A THESIS

THE IMPACTS OF LIGHT SIGN INSTRUCTIONS

FROM THE ATC TO PILOTS: A SEMIOTIC ANALYSIS

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ENGLISH LANGUAGE STUDIES

POSTGRADUATE PROGRAM HASANUDDIN UNIVERSITY

MAKASSAR

2023

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Makassar, 24 Maret 2023

Hadibowo Wicaksono

ACKNOWLEDGMENT

Assalamualaikum Warahmatullahi Wabarakatuh,

First of all, the writer would like to give a lot of praises and thanks to Allah SWT who had given His bless the life of the writer, and gave him the motivation to complete this thesis. The writer also hoped may Allah SWT always give His blessings to all of us The writer would also give the Shalawat and regards to the Prophet Muhammad SAW who had guided all of people from the darkness to the light

This thesis served as an effort to fulfill one of the requirements in completing the learning process in this university, and the writer also realized that there were many people who had supported and given their best guidance and suggestions in finishing the study. To everyone who had given their encouragement, guidance, critiques, suggestions, understanding, and patience, the writer would express his gratitude to them

There are a lot of difficulties and problems that the writer faced when writing this thesis, but all of them are able to be solved by people who had aided and given him solutions. First, the writer would like to express his gratitude and give appreciations to his supervisors Prof. Dr. Fathu Rahman, M.Hum and Dr. Harlinah Sahib, M.Hum who had given a lot of solutions and advices in supervising the writer's process, and the writer would also say a lot of thanks to all of the lecturers in the English Language Study who had guided him from the start until the end

The writer's gratitude is also extended to the examiners who also provided the comments and suggestion for this thesis Prof. Dr. Noer Jihad, M.Hum, Dr. M. Amir P.,M.Hum and Dra. Herawaty, M.Hum., M.A., Ph.D

For the next expression, the writer would also like to say thanks and give appreciations to his parents Herry Herlino and Agnes Diana Katika Dewi, Rizky Mahlisa, Fabella Novega and all of her family, who had given their loves, aid, supports, motivations, and prayer for his success in completing his studies as a college student because the prayer and supports from the family are also the most important things for the writer in his completing his study.

For the next expression, the writer would also like to say thanks and give appreciations to his friends Nasya Putri Rahmaniati, M. Dzikra Yaza Pratama, Nur Shella Firdaus, Didik Agus Suryono, Gatut Nugraha Sumarnanto Budhi, Andi Muhammad Alfian, and Mohamad Romy. Who had given prayer and supports from the friend are also the most important things for the writer in his completing his study.

Lastly, the writer would also like to express his gratitude to his friends, especially from the English Language Studies Department 2019-2 The writer would say thanks for their support, care, and motivation.

Makassar, 24th March 2023

Hadibowo Wicaksono

ABSTRACT

Hadibowo Wicaksono the impact of light sign instruction from ATC to Pilot: semiotic analysis (supervised by **Fathu rahman and Harlinah Sahib**)

This study aims to explain 1. Only light sign types are used on avocation 2. Analyzing the process of distinguishing the meaning of light sign 3. Analyzing the pilot's process of signalling light signs. This research uses qualitative descriptive methods and techniques of data collection in the form of observation, interview, documentation and note-taking.

The light sign from the gunlight has 3 colours they are red, green, and white besides that, researcher found that there is a chance for the accident may happen because of the ambiguity. The pilots respond from aircraft that the departure, arrival and those who fly nearby are divided into 3 categories in responding to light sign that the pilot had a problem in understanding or seeing the light signs, not seeing the light sign well, and seeing the light sign well. The results of show that most pilots experience problems in seeing or understanding light signs. One of the inhibiting factors is the ambiguity that arises because there are two or four meanings in one colour used. So, this study proposes a suggestion to change the way the light sign from gunlight is used based on the position that possible light sign instruction to the pilots, and the position the light sign being transmitted to the pilot.

Keywords: Light sign, Semiotics, Linguistics, Aviation, Air traffic controller.

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ABSTRAK

Hadibowo Wicaksono Dampak instruksi dalam tanda cahaya oleh ATC kepada Pilot: analysis semiotika (dibimbing **oleh Fathu Rahman dan Harlinah Sahib**)

Penelitian ini bertujuan menjelaskan 1. tipe-tipe light sign yang digunakan pada aviasi 2. Menganalisis proses membedakan arti dari light sign 3. Menganalisis proses pilot mempresepsikan signal-signal light sign. Penelitian ini menggunakan metode deskriptif kualitatif dan tehnik pengumpulan data, observasi, interview, dokumentasi dan tehnik catat.

Tanda cahaya yang dihasilkan oleh *gulight* memiliki 3 warna yaitu merah, hijau, dan putih selain itu peneliti menemukan adanya peluang terjadi kecelakaan pesawat udara karena ambiguitas. Respon pilot yang akan terbang, sedang terbang dan mendarat dibagi menjadi 3 yaitu, melihat dan memahami dengan baik, tidak dapat melihat atau memahami, serta pilot mengalami kendala untuk melihat atau memahami. Hasil penelitian menunjukan sebagian besar pilot mengalami kendala dalam melihat atau memahami light sign. Salah satu faktor penghalangnya adalah ambiguitas yang muncul karena terdapat dua atau empat arti dalam satu warna yang digunakan. Maka penelitian ini mengajukan saran untuk merubah cara penggunaan tanda cahaya dari *gunlight* berdasarkan kemungkinan instruksi yang diberikan kepada pilot dan berdasarkan posisi lampu untuk memberikan tanda cahaya kepada pilot.

Keywords: Lingustics, Semiotics, Light sign, Aviation, Air traffic controller.

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ATC   : Air Traffic Controller

ATS   : Air Traffic Service

VLC   : Visible Light Communication

LED   : Light Emitting Diode

CPL   : Commercial Pilot License

ATPL   : Airline Transport Pilot License

DEFENITION

Aerodrome. A defined area on land or water (including any buildings, installations and equipment) intended to be used either wholly or in part for the arrival, departure and surface movement of aircraft.

Air traffic control clearance. Authorization for an aircraft to proceed under conditions specified by an air traffic control unit.

Air traffic control instruction. Directives issued by air traffic control for the purpose of requiring a pilot to take a specific action.

Air traffic control service. A service provided for the purpose of:

a) preventing collisions:

1) between aircraft, and

2) on the manoeuvring area between aircraft and obstructions; and

b) expediting and maintaining an orderly flow of air traffic.

Air traffic control unit. A generic term meaning variously, area control center, approach control unit or aerodrome control tower.

Apron. A defined area, on a land aerodrome, intended to accommodate aircraft for purposes of loading or unloading passengers, mail or cargo, fueling, parking, or maintenance.

Blind transmission. A transmission from one station to another station in circumstances where two-way communication cannot be established but where it is believed that the called station is able to receive the transmission.

Incident. An occurrence, other than an accident, associated with the operation of an aircraft which affects or could affect the safety of operation.

Landing area. That part of a movement area intended for the landing or take-off of aircraft.

Runway. A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.

Runway-holding position. A designated position intended to protect a runway, an obstacle limitation surface, or an ILS/MLS critical/sensitive area at which taxiing aircraft and vehicles shall stop and hold, unless otherwise authorized by the aerodrome control tower.

Runway incursion. Any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle or person on the protected area of a surface designated for the landing and take-off of aircraft.

Threshold. The beginning of that portion of the runway usable for landing.

Touchdown. The point where the nominal glide path intercepts the runway.

Taxiing. Movement of an aircraft on the surface of an aerodrome under its own power, excluding take-off and landing.

Taxiway. A defined path on a land aerodrome established for the taxiing of aircraft and intended to provide a link between one part of the aerodrome and another.

CHAPTER I

INTRODUCTION

A.   Background

Light Sign Communication is usually conducted between ATC or Air Traffic Controller and pilots when the radio of aircraft does not work properly. This tool of communication is usually called gunlight. Gunlight itself is a tool that is similar to flashlight. In addition, ATC communicate with pilot uses gunlight by sending or conveying information which is usually called light sign.

Furthermore, regarding the methods or the ways of operating the gun light in the purpose of producing light sign, two signs are usually seen. That is an on-off-on-off and on-on-on-on. On-off-on-off can be said as series of flashes, and on-on-on-on can be said as steady color or continuously on. Each method of the gun light operation has two different meanings; therefore, it can be said that gunlight conveys messages or instruction in the form of ambiguous light sign. In other words, it can bring positive and also negative impact to the aircraft, pilots and passengers as well.

Gunlight has three colors. Green, Red, and white. There are two ways to operate the gunlihgt. Series of flashes (on-off-on-off) and continuously on (on-on-on-on). Except for the white color, the only way to

use this color is constantly on (on-on-on-on); the reason behind this method is to differentiate the light sign itself from the white light surround.

In total, green color has four meanings. Red color has four meanings also, and the last is white color has two meanings. It can be said that gunlight conveys messages or instructions in ambiguous light signs. In other words, it can bring positive and negative impacts on the aircraft, pilots, and passengers.

In line with light sign communication in aviation also, this kind of sign is related to messages or instruction sent through an instrument called gun light. This kind of sign sent through gun light which is shown in the form of Semiotic code. Semiotic code is a kind of a set of cultural convention, contemporary sub-codes, and themes used to communicate meaning. It can also be the framework, a learned a shared conceptual connection at work in all uses of signs (language and visual). Besides, this light sign is an alternative tool of communication which usually uses a tool called gunlight, and also only used when the radio is damaged.

In addition, the Light sign has several benefits for the pilots. First, the light sign is the only way that can be used instead of radios to communicate to the pilots when the radio failed. Furthermore, light sign tools are so faster and easier to use that the ATC can operate this kind of tool easily. Then, in a Radio Failure Condition, ATC can respond to this kind of emergency. In addition, the Gunlight are so light weight that they

are easier to move. Finally, the location of the firing lights can be adjusted to the situation and conditions in the field. As discussed above this tool is almost similar to flashlight which has large size, and it has also three colors red, green, and white.

In relation to the light sign, the statements mentioned above are related to the positive impact or positive effect of the light sign. However, this kind of sign can also have a negative influence to the pilots because firstly it has more than one meaning or ambiguity. As a result, it creates dangerous or disaster to the pilots and passengers and the aircraft as well.

Furthermore, the light sign is very rarely used by ATC to the Pilots because it is only used when something has problems. It is usually used before the aircraft is taking off and before landing and it can cause unfamiliarity in using this kind of tool. Thirdly, no call sign is mentioned when this sign is used.

Finally, because no call sign was called, more than one aircraft saw the call sign, so both aircraft that saw the light sign would carry out the instructions instructed by the light sign.

Communication can be defined as transfer information from one place to another in a variety of ways or process. It is required for flight safety (Budhi, et al, 2021). Communication uses in aircraft term or in ATC. In addition, communication in the field of aviation is so vital that can impact fatal result when the flight crew does not understand what is being

conveyed. It is contemplated more deeply, and it is hoped that the community will be aware and understand and respond to all cases that arise relating to language sent by the ATC to the pilot and also respond to light sign sent by ATC. Language has a function to interpret the ideas, concept, and feelings to make people understand or respond about the instruction in the form of symbol such as words, sentences or language (Rabiah, 2018: p. 1). It is traditionally said that language is a tool for interacting or a means of communication in a sense, meaning conveying thoughts, ideas, concepts, or even feelings. The concept that language is a tool for conveying thoughts has a long history.

Humans usually use verbal and non-verbal communication. For verbal communication people usually use language through spoken and written form. They also communicate with articulatory phonetics, as they speak. Sign is an alternative means beside the one they usually speak or write. The air traffic controller is responsible for guiding and helping the pilots to navigate safely, and efficiently, therefore the task of an air traffic controller starts from the moment the aircraft is doing pushback and or starting the engine.

In connection to the traffic and pilots, Air traffic controllers are usually divided into three sectors based on their area of responsibility. For take-off and landing activity and also movement on the taxiway, the responsibility is given to the air traffic controller inside the tower control unit and air

traffic controller who guides the pilot after taking-off or before landing is an approach control unit. When the pilot has already maintained their altitude on the cruising level, the responsibility of control is given to the area control unit. Communication in common includes two parts, namely verbal and non-verbal. Verbal communication is usually related to language in the form spoken and written language.

Tinarbuko (2003) proposed that light sign is related to Semiotic in visual communication which is a series of process in conveying information or messages to others by using depiction media, which can only be read by senses of sight. This kind of communication usually combines arts, symbol, pictures, graphic design, and colors in its explanation. Meanwhile, non-verbal communication is relevant with the body movement (Sahib, 2019).

As we know all that language or words are primary means in doing communication in the field of aviation. However, alternative communication such as light sign has more vital function than verbal communication. Less attention or to this sign it can create fatal result to the pilots if they cannot pay attention to that sign well. In short, both verbal and non-verbal in the form of visual communication of Semiotics must have equal function.

In relation to the aviation, the ATC communicate with pilots and guide the traffic is via radio communication and flashlight. This radio communication commonly uses six languages that can be used English,

Spain, Arabic, French, Chinese, and Russian but the main language is usually English. In addition, those six languages are also used to control the traffic or communicate to each pilot in order to accomplish data exchanges or giving them information that helps to maintain an orderly flow of air traffic on two-way directions.

In addition, air traffic controller also uses lamp signal from the light sign and also used between ATC and pilots. The second tool of aviation used by the ATC as a direction to the pilots tend to have risky or create fatal result if there is miscommunication or misperception in understanding the signal sending by the ATC to the Pilots. For example, aircraft **A** is asked to do a certain instruction, but because aircraft **B** also seeing the light sign so does the instruction, as a result it is fatal. There are usually three different colors and two different ways to deliver the light sign to the aircraft, which had radio failure, different position of the aircraft also affects the meaning.

In agreement with semiotics and language analysis, it is considered its scope is enough because Language activities are basically referred "to whom the speakers speak the language, where the speakers speak, when, and what language is spoken" and also from a semiotics point of view, the function of language can be seen from various aspects, such as *langue* and *parole* as suggested by Saussure in Lyons (1968:38).

In relation to the speaker's point of view, language has functions as

a personal identity which was proposed by Jakobson calls the emotive function. That is, the speakers in this case the ATC express their position about what they are talking about.

The speakers do not only express emotions or ideas through language, but also show sign in the form of non-verbal communication when delivering a speech. Therefore, the pilots can understand that the ATC sends sign to the pilots. In short, communication can be seen from people's daily lives practice of communication or interaction between individuals and groups.

The language that people used is usually influenced by where the people live, as well as tribe our surroundings. In this case, culture is related to the way of human's life. The humans learn, think, feel, believe, and seek what is culturally appropriate. Language, friendship, customs, practical communication, social action, economic activity, politics, and technology, all of these are based on cultural patterns. This means that communication and sign cannot be separated, because sign does not only determine who is talking to whom, about what, and where the communication takes place, but it also determines the encoding of messages, meanings and messages that has for the conditions of sending, paying attention, interpreting messages. In this phase, the function of language communication takes part in the field of transportation.

Transportation has vital functions or role in the sign of the territorial unity of the Republic of Indonesia for distribution equitable development and welfare for its citizens. Therefore, the government is continuously trying to improve transportation services to all corners of the country. Transportation does not only facilitate the movement of people/ passengers, but also the movement of goods. In addition, transportation also provides benefits to maintain price stability of goods, increase the economic value of a region, and accelerate regional development. The government continues strive to provide reliable transportation service to get achieve the expected benefits.

The higher the frequency crossing or landing flights at the airport at this time, then the duties and responsibilities in charge of air traffic operations service become heavier. Therefore, the quality and reliability of work tools and resources the Human Power must be the most primary thing to achieve safety aviation in the world of aviation, there are three important pillars to become the main factors of quality and reliability of human power they are: Airline, Airport, and Air Traffic Service (ATS). Current air transportation requires a supporting sector both in terms of facilities and human resources. Wrong one of the human resources that must exist in supporting air transportation is Air Traffic Controller or in Indonesian is usually known as *Pemandu Lalu Lintas Udara.*

Air traffic controllers are tasked with guiding flights to arrive at their destinations safely, effectively and efficiently. The traffic guide is in charge of guiding the Pilot who flies the aircraft from one point to another safely. In the process, air traffic controllers communicate with pilots by using English regulated by the International Civil Aviation Organization. Air traffic controllers and pilots urgently need to communicate each other to maintain flight safety. In addition to flight safety, this two-way communication also serves to maintain effectiveness and efficiency as long as the aircraft moves in place and then flies until it lands back at the destination airport. Likewise, all aircrafts connected to this frequency can talk alternately. For traffic guides at the control tower, if there is damage, a communication aid in the form of a light signal is needed, which is called a Light sign.

Furthermore, (Kumar, 2014: p. 26) stated that LED based VLC system can be used in vehicles environment on existing infrastructure such as LED traffic signal light. It means that LED signal becoming the important things to lead someone understand the meaning of the light signals. The transferring the information to the Pilot of aircraft depicts the description of the information will be received by the Pilot by using light sign. The concept of light sign signal for the Pilot has multifunction, it makes the Pilot confuse to describe the functions of the signal. Therefore, the researcher is interested in analyzing the ambiguity of the signal comes from the light sign for the Pilot to make the aircraft landing or take-off

safely.

Communication between pilots and Air Traffic Controller (ATC) usually use VHF radio (Very High Frequency) wave to do communication. When the VHF radio does not work properly or it has problem, ATC usually uses a tool called Light sign. Light sign as an alternative tool has functioned for communicating between ATC and the pilots. This light sign usually has three colors: green, red, and white. Basically, this kind of sign light has two ways in operating this light sign. In relation to its uses, red color usually consists of two ways in its operation as follows:

1. By series flashes dot (…….) or on off, on off.

2. By turning the red color or it is on and on steadily.

For green color, its operation is the same as red color's ways. However, for white color, it is usually turned on by vice versa or on of, on of. The reasons or the causes why white light color has only one way to deliver or show to pilots is to differ surrounding white light. Showing the same delivery in color and ways does not mean that the same meaning. In other words, it has a different meaning. It depends on the position or condition of the aircraft, which can receive and see the light sign. As a result, this light sign can create fatal or catastrophic or accidents. This kind of situation above is usually called ambiguity since it can be positive and negative result.

In line with the following table from *annex 2 rules of the air* contains a list of light signs from light sign, how the air traffic controller uses this sign for the Pilot, and the meaning of the light sign.

Table 1. Light and pyrotechnic signals

Light		From Aerodrome Control to:	
		Aircraft in flight	Aircraft on the ground
Directed towards aircraft concerned (see Figure A1-1).	Steady green	Cleared to land	Cleared for take-off
	Steady red	Give way to other aircraft and continue circling	Stop
	Series of green flashes	Return for landing*	Cleared to taxi
	Series of red flashes	Aerodrome unsafe, do not land	Taxi clear of landing area in use
	Series of white flashes	Land at this aerodrome and proceed to apron*	Return to starting point on the aerodrome
Red pyrotechnic		Notwithstanding any previous instructions, do not land for the time being	
* Clearances to land and to taxi will be given in due course.			

Light sign usually has three colors, red light, green light, and white light. The meaning of each light depends on how it is delivered to the pilots.

1.   Red light

The red light is used by the ATC for the purpose of instructing the pilot in two ways: by on-off-on-off and continuously on-on-on-on. Table 1, the instructions sent to the pilot to carry out the flight process by making a circle which is usually called holding. It aims to give way to other aircraft close to it, the purpose of the instructions to stop running. Instructions not to land, due to unsafe runways and instructions to stay away from the runway. The red light is on continuously (on and on). For aircraft in flight, it means that the pilot's instructions and clearance are addressed to pilots to

give and prioritize other aircraft that are closed to them. While the aircraft that is on the ground means that it stops moving at that moment.

2.   Green light

ATC uses the green light to give pilot instructions in two situations: on-off-on-off and continuous on-on-on-on. Table 1 shows these meanings: instructions to the pilot for landing, instructions for take-off, instructions for fly back to the airport for landing, and instructions for taxi.

When the ATC transmitted steady green light continuously: for a flying aircraft means instructions and permission is given to the pilot to land. As for the aircraft in the ground, it means the instructions and permission given to the pilot to take off. Meanwhile if the ATC gave series of flashes green light, for an aircraft in flight, it means that there is an instruction to the aircraft to make a turn and return to the airport where the aircraft took off. Instructions and permission to land and taxi out (exit the runway) and the aircraft parking stand will be informed later. As for the aircraft on the ground means the instructions and permission given to the pilot to go or taxi to a certain area. It depends on the position of the aircraft given at the time the light signal is shouted from the light sign.

3.   White light

The white light is used by ATC to give instructions to the pilot in only one way, namely on-off-on-off which means landing and immediately

vacate (walk out) from the runway to the aircraft or. White light is usually switched on and off reciprocally. Here there is a white light running process for the flight being flown meaning instructions to make a landing. After landing or exiting the runway onto the apron or into the aircraft parking lot.

For aircrafts still on the ground, it means instructions to return to the original position of the aircraft on the aircraft. For this white light is not lit continuously, because if it is turned on continuously it will be the same as ordinary lights those around the airport.

ATC and the pilot meet to communicate each other in order to keep the safety during the flight. Besides safety in flight, the two ways communication has also function to keep affectivity and efficiency from the first departure until landing in the designated airport. Normally, communication between Pilot and ATC will use radio with the final result is voice or sound which can be accepted by all aviation which have radio to catch the VHF.

Yet, when the radio communication is broken down or has problems in the aviation or in land no other choice to communicate with and then if this kind of accident happens at the high position of the aircraft or aviation or the pilot cannot see the references or condition in land well, no other tools cannot be used for communication except light sign.

When the problem of radio communication happens to the ATC, all movement and communication in the area controller will be chaos because the air controller has no more ability to give information, instruction and permission at the time of flight or doing movement at the airport.

Due to the various reasons above, the researchers conducted this research within the focus of semiotics and limited the research discussions to light signs used in the field of aviation used by air traffic controllers.

B.   Research Question

The background described in the previous chapter raised some questions. These questions which was answered as part of this study are listed below:

1. What are the types of the light sign used in aviation?

2. How does the Pilot differentiate the signal's meaning from the light sign?

3. How does the pilot perceive the signal from the light sign?

C.   The Objective of the Research

Based on the research questions mentioned above, this research aims to fulfil three targets, as follows:

1. To explain the types of light sign used in aviation.

2. To analyze the process of the pilot differentiate the meaning from light sign.

3. To analyze the process of the pilots perceive signals from light signs.

D.   Rationale of the Research

The rationale of this research provides a better understanding on the signal comes from the light sign in planning to make aircraft taking off and also landing. This paradigm can disclose the closeness and the rigidity of language system and relate it to another setting. The object of this research is communication as a sign, in this case, the signal of the aircraft to inform the meaning of the light sign.

E.   Significance of the Research

The study is expected to produce significant results in both theoretical and practical benefits. Theoretically, this Research is expected to improve the implementation of the function of the signal from the light sign as a model for other researchers who wants to conduct similar research.

Practically, this Research provides the readers a broad overview of the investigation of signals from the light sign. It is also crucial for the Pilot to recognize their response to make the aircraft is successfully landing or taking off. Although no fatal accidents have occurred as a result of misunderstandings about light signs, researchers believe that accidents

could occur, so this research is expected to close the gap for future fatal accidents by ambiguity in the light signs used by ATC to communicate with pilots.

F.   Definition of Key Terms

1. Communication refers to language as a communication tool between community members in the form of a sound-symbol produced by speech tool Keraf (1997:1). It means that communication is a language device to interact with other people to send information, ideas, concept, and feelings.

2. Light sign Signal is an air traffic controller wants to communicate or give clearances.

3. The Air Traffic Control System Baseline Methodology Guide serves as a reference in designing and implementing baselines.

CHAPTER II

LITERATURE REVIEW

A. Previous Studies

Light sign is one of interesting areas that is very vital to be researched which attract attention many researchers to provide insightful understanding to them. There have a number of researchers been talking or discussing about the light sign. The problematic of transferring ideas to each other becomes a major topic of people. The importance of transferring ideas increase continuously in the future since many researches have been conducted by the previous researchers for indicating the significance of communication concepts as a strategies for becoming people understand about the meaning.

The first researcher, Mosier et al., (2013) suggested that Pilot – ATC communication very often encountered conflicts although, this conflict can create a good result in the advancement of aviation. The results show that the workload is high the approach and landing phases are conducive to communication conflicts that different interpretations of the same information may lead to conflicts and the operator countries can affect communication and collaboration between flight crew and ATC.

The relationship between this Research and Mosier research is both the research focus on the visible light communication as light sign.

However, the current study has different focus concerning with the object is being observed. The previous study focuses on having communication conflicts between pilots and ATC. The current study on the other hand analyzes the light sign as communication to give the information to the Pilot.

Next, Monechi et al. (2015) stated that Congestion is very often happening in Air Traffic Networks. Their research result shows that the Air Transport system is a complex dynamic network of human-controlled flights that must solve the potential conflict by directing the aircraft's trajectory. In addition, on increasing the traffic load injected into the system, the model predicts a transition from a phase where all conflicts can be successfully resolved again to a phase where many conflicts cannot be resolved again.

The relationship between this research and previous research is that the research focuses on air control navigation as a medium of communication. However, this current research has a different focus concerning the object being observed. The previous study focuses on Congestion in communication conflicts between pilots and ATC. Then, this current study analyzes the light sign as communication to give the information to the Pilot.

The third researcher is Yulian et al. (2016) proposed that the design and implementation of Visible Light Communication Devices as Video

Transceiver. Their findings show that in the use of transmitters in the process of sending information given by one person to another is in the form of sound and video. In addition, pilots use LED (visible light communication) as a sign to give meaning to someone in communicating. The relationship between this Research and previous Research is that both focus on the visible light communication as light sign.

However, the current study has a different focus concerning the object being observed. The previous study focuses on creating the VLC to support the communication transmitter for the Pilot. Then, the current study analyzes the light sign as communication to give the information to the Pilot.

Then, (Costello, 2016) also claimed that his writing argues for the rediscovery of the human aspect of information systems. This is done by providing an overview of signs and symbols in the literature, specifically from the works of Ferdinand de Saussure (1857-1913) in North and Charles Sanders Peirce (1839-1914) in North.

The approach taken is dialogical action research, as it provides a mechanism for implementing change while keeping operational details under the practitioner's control. The relationship between this Research and previous Research is that the Research focuses on air control navigation as a medium of communication.

However, the current study has a different focus concerning the object being observed. The previous study focuses on manufacturing in communication conflicts between pilots and ATC. Then, the current study analyzes the light sign as communication to give the information to the Pilot.

Costello (2016) further argued that for the rediscovery of the human aspect of information systems. It is in line with an overview of signs and symbols in the literature, special from by Ferdinand de Saussure and Charles Sanders Peirce. Then it presented the concept of Organizational Semiotics proposed by Stamper. The findings show that human behavior is simple, and its complexity comes from the environment. The humans communicate through signs, symbols and language and the subsequent actions that derive from these are the most complex aspects of information creation.

The relationship between this Research and previous Research is both the research focus on air traffic controller as a medium of light sign to communicate each other. However, the current study has different focus concerning with the object being observed. The previous study focuses on increasing the medium of communication by using sign. Then, the current study analyzes the light sign as communication to send information to the Pilot.

Similarly, Trihantoro et al. (2017) suggest the implementation of Visible Light Communication (Vlc) for sending the text. Their finding shows that the use of LED lights as a medium in sending information to someone's signal. The signs that are sent are numbers, symbols, and letters to give meaning to pilots so they can communicate more quickly. The relationship between this Research and previous Research is both the research focus on the visible light communication as light sign.

However, the current study has different focus concerning with the object being observed. The previous study focuses on creating the LED to support the medium of communication. Then, the current study analyzes the light sign as communication to give the information to the Pilot.

Next is (Suryono et al., 2020). They proposed the thesis entitle Phonetic and Phonology Study: A Sound and Spelling Outlook on Waypoints in Makassar Air Traffic Service Center. They suggested that there was a lack of awareness in English sound and spelling within air traffic controllers in Makassar Air Traffic Service Center. It means that there are several factors that cause this condition such as: absence of subject and spelling sounds in the initial ATC syllabus training.

This Research and previous Research is both the research focus on air traffic controller as a medium of light sign to communicate each other. However, the current study has different focus concerning with the object being observed. The previous study focuses on phonetic and phonology

study of sound.

Budhi et al. (2021) in their research entitled The Possible Problem of Similar Call Sign in Verbal Air-Ground Communication. They suggested that the possible risk of similar call sign in aviation, especially in Makassar Air Traffic Service Center. In addition, a study of similar call signs in the context of air-to-ground verbal communication, especially in relation to the perspective of procedures and risky issues, may be of particular relevance to linguistic studies. That means that Interaction between ATC operator and Pilot must be accurate, understandable, and appropriate, no ambiguity and unclear point to avoid (not minimize) incidents and accidents.

The relationship between this Research and previous Research is both the research focus on air traffic controller as a medium of light sign to communicate each other. However, the current study has different focus concerning with the object being observed. The previous study focuses on increasing the medium of communication by using sign. Then, the current study analyzes the light sign as communication to give the information to the Pilot.

Rahmanianti (2021) Homonymous words in air traffic control phraseology. this research also aims to provide solution in order to solve communication problem regarding homonymous words in air traffic control phraseology. She suggested that Air traffic control phraseology has an important role in air-ground communication. In giving air traffic service,

ambiguous message is one of the causes which may lead miscommunication. She used qualitative method she collected data from air-ground communication between air traffic controller and pilots.

Susanto et al. (2021) in their research Peranan Air Traffic Control untuk Keselamatan Penerbangan di Indonesia. Based on the findings, the findings shows that Air Traffic Controllers ideally have work stress the low one. The high risk of work and involving the lives of many people becomes a burden and responsibility separate responsibility for Air Traffic Controllers. The relationship between this Research and previous Research is both the research focus on air traffic controller as a medium of light sign.

However, the current study has different focus concerning with the object being observed. The previous study focuses on increasing the medium of communication by using air traffic controllers. Then, the current study analyzes the light sign as communication to give the information to the Pilot.

Based on the explanation above, the six researchers discussed the function of the LED which was used as a form of information to the Pilot in focusing on the signal function. In summary, the findings are similar to the current study in that they address the function of the signal addressed to the Pilot. Furthermore, the difference in focus is observed, namely the function of the light sign which aims to reduce the ambiguity to the Pilot.

The differences between previous researchers and the researcher's writing lies the researcher research about the light sign communication which can impact to negative result on the aviation industry, because light sign communication had more than 1 meaning or ambiguous.

B.   Pertinent Ideas

1.   Visible Light Communication

Visible light is the form in which electromagnetic radiation with wavelengths within a certain range are interpreted by the human brain. The spectrum visible wavelengths from 380 nm to 750 nm. VLC system (visible light communication) is a data communication medium using visible light between 400 THz (780 nm) and 800 THz (375 nm). Visible light communication (VLC) is a new paradigm that could revolutionize the future wireless communication. In VLC, information is transmitted by modulating the visible light spectrum (400-700 nm) which is used for illumination.

The information signal is superimposed on the LED light without introducing any flickering to the end user. Thus, it will be "green" compared to providing two separate sources for lighting and communication network connectivity. Besides that, low-frequency band fatigue to cope with the exponential growth for high-speed wireless access is another reason to explore new technologies. The visible light spectrum is unlicensed and available hardware, which can be used for data

transmission.

Tinarbuko (2003) proposed that light sign is related to Semiotic in visual communication which is a series of process in conveying information or messages to others by using depiction media, which can only be read by senses of sight. This kind of communication usually combines arts, symbol, pictures, graphic design, and colors in its explanation.

In line with the concept of Semiotic in visual communication explained in by Tinarbuko, Charles sanders Peirce (1839-1914) in North (1995) also suggested that Symbols and colors are also related to triadic systems proposed by Peirce. Therefore, it is appropriated that this research is related to Semiotic in visual communication and also semiotic pragmatic under Peirce point of view.

2. Air Traffic Control

ATC (Air Traffic Control) is a complex system, which help maintain order in air traffic, guarantee flight intervals, and prevent aircraft crash (Li, et al., 2017). In accordance with the with the advancement of technology, there are few people which defines the laws of the air, that the law of air is a series national and international regulations regarding aircraft, air navigation, air transportation commercial and all public legal relations or civil, arising fromnavigation domestic and international air.

Susetyadi & Nurhayati (2017) stated that to carrying out this task requires a ATC officer in traffic flow regulation the air that starts from the aircraft does first contact (communication) arrived with the aircraft landing at destination airport. Every airport has a building plays an important role as a center for coordinating safety and efficiency of aircraft movement (Pariyan et al., 2018).

Figure 1. Sultan Hasanuddin Airport Layout

1	ABOUT TO LAND
2	WAITING SEQUENCE FOR DEPARTURE
3	READY FOR TAKE-OFF
4	LANDED
5	TAXI TO APRON
6	TAXI OUT APRON TO RUNWAY
7	ON FLIGHT
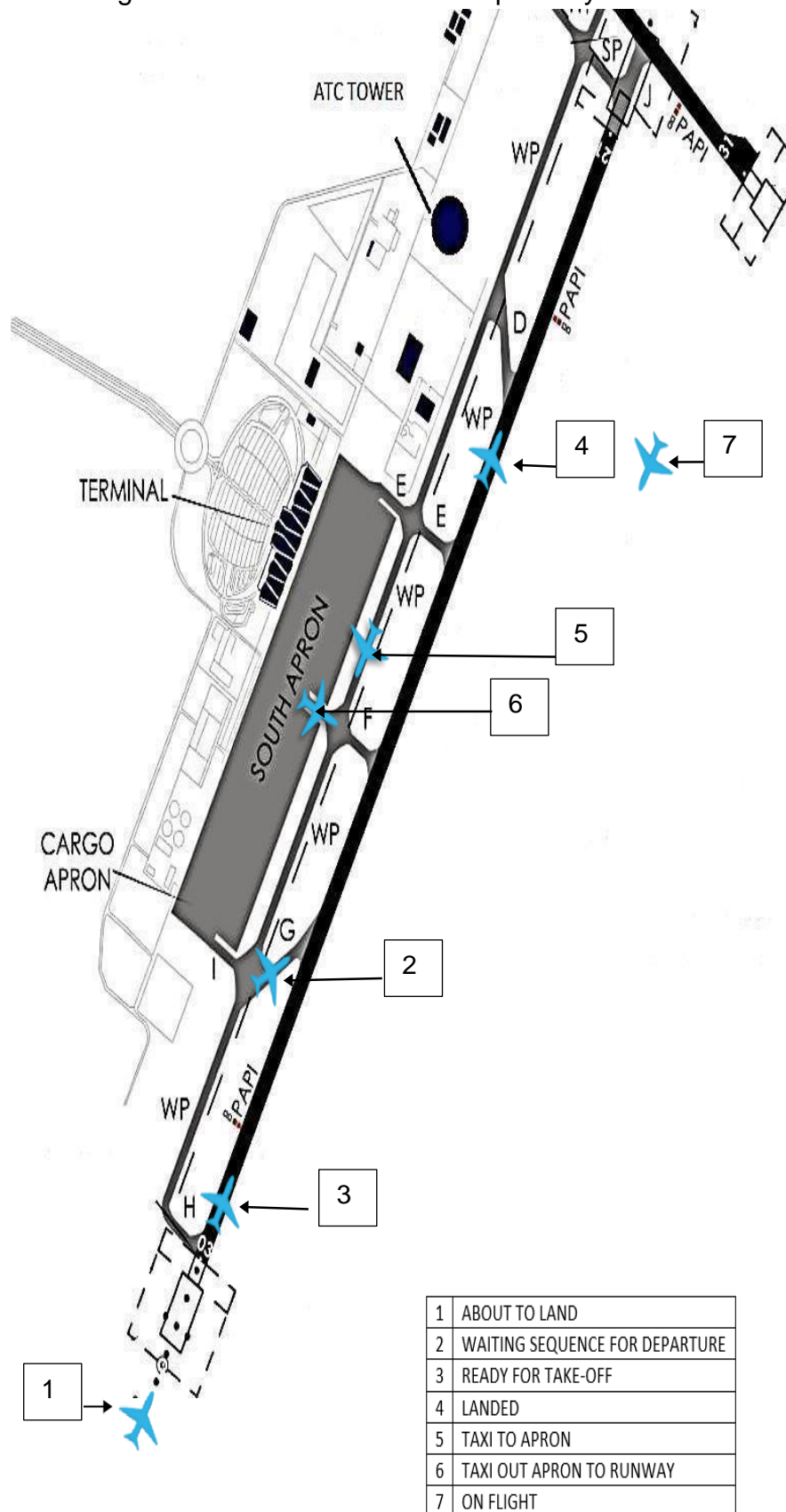
A.   Number 1

Number 1 is an aircraft that is in flight and is about to land. In this position, if the aircraft is given a green light on and off, it means it is being instructed to land; however, if the aircraft is given a red light on and off, it will not land and will fly back to a certain height due to the meaning of the light. The ATC officer's instructions are not to land because the runway is unsafe for landing. However, if a white light sign is turned on and off, the aircraft will land on the runway and, after landing, will walk out of the runwayto the aircraft's parakeet, known as the apron.

B.   Number 2

Number 2 is an aircraft waiting in line to take off from the runway. The aircraft will enter the runway if the green light is turned on and off.

C.   Number 3

Number 3 is an aircraft that is already in a ready to take-off position. If the green light is on, the aircraft will take off because the light indicates to the pilot that it is time to take off. However, whether the red light is on or off, the aircraft will leave the runway via the shortest or safest route deemed safe by the pilot.

D. Number 4

Number four is the aircraft that has safely landed on the tarmac. In this position, the aircraft requires ATC instructions to exit the runway, so if a red light is flashing, it will turn on and off.

E. Number 5 and 6

Numbers 5 and 6 are aircraft that walk into and out of the aircraft parking lot, also known as the apron. If the red light is on in this position, the aircraft will stop running because it must immediately stop moving. If, on the other hand, the green light blinks on and off, it is a signal to get back on the road.

F. Number 7

Number 7 is an aircraft that fly around the airport that the ATC still able to look out in visual without additional device to help the ATC to identify the aircraft.

Because this light signal can be seen by two or more aircraft, there is a chance of misinterpretation, which means that another aircraft that is not expected to receive instructions from the light signal sees and follows the instructions. This is due to the fact that the instructions from the light signal have two meanings. As a result, the light sign, as an alternative communication method between ATC and the pilot, still carries the risk of causing a fatal accident due to ambiguity issues.

3.   Light sign

Light sign is a tool that is used to guide the aircraft when an emergency when the Tower's or aircraft's radio is interrupted. Gunlight color emission in aviation is governed by established regulations ICAO in Annex 2. Information sent by Air Traffic Controller officers (ATC) using Gun light includes commands for landing, take off, and others and so on, both for aircraft in flight and with vehicles or aircraft on the ground The importance of having a Gun Light in an airport is to be able to assist ATC in providing scouting services when Emergencies are also regulated in the Decree of the Minister of Transportation NO. 44 of 2002 about the "Airport Arrangement" but currently the operation of the light sign is still using the manual method for operation in this flashing mode of course cause misunderstandings between pilots and ATC officers if the frequency is not right, besides that the operation for changing the color itself is still using manual way by turning the front lever.

Based on the explanation above, the researcher can conclude that the function of the signal coming from the light sign is to represent the meaning of the signal color to make the Pilot quickly understand the function of the deflected color.

4.   The Terms of Semiotics

Semiotics is the study of sign in human life. The term semiotics comes from the Greek word" *Semeion"* which means "Sign". Signs are

used widely in everyday life as a kind of visual language (Wicaksono, Rahman, & Sahib, 2020, p. 1). It means that all things are present in human's life which are seen as signs. The simple example of semiotic can be found, in word, traffic light, flag, and many others. Ferdinand De Saussure (1913:2589) as cited in (Sahib, 2017: p. 45) as the father of structural semiotics proposed the theory of Semiotics which combines between language and sign. Saussure sees the sign in the relations to language. She claimed that there are five important points in structural semiotics:

1) Sign is something structural in the human cognition in social life, meanwhile, sign users are based on rules (*langue*) and practical language (*parole*) in human's life or how parole modify *langue*.

2) When human sees the cultural symptom as sign, then Saussure sees as structure which consist of *signifier* and *signified* (form and meaning).

3) Human in their life, sees signs through two axis, syntagmatic and associative (signs interrelation within human cognition which formulates systems and paradigm).

4) Interrelationship of signs has syntagmatic characteristics (in-prasentia) and associative (in-absentia).

5) Language can also be investigated diachronically (historical

development), and synchronically investigation (in certain time).

Language as social phenomenon can be seen into two levels, *langue* and *parole.* De Saussure (1916:170-175) as cited in (Sahib, 2017: p. 45) stated that giving meaning to signs of language occurred when the language users relate, or associate sign's giver or indicator (signifier) and sign's given (signified).

Since what something discussed is signs of language, in addition, syntagmatic and associative relation can be seen in the sentence John kicked the ball. This sentence consists of subject +Verbs. In other words, syntagmatic relation or horizontal relation is related to sentence structure. In contrast associative relation or vertical relation is relevant with vocabulary such as educator, education, educate, educated people and many others.

De Saussure further states that semiology is a science that studies the life within society is conceivable called it semiology (from Greek *Semeion* sign). Semiology would show what constitutes sign, what laws govern them. Since the sign does not yet exist, no one can say what it would be; but it has a right to existence, a place staked out in advance.

C.   Charles Sanders Pierce

Another well-known scholar of semiotics is Charles Sanders Pierce (1949), an American Philosopher who develops pragmatism philosophy

through semiotic study. Peirce (1839-1914) I North (1995) stated that sign and its clarifying meaning is not seen based on its structure but through a cognitive process or the five senses called *semiosis*. According to him, *semiosis* might be said as a process of clarifying meaning and sign interpretation through three stages. Pierce further stated that the three aspects must be considered in explaining signs. These aspects are called triadic systems (three steps). Since semiotics originates from concrete things, this semiotic is called pragmatic semiotics. Because signs are previously begun from representamen which represents something inside the human cognition (object), Pierce theory of semiotics defines sign is *"something that represents something else"*.

This definition becomes clearer when people come into three categories of sign which is based on the relationship between representamen and object. Pierce asserts that pragmatic semiotic studies the relation of inter-sign, sign user, and the use of sign. Based on the object, Pierce (1960) as cited in (Patu, 2016) divided sign into icon, index and symbol. The icon, in short, is related to the object which was denoted by similarity or likeness such photos, replica, onomatope and many others. An index is related to causes and results. The index denotes its object; it exists in virtue of a real, existential connection with its object, and in doing so it assures us that the object it represents really exists.

Different from index, Symbol is a sign which refers to the Object that it denotes by *virtue of a law*, usually an association of general ideas, which operates to cause the Symbol to be interpreted as referring to that Object (Peirce, 1998, p. 292). Symbol also explains the social convention about things based on society. While language, then, is the primary example of symbols, within language pronouns for example operate as indices, denoting existent objects. An index might equally be a gesture such as pointing, or a symptom that is a sign of an illness, or a natural sign as a footprint is to the tracker of a deer. Icons, operating a step further away from the symbolic elements of language, might include a painted portrait (the resemblance being to the person's appearance), or a swatch of colored fabric to match a thread, but would also include such common things as a child's doll, or a painting the child may make, or the pictures in a picture book.

According to Charles Sander Peirce's Theory of Semiotics, semiotics is based on logic, because logic studies how people reason, while reasoning according to Peirce is done through signs. These signs, according to Peirce, allow us to think, relate to others, and give meaning to what the universe presents. In this case, humans will have a variety of signs in various aspects of their lives. Where linguistic signs become one of the most important. In this semiotic theory, the function and use of signs becomes the center of attention. Signs as a communication tool are very important in various conditions and can be used in various aspects of

communication. Pierce divided semiotics become three parts based on the objects, such as:

a.   Icon

An icon is a representation that closely mimics the form of the thing it represents. It might also be seen as a connection between signs and related things. The dream will take on the meaning that the icon's purpose is to convey. The simplest illustration among many we come across yet are unaware of is a map.

b.   Index

A causal, or cause and effect, sign is something that has an index. In this instance, there is a causal connection between the sign and the thing. Sign refers to a message's outcome. One typical illustration is smoke as a fire sign. In other words, a sign is said to be index insofar as the signifier is adjacent to the signified or is a sample of it.

c.   Symbol

A symbol is a sign that has a connection to both the signifier (concept, form) and the signified (meaning, senses). Something is used as a general reference by the signifier and symbolically represented by a sign. For instance, everyone is aware of and in agreement that a red light indicates stop.

Moreover, Peirce defined the index in different from symbols and icons as a category comprising not only natural, but also many conventional signs. A sign vehicle is an index if it is "really affected" by its referential object. "The index is physically connected with its object. They make an organic pair, but the interpreting mind has nothing to do with this connection, except remarking it, after it is established".

According to Goudge (1965), he focuses the interpreter's attention on the object. It involves the existence of the object as an individual entity. It asserts nothing but shows the object. From these statements, Peirce included the following diverse phenomena in the class of indices: a weathercock, a yardstick, a photograph, a rap on the door, a pointing finger, an appellative cry, and the field of linguistic deixis, including proper names and possessive, relative, personal, and selective pronouns.

For indexical expressions in language, Abercrombie (1967: 59) adopts the term index to designate stylistic features of language use "which characterize the source of the signal as a particular individual" or member of a sociolinguistic group.

In addition, Saussure pays more attention to a very important linguistic sign. According to him, every sign generally applies linguistic signs. Yet, linguistic sign is not always applied for other signs. Moreover, signs are related to objects that resemble them, there is a causal relationship with signs or because they are conventional with these signs.

Therefore, in general, Peirce argues that this theory applies in general. Therefore, this linguistic sign in Peirce's theory is important but not the only the most important thing. Various signs that are blasphemed with their objects become a general discussion as Peirce wants in this theory. Various signs created in order to communicate are representations of linguistic language or generally accepted linguistic signs.

Saussure's weakness in developing semiotics is that he does not discuss the pragmatic aspect of the language, while Pierce's weakness is that he does not explain the langue aspect of the sign. In short, Saussure does not see the contextual aspect of language (interactional text, or what is really happening), whereas Pierce does not discuss denotational text of language (what is being said).

Another semiotics' expert is Silverstein (2001:239) in (Sahib, 2017: p. 50) who analyzed the perspective of functional semiotics. This theory is developed within the field study of linguistics anthropology, which is sometimes called anthropological linguistics. In his study, he tried to relate between denotational text and interactional text by using indexical mediation.

Based on the explanation above, the researcher concludes that the use of semiotics in daily activities has a significant role in producing multilingual meaning for people, objects, sounds, or things. In this case, the researcher focused on the analysis of index based on the Pierce'

analysis point of view.

In relation to the study of signs (semiotics) proposed by Tinarbuko, F de Saussure and Peirce the researcher saw that those scholars above argued that symbols are the key important points in doing research about light sign in which semiotics for Tinarbuko includes symbol and colors. Meanwhile Peirce suggests that there are three aspects of the study of signs (semiotics) such as Icon, Index, and symbol. Symbol proposed by Peirce is related to convention laws. In line with this research symbols stated by Peirce is along with the researcher's research about convention, international agreement of the users of light sign. It is also related the laws and constituent taken from International Civil Aviation Organization (ICAO). In addition, De Saussure also stated about symbol which is related to language.

D.   Conceptual Framewok

```
                    ┌─────────────────────┐
                    │  Visible Light Sign  │
                    │   Communication      │
                    └──────────┬───────────┘
                               │
                               ▼
                    ┌─────────────────────┐
                    │  Light Sign/Semiotics│
                    └──────────┬───────────┘
                               │
                               ▼
                    ┌─────────────────────┐
                    │    Air Traffic       │
                    │  Controller (ATC)    │
                    └──────────┬───────────┘
                               │
                               ▼
                    ┌─────────────────────┐
                    │        Pilot         │
                    └──────────┬───────────┘
                               │
        ┌──────────────────────┼──────────────────────┐
        ▼                      ▼                      ▼
┌───────────────┐    ┌───────────────────┐    ┌───────────────┐
│ Types of Light│    │ The Sign's meaning│    │   The Pilot's │
│  Sign Used    │    │                   │    │   Perception  │
└───────────────┘    └───────────────────┘    └───────────────┘
```
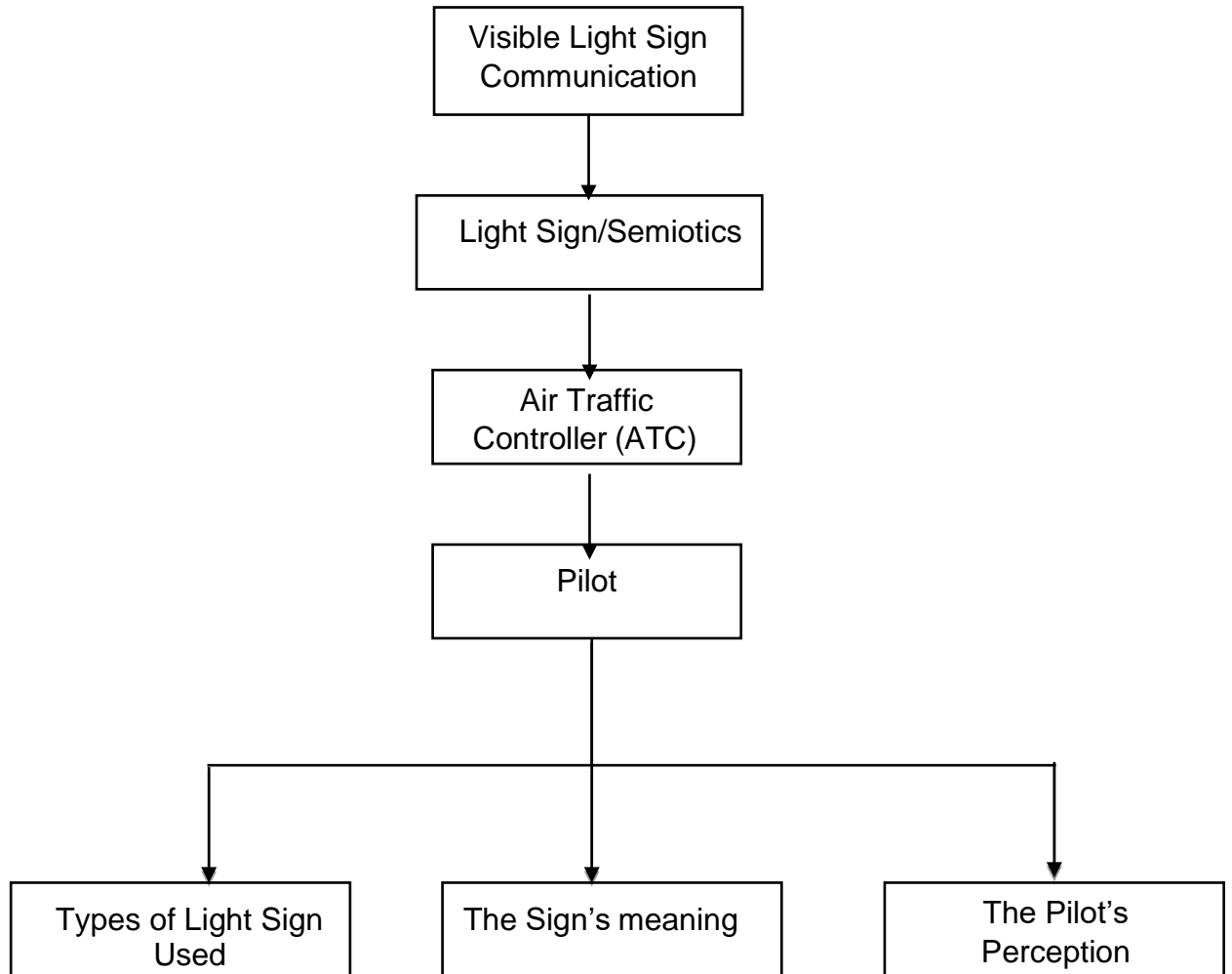
Figure 2.2 Conceptual Framework