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Improving Airport On-Time Performance Using Kepner-Tregoe Problem-Solving Approaches

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ABSTRACT

Indonesia's Soekarno-Hatta Airport has been putting efforts to provide a better service to airline passengers. However, due to some problems, Soekarno-Hatta Airport's on-time performance has recorded a drastic decline since the beginning of 2016 to early 2018. Therefore, this study aims to propose a strategy to improve Soekarno-Hatta Airport's on-time performance using creative problem-solving approaches. The proposed strategy is designed based on secondary data collected from January 2016 to December 2018. This study evaluates the data using creative problem-solving approaches and uses Singapore's Changi Airport as a benchmark airport. The root causes of improving on-time performance is identified using Kepner-Tregoe Problem Analysis, while the solution is designed using SCAMPER technique, Kepner-Tregoe Decision Analysis, Adverse Consequences table and Kepner-Tregoe Potential Problem Analysis. The result reveals several problem's root causes which influence the low on-time performance in Soekarno-Hatta Airport such as: less integrated baggage handling system, longer passenger loading process due to long queue at check-in gates, high number of arriving delay caused by late departure from origin port, and unpredictable weather. The proposed solution for these problems is improving the baggage handling system in Soekarno-Hatta Airport using the latest conveyor technology. By implementing this solution, it is expected that the on-time performance in Soekarno-Hatta Airport will increase and reach the same level as Changi Airport's.

Keywords: *on-time performance, airport, creative problem-solving*

ABSTRAK

Setiap tahunnya, Bandara Udara Internasional Soekarno-Hatta selalu meningkatkan upaya dalam memberikan pelayanan yang terbaik bagi penumpangnya. Namun berdasarkan data historis bandara tersebut pada tahun 2016 hingga 2018, terdapat penurunan kualitas kinerja ketepatan waktu. Bercermin dari masalah tersebut, penelitian ini ditujukan untuk memberikan strategi terbaik bagi Bandara Soekarno-Hatta dalam meningkatkan kinerja ketepatan waktu pelayanan bandara menggunakan pendekatan berpikir kreatif. Penelitian dilaksanakan dengan menggunakan Bandara Udara Internasional Changi Singapura sebagai benchmark, dengan berpatok pada data historis kedua bandara dalam rentang tahun 2016 hingga 2018. Akar permasalahan dari menurunnya kinerja ketepatan waktu pada Bandara Soekarno-Hatta diidentifikasi menggunakan Analisis Kepner-Tregoe, sedangkan solusi dari permasalahan ini didapatkan menggunakan metode SCAMPER, Kepner-Tregoe Decision Analysis, Tabel Adverse Consequences, dan Kepner-Tregoe Potential Problem Analysis. Hasil dari studi ini menunjukkan bahwa menurunnya kinerja ketepatan waktu disebabkan oleh beberapa hal seperti; sistem penanganan bagasi yang kurang terintegrasi, lamanya waktu pemuatan penumpang, tingginya jumlah keterlambatan pada penerbangan kedatangan dan kondisi cuaca yang tidak menentu. Penelitian ini menghasilkan sebuah solusi yaitu dengan meningkatkan sistem penanganan bagasi menggunakan teknologi conveyor terbaru. Dengan diterapkannya solusi ini, diharapkan pelayanan dalam segi kinerja ketepatan waktu Bandara Soekarno-Hatta dapat meningkat hingga menyamai pelayanan pada Bandara Changi.

Kata kunci: *Kinerja Bandara, Kinerja Ketepatan Waktu, Berpikir Kreatif*

1. INTRODUCTION

Good economic growth provides promising business opportunities for aviation businesses in the world, especially in developing countries like Indonesia. Indonesia is a developing country with a tropical climate located in Southeast Asia with a large part of its territory consists of waters. The high percentage of water areas in Indonesia represents the importance of the aviation business role for the connectivity and growth of the Indonesian economy. The need of high mobility and the economic capability of the Indonesian people to use aviation services are enough to prove that aviation business has large and promising business opportunities in Indonesia.

Large business opportunities must be supported by good service to achieve company success and customer success. Customer Success according to Lincoln Murphy is when customers reach or get the desired results through their interactions with the company. The company term refers to the infrastructure in the world of aviation where stops and departures of an airplane happen, namely the Airport [1]. In the airport business, customer success is represented by Passenger Sentiment. Passenger Sentiment level is strongly influenced by two main factors: Service Quality and On-time performance [2].

Based on the Best Airport Ranking Survey conducted by the AirHelp Company in Winter 2016/2017, it was found that Soekarno-Hatta Airport has on-time performance value of 6.6 out of 10.0. This value is quite far compared to the first rank of the best airport which was held by the neighboring country of Singapore's Changi Airport with 8.8 value [3]. Due to the location of both countries are located next to each other, the airport target markets are mostly similar. Both airports tend to develop the facilities not only for the final destinations, but also for transits, hence the Indonesian Government has been trying to improve Soekarno-Hatta Airport to compete with Changi Airport by adding new terminal and improve its facilities. Meanwhile, based on a survey and assessment conducted by SKYTRAX, Changi Airport also ranked first in the world's best airports in 2017 and 2018, and Soekarno-Hatta Airport is ranked 44th in 2017 and ranked 45th in 2018 [4]. The two results of the survey prove that Indonesia's Soekarno-Hatta Airport has poor service especially in the On-time performance aspects.

Comparing the on-time performance of both countries within time range of January 2016 to October 2018, the Soekarno-Hatta's on-time performance trend tended to decline, even though in a single month which is at the end of 2018, the number was drastically increased to 90%, while Changi's trend tended to be stable at around 80% [5]. This on-time performance graphic is illustrated in Figure 1.

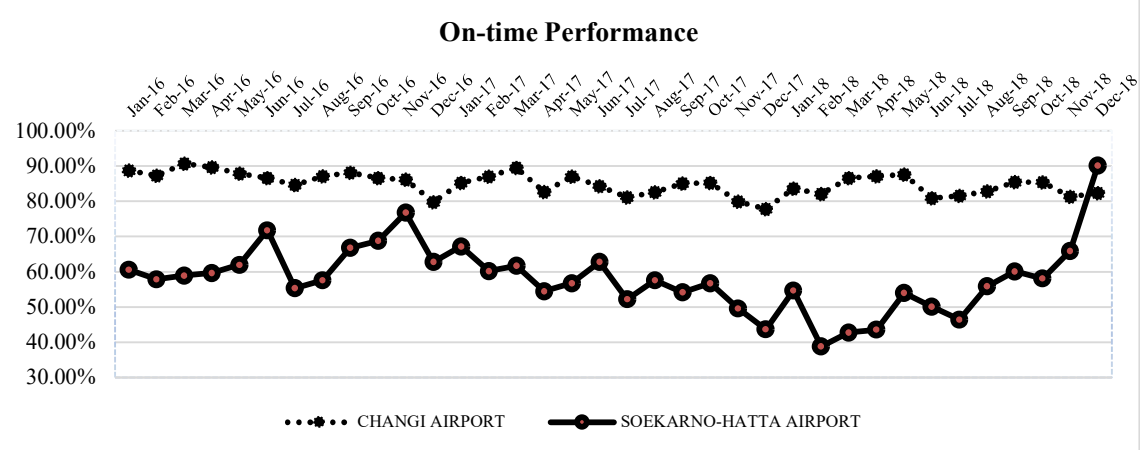

Figure 1. On-Time Performance in 2016-2018

This study proposes a solution to improve on-time performance of Soekarno-Hatta Airport using a Creative Problem-solving (CPS) methodology. This study collects some secondary data related to the on-time performance of Soekarno-Hatta Airport and Changi Airport as a benchmark airport. The data is further evaluated using Kepner-Tregoe Situation Appraisal (KTSA) to manage problem priorities, Kepner-Tregoe Problem Analysis (KTPA) to identify the root cause of the problem. Generating alternative solutions is done by implementing a brainstorming technique, SCAMPER. It also applies Kepner-Tregoe Decision Analysis (KTDA) and Adverse Consequences table to decide a final solution. Finally, a Kepner-Tregoe Potential Problem Analysis is used to foresee the potential risks that may occur if the chosen solution is applied and identify the actions that may be taken.

2. METHODOLOGY

To solve the problem of on-time performance in Soekarno-Hatta Airport, a CPS method is implemented. CPS is a problem-solving model by applying high thinking processes [6]. It enhances creative thinking skills and complex problem-solving skills. The main steps in CPS approach are data collection, data processing to identify the problem root causes, brainstorming ideas and decision-making process [7]. The complete research procedure in this paper is illustrated in Figure 2.

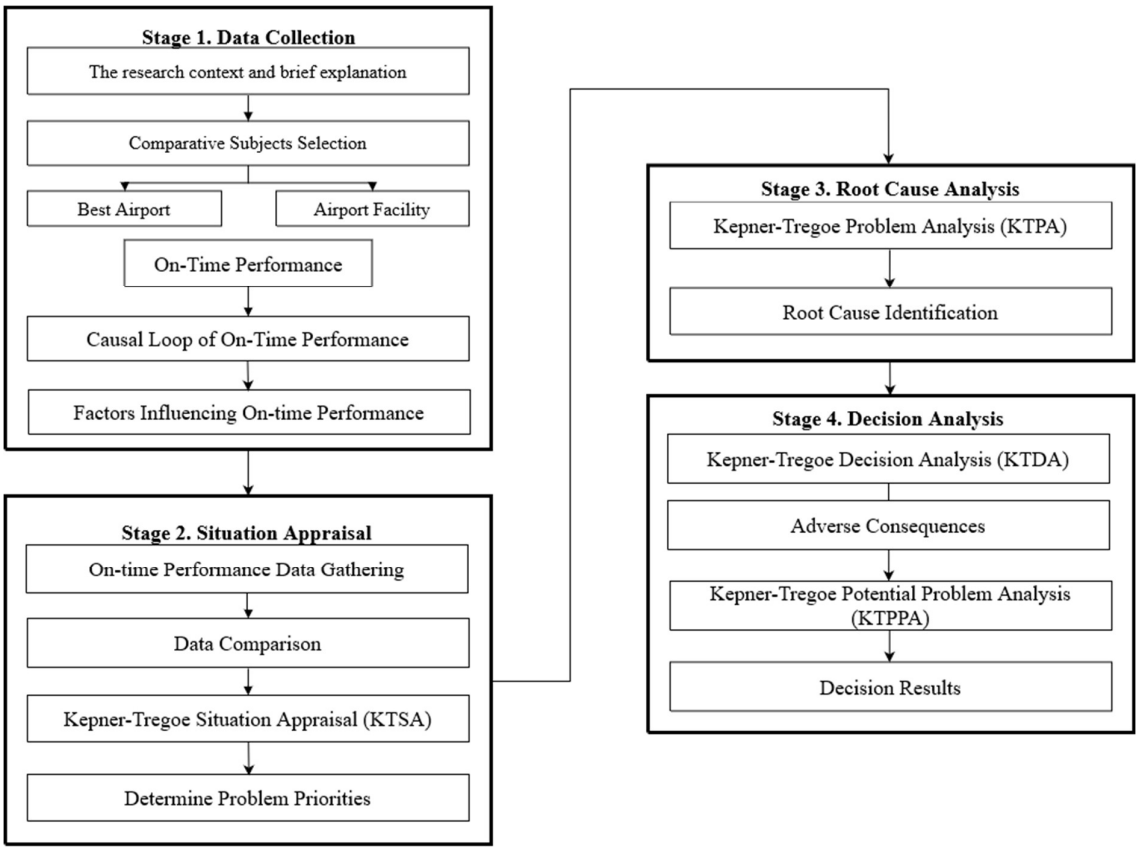

Figure 2. Research Methodology

The first step is identifying the factors that directly influence the airport on-time performance by implementing Causal Loop diagram by using STELLA (Systems Thinking for Education and Research) software. Once those factors are identified, the data of each factor are collected from both

Changi and Soekarno-Hatta Airport. This study collected secondary data from previous studies and online publications. The data collected are historical data from January 2016 to December 2018. The data are then evaluated to identify the symptom of the problem related to Soekarno-Hatta Airport's On-time performance, and further evaluated until a final solution is obtained. There are two types of methods that are used in this paper, one method enhances individual's complex problem-solving skills, namely Kepner-Tregoe. This method is the main method used in this study. Another one is a supplement method to help generating ideas which will be further used in the Kepner-Tregoe methods, namely SCAMPER technique.

2.1 Kepner-Tregoe Problem-solving Methods

There are various problem-solving methods available and being used by academics and experts around the world, but this paper focuses on a certain type of method called Kepner-Tregoe (KT). KT method was initiated by Ben Tregoe and Charles Kepner in the late 1950s. This method has been proven as a global leader in improving business performance by implementing troubleshooting methods, and has been used by global organizations such as NASA, IBM, Sun Microsystems and Siemens. The KT concept identifies a problem as a gap or deviation between something that is supposed to happen and something that is actually occuring. This deviation is then analysed in a logical sequential order to identify the root cause of the problem and decide logical solutions.

The process of KT method involves several logically ordered sub-methods, namely Kepner-Tregoe Situation Appraisal (KTSA), Kepner-Tregoe Problem Analysis (KTPA), Kepner-Tregoe Decision Analysis (KTDA) and Kepner-Tregoe Potential Problem Analysis (KTPPA). The sequence is shown in Figure 3.

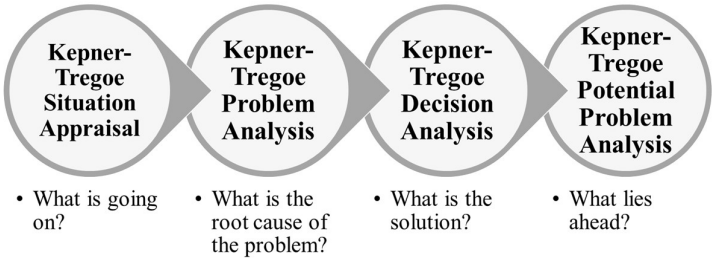

Figure 3. The Steps of Kepner-Tregoe Problem-solving Methods [8]

KTSA is an analytical tool for evaluating problems that enables an individual to recognize a situation which needs an action, and manage problem priorities efficiently especially when several problems occur simultaneously.

KTPA is a tool used to determine the root cause of a problem by distinguishing what the problem is from what it is not. This is done by describing the problem in detail in four dimensions by answering 'what is the specific deviation? What could be the problem but it is not?', 'where is the location of the deviation? Where does the deviation not occur?', 'when was the deviation first observed? When is everything was normal?', 'what is the extend of this deviation? How many objects could have the deviation but do not?' [8][9]. This tool also allows users to avoid perceived problem and find the real root cause, because only then one can be sure to take corrective action that may correct the problem and keep it from recurring [10].

KTDA is a logical algorithm for choosing between different alternative solutions to find the one that best fulfills all the objectives [11]. The first step in KTDA is to define the decision statement, which is used to define the intended result of the decision. Next, the objective criteria of "musts" and "wants" must be developed to help evaluating the alternative solutions that will be chosen. The Wants

criteria will be weighted to identify how much each Want will influence the final decision to be taken. Then, all of the alternative solutions must be compared by scoring their rating against each Want. Comparing these scores, the alternative solution with the highest score may become the chosen solution [12]. Furthermore, Adverse Consequences table is used to explore the risks associated with each alternative solution. This acts as an additional insight into the alternatives being considered at the KTDA table. The alternative solution which have the lowest score in the Adverse Consequences table is the winner, because the lower the solution posseses threats, the more possible for the user to solve the problems without many challenges [13].

KTPPA is a tool used to anticipate future problems that may arise if a user implements the chosen decision derived from KTDA process. This method identifies the potential problems, analyses the likely causes of those problems, takes actions to prevent those problems and prepares contingent actions to reduce the likely impact [14]. The results of these KT tools later are used to compile final solution and conclusion to the problem faced in this study.

2.2 SCAMPER technique

The KTDA method includes different alternative solutions to be compared each other to produce the best solution. But these alternative solutions do not come out of thin air. Users will need to brainstorm their ideas to generate those alternative solutions. Hence, a creativity in thinking is required. Creative thinking process emphasizes on divergent thinking. Divergent thinking is the most common cognitive process used in researches, studies and assessments [15]. Divergent thinking is implemented to obtain various and numerous ideas or alternative solutions. There are several techniques to enhance divergent thinking available, and one of the techniques that is used in this study is called SCAMPER. SCAMPER is simply an acronym, consists of idea-spurring questions to suggest some alternative solutions of something that already exists [16]. Every letter refers to a specific thinking process in the form of the triggering questions as follows:

- S – Substitute : What components / materials / people can I substitute?
- C – Combine : What ideas / objects can I combine / mix / integrate?
- A – Adapt : How can I modify the ideas / products to adapt to the changing situations?
- M – Modify, Magnify, Minify : How can I modify / magnify / minify this object?
- P – Put to Other Use : How can I make this object available for other functions? How can I use this object in a different concept?
- E – Eliminate : What part of ideas / object can I eliminate?
- R – Rearrange : How can I rearrange the existing sequence / layout?

3. RESULT AND DISCUSSION

As KT methods focuses on the deviant situation in a systematic process, in this study case the expected situation or desired process in the airport is based on Changi Airport as the benchmark. It is shown graphically in Figure 4. To begin the problem-solving heuristics, a situation appraisal (KTSA) is implemented by evaluating several factors that affect the airport on-time performance. The goal is to converge the problems so a problem priority can be identified.

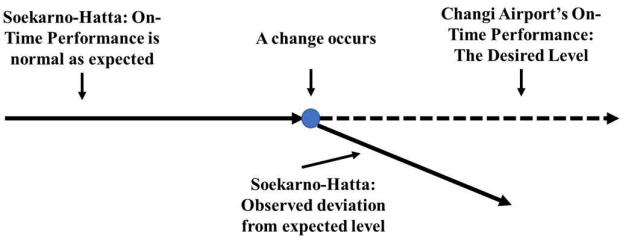

Figure 4. The General Concept of Deviation in Kepner-Tregoe Methods

A data collection is used beforehand to compare the on-time performance between Soekarno-Hatta Airport and Changi Airport. The criteria that are used to determine the on-time performance are identified in the Causal Loop Diagram using STELLA Software. As stated previously in the introduction, customer success in the airport business is represented by Passenger Sentiment. Passenger Sentiment level is strongly influenced by two main factors: Service Quality and On-time performance [2]. Service Quality is heavily influenced by the airport facilities, while the on-time performance is influenced by several factors such as baggage delay, passenger movement, arriving delay, departure delay, traffic congestion, runway capacity and number of cancellations [17]. These factors are directly proportional to Passenger Sentiment as can be seen in the Causal Loop Diagram in Figure 5.

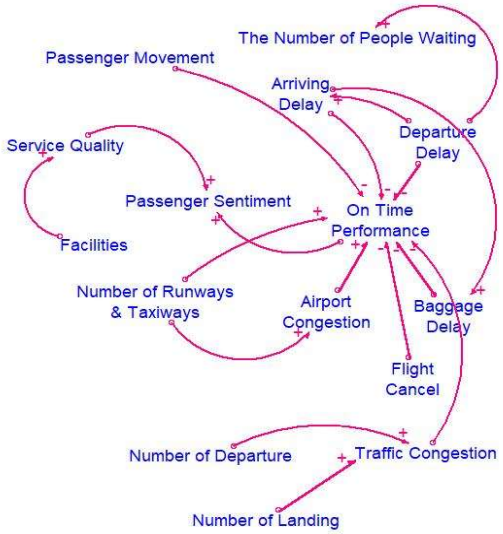

Figure 5. Causal Loop Diagram of Passenger Sentiment

The data from each of the factors that directly influence the airport on-time performance in Changi and Soekarno-Hatta are subsequently gathered and illustrated in Table 1.

Table 1. Comparison Factors of On-Time Performance in 2017-2018

Factors	**Changi**	**Soekarno-Hatta**	**Units**
Baggage Delay [18]	12	20	Minutes
Traffic Congestion [19]	7202	1202	Flights each week
Runway Capacity [20]	42	72	Per hour
Passenger Movement [20]	82 per 85	63,1 per 43	Passenger per passenger capacity (Million)
Arriving Delay [21]	0,4	0,5	Index[a]

Departure Delay [21] [22]	2,0	25	Index[a]
Number of Cancellation [5]	0,14	0,59	%

Based on these data, it is found that Soekarno-Hatta Airport still lag behind Changi Airport in several on-time performance aspects such as baggage delay, passenger movement, arriving delay, departure delay, and number of flight cancellation. However, there are some factors which are not considered as the problem of the low on-time performance in Soekarno-Hatta Airport, namely the traffic congestion and runway capacity. In these two factors, Soekarno-Hatta has higher performance than Changi, due to Air Traffic Control efforts to increase the runway capacity and to reduce traffic congestion. These efforts are carried out to balance the rapid growth of passengers in Indonesia which approaches 30% per year [23]. The passenger rapid growth resulted from increasing economic growth which persuades many Indonesian to consider air transport as an alternative option [24].

The KTSA is further examined accordingly and a problem symptom appears as several factors affecting the Soekarno-Hatta Airport's on-time performance could not compete with Changi Airport's, which may cause the low percentage on-time performance of Soekarno-Hatta Airport. Those problems are the high baggage, arriving and departure delay, high number of flight cancellation and the high number of passenger movement if compared to airport's passenger capacity.

After separating and clarifying the concerns of the problems, a consideration of the seriousness, urgency and the growth of those problems should be done. It is clear that in order to improve Soekarno-Hatta Airport's on-time performance, those problems are considered as serious and urgent to be solved. If they are not solved immediately, the performance of Soekarno-Hatta may be stagnant or reducing, which may cause the airport inability to compete with Changi. To conclude the KTSA method, a determination of analysis needed is carried out, which is finding the root cause of those low performance factors by using the next KT method, KTPA. The illustration of the KTSA method is described in Figure 6.

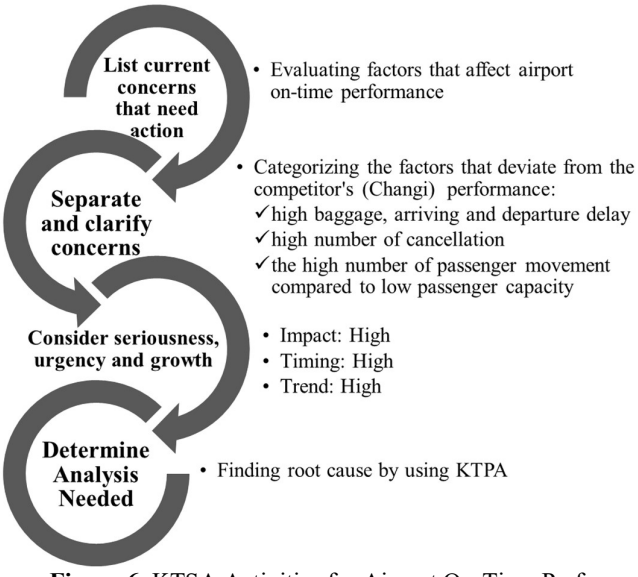

Figure 6. KTSA Activities for Airport On-Time Performance

Continuing the situation appraisal activities and in order to improve Soekarno-Hatta Airport's on-time performance, the root cause of the problem must be identified using one of the creative problem-solving tools, Kepner-Tregoe Problem Analysis (KTPA), as described in Table 2. This tool is used because it allows users to explain any situation in which an excepted level of performance is not being

achieved (in this case, the on-time performance of Soekarno-Hatta airport) and in which the cause of that poor performance is not yet known [25].

The study then focused on the real root cause of the problem affecting the on-time performance in Soekarno-Hatta, based on the further evaluation of the distinctions identified on the KTPA table. From the Table 2, it is known that low on-time performance could give impacts on many aspects in the airport, including some of the passengers, especially ones who have done their check-in. These passengers may experience a direct loss due to numerous airport delays. On the other hand, passengers who have not done the check-in are still allowed to change their schedules and tickets, meaning they are not included in the problem scope.

Table 2. Root Cause Analysis by KTPA

	Is	Is Not	Distinction
What	The low level of Soekarno-Hatta Airport's On-Time Performance especially in its factors, namely baggage delay, passenger movement, arriving delay, departure delay, and number of flight cancellations	Other On-Time Performance factors such as traffic congestion and runway capacity.	• Baggage delay caused by the lack of integrated baggage handling system at Soekarno-Hatta Airport while Changi Airport has deployed the greatest technology nowadays, such as CrisBag Tote-Based Sortation System and CrisBelt Conveyor System. • Loading passengers required such a long time that causes delay. It takes approximately 60 minutes which results in a high departure delay rate. One reason is the long check-in process due to long queue. • Delay in flight arrivals from the origin airport causes delay. • Bad weather caused the number of cancellations to increase.
When	2016 – 2018	Before 2016	The increase of Indonesia GDP growth rate gave impact to the rise of Indonesia's purchasing power, which simultaneously increased the number of Soekarno-Hatta passengers in the last ten years [19].
Where	Soekarno-Hatta Airport	Changi Airport	Changi Airport has better management system, proved by its high ranks.
Extent	All checked-in passengers who will depart from and arrive to Soekarno-Hatta Airport.	Prospective passengers who have not checked in.	Passengers who have checked-in will experience a direct loss if the airport's on-time performance is low because their capability to reschedule the tickets is limited.

In order to reduce the adverse impact for passengers, four root causes that affect the low on-time performance of Soekarno-Hatta's airport are identified by analyzing the distinction in the KTPA table:

1. The baggage handling applied at the Soekarno Hatta Airport is less integrated, yet it needs to accommodate the high volume of passengers daily.
   Although it has not been handled conventionally, Soekarno Hatta Airport system still lag behind Changi Airport's. Changi Airport has implemented the latest technology, using CrisBag tote-based and CrisBelt conveyor system [26]. These latest technologies make the baggage handling process much faster: passengers at Changi Airport spend 8 minutes less than passengers at Soekarno-Hatta Airport, who spend 20 minutes waiting for their baggage.
2. Long queue at check-in gates gives impact to high departure delay rate [27].

3. Arriving delay is mainly caused by the late departure from the origin airport.
4. The climate is unpredictable.
   Nowadays, heavy rain or strong winds come during unexpected times. Bad weather may disturb the flight system and the pilot's visibility, which causes accidents to become more probable. Therefore, to avoid accidents due to bad weather, airlines may cancel flight schedules during bad weather.

Correlating the root causes that previously has been identifed, a brainstorming process to generate alternative solutions to improve Soekarno-Hatta's on-time performance is carried out using SCAMPER technique in the Table 3.

Table 3. Generating Ideas by SCAMPER

Technique	Alternative Solutions
S – Substitute	Substitute the current baggage handling system with the similar system applied at Changi Airport: Crisbelt Conveyor.
C – Combine	Integrate control centre for airport operational activities through the implementation of Airport Operation Control Center (AOCC). It is built in order to maximize the services of airport utilities.
A – Adapt	Update the latest weather forecast technology to adapt to the changing climate, in order to increase forecasting accuracy. This may give impact to avoid unnecessary delays due to false weather forecasting.
M – Magnify	Develop airport infrastructure by adding terminals and runways to increase passenger capacity and accomodate the high number of passengers.
	Adding more check-in stations to avoid passengers queuing due to high number of passengers.
P – Put to Other Use	Design the airport not only for passenger's choice of destination aiport, but also for domestic / international transit airport.
E – Eliminate	Eliminate incompetent airport workers.
R – Rearrange	Re-arrange airport layout so that loading passengers are faster by re-order passenger waiting area and apron.

After implementing SCAMPER technique, two alternative solutions are generated and chosen, based on 'Substitute' and 'Combine' phase. The two alternative solutions are, improving baggage handling system to the latest technology using Crisbelt Conveyor, and Building Airport Operation Control Center (AOCC), as detailed in the following:

1. Improving Baggage Handling System to the latest technology using Crisbelt Conveyor
   Based on the root causes identified using KTPA, it is discovered that the use of baggage handling system technology in Soekarno-Hatta is less integrated, thus it may affect to its low on-time performance. The low time of baggage delay in Changi Airport represents that the baggage handling system is better than Soekarno-Hatta Airport. Therefore, this study adopts the technology of baggage handling system in Changi Airport, namely CrisBelt Conveyor, as an alternative solution. This solution is expected to reduce the baggage delay time in Soekarno-Hatta and subsequently improve the airport's on-time performance value.
2. Building Airport Operation Control Center (AOCC)
   AOCC is a control center that oversees airport operations; including air side, land side, arrivals and departures activities at the airport in real time. AOCC has been proved to be able to improve airlines and passenger services in Juanda Airport, Surabaya, another big city airport in Indonesia. Information obtained shows that in 2016, the AOCC has improved the on-time performance at Juanda Airport by 95.5%, which ranked higher than Singapore's Changi Airport on-time performance value of 87.1% at that time [28]. The existence of AOCC in Soekarno-Hatta Airport

is expected to help the optimization of arrival and departure activities, including loading passenger time.

Both alternative solutions proposed are then evaluated using Kepner-Tregoe Decision Analysis (KTDA) method as shown in Table 4. The decision statement is to identify how to increase the on-time performance of Soekarno-Hatta Airport in order to be able to compete with Changi Airport. The final solution chosen must fulfill the Musts and Wants criteria stated. The solution must be able to be implemented within five years, and increase the on-time performance to 80% - 90% and maintain the stable state (with Changi Airport as benchmark). The solution is preferred to be sustainable, environmentally friendly, capable of being easily expanded or upgraded on demand and also give profit to airport developer. Both alternative solutions must be weighted and rated to evaluate the final score. The alternative solution with the highest score is preferred.

Table 4. Decision Analysis Using KTDA

Alternative Solutions		**Implementing CrisBelt Conveyor for Baggage Handling**		**Building AOCC**	
Musts:					
Implementation ≤ 5 years		GO		GO	
Increase On-Time Performance to Changi Airport's average value of 80%		GO		GO	
Wants:	**Weight**	**Rating**	**Score**	**Rating**	**Score**
Sustainable	9	5	45	7	63
Environmentally Friendly	5	9	45	7	35
Capable of being easily expanded or upgraded on demand	7	9	63	5	35
Easy operation for airport personnel	9	6	54	4	36
		Total	207	Total	169

Based on Table 4, the Musts criteria for both alternative solutions are fulfilled as GO, because both of them do not need duration implementation for more than five years, and there are possibilities of increasing on-time performance because:

- The Crisbelt conveyor system has been used at Changi Airport
- The AOCC has proved to help improving Juanda Airport, which defeated Changi Airport's rank in 2016

At the segment of the Wants criteria, alternative solution implementing Crisbelt conveyor successfully fulfill the environmentally friendly criteria, because this conveyor is designed to minimise energy consumption, and has quiet operation [29]. It is also sucessfully fulfill another critera of capable of being easily expanded or upgraded on demand, because this type of conveyors is flexibly designed to specify additional features. On the other hand, the second alternative solution of building AOCC lacks to fulfill the criteria of easy operation for airport personnel, because this control center integrates airport activies and requires specialized human teams that work under the control of an operations supervisor [30]. After evaluating the alternative solutions using KTDA, further analysis on the Adverse Consequences of each alternative solutions are performed, as described in Table 5. Based on both KTDA and Adverse Consequences table, it is decided that the chosen solution is improving Baggage Handling System to the latest technology using Crisbelt Conveyor.

Table 5. Adverse Consequences

Adverse Consequences	**Probability of Occurrence**	**Seriousness If It Occurs**	**Threat**
Implementing CrisBelt Conveyor for Baggage Handlings			

Increased Maintenance Cost	5	5	25
Require Additional Land	3	3	9
Require further personnel training for familiarization with the automation system	5	5	25
High Investment Cost	3	5	15
TOTAL			**74**
Building AOCC			
Increased Maintenance Cost	7	7	49
Require Additional Land	5	5	25
Require further personnel training for familiarization with the automation system	7	7	49
High Investment Cost	3	7	21
TOTAL			**144**

This solution has the highest score of 207 in KTDA table and the lowest threat of 74 in Adverse Consequences table, which illustrate that by implementing Crisbelt Conveyor System in Soekarno-Hatta, it is expected that the on-time performance may increase in a stable state. Hopefully by integrated system, passengers may spend less time waiting for their baggage, and airport personnel spend less time handling the baggage from aircraft [31]. The solution chosen also has minimum impact on increased maintenance and investment cost, does not require much additional land and little training to airport personnel. However, any chosen solution may also impose potential problems. To anticipate future problems, a step of instituting preventive and contingent actions are carried out using KTPPA as illustrated in Table 6.

Table 6. KTPPA for the Chosen Solution

Potential Problems	Possible Cause	Preventive Action	Contingent Action
Increased maintenance cost	As time goes by, machine wears out and needs more maintenance.	Schedule regular maintenance to reduce failures that may cost more maintenance fee	Arrange more maintenance budget
	Poor maintenance by airport personnel	Apply strict supervision to maintenance personnel	Arrange more maintenance budget
Require additional land	Facility area is fully used for existing equipment	Removing equipment that do not add value to the airport facility	Design new space for the new conveyor system
Incompetent personnel that operates the new conveyor system	Lack of familirization in handling materials using the new conveyor system	Implement initial training for existing and new airport personnel who works with the conveyor system	Evaluate the work performance of the personnel, give punishment or terminate their contract
Lack of investment budget	Mispredict on the investment cost	Arrange budget in detail	Find other fund supports
	Budget allocation for other sector	Secure budget and convince stackholders of the importance of this new conveyor system	Find other fund supports

4. CONCLUSION

This study proposes a solution to improve on-time performance of Soekarno-Hatta Airport, Indonesia. It applies creative problem-solving approaches to identify root causes problem and find the solutions. The KTSA approach is used to manage problem priority by separating the deviant factors that cause the low on-time performance level at Soekarno-Hatta Airport. The KTPA approach is used

to identify several root causes which hamper the on-time performance such as less integrated baggage handling system technology, slow passengers loading process time results in a high departure delay rate, arrival delay is caused by late departure from the origin airport and unpredictable weather. Based on the root causes that were identified, alternative solutions are generated using a divergent thinking technique called SCAMPER.

Furthermore, the KTDA and Adverse Consequences approaches are used to decide the proposed solution: improving Baggage Handling System using the latest technology, namely Crisbelt Conveyor. This solution is resulted from the KTDA table as the highest score at 216 and the lowest threat at 74 in Adverse Consequences table. These values illustrate that by implementing Crisbelt Conveyor System in Soekarno-Hatta, the on-time performance is expected to increase and maintain its number in a stable manner in less than five years. This solution has a minimum impact on increased maintenance and investment cost; it requires straightforward training for airport personnel and does not require much additional space. However, as future problems may arise, an anticipation is conducted by implementing the KTPPA approach. Future study should consider more factors that might affect airport on-time performance to get a more comprehensive improvement strategy.

5. REFERENCES

[1] Nwaogbe, O. R., Ogwude, I. C., & Ibe, C. C. (2017). Efficiency Analysis of the Nigeria Airports: An Application of DEA-BCC Model. *International Scientific Journal of Air Transport Industry (AERO-Journal)*, (2), 28-39.

[2] Wiredja, Dedy. (2017). *Assessment of airport service performance: A passenger-centred model.* Queensland University of Technology.

[3] AirHelp. (2018). Airport World Ranking 2018. Retrieved 11 November, 2018, from https://www.airhelp.com/en/airhelp-score/airport-ranking/

[4] World's Top 100 Airports 2018. (2018). *Skytrax World Airport Awards.* Retrieved 29 November, 2018, from https://www.worldairportawards.com/worlds-top-100-airports-2018/

[5] Airports On-Time Performance Report. (2017): OAG Aviation Worldwide Limited

[6] LeBlanc, Steven E, & Fogler, H Scott. (2008). *Strategies for creative problem solving*: Prentice Hall.

[7] Byatt, Gareth, Hamilton, Gary, Hodgkinson, Jeff, & Okes, Duke. (2011). Root cause analysis and corrective action for project managers. *American Society for the Advancement of Project Management*.

[8] Kepner, C. H. (1976). The Rational Manager: A Systematic Approach to Problem Solving and Decision Making. Kepner-Tregoe. *Inc., Princeton, NJ*.

[9] Marty, Carl S. (1966). Book Review: Your Job Situation…: The Rational Manager: A Systematic Approach to Problem Solving and Decision Making: SAGE Publications Sage CA: Los Angeles, CA.

[10] Vernon, David, Hocking, Ian, & Tyler, Tresoi C. (2016). An evidence-based review of creative problem solving tools: A practitioner's resource. *Human resource development review, 15*(2), 230-259.

[11] Okes, Duke. (2019). *Root cause analysis: The core of problem solving and corrective action*: ASQ Quality Press.

[12] Parker, Jeremy S, & Moseley, Jonathan D. (2008). Kepner-tregoe decision analysis as a tool to aid route selection. part 1. *Organic Process Research & Development, 12*(6), 1041-1043.

[13] Kurnia, G., Dahliyanti, A., & dkk. (2019). *Buku Ajar Berpikir Solusi Kreatif (Creative Problem Solving).* Jakarta: Salemba Teknika.

[14] Hrůzová, Helena. (2012). *Decision Problem Analysis by Using KT Problem Solving and Decision Making Methodology*. Paper presented at the The 6th International Days of Statistics and Economics, Prague, Czech Republic. https://msed.vse.cz/files/2012/Hruzova_2012.pdf

[15] Ozyaprak, Melodi. (2016). The effectiveness of SCAMPER technique on creative thinking skills. *Journal for the Education of Gifted young scientists, 4*(1), 31-40.

[16] Serrat, Olivier. (2010). Bridging Organizational Silos,. Washington, DC: Asian Development Bank.

[17] Efthymiou, Marina, Njoya, Eric Tchouamou, Lo, Pak Lam, Papatheodorou, Andreas, & Randall, Daniel. (2019). The Impact of Delays on Customers' Satisfaction: an Empirical Analysis of the British Airways On-Time Performance at Heathrow Airport. *Journal of Aerospace Technology and Management, 11*.

[18] Secretary, Corporate. (2017). Angkasa Pura II has been impelementing The Baggage Handling Transparency at Soekarno-Hatta Terminal 3. *Siaran Pers.* Retrieved 8 December, 2018, from https://angkasapura2.co.id/en/informasi/siaran-pers-detail/angkasa-pura-ii-has-been-impelementing-the-baggage-handling-transparency-at-soekarno-hatta-terminal-3-1230

[19] Air Traffic Statistics. (2018). *Traffic Statistics.* Retrieved 6 December, 2018, from http://www.changiairport.com/corporate/our-expertise/air-hub/traffic-statistics.html

[20] Z. Wuragil B.K., L. Hairani, I.K. Safitri. (2018). Menyongsong 100 Juta Penumpang, Bandara Soekarno-Hatta Membenahi Diri *Investigasi.* Retrieved 6 December, 2018, from https://investigasi.tempo.co/270/menyongsong-100-juta-penumpang-bandara-soekarno-hatta-membenahi-diri

[21] Flightradar24. (2018). Arrivals. Retrieved 29 November, 2018, from https://www.flightradar24.com/data/airports/cgk

[22] Mustikasari, Mustikasari, Wardhana, Aditya, Mafrudoh, Lut, Octaviani, Reni Dian, & Susanthi, Novi Indah. (2018). The Operational Delay With on Time Performance Terminal 3 Soekarno Hatta Airport (Case Study of PT Garuda Indonesia). *Advances in Transportation and Logistics Research, 1*(1), 975-985.

[23] Anwar, Fadrinsyah. (2017). Kajian Kausalitas Permintaan Trafik Terhadap Kapasitas Bandara Berdasarkan Persepsi Pengelola Bandara (Studi Kasus: Bandara Internasional Soekarno-Hatta). *Warta Ardhia, 41*(1), 11-18.

[24] International, Airports Council. (2018). Passenger Traffic 2016 FINAL (Annual). *Passenger Summary.* Retrieved 30 November, 2018, from https://aci.aero/data-centre/annual-traffic-data/passengers/2016-final-summary/

[25] Kepner, Charles Higgins, & Tregoe, Benjamin B. (1981). *The new rational manager* (Vol. 37): Princeton research press Princeton, NJ.

[26] Symonds, Dan. (2018). Beumer Group's Baggage Handling System Takes Off at Changi Airport Retrieved 10 December, 2018, from https://www.passengerterminaltoday.com/news/airport/beumer-groups-baggage-handling-system-takes-off-at-changi-airport.html

[27] Novrisal, D, Wahyuni, N, Hamani, N, Elmhamedi, A, & Soemardi, Tresna Priyana. (2013). *Simulation of departure terminal in Soekarno-Hatta International Airport.* Paper presented at the 2013 IEEE International Conference on Industrial Engineering and Engineering Management.

[28] Perdana, Rio Sandy. (2018). Bandara Juanda Paling Tepat Waktu Se-Asean, Kalahkan Bandara Changi Singapura. *Transportasi dan Logistik.* Retrieved 20 November, 2018, from

https://industri.bisnis.com/read/20180517/98/796150/bandara-juanda-paling-tepat-waktu-se-asean-kalahkan-bandara-changi-singapura

[29] Group, Beumer. (2012). Crisplant's CrisBelt Baggage Conveyor System Receives BNP Approval. Retrieved from Beumer Group Press Release website: https://www.airport-technology.com/contractors/baggage/crisplant/pressreleases/presscrisbelt-baggage-conveyor-receives-bnp-approval/

[30] Castro, António JM, & Oliveira, Eugénio. (2011). Airline operations control: A new concept for operations recovery. *Airline industry: Strategies, operations and safety*.

[31] Boysen, Nils, Briskorn, Dirk, Fedtke, Stefan, & Schmickerath, Marcel. (2019). Automated sortation conveyors: A survey from an operational research perspective. *European Journal of Operational Research, 276*(3), 796-815.