

Future Trends Report

Based on Analysis of the Future Scene in Mid-Term and Final Evaluation

STEP 1. Identify Challenges

Read the Future Scene carefully and generate ideas for challenges, concerns, and possible related problems. Choose the 5 most important challenges and write them in the space provided. Include applicable research with appropriate in-text citations.

Challenge 1 : Manpower Shortage

Based on our interview conducted on 28-May-2019 at SIA Office with Mr Terrence Francis Charles, Security Manager of Singapore Airlines, and Mr Alfred Leong, SATS Police Officer, manpower shortage is one of the greatest security challenge faced by Changi Airport. Airport security company have difficulty employing security officers because they can only employ officers from Singapore, Malaysia and Taiwan due to trust level. Moreover, the salary and career path are not attractive (especially to Singaporean).

Airport security is still a labour intensive industry. With the increasing air travel, shortage of manpower will directly affect the security level of the airport. To overcome manpower shortage, security company may compromise on the selection of staff and security officers have to work long hours, which will cause security lapses and poor services.

With fourth industrial revolution disrupting the security industry, many routine tasks will be performed by advance technology. Airport security company will have difficulty employing security officers with the right skill set to operate in fourth industrial revolution environment.

Research

1. According to Mr Chua Chwee Koh, Certis Cisco's technology and operations chief, there is a shortage of security guards in Singapore and there is a good chance that robots and technology will replace a lot of work in the near future. He also said that people may prefer the human touch, but when there is not enough manpower, there will be a tipping point. In 2030, there may well be more robots in Singapore than security guards.

Sue-Ann Tan (n.d.). Certis boosts security services with tech tools. Retrieved from:

<https://www.straitstimes.com/business/certis-boosts-security-services-with-tech-tools>

2. According to The Straits Times, there are only Singaporeans and Malaysians eligible to be APOs (Auxillary Police Officer). Due to severe manpower shortage, Certis Cisco is looking to hire Taiwanese Nationals to be Auxillary Police officers, in a move to ease the labour crunch.

Tan Tam Mei (n.d.). Certis Cisco recruiting officers from Taiwan. Retrieved from: <https://www.straitstimes.com/singapore/certis-cisco-recruiting-officers-from-taiwan>

3. According to Mr Tan Toi Chia, Certis Cisco's senior vice-president of corporate planning, group communications and marketing, Certis has 34,000 employees worldwide, including 16,000 in Singapore. At Changi Airport, where it has about 4,000 workers, leveraging technology is critical.

Karamjit Kaur (22-May-2019). Certis looks beyond Singapore to grow airport business Retrieved from: <https://www.straitstimes.com/singapore/transport/certis-looks-beyond-spore-to-grow-airport-business>

4. According to The Straits Times, a baggage handler was forced to carry bags due to power failures and limited manpower. Out of anger and frustration, the baggage handler purposely swapped the tags of 286 bags at Changi Airport Terminal 2.

Shaffiq Alkhatib (n.d.). Former baggage handler admits swapping tags of 286 bags at Changi Airport Terminal 2 Retrieved from: <https://www.straitstimes.com/singapore/courts-crime/former-baggage-handler-admits-swapping-tags-of-286-bags-at-changi-airport>

5. According to Airport Technology, a growing shortage of Transportation Security Administration (TSA) screening officers in the United States is increasingly exposing passengers to safety risks.

Adele Berti (16-July-2019). Missing in action: where are aviation employee shortages hitting hardest? Retrieved from: <https://www.airport-technology.com/features/aviation-staff-shortages>

Challenge 2 : Travellers' Experience

Based on our survey with 100 participants, the survey result shows that ~90% of the travellers are quite satisfied with the security screening at Changi Airport. ~80% of the travellers think that the security level at Changi Airport is high. However, they feel that the security level at retail areas and check-in areas are low. They also feel that they prefer more convenience, suggesting that other areas like queueing time, removal of items and restriction of liquids during security screening could be improved.

Changi Airport has won many accolades for being the best airport and travellers' expectation are very high. Travellers expect excellent quality services and seamless travel experiences with minimum interruption caused by security check. Hence, it is very

challenging to continually meet travellers expectation while maintaining high security level at airport.

With the impending fourth industrial revolution, major air hubs are investing heavily on Artificial Intelligence (AI) aided security system to improve the airport security level and enhance traveller experiences. Changi Airport will lose travellers to other regional air hubs if there are any security lapses or drop in services level. Any losses in travellers will have far reaching implication to the country economy and air hub status. In recent years, Singapore's position as a stop-over destination for long-haul travellers has been challenged by rival airport hubs, particularly Dubai. In 2013, Qantas decided to move its hub for Australia-Europe flights from Singapore to Dubai, reducing Changi's share from the market.

Research

1. According to SkyTrax, Singapore has been named the best airport in the world from 2012 to 2019 consecutively, also bagging the best airport title 10 times in the 20-year history of the World Airport Awards.

OUR PRIDE Thanks to you, we've won some 595 awards and counting. Retrieved from: <http://www.changiairport.com/corporate/about-us/awards-and-accolades.html>

2. According to an article by The Straits Times, Changi Airport has been named the world's best airport for seven straight years.

Karamjit Kaur (n.d.). Changi Airport bags Skytrax best airport title for 7th straight year Retrieved from: <https://www.straitstimes.com/singapore/transport/changi-airport-bags-skytrax-best-airport-title-for-7th-straight-year>

3. According to IATA Global Passenger Survey 2018, travellers' preferences are evolving rapidly, they now prefer:
 - travel simple and efficient, conscious and paperless;
 - fast, intuitive and self-serviced airports experience;
 - being notified about flight or bad status is important, with a human touch when disruption happens;
 - 57% don't want security screening;
 - 53% don't want immigration.

IATA Global Passenger Survey (2018). Retrieved from: <https://www.iata.org/publications/store/Documents/GPS2018%20Highlights.pdf>

4. According to the IATA Annual Review 2019, passengers no longer simply buy an air ticket; they purchase a travel experience, from booking and check-in, through security, to collecting luggage.

IATA Annual Review (2019). Retrieved from: https://annualreview.iata.org/?_ga=2.166990846.1777611548.1561388945-1172889233.1561388945

5. According to an article by The Straits Times, Changi Airport invested US\$1.7 billion in Jewel to continually improve traveller experiences. Travellers can have an early check-in and wander around freely, and for those who cannot, they can still drop their bags off at a designated area in Jewel.

Karamjit Kaur (n.d.). Jewel a timely investment in future of Singapore air hub. Retrieved from: <https://www.straitstimes.com/singapore/transport/jewel-a-timely-investment-in-future-of-singapore-air-hub>

6. According to The Edge, Changi Airport is having tough competition as rival airports increase their capacity to serve more passengers and flights.

Manu Bhasakaran (n.d.). Singapore's hub status at risk? Retrieved from : <https://www.theedgesingapore.com/singapore%E2%80%99s-hub-status-risk>

7. According to CAPA, Qantas decided to move its hub for Australia-Europe flights from Singapore to Dubai in 2013, reducing Changi's share from the market.

Singapore Changi traffic growth to slow as Qantas drops hub and AirAsia closes base. Retrieved from <https://centreforaviation.com/analysis/reports/singapore-changi-traffic-growth-to-slow-as-qantas-drops-hub-and-airasia-closes-base-105062>

Challenge 3 : Technology Drawback

Based on our survey with 100 participants, ~50% of the travellers think that enhanced scanning technology is needed for better detection without removing items. ~60% of the travellers are comfortable with AI aided security system replacing the current one.

However, based on our observation at Changi Airport, airport security is still heavily reliant on human instead of technology. Routine duties like body search, security screening and patrols are conducted by security officers.

It is observed that Terminal 1 to 3 security screening are using X-Ray scanner, metal detector scanner and hand-held metal detector. The hand carry baggage X-Ray scanner is also manually operated by security officer and travellers will have to take out their laptop, iPad and disposal of liquids. Travellers will be requested to open the baggage for further check if the scanner screen shows a suspicious object. In addition, travellers were required to remove mobile phone, coins, keys and other metal object before passing through metal detector scanner. If the traveller wear a belt, metal watches or has a metal button on his shirt or shoes, the metal detector scanner will beep upon detecting it. By security protocol, security officer will conduct check on the traveller with hand-held metal detectors before the traveller is finally allowed to proceed to the waiting lounge. Sometimes, traveller will need to remove shoe to clear the metal detector scanning.

The existing manually operated security screening is slow and inefficient, resulting in long queue, travellers' frustration and bad experiences. Although Terminal 4 is experimenting

with more advance scanners, these scanners are not automated, but operated manually by security officer and not very efficient.

With fourth industrial revolution, the use of advance scanner, biometric technology and machine learning has increased the accuracy and efficiency of security screening. Technology drawback in Changi Airport maybe a challenge for maintaining high security with an increased air travel in 2030.

Research

1. According to International Airport Review, Heathrow Airport has installed CT security equipment, which can cut down on security screening time because this equipment enable scanning by producing detailed 3D image and travellers are not required to remove laptops, Ipad and liquids from the baggage.

Heathrow becomes first UK airport to invest in CT security equipment. Retrieved from: <https://www.internationalairportreview.com/news/93757/heathrow-uk-airport-ct-equipment/>

2. According to The Straits Times, Changi Airport Terminal 4 had installed biometric scanners, however this is only implemented in Terminal 4 and not in Terminal 1, 2 and 3. Many airports in the world now are already using biometric facial recognition.

Karamjit Kaur (n.d.). Multiple biometric checks at Changi Airport Terminal 4 Retrieved from: <https://www.straitstimes.com/singapore/multiple-biometric-checks-at-changi-airport-t4>

3. Changi Airport has installed 14 scanners across the four scanners to detect metallic and non-metallic items but do not detail the person's actual shape.

Karamjit Kaur (27-May-2019). 14 body scanners in operation at Changi Airport's terminals. Retrieved from: <https://www.straitstimes.com/singapore/transport/14-body-scanners-in-operation-at-changi-airports-terminals>

4. In US & UK, Evolv Technology introduces Evolv Edge which incorporates the latest technologies like powerful sensors which does not require travellers to take out anything. (EvolvEdge Poster, 2019)

EvolvEdge Brochure (2019). Retrieved from https://evolvtechnology.com/wpcontent/uploads/EvolvEdge_Brochure_1Up-B.pdf

5. An online YouGov poll found that around 68% of UK-based passengers would welcome more Artificial Intelligence solutions at airports.

Baker, J., & Baker, J. (2019). AI at airports: how is artificial intelligence speeding up security? Retrieved 28 July 2019, from <https://www.airport-technology.com/features/ai-at-airports-security/>

Challenge 4 : Growth in Air Traffic

Based on our interview with SATS Police, with the increase in air travelling in regional countries and the completion of Terminal 5 by 2030, the number of air travellers to Changi Airport will increase tremendously. In addition, with JEWEL adjoining Changi Airport, there will be spill-over effect from JEWEL which will further increase the crowd to Changi Airport.

With the regional economy stimulated by the fourth industrial revolution, air travel will become very common and there will be an increase of travellers in transit to Changi Airport. Airport security company must deploy more resources to maintain security at Changi Airport.

Research

1. According to The Straits Times, Changi Airport Terminal 5, which is expected to open in 2030, is slated to handle up to 70 million passengers a year. With a 100% increase in travellers to the airport, airport security company has to plan ahead and formulate a strategic plan to manage the security at Changi Airport.

Karamjit Kaur (n.d.). Record passenger haul for Changi Airport in 2018 but global uncertainties loom. Retrieved from:

<https://www.straitstimes.com/singapore/transport/record-passenger-haul-for-changi-airport>

2. According to The Straits Times, Terminal 5 capacity may not be enough for Changi Airport's projected growth. Despite the increase in airport handling capacity from 66 million to 135 million travellers, some experts forecast the handling capacity may be fully utilised by 2031 or even earlier.

Karamjit Kaur (n.d.). T5 'may not be enough' for Changi's growth Retrieved from:

<https://www.straitstimes.com/singapore/t5-may-not-be-enough-for-changis-growth>

3. According to OAG Busiest Routes 2019 report, 15 of the Top 20 busiest international routes are in Asia Pacific, with a cluster around the Asian hub airports of Singapore, Hong Kong, Kuala Lumpur and Bangkok. The busiest international route in the world is Singapore – Kuala Lumpur with over 30,000 flights in the course of a year, operated by 8 carriers with an average of 82 flights per day.

OAG Busiest Routes 2019 report (March 2019).

Retrieved from: <https://www.oag.com/world-busiest-international-and-domestic-routes-2019>

4. Due to geographical location of Singapore, it has been the second largest airline hub operation in Asia. Other than serving as the transit point for travellers on the "Kangaroo Route" connecting Europe and Australia, Singapore convenient location between two of the most populous countries in the world., India and Indonesia, as well as a range of popular tourist destinations in the region, means that Singapore will continue to play the role of a regional airhub and the number of travellers to Singapore will continue to grow.

Challenge 5 : Terrorism Threats

Although about 78% of the respondents to our surveys felt that the security level at Changi Airport is very high, travellers did not realise the security level at some parts of the airport are quite low. Based on our interview with SATS police officer, we discovered that excellent travellers' experiences and providing high quality services are the top priority at Changi Airport. To minimise disruption to travellers' experiences, security check at some areas are not conducted and security level are thus compromised (Eg: check-in counters, retail areas of Terminal 1, 2 and 3).

In most airports, security screening started at the airport main entrance. Travellers's luggage have to be scanned by X-ray scanner and travellers / visitors have to pass through hand-held explosive scanner and metal detector scanner, before they are allowed to enter into the airport. This security protocol is to stop terrorist with explosives entering the airport.

However, based on our observation at Terminal 1, 2 and 3, travellers were allowed to enter into airport without going through any security check. With the exception of check-in luggage which will be screened at the check-in counter, there are no security check at the check-in area, public retail and restaurant area, immigration counter and the duty-free shopping and restaurant area inside the airport secured area. Security screening was only conducted at the boarding gate before travellers entering the waiting lounge. The emphasis on providing excellent travellers experiences is actually compromising security and makes Changi Airport vulnerable to terrorist attacks. This could be very problematic with the fourth industrial revolution as with fast networks and more advanced technologies, terrorists may attack Singapore with smarter ways like drones and cyberattacks. The impact of terrorist attack is detrimental to Singapore's economy and greatly affect Changi Airport's status as an aviation hub.

Research

1. According to the Channel News Asia, Changi Airport is a 'completely plausible' target for terrorists, it being a high-profile airport, an attack may not be a far-fetched scenario.

Aqil Haziq Mahmud (n.d.). Changi Airport a 'completely plausible' target for terrorists: PM Lee Retrieved from: <https://www.channelnewsasia.com/news/singapore/changi-airport-a-completely-plausible-target-for-terrorists-pm-9317020>

2. According to Today, terrorism threats are due to the resilience of terror-groups, involvement of Singaporeans in conflict zones and so on. Only a small number of Singaporeans think a terror attack here is imminent.

Muhammad Faizal Abdul Rahman Terror threat: Why Singaporeans should care Retrieved from: <https://www.todayonline.com/commentary/terror-threat-why-should-singaporeans-care>

3. According to Singapore Terrorism Threat Assessment Report 2019, terrorism threats to Singapore remain high. Even though there is no credible intelligence of an attack being planned against Singapore, Singapore was targeted in 2016 by two ISIS-linked plots. Singapore also faces the risk of attacks by individuals who are radicalised by ISIS propaganda.

Ministry of Home Affairs. Singapore Terrorism Threat Assessment Report 2019 Retrieved from: <https://www.singaporenewstribes.com/singapore-terrorism-threat-assessment-report-2019>

STEP 2. Select the Underlying Problem

Using the challenges listed in Step 1, identify a problem of major importance to the Future Scene situation. Write your Underlying Problem making sure your question clearly explains the action that will be taken and the desired results/goal of that action.

Incorporating Challenge(s) #1,2,5

Underlying Problem:

Given that the manpower shortage may be a potential challenge in 2030 which may affect the security level of Changi airport, how might we improve the security level at Changi airport by relying less on manpower, so that Changi airport can cope with the increase in air travelers and maintain its customer experiences in the years 2030 and beyond?

STEP 3. Produce Solution Ideas

Generate solution ideas to the Underlying Problem in Step 2. Choose the 5 most effective solutions and write the elaborated ideas in the space provided. Include applicable research with appropriate in-text citations.

Solution 1: Intelligent Security System (ISS)

We, the Ministry of Airport Security, shall work with Changi Airport Group and the Ministry of Home Affairs. These companies shall offer grants and incentives to airport security companies to collaborate with top security and AI specialists to research and develop Intelligent Security System which uses advance security technologies and artificial

intelligence. The use of Intelligent Security System shall reduce manpower as advanced technologies can perform routine and repetitive jobs (i.e. surveillance, patrolling, screening) more efficiently and accurately. Artificial Intelligence shall identify security threats accurately, especially in high passenger traffic area. With the use of Intelligent Security System, it can free up security staff to analyze, make sound judgement and handle more complicated situations. This security system shall be implemented in all terminals to provide the best experience for travellers. By June 2030, this security system shall be fully functional in all 5 terminals.

Research

1. According to The Straits Times, Certis Cisco now boosts security services with tech tools which can improve productivity and reduce manpower costs. Certis can have staff at its command center monitoring many areas through sensors and cameras, instead of deploying staff on site.

Sue-Ann Tan (n.d.). Certis Cisco boosts security services with tech tools Retrieved from: <https://www.straitstimes.com/business/certis-boosts-security-services-with-tech-tools>

2. Over the last two decades, airports worldwide have significantly ramped up security in response to emerging threats. Meanwhile, rising passenger expectations have put pressure on major transport hubs to bolster throughput, cut queues and make the journey from entrance to departure gate as seamless as possible A numbers of aviation hubs around the world are investing in Artificial Intelligence (AI) to resolve the above problems.

Baker, J., & Baker, J. (2019). AI at airports: how is artificial intelligence speeding up security? Retrieved from <https://www.airport-technology.com/features/ai-at-airports-security/>

3. Miami International Airport's Transportation Security Administration unveiled a new 3D CT scanner at a security checkpoint lane.

Estrada, L. (2019). Miami International Airport's TSA uses 3D CT scanner to detect explosives. Retrieved from <https://wsvn.com/news/local/miami-international-airports-tsa-uses-3d-ct-scanners-to-detect-explosives/>

4. Terahertz scanner based on terahertz (THz) imaging technology is suitable for high throughput screening, high traffic area. Terahertz can detect weapons, including cold steel, fire arms, bombs, grenades, explosive belt and various contraband items hidden under clothes. The effective imaging range of up to 3m ensures remote detection of suspicious objects and it enable remote scanning without travellers' knowledge. Thus, it will not disrupt travellers' experience.

Scanner, T. (2019). Terahertz security body scanner | TeraSense. Retrieved from <http://terasense.com/products/body-scanner/>

5. Multiple companies are developing security devices powered by artificial intelligence (AI) in order to reduce time, increase effectivity and drive the future of security devices at large.

Gallo, S. (2019). Artificial Intelligence: The Future of Airport Security? Retrieved from <http://blog.bccresearch.com/artificial-intelligence-the-future-of-airport-security>

6. Heathrow Airport has announced the deployment of new computed tomography (CT) security equipment throughout the airport over the next few years. When fully deployed, the 3D equipment could eliminate the need for passengers to remove their liquids and laptops from cabin baggage when passing through security.

Heathrow becomes first UK airport to invest in CT security equipment. (2019). Retrieved from <https://www.internationalairportreview.com/news/93757/heathrow-uk-airport-ct-equipment/>

7. EvolveEdge scanner uses active millimetre wave (MMW) and electromagnetic sensors to detect both weapons and bombs. Travellers can walk through the scanner at regular pace without the need to stop, pause, take out their mobile phone and other belongings. The scanner can also scan luggage and bag, travellers don't need take out laptop, Ipad and liquid.

EvolveEdge Brochure (2019). Retrieved from

https://evolvtechnology.com/wpcontent/uploads/EvolvEdge_Brochure_1Up-B.pdf

8. Regional airports are ramping up their internal security measures as they say the most dangerous threats in today's aviation world come from within. Artificial Intelligence will play a major role in staff clearance as it will ensure swift analysis and predictions of potential behaviour.

Airports turn to Artificial Intelligence to find the dangers within. (2019). Retrieved from <https://www.thenational.ae/uae/government/airports-turn-to-artificial-intelligence-to-find-the-dangers-within-1.697740>

9. Transport hubs in Los Angeles, Denver and Washington are soon to trial high-speed body scanners that can complete its scan in a fraction of second, using computer vision and machine learning to spot guns and bombs.

Harris, M. (2019). AI-powered body scanners could soon be inspecting you in public places. Retrieved from <https://www.theguardian.com/technology/2016/oct/25/airport-body-scanner-artificial-intelligence>

10. Changi Airport will pilot a Multi-Signal Surveillance Platform, which combines audio with video analytics to monitor security incidents.

Fabian Koh (23-Oct-2018). Changi Airport to use audio, video analytics to monitor security incidents from mid-2019. Retrieved from:

<https://www.straitstimes.com/singapore/government-security-sector=and-community-need-to-work-together-to-counter-threats-heng>

11. Xjera Labs has successfully developed a sophisticated dense 52-layer neural networks that can detect individuals, vehicles, and objects from video footage with a 97% accuracy, based on a database containing 20,000 people whose faces have been captured on CCTV.

Mary-Ann Russon (22-May-2017). Behind the world's most sophisticated facial recognition system that tracks absolutely anything. Retrieved from:

<https://www.ibtimes.co.uk/behind-worlds-most-sophisticated-facial-recognition-system-that-tracks-absolutely-anything-1621122>

12. 840 people being nabbed at the checkpoints in the last three years using biometric fingerprint screening. Apart from the systems in place, ICA has plans to progressively deploy new technology using three biometric identifiers – fingerprint, facial and iris – to complement fingerprint matching for immigration clearance.

Karamjit Kaur (20-May-2019). Biometrics helps nab visitors with false IDs

Retrieved from: <https://www.straitstimes.com/singapore/transport/biometrics-helps-nab-visitors-with-false-ids>

Solution 2 : Retrain Staff

We, the Ministry of Airport security, shall retrain airport security staff and improve their skill level. The Ministry of Home Affairs and Changi Airport Group shall offer grants and incentives to airport security companies to retrain staff. It shall be continuously implemented and the training shall be conducted at the Changi Airport Group Training Centre. It shall be jointly organized to induct training for security staff, to learn to operate advanced security technology, raise awareness of security threats and to improve customer service. With this retraining, routine surveillance, patrolling and screening will be done by the advanced technology so that security staff can be freed to handle complicated situations to improve efficiency. By raising awareness, security staff will be more alert in the event of a security threat.

Research

1. According to an article by The Straits Times security officers are now being armed with new tech skills. Security supervisor Mohamad Yashin spent his time patrolling malls and monitoring closed-circuit television (CCTV) cameras on-site when he first join, but now, he is a deputy operations manager who leads a team of 13 operators at the command centre at Certis Commonwealth, allowing him to take and more responsibilities.

Sue-Ann Tan (n.d.). Arming security officers with new tech skills Retrieved from:

<https://www.straitstimes.com/business/arming-security-officers-with-new-tech-skills>

Solution 3 : Airport Security Manager (ASM)

We, the Ministry of Airport Security shall cooperate with Changi Airport Group and airport security companies to implement Airport Security Manager (ASM), a robot which shall be used to manage security better in airports. These robots shall be placed in Changi Airport Terminals 1 to 5 and it shall be fully implemented by January 2030. Airport Security Manager is a robot which will patrol around the airport and scan for suspicious threats. The information detected will be sent to the Security Command Center. With Airport Security Manager, the security risk at the check-in and public areas will be reduced and the manpower shortage problem shall be improved as there is no longer a need for security guards to patrol around.

Research

1. According to The Straits Times, Changi airport now has 'Robocop', a new robot to help with security by patrolling.

Karamjit Kaur (n.d.). Watch out for traffic 'RoboCop' at Changi Airport Retrieved from: <https://www.straitstimes.com/singapore/transport/watch-out-for-traffic-robocop-at-changi-airport>

2. Narita International Airport unveiled four new robots to be deployed for security patrols at the international airport located in Tokyo's neighbouring prefecture of Chiba, local media reported on Thursday (May 30).

Japan's Narita airport rolls out security robots in run-up to 2020 Olympics. (2019). Retrieved from <https://www.straitstimes.com/asia/east-asia/japans-narita-airport-to-use-security-robots-in-run-up-to-2020-olympics>

3. With Tokyo hosting the 2020 Olympics, Haneda Airport is bracing for a sharp increase in visitors from abroad and hopes robots can compensate for a lack of staff. The robots can carry out simultaneous interpretation in four different languages and will approach travellers and asking if they need its help. The robot can converse with visitors through its AI system and give directions. Some of the robot is programmed to carry luggage through the airport alongside the travellers.

Tokyo airport robots to provide assistance to travellers ahead of 2020 Olympics (12-December-2017)

Retrieved from: <https://www.straitstimes.com/asia/east-asia/tokyo-airport-robots-to-provide-assistance-to-travellers-ahead-of-2020-olympics>

Solution 4 : Cooperate with various agencies

We, the Ministry of Airport Security, shall cooperate with more agencies to ensure that airport safety is not compromised. We can cooperate with more agencies and uniformed groups to assist the airport security in Changi Airport. The cooperation shall apply on all the terminals, T1 to T5 by June 2030. We can induct training and share important information regarding intelligence. Uniformed groups like the Police Force shall also provide more manpower during peak hours to help patrol the airport. With more cooperation from various agencies, there could be a better sharing and dissemination of information and most importantly, it shall greatly improve the manpower shortage issue at the airport as there will be more manpower provided by uniformed groups like the SAF, Singapore Police Force and the Civil Defence Force.

Research

1. According to an article by The Straits Times, a staged terror attack occurred at the early hours of Changi airport T3. PM Lee stated that a terror attack is 'completely plausible' and 'urged the various agencies to cooperate closely and have ample practice'.

Danson Cheong (n.d.). Airport a high-profile target for terrorists, says PM Lee. Retrieved from: <https://www.straitstimes.com/singapore/airport-a-high-profile-target-for-terrorists-says-pm-lee>

2. The Singapore Police Force (SPF) and the Singapore Armed Forces (SAF) conducted an islandwide counter-terrorism exercise from 19 to 20 February 2019. This exercise is part of continuous efforts by the Home Team and the SAF to test and validate Singapore multi-agency response plan in the event of terrorist attacks.

Islandwide Multi-Agency Counter-Terrorism Exercise (22-February-2019)

Retrieved from: https://www.police.gov.sg/news-and-publications/media-releases/20190222_Islandwide_Multi_Agency_Counter_Terrorism_Exercise_OTHER_S

Solution 5 : Pay Rise for Security Officers

We, the Ministry of Airport Security, shall increase wages and improved benefits for security officers, in an attempt to attract more and younger Singaporeans to join the sector and easing the manpower crunch. These measures are needed to uplift the security industry given the increasing demand for security services and rising threat of terrorism. Changi Airport Group can grant Certis Cisco incentives for the hiring of more security officers. Furthermore, with retrenchment and people having no jobs, people will need to have a job and raising the salary of this job will make it look more attractive for people to join this industry. This increase can take place gradually, starting now, until there are enough workers. With pay rise for security officers, the security officers shall be more motivated to

do their job well and serve the travelers with better quality service. Most importantly, since there are more manpower, the manpower crunch shall be improved.

Research

1. According to The Straits Times, Certis Cisco is now recruiting officers from Taiwan. Candidates, who are successful, will have a monthly salary of NT\$60,000 (S\$2,700) and an additional bonus upon completing their contracts, while the average Taiwanese graduate's starting pay is about NT\$27,000.

Tan Tam Mei (n.d.). Certis Cisco recruiting officers from Taiwan. Retrieved from:
<https://www.straitstimes.com/singapore/certis-cisco-recruiting-officers-from-taiwan>

2. According to Mr Chua Chwee Koh, Certis Cisco's technology and operations chief, technology helps the firm upgrade the skills of existing security guards, resulting in higher pay. However, it can be difficult to get staff on board. Employee need to be open to change.

Sue-Ann Tan (n.d.). Certis Cisco boosts security services with tech tools Retrieved from:
<https://www.straitstimes.com/business/certis-boosts-security-services-with-tech-tools>

3. Security officers will be paid more while working fewer overtime hours each month in future.

SIN, Y. (2019). Basic pay for security officers to go up by \$300 by 2021, limit on overtime hours. Retrieved 29 July 2019, from
<https://www.straitstimes.com/singapore/manpower/basic-pay-for-security-officers-to-go-up-by-300-over-next-3-years-overtime>

STEP 4a. Select Criteria

Generate criteria to determine which solution idea does the best job of solving your Underlying Problem and/or addressing the Future Scene situation. Select the 3 most important criteria for measuring solution ideas and write them in the spaces provided.

Criterion 1

Which solution is the fastest to implement for Ministry of Airport Security so that it will not disrupt the customer experience and ease the manpower crunch as quick as possible?

Criterion 2

Which solution is the cheapest to implement for Ministry of Airport Security, so that less money can be spent on security and instead on better services?

Criterion 3

Which solution is the most effective for Ministry of Airport Security so that it will be able to ease the manpower crunch and ensure that we maintain the customer expectations in the years 2030 and beyond?

Criterion 4

Which solution is the least reliant on manpower to be implemented for Ministry of Airport Security so that the chances of a mistake taking place will be reduced due to lapses and ease the manpower crunch?

Criterion 5

Which solution is able to provide the most seamless travel experience when implemented for Ministry of Airport Security, so that travelers can have a good experience without having the security level compromised?

STEP 4b. Apply Criteria

List the solution ideas from Step 3 on the grid. Use each criterion to rank the solutions on a scale from 1 (poorest) to 5 (best). The weighting for one important criterion may be doubled if necessary.

Step 3 Sol'n #	Solution Idea	Criteria					Total
		1	2	3	4	5	
#1	Intelligent Security System	2	3	5	5	5	20
#2	Staff Retraining	4	3	3	3	3	16
#3	Airport Security Manager	4	4	2	3	3	16
#4	Cooperate with various agencies	3	5	2	2	2	14
#5	Pay rise for security guards	3	2	2	3	3	13

STEP 5. Develop an Action Plan and Evaluate its Feasibility

Develop your top-scoring solution idea into an Action Plan. Thoroughly explain how the Underlying Problem is solved, how the plan will be implemented, and how the Future Scene will be affected. Explain how this Action Plan is feasible with secondary research consulted, preferably also with primary research (feedback from chosen community / organization).

Action Plan derived from Solution #1

Action Plan

We, Ministry of Airport Security, together with Changi Airport Group and the Ministry of Home Affairs, shall implement an Intelligent Security System (ISS) in all terminals and by June 2026, this system will be fully functional in T1,2 and 3. By September 2028, it will be installed and implemented in T4 and in T5. The whole system will be in full operation by June 2030, so as to raise security levels in Changi Airport with less manpower and maintain our customers' experiences. This Intelligent Security System will make use of advanced technology, such as Millimeter Wave scanners, CT scanners, Terahertz scanners and Biometric technology. Terahertz technology shall be placed at the entrance of the airport, allowing us to detect threats and react with speed and possibly prevent an attack from occurring. The data detected by the scanner will be sent to the command center whereby artificial intelligence will analyse the data received. Upon detecting suspicious threat, AI will send signal to the security officers for necessary action.

The system shall be able to function better than the past, as it does not have problems such as lapses and poor services. It is consistent, and is more accurate and efficient. While routine and repetitive jobs such as patrolling are handled by robots, humans can work from the command center to handle more complicated situations that the robots will not be able to perform. With this security system in place, the current manpower shortage in Changi Airport shall be improved and Changi Airport Group will also be able to better handle the growth in air traffic, coping with roughly 135 million passengers by 2030. With ISS, we shall be able to provide our travelers with excellent quality service and seamless travel experience, as well as resolve the manpower shortage issue without compromising airport security.

Implementation timeline

This is the implementation timeline of our action plan:

- 2020: Feasibility study with Changi Airport Group
- 2021: Finalised proposal and agreement to implement ISS
- 2022: Procurement of different technologies
- 2023: Installation of ISS in T1,2 and 3.
- 2024: Completion date for first trial run of ISS in T1, 2 and 3
- 2025: Implementation of ISS in T1, 2 and 3.
- 2026: Installation of ISS in T4
- 2027: Subsequent trial runs of ISS in T1, 2, 3 and 4
- 2028: ISS to start functioning fully in T1, 2, 3 and 4
- 2029: Further improvements made to ISS to enhance its abilities
- 2030: Construction of T5 complete, implementation of ISS occurs concurrently

Addressing our Key Verb Phrase

- Given that the Key Verb Phrase in our Underlying Problem is “how might we improve the security level at Changi Airport by relying less on manpower”, our action plan and solution addresses this. With ISS, routine and repetitive jobs will be replaced by advanced technology, leaving security guards to handle more complicated situations. Thus, airport security level will be improved with advanced technology and less manpower is needed.
- With ISS, advance scanner enables accurate and efficient security screening. Travellers can pass through the scanner without taking out laptops, ipad, liquid from their luggage. Traveller also not required to take out mobile phone, wallet and other metal objects.

Impact

- The implementation of the Intelligent Security System will positively impact the airport security industry. With advance technology, security screening will be more accurate and efficient. This will reduce the reliant on manpower, reduce queuing time and minimise inconvenience caused by removing laptops and liquid from luggage.
- With AI, threat analysis will be carried out more precised and fast. This enables security screening being carried out without traveller awareness. This will greatly enhance traveller seamless experience, and, without compromising security.
- Airport security company can cope with the increasing traveller with limited manpower.
- With ISS, customer experience of Changi Airport will also be improved as travelers do not need to encounter security guards with bad attitude and poor services which often lead to arguments and frustration.
- Our action plan does not cause any form of mental or physical harm to staff or travelers. In fact there will be less pressure on the staff, and the airport will become safer and less vulnerable to threats such as terrorism.

Resistors and Supporters

- We believe travellers, Changi Airport Group, security companies and the Ministry of Home Affairs (MHA) would support this idea. For airport security company and MHA, ISS help them to overcome manpower shortage and improve security level. For Changi Airport Group, ISS provide a secured and excellent traveller experience,
- Potential resistors will be some of the security guards who are in need of jobs. With ISS, the manpower needed will be greatly reduced and some security guards may be replaced by ISS, causing them to lose their jobs. Another possible resistor will be AI Critics who are skeptical about AI and concern about intrusion of privacy, cyber-attack.

Potential Obstacles / Solutions

We have identified five main obstacles to ISS implementation:

1. Integration of security system

Potential Obstacles:

The core of ISS is to use artificial intelligence to control and integrate various airport security system and such integration is challenging at all level. At the organization level, the use of advance technology has implications on future recruitment, training and workforce. At the operational level, the airport security team need to understand where the human is still needed, how different technologies, processes and skills should be integrated for best effect.

Solutions:

- Airport security company to review the current operation and to determine the types of technology and the roles of human in the ISS.
- Airport security company to work closely with security technology company, AI specialists, and Cyber Security Agency of Singapore (CSA) to integrate the different technologies and human in the ISS.
- Airport security company to analyse the skill set required and retrain the security officers to operate ISS.

2. Threat of cyber-attack on ISS

Potential Obstacles:

Singapore will continue to be the target of cyber-attacks. In 2018, notable cyber-attack incidents included cyber-attacks on SingHealth and a number of universities in Singapore. As airports increasingly use digital technology in their day-to-day operations, they are becoming more vulnerable to attack and data breaches. Some of the anticipated cyber-attack trends include more frequent data breaches, more disruptive attacks against the Cloud, leveraging on Artificial Intelligence (AI) to search for vulnerabilities and create smarter malware etc.

Solutions:

- Changi Airport Group, airport security company to stay vigilant and strengthen their cyber security to keep pace with increasingly targeted and sophisticated threats. Airport security company to set-up a specialised cyber-security team to monitor and counter cyber-attack threats.
- Partnership with CSA and the cyber security community to collectively build a safer and more secure cyberspace.
- Prepare a back-up plan to counter cyber-attack. In the event of cyber-attack, ISS shall allow the operation mode to shift from AI mode to manual mode to ensure airport operation will not be disrupted. In manual mode, the advance scanner will continue to function normally and operate by security officer instead of AI.

3. Lack of AI Talent

Potential Obstacles:

Due to the relatively late development of AI in Singapore, there is simply not enough talent to integrate various advance technology and implement ISS. Moreover, current batch of security officers are not trained to operate machines which think and learn for themselves.

Solutions:

- The immediate solution for the implementation of ISS is to attract foreign talent and to engage AI specialists to narrow the knowledge gap.
- For longer term solution, Changi Airport Group and airport security company to cooperate with university and polytechnics to develop AI related courses in the institution.
- Changi Airport Group and airport security company to offer scholarships to increase its artificial intelligence talent pool.
- Government agencies will work together with tripartite partners to implement the recommendations for the security sector to create more meaningful careers with stronger emphasis on skills with faster progression through the ranks so as to increase their productivity and improve security outcomes

4. People's Trust

Potential Obstacles:

ISS which leveraged on artificial intelligence may be resisted by people who are skeptical about AI and concern about intrusion of privacy, cyber- attack. This may eventually lead to public loss of confidence of the airport security level.

Solutions:

- The root cause of this obstacle is people don't feel comfortable because average human doesn't understand how the decision was made by AI.
- Changi Airport Group and airport security company to organise exhibition(s) to showcase the functions and benefits of robots and advanced scanners so as to increase people's awareness and trust of how these new technologies work as part of the moves to boost security amid increasing threat levels.

5. Cost

Potential Obstacles:

Due to scarcity of data published, we have difficulty researching the cost of the security system at Changi Airport. However, due to the use of advance scanner and artificial intelligence, it is anticipated that ISS may be more costly than conventional X-ray scanner.

Solutions:

1. Singapore government is willing to set aside budget to support defence and security. For example, according to 2019 budget, about 30% of the government total expenditure is being set aside to support defence, security and diplomacy efforts.
2. Singapore government is willing to invest to upgrade Changi Airport and airport management system. For example, Singapore government expects to spend several billion dollars over the next few decades to upgrade Changi Airport's air traffic management system.

3. Although ISS may be more costly than conventional X-ray scanner, the total cost for ISS is small compare with the total cost to operate or build an airport. Moreover, the cost of ISS is justifiable considering the increasing competition for travellers, increasing air traffic and raising terrorism threat. To work with Changi Airport Group and Singapore Government to commit a substantial portion for funding of new security equipment and systems infrastructure.

Research (for Action Plan and Evaluation)

1. According to International Airport Review, integration of security system is proving challenging for airports to get the true value out of technology investment.

Anthony Bridges (7-Aug-2017). Airport security: current challenges and trends.

Retrieved from: <https://www.internationalairportreview.com/article/37142/airport-security-current-challenges-and-trends/>

2. Files were encrypted and held at ransom in multiple official computers by an attacker known as SamSam at Hartsfield-Jackson Atlanta International Airport. The Atlanta airport switched off the Wi-Fi service to avoid any malicious ransomware spreading to airport authority computers, airline computers, and possibly customers' computers. While the Wi-Fi network was affected, no flight disruptions were caused.

Saraogi, V., Saraogi, V., & Saraogi, V. (2019). Five times airports were involved in cyberattacks and data breaches. Retrieved from <https://www.airport-technology.com/features/five-times-airports-were-involved-in-cyberattacks-and-data-breaches/>

3. According to Cyber Security Agency of Singapore (CSA), Singapore has been, and will continue to be, the target of cyber-attacks by Advanced Persistent Threat (APT) groups and other actors. In 2018, notable incidents included cyber-attacks on SingHealth and a number of universities in Singapore.

Singapore Cyber Landscape (2018)

Retrieved from: <https://www.csa.gov.sg/news/publications/singapore-cyber-landscape-2018>

4. According to Bernard Marr, there are still not enough talent to enable every businesses to unleash their vision of machine-powered progress on the world. There is a skill shortage and not enough people who know how to operate machines which think and learn for themselves.

Bernard Marr (13-Jul-2017). The biggest challenges facing artificial intelligence (AI) in business and society

Retrieved from: <https://www.forbes.com/sites/bernardmarr/2017/07/13/the-biggest-challenges-facing-artificial-intelligence-ai-in-business-and-society>

5. With fourth industrial revolution, major companies are fighting for artificial intelligence talents by offering postgraduate scholarship.

Rosalind Ang (4-Jun-2019). OCBC Bank launched a postgraduate scholarship to increase its artificial intelligence talent pool, in partnership with both NUS and NTU.

Retrieved from: <https://www.straitstimes.com/singapore/ocbc-bank-launches-postgraduate-ai-scholarships>

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10. More emphasis on skills, faster progression for security officers after Government accepts recommendations. (2019). Retrieved from

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