Evaluation of factors affecting air cargo terminal operation performance during COVID-19

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Abstract
COVID-19 affecting to aviation industry in many aspects, not only in passenger side, but also in air cargo. This crisis impacts a lot on air cargo capacity due to the change in actual flight movements. The operation process needs to be change according to the new law and regulation and to comply with WHO. The problem raised when volume of air cargo is unstable which affect to management planning. This paper analyzed (1) how pandemic disease impact shipping and cargo operations and (2) Significant factors affecting to air cargo terminal process due to COVID-19. Evaluating the factors that has a significant impact to air cargo terminal operation performance is main contribution for this paper. Using MCDM technique, Best-Worst Methods, to identify and rank the factors. As a result, Manpower and Handling process are the top factors affected from pandemic disease. To answer the research questions, this paper revealed two contributions; First the industry would understand the current situation and the factors that need to be solve first. Second, this paper also provides the policy and practice for practitioner in order to utilize air cargo capacity.

Keywords
Air Cargo operational performance, Logistics, COVID-19, Risk and Best-Worst Method.

1. Introduction
During the pandemic situation, the number of passenger and cargo is decreasing due to the country regulation. According to IATA (2020), Industry-wide cargo tonne-kilometres (CTKs) fell by 6.6% year-on-year in November 2020 and Belly hold cargo capacity fell by 53.0% Year over Year (YoY) in November 2020. While actual dedicated freighters increased slightly, airline were unable to match the increase in demand for the peak season due to limited fleet size and several specific operating issues (IATA, 2020). In case of Asia Pacific, international traffic within the region continuing decreased (down 19.6% YoY in November), however, exports toward North America and Europe are buoyant, driven by e-commerce and PPE shipments IATA (2020). This is slightly bringing up air cargo volume. However, with this reason, air cargo terminal capacity is particularly tight on those markets. The air cargo industry, therefore, continues to face challenges of sustainability, profitability, and customer satisfaction. As the world of air cargo is rapidly changing due to the new regulation from pandemic disease, the air cargo terminal performance is definitely affected. This would lead to many challenges such as handling process or terminal operation. Not only the operation affected, but also customer’s behavior which is changed to be more sensitive and demanding.

Air cargo is now becoming one of the serious issues in Thailand’s aviation industry. The demand for air cargo operations is increasing, even in the pandemic disease; however, irregularities are still occurring from operation practices and processes at airports. The current demand for world air cargo has come into a period of uncertainty growth due to numerous unpleasant instabilities in countries including pandemic disease. The turmoil led to unhealthy air cargo operational process. This needs to improve for a better performance to cope with the recovery period. The ability to adapt to the transformation is still inferior in terms of performance. For Air cargo transport, it involves a sequence of services from origins via hubs to destinations to move cargo through a shipper, a forwarder, a road transporter (or trucker), an airline (or carrier), and a consignee (Derigs et al., 2009).
1.1 Objectives

The purpose of this study is to pinpoint the factors influencing the operational performance of air cargo terminal. We define performance as the degree of quantitative factors from the cargo terminal point of view. A set of significant factors is established for the performance of air cargo terminal operation. This paper, therefore, evaluate the significant factors affecting air cargo terminal operational performance during the pandemic disease in order to increase operational performance level and customers’ satisfaction. This paper analyzed two significance areas.

(1) How pandemic disease impact shipping and cargo operations and
(2) Significant factors affecting to air cargo terminal process due to COVID-19.

2. Literature Review

For the literature review, this study considers two perspectives which are air cargo terminal’s operation performance and factors selection process.

2.1 Air cargo terminal operation performance during COVID-19

Before cargo is moved to the aircraft for departure, it is delivered to the airport via air cargo terminal by trucks and then unloaded for inspection, information verification, sorting, and packing. This process involves decision problems on manpower planning and scheduling, cargo processing, and truck arrival, as well as on unloading management for air cargo terminal operations, all of which are interdependent. There are several handling processes enforced by authorities, airline requirements and The International Aviation Transport Association (IATA). However, air cargo operation has been studied at a minor stage in airport research and some papers put air cargo as a secondary part especially in air cargo terminal services. The typical air cargo terminal has four major activities of transit, sorting, storage, and cargo information handling processes (Hu & Huang, 2011). Although, efficient air cargo terminal operations are critical for improving service performance to users and few studies have focused on air cargo terminal performance (Lin, Ling, & Han, 2005). Ohashi et al. (2005) applied numbers of runways, hours of loading/unloading, time for customs clearance, cargo throughput and air cargo processing time on a study of choice of air cargo transshipment airport: an application to air cargo traffic to/from Northeast Asia. Researchers were interested in different perspectives. Factors are at their own concentration and dispersed in different subjects. Table 1 shows the list of factors from previous research for this study.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lau and Zhao (2006)</td>
<td>• Cargo routing</td>
</tr>
<tr>
<td></td>
<td>• Scheduling</td>
</tr>
<tr>
<td>Yan et al. (2008)</td>
<td>• Manpower Requirement</td>
</tr>
<tr>
<td></td>
<td>• Work timetable</td>
</tr>
<tr>
<td>Rong and Grunow (2009)</td>
<td>• Manpower Requirement</td>
</tr>
<tr>
<td></td>
<td>• Personal shift</td>
</tr>
<tr>
<td>Ou et al. (2010)</td>
<td>• Truck</td>
</tr>
<tr>
<td></td>
<td>• Scheduling</td>
</tr>
<tr>
<td>Xu et al. (2014)</td>
<td>• Cargo Routing</td>
</tr>
<tr>
<td></td>
<td>• Scheduling</td>
</tr>
<tr>
<td>Rodbundith et al. (2019)</td>
<td>• Electronic import goods declaration</td>
</tr>
<tr>
<td></td>
<td>• Cargo security (facilities, operations)</td>
</tr>
<tr>
<td></td>
<td>• Cargo terminal area (sq. m.)</td>
</tr>
<tr>
<td></td>
<td>• Available tracking and tracing service</td>
</tr>
<tr>
<td></td>
<td>• Short-shipped cargo</td>
</tr>
</tbody>
</table>

According to the table, the researcher is mainly focus on the manpower and scheduling in order to minimizing the cost in the past. However, as today is the era of disruption, beside the regulation, customers are more demanding and increasing their expectation. The focus might have been changed from the past. Rodbundith et al. (2018) and Suwanwong et al. (2019) mainly discussed on the service level agreement. This research, therefore, concentrates on the factors that effect to air cargo terminal performance during COVID-19.
2.2 Factors selection method

Factor selection among a set of alternatives along with numerous contradictory criteria is a multiple
criteria decision making (MCDM) problem. The objective of this research is to select the most appropriate factors
among alternatives for significant factors affecting air cargo terminal operational performance. MCDM methods
support decision makers solve complex decision problems involving conflicting criteria in a systematic and
consistent way. Mardani, Zavadskas, Khalifah, Jusoh, and Nor (2016) show that use of MCDM methods has
significant growth in the field of transportation systems.

MCDM includes many methods such as AHP, TOPSIS, PROMETHEE, SAW, and the newest method -
Best-Worst Methods. Between these methods, only TOPSIS and AHP were found to be used most in air transport
study. Marvelous efforts have been consumed and noteworthy advances have been completed towards the
development of several MCDM methods for solving different types of decision problems Yeh, Deng, and Pan
(1999); Triantaphyllou (2000). In spite of this, there is no generally accepted approach for the general MCDM
problem (Yeh, Deng, & Chang, 2000), and the proof of the decision outcome remains generally an open issue.
The outcome is quite regularly reliant on the method used.

There are many ways and methods to evaluate factor selection. Therefore, to select the suitable method,
it is depending on the research objective and data collection. This research utilizes two MCDM methods, Best-
Worst Method to define the weights of criteria and VIKOR to rank alternatives and select the best alternative.
Best-Worst Method (which is developed based on AHP model) is used to define the weights in the hierarchy of
criteria. VIKOR as a compromise ranking method are used for ranking and selection process in order to be assured
in selecting the best alternative. Another reason for using these methods is their successful applications to the
MCDM problems in the literature.

Best-Worst Method is the latest MCDM technique proposed by Rezaei (2015), which is based on
pairwise comparisons to acquire the weights of alternatives and criteria respectively to several criteria. It reduces
the number of pairwise comparison by only executing reference comparison which means that experts are only
required to define the preference of best criterion over other criteria and the preference of all criteria over the
worst criterion, using on a 1-9 scale. By removing secondary comparisons this method is much more efficient and
easier to obtain weights in an MCDM problem. This method had been used in a variety of contexts such as supplier
selection (Rezaei, Nispeling, Sarkis, & Tavasszy, 2016), sustainable supply chain (Sadaghian, Ahmad, Rezaei,
& Tavasszy, 2015), energy efficiency of buildings (Parmarth Gupta, Anand, & Gupta, 2017), urban sewage
treatment technologies sustainability assessment (Ren, Liang, & Chan, 2017), and measuring university-industry
PhD projects efficiency (Salimi & Rezaei, 2016).

The literature on VIKOR and Fuzzy VIKOR methods is reviewed by Yazdani and Graeml (2014) for a
total of 198 papers with 9 main application areas from 2002 to 2014, by Gul, Celik, Aydin, Gumus, and Guneri
(2016) for a total of 343 papers with 13 main application areas from 1998 to 2015 and by Mardani, Zavadskas,
Govindan, Amat Senin, and Jusoh (2016) for a total of 176 papers with 15 main application areas from 2004 to
2015. Uludag et. al. (2013) applied Fuzzy VIKOR and Fuzzy TOPSIS methods to a potential city airport location
selection problem by assessing thirty-four sub-criteria under nine main criteria (geographical specifications,
climatic conditions, infrastructure conditions, costs, transportation, the possibility of extension, legal restrictions
and regulations, potential demand, environmental and social effects) for five location alternatives. Milosevic and
Naunovic (2013) adopted VIKOR for determining the most suitable location for a sanitary landfill facility from
three alternatives by evaluating thirty-two sub-criteria under five main criteria (hydrogeological criteria,
meteorological criteria, spatial criteria, socio-political criteria, and legal and economic criteria) and use fuzzy
AHP for determining weighting coefficients of the evaluation criteria. Liu, You, Chen, and Fan (2014) proposed an
extended VIKOR method based on the interval 2-tuple linguistic variables to select the best disposal site for
municipal solid waste among four alternatives considering four criteria (adjacent land use, climate, road access,
and cost). Mokhtarian, Sadi-Nezhad, and Makui (2014) proposed Interval Valued Fuzzy VIKOR as a reliable
method to select an appropriate location for digging some pits for municipal wet waste landfill. Pankaj Gupta,
Mehlawat, and Grover (2016) proposed an extended VIKOR method using trapezoidal intuitionistic fuzzy
numbers and apply it to the plant location selection problem with six criteria (skilled workers, expansion
possibility, availability of acquirement material, investment cost, transport facilities, and climate) and three
analysis to classify feasible incinerator locations based on economic, environmental, and social criteria and then
use AHP, VIKOR and PROMETHEE methods to select the best location for a central healthcare waste incinerator.

The provided information indicates that there have been very few studies of factor selection for air cargo
terminal operational perspectives in the journal papers, therefore, presented MCDM problem and significant
factors for evaluating factors is considered as the main contribution of this research to the literature.
3. Methods

**Factor weighting using Best-Worst Method (BWM)**

Multi-criteria decision-making (MCDM) is a significant branch of decision-making concept. As mentioned in section 2, the latest MCDM method is Best-worst method was selected for this research. The step of BWM was describe below (Razaei, 2015);

**Step 1:** Build the set of decision criteria. In this step, the criteria \( (C_1, C_2, \ldots, C_n) \) that should be used are considered. This step is done by factor screening process at the very beginning of the phase. The structure of the criteria can be built as the hierarchy level as shown in Figure 1.

**Step 2:** Select the best criteria (most important) and the worst criteria (least important). In this step, the decision-makers identify each criterion and decide the most- and least important among the criteria. There is no comparison process in this step.

**Step 3:** Determine the preference of best criteria over all other criteria using the number between 1 and 9, as shown in Table 2. The value of 1,3,5,7,9 characterize equal importance, weak importance, essential importance, demonstrated importance, and extreme importance, respectively; while the value 2,4,6, and 8 are used to compromise between the values. The result of Best-to-Others vector would be:

\[ A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn}) \]

Where \( a_{Bj} \) represent the preference of the best criteria B over criterion j. It is clear that \( a_{BB} = 1 \)

**Figure 1 Criteria structure Source:** Organized by Author

**Table 2 The fundamental scale of absolute numbers**

<table>
<thead>
<tr>
<th>Intensity of Importance</th>
<th>Definition</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equal importance</td>
<td>Two activities contribute equally to the objective</td>
</tr>
<tr>
<td>2</td>
<td>Weak or slight</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moderate importance</td>
<td>Experience and judgement slightly favor one activity over another</td>
</tr>
<tr>
<td>4</td>
<td>Moderate plus</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Strong importance</td>
<td>Experience and judgement strongly favor one activity over another</td>
</tr>
<tr>
<td>6</td>
<td>Strong plus</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Very strong or demonstrated</td>
<td>An activity is favored very strongly over another: its dominance demonstrated in practice</td>
</tr>
<tr>
<td>8</td>
<td>Very, very strong</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Extreme importance</td>
<td>The evidence favoring one activity over another is of the highest possible order of affirmation</td>
</tr>
</tbody>
</table>

Source: Saaty (2008)
**Step 4:** Determine the preference of all criteria over the worst criteria using the number between 1 and 9, as shown in Table 2. The result of Best-to-Others vector would be:

\[ A_w = (a_{w1}, a_{w2}, ..., a_{wn}) \]

Where \( a_{wj} \) represent the preference of the criterion \( j \) over the worst criteria \( W \). It is clear that \( a_{ww} = 1 \)

**Step 5:** Find the optimal weights \( (W_1^*, W_2^*, ..., W_n^*) \). The optimal weight for the criteria is the one where, for each pair of \( W_b/W_j \) and \( W_j/W_w \), the \( W_b/W_j = a_{bj} \) and \( W_j/W_w = a_{wj} \). The next step is to satisfy these condition for all. The solution, where the maximum absolute difference \( \left| \frac{w_B}{w_j} - a_{bj} \right| \) and \( \left| \frac{w_j}{w_w} - a_{wj} \right| \) for all \( j \) is minimized, should be made. Considering the non-negativity and sum condition for the weights, the following problem is resulted:

\[
\begin{align*}
\text{Min } & \xi \\
\text{s.t. } & \left| \frac{w_B}{w_j} - a_{bj} \right| \leq \xi, \text{ for all } j \\
& \left| \frac{w_j}{w_w} - a_{wj} \right| \leq \xi, \text{ for all } j \\
& \sum_j w_j = 1 \\
& w_j \geq 0, \text{ for all } j
\end{align*}
\]

Solving problem (1), the optimal weights \( (W_1^*, W_2^*, ..., W_n^*) \) and \( \xi^* \) are obtained.

The last step is to test the consistency through calculation, modifying it if necessary, to get an acceptable consistency. Table 3 shows the order of the consistency index table according to study of Razaei, (2015) which is used to calculate Equation (2). The consistency ratio for Best-Worst Method using \( \xi \) and the corresponding consistency index, as follow;

\[
\text{Consistency Ratio} = \frac{\xi^*}{\text{Consistency Index}}
\]

<table>
<thead>
<tr>
<th>( a_{bj} )</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI</td>
<td>0.00</td>
<td>0.44</td>
<td>1.00</td>
<td>1.63</td>
<td>2.30</td>
<td>3.00</td>
<td>3.73</td>
<td>4.47</td>
<td>5.23</td>
</tr>
</tbody>
</table>


4. Data Collection

In according to air cargo terminal performance, there are several criteria that air cargo terminal has to improve in order to increase the customer satisfaction and operational efficiency during this difficult time. As mentioned, there is very limited research focus on air cargo performance, the factors from the previous research are very few. This study, to enable cargo terminal operational performance, the operators shall seriously investigate these factors to enhance handling performance. The factors are mainly come from two sources: literature review and expert interview as shown in Table 4. The factors from literature review are commonly used in purpose of evaluating air cargo terminal performance. In term of expert interview, there are 7 experts from air cargo and related area. They are all agree that during this trying time, there are basically three factors that need to be included which are cut off time, Manpower, and cargo handling process.

<table>
<thead>
<tr>
<th>Factors</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-shipped cargo</td>
<td>Literature review</td>
</tr>
<tr>
<td>Minimum connecting time</td>
<td></td>
</tr>
<tr>
<td>Electronic import goods declaration</td>
<td></td>
</tr>
<tr>
<td>Cargo security (facilities, operations)</td>
<td></td>
</tr>
<tr>
<td>Cargo terminal area (sq. m.)</td>
<td></td>
</tr>
<tr>
<td>Available tracking and tracing service</td>
<td></td>
</tr>
<tr>
<td>Cut off Time</td>
<td></td>
</tr>
<tr>
<td>Manpower</td>
<td>Expert interview</td>
</tr>
<tr>
<td>Cargo handling process</td>
<td></td>
</tr>
</tbody>
</table>
As mentioned earlier, time is matter to air cargo in any situation. To transport products by air is lesser carrying capacity while more expensive logistics cost, shippers will ship their goods by air when goods is very important to arrive at the desired time to destinations and shorter time is preferably significant. Shorter cut-off time is helpful to shippers to have times to transport just finished goods from manufacturers to airports. This is the nature of air cargo after its production process. If cargo terminal operator agrees on shorter cut-off time meaning that their in-house handling process must be faster and more efficient to deliver to aircraft side on time. During COVID-19, manpower and cargo handling process are affected by changing in regulations. It has a big impact to air cargo terminal operational performance overall.

Cargo terminal shall seriously look into these factors in order to satisfy airlines, shippers, freight forwarders and consignees. The question is how to handle cargo with nil irregularity and faster in cargo terminal custody. This is important to cargo terminal to gain higher standard of their operational performance in all area of handling activities. Redundant, duplicated, or repeated activities must be terminated and improved to serve related stakeholders in the airport. Therefore, requested experts and users in air cargo terminals to provide the significant factors for evaluating air cargo terminal performance.

- **Short-shipped cargo**
  Short-shipped cargo is the left-over cargo. The increasing amount of short-shipped cargo reflects poor management of the airline, which affects its overall reputation. The defects occurring with the airline's ground operations not only influence the airlines but also the cargo shippers and consignees. One main reason is that air cargo is time-sensitive: longer delivery time and short-shipped irregularity are unsatisfactory for the shipment owners. Short-shipped cargo as a key factor leads to increased waiting times, which reduce the overall air cargo terminal performance (Suwanwong et al., 2019).

- **Minimum connecting time**
  Minimum connecting time for air cargo is different from the one for air passengers. As there is no standard for the minimum connecting time, it usually depends on airports and airlines. A small-size airport has shorter minimum connecting time than a large-size airport. According to Suwanwong et al. (2019), based on interviews with experts of Thai Airways International (TG), approximately 6–12h are the minimum connecting time if a transshipment is involved and/or the cargo needs to be towed to other terminals.

- **Electronic import goods declaration**
  Electronic import goods declaration is a part of E-freight and E-AWB project of IATA. This an industry-wide program involving carriers, freight forwarders, ground handlers, shippers, customs brokers and customs authorities that aim to build an end-to-end paperless transportation. All import goods is declared electronically to customs. This allows shipper or its freight forwarder to perform customs clearance 24/7 and fasten the clearance process with customs instead of traditional AWB and other document required by especially import country-customs. Air cargo terminal acts on behalf of carriers shall be enable to deal with electronic import goods declaration with customs efficiently.

- **Cargo security (facilities, operations)**
  Supply chain security is an increasingly important and complex element in air cargo operations and workflows as governments and organizations pursue a network and layered approach to security regulations, program requirement and technologies. The international Civil Aviation Organization (ICAO) is one of two primary international organizations provide standards, recommended practices and guidance material for countries and stated in the field of air cargo security. The other primary organization in this field is the World Customs Organization. Both organizations control the application of security screening and controls upstream in the air cargo supply chain including cargo facilities and operations. Cargo security is fully monitored and controlled at state and international levels. Air cargo terminals must obey regulations enforced by nations’ civil aviation authorities.

- **Cargo terminal area (sq. m.)**
  Several parties such as Boeing or IATA forecast growing air cargo transport each year. With limited area of cargo terminal, the performance and service quality are at risk to handle increasing cargo tonnages. Cargo terminal operator are well-aware of this significant criterion to their future expansion to cope with growing demand from...
carriers. Impromptu future expansion may have defected cargo terminal performance and revenue from limited cargo terminal area to accept more cargo tonnages from new customer airlines.

- Available tracking and tracing service
  The cargo-IMP Status Update. This message is used to notify/update interested parties especially shippers, freight forwarders and consignees with a (change of) status of a specified consignment as recorded in the system of a handling cargo terminal. Usually, the system relates to airline website to allow interested parties to track and trace their current consignment’s delivering status. This tracking and tracing service is mandatory required from airlines to shippers, freight forwarders and consignees.

- Cut off Time.
  To transport cargo by air, time is matter. Normally, export cargo is directly delivered by freight forwarders from factories after production to cargo terminal. There are several conditions such as traffic, trucking quality or road infrastructure may delay consignment delivery to airports. Shorter cut off time to accept cargo from freight forwarders are preferable to them. Cargo terminal is necessary to handle cargo faster to ensure that airlines especially passenger airlines are punctual to their departure time. The proper cut off time is significant to be specific between cargo terminal, airlines and shipper freight forwarders.

- Manpower
  Covid-19 has limited numbers of manpower with lockdown, working hour constrain and travel method to work in the workplace especially in cargo terminal which loaders and staff are gathering to work in cargo and document handling. Hygienic and quarantine measures by the government are strictly applied during the pandemic. Manpower resource is shortage and adjusted in work shift and available staff amount in according to day to day basis. The work from home process is enforced to office staff while there is not sufficient and efficient IT system and tool available to staff for this unwell-prepared situation. Certainly, collaboration between staff working from home and handling physical cargo at frontline is relied on online and tele-communication and unlike face to face cooperation in the workplace.

- Handling process
  Usually, most carriers utilized passenger aircrafts to carry cargo and baggage. The cargo volume was selected and not maximized as by product right after passenger baggage. However, processes are changed during Covid-19 for passenger unavailability and not travelling. Carriers swiftly strategize to convert their aircrafts to cargo flights to at least earn some revenue from cargo transport fee rather than aircraft grounding or bankruptcy. Cargo flights carry much more cargo volume than passenger flights; particularly, aircrafts with cargo in cabin loading cargo on passenger seats or removing the seats and load cargo. Cargo flights and cargo in cabin require difference in handling processes with more manpower and time to handle cargo properly. Space control department works in opposite ways to load plan from passenger aircraft to cargo aircraft like freighter. Cargo terminal prepares cargo built up into carts instead of unit load device (ULD) for cargo in cabin for loading into aircraft. Loading and unloading aircraft is necessary to have self-invented equipment ever for cargo in cabin to move cargo as fast as they can. Catering trucks are used to load and unload cargo to/from passenger cabin due to unsuitable equipment from ramp ground service department. Staff loads cargo piece by piece from catering truck or passenger steps in passenger cabin or invents rolling conveyors. All handling processes are revised in according to tactics by each cargo handling operator. Until now, there is still uncertain and unsettled in cargo handling processes to standardize cargo in cabin flights.

5. Results and Discussion

After conducting the experts’ group discussion for factor selection process, in this step, a structured interview was applied in order for determining the weight and significance of each variable. The survey is organized and delivered to the experts in the management level who came from related aviation industry such as air cargo terminal operation, airline, and freight forwarders. Below is the step of the method to calculate the weight of each criterion.

**Step 1:** Determine a set of criteria; this step consider the criteria that should be used which already done by the group discussion. Nine variables were selected for this step.

**Step 2:** Determine the best (the most important criteria) and the worst criteria (the least important criteria); in this step, the decision makers decided the criteria without any comparison. Table 5 show the results that the most important criteria is Manpower, and the least important criteria is Electronic import goods declaration.
Table 5 Determine the best and worst criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manpower</td>
<td>Best</td>
</tr>
<tr>
<td>Electronic import goods declaration</td>
<td>Worst</td>
</tr>
</tbody>
</table>

5.1 Numerical Results
The next step is to construct Best-Worst method to investigate the weights and priority of each variable. The analysis was made on a scale from 1 to 9. Table 6 presents the final weights of each criteria. Among the 9 criteria, the experts decided that manpower was the most important variable.

Table 6 Factor weighting summary

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Weight</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-shipped cargo</td>
<td>0.053</td>
<td>6</td>
</tr>
<tr>
<td>Minimum connecting time</td>
<td>0.036</td>
<td>8</td>
</tr>
<tr>
<td>Electronic import goods declaration</td>
<td>0.031</td>
<td>9</td>
</tr>
<tr>
<td>Cargo security (facilities, operations)</td>
<td>0.093</td>
<td>4</td>
</tr>
<tr>
<td>Cargo terminal area (sq. m.)</td>
<td>0.073</td>
<td>5</td>
</tr>
<tr>
<td>Available tracking and tracing service</td>
<td>0.042</td>
<td>7</td>
</tr>
<tr>
<td>Cut off Time</td>
<td>0.125</td>
<td>3</td>
</tr>
<tr>
<td>Manpower</td>
<td>0.348</td>
<td>1</td>
</tr>
<tr>
<td>Handling process</td>
<td>0.199</td>
<td>2</td>
</tr>
</tbody>
</table>

As mentioned, due to the situation that many companies laying off staff, manpower become one of the most significant when consider air cargo terminal operational performance during COVID-19. It needs to have a very well prepare of human resource management. The volume of air cargo during this time is unstable, therefore, it is difficult to manage manpower in the terminal. Handling process and cut off time came in rank 2 and 3. Handling special cargo like COVID-19 vaccine requires many changes, as it consider as temperature control commodity. Air cargo never have experience in freezing cargo before, thus, this would change many process in the terminal.

5.2 Validation
From equation 2, the result shows the weight of Manpower to be 0.348. The experts agreed that the Manpower is main criteria that effect to the air cargo terminal performance during pandemic disease. In addition, the consistency ratio (CR) was all smaller than 0.1; therefore, the results were considered to be reliable.

6. Conclusion
In accordance to Table 6, to enable cargo terminal operational performance during this trying time, the operators shall seriously look into these first three factors to enhance handling performance. Manpower, Handling process, and Cut-off time are respectively significant to all relevant stakeholders especially cargo terminal operators. With this difficult time, most of the aviation company reducing its cost by laying off stuffs. This decision effect to human resource management. When manpower resource is becoming shortage, air cargo terminal must optimize the existing amount of manpower in order to cope up with the unstable demand. Handling a special vaccine also requires skillful manpower and handling process. This is totally impacting to service quality and handling flow provided to shippers, consignees, and carriers.

In addition, as mentioned earlier, time is matter to air cargo transport to satisfy shippers. To transport products by air is lesser carrying capacity while more expensive logistics cost, shippers will ship their goods by air when goods is very important to arrive at the desired time to destinations and shorter time is preferably significant. Shorter cut-off time is helpful to shippers to have times to transport just finished goods from manufacturers to airports, especially when COVID-19 vaccine is ready to ship. This is the nature of air cargo after its production process. If cargo terminal operator agrees on shorter cut-off time meaning that the in-house handling process must be faster and more efficient to deliver to aircraft side on time. Therefore, cargo terminal is mandatory to review their handling procedure to fasten airline transit/transfer time. Proper handling service is necessary to be well-performed by cargo terminal operators to airlines.

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As the top three factors are somehow relevant to timing required by airlines. Cargo terminal shall seriously consider these three factors in order to satisfy airlines, shippers, freight forwarders and consignees. The question is how to handle cargo with nil irregularity and faster in cargo terminal custody. This is important to cargo terminal to gain higher standard of their operational performance in all area of handling activities.
Redundant, duplicated or repeated activities must be terminated and improved to serve related stakeholders in the airport.

References

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Biography

Apichat Sopadang was born in Chiang Mai, Thailand. He graduated from Chiang Mai University, Thailand in 1987 with a degree in industrial engineer. For several years, he worked as a maintenance planning engineer in Electricity Generator Authority of Thailand (EGAT). He completed his Ph.D. from the Clemson University, USA in 2001. Following the completion of his Ph.D., he is working for Chiang Mai University as an Associate Professor and Head of Excellence Center in Logistics and Supply Chain Management (E-LSCM). He is a frequent speaker at industry and academic meetings. Dr. Sopadang also served as a consultant of Asian Development Bank (ADB) and The Japan External Trade Organization (JETRO).

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