OPTIMUM TIME MANAGEMENT OF FIRST PRE-FLIGHT DEPARTURE BY LCC OPERATORS AT KLIA2

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF COMPUTER SCIENCE

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ABSTRACT

The aim of the research was to investigate, the management of first flight, delay in first flight take off due to practices of matching pilots and aircraft on Low Cost Carriers (LCC). A case study and field study research strategies were employed for the methodology. A sample of 61 first flights of the day for LCC to various destination departing from KLIA2 over a period of one month was used for quantitative analysis. The qualitative aspect was undertaken through interviews of focus groups (pilots, passengers and customer service representatives). A summary and significance test were undertaken to analyze the data for patterns and significance of delays. The research findings indicate there was significant delays in first flight take-off during the study period. Some of these delays were identified to the current system of pilots and aircraft matching. A tentative solution in the form of best practices was suggested for effective management of the first flight by LCC operators. From a theoretical point of view, it expounds and adds on to the understanding of delay, especially the first flights of the day and especially for LCC operators. There are a few limitations in the study as the focus is only on the first flight management; especially the match between aircraft and pilots for a timely departure. Other factors could also play a significant part; both controllable and uncontrollable. A comprehensive study on it can identify significance and the significance of the overall delay. An area not covered by this study and a potential cause for a separate study is interviews with top management staff; this could confirm the existence of the problem for a broader understanding of the issue and its relationship to management and cost-effective productivity.

ABSTRAK

Tujuan penyelidikan untuk menyiasat, pengurusan penerbangan pertama, kelewatan penerbangan pertama mengambil kira akibat amalan pemadanan juruterbang dan syarikat penerbangan tambang murah (LCC). Kajian kes dan kajian lapangan adalah strategi yang digunakan bagi metodologi penyelidikan. Sampel sebanyak 61 penerbangan pertama syarikat penerbangan tambang murah ke pelbagai destinasi yang berlepas dari KLIA2 dalam tempoh sebulan digunakan sebagai analisis kuantitatif. Aspek kualitatif telah dilaksanakan melalui temubual kumpulan fokus (juruterbang, penumpang dan wakil khidmat pelanggan). Ringkasan dan kepentingan ujian telah dijalankan untuk menganalisis data untuk mencari corak dan kepentingan kelewatan. Rumusan kajian menunjukkan terdapat kelewatan yang ketara di pertama penerbangan dalam tempoh kajian. Beberapa kelewatan ini telah dikenalpasti untuk sistem semasa dan padanan juruterbang pesawat. Penyelesaian tentatif dalam bentuk amalan terbaik dicadangkan bagi pengurusan yang berkesan penerbangan pertama oleh pembekal LCC. Dapatan kajian menunjukkan Jadilah kelewatan yang ketara di pertama penerbangan mati dalam tempoh kajian. Beberapa kelewatan ini telah dikenalpasti bagi sistem semasa dan juruterbang pesawat yang sepadan. Tentatif penyelesaian dalam bentuk amalan terbaik yang dicadangkan bagi pengurusan yang berkesan penerbangan pertama yang efektif oleh operator LCC. Dari sudut teori, ia menjelaskan dan menambah kepada pemahaman tentang kelewatan, terutama penerbangan pertama hari tersebut untuk operator LCC. Terdapat beberapa kekangan dalam kajian ini kerana tumpuan hanya pada pengurusan penerbangan pertama; terutamanya dalam pemadanan antara pesawat dan juruterbang untuk yang berlepas tepat pada masanya. Faktor-faktor lain juga boleh memainkan peranan yang utama; iaitu keadaan terkawal dan tidak terkawal. Kajian yang komprehensif boleh mengenalpasti kepentingan kelewatan keseluruhan. Salah satu bidang yang tidak dapat dicapai oleh kajian ini dan oleh sebab itu memerlukan kajian

berasingan adalah temu bual dengan kakitangan pengurusan atasan; ini dapat mengesahkan kewujudan masalah ini untuk pemahaman tentang isu tersebut dan hubungannya dengan pengurusan dan produktiviti yang berkesan dari segi kos.

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LIST OF ABBREVIATIONS

CI	:	Confidence Interval
DM	:	Decesion Making
DSS	:	Decision Support System
DIT		Innovation Diffusion Theory
FTL	:	Flight Time Limitation
KLIA2	:	Kuala Lumpur International Airport 2
LCC	:	Low-cost carrier
ME	:	Margin of Error
MIS	:	Management Information System
NAS	:	National Airspace System
OTP	:	On-Time-Performance
TAM	:	Technology acceptance model
UTAUT		The Unified Theory of Acceptance and Use of Technology

LIST OF APPENDICES

CHAPTER 1: INTRODUCTION

1.1 Introduction

The aviation industry is known as an industry that is heavily regulated; both compliances with country's authority prescribes standards and licensing requirements for aircraft and international established standards.

Despite heavy regulations, the aviation industry has grown and become a major player in the transportation industry within a short period (Gillen, 2006; Ssamula & Venter, 2013). It has also become more competitive as airlines expending to capture new routes and fulfilled passengers need. This also means the cost of operating has increased and the airline must find the balance between cost effective and the airworthiness of the aircraft (Tsoukala et al., 2008; Cristea et al., 2012).

Over the years, low cost airline model has been a massive successful business model in the airline industry, but the initial definition of low-cost model has evolved to include myriad new reference terms like hybrid service models.

These airlines objective is volume turnover through strategic low airfare pricing and minimising high labour and maintenance costs. However, over the years, the cost of operating has increased and airlines are increasingly balancing cost effective and the airworthiness of the aircraft (Pearce, 2012).

Airlines, as well as third party providers, constantly seek ways to reduce costs while maintaining reliability and efficiency and quality of services. The epitome, time is money is very appropriate to the airline industry as any delayed or grounded aircraft generate less or no revenue and minimising unscheduled delay as per industry standard is a major goal of every airline.

1.2 Background of the Study

In the low-cost airline industry low customer costs, on-time arrival and on-time departure are key attributes to a successful airline operation. Many variables are involved but generally categorized as flight hours and expenditure; maximizing the flight hours of available aircraft and minimizing expenditure on fleet maintenance. To achieve these goals, the availability of a sufficient number of aircraft, personnel and spare parts is coupled with structured route scheduling and structured maintenance. In the ideal system, periodic, structured on time maintenance of the aircraft fleet is technically sufficient to keep the fleet in operation on time and on budget indefinitely. These activities are also supported by various software where the emphasis is on structural and functional activities.

In reality, however, unexpected events are the norm but within levels of “acceptable” delays. According to Bureau of Transportation Statistics (2009), internal problems at carriers caused delayed arrivals of approximately one third of flights and a further one third of these late arrivals was caused by aircraft arriving late from its previous sector. Growing delays threaten the competitiveness of the airline besides adding cost to its operation. In 2008 the US Senate Joint Economic Committee received a report, that total losses to airlines, passengers and the United States economy in the previous year was estimated at around USD41billion of which USD31billion was in direct costs and the remaining in related overhangs.

In a related study from 2017, by the United States Bureau of Transportation Statistics, maintenance problems, crew problems, aircraft interior cleaning, luggage handling and refueling were among the reasons for delays, but airlines aren't required to report the reasons for their delays to the regulatory authorities by sub category and therefore is no detailed visibility of the reasons provided. Interior post flight cleaning is not a first flight of the day issue. The other delays are controllable nor directly attributable to the airline and the research will focus on flight crew problems.

There are two parts described in the delays. Those internal to the airline operator air carrier delay and aircraft arriving late. Those external to airline operators are NAS, Security and Extreme Weather. The research looks into the management of the first flight departure from the airline perspective. Referring to data provided by Bureau of Transportation Statistics will highlight two observations, as root causes of 67.4% of all flight delays “Previous flights that arrive late and that require the departure of the same aircraft result on the follow on present flights to also depart late ” and “there is no requirement for airlines to report or provide reasons for flight delays to the authorities”. A late start of the first flight delays the subsequent flight operations dependent on the same aircraft.

Among the many cost triggers of significance, especially for low cost airlines, is the delay of the first departure of the day. This delay will then snowball during the rest of the aircraft flying time of the day and cause more delays. This area of concern forms the central theme of the author.

1.3 Problem Statement

The ideal scenario for commercial airlines is to be on time at departure, keeping within the acceptable norm, that is flight taking off within 15 minutes of announced time (Flight Operations Directive, 2016). Especially for LCC, this scheduled time is critical as it involves multiple return journeys in a day and may cause a ripple effect. However, flight delays had been and have been an issue throughout (Diaz & Ruiz, 2004; Lung Wu, 2005; Beygi, Cohn & Lapp, 2010, Adam, et al., 2014; Weiwei Wu, et al., 2018).). Some delays are inevitable especially due to weather conditions and technical reasons but others can be improved through effective management. The current management of flight practices lacks effective schedule management, especially for the first flight of the day for LCCs that can contribute to flight delays.

There has been little research on delayed propagation studies and delayed contingencies plan on operators of LCCs to shed reasons for such behavior by LCCs operators. Some of the studies done on delay find delays are invertible and need to be internalized to minimize cost to the users (Diaz & Ruiz, 2004), although it may incur a cost to the airline operators. Others (Beygi, Cohn & Lapp, 2010 Adam, et al., 2014; Weiwei Wu, et al., 2018), focused on delay propagation over the day and its link to cancelled flights. Scheduling of flight is also a known cause of delay; although schedule may be robust, it lacks an element of probability in the schedule to make it more efficient; example through the inclusion of buffer time for delays (Lung Wu, 2005).

The current situation at KLIA2 points to regular flight delays by LCC operators causing inconvenience and cost to passengers. Why such a situation still occurs at KLIA2, is it significant and has schedule and matching of pilots of first flight triggering such delays is not known. Therefore, this research is focused on understanding the influence of schedule on a match of pilots and flights for first flight take-off of the day. The current situation in the airline industry suggests a need to continuously monitor aircraft flight delays (Kafle & Zou, 2016). The issue of the first flight delay due to aircraft and pilot selection although is an important consideration, especially for the first take-off of the day, is least emphasized by operators.

Hence, the expected finding of this research can provide a reference frame to evaluate the magnitude of the problem of flight delay and provide guidelines on a structure that can be incorporated as best practices to enhance managements of LCCs.

1.4 The Aim and Objectives of the Study

The previous section infers that cost reductions achieved through application of efficient time management leads to an increased value creation within an airline. This research is centered around one aspect of efficient management namely schedule management of pilots and aircrafts. Therefore, the research intends to achieve the following Aim;

1.4.1 Aim

The research aim is to investigate the significance of delay in first flights take-off of the day and the influence of schedule matching of pilots and aircraft as a contributing factor on delay for LCCs.

1.4.2 Objectives

Four objectives are structured on how to achieve the aim of this research. They are centered on how significant is the first flight delay, the current schedule and practices and its influence on delay and a proposal for efficient schedule management. The following Objectives are devised;

1. Objective 1: to investigate the significance of delay in first flights take-off for LCCs.
2. Objective 2: to investigate the current practices of airline's pilots and aircraft matching for LCCs.
3. Objective 3: to investigate if current practices of airline's pilots and aircraft matching have an effect on first flight delays for LCCs.
4. Objective 4: to propose best practices solution to optimize time management of first flight for LCCs.

1.4.3 Research Questions

The subsequent four research questions are developed to guide the research to answer objectives and subsequently the Aim.

1. Research Question 1: Is the delay in first flights take-off significant for LCCs?
2. Research Question 2: What are the current practices in use in matching pilots and aircraft for LCCs?
3. Research Question 3: Are the current practices in matching pilots and aircraft efficient as far as time management is concerned for the first take-off of LCCs?
4. Research Question 4: What are the best practical solutions to optimum time management for first flight for LCCs?

1.5 The significance of the Study

The significance of studies conducted are emphasized by the following primary motives beginning with Janice (2000) that time management is an important measurement of a key central competency of the airline. The airline industry has always faced lo profitability as a challenge and this adds significance to research conducted and suggest the need to effectively manage airline delays. Despite efforts and interest within the industry in adopting a system-based approach through application and use of numerous models and software towards a solution many areas remain outside this focus. Prior research of time management in airlines concentrated on evaluating airline time management strategies, its structures and practices related to specific aspects of time, primarily operations. However, the literature is scarce in empirical research on effective management of pilots and aircraft match, especially for first take-off. However, this issue sets a ripple effect and are felt by all stakeholders. The findings of this research, hopefully, gives a better understanding by filling a gap in the literature and guides the airline time management approaches.

1.6 Scope

To ensure that this research can achieve its set of objectives within the timeframe constraints, the research will focus on investigating the delays of first pre-flight departure by LCC operators at KLIA2.

1.7 Chapter Summary

This chapter discussed background, scope, purpose and objective of the study, followed by the definition of key terms and a brief view of the expectation of follow up chapters.

1. Chapter 1 presents a brief background of the research and its challenges with the objectives and scope of research are also defined.
2. Chapter 2 Literature review is divided into three sections; the first part is on analysis of low-cost airlines' including the rationale for its rapid growth and a discussion of LCC in Malaysia. The second part is on cost and time management where the literature is sourced for theories on time management and its relation to cost to identify its importance for a viable business model. Lastly, discusses the general concepts of best practice solution and its development with a focus on best practice solution in the airline's industry
3. Chapter 3 defines the research methodology employed to achieve the research objectives.
4. Chapter 4 describes the findings and analysis of the conducted project to develop best practice solutions for the first pre-flight departure at KLIA2 and discussed the development of the best practice proposal.
5. Chapter 5 concludes the research and discusses how the research objectives were met. and the contribution of the research outcome.

CHAPTER 2: LITERATURE REVIEW

In this section, the literature review will take three distinct approaches. The first approach is to look in depth the current practices of the first flight by the LCC operators as this consists of an analysis of LCC airlines that is the scope of the research. The second is a review of technology and time management to better understand the optimization of time management and how it will be able to fit in the airline first departure. Lastly the decision support solution and how it will be able to enhance the first pre-flight departure.

2.1 Low Cost Airlines

The airline industry constitutes one of the clearest examples of a hitherto privileged service being transformed into a mass market driven service. The primary source of growth is from substantially increased numbers of regular passengers motivated by the large drop in airfares offered by low cost carriers. Most air travelers like most well informed and discerning customers are aware that prices are proportional to the services subscribed and accept the trade off, of cheap fares against minimal add on frills. The net result of this, is that low cost carriers have become market leaders in the airline sector and continue to increase their market share.

2.1.1 Rapid Expansion of LCC

According to Strassmann (1990), the primary impetus for the low-cost carrier concept was driven by the 1970's deregulation in the United States of the airline carrier industry, specifically the US 1978, Airline Deregulation Act. This act transferred partial control of the industry into the hands of the private sector from the United States government. Pioneering airlines like Southwest turned air travel into a mass market commodity.

This partial deregulation of the airline industry has provided for explosive growth of the sector and a Bloomberg (2018), quotes the following. In 1974, there were 207.5

million air travel passengers in the US and in 2010 there were 721 million. This period also experienced a considerable drop in air fares. In 1974 per passenger-mile revenue was 33.3 cents (adjusted to inflation), but by 2010 the same metric was down to 13 cents. This is a 61% drop. An additional positive, is that the load factor (the percentage of filled seats versus available total seat capacity), increased from the approximately 50% in the early part of the 1970's to 74% in the noughties.

The low-cost carrier revolution and its attendant popularity has been spreading globally rapidly for more than thirty years, in Europe in the 1990's and Asia in the following decade. This has led to a decline in popularity of national carriers in European and Asian nations despite their significant local presence and status as flagship carriers, as stated by the Centre for Aviation (2015).

Figure 2.1 shows the LCCs penetration rate worldwide and by continent against the existing national carriers while Figure 2.2 shows how the LCCs penetration at Asia sub-region have increased by the years and have a steady growth rate since 2003.

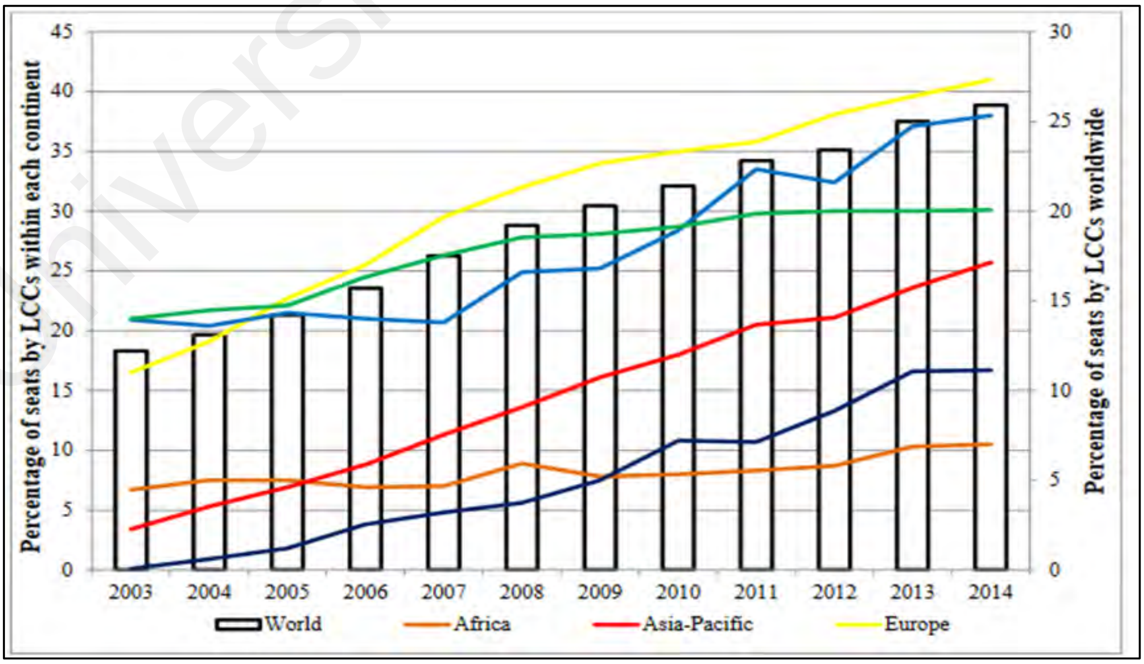

Figure 2.1: Penetration rate worldwide and by continent (Centre for Aviation, 2015)

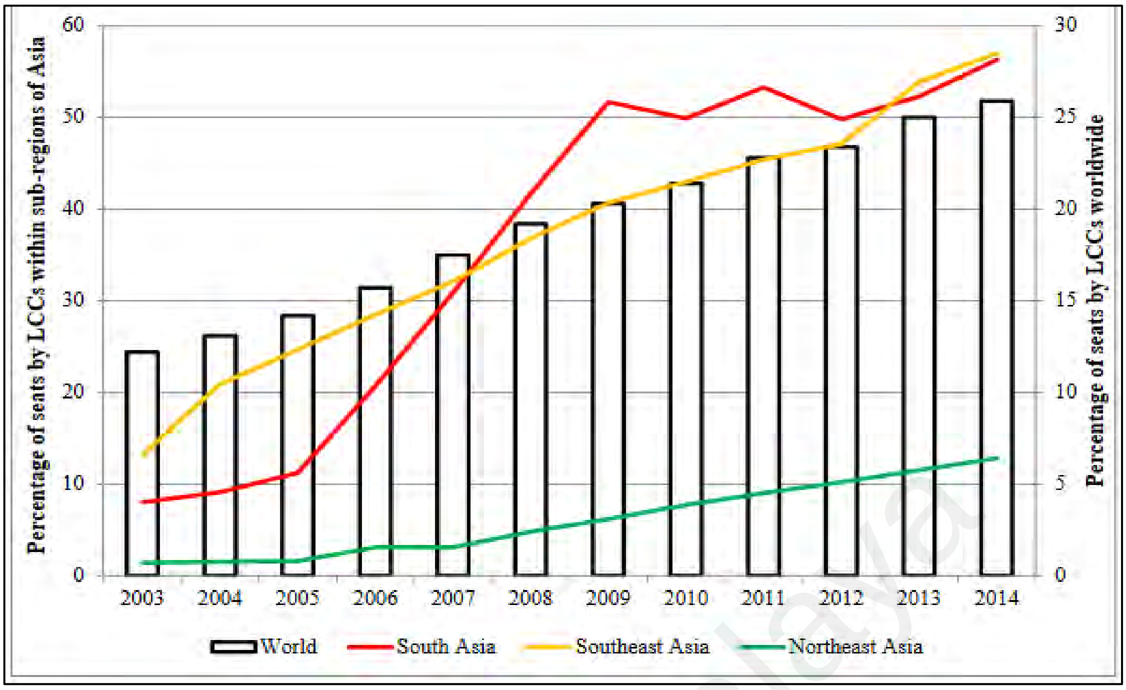

Figure 2.2: Penetration by Asia sub-region (Centre for Aviation, 2015)

In addition to the penetration rate by LCCs, the number of passengers taking LCC airlines has greatly increased over the years. Table 2.1 shows the Top-ten LCCs globally in 2013 and if this trend continues unchecked may force the mergers or shutdown of national airlines.

Table 2.1: Top-ten global LCCs in 2013 by number of passengers (Dunn,2014)

Airline	Country	Number of passengers (million)
Southwest	USA	133.2
Ryanair	Ireland	81.7
easyJet	UK	60.8
Gol	Brazil	36.3
Lion Air	Indonesia	34.1
JetBlue	USA	30.5
AirAsia	Malaysia	21.9
Norwegian	Norway	20.7
IndiGo	India	19.2
WestJet	Canada	18.5

2.1.2 Rationale for its Quantum leap

The rise of LCCs can be credited to the many creative approaches and developments since the 1970s (Dunn, 2014). National carriers adopted the hub-and-spoke model of turning a major airport into a major hub, and end destinations were made the spokes. This allowed the airlines to consolidate their passengers at the hub and then fly on to their end destination (represented by the spokes) in a lower passenger capacity aircraft. This increases load factors and simultaneously lowers the cost of airfares for passengers. It also expands the number of serviceable destinations. The hub and spoke model also have some serious shortcomings that require the maintenance of complex infrastructure for interconnected systems with the attendant high costs. Travel times for passengers are increased due to the necessity for passengers to transit through the hub as well as an increased likelihood of hub congestion cascaded by flight delays. The LCCs, however, favoured the point-to-point model when industry deregulation occurred, with its simplified infrastructure and reduced travel time for passengers. (Cook & Goodwin, 2008).

In the point-to-point system, each origin airport and destination airport are directly connected via a non-stop flight. By eliminating the hub as an intermediate stop and the attendant removal of duplication and elimination of resources invested, substantial cost savings are realized. It also addresses the reduction of a total end to end travel time that is a major factor for passengers, with the added benefit for airlines of better aircraft utilisation. The primary weakness is its reach, as only a limited number of city-pairs are available for point-to-point services to be viable, restricting the number of destinations that can be served, limiting reach.

The LCCs with their lower overhead costs, higher efficiencies and frequency of fleet utilization can offer prices that are considerably cheaper than that offered by legacy carriers on identical sectors. The majority of air travelers want the cheapest and quickest travel option and will compromise on availability of in-flight meals and in-flight entertainment. The current most competitive and compelling attraction for air travelers are low ticket prices. This thriftiness also affects and encompasses business travelers, as businesses constantly seek to lower their cost of business travel. Further aggressive downward pressure on ticket prices may be on the horizon with the arrival of ultra-low-cost carriers like Spirit Airlines Inc. (SAVE), that provides an air traveler with only a seat. (Bloomberg, 2018).

The Internet becoming the primary medium for flight ticket bookings in tandem with the elimination of printed ticket issuance has been a boon for LCCs. The tremendous increase of ticket price transparency, works to the LCCs' advantage via their lower ticket prices and ability to adapt to technology. This is in contrast to legacy airlines that handle complicated pricing structures and are somewhat reliant on travel agents to sell tickets. This reduces the technology advantages of the Internet and require complex customized ticketing systems with attendant costs.

A key LCC advantage from the use of the point-to-point model is the use of a single aircraft type its fleet. This uniformity of aircraft fleet lowers the cost of aircrew and maintenance crew training and spares inventory costs.

According to The Global and Mail (2017) several innovative LCCs such as the US based Southwest also derive considerable advantage from employing highly motivated employees. Attractive compensation and profit-sharing incentives provide great financial motives and a strong corporate brand provides considerable pride in service. In addition, short-haul routes point to point routes by LCCs, which keep employees close to home for except for the work hours as in regular jobs is also a great positive for employee morale.

In comparison long-haul flights involve time away from home measured in days or longer.

2.1.3 Low Cost Airlines in Malaysia

When mentioning LCC in Malaysia, one airline will stand out, which is AirAsia. AirAsia Group is Asia's largest low-cost carrier in Asia both in passenger numbers and aircraft fleet size.

The group's entire business model is built on a low-cost philosophy that centers on operations that are lean, simple and efficient. Several key strategies employed to affect this is shown in Table 2.2.

Table 2.2: AirAsia Key Strategies

Key strategies	**Description**
High Aircraft Utilisation	AirAsia focuses on maximizing flight frequency and on targeting a ground turnaround time of 25 minutes.
Low Fare, No Frills	Low fares by non-provision of frills like frequent flyer miles or exclusive airport facilities. Check in baggage and in-flight meals being listed as available on demand at additional cost.
Point to Point Network	All AirAsia flights (four-hour flight radius or less) are non-stop, eliminating transit locations and the attendant resources.
Fleet Uniformity	AirAsia solely uses Airbus A320s resulting in reduced duplication of staffing requirements and much smaller inventories of maintenance spares.

AirAsia has established itself as the lowest-cost airline in the world, with a cost/ASK (available seat kilometre) of US3.67 cents using these collective strategies. Airasia was the first Asian airline to go the online booking ticketless route, initially by accepting credit card payments from customers over the phone in March 2002 and followed by the further innovative use of technology in internet bookings. It has since expanded on its IT solution to increasing the ease for customer transactions with major benefit of cost savings to AirAsia Group in IT infrastructure and support costs.

As mentioned in Table 2.2 by having the four key strategies, Airasia has successfully ensured a high frequency of flights and that every three minutes an Airasia aircraft is either taking off or landing with on time performance (OTP) departure a key metric. The definition of OTP (on time performance departure) by the US Bureau of Transportation Statistics (2007) is that the aircraft must depart from its assigned designated bay within 15 minutes of scheduled departure time. Figure 2.3 shows AirAsia OTP in 2015 whereby the lowest OTP was 77% for July and November while the highest OTP is in March with 87%.

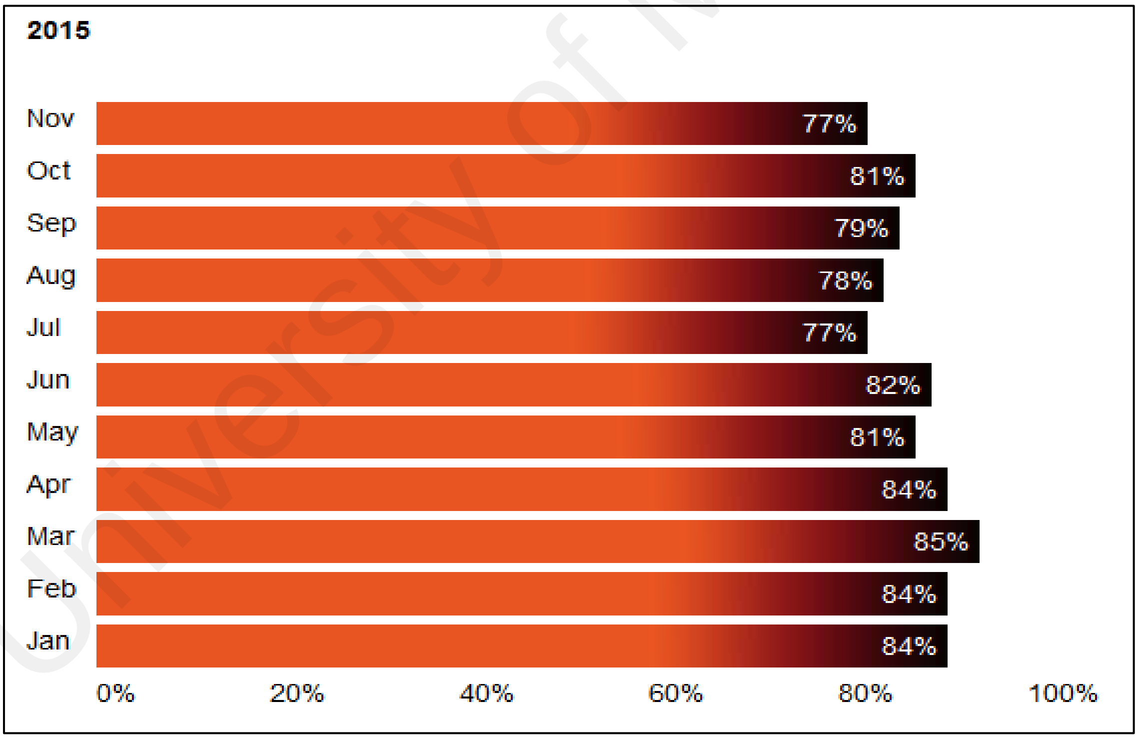

Figure 2.3: Punctuality data for 2015, AirAsia Investor Relations (2017)

2.1.4 Issues affecting Waiting, Delays and Service Evaluations

The time gap from the time a customer is ready to receive a service to the time service actually begins is referred to as waiting and understandably for many customers waiting for a service is a negative experience. Considerable research studies on waiting, delays and its cost implications have been conducted over the past thirty years on this. (Scotland, 1991; Diaz & Ruiz, 2004; Adam, et al., 2014; Weiwei Wu, et al., 2018). Researchers have advocated that service waits can be controlled by including techniques like operational management or perception management (Katz, Larson Larson, 1991; Sinastava, et el., 2008; Ngege, 2011) qualities and satisfaction infused in management analysis (Naik, 2010; Munirat Olafemi Yusuf et al., 2015).

Passenger airline delays lead to extended waiting for customers and have been receiving increasing scrutiny in recent years. Airspace congestion, severe weather, mechanical problems, and other sources cause substantial disruptions to a planned flight schedule and cause passenger delays and disruptions. Increasing the robustness of flight schedule planning can mitigate the impact of these delays in addition to reducing the potential likelihood of its occurrence with attendant cost reductions (Lan, Clarke & Barhart, 2006). Tu, Ball and Jank (2008) have identified and studied the major factors influencing flight departure delays and developed a strategic departure delay prediction model.

Kafle & Zou, (2016) proposed a novel analytical-econometric approach. This is to provide insights into flight delay propagation patterns and follow on prioritization of resource allocation by aviation system planners to improve overall system performance. This includes the assignment of a buffer period to their flight schedules to mitigate delay propagation.

The challenge here is the fact that individual flight delays accumulate and the cascading effect amplifies its disruptive effects at each succeeding flight stage. This necessitates a compromise between missed opportunities and the utilization of expensive and limited finite resources. To address this there is provision for slack into airline operations to mitigate the effects of disruption, despite excess slack being considered undesirable in a planned schedule. As stated by Beygi, Cohn and Lapp (2010) in their article, that a redistribution of slack to reduces the delay propagation during the planning stage via small modifications to the flight schedule that minimize changes to the original aircraft schedule and crew rosters had resulted in operational performance improvements under targeted conditions with only limited increases in planned costs.

Preassigned planned air crews and aircraft being may be unable to execute assigned flights and several flights are cancelled or delayed daily typically as planning coordinators need to select the lowest cost path to minimize delay impact on passengers within the defined safety constraints set. Given the nature of real-time issues and the size of daily flight schedule, a full-scale optimization is not feasible directly without reduction of size and complexity of the problems into manageable elements.

An effective near real time recovery fast crew-pairing generation system was designed and tested by Gao (2007) and Lettovsky, (2000) that reassigned aircrews from a disrupted timetable. This system was designed on the basis that the given that the planned schedule is optimal, partially utilized air crews can be reassigned to matching alternates. The system was implemented via a tree-based framework with efficient storage and retrieval of data of potential pairs once a delay is encountered.

Others like Hansen, (2012) studied the impact and correlation between the carrier cost structure and its operational aspects. The author used two unrelated sets of carrier operational performance parameters as arguments. The results of estimation from a multitude of airline cost models revealed that both delay and schedule buffers are imparted significant costs by activity outside scheduled windows increasing cost and inactivity within scheduled windows with minimal impact. Using these models, cost savings to airlines with "flawless" operational performance, were estimated in the range of \$7.1–13.5 billion. An interesting finding by Forbes (2007) that any exogenous shocks have cost implication from the study on a legislative change in take-off and landing restrictions at LaGuardia Airport. This provided the opportunity to study the effect of an exogenous shock to product quality on prices within the airline industry. It was observed that the elasticity of price response varies with the degree of competition in the market. The findings indicated that the price fell by USD1.42 on average for each additional minute of a flight delay, with the price response increasing substantially in more competitive markets.

There are external (to passengers) and internal (within organization) factors involved and in order for service recovery to be effective, employee engagement is critical. (Bamford, 2004) suggested the significant impact of employees on a quality service delivery. Comparison between airlines, reinforce the findings that airline service quality excellence is via senior management focus, drive and commitment that reinforces employee job satisfaction, loyalty and commitment.

Airport systems are built to meticulously planned schedules, but despite this system overloads do occur and flight delays are a consequence of this system overload. In addition to events beyond control, like bad weather, the non-ideal decisions of airlines and airport management at maximizing airport infrastructure usage close to its maximum operating capacity lead to airport congestion. Airport congestion is cascading as entry is not random and can accumulate over the course of day. This is quite different from road traffic congestion. A theoretical model on airport congestion by Gustavo Nombela and Ginésde Rus (2004) demonstrated that internalised pricing effects should also reflect the external costs on passengers as well as between agents and congestion charges should reflect this. A better formulation of compactness of flight schedule and number of flights slotted can be achieved taking this into consideration.

At the receiving end, the consumers suffer as a result of such delays and have an adverse effect on consumers behaviour. Diaz and Ruiz (2002) studied the relationships that exist among the attributions, the affect and behavioral intentions of consumers who suffer delays in services. They considered two different affective dimensions: anger (emotional reaction) and satisfaction with the service (cognitive and emotional evaluation). The methodology employed is based on structural equation modelling and the empirical application in the airline industry. The findings demonstrate the existence of the sequence "attribution-affect-behavioural intention", with anger being the mediator in the relationship between the attribution of control on behavioural intention (propensity to complain and repurchase intentions).

A model of the wait experience was presented by Diaz (2002) that assessed the multiple effects of delay and included effect of delay duration, the attribution of delay, alternate passenger affective reactions and passenger evaluative reactions to the delay as well as the degree of alternate passenger preoccupation over that period. A test of the empirical model conducted on delayed airline passengers reveals that quality of service evaluations are affected by delays. This impact is mediated by negative affective passenger reactions to delays. Passenger perception that the airline had control over the delays as well as passenger preoccupation over the delayed period also indirectly affected passenger service evaluations. This was mediated by passengers' affective reactions of anger and uncertainty.

Lung Wu, (2005) specifically explored the inherent delays of airline schedules resulting from limited buffer times and stochastic disruptions in airline operations. The reliability of airline schedules is discussed and a set of measuring indices was developed to evaluate schedule reliability. It found that significant gaps between the real operating delays, the inherent delays (from simulation) and the zero-delay scenario discussed. The author suggested that airline schedules must consider the stochasticity in daily operations i.e. the assumed probability of delay, only then schedules may become robust and reliable, only if buffer times are embedded and designed properly in airline schedules.

Therefore, issues affecting waiting, delays and service evaluations can be summarized as per Table 2.3 below.

Table 2.3: Earlier studies on effects of delays and the proposed solutions

Articles	**Proposed solutions**
Kafle & Zou (2016)	Analytical-econometric approach that helps aviation system planners gain additional insights into flight delay propagation patterns and consequently prioritize resource allocation while improving system overall performance.
Beygi, Cohn and Lapp, (2010)	Delay propagation can be reduced by redistributing existing slack in the planning process, making minor modifications to the flight schedule while leaving the original fleeting and crew scheduling decisions unchanged.
Gao, (2007); Lettovsky, (2000)	Developed, implemented, and tested an effective in almost real time, a recovery plan for reassigning crews to restore a disrupted crew schedule
Hansen, (2012)	Estimating a variety of airline cost models reveal that both delay and schedule buffer are important cost drivers.
Diaz and Ruiz (2002)	Considered two different affective dimensions: anger (emotional reaction) and satisfaction with the service (cognitive and emotional evaluation) with passengers are able to complain and repurchase.
LungWu, (2005)	Suggested that airline schedules must consider the stochasticity in daily operations only then schedules may become robust and reliable, only if buffer times are embedded and designed properly in airline schedules.

2.1.5 Current Practices in Matching Pilot and Aircraft for LCC Operators

The criteria used to match aircraft and pilots is complex as it contains rules that are governed by international and national aircrew regulations, aircraft availability and human factors forming the most decisive criteria.

These criteria are sifted and meshed to produce a crew and aircraft rostering schedule at least 30 days in advance of utilization. In addition, instantaneous, daily and weekly schedule changes are made to the system due to evolving short term issues from no-show of aircrew to unpredictable last-minute weather changes.

In the current practices section, these are split into parts one, two and three. Part one describes the current criteria used in selecting the aircraft. Part two is a selection of flight crew and part three is the decision and execution of ad-hoc changes to the crew and aircraft rostering schedule.

This data crunching is not manually handled but based on off the shelf support software systems in line with operator rules and policies.

2.1.5.1 Aircraft Schedule

A key component of low-cost carrier fleets is the use of common standard aircraft composed of one or two aircraft types which are to have fleet uniformity (Dunn, 2014). This greatly simplifies the maintenance, training and spares cycle. In most cases, it is a case of selecting the available serviceable aircraft, rather than selecting the right aircraft type (Ibid).

An aircraft can be classed in one of three states at all times in the low-cost carrier fleet. These are Serviceable, In Maintenance and Aircraft on Ground. The first two states are known in advance and form the basis of planning and scheduling. The third state is unscheduled corrective maintenance brought on by ad-hoc incidents, pre-flight check failures and failure to complete scheduled maintenance tasks as required. An AOG situation is thus undesirable and feeds into corrections required in the crew and aircraft rostering schedule (Kinston, et al., 2011).

Aircraft scheduling by LCC operators is nominally done one month in advance of requirements. The aircraft selection criteria will be based on the following criteria, but only as per Table 2.4 shows items 2, 3 and 4 are parent processes that affect the first flight operations. Item 1 is a ‘constant’ that cannot be changed to suit operations or improve matches for purposes of research here (Ibid).

Table 2.4: Selection criteria of aircraft for operations

Criteria	Description
1. Sectors Serviced	This is governed by the routes in service and described as “sectors” in airline parlance. Sectors are set by commercial requirements and approved by both national and destination authorities and here to describe external constraints to the selection process. LCC aircraft flight times vary between less than an hour to up to five hours per sector for a narrow body type jet aircraft. An LCC aircraft can fly between four and eight sectors per day of operations, with varying flight crews (if necessary) until the next maintenance cycle is required.
2. Serviceability	In service with no scheduled maintenance plan blocking usage with Extended Diversion Time Operations (EDTO) as a subset.
3. In maintenance	out of service and in scheduled maintenance
4. Aircraft on Ground	Out of service and in corrective maintenance. A day before the actual departure the engineering team will advise operation control on the current aircraft status as one criterion that might change the aircraft selection if there’s Aircraft on Ground (unscheduled maintenance). If this happens, another aircraft will be selected for that particular day.

Source: Kinston, Harry, Siddiqui, Tariq (2011). Aviation Maintenance Management

2.1.5.2 Current Practices in Pilot Management for First Flight

In current practice, the airline rostering schedule will be issued one month in advance and each crew member will have a copy. The selection criteria are fully dictated by the airline and crew must fit their time off and other private matters around the schedule (Deng, & Lin, 2010; Gopalakrishnan, & Johnson, 2005)

The conditions for crew rostering guidance, is stipulated in Flight and Duty Time Limitation and Rest Requirement found in the Flight Operation Directive – Organisation Requirement for Air Operations, Subpart FTL (Flight & duty time limitations and rest requirements) by Malaysia regulatory authority, Civil Aviation Authority of Malaysia (CAAM). One last point to note is that while conditions are stated as shall, these are fully understood in the aviation industry as mandatory compliance set by the Civil Aviation Authority of Malaysia. These are listed as presented below in the document (Flight Operations Directive, 2018):

1. An operator shall publish a monthly roster not less than 7 days in advance before the end of the month.
2. An operator shall prepare duty rosters sufficiently in advance to provide the opportunity for the crew to plan adequate pre-duty rest.
3. An operator shall establish minimum periods of notification of duty for the operating crew, or where this is not practicable due to the nature of the operation must establish in advance minimum periods of notification of days off, during which a crew member will not be required for any duties.
4. An operator shall ensure training for Rostering Staff shall include guidance on the effects of disturbing Circadian Rhythms and sleep deprivation.
5. Away from a base, the operator must provide for crew members both the opportunity and facilities for adequate pre-flight rest, in schedule accommodation.
6. An operator shall ensure when employment of a crew member on an irregular basis, then the operator shall ensure that the crew member satisfies the provisions of the company approved Flight Time Limitation scheme.

The flight time limitation is the most important criteria in establishing the monthly roster for the flight crew. Crew flight times and duty periods are subject to the following with the proviso that flight worthiness and maximum regulation hours are not exceeded (Flight Operations Directive, 2018):

1. 55 hours in any 7 consecutive days, but may be increased to 60 hours, when a rostered duty covering a series of duty periods, once commenced, is subject to unforeseen delays;
2. 95 hours in any 14 consecutive days; and
3. 190 hours in any 28 consecutive days.
4. During the period of 12 months, expiring at the end of the previous month exceeds 900 hours

Other criteria to be taken into consideration are positioning and travelling, split duty, standby duty and duties at the airport, and rest period which is well described in the Flight Operation Directive (Flight Operations Directive, 2018).

2.1.5.3 Current Practices in Pilot and aircraft rostering schedule change

Once the aircraft and crew roster are released with a 30 day notice it is considered the definitive document for flight schedules. The LCC schedulers will monitor the roster plan every 3 days and make the necessary changes as required.

Any changes on the individual flight crew times will be captured by the system with changes and notifications sent to the related flight crews. In addition, the engineering team will also provide an update if the aircraft selected for the next day flight is unavailable due to aircraft on ground conditions. These are monitored and confirmed one day in advance of the specific first flight. In an ideal scenario, the day to day data updates on aircraft and flight crews should match the plan and not deviate substantially on the approach of the 30 days start of the new schedule. The system notifies all relevant parties only if changes occur out of bounds of initial aircraft and crew roster and specific to affected parties.

Currently, to match the flight crew and aircraft for the first take-off as the software system automatically selects the flight crew and aircraft based on rules and inputs by schedulers. The rules and conditions are opaque and not available for further analysis of system efficiency on time and resource management.

“Low cost flight” and “first flight delay” as a combination is required to address the research subject and the search for a match at the following scholarly linked websites including UM Library Online Databases and Google Scholar presents no simultaneous matching items. This research is focused on providing and understanding the problem and offering best practices as a resolution to the current practices.

2.2 Technology and Time Management

Understanding developments in airline time optimising practices in terms of plane and crew selection are imperative to address the research problem underlying this study. The literature review and analysis are conducted in the context of the research questions stated for this study and is aimed at developing a conceptual understanding of the time management by establishing the links between the various variables.

The literature review presented aims to address those themes through an understanding of theories on Technology Acceptance, Time management theories, Time management, efficiency and cost in the airline industry as well as a conceptual framework in the context of research questions.

2.2.1 Introduction

One of the primary challenges the aviation industry is the endless struggle to minimise the turn-around time of the grounded aircraft. Airlines and aircraft manufacturers constantly look at and seek to introduce technologies for cost reduction and efficiency improvements. However, this has to be balanced against the risk of disruption to the industry that the introduction of new technologies might potentially affect the established airworthiness and safety standards. Civil aviation organizations continuously monitor the space for productive new technologies that benefit the industry and there are multiple theories that have explained the need for and absorption of technology in practice. The three that will be discussed in the subsequent sub sections are the Diffusion Innovation Theory (DIT), Technology Acceptance Model (TAM), and the Unified Theory of Acceptance and Use of Technology (UTAUT).

An airline quality and subsequently its success, in addition to safety, is also measured by its "On-Time Performance'. Through On-Time-Performance (OTP) the airlines are able to optimized flight planning. Time management is critical for airline operators, especially LCC operators where it involves multiple journeys and time lost is added cost and lower margin in a very highly competitive industry. Time Management Theories explains how to improve efficiency in a work environment. To create a strategy or design a support system with an action plan to containing effective time management, a clear understanding of time management theories is required. Hence some common management theories will be described briefly in the following subsection. The logical flow for the LR.

2.2.2 Overview of Theories and its Relation to the Airlines Industry

Basically, there are two sets of theories that play some important roles in achieving the purpose of the research; one is related to the adoption of Technology and the other the Time management. The following will discuss the Acceptance theory followed by the importance of Time management.

2.2.2.1 Theories on Technology Acceptance

There are three established theories that explain the adoption of Technology; Technology Acceptance Model (TAM), Diffusion Innovation Theory (DIT) and the Unified Theory of Acceptance and Use of Technology (UTAUT). These theories are discussed summarized in Table 2.5.

Table 2.5: Theories on Technology Acceptance

Theory	Type of Technology Acceptance
Technology acceptance model (TAM)	a. Technology acceptance model (TAM) assumes that consumer behaviour is determined by two elements; attitude in TAM is influenced a priori by perceived usefulness and perceived ease of use, both of which influence technological behaviour. b. Conceptualized by Davis (1986), and extended by subsequent researchers, has extensive acceptance, both theoretical and as a practical understanding of information technology (IT) or IT-related applications (Davis, Bagozzi, & Warshaw, 1989; Lam, Cho, & Qu, 2007). c. Consists of six distinct causally related constructs; external variables, perceived ease of use, perceived usefulness, attitude towards using, behavioural intention to use and actual system use. Perceived ease of use and perceived usefulness determines acceptance (Lee, Kozar & Larsen, 2003; Surendran, 2012) influenced through attitude and subsequent behavioural intention that culminates in actual system use (Wu & Wang, 2005).
Innovation Diffusion Theory (DIT)	a. Based on this theory first proposed by Rogers in his book which is in the 5th edition, (1983, 2003) innovations need to be combined with the following features for new technologies to be adopted: Advantage to the user, Compatibility, Experience, Complexity, Awareness, and Absorbability. b. DIT is a theory that seeks to explain how, why, and at what rate new ideas and technology spread through cultures.
The Unified Theory of Acceptance and Use of Technology (UTAUT)	a. Proposed by Venkatesh et al. (2003) where a combination of eight models of technology acceptance created the Unified Theory of Acceptance and Use of Technology (UTAUT). The model includes social cognitive theory (SCT), the theory of reasoned action (TRA), TAM and TAM2, the motivational model (MM), the model of PC utilization (MPCU), TPB and DTPB. b. This theory assumes that intention to use and adoption of technology depends on the following four factors: performance expectancy, effort expectancy, social influence, and facilitating condition.

(a) ***Rationalizing Theory to Airlines Industry and Practical Systems in Place***

The UTAUT theory explains the rationale for using technology in the airline's industry. One of the primary challenges faced by the aviation industry is the constant need to improve efficiency. As the industry becomes highly competitive, means to achieve efficiency becomes paramount for any airline survival. For this reason, both airlines and the aircraft manufacturers search for the latest technologies to minimise costs and increase efficiency to cope with ever increasing passenger numbers. As the industry becomes more sophisticated, and customers being tech savvy, the need to influence and impress these new social groups is a continuous challenge. Airlines are continuously looking to introduce technology.

(b) ***Review of Technology and Information System Usage by major LCC operators at KLIA2 include;***

There is three type of system usage by major LCCs; yield management system (YMS), customer reservation system (CRS), and enterprise resource planning (ERP) system for effectiveness and efficiency of service and to reduce the cost.

i *Yield Management System (YMS)*

This system understands, anticipates, and reacts to the behaviour of the customer to maximize revenues for the organization. It takes into account the operating costs and aids operators to optimize price and allocate capacity to maximize expected revenues. This is done at two levels of optimization; Seat and Route. Seat pricing varies at different times and reservations closer to departure dates cost more. Route prices are also adjusted according to customer demand for said route. The system combines both sets of information to produce effective pricing for all the respective flights.

ii *Computer Reservation System (CRS)*

The CRS is an integrated web-enabled reservation and inventory system suite. Driven by Navitaire Open Skies technology, this system includes the internet, customer call center and airport departure control. Customer data is centralized and managed by Open Skies and supports reservation tracing and real-time reporting of scheduled flights to Air Asia. A key feature of Open Skies is the seamless linkage with the pre-existing YMS system and used together maximise the pricing and revenue while simultaneously reducing the cost of operations.

iii *Enterprise Resource planning system (ERP)*

An integrated ERP solution is a standard feature used in airline industry to maintain integrity of process, timely month end closing of financials and speedy reporting and this was implemented by Avanade consultants in Malaysia in 2005 for Air Asia.

iv *Airline reservation system (ARS)*

The airline reservation system (ARS) is used for supply chain planning as it uses information from ERP for planning functions and operations scheduling. ARS aids the improvement of AirAsia's strategic and operational performance, classifies orders from customers, and checks availability of resources. It is also part of the passenger service system (PSS), which supports direct contact with the passenger. ARS transformed into the computer reservations system (CRS) that is used for the reservations and interfaces with a global distribution system (GDS) which supports travel agencies and other distribution channels into a unified system.

However, the issue with LCC operators is that many of the systems are not fully integrated into a common operational platform; some operate in isolation and others partly integrated. For example, although there is an operational system in place for scheduling that operates weekly, this system has a contingency for last minute change.

2.2.2.2 Time Management Theories

Time management theory underlies various training programs, presentations, courses and system design to improve efficiency in a work environment or in daily life activity. Without a clear understanding of time management theory, it is difficult to formulate a strategy or design support system for an action plan that will manage time effectively. Three of the more popular theories are explained in depth in Table 2.6.

Table 2.6: Time Management Theories

Theory	Type of Time Management Theories
Pareto Principles	a. Pareto 80-20 rule principle states that majority of impact in anything comes from a small proportion of activities, people or effort (Techtarget, 2018). b. Based on this, time management advice to focus on the 20% of activities or tasks that important to overall success.
Pickle Jar Theory	a. The tconcept of a pickle jar is first to fill it with rocks and it appears to be full until it is filled with gravel which will fill the cracks between the rocks, and it can still fit in some sand, and then water. But not the other way. b. In time management perspective, less important work is done in the spaces between and after major projects or tasks.
Maslow Theory	a. By Abraham Harold Maslow, where the importance of matching time management with other needs as human beings and integrating everything into a nourishing and wholesome (Psychology, 2011). b. As long as the efficient use of time helps to meet higher goals of fulfilment, spirituality and wellbeing, it will be perceived as helpful. c. Focuses on understanding needs, differentiating them, and setting time limits on getting each done so it does not encroach on other essential areas of life.

(a) ***Rationalizing Appropriate Theory on Time Management to Airlines Industry***

Everyday LCC operators make multiple journeys to the same destination, hence the turn- over time matters. Any delay will have a ripple effect on the return journey and airline's network throughout the day. Both airline and airport management, consistently monitor each stage of the aircraft's operational cycle from the arrival time to departure time closely and proactively to allow redirection of passenger handling resources to minimise delays. Time management software (example PASSUR SOLUTIONS software) is widely used by many of the largest airlines and dozens of leading airports. This software is designed and built to predict the Estimated Time Arrival (ETA), airspace constraints, the performance indicators of Air Traffic Management (ATM) and real-time gate conflict alerting and surface surveillance. The INFORM solutions comprise of turn monitoring, holdup prediction during ground operation, that enhance the deployment and allocation of resources, both static and mobile including equipment localization and movement options. This software is designed on the fundamental theoretical foundation of the relationship between task difficulties, its importance and priorities in management to optimize time usage.

2.2.3 Strategy and Cost

Technological development (Technology, 2011), market integration and competition (Tan, 2013) have increased the changes in air transportation. On the other hand, government policies too had a tremendous influence in shaping the development and operation of scheduled passenger air service in almost all markets (Borenstein & Rose, 2007). According to Watchtower (2010) and Yilmaz (2008), the complex nature of airline industry and the sustainability shows airlines faced with demanding governance, risk and compliance. The view is also the view by Adler & Gellman (2012), Nicolau & Santa-Maria (2012) and Niemeier & Tretheway (2012) where there's need to design effective risk management systems to handle the complex and dynamic nature of airline industry.

The current free market environment and government policy on airlines guarantees the need for development of strategies by decision makers to achieve their targets via competitive advantages. Barla and Koo (1999) opined that variables that defined the linkage between cost to market structure and market demand over the varying timelines was key. Coelho (2010) opined competitive advantage is gained from cost, agility and differentiation. Cost advantage is derived from reducing costs to consumers rather than against competition while agility is the speed of the company's ability to respond to market changes. Lastly differentiation is related to a presenting a product of superior quality that enhances a company's positive status and reputation.

2.2.3.1 Airlines' Cost

An airline's cost structure and revenue are generally grouped into operating and non-operating categories. Doganis (2010) inferred that non-operating factors may impact the financial performance of airlines and referenced Singapore Airlines (SIA) as an example. In 2006, Singapore Airlines produced USD1.456 Billion of net undiscounted taxes and only 49.2% were from operational factors. The operating costs are further divided into direct and indirect costs. The direct costs include cost of aircraft ownership, cost of operational flights including air crew and fuel, preventive and corrective maintenance, repairs and devaluation costs. On the other hand, indirect costs are the costs that remain unchanged and are not directly dependent on aircraft operations. Doganis (2010) further views other determinants like degrees of management and management control as significant influencing factors on cost. He opined that this factor and its effectiveness can be considered the key determinants of the expenditure as shown in Table 2.7.

Table 2.7: Factors Affecting the Cost of Airlines, (Doganis, 2010)

Cost determinant	Degree of management/control
Externally determined input costs	Little
Cost of labor	Some
Type/characteristics of the aircraft	Some
Route structure/network characteristics	Some
Airline marketing and product policy	High
Airline financial policy	High
Corporate strategy	High
Quality of management	High

2.2.3.2 Types of airlines and Cost Structure

The airlines are divided based on the type of business models; intercontinental, national or regional, low-cost airlines or charter companies (Carrilho, 2009) and classified into two categories low-cost and full service (Carrilho, 2009). According to Doganis (2010), low costs carriers are based on two ideas that are to be simple and offering simple product or service based on simple operations in Table 2.8. where it shows the differences in the mode of operation for LCCs and national carriers or better known as traditional carriers.

Table 2.8: Comparison between LCCs and traditional airlines mode, (Doganis, 2010)

	Low-cost carriers	Traditional network Airlines (early 2000s)
	Simple product	*Complex product*
Fares	Low, simple – one-way	Round trip - complex
	Minimum restriction	Multiple restriction
	Minimum restriction Fares rise nearer departure	Lower fares last minute
Distribution	Avoid travel agents	Dependent on travel agents
	Aim 100% direct: either online or call centre	Own ticket offices/call centre
	Ticketless	Paper tickets
In flight	Single class	2 or 3 classes
	High-density seating	Low seat density
	No seat assignment	Assigned seats
	No meals or free drinks	In-flight catering
	Simple operations	*Complex operation*
Aircraft	Single type – maximum two	Multiple types – aircraft tailored to route
	High utilization (11 hours/day)	Low utilization on short sectors
Sectors	Short – 500 to 1.000 km	From ultra-short to long
	Point-to-point	Hub-based network
	No hubbing or connecting flights	Pax-Emb/flights connect at hub
Schedules	Used to shift demand	Response to current demand
Airports	Secondary or uncongested (where possible)	Focus on large airports
	20-30 minutes turn around	1 hour turn-around on short sectors
Staff	Competitive wages	Higher wages
	Profit-sharing	Minimal profit-sharing
	High productivity	Over-staffed

LCCs also offers a simple product or service based on simple operations and minimizes overall cost as shown in (Figure 2.4). The figure shows that the input cost (labour, on board services, administrative) savings by LCCs are 31% for cost per available-seat kilometer as opposed to only 13% from traditional carriers.

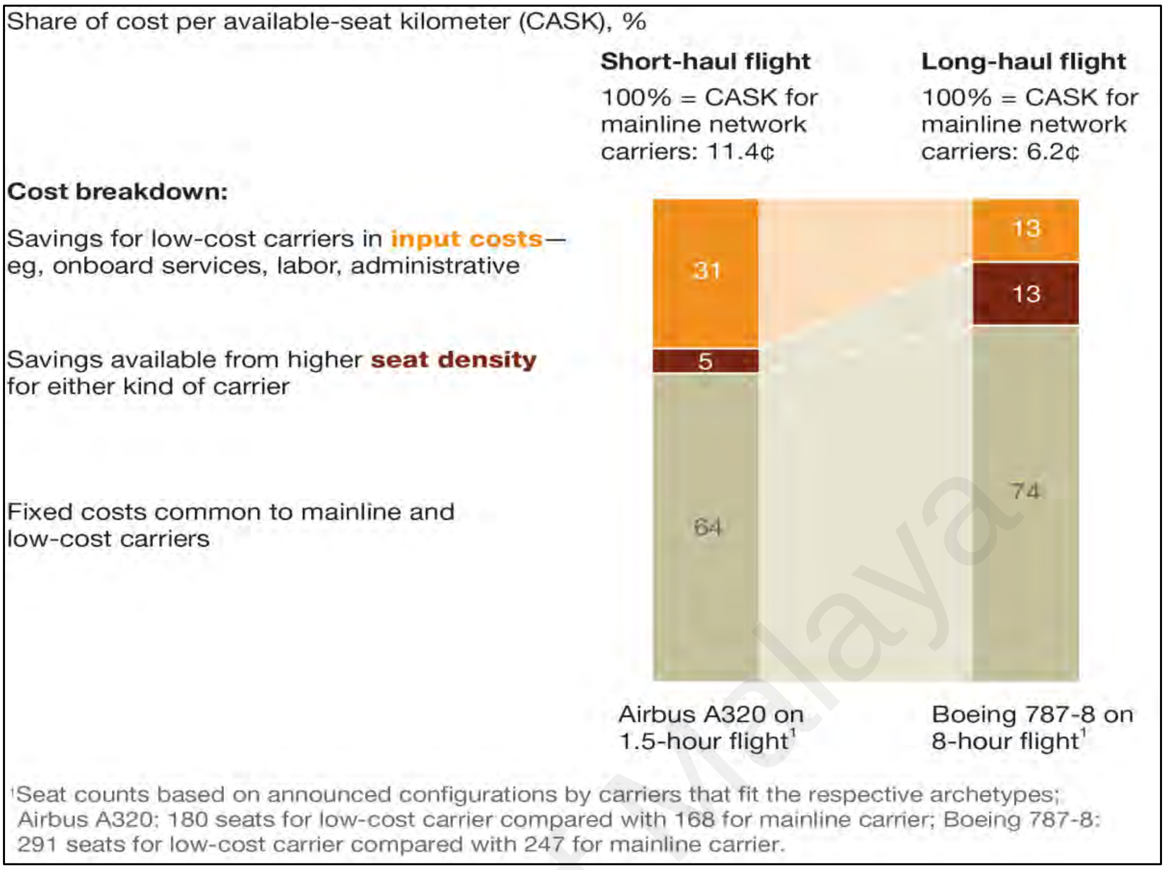

Figure 2.4: Cost per available-seat kilometer (Kearney, 2016)

Low-cost carriers have an estimated advantage of 30 percent lower costs over legacy carriers on short-and medium-haul routes. This is explained in Figure 2.5 and this saving is an added advantage for the passengers of the LCCs. The next section is the cost savings to research correlation.

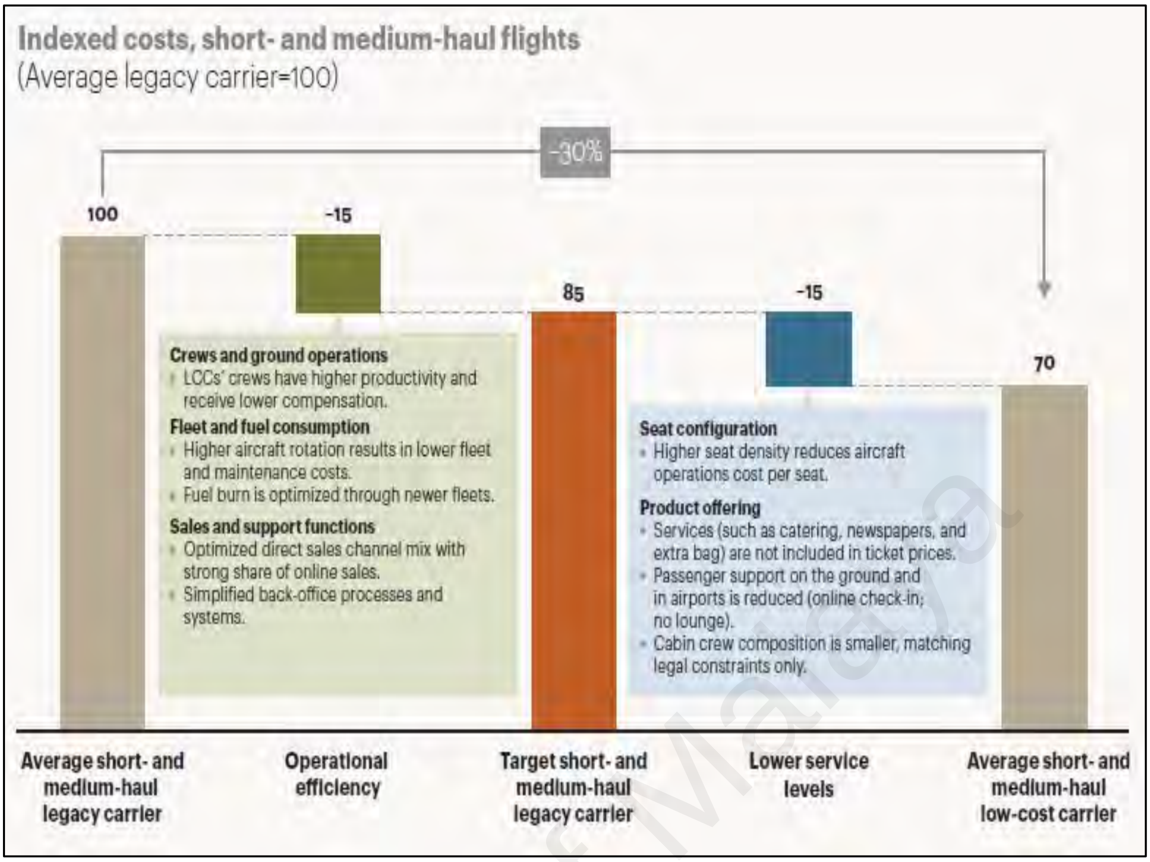

Figure 2.1 5: Cost Saving, Airlines Annual Report Analysis by Kearney (2016)

2.2.3.3 On-Time Performance

An airline's daily operational success is measured by the efficiency and effectiveness at matching actual flight completion to the published schedule. This is achieved by harmonizing the of matching suitable airworthy aircraft to qualified flight crews supported by adequate ground resources and actual flight passengers and cargo. An important strategy by LCC's at achieving On-Time-Performance (OTP) is the extensive amount of planning for the flight schedule. Each minute of flight delay time saved on each flight translates to a cumulative global total annual saving of more than US$2 billion (Figure 2.6). In an LCC on time performance translates directly to input cost savings advantage of 30%.

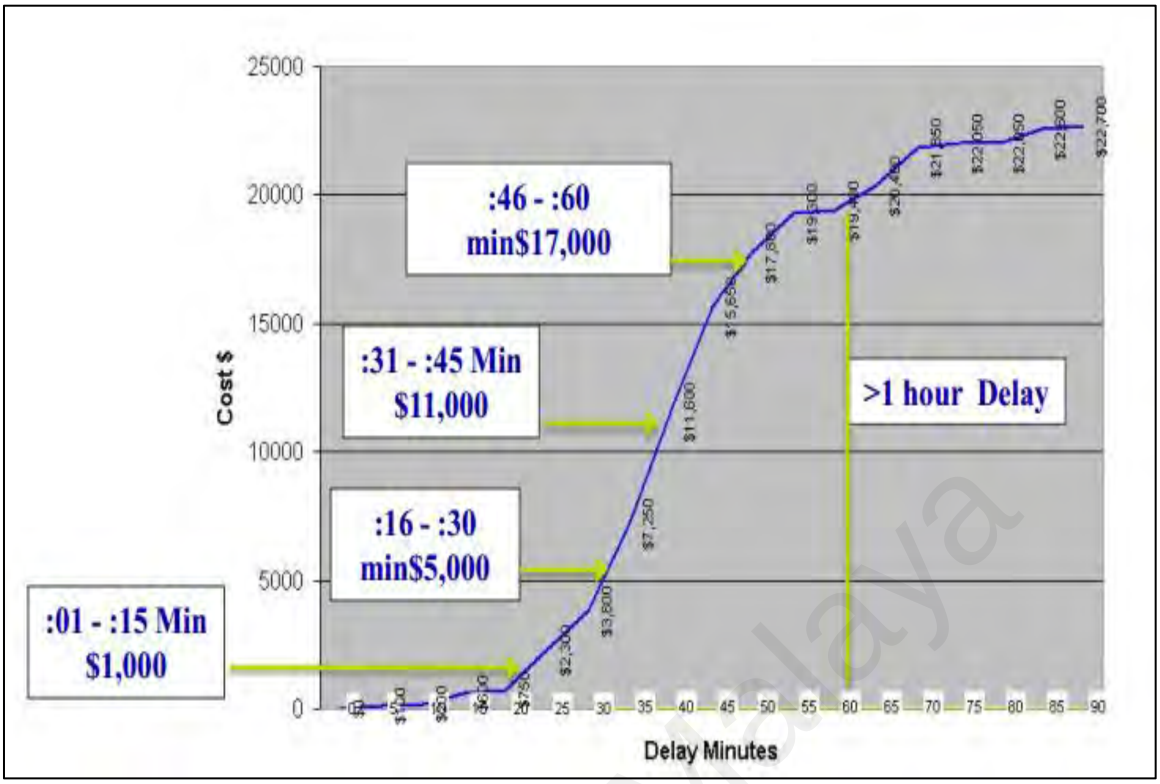

Figure 2.6: Delay Cost and Length of Delay, (Airline Operational Efficiency and Cost Geneva, 2013)

2.2.3.4 Resource Management and Automation

To be economically successful, an airline must not only have the resources but must also optimize the resources allocation and utilization in flight operations, crew management, airport operations and maintenance planning in a complex environment.

The crew and labour-related costs are consistently among the top two expenses for airlines. Efficient and effective management of crew impacts the bottom line. Crew management support system allows for better control of crew-related costs by driving greater efficiencies and improving the crew working experience. Figure 2.7 showed that crew cost is one of the highest costs for an airline.

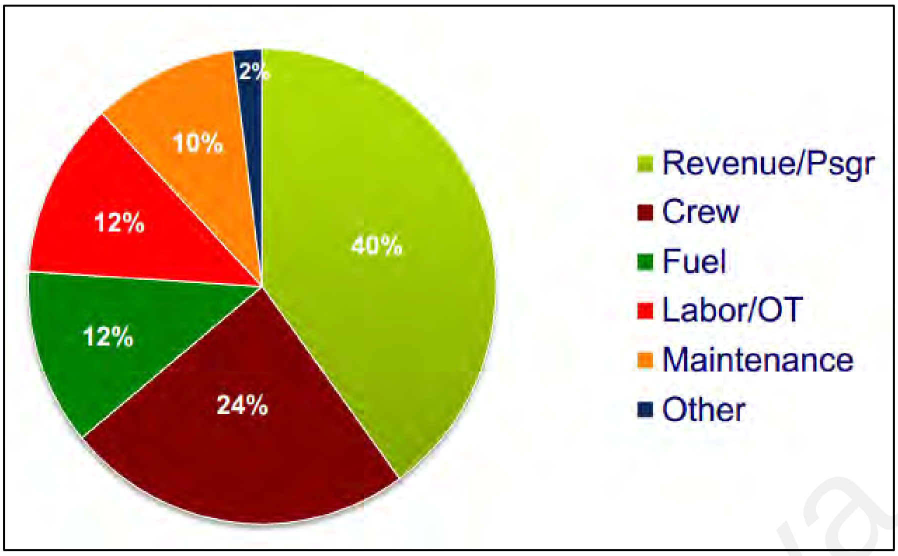

Figure 2.7: Cost Distribution, (Airline Cost Conference, 2014)

Integrating planning, pairings, bidding and rostering effectively with crew training and qualification requirements, pay and crew preferences for both regular and irregular operations. It minimizes the complexity of crew management by providing unique crew-facing solution thus improving crew quality of life by matching personal preferences into the daily operation while also maintaining optimal cost. Crew planning support system facilitates both immediate and term-based planning to achieve the minimum possible operating cost for specific business rules and constraints while maintaining crew quality of life. Optimization. pairings and crew rosters based on specific business rules and constraints.

2.3 Decision Support System in Airlines

Introduction: The airline industry has taken a complex form these days due to the highly competitive environment. Operators and managers all face similar problems, the scopes being different, in day-to-day operations, short-, mid- and long-term planning, scheduling, and having "a system" to support DM process is highly appreciated. Decision Support Systems (DSS) come in handy to decision makers not only for providing alternatives but also for data collection and analysis, visualization and validation. In the end, passengers are also using such information systems to find their flights on a daily basis to make their (travel) decisions based on the information provided. Hence a support system helps maintain all these activities in a single platform.

2.3.1 Decision Support System

Brief History: Computerised Decision Support Systems (DSS) have been extensively investigated and built by Information System technologists and researchers for over forty years. These are synonymous with the growth of computer usage, first starting in the late 1960's as the model driven DSS and extensive development of theories around this in the 1970's. By the mid 1980's this included financial planning systems, spreadsheet-based DSS and clustered Group DSS. The late 80s and early 90's saw the introduction of data warehouses, EIS and OLAP into the mix. Eventually this saw further changes in the mid 90's with a focus on the business intelligence aspect with web and knowledge based DSS. By the 2000s the push was towards an intelligent decision support system through artificial intelligence (AI) techniques (cited in Andreatta et al. 2014). The relentless march of Computerised DSS is constantly progressing with visionary novel technology input and new applications (Ibid).

Definition: Although the term Decision Support System (DSS) is ubiquitous among users with no specific person identified as the originator, in essence, this singularly used term stands for any "system" which provides valuable information towards decision making process (Diasio and Agell, 2009). Early reviewers viewed it as variables combination to facilitate decision making (DM). For example, Little (1970; cited Power, 2004), viewed it as 'a model-based set of procedures' and Keen and Scott Morton (1978; cited Power, 2004) viewed it as a pairing of man and machine's best characteristics. The introduction of the computer into the 'system', attributed to Bonczek et al. (1981; cited Power, 2004), it became the computer-based DSS with interacting components of language, knowledge and problem-processing. Turban & Aronson (2001) defined it as supporting and improving the DM process. The common denomination among all these definitions and the current common view among lay persons is that it is a tool that comes along with a computer to support decision making with the use of specific software and data input source by an expert operator and a meaningful output solution to the end user.

There is no consensus on the classification of the DSS system, however, it is centered on two extremities; data and model. Alter's taxonomy (Alter, 1980) grouped DSS according to generic decision support operations based on a review of 56 DSS in a field study

Power's taxonomy, another common taxonomy, extended on Alder's (1980) view with the grouping focused on concept rather than operation (Power, 2002). Power's classification is Data-driven, Model-driven, Knowledge-driven, Communication-Driven and Document-Driven DSS.

Others like Donovan & Madnick (1977) classified DSS as institutional or ad hoc based. A recurring pair of Institutional DSS support and an ad hoc querying data DSS support for a single request. More recently, Hackathorn & Keen (1981) classified DSS as Personal DSS, Group DSS and Organizational DSS which are distinct but can overlap. But beginning mid-1990s, the focus was on Business Intelligence with knowledge-driven DSS and the implementation of Web-based DSS.

Table 2.9: Type of DSS

Type of DSS	Description
Data-driven	Data-driven DSS focused on manipulation of a time-series of internal data and occasionally real-time data. Codd et al., 1993) opined data-driven DSS as providing the highest level of functionality and decision support. It allows for analysis of large collections of historical data, like the Executive Information Systems in use now (Power, 2002). The currently used term is a further refinement of an earlier term data-oriented DSS, Analysis Information Systems (Alter, 1980) and retrieval-only DSS (Bonczek, Holsapple and Whinston, 1981). Earliest data-driven DSS was centered around APL-based software package called AAIMS (An Analytical Information Management System). It was developed from 1970-1974 by Richard Klaas and Charles Weiss at American Airlines (Alter, 1980).
Communications-driven	Network and communications technologies are combined to facilitate decision with communication technologies and a dominant architectural component. Groupware, video conferencing and computer-based bulletin boards are commonly used here (Power, 2002). Engelbart's (1962) "Augmenting Human Intellect: A "Conceptual Framework" was the catalyst for much of the later work; and incidentally, in 1969 the author demonstrated the first hypermedia/groupware system NLS (oNLine System).
Document-driven	A document-driven DSS uses computer storage and processing technologies to provide document retrieval and analysis. This includes scanned documents, hypertext documents, images, sounds and video in combination. Documents that might be accessed by a document-driven DSS include policies and procedures, product specifications, catalogues, and corporate historical documents.
Knowledge-driven	These DSS are person-computer systems with problem-solving expertise that can give suggestion and recommendation. Power (2002) identified "expertise" as knowledge about a particular domain, understanding of problems within that domain, and "skill" at solving some of these problems. Previously used term here includes 'suggestion DSS' (Alter, 1980) and 'knowledge-based DSS' (Klein & Methlie, 1995) with Goul, Henderson, & Tonge (1992) linked Artificial Intelligence (AI) to DSS.
Web-based	With the introduction of World-wide Web and Internet, the capabilities and use of computerized decision support were further extended. The release of the HTML 2.0, accelerated development of web-based DSS with researchers reporting Web access to data warehouses. DSS Research Resources was introduced as a web-based collection of bookmarks with World-Wide Web (Berners-Lee, 1996) being recognized by software developers and academics as a serious platform for implementing Decision Support Systems of all forms (Bhargava & Power, 2001).

2.3.2 Air Transport Systems (ATS); Empirical studies

A systems approach is much appreciated in highly complex environments where problems or tasks have varying degrees of structure, the majority of them being unstructured or semi-structured. As being safety-critical human-in-the-loop distributed and complex system Air Transport system is such an environment and very fertile soil for the application of various DSS (Ivanov and Netjasov, 2014). Stamatopoulos et al. (2004) designed a DSS for "total airport management" for both short-term (operational) and long-term (tactical and strategic) planning (based on a stochastic analytical model for runway capacity estimation and simulation for apron and taxiways). Rather than a standalone concept, their DSS concept was an integrated set of models which treats the individual elements of the airfield, i.e., the runways, taxiways and apron areas together with high level of interaction. This DSS was successfully tested at Rome's Fiumicino Airport, and after some enhancements at Amsterdam, Athens, Frankfurt, Madrid, Palma de Mallorca, and Toulouse. Zografos and Madas (2006) followed on the earlier concept of Stamatopoulos et al. (2004) by introducing "a decision support system that allows decision makers and analysts to evaluate the efficiency of the total airport complex simultaneously by considering the entire spectrum of measures of airport effectiveness and their associated trade-offs". Aside from their detailed description of the developed DSS, this paper provides references for other existing models and tools. In their most recent paper, Zografos et al. (2013) further develop DSS for airport performance analysis. A similar concept which addresses the problem of strategic airport planning was also introduced by Wijnen et al. (2008).

According to Power, (2002) expert systems that require knowledge to solve particular problems and suggest or recommend actions to managers, can be classified as knowledge-driven DSS. Ansola et al. (2012) designed a system to address disturbance issues, but in the airport ground handling process. They use wireless communication (based on Radio

Frequency Identification –RFID) for real time monitoring and tracking of resources including the technical specification of such a system and combine it with modules based on artificial intelligence to optimally allocate resources. In a later enhanced system, Andreatta et al. (2014) have also used real-time vehicles data and apply heuristics to assign vehicles to apron operations. Disturbances of airport operations also include weather related. Decision support system for aircraft deicing is given in Rasmussen, et al. (2001). Their designed system collects weather data from various sources and provides users with useful information affecting airport operations. This increases situational awareness and "facilitates better and timelier DM regarding the start and stop of winter operations by snow desks, deicing operators, and slot allocation coordinators, and improved real-time decisions regarding deicing operations, runway clearing, aircraft dispatch, and aircraft control during winter storms"

Air transport players have introduced Air Transport System (ATS) as a mean to mitigate increasing cost across and improve efficiency in Airlines, Airports and Air Traffic Management (Janić, 2000). This shift is also due to globalisation, changes in global air transport regulations and information technology advancement in combination with DM framework using analytical approaches, modelling, planning and management for possible solutions (Ibid).

According to Power (2007), the first data-driven DSS used APL-based software package called 'An Analytical Information Management System' were used by American Airlines developed by Richard Klaus & Charles Weiss using System approach in ATS. This is not surprising as many major problems in Airline research are classified under "scheduling" to match available allocation of resources in a productive and timely manner.

Pioneering organizational DSS model was developed for crew-pairing in American Airlines (AA) for its 8300 pilots, 16200 flight attendants and more than 510 aircraft at that time (Anbil et al., 1991; Gershkoff, 1987; 1989) whereby analysts provided an initial solution to the linear programming optimizer model (called TRIP) and the program iteratively improved the original solution within the given constraints. Other functional areas this model was used include the decision on the opening of a new crew base and benefits, manpower requirement and economic impact evaluation of changes to operational rules and maintenance. Dijkstra et al. (1991, 1994) applied DSS in a what-if analysis of aircraft maintenance engineers' qualification on KLM contracts with other airlines companies. Verbeek (1991) emphasised the need for high planner-computer interaction, with a manipulative DSS output for the planner. Schindler and Semmel (1993) reported that Pan Am used a station staffing model based on integer LP to find a solution where the then station planners manually expanded the results to cover requirements for a longer timeframe.

Flight scheduling has been a popular research topic over decades, beginning with Hinkle and Kuehn (1967) proposing a DSS (based on heuristics model) for airlines scheduling problem. Vasquez-Marquez (1991) gave a detailed description of interactive DSS (network-based heuristics for American Airlines) slot-based substitution process and Raksha et al. (1996) on real-time DSS for schedule optimization. Babic et al. (2010) developed DSS for daily operational flight scheduling based on heuristics, with delay, cancelation and aircraft substitution options for tweaking schedule to optimize the cost function. Antes et al. (1998) developed model-based DSS for evaluation of flight schedules for cargo airlines and they generously share their experience during the implementation process with scheduling experts from the airline. Martin, (2003) researched creating flights schedule, improving an existing flight schedule or its manual modification, evaluation of profitability and performing what-if scenarios in the case of fractional aircraft ownership. Borovits and Neumann (1988) describe airline management information system (MIS) for smaller airlines, which is a combination of the airline reservation system and “an interactive DSS which is used for what-if questions regarding scheduling aircraft, crews and general personnel and for assessing and determining schedule and fare changes”.

Summary: Decision-making (DM) systems developed thus had enhanced management of complex activities involved air transport functions; day-to-day operations, short or long term planning and scheduling. Decision Support Systems (DSS) helps by providing alternatives, data collection and analysis, visualization, validation, as among some of its activities. However, there is no singular system that can be used universally and research in this direction is a continuous process. As is the case of the researcher’s aim, where the intension is to develop a design which can be integrated into other designs for efficient management of the first flight of the day.

2.4 Chapter Summary

All decision support systems undeniably aid the integration of multiple aspects of airline operation. Even with this off the shelf support, airlines struggle to tailor the level of staffing or the pace of work to their service demands efficiently. Integration of standardized operation has a limitation as the standards vary across airlines operators. Conditions and constraints in LCC airlines are much more restrictive due to time compression of tasks.

In a full-service airline, the turnaround time that is the time between touch down and takes off of the same aircraft with passengers is nominally 40-60 minutes. In an LCC airline, the turnaround time for each flight is between 25-40 minutes. The delay in the first flight causes a snowball effect and delays are cumulative across the day. Restrictions of landing and take-off times due to slot availability limit the chance of recovery on the same day. This will cause more cost for the airline as they will need to move passengers and to find a replacement crew to stay within the narrow confines of the time slots allocated. A tailor-made approach towards all variables is too costly for any airline especially LCC operators as the profit margins (op cite) are low. Incremental design that focuses on specific aspects and variables is an alternate option and can be integrated into the existing system.

As mentioned earlier in Chapter 2, there is no specific requirement to match the flight crew and aircraft for the first take-off as the software system automatically selects the flight crew and aircraft based on rules and inputs by schedulers. The rules and conditions are opaque. Therefore, it is not available for further analysis of system efficiency on time and resource management.

Currently, if there's an ad-hoc change on the crew schedule especially for the next day first flight departure the standby flight crew will be activated. These standby flight crew usually will be activated at least two (02) hours before the aircraft schedule time. However, most of the time these two hours are insufficient as the standby flight crew are at home and may be running personal errands or temporarily out of contact. It is very likely that the aircraft will deviate from the schedule and there are bound to be delayed.

Hence, this research is centered around a proposed best practice solution that focuses on the integration of first flight (flight and crew) time management, which if left unprioritized results in cascading effect on delays throughout the day. The latest event, where an airline's ad hoc arrangement to send a crew to another airport as not to disrupt the first morning flight causing a global uproar on passenger's eviction is a classic example (Reuters, 2017). This whole scenario is a result of a "deadheading" crew needed for a flight departing from another airport. Deadheading means carrying an airline's staff, free of charge, on a normal passenger trip. Airlines don't have crews standing by at every airport but in major hubs. If the crew wasn't properly repositioned, then the consequences are costly.

In the literature there are few studies devoted solely to efficiency, productivity and specific time management of flight, more so on first flight management for the day, hence the primary intention, finally, according to the best knowledge researched, this paper is the first study which measures efficiency and productivity of first flight time management and to propose an improvement and to propose a best practice solution to assist in improving the management of the First Pre-Flight Departure by LCC operators that operate at KLIA2. The best practice solutions provide the airlines with a means to understand the gap in the current system and deploy the correct customisation for their specific needs.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter will present the methodology on how to conduct the study. The focus will be on approach and justification of the selection design.

The current situation of the airline industry suggests the need for models to manage the complex operation, hence the aim is to develop a conceptual best practice framework. Earlier research centered on airline risk management and strategies. However, the literature is uncommon in empiric research on the first flight of the day and resulting issues. There's a need of continuous improvement of airline management approaches, focusing on understanding the shortcoming especially in airline schedule management to enhance current practices. The aim is to model a system for management of flights, especially the first flights for LCC and pilots, as return flight on the same day are an important consideration for such carriers.

In order to carry out an empirical study of the effects of delays on departure timing, therefore, the need to identify a new source of data. Nonetheless, this study provides a frame of reference for decision makers to assess the magnitude of the flight delay problem and the need for initiatives to address it. In this regard, it is similar to other studies that attempt to measure the size of a problem, and in developing a conceptual best practice model. Figure 3.1 below is the shows how this will be achieved by adapting Research Onion by Saunders et al. (2012).

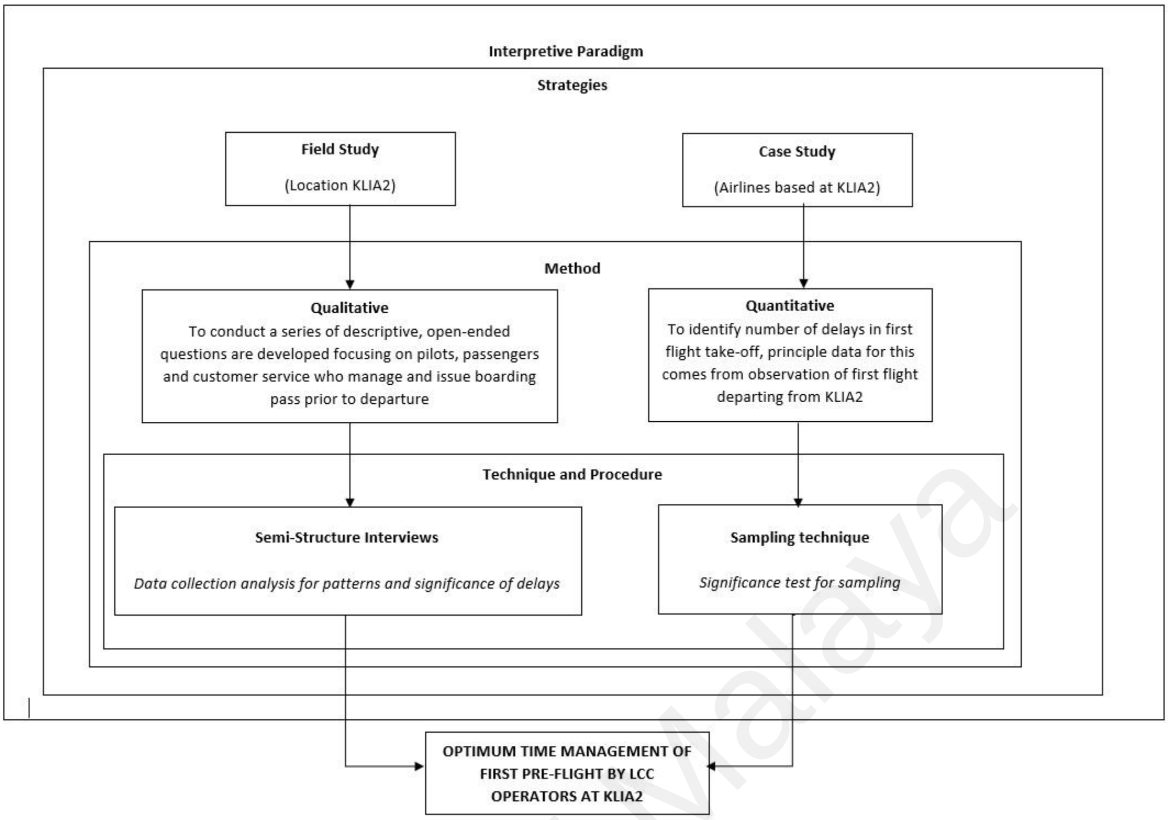

Figure 3.1: Research methodology framework

3.2 Research Paradigm

According to Saunders (2012) and also (Kuhn (1962), research paradigms provides broader view on the research. Positivism in research is concerned with independent analytical of research problem. On the other hand, interpretivism in research is infused with culture and belief in society Morgan and Smircich (1980). This research focuses on interpretive paradigm that is exploring reality.

The current research problem is well-defined in relative to an organization, where the issue of first flight management of matching pilot with aircraft, to avoid delays in the first flight and the cascading effects throughout the day. Hence, this research determines adoption of the interpretive paradigm concerned with exploring reality as a social construction "emergent, subjectively created, and objectified through human interaction" (Chua, 1986, p. 615). Previous research in management control and systems and, specifically, in the time management area would often be conducted under the interpretive paradigm (e.g. Arena et al., 2010, 2011; Mikes, 2005, 2009, 2011; Woods, 2009, 2011).

3.3 Research Strategies

This refers to philosophical and practical constructs of research from theoretical observation (Collis & Hussey, 2003). Hence, in this research, the field study methodology is employed to investigate the variety of configurations of airline time management systems and their technical and institutional factors.

3.3.1 Field study

The field study was proposed by Merchant & Manzoni (1989) and Lillis & Mundy, (2005) as, need to conduct in-depth study for conversion method use for exploratory nature of the study.

3.3.2 Case study

Social case study requires in-depth analysis are often recommended for interpretive methodology. Yin (2009) recommends a case study on contemporary events are better suited for real world events.

This research focuses at both, a field study and a case study as the current issues is at a specific location (field study) and directed at the specific carriage, that forms the bulk of first flights departing KLIA2 and other operators are only minor players (case study).

3.3.3 Definition of units of study

According to Yin (2009) and Saunders (2012), the ideal for interpretive approach is purposeful sampling. Other authors Arnold (1970) and Lillis & Mundy (2005) used dimensional approach for field study. Refer to Table 3.1.

Table 3.1: Unit of Study

Unit of Study		Description
Case study sampling	This unit of study will be used to Answer RQ1	The research is concerned with proposing guidance for effective, schedule management systems in LCC airlines, in the first instance it may suggest selecting for the case-based study of a sample of airlines first flight departure time. However, several issues arise from this rationale, the bulk of first flight take off are skewed towards a single carrier and at times no departure times are displayed on departure. **Location: KLIA2**
Field study sampling	This unit of study will be use to Answer RQ2, RQ3 and RQ4	The scarcity of LCC operating out of KLIA2 is skewed towards a single airline that forms the bulk of the flight operating out of KLIA2, implies the study is also an empirical case study of that airline. **Location: LLC airlines based in KLIA2**

3.4 Research methods

Interpretive Research is a social science and must be defined through a theoretical framework (Greetz, 1995). This research conceptualises organizational dynamics of airline management of flights, namely context and rationalities of first flight departure, was derived from the research by Arena et al. (2010) and Tekathen & Dechow (2013).

3.4.1 Data collection methods

This research is a cross-sectional study with data collection prior to testing a hypothesis. This research uses both a field study and a case study. For field study data on the first flight phenomena in airlines being late at departure data collection collected through different means according to the needs of analysis of qualitative and quantitative approaches (Van Maanen, 1983). Hence, to understand the seriousness of the issue and the rationale behind it, the author intends to use a mixed model approach of Creswell & Plano Clark (2007) on LCC airlines operated from KLIA2.

3.4.1.1 Quantitative method

The direction taken in this research is also one of a quantitative approach, as the central focus is to identify a number of delays in first flight take-off, principle data for this comes from observation of first flight departing from KLIA2. As the only reliable means of collecting such data is an observation of the display board (data kept by airlines are biased towards the allowed 15 minutes' delay, which are not classified as a delay by airlines). The need to generalize this phenomenon to a wider context means appropriate sampling technique needs to be applied with a known level of confidence and error margin for a reliable projection, hence a quantitative method is appropriate (Sagaran, 2017; Saunders et al., 2012).

3.4.1.2 Qualitative Method

Semi-interviews are employed in order to understand interviewees' views of the nature and consequences of the problem; and in-depth views of the management control in relation to their effort as opined by Ahrens & Chapman (2006).

Effort to explore airline flight management system and the need for new input would inevitably fail if the participant of stakeholders and their views is not solicited, however, due to time restriction it has resulted in limited availability of interviewees and will be kept to a statistical minimum. Through this approach, complex issues related to airline flight management were split into several themes and a series of descriptive semi-structured, open-ended questions were developed focusing on pilots, passengers and customer service personnel who manage and issue boarding passes prior to departure.

Hence, the researcher intends to use the mixed model approach, quantitative approach for generalization of the seriousness of delays of the first flight and to understand the reasons and effects of delay through a qualitative approach.

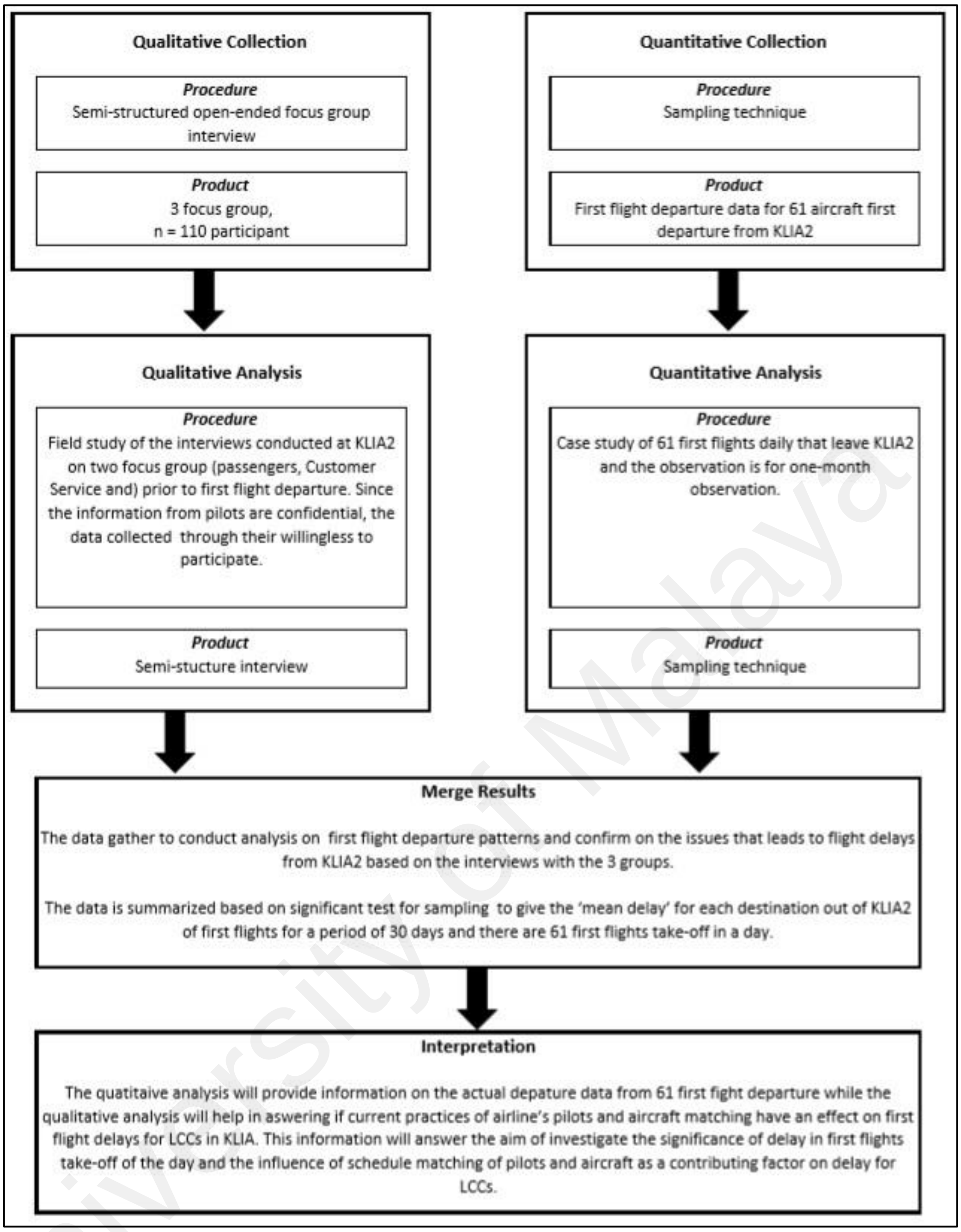

Figure 3:2 Research Methods framework

3.5 Technique and Procedure

For this section, the technique and procedure are taken for this research are summarised per Table 3.2.

Table 3.2: Summary of Technique and Procedures

Strategies	**Method**	**Technique and Procedure**
Case Study	Quantitative	Sampling Technique - Population of Interest - Sample Selection
Field Study	Qualitative	Semi-Structure Interviews

3.5.1 Sampling Technique for Quantitative Data Collection

The sampling technique for the quantitative data collection are measured based on:

(a) ***Population of Interest***

The aim is to investigate first flight departing from LCC hub and there are 61 flights daily that leave KLIA2. These flights are operated by a major player and three minor players. This pattern is retained for 6 months and a new schedule is prepared thereafter giving a total of 10980 first flight of the day taking off from KLIA2 (61flights dailyx30daysx6months). The next 6 month schedule does not have a marginal change and usually, the changes are at the time of departure. This forms the population of interest.

(b) ***Sample selection***

As the cycle is repeated, a month is selected at random and within a six months' period before the schedule is changed for investigation. The sample size is therefore 1830 first flight take-off (61 first daily flightsx30days). The basic selection is to have some reliability in generalization with some confidence. Based on sample size calculator, the minimum sample size required is 1583 for a 99% CI and 3% ME, and the sample size selected has slightly exceeded that as shown in (Figure 3.3).

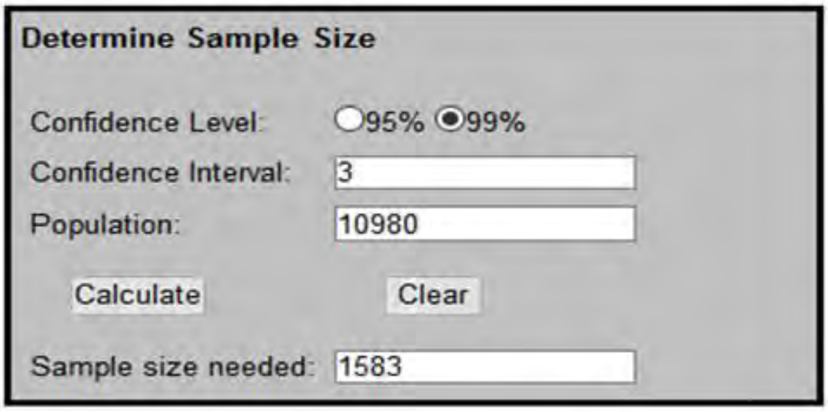

Figure 3:3: Sample size, Source: https://www.surveysystem.com/sscalc.htm

Questionnaire distribution size depends on the accuracy, also known as external validity (ability to generalize). Basically, it depends on, the purpose of the study, the size of population in the study, the sample as the smaller the error, the larger the sample should be and finally the sample size which needs to be at least a sample size of 30 as statistical books have suggested a minimum of 30 to observe any quantitative analysis patterns.

A more appropriate statistical technique involves the use of confidence level, level of variability, and the level of precision matter (for external validity purpose) to come out with a suitable sample size. Refer to Table 3.3.

Table 3.3: Statistical technique

Type	Technique description
Level of precision (sampling error)	It is true value range estimate of the population. For example, if researcher finds a sample of 70% students from a school have implemented IT in their studies with a precision rate of ±5%, then it can be concluded that between 65% and 75% of the students in the population have adopted IT in their studies.
Confidence Level	A 95% confidence level shows that 95 out of 100 samples should have true population value inside the specific interval range above (i.e. between 65% and 75% of the students in the population have adopted IT in their studies).
Degree of Variability	This measures the spreading of attributes in a population. In short the more mixed the attributes of the population, the larger the sample size for a specified level of precision. For example, twenty percent(0.2) indicates that a huge majority do not have the attribute of interest while 80%(0.8) indicates that huge majority do have the attribute of interest. 50% (0.5) proportion demonstrate maximum variability in a population, and often used in defining a more conservative sample size.

(a) ***Sampling Technique Used for Quantitative Analysis in Answering Research Question 1***

RQ1: Is the delay in first flights take-off significant for LCCs?

A simple random sampling technique is used to select a month from a 6-month period in the first half year of 2018 (January until June).

The reason being any minor addition or omission to the flight schedule is done on a monthly basis and it has a minimum effect on the overall schedule. But a major revision of flight schedule is undertaken every 6 months once, this adjustment has a noticeable influence on the schedule. This cycle is repeated for the next 6 month-period with monthly minor adjustment. Hence, a simple random selection of a month over the 6 months is justified and practical for the study.

A set of numbers from 1 to 6, in that order, is used to identify January to June and a random table is used to select a single number from the six numbers (which implies the month for the investigation), hence the investigation period here is a month selected at random.

Source of data was secondary data (and for this research is taken as primary data for investigation). This record are kept by the airlines and for this research, researcher obtained the data from Airportia based on observation of flights off KLIA2 for a month period from January until June 2018. Sample size referred as ‘n’.

Based on the earlier justification, the population here is all first flights of the day during the 6-month period (N=10980)

For any generalization of Quantitative findings, which is the case for the RQ1, there is the element of how confidence are we with the findings and the likely error in our findings, hence a sample size is selected should reflect both this information, the least.

Hence; n = 1583 (For CI= 99%, ME=3) refer Figure 3.2.

(b) ***Sampling Approach for Qualitative Studies in Answering Research Question 3***

RQ3: Are the current practices in matching pilots and aircraft efficient as far as time management is concerned for the first take-off of LCCs?

Basically, it depends on, the purpose of the study. There are three main types of qualitative sampling: purposeful sampling, quota sampling, and snowballing sampling. Purposeful Sampling is the most common sampling strategy. In this type of sampling, participants are selected or sought after based on pre-selected criteria based on the research question.

As the experience of stakeholder in this specific scenario of using LCCS are involved, with the preselecting criteria being established, purposeful sampling is most appropriate to answer RQ3.

To determine the size of the sample for RQ3, most scholars argue that the concept of saturation is the most important factor on sample size decisions in qualitative research (Crouch, & McKenzie, 2006; Guest, Bunce, & Johnson, 2006; Latham, 2013). Meaning, the amount where additional participants don't provide any additional insights. Guest, Bunce, and Johnson (2006) propose that saturation often occurs around 12 participants in homogeneous groups. To ensure that you have saturation you have to go beyond the point of saturation to make sure no new major concepts emerge in the next few interviews or observations. Consequently, 15 as a minimum for most qualitative interview studies works very well when the participants are homogeneous. However, for practical reasons Crouch & McKenzie (2006) propose that less than 20 participants in a qualitative study help a researcher build and maintain a close relationship and thus improve the "open" and "frank" exchange of information. This can help mitigate some of the bias and validity threats inherent in qualitative research.

However, if there is a need to interviewing different types of participants then this sample size need to be replicated for each type in order to reach saturation (Latham, 2013).

The author selected a sample of 30 with an addition of 10 from the maximum number 20 identified by scholars (Ibid) for users of LCCs. This was reduced for the case of another stakeholder the pilots and ground crews but consistent with the number proposed by scholars.

Interviewees from the passengers at KLIA2 are selected based on willingness to participate, this is also the case with pilots and ground crews who operate at KLIA2.

However, pilots and management staffs, especially the schedule maker and the top management, the core qualitative source of data, are identified on an earlier acquaintance as this source is highly confidential.

On the Time Period for Interviews, the interviews were conducted between January until June 2018 for all three groups. Since the passengers and Customer Service on duty have limited time due to waiting for flights for the passengers and performing their duties for the Customer Service, the interview questionnaire given to them is a short but relevant interview question. Their response to the questionnaire will be use to analyse first flight departure patterns and confirm/validate on the issues that leads to flight delays from KLIA2 based on the interviews with the 3 groups. As for the pilot, since the data collected and their position is confidential, the researched have identified and approach pilots that voluntarily providing the information as the information from the pilot themselves will provide significant information to the research.

Information that will be collected from passenger will be why they choose early departure or first flight departure and if their have experience delay on first flight departure, how do they handle the situation.

Information that will be collected from Customer Service will be more on their experience in encountering delay, reason for the delays and how do they handle the contention from the passengers.

Information that will be collected from pilots will be more specific such as have they piloted first flight of the day and was there any delay and does the delay cause subsequent delays for the day. If there’s delay, is that because of last minute request to filled in for another pilot and how do they handle it and what does pilot expect from the rostering crew who does the rostering of pilot and aircraft.

(c) ***Sampling Approach for Qualitative Studies in Answering Research Question 2***

RQ2: What are the current practices in use in matching pilots and aircraft for LCCs?

This is a secondary data based reviewed, the practices for the time period of 6 months are used to review and observation made by the researcher based on the civil aviation regulation requirement as well as discussion with airline top management which is highly confidential. The current practices look into the aircraft scheduling impact on matching aircraft and pilots as well as pilot reporting time, operating hours and the impact of exceeding the operating hours due to aircraft delays.

(d) ***Sampling Approach for Qualitative Studies in Answering Research Question 4***

RQ4: What are the best practical solutions to optimum time management for first flight for LCCs??"

The result of both qualitative and quantitative analysis will enable the researcher to provide the best practical solutions to optimum time management for first flight for LCCs. The quantitative analysis will provide information on the actual departure data from 61 first fight departure while the qualitative analysis will help in answering if current practices of airline's pilots and aircraft matching have an effect on first flight delays for LCCs in KLIA. This information will answer the aim of investigate the significance of delay in first flights take-off of the day and the influence of schedule matching of pilots and aircraft as a contributing factor on delay for LCCs.

This is an opinion piece and recommendation by the author, that analysis of good practices by the LCC airlines should contribute to minimizing the delays of the first flights.

3.6 Data analysis methods

Study of inductive approach with interpretive paradigm was mentioned by Creswell (2009). Organization and interpretation of rich data collected throughout the case study stages were undertaken in a rigorous and systematic manner where a significance test for sampling is conducted.

The strategies involve collecting data in an iterative process; data collected in one phase contribute to the data collected in the next. Data was collected in these designs to provide more data about results from the earlier phase of data collection and analysis, to select participants who can best provide that data, or to generalize findings by verifying and augmenting study results from members of a defined population (Creswell & Plano Clark 2007:121, cited Sagaran, 2017).

(a) ***Data Analysis Technique Adopted for Research Questions***

i *Quantitative Analysis of Research Question:*

For research Question One "Is the delay in first flights take-off significant for LCCs?"

This will be answered through the use of quantitative analysis. The summary statistic will be used initially to study the phenomenon of delay of first flight through the use of mean and standard deviation. The proportion of delays over the test period will be investigated through comparison.

Any deviation beyond the 15 minutes' allowable time is tested for significance of the delay beyond the announced time. For this, the following Hypothesis is set.

As the tested is based on more than the average '15 minutes' delay, a one-tail t-test is most suitable to determine if there's indeed a delay or if the delay is significant based on the actual take off of the first flight and the schedule flight time.

The Hypothesis Devised

The null hypothesis; HO: $\mu = 15$ minutes (departure of a first flight is 15 minutes of announced time)

The alternate hypothesis; H1: $\mu > 15$ minutes (departure of a first flight is more than 15 minutes of announced time).

ii *Qualitative Analysis of Research Questions:*

Quantitative statistical analysis is used to augment the next phase which is the qualitative analysis for an in-depth analysis.

For research Question Two “What are the current practices in use in matching pilots and aircraft for LCCs?”

The data for the current practices derived from Flight Operation Directive and this is mandated to all LCC operators in Malaysia

For research Question Three “Are the current practices in matching pilots and aircraft efficient as far as time management is concerned for the first take-off of LCCs?”

This will be answered through the use of qualitative analysis in the form of a survey that takes the form of interviews of various stakeholders. The information gathered will be review and analyze for patterns and the significance of delays towards the passengers, customer service on duty as well as the pilot of the first flight of the day.

For research Question Four “What is the best practical solutions to optimum time management for first flight for LCCs?”

This will be answered through a recommendation for best practices based on issues with the current schedule.

(b) ***Questionnaire Design for Qualitative Analysis.***

There are three groups of stakeholders views that are central to understand the quantitative findings of first flight departures. Customer service personals, LCC passengers and Flight crews, three separate questionnaires are prepared to induce the views of this group.

i For Customer Service On-Duty; there are 4 Qs

ii LCC passenger; there are 4Qs

iii Flight Crew; there are 7Qs

The objective is to identify revealing patterns, themes in the data and make connections to the significance and likely reasons for delay. Hence, the number of questions in each questionnaire is structured to lead to this reason. Due to the uniqueness of the study, first flight consideration, the researcher took the liberty to device original questions based on the needed objectives.

These Questions give the respondent an easy method of indicating his answer and to rely less on memory in answering a question.

Pre-test of the questionnaire for validity, prior to a full-scale survey, the following were undertaken by the researcher;

a. Whether the questions have any language mistakes that need correction,
b. whether the questions are appropriately worded and will achieve the desired results
c. whether the questions have been placed in the best order
d. whether the questions are understood by all classes of respondent
e. whether additional or specifying questions are needed or whether some questions should be eliminated ·

f. whether the instructions to interviewers are adequate.

(c) ***Instrument Validators***

The first point was corrected by a repeated review by the author, this was followed by a review by an English Language Teacher. The others issues were studied through 3 willing respondents from the three stakeholders' groups who were more than willing to give positive feedbacks. Finally, the advice of a research methodology expert was solicited for final clearance.

3.7 Validity Consideration for both Quantitative and Qualitative Studies

Theoretical Consideration. The chosen methodology approach requires some concern on validity and reliability.

Types of Validity. According to Yin (2009), validity is the range to which the research process allows assessing what it meant to assess and the extent it reflects the reality.

1. Internal validity is validity of results originating from implementing correct sample and meticulous data collection and analysis protocols.
2. External validity is generalization of research findings.

No research is generally accepted without a consideration given to the validity and reliability of measurement as they play important roles in the generalizing of findings. Black (1993) views research in social science will tend to limp along not benefitting from others' efforts except in generalizability but Guba, (1978) questions the significance of generalized research results when variables are fraught with local variables and in changing situation, where replication is impossible. However, the general consensus among researchers is skewed towards the benefits of generalization.

1. Validity is about what we intend to measure is measured.

2. Reliability represents internal consistency; measurement is consistently measured.

Anderson and Gerbing, (1988) and Iacobucciand Churchill, (2009), identified four validities; face validity, content validity, construct validity, predictive validity and Olson et al., (1995) and Bryman and Bell, (2011) included external validity.

1. Face validity is a subjective evaluation, is concerned with how closely the operationalization appears 'on its face'. Author administered the research instrument to the professors and researchers in this field of study, to seek the feedback and critical evaluation of the instrument
2. Convergent validity is a concern of scores produced from two different instruments measuring the same concept, are highly correlated. The researcher has undertaken the comparison analysis between the adapted instrument and the Likert scale self-administered instrument (Rivers, 2014) to measure the correlation among the variables.
3. Discriminant validity, based on theory, is achieved when two constructs are expected to be uncorrelated, and the scores produced by measuring them are empirically found to be truly uncorrelated.
4. Predictive validity; the ability of a measuring instrument to actually predict what it is intended to predict; nomological validity is commonly used here, which refers to the extent to which predictions from a conceptual model are confirmed (Meehl, 1955) can be assessed through internal validity (Olson et al. (1995).

(a) ***Validity and Reliability Consideration Undertaken for the Study.***

i Internal Validity for the Study: The internal validity of this research was ascertained by a carefully prepared sample of a reflective audience, using both content and face validity, who are directly involved. Suitable and meticulous data collection and analysis techniques and steps were applied. In addition a rigorous test on interview questions, by way of a pilot test, supported this contention. By applying internal validity to the research, rich, contextualized insights were extracted from the investigated phenomena that provided for interpretive paradigm. Hence, this validity is applied for the qualitative aspects of the study namely the interviews.

ii Reliability for the Study: Stenbacka (2001) argues that since reliability issue concerns measurements then it has no relevance in qualitative research. Therefore, if it is used then the "consequence is rather that the study is no good" (p. 552). The concept of good quality research when reliability is a concept to evaluate quality in the quantitative study with a "purpose of explaining" while quality concept in the qualitative study has the purpose of "generating understanding" (Stenbacka, 2001, p. 551). The researcher takes a cue from the above author and have not emphasised reliability for the qualitative aspect of the study, and believes the validity aspects maintain the quality of the study.

iii External Validity for the study: For the external validity, available statistical concepts were used during the sampling and collection of data. Although the first flight departure delay time are secondary data, this data is considered as primary data as far as the research is concerned. This is allowed as the data is raw data and not processed (Sagaran, 2017). Hence, sampling size, with the use of confidence interval and margin of error acts as external validators for the research where quantitative 'delay time' is used. This makes the findings to be generalized to the general population of interest to the research. This validity is applied to the quantitative aspects of the study. As the quantity study depends on secondary data, and not through a questionnaire the need for Reliability does not arise.

(b) ***Issues with Validity Consideration.***

The research also acknowledges the limitation of the chosen methodology for conducting the empirical study regarding statistical generalization from the findings. This limitation is believed in the nature of the data source.

Qualitative research assessment has always been a controversy Baster and Chua, (2008). In addition to assessing the reliability and validity of this study, alternative validation criteria relevant to the qualitative research are also considered.

3.8 Ethical considerations

Conducting research with human subjects may pose ethical concerns regarding the well-being of the participants. Therefore, ethical consideration was given prior, during and after for the research. The guidelines for this follows those identified by Sagaran (2017) in Table 3.4.

Table 3.4 Ethical consideration (Sagaran, 2017)

Ethical consideration	Guidelines
Data Colleting Stage	The following were respected and noted; a. Right to privacy b. Netiquette - rules of etiquette that apply when communicating over computer networks, especially the Internet need to be followed c. Confidentiality and anonymity d. No chat rooms with the results e. Careful with the observations – be objective and not subjective f. Habituation – a decrease in response to a stimulus after repeated presentations g. Debriefing – part of a simulation experience, and gives participants an opportunity to reflect on what they did right and what needs improvement
Data Protection and Research	The following were observed; a. Process personal data fairly and lawfully b. Accurate and keep up-to-date c. Keep securely d. Do not transfer outside the country e. For an interview, use the replacement name rather than the actual name f. The use of top management rather than the CEO is more appropriate

3.9 Chapter Summary

This chapter presented the overall methodology to achieve the aim of the research. It discussed the steps of the research process necessary; paradigm, approach, strategy and data analysis. It further, discussed the rationale in selecting the mix-method and how the data was collected for each of the selected methods to be inconsistence with the devised objectives. It had also discussed the technique of selecting the size of the sample for the given reliability and confidence and appropriate statistical technique to analyze the data collected. Finally, it concluded with a discussion of ethical and validity consideration.

CHAPTER 4: DATA ANALYSIS

4.1 Introduction

The earlier chapter contains a detailed analysis and discussion of the research design and methodology for the study. This chapter presents an analysis of the data collected.

First, we will observe the frequency pattern through the use of frequency tables and summary statistics. Initial Exploratory analysis is very useful to show; trends, proportion and distribution of values. Some of these analyses will form part of the investigation.

The chapter will look into two types of data analysis:

1. Quantitative Analysis – a Case study of 61 first flights daily that leave KLIA2 and the observation is for one-month observation
2. Qualitative Analysis – a Field study of the interviews conducted by the passengers, Customer Service on duty as well as the pilot themselves on their first-hand experience on flight delay.

4.2 Case Study - Quantitative Analysis

There were 61 flights operating daily out of KLIA2 of which three are minor operators (Jetstar, Cebu Pacific and Tigerair), the balance fifty-eight are from the major operator (AirAsia). Based on a thirty-day observation, a total of 1830 first day flights were observed.

The data is summarized to give the 'mean delay' for each destination out of KLIA2 of first flights for a period of 30 days and there are 61 first flights take-off in a day.

4.2.1 Summary Statistics of Flight of the Day

In Table 4.1, Table 4.2 and 4.3 will show the one-month data collected for 61 aircraft that departs from KLIA2. The data collected is the duration of delays between the actual departure of the aircraft against the scheduled departure.

Table 4.1: Aircraft number 1-20 first flight for 30 days' delay summary (Airportia)

	AIRCRAFT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DELAY	Day 01	49	72	15	0	30	0	0	54	0	0	25	63	11	0	0	36	65	35	28	9
	Day 02	27	33	25	23	0	20	21	31	0	0	23	29	35	0	23	0	36	19	9	17
	Day 03	11	16	11	16	0	0	33	0	13	0	7	18	15	0	0	0	17	54	24	15
	Day 04	16	23	15	16	0	16	30	27	0	0	14	18	9	0	29	0	16	17	16	14
	Day 05	73	0	15	0	0	0	20	17	0	0	16	17	21	0	0	0	15	17	19	14
	Day 06	76	31	14	0	16	0	26	0	0	0	7	29	14	22	0	0	19	54	14	17
	Day 07	39	29	21	16	26	0	9	17	8	0	27	17	16	19	0	0	22	17	11	15
	Day 08	18	19	17	16	22	21	96	37	0	0	16	57	19	15	0	0	51	29	34	9
	Day 09	9	34	16	10	22	17	19	18	15	0	36	14	12	0	15	0	55	27	6	10
	Day 10	27	23	21	0	15	24	38	15	0	0	0	24	18	0	20	0	12	21	19	19
	Day 11	19	19	13	19	24	14	32	58	17	18	12	28	8	29	19	20	48	24	38	17
	Day 12	16	30	10	17	25	0	18	0	27	0	16	20	14	0	28	23	19	9	24	3
	Day 13	17	20	31	0	17	16	49	36	0	0	27	27	7	19	0	0	24	17	28	28
	Day 14	10	26	16	8	16	0	27	17	0	0	22	22	8	21	10	0	36	17	12	5
	Day 15	13	0	10	0	27	11	31	37	0	0	17	17	10	0	0	0	34	32	16	8
	Day 16	31	27	22	17	13	11	30	15	12		7	25	23	0	0		50	16	21	12
	Day 17	0	37	14	0	32	0	46	21	0	0	34	0	5	19	0	0	54	22	0	0
	Day 18	0	38	0	0	0	0	25	33	0	0	33	0	0	27	0	0	13	11	0	11
	Day 19	15	21	0	0	0	0	24	20	9	0	21	18	19	26	0	13	33	26	0	12
	Day 20	33	36	23	0	8	13	25	0	4	0	29	37	0	14	0	16	28	12	0	26
	Day 21	58	18	11	0	10	9	26	12	0	0	23	36	17	18	0	37	13	14	0	0
	Day 22	20	0	11	0	15	0	0	0	0	0	33	18	9	0	0	24	0	0	0	12
	Day 23	11	0	12	19	0	0	0	0	0	21	9	10	0	0	0	23	0	0	27	24
	Day 24	13	0	16	13	0	0	0	0	0	0	20	26	0	0	0	0	0	0	33	13
	Day 25	39	0	16	17	0	0	0	0	20	0	13	50	0	0	0	15	0	0	64	10
	Day 26	25	0	0	37	0	0	0	0	0	18	0	25	0	0	0	33	0	0	19	28
	Day 27	25	0	11	21	0	0	0	0	0	25	0	31	0	0	0	28	0	0	44	9
	Day 28	20	0	25	25	0	0	0	0	0	12	18	31	0	0	0	24	0	0	16	21
	Day 29	0	0	8	0	0	0	0	0	0	40	13	0	0	0	0	0	0	0	0	0
	Day 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.2: Aircraft number 21-40 first flight for 30 days' delay summary (Airportia)

	AIRCRAFT	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
DELAY	Day 01	10	21	33	115	38	66	0	0	12	26	86	15	0	0	35	0	8	46	86	40
	Day 02	22	30	38	15	27	22	18	62	33	27	16	0	0	35	7	45	19	34	35	47
	Day 03	34	46	42	21	24	49	14	20	14	22	37	16	0	14	18	45	8	35	13	24
	Day 04	13	26	11	19	18	24	0	20	14	11	23	0	13	2	22	23	10	25	12	20
	Day 05	17	18	12	18	24	17	0	24	9	14	15	13	12	14	11	39	11	17	27	20
	Day 06	12	21	8	23	8	26	20	17	13	12	29	15	17	7	51	37	15	5	15	20
	Day 07	17	17	16	21	33	21	20	25	26	15	20	0	28	40	16	27	15	17	16	18
	Day 08	16	64	22	46	18	18	11	26	15	19	26	8	27	18	16	18	16	14	38	30
	Day 09	25	16	20	17	34	13		14	19	10	27	0	13	7	13	18	22	72	22	32
	Day 10	8	18	10	17	19	20	20	22	22	17	63	9	0	4	19	25	13	21	23	13
	Day 11	18	18	20	16	25	40	17	21	24	27	53	0	8	11	15	18	152	14	15	19
	Day 12	9	22	14	15	23	10	0	35	26	20	15	11	11	21	10	16	18	13	82	30
	Day 13	15	16	10	34	19	50	11	33	16	12	0	32	28	13	10	17	17	19	11	19
	Day 14	12	14	14	21	23	10	36	22	34	13	0	23	13	4	7	21	0	37	15	29
	Day 15	24	26	13	21	36	18	0	41	21	14	0	0	18	27	14	21	0	30	26	36
	Day 16	23	23	0	25	9	18	0	25	24	16	0	25		19	27	39	0	37	24	14
	Day 17	18	0	25	0	26	0	18	30	0	0	0	19	11	0	27	0	0	0	0	0
	Day 18	8	0	13	0	32	0	7	24	0	0	0	0	37	0	17	20	0	0	0	0
	Day 19	8	18	28	19	24	16	27	26	20	16	0	0	21	0	29	26	0	12	18	0
	Day 20	15	16	12	47	27	21	19	22	12	40	0	8	23	9	21	19	0	14	19	0
	Day 21	14	8	18	23	13	13	21	22	12	23	0	2	14	0	29	20	0	30	55	0
	Day 22	0	9	0	9	0	16	0	0	15	20	0	18	0	0	0	0	0	15	11	0
	Day 23	0	21	0	15	0	16	0	0	28	22	0	43	0	17	0	0	90	15	17	19
	Day 24	0	25	0	18	0	19	0	0	19	9	0	26	0	12	0	0	0	33	20	14
	Day 25	0	18	0	22	0	13	0	0	31	19	0	16	0	0	0	0	0	8	32	21
	Day 26	0	10	0	39	0	29	0	0	8	31	14	12	0	13	0	0	0	22	0	29
	Day 27	0	14	0	29	0	19	0	0	17	32		30	0	14	0	0	17	21	11	26
	Day 28	0	22	0	30	0	17	0	0	9	9	74	25	0	12	0	0	0	49	22	16
	Day 29	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0
	Day 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4.3: Aircraft number 41-61 first flight for 30 days' delay summary (Airportia)

	AIRCRAFT	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61
DELAY	Day 01	0	27	49	6	12	0	65	24	0	35	0	63	50	45	0	80	0	0	0	15	70
	Day 02	18	38	45	0	14	16	7	0	36	47	36	29	31	54	0	17	0	38	0	16	31
	Day 03	65	15	22	0	14	0	18	28	16	15	19	18	90	15	10	73	0	14	0	17	23
	Day 04	65	16	8	5	17	13	14	21	14	35	13	18	20	20	18	34	0	10	2	17	14
	Day 05	26	23	15	0	14	15	23	32	20	31	6	17	15	18	17	11	0	23	0	26	28
	Day 06	13	36	25	0	14	0	18	0	34	49	18	29	20	92	18	52	0	20	0	7	21
	Day 07	14	27	36	11	11	8	33	0	14	16	30	17	25	32	13	15	0	15	0	48	26
	Day 08	66	23	29	16	17	0	0	0	41	25	0	57	14	16	23	16	0	20	0	25	21
	Day 09	32	22	14	0	29	9	13	32	21	11	26	14	15	16	22	9	0	22	0	42	15
	Day 10	0	24	48	6	33	0	10	26	24	28	41	24	15	52	22	19	0	18	0	9	23
	Day 11	0	16	11	10	15	11	7		26	28	55	28	37	35	47	30	0	11	0	17	15
	Day 12	0	21	20	14	21	32	16	0	20	17	15	20	20	17	15	11	23	28	0	13	23
	Day 13	0	19	13	0	15	23	0	21	25	18	23	27	57	17	22	11	0	14	0	24	21
	Day 14	0	20	11	0	13	0	11	0	17	34	23	22	34	32	21	45	0	20	0	14	23
	Day 15	0	34	38	8	19	25	22	29	34	21	31	17	67	20	19	13	0	22	0	25	25
	Day 16	0	0	17	11	24	19	20	27	11	30	11	25	39	13	27	68	0	12	0	0	22
	Day 17	0	0	0	0	17	0	20	0	0	0	0	0	0	0	23	0	0	0	0	0	24
	Day 18	0	0	0	0	28	0	9	0	0	0	0	0	0	0	0	0	20	0	0	19	12
	Day 19	0	18	0	0	10	8	24	0	0	30	0	18	0	0	9	0	30	0	0	15	13
	Day 20	0	13	0	3	32	2	47	0	0	25	0	37	0	0	19	14	13	0	0	16	19
	Day 21	0	29	0	0	21	18	24	10	0	22	0	36	0	0	18	34	21	0	0	37	24
	Day 22	0	18	0	0	12	43	0	0	0	20	0	18	0	0	0	30	19	0	0	21	0
	Day 23	0	33	24	10	0	26	0	0	30	84	14	10	50	22	0	27	0	28	17	20	0
	Day 24	0	26	19	10	0	16	0	0	19	30	18	26	24	27	0	12	0	20	24	36	0
	Day 25	0	24	16	7	0	12	0	0	17	44	33	50	23	13	0	45	0	36	23	19	0
	Day 26	0	25	19	12	0	30	0	0	69	28	39	25	56	17	0	40	0	27	26	12	0
	Day 27	0	30	7	0	0	25	0	0	22	20	60	31	43	30	0	16	0	13	0	0	0
	Day 28	0	14	17	8	0	25	0	0	19	33	20	31	24	22	0	36	0	56	22	0	0
	Day 29	0	17	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Day 30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

An analysis was done on the average delayed time in minutes with the following condition:

1. In absolute terms i.e. no delay (delay time=0 minutes).
2. In relative terms i.e. the industrial standard meaning of delay, 15 minutes or more.

For absolute term (delay time = 0 minutes), of the 61 first flight of the day to 61 destinations, both domestics and international, over the observation period, none had a mean on the dot, although there were times when individual departing flights were on time, but on average none of the first flights departed on time.

On average, fourteen destinations had a mean departure time delayed by more than 20 minutes (23%), twenty-two had a mean delay between more than 15 minutes but less than twenty (36%) and the rest (25) less than 15 minutes but more than zero (41%). Further, this means 59% of the first flight of the day depart late as compared to the technical definition of late (late beyond 15 minutes). Table 4.4 shows the summarized of the delay.

Table 4.4: Summary of the delay

More than 20min delay	More than 15 min and less than or equal to 20min delay	Less than 15 minutes but more than zero delay
n=14	n=22	n=25
Domestic n=4	Domestic n=9	Domestic n=12
International n=10	International n=13	International n=13

n* - the number of first flight departure with an average delay time

4.2.2 Significance Test

Having in mind the importance and potential for impact of within 15 minutes' departure for no delay position, the main hypothesis is presented as follows. Significant tests were undertaken on those flights that had more than an average 20 minutes' delay.

(a) ***The hypothesis;***

The null hypothesis; HO: μ= 15 minutes

(That is the time of departure of the first flight is 15 minutes of announced time; i.e. the population mean equals the hypothesized mean)

The alternate hypothesis; H1: $\mu > 15$ minutes

(That is the time of departure of the first flight is more than 15 minutes of announced time; i.e. the population mean differs from the hypothesized mean)

(b) ***Testing Assumption:***

For small sample $n \leq 30$, the use of t-test, for a normal population the use of again of the t-test.

(c) ***Testing significance:***

Alpha, α =0.05 and 0.01

Test statistic: $t= (\bar{x}-\mu)/(s/\sqrt{n})$

Test Results: Using one tailed test is shown in Table 4.5

Table 4.5: T test using one tailed test

#	Average delay	Standard Deviation	Given mean	The sample mean - given mean	Test Statistic	Comparing critical region with one tailed Alpha (0.05)	Critical value (0.05 & 29)
1	24.52	18.84	15.00	9.52	7.58	Significant	1.699
2	19.10	16.86	15.00	4.10	3.65	Significant	1.699
3	20.93	20.42	15.00	5.93	4.36	Significant	1.699
4	22.94	14.93	15.00	7.94	7.97	Significant	1.699
5	21.45	19.75	15.00	6.45	4.90	Significant	1.699
6	22.61	20.62	15.00	7.61	5.54	Significant	1.699
7	21.35	16.10	15.00	6.35	5.92	Significant	1.699
8	21.71	20.46	15.00	6.71	4.92	Significant	1.699
9	20.57	9.60	15.00	5.57	8.70	Significant	1.699
10	25.35	16.76	15.00	10.35	9.27	Significant	1.699
11	23.16	14.94	15.00	8.16	8.19	Significant	1.699
12	25.19	22.73	15.00	10.19	6.73	Significant	1.699
13	20.58	20.02	15.00	5.58	4.18	Significant	1.699
14	24.90	21.63	15.00	9.90	6.87	Significant	1.699

Of the 14 flights having means more than 20 minutes late, 14 flights had significant variance from the technically defined 15minutes allowance (23%).

Answering Research Question 1 “Is the delay in first flights take-off significant for LCCs?”

None of the 61 first flights of the day were able to maintain on-the-dot time take-off, throughout the 30 days’ observations. Less than 50 percent of flights were able to keep within the 15 minutes delayed allowed by international standards. Twenty-three percent of flights have an average of more than 20 minutes’ delay and classified official as “delay”. A t-test had shown the delay is significant for all 14 flights with more than 20 minutes’ delay. Overall, the first flight take-off is a cause of concern for flights out of KLIA2

Summary: The result does not take into account the deliberate omission of data in some days. Although this figure does not raise alarm at the moment, there is plenty of room to improve on this reporting.

There may be a couple of reasons for the delay and the next section will attempt to investigate this through interviews with stakeholders.

4.3 Qualitative Analysis – Field Study

Interviews from the passengers are randomly selected based on willingness to participate on the mentioned date. The Customer Service on-Duty staff are selected on a willingness to participate. However, pilots and management, especially the schedule makers, are specifically selected based on the understanding that they are not personally identified.

Further analysis was undertaken, to have an in-depth experience of pilots on first flight management. For these, an additional 50 pilots were selected based on snowballing (willingness to participate) from among the 914 number of total pilots. The interview was stopped when it reached 50 respondents. Fifty is a reasonable number to observe as statistical books have suggested a minimum of 30 to observe any patterns. For Customer Service on-Duty and Passenger, 30 of each group were interviewed.

The structure of the questions for interviews are presented below:

1. Interviews with Customer Service on-Duty – Appendix A
2. Interview with Issuing Passengers – Appendix B
3. Interview with Pilots – Appendix C

4.3.1 Interviews with Customer Service on-Duty

Verbatim
Have you encountered a first flight of the day departing after 15 minutes of announced departing time on a daily basis? Did you anticipate late departure for the first flight of the day? What is the reason for the delay? Did you ever deal with contention from passengers How did you handle it?

Thirty boarding support personnel and clerks were identified through a snowballing technique and only those having a minimum of two years on the job and are willing to participate were selected. These group is independent and does not come under the jurisdiction of the airlines but under the airport management.

Five questions were designed in this section and the responses are as follows: -

Q1: Have you encountered a first flight of the day departing after 15 minutes of announced departing time on a daily basis?

The answer to this question is a 'Yes' from all thirty respondents.

Q2: Did you anticipate late departure for the first flight of the day?

Thirteen respondents said 'yes' and seventeen said 'No'

Q3. What is the reason for the delay?

Four reasons were identified; crew, aircraft, weather and airport. Crew the highest identified the reason for delay with twelve, followed by aircraft and airport eight and weather two.

Q4: Did you ever deal with contention from passengers?

All respondents said 'Yes' to this question.

Q5: How did you handle it?

Twenty said the will refer to supervisor on duty and ten said they will explain to the passengers.

Table 4.6 summarised the interview conducted with 30 customer service while Figure 4.1 shows the reason of delays percentage based on their own experience. Figure 4.2 shows how they deal with the delays where 67% of them will refer to their supervisors.

Table 4.6: Customer Service on-Duty Interview Summary

Customer Service on-Duty	Yes	No
Have you encountered first flight of the day departing after 15 minutes of announced departing time on a daily basis?	30	0
Did you anticipate late departure for the first flight of the day?	13	17
Did you ever deal with contention from passengers	30	0

Figure 4.1: Reason for first flight delay – Customer Service on-Duty

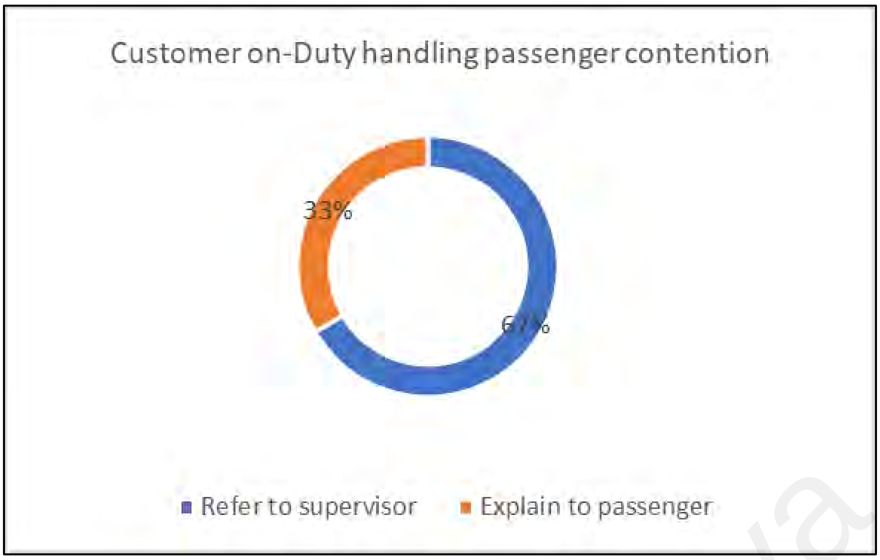

Figure 4.2: Customer on-Duty handling passenger contention

4.3.2 Interviews with Issuing Passengers

Verbatim
Do you often take the first flight of the day?
What made you choose the first flight?
Did you anticipate late departure for the first flight of the day?
How did you handle delayed flight?

Thirty boarding passengers who are willing to participate were randomly selected. Only those who are regular traveller were selected (otherwise that respondent is dropped from further questioning). This group is independent of both airlines and airport management.

Four questions were designed in this section and the responses are as follows: -

Q1: Do you often take the first flight of the day?

Sixteen said yes, and fourteen said sometimes.

Q2: What made you choose the first flight?

Nine said due to last minute business meeting and twenty-one to vacation and cheap fare.

Q3: Did you anticipate late departure for the first flight of the day

All respondents said 'Yes'

Q4: How did you handle delayed flight?

Business travellers will catch up with their work emails and prepare for their meeting. Leisure travellers will tend to sleep, entertaining themselves by watching a movie or listening to music.

Table 4.7 summarised the interview conducted with 30 passengers while Figure 4.3 shows the reason why the passenger chooses to fly on the first flight departure. Figure 4.4 shows how they deal with the delays.

Table 4.7: Passenger Interview Summary

LCC Passengers	**Yes**	**No**
Do you often take the first flight of the day?	16	14
Did you anticipate late departure for the first flight of the day?	30	0

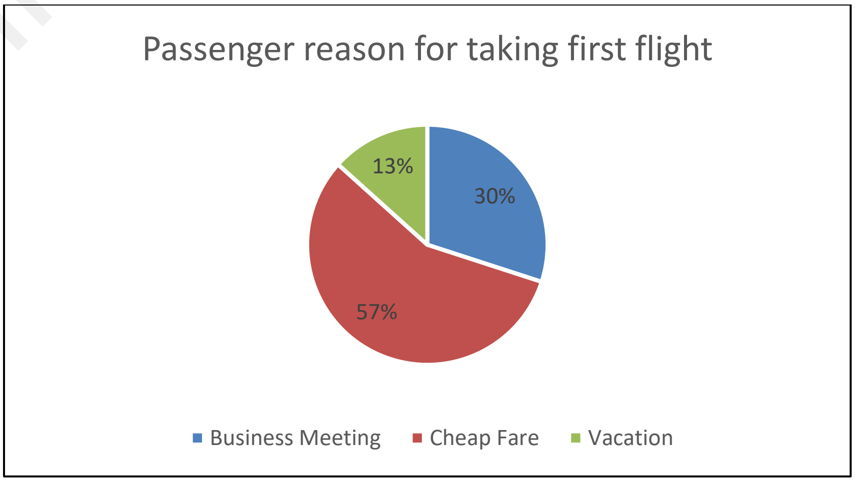

Figure 4.3: Passenger reason for taking the first flight

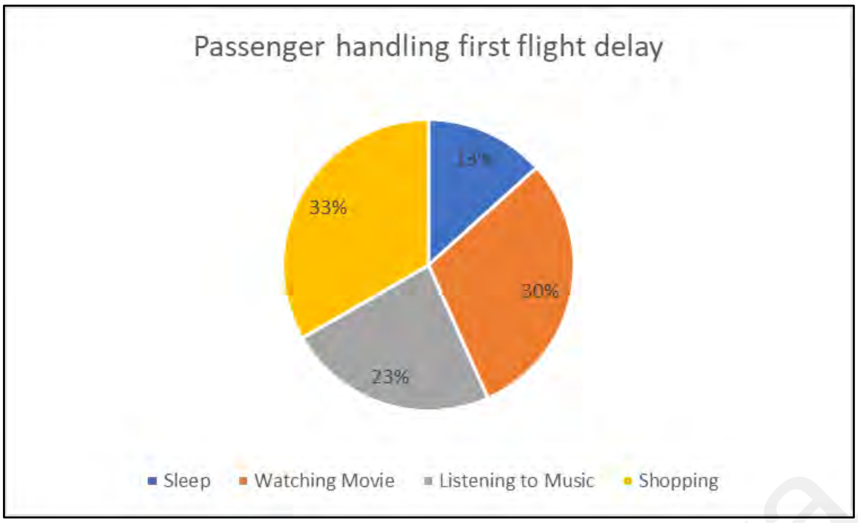

Figure 4.4: Passenger handling first flight delay

4.3.3 Interviews with Issuing Pilots

Verbatim

Have you piloted the first flight of the day?
Do you encounter delays regularly in the first flight of the day?
Do you believe, first flight delay will cause subsequent delays for the day?
Have you ever encountered a last-minute request to fill in for another's pilot absence?
Do you think this will cause some delay in departure?
How did you handle it?
What would you expect differently in hindsight from rostering crew?

Fifty LCC flight crew or commonly known as pilots were identified through a snowballing technique and only those willing to participate were selected. This group works for the airlines; hence identity is held confidential.

Five questions were designed in this section and the responses are as follows:

Q1: Have you piloted the first flight of the day?

All respondents said 'Yes'

Q2: Do you encounter delays regularly in the first flight of the day

Twenty-one said "yes" and the rest 'sometimes' or 'occasionally'

Q3: Do you believe; first flight delay will cause subsequent delays for the day?

All respondents said ‘Yes’

Q4: Have you ever encountered a last-minute request to fill in for another’s pilot absence?

Thirty-five said ‘yes, ten said ‘sometimes’ and five said ‘no’

Q5: Do you think this will cause some delay in departure?

All respondents said ‘yes’

Q6: How did you handle it?

All respondents said it is part of job function and they will try their best to be at the airport as per the required time.

Q7: What would you expect differently in hindsight from time scheduler?

All respondents said better management of their rostering plan is required and to have more standby crew options available as well as early notification.

Table 4.8 summarised the interview conducted with 50 pilots that have flown the first flight of the day. Figure 4.5 shows the pilot expectation from Rostering Crew to improve on the first flight departure of the day.

Table 4.8: LCC Flight Crew Interview Summary

FLIGHT CREW	YES	NO	SOMETIMES	OCCASIONALLY
Have you piloted the first flight of the day?	50	0	0	0
Do you encounter delays regularly in first flight of the day?	21	0	16	13
Do you believe, first flight delay will cause subsequent delays for the day?	50	0	0	0
Have you ever encountered a last minute request to fill in for another's pilot absence?	35	5	10	0
Do you think this will cause some delay in departure?	50	0	0	0

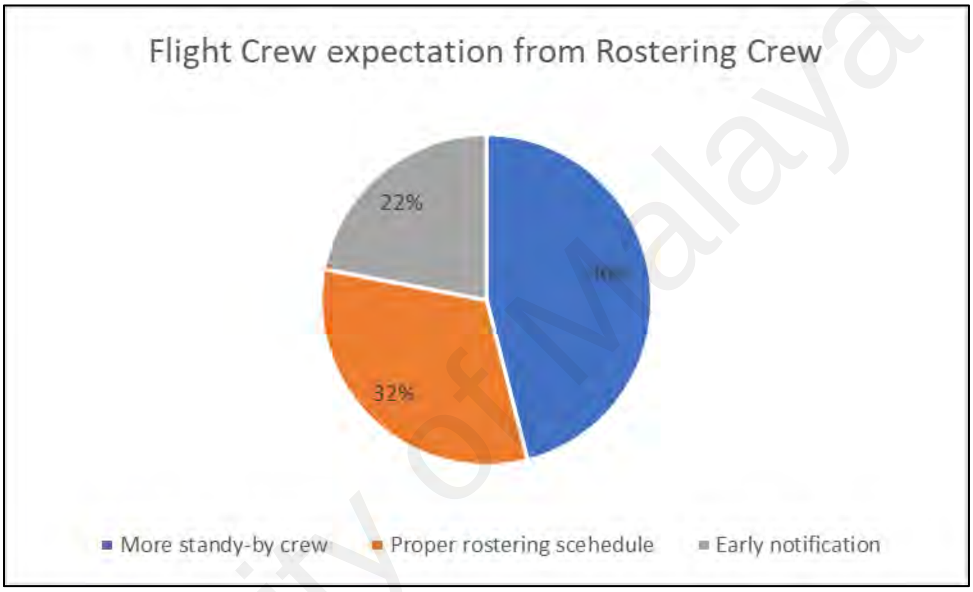

Figure 4.5: Flight Crew expectation from Rostering Crew

Answering Research Question 3: Are the current practices in matching pilots and aircraft efficient as far as time management is concerned for the first take-off of LCCs?

Late first flight take-off for the day is an issue for low cost careers but not very serious in the current period. All three groups interviewed and field investigation point to the existence of this issue but no evidence of seriousness in the current period.

For the customer service, it's part of their work routine and when it does happen, they will refer to their supervisor for guidance or will inform the passengers about the delay.

One of the surprising findings was the response from the majority of the passengers. Most of the frequent flyers with LCC airline are leisure travellers. Business travellers mostly avoid travelling with LCC airlines unless they have last minute business meetings to attend. Both types of travellers anticipate delays in their LCC flight departures. First flight delays to business meet frustrate the business travellers. Surprisingly it's the opposite for the leisure passengers, they are resigned to the fact that their flights will be not on time. Most of them believe they got a very good deal for the fares and do not mind the delays as they can shop and sleep at KLIA2 while waiting for the flight departure.

For the flight crew, the delay of the first flight leads to consequent delays on the next flight departure. Filling in for another crew will most probably cause a delay of the flight departure as they are notified only two hours before the flight departure. Depending on location and situation they may not arrive within the required window. Therefore, most of the correspondents would like to have a proper rostering plan and to have more standby crew available.

Although the delays are there, there is no significant influence due to last minute changes in pilots' schedule. However, the schedule is something that needs attention now as it was also mentioned by the pilots as a likely reason for the departure delay. All LCCs are expanding and increasing their frequencies with more new destinations and if left unchecked will create significant issues in the future.

4.4 Best Practice Proposed Solution

This research has looked into the current practices of pilot reporting and has proposed to design and develop a best practice solution for effective management of first flight.

4.4.1 Current Practice

Answering Research Question 2 “What are the current practices in use in matching pilots and aircraft for LCCs?”

In current practice for KLIA2 LCC operators the flight crew duty reporting time starts 60 minutes before the aircraft departure. The minimum duty reporting time is 60 minutes by regulations.

This requirement of the duty reporting time is mandated in the Flight Operation – Operating Manual A of all LCC operators and in fact all operators in Malaysia.

Flight Crew have a minimum of 9 and a maximum of 14 hours of flight duty daily.

1. The flight duty time is depending on the start time of the duty period
2. Total sectors were flown by the flight crew for the day
3. For the first flight, early morning departure that starts between 6 is to 759am, the minimum flight duty time is 9 hrs. and maximum duty time is 13 hrs.

If the flight crew exceed the flight time, they are required to step down and another flight crew will be needed to fly the next flight.

4.4.2 Best practice Test Proposed

What are the best practical solutions to optimum time management for first flight for LCCs?

Based on the current practise as well as the result of the data analysis, below is the proposed best practise solution for flight reporting.

1. To have a 15-minute incremental increase in reporting time buffer specifically for first flight departure from the standard duty reporting time.
2. For the purpose of sampling, the daily flight duty time is capped at 9 hours.

3. Based on the quantitative analysis on average 14 out of 61 flights have a significant delay (more than 20 mins). To choose those flights to sample and to do analysis on the outcome of the incremental buffer of the duty reporting time.
4. To run the model for 2 weeks.
5. To compare and verify current practise against the best practise model for improvements if the duty reporting time is 75 minutes before the first flight departure.
6. To repeat the same test and have an increase to 30-minute reporting time buffer specifically for first flight departure from the standard duty reporting time.

The expected outcome of the research is as follows:

1. Current quantitative data collection confirms 14 out of 61 flights are more than 20 minutes late. The fourteen 14 flights had significant variance from the technically defined 15 minutes' allowance (23%).
2. With the best practise solution of incremental increase of reporting duty time to 75 minutes and 90 minutes respectively and capping the maximum duty flight time for the first departure at 9.5 hours, the researcher expects:
   a. The number of flights that have shown more than 20 minutes' delay will be reduced.

The subsequent flight delays will be reduced and the possibility of the flight crew exceeding their flight duty period will also decrease.

CHAPTER 5: DISCUSSION AND CONCLUSION

5.1 Introduction

This research was conducted on LCCs operating from KLIA2. The aim was to understand the issue of late departure of first flights for the day and its cascading effect on subsequent return journeys. The literature reviews were used to develop and confirm the study hypothesis. Importance of first flight departures was reviewed together with the consequences.

A quantitative analysis was undertaken on flight departure times of first flights of the day for the various destination at KLIA2 during the test period on data kept by the Civil Aviation Authority of Malaysia. This was followed by a qualitative analysis of face-to-face interviews of various stakeholders for an in-depth deeper understanding of issues related to the departure time of first flights and its consequences.

Major Findings have indicated the following:

1. Only a handful of flights were able to keep up within the announced departure time, but for many other first flight departures this was an issue; both for the principal operator and other minor operators of LCCs out of KLIA2.
2. Some of the delays are attributed to matching pilots and flights for the first flight of the day by operators of LCCs out of KLIA2.

5.2 Discussion of Main Findings

This section contains a discussion on the main findings on first flight departures of the LCC at KLIA2 especially "Is this an issue and cause for concern?".

Research findings confirmed that it is indeed a concern; there are often delays in the first flight on any given day. Understandably, no initiative is taken to correct the delay issues and it is left to the front-line staff to handle complaints. There is also a discrete expression of concern on the issue of match especially for the first flight of the day, from pilots and latent support for a better system in place.

Although the evidence of delay is an issue, the research focused on scheduling as an issue; a match between flight and pilot that are controllable. Other issues, could also contribute to delays such as technical problems, the researcher believes that an efficient system is able to reschedule a different combination of flight and pilot within the given 15 minutes' delay which is an acceptable norm in this industry if an effective system is in place. Although the current research has not clearly correlated the schedule as an issue for the first flights, there is an indication that it does but not significantly for the current period. If left unchecked will become a routine for the operators to believe such delays are norms in this type of business and acceptable to the users leading to a significant problem in the future.

5.3 The contribution of the Study

(a) ***Theoretical Contribution***

From a theoretical point of view, it expounds and adds on to the understanding of delay in flights. Many studies have established the issue of schedules and its relationship to delays. Further, there are indications that delays do have a ripple effect and are a major influence on the efficiency and significant drivers of cost to operators. How serious are delays of first flight especially for low cost operators? This understanding lacks in the current literature, hence this research finding adds on to our understanding of delays and the likelihood of its beginning at first flight take-off of the day. Furthermore, is this an issue with major low-cost operator at a localized hub, and to stakeholders, this finding does indicate that major operator even at its major hub do have the same problem like other minor operators although they have better assets at their disposal.

(b) ***Practical Contribution***

This study has identified first flight delays is indeed an issue and a likely cause of subsequent delays for LCCs operators for both major and minor players at KLIA2. It has identified the views of various stakeholders on delays and the need for operators to undertake remedial measures on delay issue before the situation goes out of control and affect efficiency. The study has also identified delays of flight to current scheduling practices and the need to enhance the current practices. The System structure that is recommendation can be incorporated into the current system to improve pilot reporting and duty period schedule. This study also recommends to operators actively engage effected employees and empowered them to contribute positively to the best practice solution for greater efficiency to current practice.

5.4 Limitation

As much as the research has a practical and theoretical contribution, the research also presented some limitations. The research results revealed issues of a first flight delay in departure at KLIA2 from both major and minor operators based at this location. However, there are some facts that should be stated:

1. The present study had limitations as it had focused only on the first flight management; especially the match between aircraft and pilots for a timely departure. Other factors could also play a significant part; both controllable and uncontrollable. A comprehensive study on them can identify weights due to a match between pilots and aircraft and the significance of the overall delay.
2. While concluding parts of this study, one area which this study could not reach and therefore a cause for a separate study is interviews with top management staff; this could confirm the existence of the problem for a broader understanding of the issue and its relationship to management and productivity.

The recommendations and suggestions are to extend the period of study and involve airport management who are independent operators from LCC operators to identify their contribution towards the problem, especially when take-off of flights are their jurisdiction.

5.5 Future Works

During the conduct of this research, the best practise solution is constructed from data analysis of both quantitative and qualitative analysis. Nevertheless, the best practise has not been put to test in an actual situation. Future work could implement the best practices to the actual airline crewing system to examine its effectiveness of the proposed best practise solution. Additionally, there may be a possible existence of other relations between the factors. The conduct to explore these possibilities can be undertaken in order to attain a better comprehension of the research.

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