised officer may require (Food Act 1983);

IV. Seize and detain for such time as may be necessary any food or appliance which he believes any provision of the Food Act have been contravened by you, your employees or your business (Food Act 1983);

V. Examine you, your employees or any person found in the premises whom he believes to be acquainted with the facts and circumstances of any matter under the Food Act (Food Act 1983); and

VI. May arrest without a warrant any person regarding your business if in the event he believes that such person has committed an offence under the Food Act or any applicable regulation if such person fails to furnish his name and address or he has furnished a false name, and address or that this person is likely to abscond (Food Act 1983);

Food processed and sold by your business must:

i. Not containing substances injurious to health (Food Act 1983);

ii. Not unfit for human consumption (Food Act 1983);

iii. Not be adulterated food, wherein food is for example diluted from the description as stated in the food label and so on (Food Act 1983);

iv. Comply with labelling requirements (Food Act 1983); and

v. Be advertised truthfully (Food Act 1983).

E. Requirement by the Food Hygiene Regulation 2009

The Food Hygiene Regulations 2009 was made to ensure amongst other things, the following:

1. That food premise is hygienic and satisfactory in terms of design and building
2. That food handlers maintain personal hygiene and put into place practices that keep the food free from contaminants;
3. That all appliances, equipment and tools are easily cleaned are clean, and
4. To provide for mandatory food safety assurance programmes such as MESTI, HACCP, GHP and GMP.

The Hygiene Regulations amongst others, require the following:

1) To put into place a food traceability system (Food Hygiene Regulation 2009);
2) Employ food handlers that have gone for the relevant medical examinations and vaccinations. Such handlers must attend training to ensure the relevant standards of hygiene and sanitation are maintained (Food Hygiene Regulation 2009);
3) Mandatory registration of the Premises with the Ministry of Health, Malaysia, wherein upon registration, a certificate of registration will be issued (Food Hygiene Regulation 2009);
4) The certificate of registration must be displayed at the Premises

Regarding the premises, the Hygiene Regulation requires the following:

I. To be located away from sources of contamination, have cleaning and disinfection cleaning facilities and ample water supply (Food Hygiene Regulation 2009);

II. Pest control system must be employed to ensure Premises are free from pests (Food Hygiene Regulation 2009);

III. Have a good system to dispose of refuse (Food Hygiene Regulation 2009);

IV. Located away from contaminants (Food Hygiene Regulation 2009);

V. Designed to facilitate cleaning and disinfection (Food Hygiene Regulation 2009);

VI. Have ample water supply, space for storage and distribution of water (Food Hygiene Regulation 2009);

VII. All wall and floor surfaces must be easily cleaned and kept clean (Food Hygiene Regulation 2009);

VIII. Lighting, ventilation, ceilings, doors, furniture, fittings, food contact surface, washbasins, toilets, draining, food storage and changing room must be designed and implemented according to the requirements of the Hygiene Regulation (Food Hygiene Regulation 2009);

IX. Ensure that all food be stored in containers and areas free from contaminants (Food Hygiene Regulation 2009);

X. Pack all food that is free from contaminants and is maintained in the original state due to the nature of the packaging technology (Food Hygiene Regulation 2009);

XI. All food is categorised and stored in the correct areas to not cause cross-contamination. Comply with all space requirements in the Hygiene Regulation and implement a First In and First Out system in food storage (Food Hygiene Regulation 2009).

F. Requirement by Food Regulations 1985

Specific Regulation for Edible bird nest stated in 178A of the Food Regulations

For these Regulations, edible birds nest shall be bird nest produced from the glutinous material in the saliva secreted in the swiftlet's two sublingual salivary glands from the Aerodramus species which are Aerodramas fuciphogus, Aerodramas Maximus or Collocalia species which is fit for human consumption;

Edible bird nests may undergo cleaning processes including sorting, soaking, picking of feathers and impurities, moulding and drying, and

Raw edible bird nest which has undergone cleaning processes under sub-regulation should contain no more than 30 milligrams per kilogram (mg/kg) of nitrite which is naturally present.

Table A: Registrations, Licenses and Certificates

No	Registrations, Licenses or certificates to be obtained	Purpose to obtain such licenses	Relevant Government Department	Certain main documents and matters to be prepared for application
1	Business and signboard licenses	Licenses to conduct business at a locality and to put up the	Local authority	Processing manual and certificate of registration for company, picture or

		business signboard		premises etc;
2	Certificate of Food Premises from Ministry of Health	Complying with Regulation 3 of Food Hygiene Regulations 2009 by registering processing premises at local Food safety And Quality Division	Food Safety And Quality Division Ministry of Health	As above, in addition to personal details of workers and products handlers
3	MESTI Certification for hygiene	To ensure that hygiene standards and procedures are implemented and practised throughout the processing and delivery of the company product.	Food Safety And Quality Division Ministry of Health	Processing manual, Company registration details, amongst others
4	Registration and application for CVHP/VHM certification from the Department of Veterinary Sciences	For the registration of processing, plant wherein products are edible bird nest to be exported to China	Department of Veterinary Sciences, Ministry of Health	Putting together manual Implementing a track and traceability system in place by using invoices, receipts, buying and selling records, QR codes, RFID or Barcodes. Prepare for adequate audit and compliance

				audit
5	Register with the China National Certification and Accreditation Administration (CNCA) Only available to GVHP/VHM certificate holders	This is to comply with Chinese health and veterinary requirement for the export of processed bird nests into China	China National Certification and Accreditation Administration (CNCA)	Prepare for inspection from CNCA auditor