20 January 2016

Introduction Note

about the potential causes of the crash of flight MH-17
for the Public Hearing
by the House of Representatives of the Netherlands' Parliament
on 22 January 2016

by Markus Schiller[1]

Honorable Members of Parliament, Ladies and Gentlemen,

Thank you for the invitation to join today's hearing. I hope that I can contribute to increase the understanding of the terrible events of July 17, 2014.

Please allow me to start with some brief information about myself.

I am an aerospace engineer by training. I received my Diplom-Ingenieur Luft- und Raumfahrttechnik (which is equivalent to a Master's degree in Aerospace engineering) in 2005, and I received the Doktor-Ingenieur (which is a PhD in engineering) in 2008, both from the Technical University Munich.

From 2006 on, I was employed at Schmucker Technologie, a small company in Munich that offered consulting services in the fields of rocketry, space, and defense, with a special focus on assessments of ballistic missiles – Prof. Robert Schmucker, the company's director and my mentor, had been a UN weapons inspector in Iraq in the 1990s, inspecting Saddam Hussein's missile programs.

From 2010 to 2011, I spent one year as a Nuclear Security Fellow at the RAND Corporation in Santa Monica, California, where I developed a methodology to assess foreign missile programs with only limited information available. I used this methodology to analyze the North Korean missile program, and RAND published my assessment as a Technical Report in September 2012.

In 2011, I returned to Schmucker Technologie, continuing my work in the field of rocket assessments, and also supporting Robert Schmucker in writing a comprehensive book about ballistic missiles, which was finally published in April 2014.

Schmucker shut down his company in early 2015, and in May 2015 I started my own consulting company for rockets, space, and defense, named ST Analytics.

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I have been working in the field of missile analyses for more than 10 years, since I wrote my first term paper for Prof. Schmucker in 2003 (it was about the first North Korean satellite launch attempt). Over the years, I worked on assessments for various national and international institutions as well as for aerospace companies, held presentations and seminars at many occasions and locations including RAND, the Pentagon, and the universities Stanford and Princeton, and wrote and co-authored many papers and essays. By now, I regularly offer advice on missile related questions to two Panels of Experts at the United Nations, and I have an annual teaching assignment for a course on "Missiles" at the Bundeswehr University in Munich.

I want to emphasize that my expertise is focused on ballistic missiles and space transportation systems. However, I can state that I am also familiar with the basics and the special characteristics of other rocket types, including surface-to-air and air-to-air missiles.

As mentioned, during my time at RAND I developed a methodology to analyze problems that we do not know much about, based on an approach that already had been developed during my time at Schmucker Technologie, and had been successfully applied there to various problems.

I am convinced that this methodology can also be used to get a better idea of what happened to MH17.

The basics of this methodology are simple:

- Collect every piece of information available.
- Define various hypotheses (or scenarios) about what could have happened.
- Determine a level of confidence for every single piece of information (which means that you check every available piece of information for its credibility).
- Test the available data pieces for their consistency with each of the previously defined hypotheses (or scenarios).
- Create an "inconsistency score" for each of the hypotheses – if credible pieces of information (or data points) show inconsistencies or discrepancies with a hypothesis, the hypothesis receives a penalty score. The lower the "inconsistency score", the more plausible the hypothesis.

The key hereby is consistency, complemented by plausibility. Categorizing the available information into data of high, medium, and low confidence, thus sorting out "bad data", is also very important.

For MH17, this approach has already been rudimentary applied by some open source investigators, but some of the basics also shine through in the officially released reports.

The report by the NLR titled "Investigation of the impact damage due to high-energy objects on the wreckage of flight MH17", for example, shows in a very convincing way that the hypotheses "Air-to-Air Gun" and "Air-to-Air Missile" should be excluded due to major inconsistencies, and that the damage pattern at the recovered MH17 wreckage is completely consistent with an attack by a 9M38 or 9M38M1 surface-to-air missile from a

Buk missile system (see NLR page 63-65). All available "pieces of the puzzle" are hereby consistent with this hypothesis. This includes the size and number of particles that hit the aircraft, the location of these hits, and the size and shape of the foreign fragments that were found in the aircraft's cockpit area.

There is little doubt by now that a Buk missile downed MH17 – this scenario is plausible, and it is consistent with the available data, including missile trajectory simulations based on reconstructions that we did on our own at Schmucker Technologie, using our own rocket launch simulation software. However, the location of the launcher still seems to be disputed. While providing a large area that covers all Buk missile launch sites that could have resulted in the observed damage pattern, the NLR report also mentions a missile approach vector "7 degrees from below and 20 degrees from the right with respect to the aircraft forward axis" as the best match between the simulations and the observed damage (see NLR page 56). This is further backed by the TNO report titled "Damage reconstruction due to impact of high-energetic particles on Malysia Airlines flight MH17", which sees 10 degrees from below and 27 degrees from the right as the "best match" between their simulations and the observed damage on the wreckage (see TNO page 21).

Taking the known shortcomings of our missile simulation software into account, which was developed for ballistic missile analyses, our results are surprisingly close to the "best match" values from the NLR and TNO reports. For a launch from the possible site in East Ukraine that was identified by the open source community around the "bellingcat" website, our simulation gives angles relative to the aircraft flight vector of around 19 degrees from the right for the horizontal angle, and 14 degrees from below for the vertical angle (which most likely would be lower if our software would be capable of automatically optimizing trajectories).

This was just one example, and much more data is available. Adding all of these "pieces of the puzzle" to the "big picture" after they have been tested for their credibility, including open source assessments, governmental reports, and independent analyses, the most plausible scenario that led to the loss of flight MH17 should emerge.

Let me finish my statement with a summarizing conclusion.

If there is no hard evidence available for a certain scenario, a large number of indications can help to get an idea of the scenario's plausibility: If a hard fact is inconsistent with this scenario, this scenario should be ruled out. But if every hard fact is consistent, the scenario should be seen as plausible.

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