Action 1.4 (Thomas & Vladimir: I don't think we have to do so; we can say that we will see this for the next edition)

1) **Sections 3.2 and 3.3 could be merged into a single one (remove the title of 3.3)**

Closed: next edition

Action 2.3 (Heiner & Holger: I would not take that one, except if you feel comfortable adding a few lines… We can say that these sensitivity analyses are complex and ongoing, to be included in further editions)

1. Page 21, table 2.5 and subsequent discussion: It would be good to understand the sensitivity of these impact rates for catalog objects to a small number of impacts of massive derelicts (of scale of the Iridium / Cosmos conjunction, or greater)? Do one or two large impacts earlier in time significantly change conclusions?

Closed, answering it requires significant additional activities.
To be kept in mind for next edition

Action 2.4 (Christian, Dave, Fernand, Dan: Beware, in my copy page 57 is not section 5.5… Not sure to understand what he wants, and not sure that it is not already covered by chapters 12 & 13; maybe no action there)

2. Page 57, section 5.5. This section could use greater elaboration on codified best practices, perhaps in summary table format

Closed, mentioning it is already taken into account in §9, 12 & 13
To be kept in mind for next edition

Action 2.5 (Paula & Juan-Carlos: Please feel free to answer as you wish; it is obvious that one can always add more and more information…)

3. Figure 8.6: Averages of MC runs do not tell the whole story. For selected assumptions it would be good to show the max/min curves as well as ranges for percentage of cases falling below (1sigma, 2sigma, 3sigma)

Closed, mentioning the curves would become too complex, and recalling the corresponding reference.
To be kept in mind for next edition

Action 2.6 (Paula & Juan-Carlos: Same as 2.10. Feel free to answer that this is documented in the references which are mentioned in the report)

4. Figures 8.6 through 8.8 – what is the sensitivity to one or a small number of early catastrophic collision between large derelicts?

Closed, answering it requires significant additional activities.
To be kept in mind for next edition

Action 2.10 (Christophe: I'll mention that this will be done once we have the information from everyone, including Chinese, i.e. Edition 2)

1. Chapter 4, Space Situation Awareness. A summary table of all systems would be very helpful as a quick reference, and to compare/contrast capabilities.

Closed. To be done for revision

Are the conclusions and recommendation clear and synthetic?

While there are some recommendations embedded in the chapters and text, and in some cases listed specifically in the chapters, there is no overall synthesis of recommendations.
Some specific recommendations that may be warranted (extracted from the document):

1. Page 135 “Situation may worsen in the future . . .” For a subsequent update, modeling and assessment of planned small-sat constellations and increased launch rates for “New Space” entrants should be considered.

Not felt as a recommendation.
Could be addressed in a clearer way in revision

Action 6.1 (Darren & Christophe: we can only agree and propose to do so for the second edition…)

3) Is the study taking into account all aspects, cross disciplinary and with sufficient international prospective?

I think that emerging countries will play an increasingly important role in space exploration, specially at LEO, mainly with the expansion of miniaturized technologies and low cost nano-scale satellites. To a large extent they are disregarded by the present report. How do they participate in generating debris (present and future) and what they (can) do to mitigate present and future risk? How can they participate of global monitoring or other cooperative activities? How do they fit in the legal framework that should be developed in the next decade?

Closed for now, but to be addressed in a dedicated paragraph in the next revision of the Report, as this message has to be clear to emerging countries

Remarks from Moriba

1. We should develop a more rigorous definition of what a “trackable” and “non-trackable” space object is. It is not only about the size of the object, which leads me to:

2. We should develop a more rigorous definition of “probability of detection” for space objects. There are three key contributors to the probability of detection:

    a. Sensor dependency: all sensors lie…there is not truth sensor. They all are corrupted by noise and biases and can only measure in a subset of frequencies/modalities/configurations

    b. Everything between the sensor and the object: as an example, ground based telescopes don’t do well with daylight tracking or detection objects in the presence of significant cloud cover.

    c. Space Object Dependency: the object’s orientation, material properties, size, etc. (i.e. it’s physical and kinematic characteristics) are varying spatio-temporally and this variation must be reflected in the overall detection probability. As an example, the MSG-2 cooler cover is seasonally lost. It is likely that at certain times of the year, the object (being fairly flat) is edge-on to an observer and thus creates little-to-no visible signal. The object is still there. The sensors used have not changed. However, its probability of detection has changed, all else being equal!

3. We talk about understanding the population statistically for non-trackable objects. I wave a flag of caution on this one. How many detections within the pool of detections are from unique objects. In other words, the looming issue is in the ability to “tag and track” objects! Unique Space Object Identification (USOI) is a major challenge in SSA and cataloging objects. How does one correctly (or to quantifiable and measureable accuracy and precision) associate/correlate any given detection to a unique space object? Which leads me to:

4. We talk about Measurements to do our job of understanding the orbital debris population but make no mention of the required astrodynamics models or estimation/inference (orbit determination and USOI characterization) algorithms and methods required! We cannot physically “tag and track” most resident space objects, so we must do so with our ingenuity, our understanding of the space environment effects and impacts on space object motion and behavior as well as advanced and robust mechanisms to know which object is which and how to maximally exploit the information content of the data we collect…how to optimally fuse the sensor and information sources, etc.

The last overall comment is that the cited work comes from only a handful of people and there is a LOT more work happening globally, in our community (i.e. the literature references in this document reflect what we in the US call a “kiddie pool”). “We” can and should do much better here. If someone outside of our community looked at this document, they’d only believe that we have a contributing community of a dozen or so people.

Remarks from Thomas

Reviewer #9, Action 9.2:
GORID is unique, as it is the only GEO sensor so far. There were many LEO in-situ detectors flown, so I hesitated to name any of them (apart from the legacy detectors like LDEF), otherwise we risk to have an incomplete list. This is the reason why I mentioned only a planned, large detector. We can change that, what do you think?

Remarks from Dan

Here's the SDA's proposed replacement text:

12.3.4 Space Data Association

In March 2017, the SDA announced its SDC 2.0 initiative which advances its capabilities even further, employing the Commercial Space Operations Center (or ComSpOC) to fuse authoritative operator observations, maneuver plans and RF data with ComSpOC's observations to produce previously-unattainable quality and actionability of SSA products. This represents a real step forward in assisting satellite operators to ensure the best tools necessary to enhance space safety and service quality by producing actionable SSA metrics and notifications.

Remarks from Frank

1) Chapter 6: The order of listing of the references is not sequential. Shall I take care of this?

For the next version of the status report I propose

- To try including more journal references and more recent journal references
- (at least for Chapter 6) To include actual projects from a few more agencies' such as CNSA, ESA, CNES