# A New Experience for Passenger Flow at U-Tapao airport

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## Abstract

The passenger flow is one of the solutions that could prove a good flow and provide a good experience for airport passengers. For this purpose, the researchers studied the passenger flow in the airport terminal to determine passenger flow criteria for providing the U-Tapao airport terminal prototype concept. The researchers used passenger flow theories to analyze a movement flow to determine the passenger flow criteria for the prototype criteria and test with U-Tapao. The U-Tapao prototype concept significantly benefits the passenger flow and provides a new experience from a good flow, that is, a direct route, short walking distance, and space with signs to provide better wayfinding orientation. The study's results provide a good flow criterion of the passenger flow that can adapt to design or develop the airport terminal. Also, it evaluates the movement flow of passenger performance.

***Keywords*****:** *Passenger Flow, Terminal Operational, Airport terminal, Prototype, U-Tapao*

## 1. Introduction

Passenger flow is a critical success key driver to provide taking an impressive experience of a passenger at the airport terminal and take them to the destination faster. The flow is not depending on just only suitable signage position or information in the signage, This would be organization element of architecture such as planning, the components of the airport terminal, the relationship of function departure, arrival and transit, space orientation, and route direction. Passengers should be impressed when they are in the terminal building also drop off and pick up passenger space. If the passenger flow has excellent performance, it will provide an impressive experience to the passenger.

The general airport terminal often considers airport management, concession area, or facilities but not often relates to the significance of the flow of the passenger. In this result, some of the airports still have similar problem airports such as passenger overcrowd, many decision points, unclear signage, long walking distance, unknown wayfinding, etc (National Academies of Sciences, Engineering, and Medicine, 2008). This problem has happened in many airports to impact provide effect unimpressive feeling and effect to passenger feel unsafe when entertaining at the airport. Hence, The airport terminal would be a safe place for the passenger and consider passenger flow that general airport terminal should be. This problem could help by a terminal operational guide to increasing the performance of the flow. U Tapao is the one that has high potential to be a secondary airport terminal and the new gate of Thailand by the government policy also the physical location. The policy was support in part of the business and tourist, connect public transportation to the capital city (EEC Eastern Economic Corridor, 2019).

## 2. Objectives

1) To study the passenger flow theories in the airport terminal
2) To determine passenger flow criteria
3) To determine the U-Tapao airport terminal prototype concept

## 3. Materials and Methods

The author has interested in organizing passenger flow in an airport terminal and using Terminal operation tools. This theory is a standard guideline to develop the passenger flow (Figure 1) and describe the process that is used in a case study to follow the process (Figure 2).

3.1 Conduct a literature review on the Terminal Operational guide to the study and analyze the passenger flow at the airport terminal.

3.2 Collect significant data by studying a terminal operational guide. Identify data by specific in part of the architecture organization, space, and passenger needs with suitable airport terminal case study.

3.3 Review case studies and theories for synthesis criteria to provide an alternative prototype.

3.4 Collect alternative prototype for U-Tapao airport by potential and target group fact.


**Figure 1** The main issue of the Terminal operational guide graphic

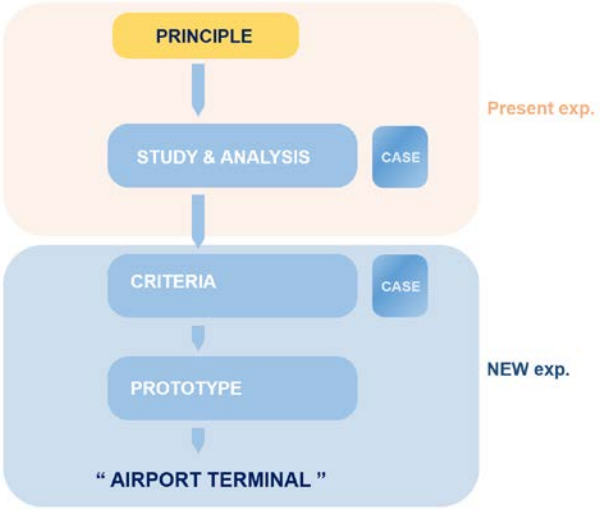



**Figure 2** The process to follow in the terminal operational guide diagram

## 4. Results and Discussion

4.1 "Best practice paper that brings together existing experience on passenger flow measurement solution and provides a guideline for airports" (ACI Worlds Airport IT Standing Committee, 2015). The paper presented the solution to finding the Terminal operational that standard guide that considers on passenger flow and must be used with tacking sensors in terminal to provide raw data (The result would be about metrics number to calculate performances of the flow. For this reason, it should consider significant relevant fact from the theories for being a factor for analyzing the case study and change the kind of result to be an architectural part but the relevant not include passenger needs. There are five main significant relevant data to consider are;

4.1.1 Waiting time

The retrospective waiting time is the time passenger have to wait in the queuing area before they left. The predictive waiting time is the expected time passenger will have to wait in the queuing area when he enters the area (ACI Worlds Airport IT Standing Committee, 2015).

4.1.2 Process though

The process through is the average throughput count of a process point per time interval (ACI Worlds Airport IT Standing Committee, 2015).

4.1.3 Show-up profile

The uses BCBP scanners capable of reading both paper and mobile BCBPs. The comparison of the timestamps of scans and relevant flight data from the AODB gives a show-up profile (ACI Worlds Airport IT Standing Committee, 2015). It means that the passenger scan process including security and immigration check process.

4.1.4 Queue length

The queue length indicates the number of people in the indication area (at the end of the queuing area) greater than a threshold for predefining the minimum time a queue length overrun. (ACI Worlds Airport IT Standing Committee, 2015). On the other hand, it can be indicated by counting of passengers in each area

4.1.5 Area occupancy

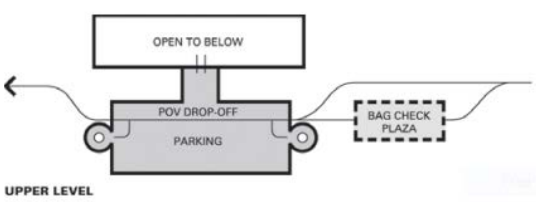
The area occupancy is typically defined as the number of passengers in a pre-defined area. From this, it is easily possible to calculate a density of passenger in an area by dividing the number of passengers in the pre-defined area by its square meters" (ACI Worlds Airport IT Standing Committee, 2015) This area indicates the density area that passenger was pass though

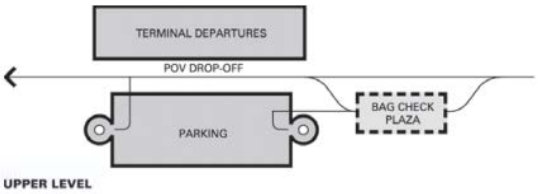
"The scope of the document is on a technical solution that does not assume ab explicitly cooperative passenger behavior" (ACI Worlds Airport IT Standing Committee, 2015) these theories do not assume an explicitly cooperative passenger behavior. In this result, the author had to use another research document that was considered passenger behaviors to provide a clear result.

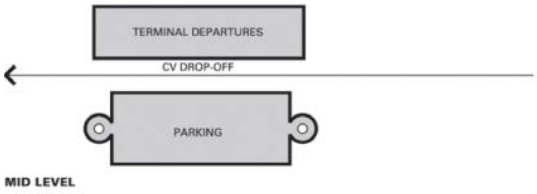
4.2 In the study of another research for considering cooperative passenger behaviors, the document research is an innovation of airport facilities and it has created an alternative prototype concept with a summary criteria table. The document has categorized part of the function to be three parts are transit, departure hall, and arrival hall by different needs of passengers in each function. "The innovation developed thought this research effort are a combination of existing approaches that have not been widely implemented and of a new method for improving the passenger experience and enhancing operational efficiency". The alternative would consider relevant to passengers needs but the criteria summary table not include a terminal operational guide in each function (National Academies of Sciences, Engineering, and Medicine, 2008)

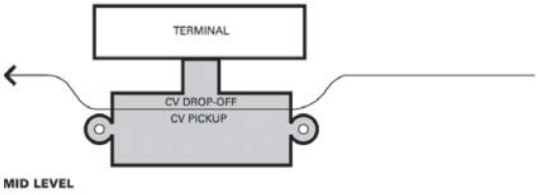
4.2.1 Transit

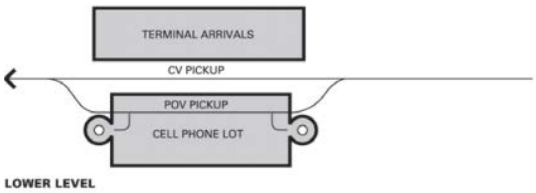
The alternative consists of several features and configurations that would be numerous variables but not include goals of the airport and terminal operational. It was relevant on vehicle parking, curbside facilities, and improve passenger service. The five alternative prototype concept that was created by relevant on private owner vehicle (POV) and commercial vehicle (CV) space (Figure 3), the relationship of each function (National Academies of Sciences, Engineering, and Medicine, 2008). The result of the alternative concept has different relevant conditions in each concept but it considers passenger flow and needs of passenger and summary table (Table 1) would show the benefits that alternative was considered.

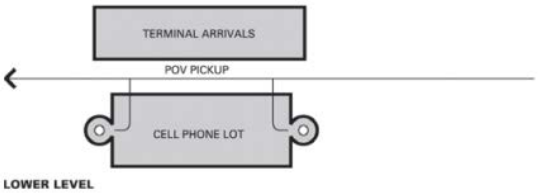


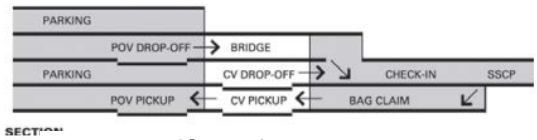



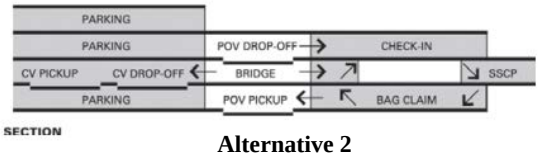



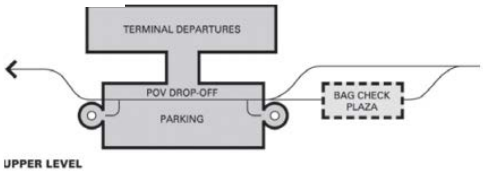



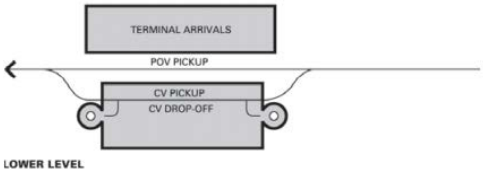



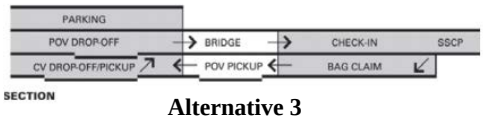

**Alternative 1**




**Alternative 2**




**Alternative 3**

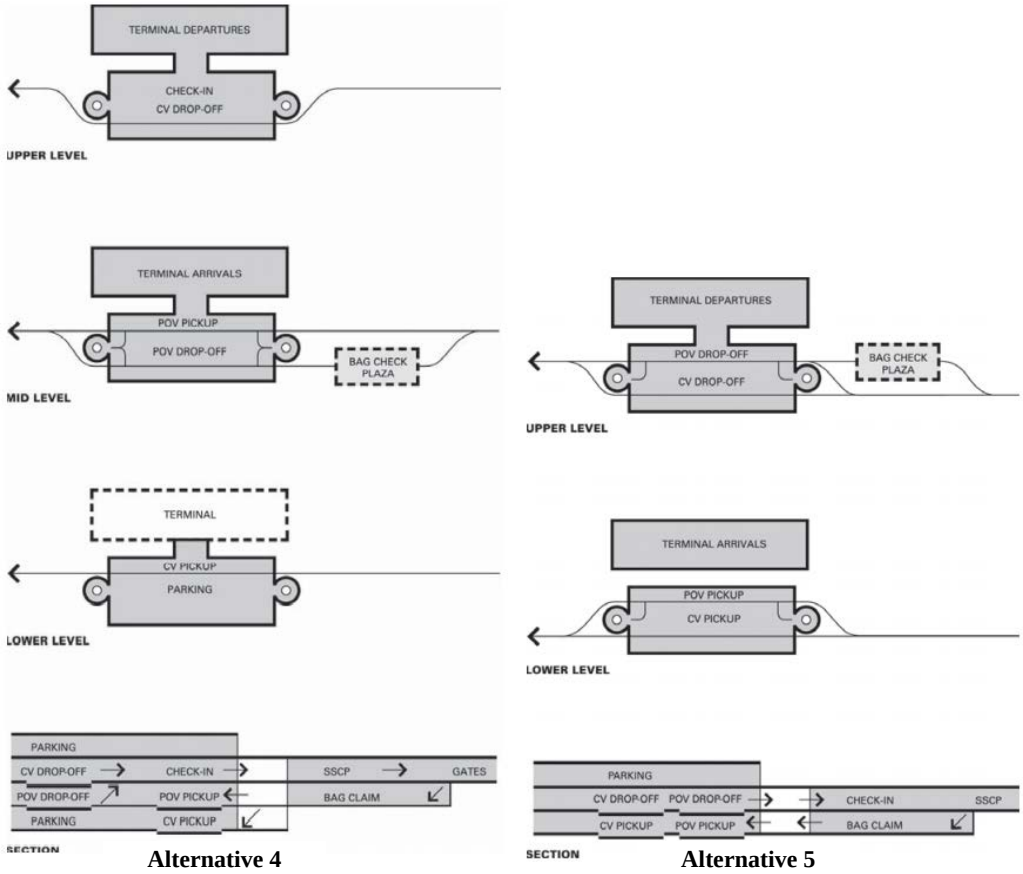



**Figure 3** Transit alternative evaluation diagram from Innovation for airport terminal facility. (National Academies of Sciences, Engineering, and Medicine, 2008)

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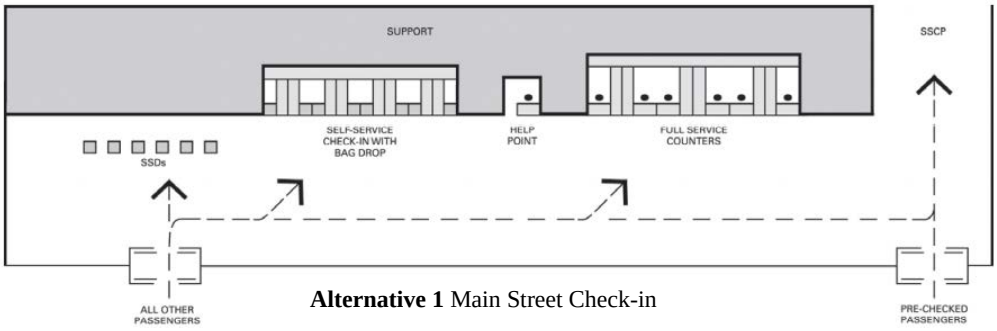
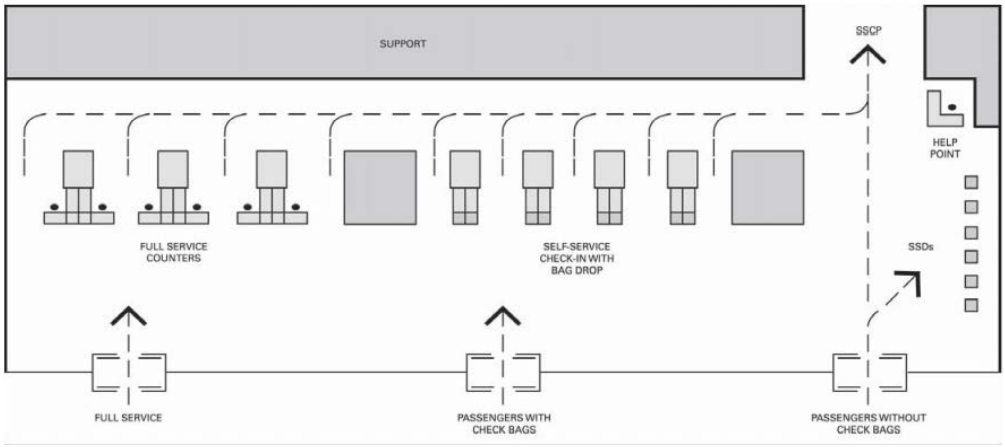
**Table 1** Transit alternative criteria evaluation from Innovation for airport terminal facility. (National Academies of Sciences, Engineering, and Medicine, 2008)

4.2.1 Departures Hall

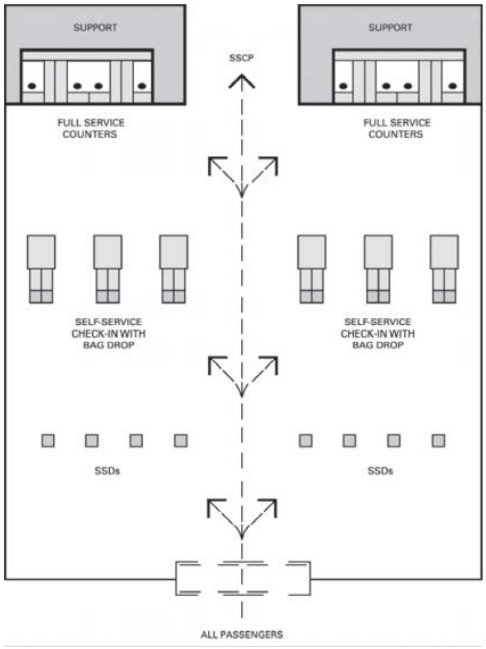
A passenger categorize could be providing multiple needs of each passenger type. In the departure hall, the passenger has multiple solutions to get a boarding pass and go to the next process. Hence the departure should be a separate type of check-in service such as; self-check-in without baggage, self-check-in with baggage, full-service check-in with baggage, and full-service check-in without baggage. These alternatives (Figure 4) presented the different positions of the check-in service process, it has separate three types of check-in service to be full service, self-service with bag drop, and self-service without bag drop. Five alternatives provide an easier and fastest route in each kind of service by different conditions (Table 2).




**Alternative 1** Main Street Check-in




**Alternative 2** Three-lane Check-in diagram




**Alternative 3** Three-stage Check-in diagram



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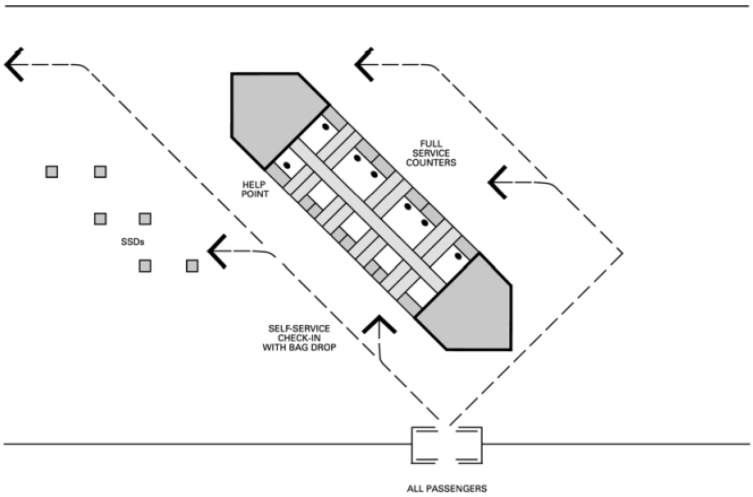


**Alternative 4** Directional Check-in diagram

**Figure 4** Diagram of Departure alternative evaluation from Innovation for airport terminal facility. (National Academies of Sciences, Engineering, and Medicine, 2008)

**Table 2** Departure alternative criteria evaluation from Innovation of airport terminal facility. (National Academies of Sciences, Engineering, and Medicine, 2008)

4.2.2 Arrival Hall

Arrival passengers could pass through the security check process and be affected by the security exit. The multiple exits help distribute passenger traffic routes but it makes passenger difficult to know where the entrance to departure hall (Figure 5). From the passenger perspective, a single entrance was simplified wayfinding and could be directly in the entrance (Figure 6)

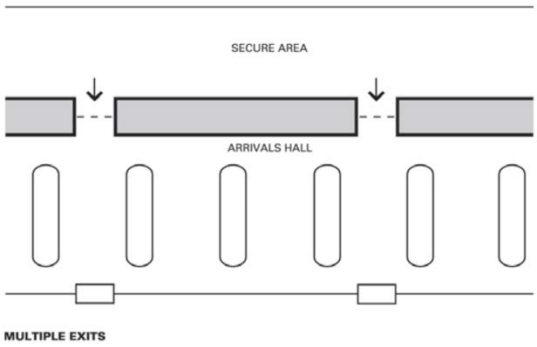


**Figure 5** Multiple entrance diagram from Innovation for airport terminal facility.
(National Academies of Sciences, Engineering, and Medicine, 2008)

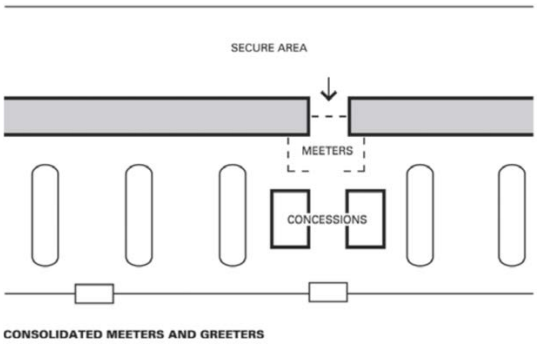


**Figure 6** Single entrance diagram from Innovation for airport terminal facility.
(National Academies of Sciences, Engineering, and Medicine, 2008)

4.3 For case study and analyst, it must select three cases that be suitable airport terminals to do in the next step. The condition to select the case would be airport terminal 2020 awards ((Skytrax, 2020). The first case is Changi international airport, the airport that taking a positive experience for the passenger. The second case is Haneda International airport, the airport that provides a good facility for the passenger (Skytrax, 2020). The last case is Suvarnabhumi airport (the main airport of Thailand) to know the terminal potential in Thailand. Facts to analyst would be;

4.3.1 Path

Study passenger path to know the waiting area, queue length area, area occupancy, the crossing path that provides decision point and walking length, Area that should have signage to tell wayfinding.

4.3.2 Process thought

Study a count of processes in each function to finding a better solution for the passenger.

4.3.3 Terminal elements configuration

Study the function configuration, relation, and building layout in section and plan.

The results of the analysis would be Suvarnabhumi airport (Thailand) and Haneda airport (Japan) significant to tourist passenger but Changi airport (Singapore) consider to business travelers. The architecture organization in each airport would be different cause the type of passenger has different such as; tourist passenger needs large space for counter check-in in departure hall and bag climb hall, Space in departure and b ag climb hall would be larger than arrival hall. For the Business passenger, directly transit area to departure hall and arrival hall considering on express wayfinding.

4.4 In part of providing criteria would be merging alternative concept from the Innovation of airport terminal facility and terminal operational guide. Keep structure concept and develop with the terminal operational and passenger needs but the criteria must to different relevant considering in each function. A condition to select the alternative prototype concept should consider on potential in each airport, type of passengers, and condition of each airport to provide a suitable concept. The three significant functions that were separated and merge the terminal operational concept to the previous concept are;

4.4.1 Transit

A table was merged terminal operational with the previous concept (Table 3).

**Table 3 3** The table indicate alternative criteria for transit (significant on passenger flow)

| | Alternative | | | | |
|---|---|---|---|---|---|
| Passenger criteria | **1** | **2** | **3** | **4** | **5** |
| *1.Walking* | ○ | — | — | ○ | ● |
| *2.Number of level change* | ○ | ○ | ○ | ○ | ● |
| *3.Wayfinding Orentation* | ● | ● | ○ | ○ | — |
| *4.Reduce cluster point* | — | ○ | ○ | ○ | — |
| *5.Process though* | ○ | ○ | — | ● | ○ |
| *6. POV Transit* | — | ● | ● | ○ | ○ |
| *7.CV Transit* | ● | ● | ○ | ● | ○ |

● *Significant benefits* *POV-Private owner vehicle*
○ *Marginal benefits* *CV-Commercial vehicle*
— *No considerable benefits*

4.4.2 Departure Hall

A table was merged terminal operational with the previous concept (Table 4).

**Table 4** The table indicate alternative criteria for departure (significant on passenger flow)

| Passenger criteria | Alternative 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| *Hall depth* <15 m.* | ● | — | — | — |
| *Hall depth* 15 m. > 25 m.* | ○ | ● | — | ○ |
| *Hall depth* > 25 m.* | ○ | ○ | ● | ● |
| *Single-level terminal* | ● | — | — | — |
| *Multi-level terminal* | ● | ● | ● | ● |
| *Waling Distance* | ● | ● | ○ | ○ |
| *Wayfinding Orentation* | ● | ● | ● | ○ |
| *Process though* | ● | ● | ○ | ○ |
| *Queue lengh* | ○ | ● | ● | ○ |
| *Tourist travelers* | ● | ● | ● | ○ |
| *Bussiness travelers* | ● | ● | ● | ● |
| *Major renovation* | ● | ○ | — | ● |
| *New construction* | ○ | ● | ● | ● |

● *Highly relevant*
○ *Relevant but not optimal*
— *Not a consideration*
* *Departure hall depth is the depth of the space availabe for circulation and check-in function*

4.4.3 Arrival

In the innovation airport, the terminal facilities concept explained a suitable concept for the passenger is single entrance cause it providing better space orientation to the arrival hall.

4.5 For U-Tapao airport terminal would be significant benefits on Business passenger and group tourist cause of the potential and government policy (EEC Eastern Economic Corridor, 2019). A business passenger often comes to the airport by POV and the CV type still considers a benefit. In departure hall, alternative 2 is suitable with the potential of the airport and type of passengers. So, the result would be to select alternative 2 for transit, alternative 2 for departure hall, and single entrance (Figure 7).

4.5.1 Transit

The transit alternative was selected is alternative 2 (Figure 3) by a factor of passenger behavior and type of passenger. Alternative 2 was a separate type of transportation and the functional relationship that provide a direct route to each type of passenger by separate public transportation and private transportation.

4.5.2 Departure

The departure alternative was selected is alternative 2 (Figure 3) by categorizing the check-in process. The check-in process could separate self-service and full-service to provide a faster route to get a boarding pass, reduce passenger overcrowd in each check-in type and passenger can choose a better choice to them for check-in. The full-service was taken times more than another type of service counter and could be the overcrowded route, so in this zone should to separate zone from the self-service area.

4.5.3 Arrival

The arrival alternative is a single entrance. Circulation would be a separate direct main entrance to the exit and separate passenger that want to get baggage from bag claim. A single entrance should provide an easy meeting point when a passenger has arrived at the airport and it also reduces confusion in the arrival hall.


**Figure 7** U-Tapao terminal prototype diagram

The discussion result in the three alternatives that were selected, it provides the primary criterion of passenger flow e.g., walking distance, number of level change, wayfinding orientation, and process though. In part of transit hall, it should concern about POV and CV transit for a support criterion to provide suitable condition to a passenger. Departure hall should concern with a proportion of the type of passenger (Business travelers and tourist travelers) to support passenger needs in each type. A process check-in in departure hall is the one of importation condition because it can provide a fast process to get a boarding pass. The major renovation and new construction would be a condition to pick the alternative. Arrival hall should to several exits to provide easy meeting point wayfinding and separate get baggage passenger and direct to exit passenger. In addition, the alternative could provide a suitable direct route that bases on U-Tapao potential, better wayfinding orientation, would be turn space to signage to guide direction, better process thought, and short circulation.

## 5. Conclusion

The U-Tapao airport terminal prototype was selected by an alternative prototype from the synthesis of passenger flow to provide a direction walk route in each function, such as excellent space orientation, easier wayfinding, reduced passenger overcrowd in some areas, and suitable functionality for the multiple passenger types. A flow performance would be increased and will provide a new experience for the customer at the airport. The prototype was selected based on the airport's potential, and in this case, U-Tapao has ECC police to support (Ref.) to provide future potential that will be in the future.

5.1 Transit

The prototype was selected for its significant benefits for POV and CV passengers, which causes the police to connect the CV passengers to the capital city and an economic plan that will provide the POV to support business travelers.

5.2 Departure

Cleary check-in lanes by separating types of check-in processes would be better for U-Tapao passengers due to the potential of having international flights is more than domestic flights. Thus, if the passenger can choose a better check-in solution, it would be better and faster.

5.3 Arrival

In fact, of many numbers of flights and number of passengers per hour, the exit should express itself and a single exit would be better to find a meeting point.

## 6. Acknowledgements

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