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Laptop Bombs and Civil Aviation:

Terrorism Potentials and Carry On Travel Bans

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Contents

Foreword

This TRENDS Working Paper represents a more in depth analysis of a prior Insights essay from the Terrorism Futures Series. It remains focused on the heightened concerns expressed over the smuggling of explosives hidden in laptops by Al Qaeda, and now Islamic State/Daesh, operatives for civil aviation bombing purposes. It also, however, provides a more detailed look into ongoing radical Islamist airliner explosive device targeting approaches and activities. These are broken down and tabled per four identified approaches, that is, via checked baggage (or parcel cargo), close to the body, internal body (animal), or carry on item devices being characterized. Imagery and information derived from radical Islamist English language magazines—specifically, *Inspire* (an AQAP; Al Qaeda Arabian Peninsula publication) and *Dabiq* (a Daesh publication)—is also utilized. In addition, a more detailed red team analysis of the terrorism potentials related to the laptop bombing mode of attack is made and more information related to the laptop (as well as similar sized electronic device) travel bans that have been enacted and are now being considered is provided. This area of threat concern is extremely important to a global airline industry that generates in excess of $700 billion dollars of revenues each year. If radical Islamist terrorists are able to effectively target passenger airliners with laptop (and related consumer electronics) bombs by bypassing current screening technologies and protocols, they will detrimentally impact consumer confidence related to the safety of this mode of travel. Should such a scenario develop, laptop and related device travel bans—although economically costly and disruptive to business travelers—may be required as a stopgap measure to restore passenger confidence until adequate countermeasures have been put into place.

Civil Aviation Bombings

Passenger airliners have been the targets of terrorist bombing attacks for some decades now with Gulf Air Flight 771 crashing into the desert near Abu Dhabi, UAE in September 1983, Air India Flight 182 breaking up after taking off from Montreal, Canada in June 1985, and Pan Am Flight 103 exploding over Lockerbie, Scotland in December 1988 representing some of the earliest and most catastrophic incidents. While various terrorist groups have engaged or attempted to engage in these forms of attacks, since the mid-1990s Al Qaeda has made a concerted effort to target airliners.

This concerted effort is composed of nine incidents directly linked to that organization along with one incident indirectly linked (via Shamil Basayev's Chechen group). In addition, a relatively recent incident in October 2015 conducted by the Islamic State/Daesh—an Al Qaeda evolutionary offshoot—has also taken place (See Table 1). These civil aviation explosive device targeting incidents have been undertaken via one of four approaches: checked baggage (or parcel cargo), close to the body, internal body (animal), or carry on item devices—which have been alternatively utilized over time in an attempt to bypass airport screening technologies and protocols [1].

Table 1.0 Al Qaeda and Islamic State/Daesh
Airliner and Cargo Aircraft Bombing Activity

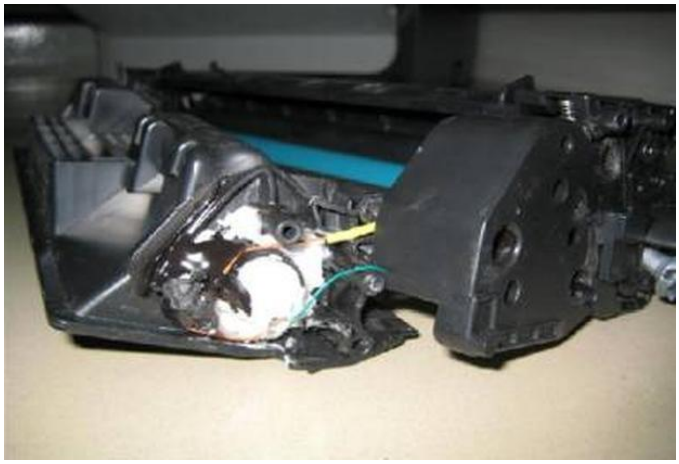
DATE	TARGET	GROUP	TTP; OUTCOME
11 December 1994	Philippine Airlines Flight 434 (Out of Cebu to Tokyo)	Al Qaeda (Ramzi Yousef Cell)	Liquid Explosives (*Cary On*); Detonated but Aircraft Landed Safely (1 Killed, 10 Injured) (Bojinka Plot—Test Run)
6-7 January 1995	Up to 11 Airliners were to be Targeted (Out of Asia to the US)	Al Qaeda (Ramzi Yousef Cell)	Liquid Explosives (*Carry On*); Interdicted at the Planning Stage (Bojinka Plot)

22 December 2001	American Airlines Flight 63 (Out of Paris to Miami)	Al Qaeda (Richard Reid—Operative)	Shoe Bombs (*Close to the Body*); Passengers Stopped Lighting of Fuses
24 August 2004	Volga-AviaExpress Flight 1353 & Siberia Airlines Flight 1047 (Out of Moscow to Volgograd and Sochi Respectively)	Chechens (Shamil Basayev's Group with Al Qaeda ties; Amanta Nagayeva & Satsita Dzhebirkhanova Operatives)	Bra Bombs (*Close to the Body*); Both Airliners Destroyed in Flight (90 Killed)
9 August 2006	Up to 10 Unspecified Flights (Out of the United Kingdom to the US and Canada)	Al Qaeda (London Cell)	Liquid Explosives (*Carry On*); Interdicted at the Planning Stage
Pre-November 2008	Unspecified Cargo Plane (Out of Baghdad to Los Angeles)	Al Qaeda (Iraqi Component)	Explosives Sewn into 2 Dogs (*Body Cavity*)—Dogs Died in their Cages Prior to Being Loaded Onto the Aircraft; Post-Mortem Plot Discovery
25 December 2009	Northwest Airlines Flight 253 (Out of Amsterdam to Detroit)	Al Qaeda (AQAP; Umar Farouk Abdulmutallab—Operative)	Underwear Bomb (*Close to the Body*); Failed to Detonate—Localized Fire with Perpetrator Subdued
29 October 2010	FEDEX and UPS Cargo Planes in the UAE and Britain Heading to the United States	Al Qaeda (AQAP)	Packages Containing Printer Cartridge Bombs Originating in Yemen (*Checked Baggage; Cargo*)—Cell Phone Detonated—Interdicted On Board
Late April 2012	Unspecified Passenger Airliner (Final Destination to be the U.S.)	Al Qaeda (AQAP)	Upgraded Underwear Bomb (*Close to the Body*); Interdicted About One Week Before Deployment While Bomber in Transit from Yemen
31 October 2015	Metrojet Flight 9268 (Out of Sharm El Sheikh to St. Petersburg)	Islamic State/Daesh (Wilayat Sinai)	Bomb in Beverage Can (*Carry On*) [1]—Rocker Switch—Aircraft Disintegrated in Flight (All Killed; 224)
2 February 2016	Daallo Airlines Flight 159 (Out of Mogadishu to Djibouti City)	Al Qaeda (Al Shabab; AQAP Technical Support—	Laptop Bomb (*Carry On*); Hull Breech—Plane Landed Safely (2

		Abdullahi Abdisalam Borleh Operative)	Injured; Bomber Killed)

1. The device responsible for the explosion has not been confirmed—a beverage can would not normally be allowed to be carried through screening by a passenger. This suggests insider threat potentials or a different type of explosive device and/or detonation method was utilized. *Sources: This table has been compiled from numerous newspaper articles and media reports.*

The initial approach—which places the bomb in checked baggage (or in parcel cargo)—is considered an inferior one because of the foreseen difficulty of device detonation. While it has been historically utilized—such as in the Pan Am Flight 103 incident—it has only been attempted by AQAP in late October 2010 by means of placing explosives (PETN; Pentaerythritol Tetranitrate) in printer cartridges carried as cargo onboard FEDEX and UPS cargo planes in the UAE and Britain heading to the United States. The operation was interdicted while the explosive devices were on the aircraft due to Saudi Arabian intelligence warnings likely provided by an insider[2].



AQAP printer cartridge containing PETN explosive intercepted in Dubai

Dubai Police via Emirates News Agency

The second approach—utilizing close to the body bombs—has been attempted in December 2001, August 2004, December 2009, and April 2012. These activities began with the well-known Richard Reid shoe bomber incident that took place on American Airlines Flight 63 out of Paris to Miami. In that incident, the Al Qaeda operative was

unable to successfully light the fuses of his shoes to detonate the explosive (PETN) contained within them before being subdued by the crew and nearby passengers[3]. The second August 2004 incident resulted in the destruction of two domestic Russian flights (Volga-AviaExpress Flight 1353 & Siberia Airlines Flight 1047) by Chechen operatives wearing bra bombs containing RDX (Research Department Explosive; or Cyclonite) explosive[4].

The third and fourth incidents—from December 2009 and April 2012, respectively—are focused on underwear type devices devoid of any metal content, as developed by AQAP. The attack on Northwest Airlines Flight 253 by Umar Farouk Abdulmutallab utilized an IED composed of 80 grams of PETN detonated by a syringe injection method. The device was hidden in the void behind the man's private parts that made it opaque from traditional screening measures but failed to detonate due to moisture issues from being worn so long[5]. This was followed a few years later with an upgraded underwear bomb plot with the new device interdicted while it was still in Yemen. It was said that a new type of explosive was being utilized which was causing upgraded security measures to be implemented by U.S. TSA (Transportation Security Administration)[6] AQAP then went on, in the Winter 2014 edition of *Inspire* (Issue 13), to promote the manufacture of close to the body bombs—of the incident three and four conceptual type—under the article title 'The Hidden Bomb' as an element of its Open Source Jihad (OSJ) program.

The 'Hidden Bomb' with Syringe Ignitor & Percussion Cap

Inspire Magazine, Issue 13. Winter 2014: 73

Internal body cavity bomb utilization—representative of the third approach—has been attempted only once in the pre-November 2008 time period and not with a human operative. Rather, it was derived from a plot to surgically implant explosives into two stray dogs and then have them detonate on a cargo flight from Baghdad to Los Angeles as part of a dog adoption program. The dogs died in their cages due to botched stitching before being loaded onto the cargo flight and were subsequently determined to be carrying internal bombs within them[7]. As in the checked baggage (parcel cargo) approach, this method may suffer from increased difficulties related to bomb detonation.

The final approach—based on using carry on items to hide the bomb—is a predominant one and has taken place in five incidents found in December 1994, January 1995, August 2006, October 2015, and February 2016. The initial three were all liquid explosive based—the first two of which were components of Ramzi Yousef's Bojinka plot[8] and the later one an Al Qaeda London cell plot[9]. This TTP (Tactic, Technique, and Procedure) has been subsequently neutralized by carry on liquid bans (over a certain amount) and new liquid explosive detection capabilities. The fourth incident—the Russian Metrojet Flight bombing in October 2015 out of Sharm El Sheikh is still shrouded in mystery. It may have involved an explosive placed in a beverage can—per a November 2015 *Dabiq (Issue 12)* magazine article—however, for the rocker device to be operated it would have required the Islamic State/Daesh operative to manually toggle the device which would not normally be possible since such a beverage can should not have been allowed through airport security[10]. The fifth carry on items incident targeted Daallo Airlines Flight 159 out of Mogadishu to Djibouti City. In this incident, Abdullahi Abdisalam Borleh—an Al Shabab operative with likely AQAP technical support—detonated a laptop bomb that resulted in a hull breach that killed him and injured two nearby passengers. The aircraft had not reached cruising altitude which likely saved it from destruction and it was able to safely make an emergency landing[11].

Beverage Can Containing Explosives, Blasting Cap, and Rocker Switch

Dabiq Magazine, Issue 12. November 2014: 3

It is this approach utilizing a laptop bomb in February 2016—along with earlier 2014 intelligence relating to AQAP bomb making TTPs shared with the Al Qaeda 'Khorasan' component in Syria[12] and finally now unspecified Islamic State/Daesh heightened interest in civil aviation bombings[13]—that has triggered the recent laptop and similar sized electronic devices travel bans on certain international flights.

Terrorism Potentials

From a red team perspective, the major technical decision points related to smuggling laptop bombs onto passenger airlines pertains to bypassing contemporary airport screening measures in the areas of *explosives detection* and *laptop forensics and functionality tests*[14]. Soft considerations also exist. They include smuggling bomb laden laptops through lower tier airports with inadequate screening technologies, procedures, and practices and using confederates that share the attacker's ideology or are simply paid off (e.g. the insider threat) to help allow the laptop through security and onto the targeted airliner[15]. While they will be taken into consideration, they will not be focused upon concerning this discussion of terrorism potentials.

Explosives detection defeat strategies can be focused on either utilizing new and novel forms of explosives that are not in scanner datasets—much in the same way the early use of TATP (Triacetone Triperoxide) represented an initial screening vulnerability—or utilizing known threat explosives that have had their residue and off-gassing signatures masked so that common swabbing/patching and machine olfaction techniques are neutralized (via Explosive Trace Detection; ETD)[16]. For terrorist mission requirements, explosive signature masking and/or elimination is preferable as it relies upon the utilization of known and effective explosives rather than attempting to develop new and unproven ones outside of known explosive chemical groupings presently being screened for. Such signature masking and elimination can be attempted to be accomplished by means of clean room-like techniques and the vacuum sealing of explosives—the latter of which was a TTP utilized by the Tamil Tigers (Liberation Tigers of Tamil Eelam) in some of their devices in the past[17]. Non-porous device skin materials and acetone and alcohol baths are also now commonly utilized by AQAP to mask explosive signatures in their bomb designs.

Laptop forensics and functionality test defeat focuses on making sure that x-ray imaging (and potentially decay signature sensing) of a laptop will not result in anomaly detection related to its internal components and, if a laptop is turned on, that it will minimally function during an inspection. The intent is to facilitate a 'contextual narrative' for the device that airport screeners will accept and thus allow it to pass through their screening procedures. To effectively bypass the x-ray screening hurdle, a terrorist group would be required to take baseline images of a laptop to provide a comparative standard against IED (Improvised Explosive Device) alterations required to turn the computer artifact into a functioning bomb. Laptop selection criteria would be based on ubiquitous business systems that have reasonable cost so as not to stand out while at the same time possess relative bulkiness so that enough internal space exists for alterations to be made without making the laptops non-functioning. Explosive caching focal points would be internal optical drives—though most newer laptops no longer come with them—hard drives, batteries, and void

spaces that can be made to appear as functioning components as well as external USB optical drives and other peripherals (e.g. keyboards and power supplies and transformers) one might take on a business trip with them. The laptop bomb alterations need to be done in such a way that, if a screener asks for the system to be turned on, it must appear to minimally function[18].

While such airport screening defeat strategies may represent major obstacles for terrorist groups—though recently some of the Al Qaeda affiliates appear to be making progress with their homebrew lab capabilities—the Islamic State/Daesh has until recently commanded more technical resources than any other previous terrorist organization in existence[19]. In fact, that entity has possessed the scientific capacity of a city-state with its over two year control of the University of Mosul, one of the largest research centers in the Middle East—that included electrical engineering and chemistry labs and medical imaging facilities—as well as ongoing control of smaller, as well as satellite, universities in Raqqa, Deir Ezzor, and al-Hassaka Syria[20]. At a minimum, we know that various university facilities in Mosul, as well as in Raqqa, were put on a war footing and used to research and produce weaponry for the Islamic State/Daesh[21]. Armaments manufactured have included armored VBIEDs (Vehicle Borne Improvised Explosive Devices), teleoperated rifles and machine guns, rockets dispersing chemical agents, batteries for MANPADS (Man Portable Air Defense Systems), bomblets for drone aerial bombardment, and FLIR (Forward Looking Infrared) masking and generating materiel.

Additionally, the Islamic State/Daesh has had access to airport screening equipment captured from Mosul International Airport (OSM) and potentially from some smaller airports within their earlier territorial footprint in Iraq and Syria. The Mosul airport security equipment manifest is unclear, with an unknown potential number of x-ray machines, metal detectors and/or explosive residue sensors that may have been seized from it's sole passenger terminal. As of June 2003, a Heimann Hi-Scann 6040TS screening system (if functioning is unknown) was evident in the departures area but there was "no walk-thru detecting equipment" existing at that time[22]. Later

information on the airport's passenger screening capacity is not readily available so what actual screening machinery was seized is unknown. Still, given such a past technical capacity and possible access to some airport screening equipment and combined with the fact that the Islamic State/Daesh had decided to fully shift from a *Dabiq* (e.g. remaining and expanding) to a *Rumiyah* (e.g. attacking the Romans) strategy in September 2016, the potentials for the increased threat of laptop and related electronic device bombings of civil aviation have now undoubtedly increased.

Such bombings could now be conducted by the Islamic State/Daesh independently of Al Qaeda components or in some limited coordinated manner with them, although any form of actual near term rapprochement between the two competing radical Islamist groups is debatable. Still, if either scenario is now in play, it would go a long way to help explain the proactive laptop and electronic device carry on bans enacted and being considered. Such bans are more typically reactive in nature and immediately implemented only after a specific airliner incident related to them—such as explosives found in shoes (with the ensuing she screening requirement) and the use of liquid explosives (with carry on limits mandated and separate contenting screening enacted)—has taken place. This logic pertains to the fact that such a long lag time exists from when the initial Al Qaeda Daallo Airlines Flight 159 laptop bombing took place in February 2016. The timing of the present carry on laptop and electronic device travel ban is thus very unusual coming over a year later and thus likely reflects the fact the Islamic State/Daesh also now represents a credible laptop bombing threat to civil aviation. An unconfirmed report supports such a supposition:

> The night the ban was announced mid-March, reports claimed the so-called Islamic State group (ISIS) had been "working on ways to smuggle explosives on to planes by hiding them in electronics" and that this tip-off was from a credible source. A security source then told the *Guardian* that the decision had been made after "the exposure of a terror plot involving an Apple iPad." These reports have not been confirmed, though[23].

Interior and Exterior Views of Laptop Bomb Damage to Daallo Airlines Flight 159

Associated Press and Stringer/Anadolu Agency/Getty Images

Carry On Laptop and Electronics Travel Bans

The present laptop (as well as similar sized electronic device) travel ban was enacted on 21 March 2017 by the U.S. Department of Homeland Security (DHS). It focuses on the following items:

> Examples of large electronic devices that will not be allowed in the cabin on affected flights include, but are not limited to:
>
> • Laptops
> • Tablets
> • E-Readers
> • Cameras
> • Portable DVD players
> • Electronic game units larger than a smartphone
> • Travel printers/scanners[24]

And pertains to the following ten international airports:

> • Queen Alia International Airport (AMM)
> • Cairo International Airport (CAI)
> • Ataturk International Airport (IST)

- King Abdul-Aziz International Airport (JED)
- King Khalid International Airport (RUH)
- Kuwait International Airport (KWI)
- Mohammed V Airport (CMN)
- Hamad International Airport (DOH)
- Dubai International Airport (DXB)
- Abu Dhabi International Airport (AUH)[25]

These last point of departure airports into the United States reside in the following eight Middle Eastern and North African countries; Egypt (1), Jordan (1), Kuwait (1), Morocco (1), Qatar (1), Saudi Arabia (2), Turkey (1), and the United Arab Emirates (2). These airports are geographically clustered in the primary Islamic State/Daesh areas of regional operation in Iraq, Syria, and Libya. Additionally, AQAP (Al Qaeda in the Arabian Peninsula) and Al Qaeda Khorasan group elements in Syria and Iraq also possess operational capacity potentials in many of the nations that contain these airports. Of additional note is the fact that "There is no impact on domestic flights in the United States or flights departing the United States. Electronic devices will continue to be allowed on all flights originating in the United States"[26].

The United Kingdom simultaneously followed suit on 21 March 2017 with a similar laptop and electronic device cabin ban from last point of departure airports in Egypt, Jordan, Lebanon, Tunisia, Turkey, and Saudi Arabia[27]. Banned carry on laptops and electronic devices will be allowed in passenger luggage in airliner cargo bays under both the U.S. and UK new travel protocols, reflecting how much more difficult it is to detonate such IED devices by means of a timer, barometric, GPS, or remote texting initiator as opposed to by those devices carried into the cabin by a terrorist operative[28]. Of note is the fact that Western European nations—such as France and Germany—who are actively being targeted for attack by radical Islamists have not acceded to similar computer device travel bans.

Speculation persists that the laptop and electronic device ban may be expanded by DHS to cover additional specific last point of departure airports into the United States or become a blanket ban affecting all flights into the U.S. or even potentially be mandated for all international flights originating from the U.S. and/or domestic U.S. flights themselves[29]. One recent plan now mentioned may extend the ban from the present 10 international last point of departure airports to as many as 71 of them[30]. Such future determinations are still an unknown but will be based on some sort of cost-benefit analysis related to these increased safety requirements. These will be made in the face of actual incidents, plots, and intelligence related to Al Qaeda affiliate and Islamic State/Daesh activity versus lost business productivity for airline passengers and general security screening line slowdowns as well as revenue losses from a) less monies received from passenger inflight laptop and electronic device internet and movie purchases and b) future flight cancellations from business class and other passengers due to these travel carry on restrictions.

What is certain, however, is that both Al Qaeda—with AQAP as its creative bomb making component—and now the Islamic State/Daesh—with its considerable technical capacity and increasing orientation towards attacking the U.S. and UK—are actively attempting to smuggle laptop bombs and other bomb laden electronic devices onto passenger airliners headed towards those countries and then detonate those devices as a component of their terrorist campaigns directed against them. Given the secretive nature of the intelligence warnings that have promoted the recent and ongoing laptop and electronic device bans, no determination can be presently made of its efficacy. What is known, however, is that radical Islamist terrorist groups are actively targeting civil aviation and the question regarding the next attack will not be a matter of if, but of when.

Notes

[1] The internal body cavity method using secreted bombs in humans has been utilized for VIP (Very Important Person) assassination attempts but not for airliner bombing purposes as of yet. See Robert J. Bunker and Christopher Flaherty (Primary Authors), *Body Cavity Bombers: The New Martyrs—A Terrorism Research Center Book*. Bloomington: iUniverse, 2013.
[2] "Yemen-based al Qaeda group claims responsibility for parcel bomb plot." *CNN*. 6 November 2010, http://edition.cnn.com/2010/WORLD/meast/11/05/yemen.security.concern/?hpt=T2.
[3] For an initial incident overview, see "Shoe Bomb Suspect Had Enough Explosives to Bring Down Plane." *ABC News*. 24 December 2001, http://abcnews.go.com/US/story?id=92054&page=1.
[4] "Bomb traces in both Russian jets." *BBC News*. 29 August 2004, http://news.bbc.co.uk/2/hi/europe/3607886.stm, Associated Press, "Russian plane crashes caused by explosives." *NBC News*. 30 August 2004, http://www.nbcnews.com/id/5810127#.WTmaFlenPvk.
[5] Richard Esposito and Brian Ross, "Investigators: Northwest Bomb Plot Planned by al Qaeda in Yemen." *ABC News*. 26 December 2009, http://abcnews.go.com/Blotter/al-qaeda-yemen-planned-northwest-flight-253-bomb-plot/story?id=9426085 and "Underwear bomber plot failed because he 'wore same pants for two weeks.'" *BBC News*. 25 July 2014, http://www.telegraph.co.uk/news/worldnews/al-qaeda/10989843/Underwear-bomber-plot-failed-because-he-wore-same-pants-for-two-weeks.html
[6] "US 'foils new underwear bomb plot' by al-Qaeda in Yemen." *BBC News*. 8 May 2012, http://www.bbc.com/news/world-us-canada-17985709 and Kimberly Dozier, "TSA Chief: Al-Qaida altered underwear bomb formula." *The Seattle Times*. 27 July 2012, http://www.seattletimes.com/seattle-news/politics/tsa-chief-al-qaida-altered-underwear-bomb-formula/.
[7] Jean-Marc Leclerc, "Avions de ligne : la menace des chiens kamikazes." *Le Figaro*. 1 Novembre 2010, http://www.lefigaro.fr/international/2010/11/01/01003-20101101ARTFIG00486-avions-de-ligne-la-menace-des-chiens-kamikazes.php. See also Ian Sparks, "The Sick Iraqi Terrorist Plot to Bomb U.S. Plane with Exploding DOGS." *Daily Mail*. 5 November 2010, http://www.dailymail.co.uk/news/article-1327052/Kamikaze-canines-The-sick-Iraqi-terrorist-plot-bomb-U-S-plane-exploding-DOG.html.
[8] For information on the Bojinka plot, see "Terrorists plotted to blow up 11 U.S. jumbo jets." *The Baltimore Sun*. 28 May 1995, http://articles.baltimoresun.com/1995-05-28/news/1995148047_1_bojinka-philippines-plot and Raymond Bonner and Benjamin Weiser, "Echoes of Early Design to Use Chemicals to Blow Up Airliners." *The New York Times*. 11 August 2006, http://www.nytimes.com/2006/08/11/world/europe/11manila.html?_r=0

[9] John Ward Anderson and Karen DeYoung, "Plot to Bomb U.S.-Bound Jets Is Foiled." *The Washington Post*. 11 August 2006, http://www.washingtonpost.com/wp-dyn/content/article/2006/08/10/AR2006081000152.html and Nic Robertson, Paul Cruickshank and Tim Lister, "Document shows origins of 2006 plot for liquid bombs on planes." *CNN*. 30 April 2012, http://www.cnn.com/2012/04/30/world/al-qaeda-documents/index.html

[10] Gwyn Topham, Matthew Weaver, and Alec Luhn, "Egypt plane crash: Russia says jet was bombed in terror attack." *The Guardian*. 17 November 2015, https://www.theguardian.com/world/2015/nov/17/egypt-plane-crash-bomb-jet-russia-security-service and Lizzie Dearden, "Isis plane attack: Egypt admits 'terrorists' downed Russian Metrojet flight from Sharm el-Sheikh for first time." *Independent*. 24 February 2016, http://www.independent.co.uk/news/world/africa/isis-plane-attack-egypt-terrorists-downed-russian-metrojet-flight-from-sharm-el-sheikh-islamic-state-a6893181.html. Note—an alternative interpretation of the rocker switch is as an arming-safe switch with the electrical charge being sent to the blasting cap by an alternative method. See C.J. Chivers, "Bomb Experts Analyze the ISIS Soda-Can Bomb Photo." *The New York Times*. 18 November 2015, https://www.nytimes.com/live/paris-attacks-live-updates/a/.

[11] "Somali officials: Suicide bomber may have blown hole in jet." *CBS News*. 6 February 2016, http://www.cbsnews.com/news/somali-officials-suicide-bomber-may-have-blown-hole-in-jet/ and Robyn Kriel and Paul Cruickshank, "Source: 'Sophisticated' laptop bomb on Somali plane got through X-ray machine. *CNN*. 12 February 2016, http://www.cnn.com/2016/02/11/africa/somalia-plane-bomb/index.html.
[12] Robert Liscouski and William McGann, "The Evolving Challenges for Explosive Detection in the Aviation Sector and Beyond." *CTC Sentinel*. 19 May 2016: 1, https://www.ctc.usma.edu/posts/the-evolving-challenges-for-explosive-detection-in-the-aviation-sector-and-beyond. The original article focusing on this threat is Associated Press, "Aviation official: Khorasan Group a threat to flights." *The Salt Lake Tribune*. 27 September 2014, http://www.sltrib.com/news/1623341-155/group-khorasan-pistole-qaida-airports-security.

[13] Pierre Thomas and Mike Levine, "New airplane electronics rules stem from ISIS-associated threat." *ABC News*. 21 March 2017, http://abcnews.go.com/Politics/airplane-electronics-rules-stem-isis-threat/story?id=46287186 and Jamie Dettmer, Victor Beattie, et.al. "Reports: IS Threat Led to US Laptop Ban." *Voice of America News*. 22 March 2017, https://www.voanews.com/a/islamic-state-threat-led-to-us-laptop-ban-media-reports/3777042.html.

[14] Configuring tablets for improvised explosive device (IED) purposes will not be addressed in this short essay.
[15] For more on these considerations and airport explosive screening in general, see Robert Liscouski and William McGann, "The Evolving Challenges for Explosive Detection in the Aviation Sector and Beyond": 1-6.

[16] For background information on the origins of TATP in 1895, terrorist use, and its detection, see Michael E. Sigman and C. Douglas Clark, "Chapter 16: Analysis of Triacetone Triperoxide by Mass Spectrometry." Mike S. Lee, *Mass Spectrometry Handbook*. New York: John Wiley & Sons, Inc., 2012: 373-388.

[17] Peter Chalk, "Tigers Evolve: The Liberation Tigers of Tamil Eelam's Developing Suicide Attack Methods." *Jane's Intelligence Review*. Vol. 19., No. 3. March 2007: 17.
[18] A secondary option is to configure the laptop bomb in such a way that the laptop is rendered non-functioning but this is viewed as an inferior screening penetration strategy and will result in mission failure in case airport screening asks for the laptop to be turned on. Note: It is unknown if laptop batteries can be replaced in such a way as to still adequately charge the laptop in such a manner that it can be turned on for a short duration.

[19] This technical capacity far exceeds that of Ramzi Yousef—an Al Qaeda central bomb maker in his day—who was involved in the 1993 World Trade Center bombing, 1994 Philippine Airlines Flight 434 bombing, and 1995 Bokjina multiple airliner bombing plot as well as that of Ibrahim al-Asiri—an AQAP bomb maker—who is likely still at large and involved in numerous incidents including the attempted 2009 Northwest Airlines Flight 253 underwear bombing, the 2009 attempted assassination of Saudi prince Muhammad bin Nayef by means of a body cavity bomb, and the 2010 printer cartridge airliner bombing attempts. While both of these bomb makers have shown themselves to be very resourceful, they have possessed 'homebrew' manufacturing facilities at best which pale in comparison to research university level facilities. This technical capacity also exceeds that possessed by the Japanese doomsday cult Aum Shinrikyo who was also operationally challenged in their terrorist activities.

[20] Mohammad AlAhmad, (Will Todman, trans.), "The crisis of higher education for Syrian refugees." 17 June 2016, https://www.brookings.edu/blog/education-plus-development/2016/06/17/the-crisis-of-higher-education-for-syrian-refugees/.

[21] Stuart Ramsay, "Exclusive: Inside IS Terror Weapons Lab." *Sky News*. 5 January 2016, http://news.sky.com/story/exclusive-inside-is-terror-weapons-lab-10333883.
[22] Skylink, *Aerodome Assessment: Mosul Airport, Iraq*. 12 June 2003, p. 32, http://pdf.usaid.gov/pdf_docs/Pnacy265.pdf.

[23] Victoria Woollaston, "The UK's laptop ban on flights: everything we know so far." *Wired*. 30 May 2017, http://www.wired.co.uk/article/uk-laptop-ban-flights-explained. See the original article discussing the iPad plot at Ewen MacAskill, "Laptop ban on planes came after plot to put explosives in iPad." *The Guardian*. 26 March 2017, https://www.theguardian.com/world/2017/mar/26/plot-explosives-ipad-us-uk-laptop-ban.

[24] U.S. Department of Homeland Security, *Fact Sheet: Aviation Security Enhancements for Select Last Point of Departure Airports with Commercial Flights to the United States*. Washington, DC: 21 March 2017, https://www.dhs.gov/news/2017/03/21/fact-sheet-aviation-security-enhancements-select-last-point-departure-airports.
[25] Ibid.
[26] Ibid.
[27] Department for Transport and The Rt Hon Chris Grayling, *Written statement to Parliament: Additional airline security measures on some routes travelling to the UK*. London, UK: 21 March 2017, https://www.gov.uk/government/speeches/additional-airline-security-measures-on-some-routes-travelling-to-the-uk. See also, *Hand luggage restrictions at UK airports*. Nd, https://www.gov.uk/hand-luggage-restrictions/electronic-devices-and-electrical-items. Still, rule differences exist causing some confusion, see Simon Calder, "US and UK are diverging on what is and isn't included in the controversial bans." *The Independent*. 31 March 2017, http://www.independent.co.uk/travel/news-and-advice/laptop-ban-whats-included-usa-uk-emirates-power-banks-etihad-dubai-abu-dhabi-iata-a7659811.html.
[28] One safety concern expressed with the bans is that lithium batteries may pose a fire risk in the cargo bays. See Robert Wall and Susan Carey, "Laptop Ban May Pose Risk." The Wall Street Journal. 2 June 2017: p. A3.
[29] See, for instance, Jackie Wattles, "DHS Secretary: U.S. 'might' expand laptop ban to all international flights." *CNN Money*. 29 March 2017, http://money.cnn.com/2017/05/28/news/laptop-ban-expansion-john-kelly/, Rene Marsh and Mary Kay Mallonee, "DHS secretary: Electronics ban may be expanded to flights departing US." *CNN*. 27 May 2017, http://edition.cnn.com/2017/05/26/politics/john-kelly-laptop-ban/?iid=EL, and David Schaper, "Fears Grow As DHS Officials Consider Expanding Airline Laptop Ban." *NPR*. 3 June 2017, http://www.npr.org/2017/06/03/531347271/fears-grow-as-dhs-officials-consider-expanding-airline-laptop-ban.
[30] Naeim Darzi, "Homeland Security: US Might Expand Laptop Ban to 71 Airports." *The Epoch Times*. 7 June 2017, http://www.theepochtimes.com/n3/2255692-homeland-security-us-might-expand-laptop-ban-to-71-airports/?utm_source=dlvr.it&utm_medium=twitter.