CHAPTER I

INTRODUCTION

1.1 Background

Labraqairport located in Labraq city , 25 km east of the Albetha in Libya circle on the spin-off 27-21 north at its intersection with longitude 74-22 east longitude and altitude of 650 m above sea level.

This airport built in 1967, a total value of 1,000,000 dollar US by a group Bethune Syrian National and project manager Renaissance Architecture.After the military coup stoppedin 1986, the airport return as an airport of a civilian-military joint, andin 1996 it has not been converted to a civilian airport only.

Saw the airport before the conflict Libyan between the rebels and Gaddafi special forces arrived at the airport Labraq gathered under the command of a senior officer close to the Gaddafi camp for to intervene in the event of any riots or violence affects installations of the State or one of its members, having seen the city of white massive protests on the housing on January 14, 2011.

After the outbreak of the conflict between the rebels and the Libyan Qadhafi saw the battle, and eventually the rebels have managed to control it in the February 18, 2011, and were also able to capture some of the aircraft which landed in it, and the destruction of the airport runways. Later, on February 21 of that year attacked the al-Gaddafi, the airport to hitting the from the hands of the rebels, but they succeeded in downing a helicopter and have formed popular committees to protect him, and remained so the airport and all city of white in the hands of the rebels until the fall of Colonel Muammar Gaddafi.

Discussing about general air transportation especially airport in Libya , bellow is the map of some airport in Libya :

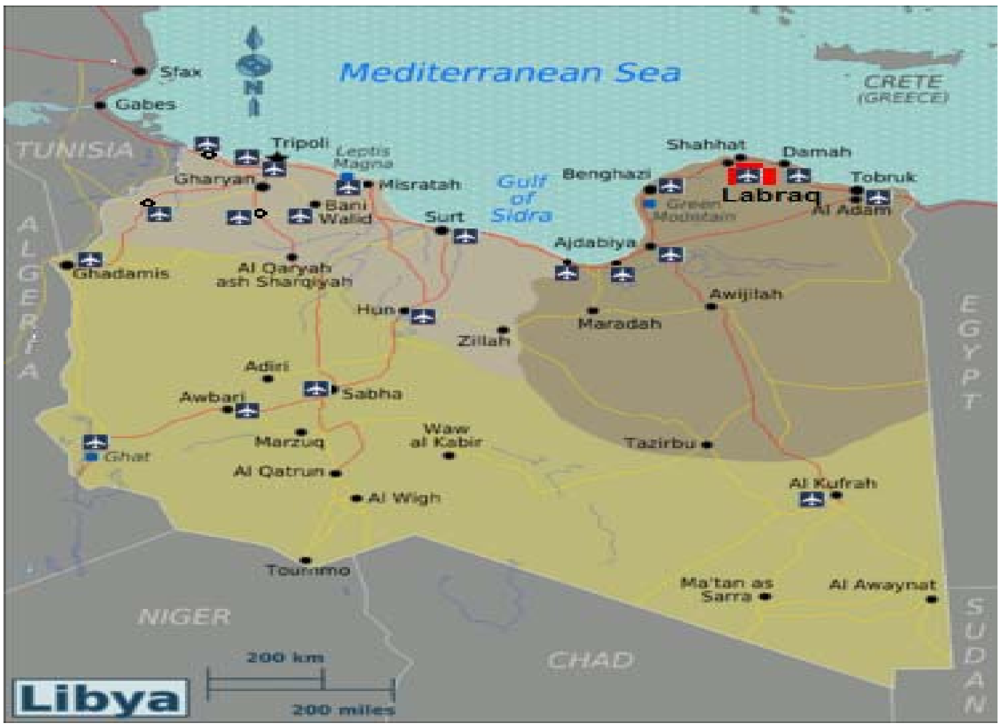


Figure 1. Map of Airport in Libya (source; wikipedia.com)

Distance between Abraq International Airport and Tripoli International Airport is 1250 kilometers. The distance between Abraq International Airport and Tunis International Airport is 1950 kilometers.

Table 1.

Name of City and Airport in Libya

Name of City	Name of Airport
Ajdabiya	Ajdabiya Airport
Kufra	Maaten al-Sarra Air Base
BaniWalid	BaniWalid Airport
(Bayda)	**(Labraq International Airport)**
Benghaz	Benina International Airport
Brak	Brak Airport
Brega	MarsaBrega Airport
Derna	Martuba Air Base
Ghadame	Ghadames Airport
Ghat	Ghat Airport
Hun	Hun Airport
Hun	Al Jufra Air Base
Kufra	Kufra Airport
Misrata	Misrata Airport
Misrata	Nanur Airport
Mizda	Habit Awlad Muhammad Airport
Nalut	OkbaIbnNafa Air Base
Ra's Lanuf	Ra's Lanuf Airport
Sabha	Sabha Airport
Sirte	Gardabya Airport
Tobruk	Tobruk Airport
Tripoli	Mitiga Airport
Tripoli	Tripoli International Airport
Ubari	Ubari Airport
Waddan	Waddan Airport
Zuwara	Zuwara Airport

Source: Adeddalskan Statistics, 2010

Each city has different number of density in term of population. Bellow is the data about the number of population in every city in Libya.

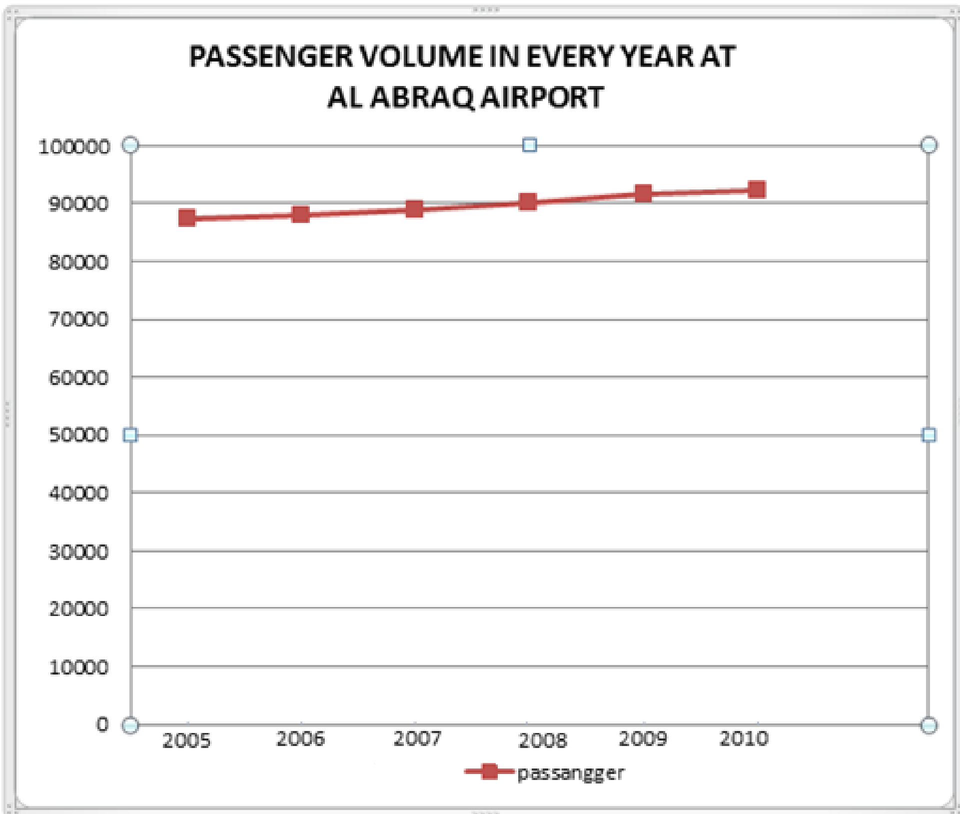
Table 2.

Libyan cities and Number of Population in 2009

No	Name	Population
1	Tripoli	1.150.989
2	Benghazi	650.629
3	Misurata	386.120
4	Albida	206.689
5	Tarhunah	201.697
6	Elkoms	191.943
7	Elzawea	186.123
8	Zuwarah	180.310
9	Ajdabiya	134.358
10	Sirte	128.123
11	Sabha	126.386
12	Tobruk	121.052
13	Azizia	106.068
14	Sabratha	102.038
15	Zliten	99.289
16	Marg	85.315
17	Gharyan	85.219
18	Derna	78.782
19	Yafran	67.638
20	Nalut	66.228
21	Sorman	56.221
22	Elqoba	53.064
23	BaniWalid	46.350
24	Elkufra	46.050
25	Murzuq	43.732

Source: Adeddalskan Statistics, 2009

Dataon the volume ofpassengersflying especially inLabraq Airport on thelast 5 yearsis as follows:



Source : Labraq Internal Report 2012

*Note : Data until September 2012

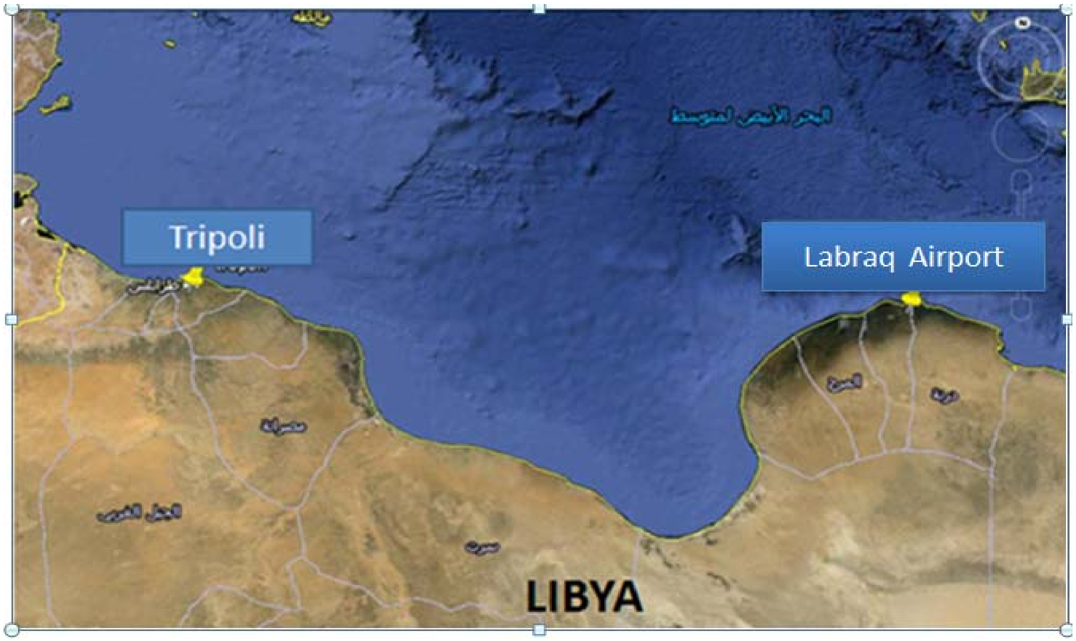


Figure 2. Location on LabraqAirport in Libya

Figure 3. Picture on LabraqAirport in Libya

1.2. Objectives of Study

The objective of this research is reconstruction of the terminal building for Labraqairport to be more comfortable and more modern and to quantitatively evaluate the characteristics of the airport terminal configurations those are available in airport theory literature.

1.3. Problem Statement

The problem is that the airport does not have the specifications airports due to :

- old building built in 1967 or already 45 years
- not modern,
- the small size of the passenger terminal
- administration, departure halls, reception rooms, security and baggage claim conducted in one small building which causing obstruction of the work**.**
- small area of the building
- does not have a restaurant
- only no coffee and no place to sit to drink coffee or tea only Teck Levi
- the small size of the entrance hall
- no place to sit inside the entrance hall
- there are no shops
- there are no restaurants
- there are no stores that sell tickets
- no Goods Exchange
- no automated teller machines

- only two small bathrooms
- the small size of the space functioning bags
- small functioning bags
- no place seating for traveling companions
- only one bank to process departure and reception
- only machine revealed a single security
- there are parking

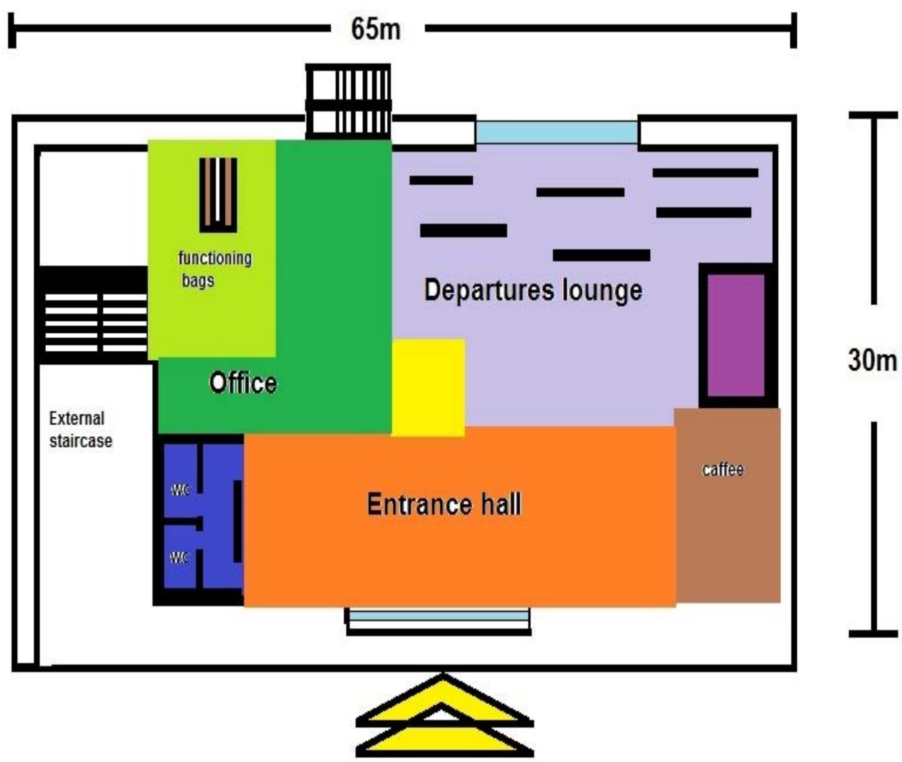


Figure 4.The existing Airport Terminal Ground Floor of Labraq Airport in Libya

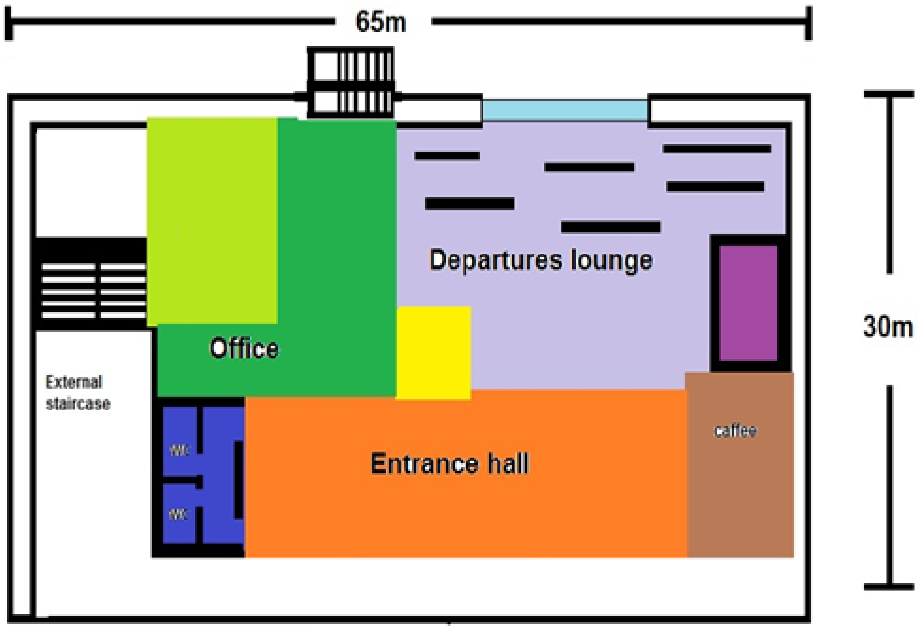


Figure 5.The Old airport Terminal First Floor of Labraq Airport in Libya

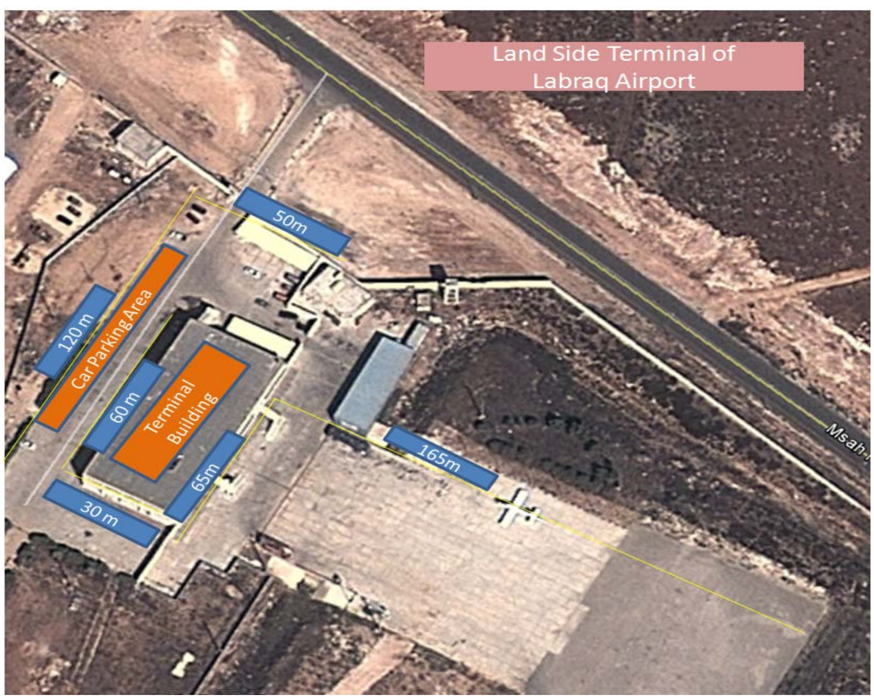


Figure 6. Terminal of LabraqAirport in Libya

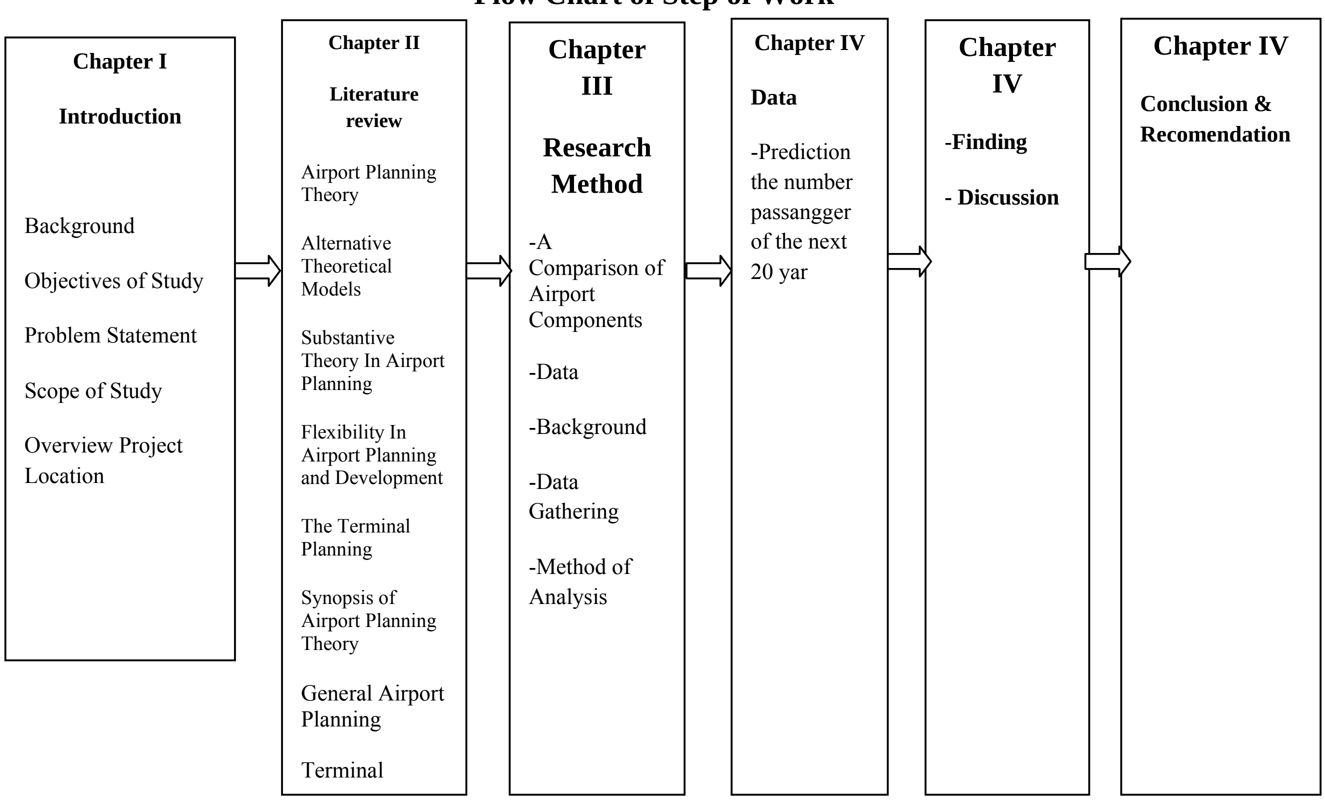
1.4. Scope of Study

The scope of the reconstruction here is development the design of the terminal building that has different characteristics. To limitthe problem that appears, then the limit is determined as follow small terminal building, leak of facilities, all operation in the same place (terminal). Today, the characteristics for the local flight are scheduled to have only two flights each day in the morning and in the afternoon. In other words, there are only two departures and two arrivals from Tripoli to Labraq vice versa and twice a week flight from Tripoli to Tunis.

1.5. Overview Project and Step of Work

The research was conducted in Labraqairport, Libya. The location can be showed by the figure 3 and 4 above. The step of work for every chapter in this thesis is as follow

Flow Chart of Step of Work



CHAPTER II

LITERATURE REVIEW

2 Airport Planning Theory

2.1 Classic Airport Planning Theory

One of the major similarities between airport planning and city planning is the application of the Rational Comprehensive Theoretical Model as the guiding framework behind the majority of planning decisions. Many theories have evolved challenging the rational model. Criticisms and shortcomings of the process are widely publicized; however the rational model certainly does have its place in any planning process. Perhaps not the dominance and conviction it once possessed over planning, however, it remains a significant part. "Though planning practice is changing and recent theories have shown sensitivity to many issues which the 'Classical' rational model fails to address, this model of what should be done has yet to be supersede" (Alexander 1992, p.86).

This statement reigns true in general urban planning practice, and is as evident in the airport planning domain. Unlike general urban planning projects, airport planning is guided by domestic and international bodies that oversee development. As such, some type of framework is needed in order to "govern" and create standards for the industry. This is one of the main factors that has maintained the rational model as the base in airport development. Internationally, airport planning is guided by manuals and publications issued by the International

Civil Aviation Organization (ICAO), and International Air Transport Association (IATA), which are partially based on the rational model (Dempsey et al. 1997, p.25). In addition to the publications of materials, these organizations and others such as Transport Canada airport development projects in Canada. (The FAA oversees any airport development projects in the U.S.)."In planning rationality implies that a plan, a policy or a strategy for action is based upon valid adsorptions, and includes al1 relevant information relation to the facts theories and concepts on which it is based" (Levin 1976, p.225).

Contemporary publications and policies of al1 major aviation sources are now not limited to rational information. Airport planners are constantly working toward the inclusion of other planning theories to complement the rational mode1 and provide a better end product.

For explicit purposes airport planning will be divided into two major factions. The first being general airport planning, this includes al1 aspects of the airport and associates areas. The second is the planning of the terminal building. It is necessary to make the distinction between the two elements in order to properly describe issues and elements that are pertinent to only one domain of airport planning. In the following text airport planning will describe the planning of the airport as a whole and references to the planning of the passenger terminal building will be listed as such. Table 1 compares a standard airport planning process (Ashford and Wright 1992) with a generic rational process as contextualized by Gerald Hodge (1992, p. 173).

Table 1 : Comparison Chart of Rational and Airport Planning

Airport Planning Process	Rational Planning Process
1. Organization and preplanning	1. Identify problem and articulate goals
2. Inventory and existing conditions 3. Aviation demand forecasts	2. Survey community conditions and make predictions
4. Requirement analysis andconcept development	3. Compare and evaluate alternative plan
5. Airport site selection	4. Adopt one plan
6. Enviromental procedure and analysis	5. Develop a program to implement plan
7. Simulation 8. Airport plan	6. Monitor current trends and review outcame plan
9. Plan implementation	7. Monitor current trends and review outcome plan

It is evident that the airport planning procedures follow the same vein as the rational process dictates for urban planning. Standard airport planning revolves around the procedural and normative aspects of planning theory. Normative aspects reflect questions such as: How do we plan and why should we plan. Procedural aspects include questions such as: What do we know about how planning takes place and how plans are implemented (Alexander 1992, p. 18).

Exhaustive amounts of airport planning literature are focused on these aspects, however, many airport planners feel that concerning themselves only with these planning domains leaves major issues unresolved and produces lackluster final projects. "Some writers have challenged the procedural emphasis of planning theory by saying that it has provided explanations and prescriptions which are content less and context less" (Darke 1983, p. 16).

However, the quality of the procedural texts is essential in developing a network of airports that conform to international and national standards. Acceptability of a project by the industry can be judged by means of an investigation into the palmer’s procedural process and not just the end product.

Although accepted as a standard by airport planners, the quest for a better measure continues. A harsh outlook is given by Richard Deneufville who cites the following weaknesses (De Neufville 1976, p.9 1):

- Information requirements are unrealistic
- Seldom are value preferences known or agreed upon
- It ignores the role of power and other political variables
- It assumes the existence of a powerful unitary actor on the applied level
- It makes the assumption that it is possible to accurately forecast demand projection, an assumption that has been widely discredited

A good airport planning procedure can be described as the inclusion of rational analysis,social interaction and political context, thus planning with the sensitivity of the airport's dynamic environment. This planning procedure would not only involve the skill and expertise associated with rational planning but the art and ability to plan within the described limits and be responsive to the intricacies of each particular job.

2.2 Alternative Theoretical Models

Dempsey, Goetz and Szliowicz (1 997) in their recent publication cite a number of alternative theoretical models that to some degree are being used in airport planning projects. One of the ones listed is Allison Graham's Organizational Behavior and Bureaucratic Politics (Dempsey et al. 1997, p.473). In this text they describe how the decision-making process can be split into organizational behavior decisions and bureaucratic decisions. The organizationaldecisions are based upon the established procedures with the individual organization. The bureaucratic side is where the plans develop as a result of political bargaining involving both government and nongovernmental players.

This type of dissection of the decision making process is especially relevant to airport planning due to the fact that politicians usually are proponents or staunch opponents of the pject. As such some decisions may end up being played out in the political arena more so than the proper organizational structure in place for the project. This leads to Harold Linstone's project analysis. He States it is necessary to analyze any project on three levels: (1) A technical level (rational model); (2) An organizational model (organizational model, incrementtalisment, and bureaucratic politics); (3) Personal,cognitive models on the basis of values, beliefs and the mindset of actors (Dempsey et al.1997, p. 473).

Two of the planning theories that play roles in airport development are Charles Lindblom's Disjointed Instrumentalism and AmataiEtozioni's Mixed Scanning Approach. in the Incremental Theory planners only develop a few possible strategies never straying very far from the precedent.

> "Because of budgetary constraints, plans and decisions makers can not consider al1 possible alternatives in the process and instead engage in making 'successive Limited comparisons' by a bmch method based on previous related experiences"(Dempsey et al. 1997, p. 472).

AmataiEtozioni's Mixed Scanning Approach scans the environment in order to divide issues into two decision making levels. The lower level fields don?

Requirein-depth analysis, saving t h e and effort. The focus is retained to produce in-depthanalysis on a smaller number of "higher lever issues (Alexander 1991, p.56; Dempsey et al. 1997,p.473). Both of these theories are quite evident in airport development. A1l the commercial airport terminal in the world can be categorized into only 4 terminal concepts. This demonstrates that while certain issues are dealt with in an exhaustive manner, many design features are only slightly modified from project to project.

2.3 Substantive Theory In Airport Planning

An extremely important aspect of terminal planning is the elaboration of the Substantive category of planning. Substantive planning is concerned with what do I have, how about and what we are planning for and whom we are planning for (Alexander 1991, p.7). This type of planning bases itself on an in-depth analysis of the subject. This form of comprehensive analysis, into what and whom we are planning for, is essential in order to develop a terminal that serves the type of passengers that are using that airport. Distinguishing between transit passengers and originating/ariving passengers is as important as knowing the volume of passengers. Different types of passengers utilize different areas and components within the terminal building, thus placing pressure on different links in the system. Designing a terminal complex that is incompatible with the type of passengers using the airport can lead to serious processing and flow problems within the terminal system.

As a result, it is of utmost importance to know whom you are designing the terminal building for. What are the characteristics of these users? Can they be properly accommodated within the system? Another range ont0 which substantive planning is necessary is the understanding and adjustments according to local population issues such as culture, civic pride, local customs etc. Generic development processes don't take into account such distinctions, however, the overall acceptance and evaluation of a project do rely heavily on a positive overall perception from the user population, travelers and locals alike.

In a continuance of who we are planning for, aviation forecasting plays a major role in the quantitative side of airport development. Forecasting volume and demand for service in the cynical industry is extremely difficult even with modem technological aids. Over reliance on forecasts could lead to design shortcomings or misplaced funds. What may occur are expansive, overbuilt, undammed and inefficient terminals. Taking into account this and other major uncertain variables, the airport planning process as well as the terminal building design must remain flexible.

2.4 FlexibilityIn Airport Planning and Development

As noted by Dempsey, Goeq and Szyliowicz in the discussion of Denver International Airport (DIA) flexibility in the airport planning process is no easy task. "DIA and airports in general are inherently inflexible due to the high capital cost, long lead times,centralization, technical orientation and aligementof interest coalitions" Dempsey et al.al 997, p.476). The rational theory does little to incorporate flexibility in the process and this may be one of its major flaws for airport planning. Additions to the planning process such as feedback loops or stages where new significant data may k introduced in order to influence the actual development can dramatically shed this inflexible stigma. Another solution may be an increase in the number of checkpoints to re-evaluate the scope of the project at certain stages.

Dempsey, Goetz and Szyliowicz, include an excellent qwte that captures the essence of a flexible process.

> "When discrepant information begins to accumulate that challenges the assumptions on which the original project was based, the project should be re-evaluated and new decisions reached about its critical elements" (Dempsey et al. 1997, p.486).

Instituting adaptability and flexibility into a terminal design concept is a major hurdle in airport terminal development. Dempsey, Goetz, and Szyliowicz cite Evans and Stigler in introducing more definite concepts of flexibility and adaptively. Adaptively represents a one-time change within an organization that permits it to function more effectively in new conditions. Flexibility is described as a more dynamic concept allowing continuing adjustments in constantly changing conditions (Dempsey et al. 1997, p.474)

Inherently, due to the nature of airports and the aviation industry in general, Flexibility rather than adaptively would be preferred. A further dissection of flexibility is given as follows (see table 2):

Table 2: Types of Flexibility

1. Robust- Degree onto which an organization is prepared to friction after king subject to unanticipated events.
2. Hedging- Defensive strategy minimizing negative impacts from environment by building in redundancy and backup systems.
3. Resiliency- Ability of an organization to function after having been subject to unanticipated events.
4. Corrigibility- Ability to learn from and adapt to new conditions.

1 &2 Anticipatory,3&4 Reactive (Dempsey et al. 1997,p.474)

In designing a terminal, airport planners have an understanding of the types of obstacles and developments that can occur in the industry. As a result anticipatory ensures are usually instituted to some degree. The unforeseen troubles are the ones that usually sabotage a project. The importance must lie with the planets ability to design a terminal that can be somewhat cross-utilized to accept and deal with unanticipated conditions.

The ultimate goal must be an understanding of the industry, its players, and its quirks.Therefore, planning not only for today, but putting in place mechanisms that will allow the terminal building to accommodate, evolve and expand (if necessary) with the airline industry .

A key to a successful airport is the inclusion of a continual planning process. The planning of the airport cannot stop once construction is complete. If research is done routinely, the life span and efficiency of the airport can be extended. This cm be accomplished by monitoring the activities and manipulating the airport structure to respect and accommodate the changes. These changes can be an increase in demand,technology, percentages of conectingtraffic etc.

> "The airport planer who is required to anticipate conditions 10 to 15 years in the futjuremust often have reason to guesswork. Even if the guess is correct initially, conditions change and result in a mismatch between terminal architecture and the traffic to be sewed. To guard against this,airport planners now tend to favor flexible designs that can be expanded modularly or offer the opportunity for low-cost, simple modifications as future circumstances might demand (Wells 1992, p. 153).

2.5 The Terminal Planning

The terminal planning process can be divided into four stages: 1. Programming, 2.Concept Development, 3. Schematic Design, 4. Design Development (Horonjeff and McKelvey 1994, p.447).

1. Programming

   This stage encompasses the initial introduction into the project. For any terminal development the goals are functionality, flexibility, and convenience. This stage defines the objectives of the particular project with respect to these general goals. Other main components of this phase are the project scope and the rationale. This stage also involves the establishment of preliminary schedules, capital and operating costs and the initial space requirement program (Horonjeff and McKelvey 1994,p.448).

2. Concept Development

In this stage the space program developed in the programming stage are allocated in a general way to the terminal complex. At this phase, the main type of terminal concept is decided upon. The characteristics of the terminal building are developed. Other essential planning decisions such as degree of centrality for services are decided (Horonjeff and McKeIvey 1994, p.466).

3. Schematic Design

   In this step the terminal begins to take form. The many components that make up a terminal building are given general location and site. The functional relationships between the components are analyzed. The size of the facility is determined with regards to the desired level of convenience (Horonjeff and McKelvey 1994,p.481). A main element of this phase is an initial examination into the passenger and baggage flows within this pre-built terminal. Computer simulation can be used to demonstrate the potentialal problem areas.

4. Design Development

   The schematic ideas are refined into detailed plans. The exact sizing of the facility and its components are established. The plans evolving from this stage are the ones sent for acceptance from the necessary authorities. Details on the capital budget,and operating costs are established.

A detailed list of the decisions made in the schematic and design level is given by Jeff Horonjeff and McKelvey (1994, p.448):

1. Processing cost per passenger

2. Walking distances for various types of passengers
3. Passenger delays in processing
4. Occupancy levels and degree of congestion
5. Aircraft manuvering delay and costs
6. Aircraft fuel consumption in maneuvering between runways and terminals
7. Construction costs
8. Administration, operating and maintenance
9. Potential revenue sources and the expected level of revenue from each

2.6 Synopsis of Airport Planning Theory

To place these theories in perspective, the rational theory although limited is certainly a reliable framework into which we can build a contingent theory that combines "operational prescriptions with situational realism"(A1exander 199 1, p.57). In the airport planning field, the rational theory manuals can provide a prescriptive element however, more emphasis must be placed on the actors involved, the decision team and the situational context. The introduction of flexibility (to allow for the cyclical changes in the business to be properly deall with) and an impasion into to the substantive (to be properly informed), are essentials to proper airport and terminal planning.

2.7 General Airport Planning

2.7.1 Key Elements of Airport Planning

All airport terminal-planning operations can be incorporated into one of two major categories focusing on: physical planning or operational planning. A third element in the planning structure is the element. Due to the nature of the airline business and on-time performance, the time element is fixed therefore modifications must lie within the physical or operational elements. Physical planning is comprised of the terminal design,general layout and size of facility. Operational planning includes all activities within the terminal building (human and mechanical), as well as the functions and flows within the terminal building. Understanding and planning in accordance to operational activities is the most important step towards an accepted and efficient airport design.

A barrage of systems and interests intersect at the terminal complex:

- Physical systems; landside, airside elements compete for landuses.
- Passengers, airlines, and airport manager operators compete for systems and physical form that best services their needs.
- Economic goals vs. passenger convenience also play a major role in sizing and layout of the facility.

"The role of the planner is to determine the relations between passengers convenience and cost throughout the terminal's life and find, for any level of convenience, the plan that costs the least, or, for any level of cost, the plan that provides the most convenience." (Elek and Bienhaker 1972,p.323)

A major influencing factor in the design of the terminal complex is the interface of both landside and airside functions at this location. Landside functions include; parking, pedestrian access to building, and availability of curb space. Airside functions include al1 aircraft operations and requirements, taxiways,runways, aprons, and gates. The airside network has a larger space requirement than the landside element; therefore there is a geometric conflict at the confluence of these two systems, which is the terminal building. A goal of airport planning is to design an efficient and seamless passenger flow between the landside and airside elements via the passenger terminal building. However, there is a fine Iine in the degree of interdependence of these three systems (landside, terminal and airside).

A level of integration is desired, however, the flexibility for expansion of one element without physically affecting the other two elements is necessary in order to limit economic costs and efficiency in the future. The different terminal concepts have come about from the attempts at designing the most appropriate system for present and future needs of the essence of layout designs lies within the function and flow element of airport planning. The operational side of airports can benefit or be hampered by the overall layout of the terminal building. in analyzing the terminal functions and flows we may be able to alter the operational systems within the already built environment creating a more suitable and efficient operational system. This could be an important factor in deciding the future plans for an airport.

Operational activities are affected by such elements as type of passenger flow (originating, terminating, and in-transit) as well as the actual nurnber of passengers. A task of the planner is to organize the functional elements of the terminal building to accommodate the type of passengers that are readily using that particular airport.Understanding and respecting the characteristics of the actual operation is key to laying out a terminal that is responsive to the needs of the parties represented in the airport environment.

Characteristics such as type of passengers, number of passengers, number of airlines serving the site, government customs/ immigration processes, facility costs and passenger convenience, can be translated directly to the type of terminal design. Therefore,function and flow can and should be leading factors in designing terminal and determining the actual size of the terminal. Planning from the inside out is the appropriate method in this domain.

The element of airport planning that is a definite requirement to produce a "good" or successful airport is the allowance of flexibility within the terminal system. Although very intense forecasting systems are corrently used for analyzing airport activities, the future remains unpredictable to a certain extent. An airport designed solely as a "hub"(for the use of transiting passengers) may encounter some major physical obstacles if this scenario is altered and the airport is removed from the national hub system of a particular airline. In order to avoid such catastrophic planning practices, flexibility within the network is essential. Flexibility can be evident in many forms: number of gates available,types of gates, processing of passengers, as well as the flexibility of the total system between the three major elements of the airports system (landside, terminal,airside).With flexibility in place an airport can be "reborn" and expand its effective lifespan by means of the original planner's vision not to control the future but to plan accordingly.

A break down of the general airport planning domain can be divided into three levels of concentration. These are the System Planning Level, The Master Planning Level, and The Project Planning Level (Horonjeff and McKelvey 1994, p. 186).

The System Level encompasses an analysis of the aviation facilities required by a large geographical area. This is an overview of what the total aviation service will be for an entire am, how this service will be provided, and where the service will be provided This is an evaluation of aviation transportation on a macrolevel. Proper investigation at this stage requires input and participation h m numerous variables. These variables may include political representation from a national and provincial level as well as local authorities from a wide-ranging area Other elements studied at this level include the road transportation network, geographical development trends, population analysis etc.

Although not affected by the intermediate workings of the airport(s), the aviation infrastructure will be used by a wide ranging public and therefore an attempt to include al1 parties at this introductory stage should be made.In areas that encompass multiple airports, the establishment of the roles of each individual airport must be done in order to institute a harmonious aviation system.

The Master Plan is a concept of the ultimate development for the specific airport (Homonjeff and McKelvey 1994, p. 186). Al1 uses and elements that are part of the airport and or directly physically affected by the airport are included at this stage.

As mentioned previously, there are three distinct categorical separations within an individual airport system: The landside, the terminal building, and the airside.Landside elements include; land transportation (public, private), the road network, parking facilities, pedestrian access to the terminal building, and the access curb (the latter two usually being included in the terminal building category as well). The airside functions include al1 elements that deal with the movement and maneuvering of aircraft. This includes all taxiways, runways, aprons and docking gates. Also included in this are cargo areas, hangars and technical facilities dealing with the aviation operations.

When dealing with the master plan, other land use elements must also planned for.Included in this are general aviation areas, industrial and commercial areas within the airport limits as well as bordering areas. Existing neighboring residential zones and residential expansion areas are crucial elements to the master planning process. These issues can be translated into 4 components that guide the layout of the facility.

1. Airport layout - configuration of taxiways.
2. Land uses - Designation of areas for the terminal building, maintenance, commercial buildings, ground access, industrial sites and noise buffer zones.
3. The Terminal Area- land and airside.
4. Airport Access – private or public. (Wells 1992, p. 108)

The main goal of an airport is to operate at maximum efficiency at ail sectors of the airport. Maximum efficiency is also sought at the linkage points within the three systems (landside, airside, and terminal) in order to maintain capacity throughout the airport. If capacity at the terminal building is less than the capacity of the airside system the entire system remains under capacity in order to reduce delays. A single element that is inadequate holds the whole airport network hostage. Analysis of the interaction of these elements is necessary in determining the combination and size of the facilities that best serve the heterogeneous, fluctuating traffic (Denefiille 1976, p. 169).

The airport master plan must inchudethe following elements as compiled by Walter Han (1985, p.9).

1. Complete documentation of existing and proposed airport development supported by traffic forecasts.
2. An airport layout plan.
3. A land use plan incorporating land-use compatibility showing effects and consequences on the environment.
4. Airport noise compatibility program.

In order to achieve these four simple goals many studies and analyses must take place to properly prepare a master plan that is current as well as validated by sufficientdata.An extremely important starting point in airport planning is a report on the inventory that is occupying the existing airport site. Identification of these facilities as well as an accurate description of the real usage is imperative. The collection of socioeconomic and demographic data, such as population, employment, industrial and commercial activities,and land uses for the service area of the airport are valuable in the demand forecasting as well as in predicting the consequences of the development.

Forecasting remains one of the most important pre-construction studies for airport planning. Modern techniques can relate demand to a number of social, economic, and technological factors that affect air travel (Horonjeff and McKelvey 1994, p. 189). Once a forecast is complete, an analysis of capacity and delay as well as geometric and other standards governing the design of airports provides data for determining the extent of the required facilities. At this point the planner has the first approximations of the overall size and shape of the new project and can begin with impact analysis on the surounding land uses, the environment and the infrastructure (Horonjeff and McKelvey 1994, p. 192).

The ability of the airport access roads to mesh within the existing road network is essential in assuring an optimal level of accessibility for al1 users. This can dramatically reduce the costs associated with constructing an extended new road network at the same time as the building of the airport itself Redevelopment of the neighboring road network to accommodate the increase in traffic is standard practice.

The land use planning of the airport area is a major variable in deciding the actual location of terminals, cargo areas etc. Two types of zoning are effective within the airport vicinity; height and hazard. These are used in order to protect the approaches to the runways. The land uses include aviation locdes and land dedicated to non-aviation uses.

Collaboration between the airport planners and the planners of the adjacent municipalities is essential in assuring mutual acceptance of projects as well as ensuring compatible uses on either side of the airport boundary. The airport master plan and the municipal master plans and policies must be in harmony.

Environmental impact assessments have become an essential part of airport development.In addition to the obvious noise level standards, air and water quality issues have come to the forefront in airport development. More stringent regulations in acceptable noise levels and new modem quieter aircraft have reduced noise contours significantly (see appendix 5 for information pamphlet on noise regulations).

The inclusion of all members of the community (citizens, organizations, special interest groups etc.) during the planning process helps alleviate the perception that the planning authorities are attempting to pass a development project that will negatively affect them. Secrecy can create the misconception of deceitful planning practices. This is something that should be dealt with in order to create an aura of a community project from which all can benefit.

2.8 The Planning of The Passenger Terminal

Walter Hart (1985, p.35) contextualizes the overall goals and objectives of the passenger terminal.

1. Aircraft must operate with maximum efficiency at terminal gates, on apron taxi lines, and at entering and exiting points of the runway taxi system.

2. Flow of originating, terminating and transferring passengers, baggage and vehicles must be uncomplicated, with the honest distances possible and least number of horizontal and vertical movements.
3. Plans must have expansion capabilities to accommodate growth in passenger and baggage volumes
4. Plan must provide for future changes in traffic characteristics such as a change from mostly originating (+75%) to an increase in transfer (+30%).
5. Plan must provide for an increase in vehicular traffic and for changes in ground traffic distribution.
6. Plan must provide maximum opportunities for efficient use of staff and equipment.
7. Plan must be cost effective.

These goals are extremely simplify and require intense studies to achieve and match the conditions set out by these objectives. The following is a breakdown of the studies and steps in a terminal design process.

The majority of terminal development projects as well as general airport development project work within a 20-30 year planning horizon.

Other approximations and estimates for the time including airline aircraft from orders for the first five years of the plan, accurate approximations for the next five years cm be made from this data. Prototype aircraft are likely to see service in the second ten years of the plan (Beinhaker 1972,p.85).

The projection of the demand for air travel is an empirically important stage in the terminal development. The numbers that are accounted from this study set the guidelines and framework on which the overall airport facility and the passenger terminal design are based. Over-reliance on unsubstantiated or erroneous data can lead to over-development.

Forecasts are usually prepared to reflect three possible future scenarios. These would include low, medium and high projects for passenger travel. Two measures are used to identify, passenger volumes and types. Annual passenger volumes are accumulated for preliminary sizing of the terminal building. The second maasure used is a detailed hourly volume. These numbers are used to mate a typical-peak hour volume scenario but it is significantly affected by the scheduling practices and fleet mix of the airlines. (Horonjeff and McKelvey 94, p.44 1),

When discussing the flow and operating systems, many of the problems occur only at peak hours and are not relevant for the majority of the day. Therefore, we are faced with the issue of what we should we plan for. Do we plan to accommodate the capacity at peak hour, resulting in inefficient use of space and system elements for the remainder of the day? Do we plan to accommodate 80% of the peak hour number hoping to reduce inefficiency? Or do we plan for the median daily numbers etc.? Organizing our planning efforts and understanding the planning goals can regulate many system problems as well as provide a lead on how to alleviate some of the problems that our design can create.

P.H. Beinhaker (1972, p.89), breaks down the projections into three categories. The distinctions of these categories are important to allocate rresources to the appropriate stations in the terminal. These distribute the quantitative aspects of the travel demand.

- Originating departure forecasts which are related to ground transportation needs.
- Enplaned times two (2), forecasts which include all the originating/destination passengers plus passengers on connecting flights.
- Arriving and departing forecasts which includes al1 enplaned plus passengers on same aircraft in and out.

Analysis of what type of passenger uses the terminal is important at this stage. The types of passengersi.e originating or connecting are of utmost importance since the varied srpes place pressure on different components in the system.

Table 3 demonstrates how different passenger loads affect different stations/components within the terminal system.

Table 3. Demand for Passenger Services

	Passenger *type i, arriving*			Passenger *type i*, *departing*			
Facility	domestic, no bags, auto driver*	domestic, with bags, auto passenger	International with bags, auto passenger	Domestic with bags, auto passenger	Domestic no bags, auto passenger	international with bags, auto passenger	Total volume
Curb, arrivals	—	√√	√√	—	—	—	
Curb, departure	—	—	—	√√	—	√√	
Domestic lobby	—	√√	—	√√	√√	—	
International lobby	—	—	—	—	—	√√	
Ticketing counter	—	—	—	√√	—	√√	
Assembly	—	—	—	√√	—	√√	
Baggage check-in	—	—	—	√√	√√	√√	
Security control	—	—	—	√√	√√	√√	
Customs, health	—	—	√√	—	—	—	
Immigration	—	—	√√	—	—	√√	

Baggage claim	—	√√	√√	—	—	—

*Auto driver = passenger driving a car to and from airport

*Auto passenger = passenger driven to and from airport

√√ = design volume of passenger type i using facility type j

2.8.1 Facility Classification

In order to p h appropriately the planner must plan for the operations that take place in that particular locale. As mentioned previously the type of passenger is as important as the amount of passengers. The following is a brief description of the different types of facilities (Horonjeff and McKelvey 1994, p.442).

- Originating/Terminating Station: 70 to 90% of total passengers, High level of processing. High demand for parking, ticket counters, and baggage claims.
- Transfer Stations: High percentage of connecting passengers. Focus on convey and inter gate access, flow circumvents main terminal area.
- Through Station: High percentage of originating passengers on aircraft originating at another destination. Less passenger service facilities than at an originating station. Smaller departure lounges.

2.8.2 IntransitPassengers

Transit passengers usually don't have an alternative but to proceed in the manner of a regular arivalpassenger and then proceed as a regular departing passenger. Some newer airports have provided a system to better the transiting procedures of passengers. As transiting passengers provide a major percentage of traffic at some airports, the treatment of these passengers is essential to maintaining that airport as a primary choice of the travelling public. Busier international airports provide lounges for passengers without the proper travel visa/documents to enter the country in which they are travelling through on route to another country. Vancouver International has maintained itself as a gateway to Southeast Asia by providing an almost unimpeded transit process for international passengers (Hughes 1996, p.9).

As mentioned earlier flows of thepassangger and baggage are becoming a very important contemporary planning issue. As the "Spoke and Hub" system becomes the nom around the industry, the planning of the hubs must pay particular attention to the role of the transfer or connecting passengers. Some airports boast up to 80% transfer passengers. [f these airports are designed to operationally process originating and terminating passengers, the physical layout might not properly serve the majority of the passengers.

Terminating and originating passenger flows can be viewed as vertical systems running from landside to airside. A transfer passenger system may be viewed as moving horizontally. Anunacomodatingsystem might force the passenger to move along the vertical terminating system, then horizontally through the terminal building and once again vertical as an originating passenger. This is a time connsumingprocess as well as inefficient, fistrating and inconvenient for the passenger.

2.8.3 Processing Stages

The main goal of the terminal building is to transfer passengers and baggage from the landside to airside and vice versa. The passenger terminal encloses al1 the functions and systems that enable this flow of passengers and baggage. This results in flows and systems through al1 the three elements as well as some functions that are exclusive to individual elements. Each station in the processing of passengers departing and arriving is described below.

2.8.3.1 Departure Level

2.8.3.1 .1 Access Curb

This is the primary access point for the majority of the passengers and people entering the airport terminal. There is usually a fairly quick turn around time for the unloading of the passengers and baggage. An estimate of 1 to 2 minutes per private auto is given (taxis can be included in this time estimate). Buses and limousines are estimated at 5 to 15 minutes for offloading (Horonjeff and McKelvey 1994, p.448). The actual layout of the curb is dependent on the amount of traffic and types of vehicles. Many curbs surpass the actual frontage of the terminal building. Busier centers can implement systems of dedicated lanes; either privatepublic separation or departing arriving split. Vertical separation for individual activities is also common.

2.8.3.1 .2The Terminal Lobby Area

As the first sight upon entering the airport the terminal lobby is usually aesthetically appealing and architects dedicate a lot of time to this main area. The main function of the lobby area is to process the passengers and baggage. This is done at the individual airlines check-in counters. This area should provide ample space for queuing as well as passenger and visitor movement about the terminal.

The role of the terminal lobby area is quite different in the Canadian context from its U.S counterpart. As Canadian regulations permit only passengers into the concourses and gate areas, the passenger terminal lobby area becomes the focal point of any Canadian airport. These results in the majority of commercial and other services king provided at this location. It also concentrates a large percentage of the passengers in this area mil shortly prior to departure. The US system allows for well-wishers and passengers alike to proceed into the gate areas, thus increasing the amount of people in these areas,providing a better economic threshold for the introduction of commercial activities. This can also reduce the amount of time spent in the terminal lobby area as well as the need for such expansive lobby areas.

2.8.3.1 .3Security Screening

Different terminal types and configuration have the security screening at different points in the terminal. This stage usually consists of x-ray machines and operators who individually check al1 ticketed passengers prior to access to the concourses and gate areas (Many U.S. airports allow well-wishers into gate areas upon screening). Many older airports were designed prior to the implementation of screening check-points,therefore resulting in a prior location for the check-points resulting in an impediment to passenger traffic.

2.8.3.1 .4Customs and Immigration Pre-clearance

This is a stage that provides entrance into the country prior to departure rather than going through the procedures once arrived in country. A11 major Canadian airports have this service in place. The implementation of the system ad& the requirement of having a sterile area at the access gates for the country. bound aircraft This forces the airport authorities to dedicate a certain amount of space and gates for the exclusive use of thecountry. Bound passengers usually refered to as transponder passengers.

2.8.3.1 .5Departure Lounges

Lounges are located in immediate proximity to the aircraft. They are used to accommodate and seat passengers while waiting to board the aircraft. The ticket lift function and the boarding of the aircraft via the "bridge" or boarding device is located at this point. Sizes and functions of the lounges are again dependent of the type of airport terminal system in place. Common lounges used for several gates provide service while reducing the space requirements of individual gate lounges.

2.8.3.2 Arrivals Level

2.8.3.2.1Arriva1 Lounges/Corridors

The arriving passengers usually enter the airport terminal at the departure lounge.Depending on the type of flight having, (International, Transporter, or Domestic) separation of the arriving and departing passenger may be required. If so the departure lounge provides an isolated passage for the arriving passengers to proceed to the Canadian Customs and Immigration location. This eliminates contact with departing passenger and ensures all arriving passengers pass through the proper processing.

2.8.3.2.2Baggage Claim Area

The size of this facility is dependent on the type of aircraft serviced and the amount of flights arriving within a short time interval. Once again, segregated baggage claim facilities must be used for international and transborder flights. Domestic baggage claim may allow access for well-wishers into the baggage carrousel area. Issues such as exclusive belts add more space requirements to the area and can cause inefficient use of belts due to lack fights arriving by individual airlines. Sharing of belts for multiple flights can lead to some confusion amongpassengers attempting to retrieve their bags and can cause added congestion in the area due to the increased the factor to retrieve baggage.

2.8.4 Analysis of Operational Functions and Flows

A main duty of the airport planner is to understand and plan for actual operational circumstances. As previously mentioned, the flow of airline passengers can be categorized as originating, terminating, and transfer passengers.

The flow of anyone of the system can be enhanced or hampered by the physical layout of the terminal building.The expression "a chain is only as strong as its weakest link" is quite appropriate in this scenario. A passenger who is stalled at any one of the stations/components will be annoyed at the whole process. Physical layouts that impede flows usually occur due to a misunderstanding or lack of knowledge about the flows and processes of a system prior to construction. "A proper airport system must provide good service to most of the people and acceptable service to all" (Elek and Beinhaker 1972, p.332).

An example of a physical constraint on a passenger flow is the U.S. Immigration and Customs processing system at Dorval Airport in Montreal (see figure 1). Prior to the recent renovations passengers would check their baggage through U.S. Customs located behind the individual airline check-in counters (1). Once this initial check was complete,passengers would proceed back into the general terminal area and walk a distance to the security check- point (2). Once through security passengers would pass through U.S.Immigration (3) and then through a second U.S. Customs station located after a duty free shop (4). This layout caused passengers to queue at four separate 1ocaiio11a~s well as having extended walking distances.

When airport renovations were complete the process was simplified to flow a better flow and less individual stations. All the elements of the U.S. Customs and Immigration were maintained but combined into a single stop (see figure 2).

Once a passenger is checked in at the airline counter they immediately proceed into a corridor leading to the U.S. Customs and Immigration processing

Centre. The processing station is centralized (dl passengers regardless of airline) unlike the original step of the old system. The passenger maintains their baggage until fully processed by U.S.Immigration and Customs. Once passed through the two steps, passengers place their baggage onto the outgoing baggage belt. The passenger only waits in line prior to the initial step and then filters through the entire process.

While improving the passenger flow, the new layout also improved the baggage flow. In the old system if a passenger was refused entry into the U.S. at the Immigration station (3'"stop in the original process), their baggage was already loaded ont0 the aircraft that they were supposed to fly on. An airline ramp agent would then be required to physically search each bag tag to locate and expedite the baggage in question off the aircraft. This is a tirne consuming process and usually results in a departure delay.

In the new system the passenger maintains possession of their baggage until fully processed at which time they deposit their baggage ont0 the onload belt. As a result of this modification the baggage flow is also improved

Improvements in the physical facilities can usually relieve problems, however, at some airports this is not a viable option and other methods must be utilized. Flow in all aspects of the airport environment can be improved by relatively simple means. Some examples are listed below:

- Increasing the amount of check- in counters in operation, or increasing the number of Customs processing agents is a basic alteration but can carry high operating costs.

- Having a check-in counter that solely deals with longer more complicated tickets allowing a smoother flow for the remainder of the passengers in the queuing lines.
- Ensuring maximum front stage and easy access on arrival baggage carrousels.
- Enforcing offront loading time limits on airport access roads, providing more space for added cars.
- Appropriately located signage with gate information, airtime locales, and departure and arrival times.

Improved and updated information can inform passengers of changes in gates and delays as well as inform well-wishers of updated arrival times. If this information is available from outside sources such as computer terminals or telephones it can limit the amount of time spent in the terminals waiting needlessly. Long delays especially on international flights (larger aircraft, more passengers, and more well-wishers) can inundate the services in the passenger terminal building. If the delay is forecasted and passengers have the means to retrieve the information, they will postpone their arivalat the terminal building to a more appropriate time. Similarly, conveniently located and approximately designed waiting halls can ensure passengers don't walk around endlessly and congest the remainder of the terminal. Locating display screens in these areas is essential.

2.8.5 Passenger Service Bel

The forecasting relays the passenger information quantitatively. The terminal planner must then translate this information qualitatively. This is regarded as the level of service provision. Since there are no set standards for the level of service, the local airport planner must decide what type of system they intend to provide to the travelling public.Areas of concern include walking distances, space per passenger density of crowds, processing time, queuing times and types of queues etc. The end result becomes a cost/benefit analysis. The costs can be evaluated not only in an economic cost, but also as a convenience level for the passengers. An example of an imposed convenience level would be specifying that 90% of the people won? experience an inconvenience worse than the represented by that standard (Elek and Beinhaker 1972, p.366).

The convenience level issue is contentious in that the three main players are against each other. The perspectives of the l.airlines, 2.the passengers and 3.the airport authorities Vary widely with regards to this issue. Priorities for the airlines are in on-time departures,allocation of personnel, minimizing airport costs and profitability, The passenger seeks completion of mp at lowest cost, minimum delay and maximum convenience, minimal congestion, shortest distance to plane, aircraft delay times. The airport authorities seek to ". . . provide a modem airport facility which meets airline and passenger objectives in harmony with expectations of the community (Horonjeff and McKelvey 1994, p.446) while minimizing the costs of the terminal, capital and operating. Different levels of convenience will be present at various components of the terminal system . Components deemed more crucial to the operational system may have an inflated level of convenience. The overall balance of the objectives becomes a guiding factor in the terminal design. The costs of the terminal building are easily quantifie4 however the convenience factors aren't as readily given a dollar figure to compare (see figure 4). Ecomic costs include capital, operating costs of the airport as well as the individual airlines. The players must trade-off individual objectives in order to create the "best" complex with the limit resources. (financial, terminal space, land, etc,) A cost benefit analysis is usually undertaken with any controversial planning issues.

The players that participate in airport construction are identical to both of any major chic project: the architects, the engineers, the public, the politicians and the plannerwithout being too stereotypical, the main focal points of each group are quite different. The architect seeks an elaborate mix of appealing and monumental fixtures along with the focus of aesthetics rather than practicality. The engineers seek simplicity of design and "straight lines" for servicing purposes. “The diversity and complexity of their pragmatic desires inherently clash with aesthetic preferences for simplicity of concept and form" (Hart 1985, p. 103). The planner must attempt to create a balance between the needs of the population using the facility and the economics that play a major role in airport development.

> ". . . we didn't want an architect's dream and a passenger's nightmare. The real beauty of this terminal is how well the systems are designed to work and bearer serves the passengers who will be using it." (DeiterBergt in Scolof 1997, p.66)

Authorities such as ICAO, IATA, Transport Canada, and the FAA institute a certain level of standards in which airport must adhere to. Other than sizing, the discretion usually lies in the hand & of the active players in a particular project.

This results in many varying results in the quality of the facility with respect to the users. Local customs can play a major role in the development of "acceptable" quality and quantity of facilities in the planning of the airpon. While it is idealistic to attempt to assure maximum convenience to al1 passengers throughout the rnany fluctuations in the airport passenger levels, an objective of plamers should be to assure that only a small proportion of the users will experience inconveniences above a specified level (Elek and Beinhaker 1972, p.33 1).

Efficiency becomes a major factor in the balance of convenience and economics. Adding gates may solve the convenience problem during peak hours, but if the gates remain idle the rest of the day, the space is underutilized and economically costly in terms of capital as well as operating costs. If this economic cost is perceived as thr great compared to the added convenience the expansion is usually not came out. The amount of usage time and the amount of users per cost are usually a deciding factor in determining the number of gates and size of passenger facilities. A time horizon is usually implemented in order to better evaluate and distribute costs.

Passenger convenience and costs usually play an instrumental role in determining the type of terminal design implement at the airport site. Some of the terminal types are more apt to servicing economic issues. Other layouts provide better passenger convenience at the expense of economic cost. When evaluating alternative designs the planner must keep in mind a certain level of convenience in the comparison.

2.8.6 Space Planning

Once the planner has understood what level of service will be provided She or her translates this concept into the actual space requirements for the terminal building, This information is then passed on to the architect to develop the actual design within the set limits of the planner.

Within the terminal building there are a variety of competing interests with regards to space allocation within the terminal building. Table 4 distributes the percentages of space as suggested by the FAA. (Horonjeff and McKelvey 1994, p.445).

The overall space assignment is related to the horizon year (fully developed plan) estimates for total number of passengers. If a fully operational terminal is the goal, the terminal must still be within the set standards the planner has laid out the latter stages of the time horizon.

An initial step for the planner is to plan the terminal in two separate manners. The enplaning and deplaning passengers are vastly different in theory & and therefore require separate attention. In actuality the deplaning passengers attract very little attention from the planer since their stay in the airport is minimal and they pose very little stress on the system. Aside from the baggage retrieval area, (and the Customs and Immigration stage for international passengers) the arriving passengers make their way quickly through from the gate area to the pick-up ramp. Therefore minimal maneuvering space is deemed necessary in comparrison with the departing passenger.

The established forecast of annual volume and the "peak hour" values are instituted at this stage in order to establish the amount of space required to accommodate the highest passenger volume in the day. The level of convenience is a major factor in determining what percentage of users will face unfavorable conditions. Planning for 100% convenience is economically unfeasible and results in extramely high inefficiency the remainder of the day.

Forecasting is then used to estimate the number of seats per aircraft. This approximation aids& in two manners. One, it gives the planer a scale onto which he/she can approximate the size of the lounge needed. Secondly, this value along with the number of passengers per hour gives the amount of aircraft per hour, which determines the speed at which passengers can be dispatched from the terminal building (Elek and Beinbaker 1972,p.379).

In order to dock all these anticipated aircraft the planner must make an approximation on the number of gates that will be required. The peak-hour estimates are the guide to determining the amount of gates needed " Gate capacity is the maximum number of aircraft that a fixed number of gates can accommodate during a specified interval when there is a continuous demand for service" (Horonjeff and McKelvey 1994, p.354,see figure 5). As in general it can be assumed that the number of gates required should equal the maximum number of aircraft that is scheduled to arrive or to depart in an two hour period (Elek and Beinhaker 1972, p.381)

The mix of aircraft and the particular policies of the nation or the airline can effect the number of gates available for certain aircraft (see figure 6). An international flight cannot dock at a domestic gate therefore capacity must be arranged with regards to the exclusive use of the gates by one particular flight sector. The airline policies with regards to exclusive gate use (airlines own there own gates) can decrease the utihtion factor 0.5-0.6 instead of 0.6-0.8 for mutually used gates (Horonjeff and McKelvey 1994,.498).

Another important factor in the space approximation stage is the understanding of and planning for the well-wishers. Since these persons do occupy space within many components of the terminal it is essential to include them in capacity numbers and density figures. Areas such as Aval halls, restaurants and main lobby are built to include these persons.

A major airport can house tens of thousands of employees. This produces a major element to plan for with regards to facilities catered to their needs. included in these are offices, operational areas, breakrooms, garages, cafeterias etc. As noted in table 4 this can equate to a large percentage of the terminal space.

The choice of terminal concepts is usually influenced by the existing airport facility or the surrounding built environment. In most scenarios, the existing passenger terminal building constrains the planner. The expansion has to mesh well with the old facility thus limiting the suitable terminal concepts.

The following is a listing of the design considerations for the overall design of the facility as well as determining the terminal concept (Horonjeff and McKelvey 1994, p.437).

1. Development and sizing to accomplish the stated mission of the airport within the parameters defined in the master plan,
2. Capability to meet the demands for the medium and long run time M e s
3. Functional, practical and financial feasibility
4. Maximization of use of existing facilities
5. Achievement of a balanced flow between access, terminal and airfield facilities during peak hours
6. Consideration of environmental sensitivity
7. Flexibility to meet future requirements beyond planning time fiame
8. Capability to anticipate and implement significant improvements in aviation technology

2.9 Terminal Designs

Different terminal types have a major influence on the flows within the airport. A centralized airport system might provide the better flow for an inter-airline transfer passenger, where as a decentralized exclusive terminal can be better for a regular originating passenger. The advantages and disadvantages of each terminal type are described in the sub chapter below

2.9.1 Centralized vs. Decentralized Facilities

The general philosophical question in creating an airport terminal is either to have a centralized facility or create of small units of service in a decentralized layout. As in all competing ideals, each has advantages and disadvantages.

However, in the airport landscape the playing field is not level and is highly influenced by the passenger type.Therefore the actual circumstances usually weigh in favors of one option.

With al1 the terminal types described there can be a certain amount of centrality, however with some of the options this centrality is limited, and exceeding the limit would undo the positive attributes of that design.

A centralized system is usually comprised of an area that provides the processing for all passenger and baggage regardless of airline. (Each airline provides its own ticket counter,however current trends include the sharing of counter space.) Services and commercial establishments are mainly located in this main hall. Passengers proceed to gates via corridors or passenger transport systems. The main advantage of the system is the economies of scale achieved by the intensive use of services (security, baggage carrousels etc.). The cost effectiveness of a terminal is increased by the minimum use of space that is only possible with each airline contributing into the overall system. This achieves one of the planning objectives, which is to minimize the amount of idleness (Elek and Beinhaker 1972, p.336).

The main disadvantage in this system is that once the airport reaches a certain threshold size, the passenger inconveniences outweigh the economic gains. The inconveniences include long walking distances to gates, high densities and confusion in central terminal area. If the terminal exceeds a certain size, the facilities should be duplicated to properly serve both extremities of the terminal (Elek and Beinhaker 1972, p.346). The need to physically separate flights (international, domestic, and transborder) takes away from the overall economy of scale.

The decentralized system provides very short distances from the car park to the aircraft door. The epitome of this system is the Gate-Arriva1 system (DFW)described below(see figure 7). This system benefits commuters, which can get in and out of the airport in a short time. Passenger services (check-in, baggage claim) are usually provided at or in close vicinity to each gate.

The disadvantages of this system include separate service facilities (baggage carrousels,security check-points) for one or a small number of gates. This increases the cost of equipment and personnel (De Neufville 1976, p. 102). The layout is linearly distributed resulting in long distances between gates. This can be misstreating for transfer passengers at larger airports.

A major factor in the deciding the exact type of facility is the issue of corporate identification. Many airlines in attempting to advertise and promote themselves choose to use exclusive facilities which range from ticket counters, gates, baggage daim facilities, and exclusive terminals. It is essential for the planners to know what the airlines have planned. Planning prior to knowing can lead in drastic plan changes. The amount of facility sharing depends entirely on the participation of the majority of the airlines. Many airlines that only provide a lirnitedarnount of flights at the airport in question will usually share the majority of services reducing their operational costs. At airports in which airlines insist on exclusive facilities the overall size of the airport is substantially larger and the efficiency of the individual elements is usually extremely low.

A current trend that is positively affecting the sharing of facilities are airline alliances and code sharing agreements between airlines. In this scenario, the airlines both publicize the flight under their corporate logo, however only one aircraft is used and the check-in for both airlines is done at one counter. (usually done at the more dominant airline's counter.) If this is the only flight for the "minor" airline, individual counter space isn't required at that airport.

Another positive trend is that airlines are combining efforts in order to build terminals suited to their needs however still reducing costs. Terminal One at John F. Kennedy International Airport in New York is an example of this type of partnership. Four Foreign carriers namely, Luflansa, Air France, Japan Airlines and Korean Air are developing a terminal which they will jointly manage and operate out of. " At Terminal One, we (the camers) manage our own house" DeiterBergt, CE0 of Terminal One Management Inc. and executive at Luflansa Airlines (Socolof 1997, p. 66).Each airport has it own individual design characteristics. However, al1 these designs can be narrowed down into 4 distinctive terminal concepts: The Finger or Pier design, The Modular or Linear Terminal, The Satellite Terminal, and The Transporter Layout (De Neufville 76, pp.98- 123; Elek 72, pp.35 1-390; Horonjeff 94, pp.466-476).

2.9.2 Finger or Pier Design

The Finger or Pier layout consists mainly of a centralized terminal building with coridors leading out to the gate areas (see figure 6). Aircraft can be parked on both or on one side of these extended corridors. Al1 of the passenger facilities are located within the main hall. With central on the key to this layout, the main advantage is that it promotes intensive use of the facilities. This usually relates into larger single checkpoints rather than many smaller points in other layouts. Another advantage is easier maneuvering for transfer passengers. An advantage of this design is the flexibility component. This permits expansion of the gate area independently of the terminal building and landside facilities (Ele k and Beinhaker 1972, p.355). This expansion process can take place in incremental steps king econornical in terms of capital and operating costs (Horonjeff and McKevley 1994, p.446).

A disadvantage of the design is that in larger airports the walking distances can become excruciatingly long. This includes both distances from main terminal to gate areas as well as overall (check-in from curb drop off to aircraft). Central halls may become extremely congested and confusing for passengers unfamiliar with the airport.Having dual parallel piers can result in requiring a second taxi way for aircraft which in turn on consumes a lot of land.

Dorval report port as well as the majority of Canadian Airports fail within this layout or a hybrid of this layout.

2.9.3 The Modular Arrival Design

This layout is a system that provides short walking distances form curb drop-off to the aircraft. The basic design is for a single line of a i r d parking directly parallel to al1 of the passenger service facilities (see figure 7). These service facilities are self-contained small modular units that are used for a single gate or for a small number of gates. Theterminal building therefore consists of a long relatively narrow building with many small modular facilities sandwiched between the aircraft gates and the general parking lot. The easy access, simple flow to the aircraft is a main advantage of this layout.

Expansion is relatively easy by which extra modular uni6 cm be attached to present building.The disadvantage of this layout is that there is no sharing of facilities, which can create an inefficient use of the facilities. There is very little economy of scale and operating costs can be high, Due to the physical nature of the layout walking distances between gates can be long, therefore in larger airports of this type passenger transportation systems are a must.

2.9.4 The Satellite Terminal Design

This design consists of an "island" terminal surrounded by the aircraft apron. The satellite terminal is physically separated from the main landside access curb (see figure 7). Access to the satellite terminal is usually attained via a passenger transportation system. This cm be underground or above ground depending on the individual design.An advantage of this design is that it maintains the economies of scale that are present with a regular centralized terminal building. (Common departure lounges and common check-in etc.). Short waking distances are also an asset of this layout. However, the ring terminal provided access fromlandside to airside with parking usually in the center of the terminal building. Easymanerability of aircraft is also a benefit.

A main disadvantage of the design is the high cost of construction due to the need to provide an access system. Tunnel designs increase the cost even more. Arrangement for transporting baggage and mechanical systems also are needed. Another disadvantage is that it is a poor design for expansion in that the new terminal space directly consumes needed airside land.

Figure 7. Terminal of Labraq Airport in Libya

2.9.5 The Open Apron/ Transporter System

This system is comprised of a centralized terminal, which is linked to the aircraft via independent mobile units. The aircraft are parked on an open apron away from the terminal building (see figure 7). As a centralized terminal, facilities are shared and efficiency is high. This design eliminates the dimensional conflict of the airside in comparison with the terminal building. Aircraft size doesn't affect the terminal in any manner since it is physically removed from the terminal. Advantages include short walking distances, and common facilities and common departure lounges. This system can be expanded at a fraction of the cost of construction in other designs. If the amount of flights is increased, frequency of Passenger Transport Vehicles (PTV) can be increased or number of PTV's can be increased. operations can increase without effecting the main physical structure. Therefore it remains highly flexible in terms of design.

A disadvantage of the design is that it increases the passenger loading time since the passengers must be first on loaded onto a vehicle, then offloaded and onloaded onto the aircraft, this can lead to delays. Operating costs are also a factor important that the vehicles must be manned and maintained.

2.10 Determinants of Facilities in Passenger Terminal

Facilities that should be provided at a passenger terminal can be estimated using a variety of ways. This section will use a method to determine the facility.

2.10.1 Departue Curb

The data needed are :

A = number of passengers at busy hour (which will go)

P = proportion of passenges using private cars / taxi

N = average number of passengers personal drive / taxi

l = average length of curb required by private car / taxi

t = time use of curbs needed on average per private car / taxi

The formula of the length of departuecurb :

L = Ablt/60 = 0.095ap meter (+10%)

2.10.2 Departures Concourse The data needed are :

A = number of passengers at busy hour (which will go)

B = number of transit passengers

Y = average time per person which take passenger

S = required area per person (rn2)

O = number of people who take passengers

The formula to count the area needed for departures concourse is :

A = s y/60 * {3a(1+0)+b)/2

2.10.3 Check-in desks, centralized, common check-in

The data needed are :

A = number of passengers at busy hours (which will go)

B = number of transit passengers

Y = average usage time passengers processing (minute)

The formula to count the number of Check-in desks, centralized, commoncheck-in :

N = ((a+b)x t')/60 place (+10%)

2.10.4 Queue area to check in

The data needed are :

a = number of passengers at busy hours (which will go)

b = number of transit passengers

s = area required per passenger (m2)

50% of the number of passengers during rush hour came in the first 20 minutes

The formula to count the area of Queue area to check in :

$A = s \times 20/60 \times((3(a-b)/2 - (a-b))$

$= 0{,}25(a-b)$ m2 (-10%)

2.10.5 Departure Passport Control

The data needed are :

a = Number of passenger in busy hour

b = Number otranfered passenger

t = the length of time needed to control every passanger minute

Formula to count the number of officers needed :

$N = (a+b)t/60$ officer (- 10%)

2.10.6 Departure Lounge

The data needed are :

A = number of passengers at busy hours (which will go)

S = area required per passenger (m2)

U = average usage time per passenger to travel far (minutes)

I = proportion of passengers who traveled far

K = proportion of passengers traveling near

Formula to count the area of Departure Lounge needed :

A = s(cui/60-cvk/60)

= c((ui-vk)/30) ...m2 (-10%)

2.10.7 Security Check — Centralized The data needed are :

A = number of passengers at busy hours (which will go)

B = number of transit passengers

Y = capacity bag with the x-ray examination

W = number of bags per passenger

Formula to count the number of Security Check — Centralized needed :

N = ((a+b)w)/y

= (a+b)/300.... unit

2.10.8 Security Check - Gate Hold Room

The data needed are :

M = maximum number of seats o the aircraft that served gate

Y = capacity bag with x-ray inspection (piece hour)

W = number of bags per passenger

G = the first passenger arrival gate room before the room is STD (minute)

H = Period of time

Formula to count the number of Need for X-ray needed :

N = (60mw)/ y(g-h)....unit

2.10.9 Gate Hold Room

The data needed are :

M = maximum number of seats on the aircraft that served gate

S = area required per passenger (m2)

Formula to count the area Gate Hold Room needed :

A=m*s….m2

2.10.10 Arrival Health Check

The data needed is :

t = average service time per passenger existing facilities to serve all passengers B74 (450 passengers within 30 minutes)

Formula to count the number of officers of healhcek needed is :

N = 450 t/30

2.10.11 Paspor Control - Arrival

The data needed are :

D = number of passengers traveling during busy hour ending

number of transit pasengers who do not require

b = processing

t = average processing time per passenger

Formula to count the number of inspectors needed :

N-=((d+b)t)/60...inspectors

2.10.12 Queueing Area - Pasport Control - Arrival

The data needed are :

D = number of passengers traveling during busy hour ending

B = number of transit pasengers who do not require processing

S = space requirements per passenger (in2)

distance between checkpoints with each other, so that the queue length (average 1,8m) multiplied by the distance horizontal intercity passenger (0,55) = (1,00 m2) 50% the number of passengers during busy hour came in the first 15 minutes

Formula to count the area required :

A = s x 15/60 ((4 x (d+b)/2)-(d+b))...m2

= 0.25 x (d+b)... m2

2.10.13 Baggage claim Area

The data needed are :

E = number of passengers at busy hours (which would leave), including transit passengers both domestically and internationally

w = average usage time per passenger

s = area required per passenger (m2)

Formula to count the area required :

A = ews/ 60....m2

2.10.14 Arrivals Customs

The data needed are :

E = number of passengers traveling during busy hour to end,

including international or domestic passenger transit

f = proportion of passengers who perform customs inspection

t = average processing time per passenger (minute)

Formula to count the number of customs inspectors needed : N=(e x f x t)/60..persons

2.10.15 Area of Customs inspection queue

The data needed are :

E = number of passengers traveling during busy hour to end, including

interntational or domestic passenger transit

f = proportion of passengers who perform customs inspection

t = area required per passenger (m2)

Assumption distance between the counter to check in so that queue length (average 1,8m) multiplied by the distance required horizontal passenger (0,8) = (1,5m2)50% of the number of passengers busy hour came on 20 minutes the first

Formula to count the area required :

A=f x 20/60 x (3e/2 - e)...m2 (-10%)

2.10.16 Amount of baggage retrieval tool

The data needed are :

e = number of passengers traveling during busy hour to end, including international or domestic passenger transit

q = proportion of passengers that come with wide-bodied aircraft

r = proportion of passengers that come with a small body aircraf

y = trunk-making tool usage time per wide-body aircraft (minute)

z = trunk-making tool usage time per small-body aircraft (minute)

n = number of passengers per wide-body aircraft wiyh a load factor of 80%

m = number of passengers per aircraft being small with 80% load factor 80%

The number of tools required baggage :

Wide-body aircraft :N=eqy/60n

2.10.18 Curbs Arrival

The data needed are :

D = number of passengers traveling during busy hour ending

P = proportion of passengers using rivate car / taxi

N = average number of passengers per private car / taxi

L = average length of curb required by private car / taxi

T = time use of curbs needed on average per private car / taxi

Curb length rquired :

L=dplt/60n...meter (+10%)

2.10.19 Restaurant seating capacity

s = eating the maximum number of seats on the aircraft that served the airport

The number of seats needed :N=s ...seat(+10%)

CHAPTER III

RESEARCH METHOD

3.1 A Comparison of Airport Components

Chapter three is an introduction into the fundamentals of airport plans and planning. The chapter presents the theoretical material that is associated with airport and terminal planning. The chapter begins with an introduction to the key elements of airport planning. It then explores airport planning at a macro regional level and narows its focus to the planning of the passenger terminal building. At this stage it investigates the varying types of characteristics and internal components that the passenger terminal encompasses. The final section of the chapter lists and describes the four physical layouts that model al1 passenger terminal buildings.

3.2 Data

As the objective of this thesis is to analyze the final plans as well as the planning methodology associated with the planning and redevelopment of the passenger terminal building at Labraq Airport Libya. Five main questions frame the research for thisthesis :

(1) What type of terminal layout will the expansion consist of?

(2) Why was this space needed for the terminal?

(3) What planning theory is most prevalent in this case study?

(4) How to predict the space needed and what data should be presented?

(5) What is the overall impact onthe passenger terminal as a whole?

To answer all those questions, some primary and secondary data are needed. The primary data is taken by interview to the related authority of the Labraq airport those are vice president of planning and general manager and also some passengers at the airport. The primary data are about:

a. a brief of Historical review of the airport
b. operational activity in each department at the airport
c. airport future development planning, and
d. passengers’ response to the service of the airport and the flight.

The secondary data is taken by the official report of the Labraq airport that consists of data such as:

a. the number of passangers
b. the number of airplane
c. seat capacity
d. periodical flight
e. parking lot capacity for departure and arrival
f. width of terminal building
g. the number of employees

3.3 Background

In the past number of years, the airline transportation industry has changed significantly. Globally, the airline hub and spokesystem, the commercialization of the passenger terminal building, the introduction of the regional jet, air trafficcontrol, and airport congestion have been the leading factors in the redevelopment attempts at airports. Other major factors such as the rapidgrowth of travelers, the evolving airline demands coupled with new non-aviation revenue policies of airports have propelled airport planners to come up with more contemporary solutions to airport layouts and designs.

The Labraq airport landscape is coping with these global issues as well as two other major local factors that are forcing theremaping of Labraq airports. The two issues are: (1) The privatization of Labraq airports; (2)Labraq Airport open skies agreement. Recently a third issue of one majornational carrier has changed the future development plans of Labraq airports.

Over the past numberof years, Transport Libya the government division that oversaw al1the Labraq airports began to relinquish its administrative duties at the individual airport level.These dutieshave beentransferred to local semi public authoritative entities. This factor itself hasthrust the airports into a newmarket of competition,commercialism and unprecedented growth. The role of administration of theseairports is no longer basedsolely upon theoverseeing of aviation operations, but now includes the administration of competitive enterprises within an extremely competitive market.The new objective of profit makingand growth haschanged the outlook of the terminal building.

3.4 Data Gathering

To properly analyze the Abraq case study in comparison with the theoretical material tabled in the thesis, various research methods were used to accumulate the necessary quantitative and qualitative data.TheQuantitative datais related to numerical which relates to numbers of passangers, number of airplane, seat capacity, periodical flight, parking lot capacity for departure and arrival, width of terminal building, numbers of employees, and so on. Qualitative data is related to literature view, supporting sources, journals, and publication about theoretical review for this research. Apart from the texts, journals, newspapers, and other printed material, the Labraq situation wasresearched via four main avenues.

Focused interviews (Zeisel 1984, p. 137) were used on four main participants in the airport development process. Interviewees included:

1. Vice President of Planning for Labraq Airport.

2. Labraq Airline General Managers

A1l these participants were interviewed on multiple occasions during the ongoing planning process. This interview focused on the questions:

2. A brief of Historical review of the airport
3. Operational activity in each department at the airport
4. How many numbers of passangers, number of airplane, seat capacity, periodical flight, parking lot capacity for departure and arrival, width of terminal building, numbers of employees
5. Airport future development planning

Another avenue of information gathering wasa participant-observation study (Zelditch 62, p.568). In order to observe the concerns/actions of the sample of some random passangersas an "Informant" (Zelditch 1962,p.570)in order to know what they feel and want about the service and the facilities of the airport.

As mentioned in the foreword, being an employee at the airport for numerous years has allowed for the gathering of valuable information.

A substantial amount of the literature on airport planning is encompassed in literature dedicated to airport engineering and/or architecture. As late starters in this field, airport planners must continue to research and provide better insight into airport planning processes and development.

Later, the data gathered will be analysed and presented in the statistical table and also will be forecasted using multiple regression analysis. Besides, the writer will make a new layout of the proposed airport which is considering the principles of comfort, modern, and high value service based on the gathered data.Simple statistical model to predict the travel demand by plane in Labraq Airport is based on:

- population Growth,and
- growth of tourism industry.

CHAPTER IV

DATA

Inthis chapterwill discussthe datarelated to thenumber of passengers, number of aircraft, type of aircraftand the name ofthe airline thatoperatesas well asthe frequency ofdepartureand arrivalanddestination. Besides, thenumber of passengerswill be calculatedpredictionsforthe next 20 yearswill be the referencereconstruction ofthe terminalbuildingatLabrag.

Table4. Type of Airplanes, Airline Companies, Destination, Scedule and Total Number of Passanger in Labraq Airport

NAME of Airline	Type of Plane	Number of Seat	Direction	Trip	Day	Time Schedule	Number of Days in a Week	Total Passager in a Week	Average Number of Passager/ Car in a Week
Lybian Airline	CRJ	70	Tripoli--Labraq	2 ways	Sunday, Wednessday,	08:15 am (Tripoly to Labraq);	6	420	70
					Friday	10:30 am (Labraq to Tripoly)			
Boraq Airne	Boing 737	155	Tripoli--Labraq	2 ways	Saturday, Sunday, Monday,	02:00 pm (Tripoly to Labraq);	10	1,550	258
					Wenessday, Thursday	04:30 pm (Labraq to Tripoly)			
Lybian Airline	CRJ	70	Labrag--Tunisia	2 ways	Wednessday, Saturday	10:30 am (Labrag--Tunisia);	2	280	47
						12:30 am (Tunisia--Labraq)			
Total Passanger								2,250	375
Total Employee								60	60
Total number of pasenger Escorts*								4,500	750
Total People in the terminal**								6,810	1,135
Total Car come for escort and stay***								2,873	479

* Total Number of passanger Escortsby estimation that 1 person is escorted by minimum 2 person

**Total People in the terminal building is total pessanger plus total employee and plus total passager escorts

** Total number of Cars come for escort and stay is by estimation that every passenger escorted by 1 car and cars stayed belonged to employee and also taxi (25% from number of passanger)

Source : Operation Office of Labraq Airport Libya

Fromthe table above,it can be seenthatthere area total of2250passengersa weekoras many as375passengers a dayand60 employeesworking inLabraqairport.The passengerswill beescortedby afamily ortaxithereforenumber of passengers, employees andfamiliesof passengerscan reach6810peopleor1135peoplea week

Table 5. The Number of Flight and Passangger 2012 after the Revolution (in a week)

Month	Number of Flight in	Type of Flight	Number of Departure Passangger	Number of Arival Passangger	Total Number of Passangger
April	16	Domistic Flight	159	561	720
May	16	Domistic Flight	511	322	833
June	16	Domistic Flight	690	652	1,342
July	16	Domistic Flight	841	782	1,623
August	6	Domistic Flight	1,058	912	1,970
Sepetember*	20	Domestic & International	1,061	1,039	2,100
Oktober	20	Domestic & International	1,101	1,089	2,100
November	20	Domestic & International	1,129	1,121	2,250
*in September Start InternationalTrip to Tunisia					

Source :Labrag International Airport Report 2012

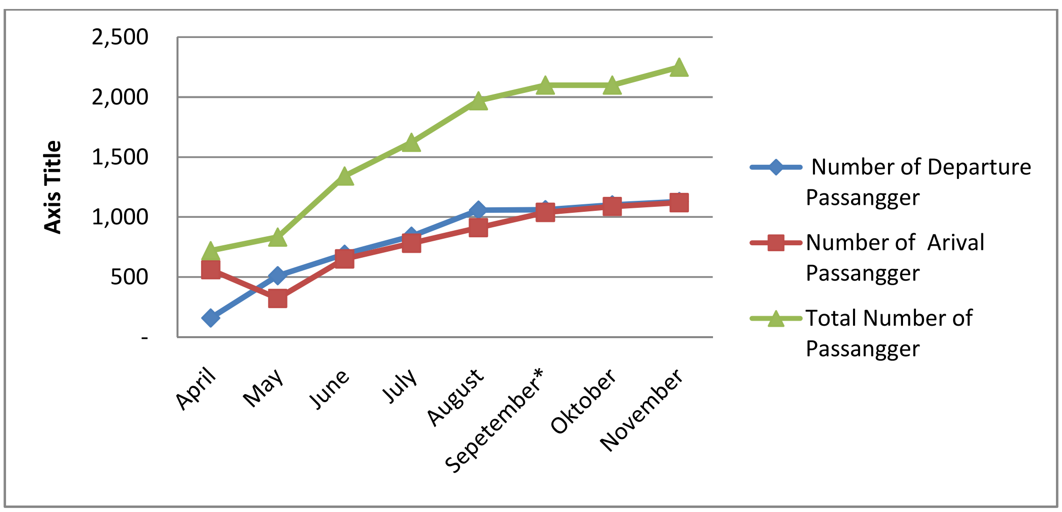


Chart 2. The Number of Passangger Flight in a week at Labraq in 2012 after Libya Revolution

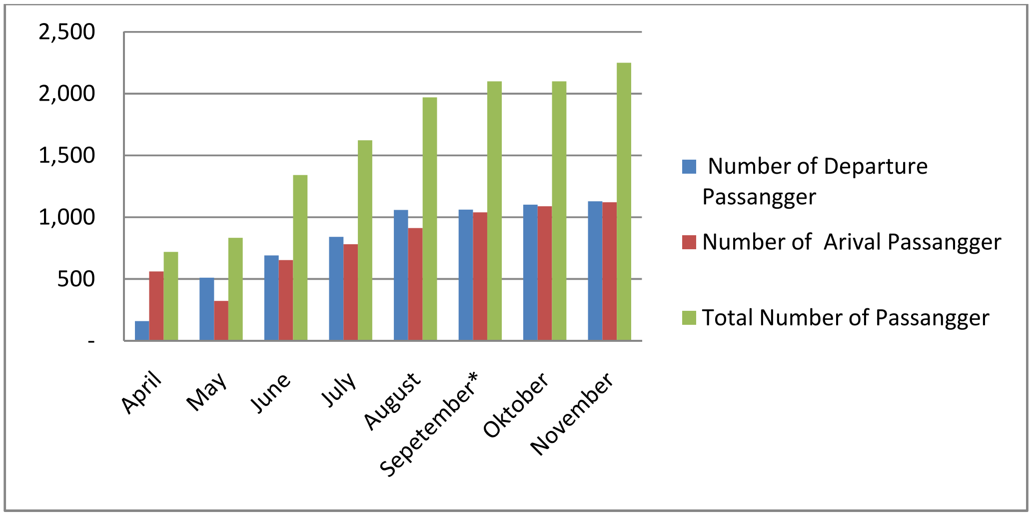
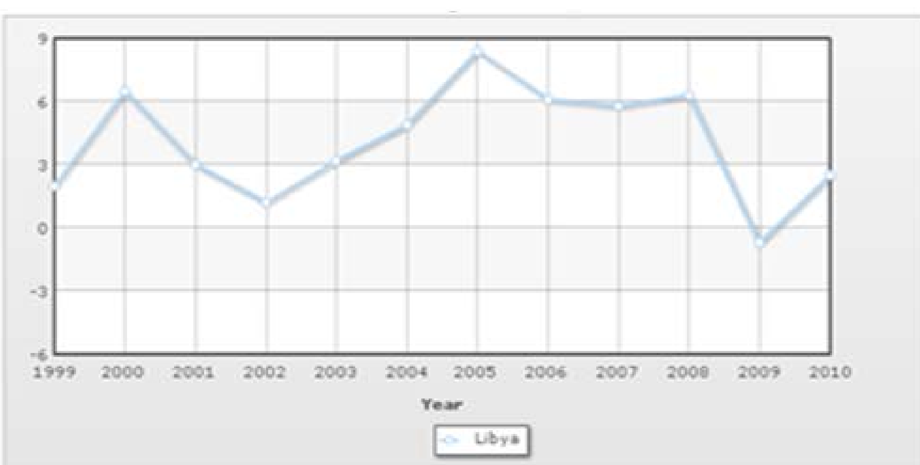


Chart 3. The Number of Passangger Flight in a week at Labraq in 2012 after Libya Revolution



Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Libya	2	6.5	3	1.2	3.2	4.9	8.4	6.1	5.8	6.3	-0.7	2.5

Chart 4. Economic growth

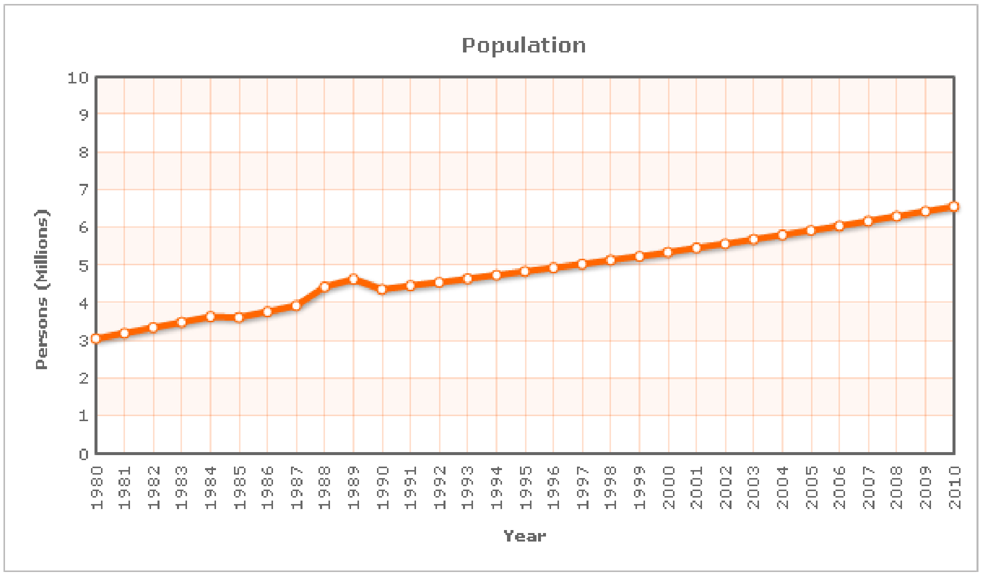


Chart 5. Population Growth

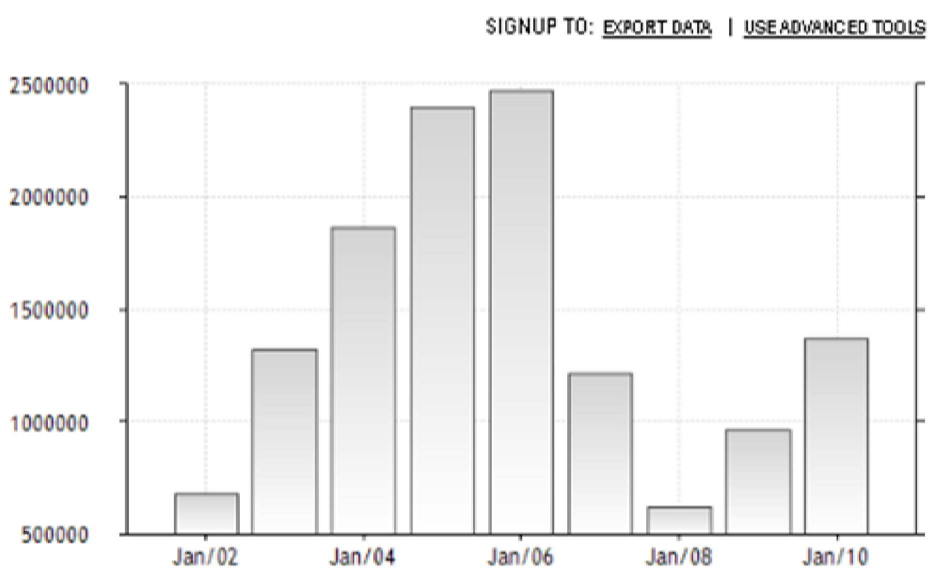


Chart 5. Tourism Industry growth

The growth of tourism industri especially in near Labrag is suported by some intersting tourisme object such as The ancient city of Cyrene Ancient Roman civilization in eastern Libya, Valleys Jihad of Sheikh Omar Al-Mukhtar who fought Italian for twenty years in the white city in eastern Libya (Cove Valley), the valley of Mark the Evangelist in East of Libya, Beach eastern Libya. The picture of the tourism objects are in the apendix.

Table 6. The Number of Tourism, Population, and Economic Growth (%) during 2005--2010

Year	Tourism	Population	Economic
2005	240,000	5,500,000	8.4
2006	250,000	5,600,000	6.1
2007	120,000	5,675,000	5.8
2008	110,000	5,800,000	6.3
2009	100,000	5,950,000	0.7
2010	140,000	6,000,000	2.5

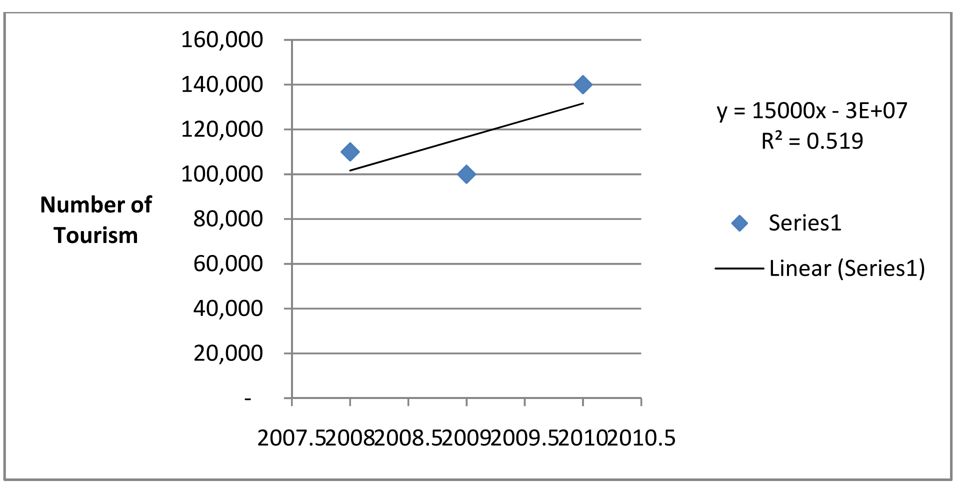


Chart 6. The Number of Tourism during 2005--2010

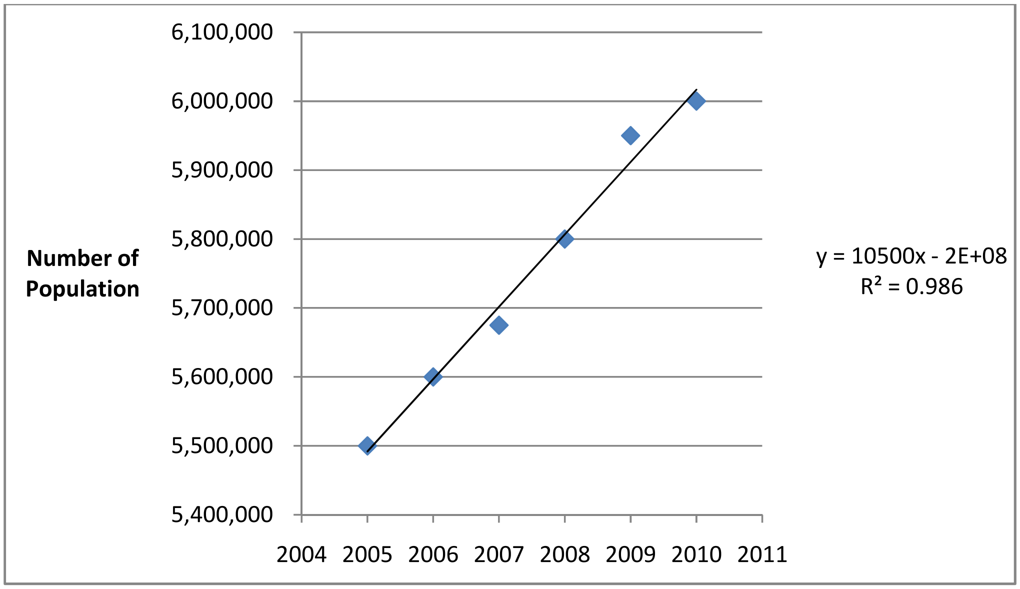


Chart 7. The Number of Population during 2005--2010

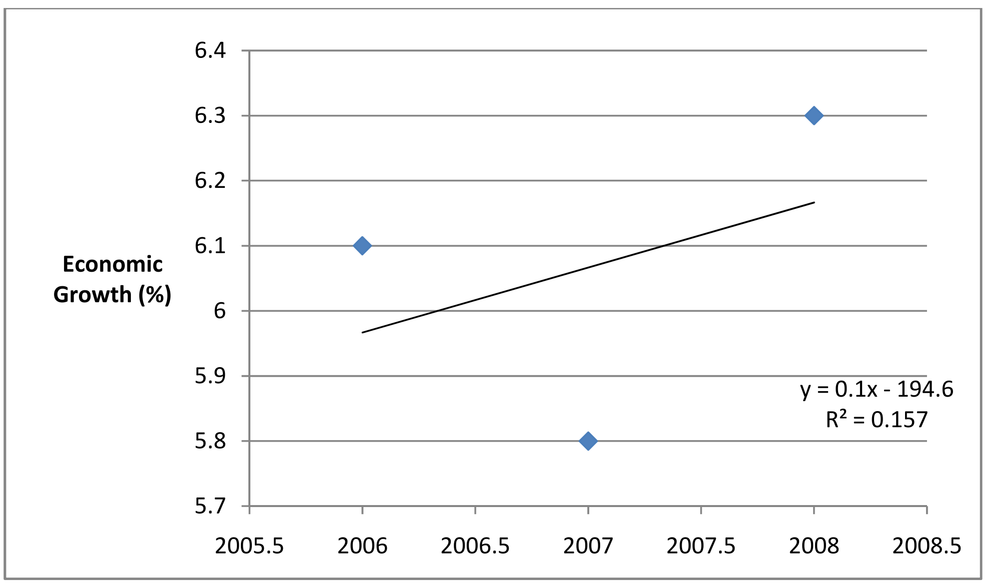


Chart 8. The Number of Economic Growth (%) during 2005--2010

Table 6. The Number of Future Passenger until 2032 in Labrag Airport

Year	No. Passengers
2013	95,862
2014	96,912
2015	97,963
2016	99,013
2017	100,063
2018	101,114
2019	102,164
2020	103,215
2021	104,265
2022	105,315
2023	106,366
2024	107,416
2025	108,467
2026	109,517
2027	110,567
2028	111,618
2029	112,668
2030	113,719
2031	114,769
2032	115,820

Source : Secondary data processed

The formula of regression to predict the next 20 years passengers is below:

$Y = a_0 + A_1X_1 + a_2X_2$

Y = Number of Passenger

X1 = Number of Tourism

X2 = Number of Population

Y = 32516.56+0.000461*X1+0.009938*X2

The number of passengers consisted of departure and arrival therefore the next terminal building considered with the number of departure passengers which is about 50% of total passengers. The existing terminal building is 30 m x 60m or only about 1800 m2 which could meet for 1250 passengers per week and 60 employ (about 178 people per day). Therefore with the prediction as the above table in the next 20 year the total passengers in 2032 will be 115,820 people in a year or about 317 passengers every day (effective work day is 7 days a week), or about 158 departure passengers every day. This means that minimum terminal building is about 1,8 times the existing building or 3240 m2.

Table 7. The Number Of Future Total Passengers And Total Departure Passengers In 2032 In Labrag Airport Yearly, Weekly, And Daily

Item	Year	yearly*	monthly**	weekly***	daily****
Total Passangger	2032	115820	9651.63	2412.9	344.7
Total Departure Passangger*****	2032	57909.76	4825.81	12064.5	172

Note :

* the number is from prediction by regression formula in table 6

** the number is from prediction passangger in a year then is devided to 12 months

*** the number is from prediction passanggermonthlythen is devided to 4 week

**** the number is from prediction passanggerweeklythen is devided to 7 days

***** the number is from half part of the number of passanggers

CHAPTER V

DISCUSSION

As it has been dicussed in the previous chapter that then the limitationsof the Labraq Airport are determined as follow: small terminal building, leak of facilities, all operation in the same place (terminal). Today, The characteristics for the local flight are scheduled to have only two flights each day in the morning and in the afternoon. In other words, there are only two departures and two arrivals from tripoli to Labraq vice versa and once a week flight from tripoli to tunis for departure and arrival. With the physical characteristic of the building are small cafeteria, small parking lot, no list for prayers, small toilet. These flight schedules only serve for 1600 people per week while the demand is more than 3000 people.

As the prediction as in chapter IV for 20 year the total passengers in 2032 will be 115,820 people in a year or about 143 passengers every day (effective work day is 7 days a week), or about 158 departure passengers every day. This means that minimum terminal building is about 1,8 times the existing building .or 3240 m2.

5.1.Area Square and the Number of Facilities ini Passenger Terminal

5.1.1 Departue Curb

The data needed are :

A = 1000 per day

P = 0.7

N = 1.7 passenger

1 = 6 meter

T = 1.5 minute

The formula of the length of departuecurb :

L= ablt/60=0.095ap meter (+10%) curb length required

L= 0.095 x 1000 x 0.7 = 67 meter (+10%)

L= 0.095 x 172 x0.7 = 11 meter (+10%)

5.1.2 Departures Concourse The data needed are :

A = 1000 passenger

B = 200 transit

Y = 20 minute

S = 1.5 m2

O = 1.5 person

T = 1.5 minute

50% of the number of passenger in the first 20 minutes

A = s(y/60) = 3(a(1+0)+b)/2 =m2

A= 1.5 x (20/60) x 3(1000(1+1.5)+200)/2=2,025.00m2

A= 1.5 x (20/60) x 3(172(1+1.5)+34)/2=348m2

5.1.3 Check-in desks, centralized, common check-in

The data needed are :

A = 1000 passenger

B = 200passeger

N = (1000+200)x2)/60 = 40 place (+10%)

N = ((172+34)x2)/60 = 7 place (+10%)

5.1.4 Queue area to check in

The data needed are :

a = 1000 passenger

b = 200 passenger

s = 1.5 m2

A = s x 20/60 x((3(a-b)/2 - (a-b)) = 0,25(a-b) m2

A = 0,25 x(1000+200) = 300 m2

A=0,25 x (172+34) =52 m2

5.1.5 Departure Passport Control

The data needed are :

A = 1000 passenger

B = 200 passenger

t = 0,3 minute

Formula to count the number of officers needed :

N = (a+b)t/60 officer (- 10%)

N= (1000+200)x0,3/60 = 6 officer (-10%)

N= (172+34)x03/60 = 1 officer (-10%)

5.1.6 Departure Lounge

The data needed are :

A = 1500 passenger

S = 0.2 m2

U = 50 minute

I = 0.6

K = 0.4

Formula to count the area of Departure Lounge needed :

A = s(cui/60-cvk/60) = c((ui-vk)/30) m2 (-10%)

N = (1500(50x0,6 +30x0,4)/30 = 2100m2 (+10%)

N= (172(50x0,6+30x0,4)/30 = 241 m2 (+10%)

5.1.7 Security Check — Centralized The data needed are :

A = 1000 passenger

B = 200 passenger

Y = 600 pieces/hour

W = 2 pieces

Formula to count the number of Security Check — Centralized needed :

N = ((a+b)w)/y = (a+b)/300 unit

N = (1000+200)/300 = 4 unit

N = (172+34)/300 = 2 unit

5.1.8 Security Check - Gate Hold Room

The data needed are :

Y = 600 pieces/hour

W = 2 pieces

H = Period of time

Formula to count the number of Need for X-ray needed :

N = (60mw)/ y(g-h)= 0.2 x (420/(50-5)) = 1.9 ~ 2 unit

5.1.9 Gate Hold Room

The data needed are :

S = 1 m2

Formula to count the area Gate Hold Room needed :

A= ms….m2

2.10.10 Arrival Health Check

The data needed is :t = 0.17 minute

Formula to count the number of officers of healhcek needed is :

N = 450t/30 = 2.55 ~ 3 officer

5.1.10Paspor Control - Arrival

The data needed are :

d= 1000 passenger

b = 200 passenger

t = 0.5 minute

Formula to count the number of inspectors needed :

N = ((d+b)t)/60 = ((1000+200)x0.5)/60 = 10 officer (-10%)

5.1.11Queueing Area - Pasport Control - Arrival

The data needed are :

D = 1000

B = 200

S = 1 m2

distance between checkpoints with each other, so that the queue length (average 1,8m) multiplied by the distance horizontal intercity passenger (0,55) = (1,00 m2) 50% the number of passengers during busy hour came in the first 15 minutes

Formula to count the area required :

A = s x 15/60 ((4 x (d+b)/2)-(d+b))...m2 = 0.25 x (d+b)... m2

A = 0,25 x(1000+200) = 300m2

5.1.12 Baggage claim Area

The data needed are :

E = 2500 passenger

w = 30 minute

s = 1.8 m2

Formula to count the area required :

A = ews/ 60....m2 = ex30x1.8/60 = 0.9xe m2 (+10%)

A= 0.9xe = 0.9 x 2500 = 2250 m2 (+10%)

5.1.13 Arrivals Customs

The data needed are :

E = 2500 passenger

f = 0,25 proportion

t = 2 minute

Formula to count the number of customs inspectors needed :

N = (e x f x t)/60..persons

N = (2500x0,25x2)/60 = 20.833333 ~21 officer

5.1.14 Area of Customs inspection queue

The data needed are :

E = 2500 passenger

f = 0,25 proportion

t = 1,5 length

Assumption distance between the counter to check in so that queue length (average 1,8m) multiplied by the distance required horizontal passenger (0,8) = (1,5m2)50% of the number of passengers busy hour came on 20 minutes the first

Formula to count the area required :

A=f x 20/60 x (3e/2 - e) = 0.25ef m2 (-10%)

A= 0,25 x 2500 x 0,25 = 156.25 ~ 156 m2

5.1.15 Amount of baggage retrieval tool

The data needed are :

y = 45 minute

z = 20 minute

n = 320 passengers

m = 100 passengers

The number of tools required baggage :

Wide-body aircraft :

N=eqy/60n = eq/425

2.10.17

D = 1300

B = 200

O = 0,.7

A = 0,7 x (1300+200x1300x0,7) = m2 (+10%)

51.16 Curbs Arrival

The data needed are :

D = 1300 passenger

P = 0.6

N = 1.7 passenger

L = 6,5 meter

T = 1,5 minute

Curb length rquired :

L=dplt/60n = 0,095 dp meter (+10%)

L = 0.095 x 430 x 0,6 = 25 meter (+10%) ~27 m'

5.2 The Design of Labrag Airport Terminal Buildings

It will bedesign and built of 3600 m². Airport construction includes terminal building, plot landscaping & infrastructure and apron connection.

Labraq International Airport is situated 19 miles (30km) south of Labraq, the capital and the largest city of Libya. Labraq International Airport is a public airport operated by the Civil Aviation and Meteorology Bureau of Libya.

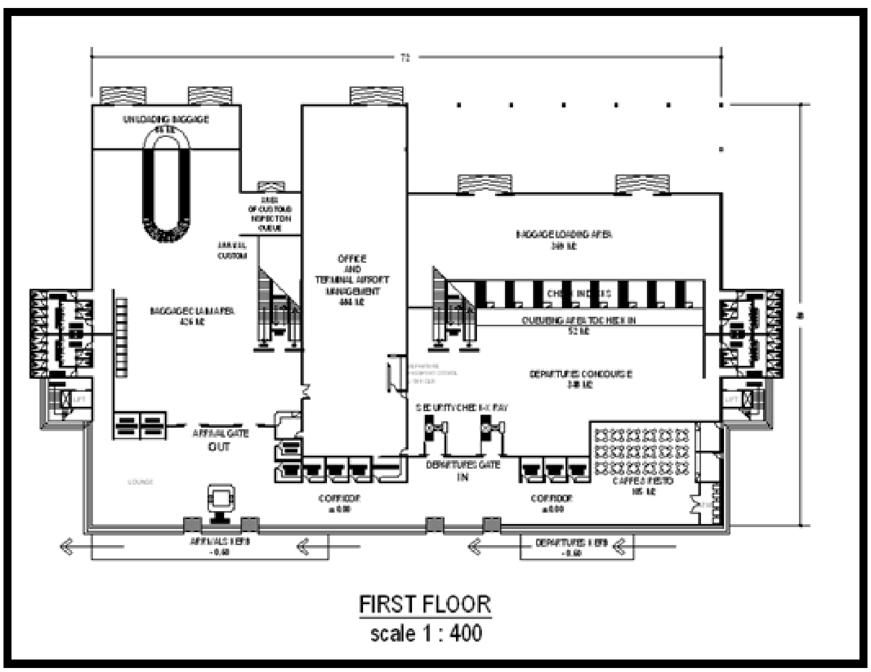


Figure 8. Design 1st Floor Terminal Building of Labraq Airport

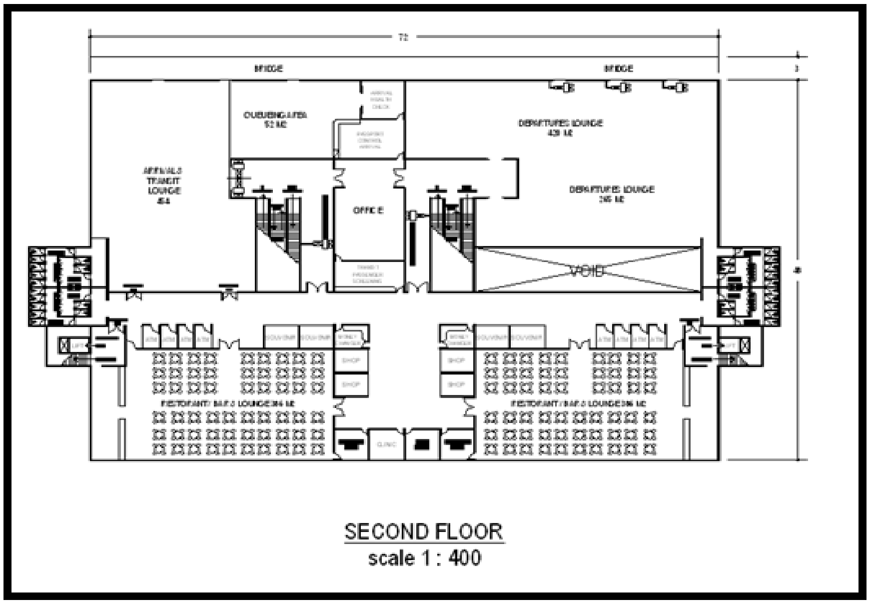


Figure 9. Design 2nd Floor Terminal Building of Labraq Airport

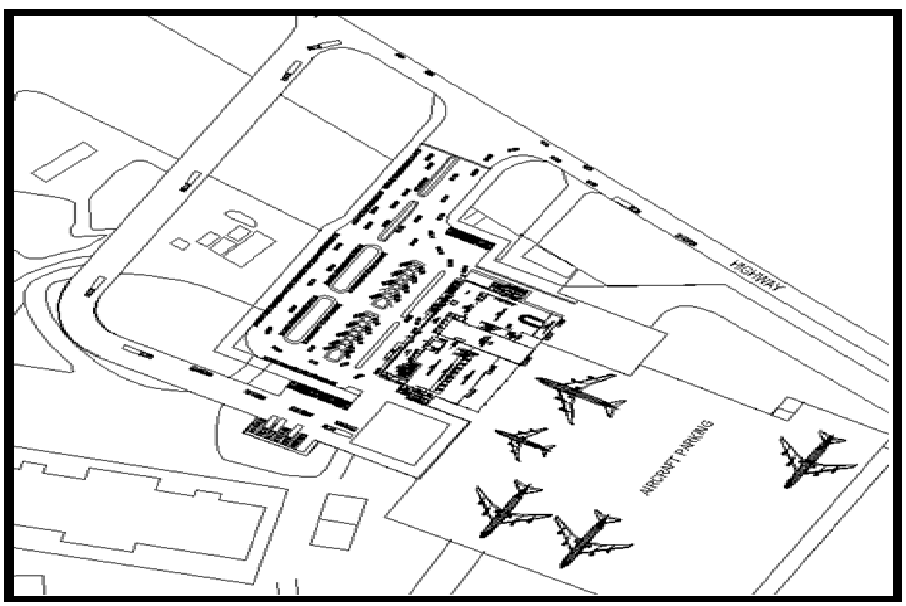


Figure 10.Site Plan of Terminal Building of Labraq Airport

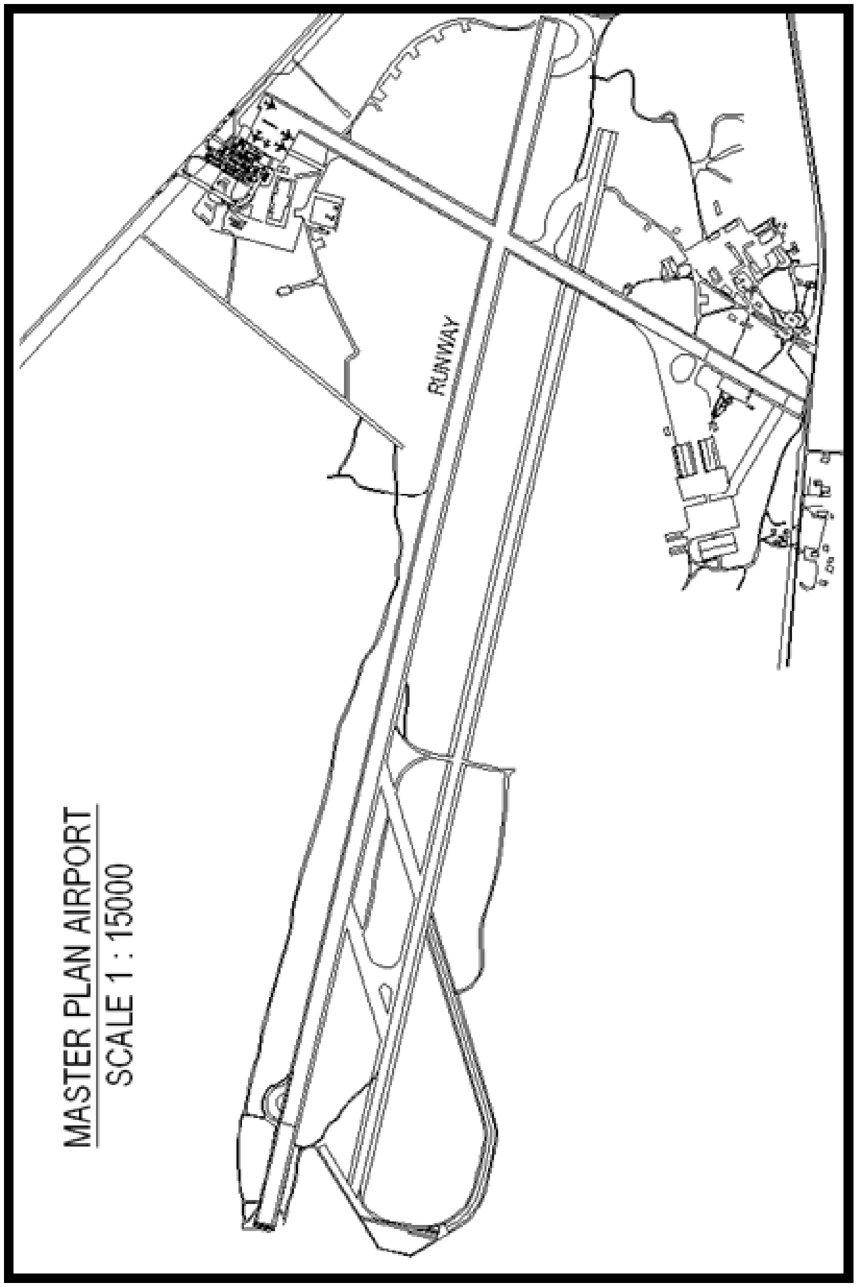


Figure 11. Site Plan of Terminal Building of Labraq Airport

CHAPTER VI

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

The conclusion that can be drawn as follows :

1. The objective of this research is reconstruction of the terminal building for Labraq airport to be more comfortable and more modern and to quantitatively evaluate the characteristics of the airport passenger terminal configurations those are available in airport theory literature.
2. The problem is that the airport does not have the specifications due to old building built in 1967 or already 45 years, not modern,the small size of the passenger terminaladministration, departure halls, reception rooms, security and baggage claim conducted in one small building which causing obstruction of the work**.**
3. Simple statistical model to predict the travel demand by plane in Labraq Airport is based on - population Growth, and- growth of tourism industry.
4. The prediction as counted for the next twenty year the total passengers in 2032 will be one point eighttimes from the existing passanggerwhich his means that minimum terminal building is about one point eighttimes the existing building .
5. The new design for terminal building according to number of passenger and all aspect of comfort and also modernity into two floor

include large parking, cargo (outside), inside (lift, a lot of toilet, new bigger baggage claim, atm machine, money changer, three restaurant, a lot of shop.

6. Special cargo is designed with private way to make passenger with a lot of carrying easy to bring them in plane.
7. Big parking lot is also designed to make escorter's car and taxi easily park in the airport.
8. Big lobby completed with executive lounge, a lot of shop and three restaurant is also designed to make passengers comfortable and more enjoy while waiting his flight

5.2 Recommendation

Some recommendations are as follows:

1. For government and authority of Labraq airport, this result of thesis could be reference to reconstruct to Labraq Airport.

2. By examining the goals and powers of various airport stakeholders, it becomes clear that the validity and usefulness of various flexible solutions differ not only on the basis of the particular airport but also on the basis of the airport actors. Whereas international organizations are well poised to change the language of airport planning, national and regional groups have the power to enforce change and to pursue real options "on" airport systems by promoting landbanking, maintaining development options, and supporting comodality. Airport owners, planners, and managers, however,

are uniquely positioned to apply flexible planning methods to specific engineering decisions by employingmodularity and multi-functionality.

3. Finally, the thesis' provide for rapid comparison between simple airport construction strategies and can prove useful within pedagogical contexts. More important, the models demonstrate methodologies for analyzing flexibility and highlight the benefits which real options can offer to airport development projects worldwide. Through hypothetical analyses of the New Labrag International Airport, it therefore becomes clear not only that real options can have positive implication for air transport planning, but also that the proper evaluation of real options strategies can become commonplace.

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