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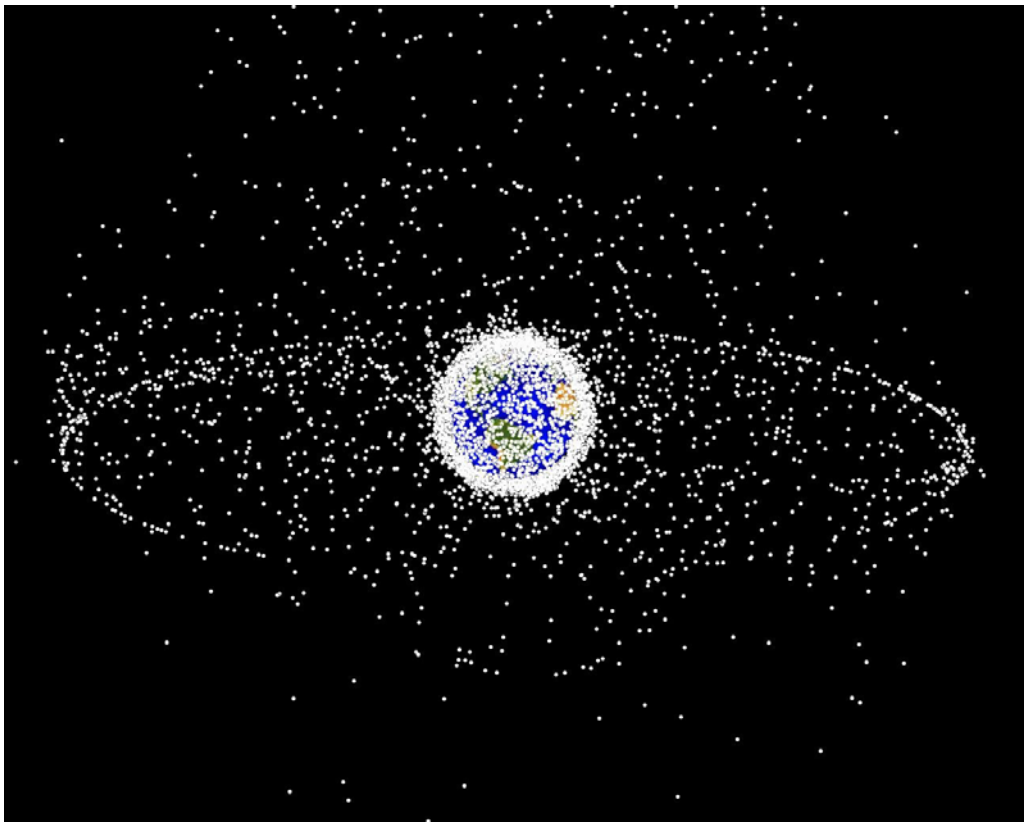

[CASCADING CRISES: ORBITAL DEBRIS AND THE WIDENING OF SPACE SECURITY]

ABSTRACT: The Kessler syndrome predicts that Earth orbit will see a runaway growth of orbital debris regardless of debris mitigation measures put in place by space users. Active debris removal is considered here as a way to ameliorate the Kessler syndrome and stave off the worst of its predictions – but the cascading problem within academia of widening 'space security' to include non-military risks in 'security' threat analyses jeopardises the deployment of active debris removal systems without the negative political repercussions of them being perceived as anti-satellite weapons. Based on a conceptual discussion of the term 'security' and the perspective of US space policy, an argument is made to keep 'space security' traditional in its focus – in that it should only be concerned with the political-military threats that space powers may pose to each other. The environmental hazards of space should not be considered security threats, although they are indeed crucial problems to address if human civilisation wishes to continue to utilise space and expand its presence into the cosmos. As orbital debris will continue to pose risks to space assets regardless of the political climate, it should be viewed in terms of a space development agenda, rather than a national security threat.

The word length of this dissertation is: 14,970

DECLARATION:

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any other degree.

Signed … B. Bowen… [signed by hand in hard copy] (candidate)

Date 31/08/12

STATEMENT 1:

This work is the result of my own investigations, except where otherwise stated. Where correction services have been used, the extent and nature of the correction is clearly marked in a footnote(s).

Other sources are acknowledged by footnotes giving explicit references. A bibliography is appended.

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Date 31/08/12

Cover image: a computer generated image representing objects in Earth orbit that are being tracked. 95% of those objects are debris objects. The orbital debris dots are scaled according to the image size of the graphic to optimize their visibility and are not scaled to Earth. Credit to NASA, image is taken from: http://orbitaldebris.jsc.nasa.gov/photogallery/beehives.html

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1: Introduction

I - Introduction

Space is an environment and a medium which is used to great effect by modern civilisation and the United States has the greatest dependence on space-based systems due to its space-based commerce, military, and critical infrastructure. Logically, anything which threatens or poses a risk to these systems can be a cause for great concern. For example, should US forces lose the use of satellite assets in any given theatre on Earth, they would lose their comparative edge of coordination and precision guided munitions (PGM). Should space commerce be disrupted, personal credit transactions and electronic bank transfers would lose the authoritative time-verification services provided by satellites and become impossible to complete.

How should the United States deal with the hazards in space? The hazards to space systems range from the intentional threats and weapons of other states (such as anti-satellite (ASAT) missiles and ground-based lasers) to unintentional and indiscriminate environmental risks such as solar storms, orbital debris, and accidental collision. Proposing answers to all of the United States' vulnerabilities and risks in space is beyond the scope of this dissertation. However, some valuable insights can be gained by addressing the topic of orbital debris and how it has been assumed into the domain of 'space security' within academia, and whether this trend of 'widening' the concept of security in space is beneficial for the study and perhaps the practice of US space policy.

II – Dissertation outline

Policy and academic insights may be gained by asking the question "should orbital debris be considered a security issue for the United States?" This central question, which

guides the entire investigation, raises a series of sub-questions: what is the meaning of security in space?; does this allow for the inclusion of orbital debris into calculations of security policy in space?; does a wider definition of space security offer greater risks of negative international reaction for dealing with space debris than a narrow, or traditional, definition of security in space? If space debris is considered a national security issue, will the United States trigger a political backlash against such a dual-use system as ADR?

Chapter two sets the theoretical foundation for the inquiry of US space policy and the normative conceptual argument over the meaning of 'space security' for the subsequent chapters. After reviewing many instances of 'security widening' to include non-state referent objects (deepening security) and non-military and non-intentional risks to space assets (broadening security). This wanton widening of security has brought about the commonly used term 'space security'. In many instances within academia, 'space security' is taken to mean the study of, or freedom from, *all* threats or risks to the operation of space systems. This includes the space weapons of another actor to debris, satellite malfunctions, and solar storms. 'Space security' is a term which is often used but hardly analysed. The second chapter analyses academic uses of the term and questions this wanton widening of the concept of US 'security' in space, and establishes a traditional definition of security in space activities as an alternative, taken to mean the political-military challenges that other actors can intentionally pose to the United States. From this definition, orbital debris is not considered a security issue.

Chapter three examines the character of US policy regarding space and security, the problem of orbital debris and how ADR systems work. It looks at a range of official documents to attempt to determine whether non-military risks have been securitised, and whether there is a risk of the contamination of non-military risks in space with the connotations of security in policy. Chapter three is also a briefing on the core problem of

the dissertation – orbital debris. Every rocket launched into orbit or activity in space creates some amount of debris – such as defunct or unused satellites, spent rocket stages, detached explosive couplings, a runaway toolkit,[1] flecks of paint,[2] and anything else that does not serve a human-derived purpose in orbit. At orbital speeds of kilometres per second (km/s), there is so much kinetic energy involved in impacts between space objects that the destruction of useful space systems from collisions is always a risk. "At [these speeds], a piece of debris has ten times the energy density of dynamite, and a few-gram object (like a penny) would likely cause a lethal event on the International Space Station."[3]

Even if there were an end to satellite launches tomorrow, it may not make a difference to the growth in the number of orbital debris in low-Earth orbit (LEO), where spy and many remote observation satellites are positioned.[4] The number of debris objects will continue to increase as a result of cascading collisions in orbit. This runaway growth in orbital debris is referred to as the Kessler syndrome. This does not bode well for the continued safe use of the space environment, and when one considers that launches will continue which will generate more debris (even with international voluntary debris mitigation guidelines in place[5]), the problem may only exacerbate further. As debris mitigation may not resolve or manage the debris problem, there are proposals of active debris removal (ADR) systems. What is analysed is how these systems pose a dual-use challenge as ADR systems can easily be seen as ASAT systems; a possible way to place

[1] Tarik Malik, 'Tool bag lost in space meets fiery end', *Space.com*, 03/08/2009, http://www.space.com/7088-tool-bag-lost-space-meets-fiery.html, accessed 15/07/2012.
[2] National Aeronautics and Space Administration (NASA), 'Space debris and human spacecraft', http://www.nasa.gov/mission_pages/station/news/orbital_debris.html, accessed 15/07/2012.
[3] Claude Phipps, Mike Lander, 'What's New for Laser Orbital Debris Removal?', *American Institute of Physics Conference Proceedings* (No. 1402, 2011) p. 339
[4] J.-C. Liou, N.L. Johnson, N.M. Hill, 'Controlling the growth of future LEO debris populations with active debris removal', *Acta Astronautica* (66, 2010) p. 648
[5] Inter-Agency Space Debris Coordination Committee (IADC), 'IADC Space Debris Mitigation Guidelines', IADC 02-01, September 2007 http://orbitaldebris.jsc.nasa.gov/library/IADC_Mitigation_Guidelines_Rev_1_Sep07.pdf, accessed 15/07/2012.

weapons in space for other stated ends. Tasking ADR systems under the 'security' rubric may intensify dual-use concerns among the space powers.

Chapter four brings the theoretical and empirical chapters' conclusions together, and puts the case forward for desecuritising the many threats to 'space security' which have been collated together by numerous academics. Despite a general policy resistance to this from the White House, it remains a concern how treating orbital debris as security issues may create greater risks with ADR deployment as the dual-use nature of such technology may create suspicions and negative political consequences within and among other space powers that the USA may be deploying ASAT weapons systems under the guise of ADR.

III – Securitisation

Columba Peoples rightly declares that the militarisation-weaponisation of space debate misses the wider dynamics and understandings of 'space security'.[6] Indeed, space is being securitised. This is proceeding within, and remains unchallenged by, academia which is focused on policy discussion and may yield influence on policymakers under the right circumstances. Debating whether the weaponisation of space serves American 'security interests' or not often relates to what one thinks space security means. As we shall see in chapter two, those in favour of making space a sanctuary tend to adopt a widened referent point of security (the international system or the space environment itself, with non-military risks treated as security threats), and those who favour or do not wholly oppose weaponisation of space (placing weapons in space) tend to concentrate on the military threats to US space systems. Failing to discuss the meaning of security in space precludes the possibility of understanding the character of space warfare, and that one could potentially engage in 'clean' warfare in space, that is, without generating debris.

[6] Columba Peoples, 'The growing securitization of space', *Space Policy* (26, 2010) p. 206

Indeed, debris (and other environmental hazards) is a risk for every use and user of space – not only for military and commercial satellites. For the economic exploitation of space, a developmental view may be more appropriate as military activity is but one kind of human endeavour in the cosmos, as much as any medium of human activity. 'Security' is something that should not dominate calculations behind every non-military space activity.

Securitisation theory partly guides this project's inquiry. Security is considered a speech act on behalf of a voice of authority[7] – in this case both the US government and academia. It is within the US government's power to deem orbital debris a security issue and mobilise resources to tackle the threat posed by renegade paint flecks and rocket boosters. The securitisation attempts within academia are critiqued, thereafter a widened securitised approach to space is contrasted with a traditional approach to space security in chapter four, using the possibility of deploying ADR systems as a case in point. This leads to a desecuritisation approach to the problem of debris and its removal. There is no overt securitisation attempt made by the US government in space, although there are subtle trends that suggest it may be happening. As a result, the greatest focus on analysing a securitising pattern falls on academic debate.

By securitising a topic such as orbital debris, the academics in question heighten the salience of an issue and imply that extraordinary means are required to deal with it. Indeed, such moves may trigger unilateral American policies, and break established 'norms' if ADR systems are perceived as ASAT weapons. [8] However, one need not subscribe to Buzan et al's entire theory of securitisation to use its principle to understand how non-military threats are being framed as security issues. For example, the assertion

[7] Barry Buzan, Ole Waever, Jaap de Wilde, *Security: A New Framework for Analysis* (London: Lynne Rienner, 1998) p. 27
[8] Ibid., p. 26

that a 'security' label precludes political debate[9] is rejected here. It is indeed over the label of security itself this study's theoretical inquiry is debating; and keeping Chinese space denial capabilities in the frame of 'security', for example, does not overwhelmingly *block* political debate on how to respond, or even whether to respond at all. Military-security policy issues are not above the realm of 'politics', as endless debate about strategy and national security in Western academic and journalist circles amply demonstrate. However, an issue framed as 'national security' may indeed reduce the number of assumptions underlying government policy that are open to critique.

It is only attempts at securitisation that are analysed, as the establishing of who are the actors, audiences, and to what extent the speech acts have succeeded in securitisation does not address the question asked. Although this project is inspired by Waever's securitisation and desecuritisation,[10] it does not follow the process of securitisation theory through to the letter by attempting to measure the success of securitisation. This dissertation only challenges the securitisation attempts. Foregoing audience reception and only looking at the speech acts from government and academia is no weakness in this study. The academic elites' arguments over the United States' space policies need to be analysed, as 'security' is a concept which is not addressed to any sufficient degree in space politics. It may be the case that runaway 'space security' widening is a symptom of political aspiration, rather than analytical clarity.[11] There is a danger posited if US government space policy, as an audience within securitisation theory, is infested with the widening of space security. However, as already stated, this study is an inquiry as to whether debris *should* be securitised (in the wake of obvious attempts to do so within academia), rather than whether it has been successfully securitised or not.

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[9] Ibid., pp. 4-5, 23
[10] Ole Waever, 'Securitization and Desecuritization', in Ronnie D. Lipschutz (ed.) *On Security* (Chichester: Columbia University Press, 1995)
[11] Simon Dalby, *Environmental Security,* (London: University of Minneapolis Press, 2002) p. 9

IV – Knowledge claims

The kind of knowledge this dissertation aims to create is normative in its character. But it draws its conclusions from both conceptual thought and empirical evidence. The research questions determine the methods used[12] - the method are a mixture of discourse analysis within academia and government documents and critical thought along one's own conceptual persuasions in the context of 'security' conceptualisation. The theoretical concepts of securitisation and security itself are drawn from academic literature; information of the real-world problem of debris is ascertained through scientific journals with a greater emphasis on empirical objectivity. Most, if not all, sources are secondary – for example there is no handling of raw space tracking data – data on debris is taken from non-governmental organisations, government documents, and academic presentations of raw data.

The end product is a challenge to certain tendencies within the literature reviewed. It is not limited to its theoretical inquiry – it aims to constructively engage with the academic literature to propose a better way, or approach, to politically handle the possibility of deploying ADR systems, if concerns over the Kessler syndrome are realised. Despite prescriptive tones, there is no extensive policy prescription, only a recommendation that certain risks in space are best considered in certain ways, lest unwanted international political repercussions occur. This study is also idiographic in that it presents an individual's subjective interpretation of a highly debated topic. As expressed by Peoples, securitisation in space is a phenomenon that is not adequately studied and goes beyond the weaponisation debate. This study does not *inherently* oppose or favour weaponisation; rather, the point is that ADR deployment may bring (perceived) weapons deployment *in* space closer than ever before if space debris is treated as a

[12] Jonathan Grix, *The Foundations of Research* (Basingstoke: Palgrave Macmillan, 2004) p. 31

security issue. This dissertation is a challenge to the acts of securitisation seen in academia (and US government policy to a much lesser extent) and how it may adversely affect a very serious problem that modern human civilisation has to face if it wishes to continue to use outer space.

2: Space Security

I – Introduction

This chapter establishes the conceptual foundation upon which the argument over keeping 'security' 'traditional' rests. After a traditional definition of space security is formed, the chapter moves on to survey how the term 'space security', or security in space politics, is used in academic sources. A traditional approach to security in space is then applied as an alternative to widened space security concepts in the rest of the dissertation. The aim of looking at academic writings is to ascertain their (possible) conceptualisations of security; whether they tend to fall into a traditionalist conceptualisation or have broadened and/or deepened it. The indicators of securitisation are thoughts of 'security' linked to particular problems, themes, or referent points. The chapter concludes that the concept of 'space security' is too often used but not adequately analysed, if at all. A case for keeping 'security' military in its terms when discussing outer space issues is presented as a conceptual lens for analysing the dangers and opportunities raised by orbital debris and their possible removal. The literature serves to illustrate the point that there is wanton widening of 'security' with regards to space activities within academia.

II – Traditional security

> "Critics normally address the *what* or *who* that threatens, or the *whom* to be secured; they never ask whether a phenomenon *should* be treated in terms of security because they do not look into "securityness" as such, asking what is particular to security, in contrast to non-security, modes of dealing with particular issues."[13]

What is security? What is to be secured? These two questions' answers form the basis for inquiry which dominates chapter four and addresses Waever's concern above:

[13] Ole Waever, 'Securitization and Desecuritization'... p. 57. Italics original.

should orbital debris be considered a security issue? Similar to the under-analysis of the term 'space security', the concept of 'security' itself may be under-conceptualised, according to David Baldwin.[14] Although one may share Buzan's logical assertion that the word 'security' should mean more than a situation of any kind of threat to any actor or value, the kind of broadening and deepening seen in *Security: A New Framework for Analysis* is particularly what should be avoided in outer space.[15]

The concept of security put forward here begins as a response to Baldwin's two questions: for whom is this security, and for which values?[16] This dissertation uses the United States as a referent object of security, with its space-dependent military capabilities and related satellite systems as physical manifestations of this statist referent object. This does not preclude the view that in ideal terms a state such as the United States should exist to serve its citizens; the state's security may be a means to another end, not an end in and of itself. Being 'secure' means perceiving a "low probability of damage to acquired values."[17] Framing a problem as a security issue usually means that it could escalate into an issue of survival, if it may not be one already.[18] Although war or the use of force *in* space may not destroy the United States as a functioning entity, such a conflict would most likely occur with another state with long-range missile technology which may have the potential to escalate into a perceived fight for survival via the four other domains of warfare (land, sea, air, and cyber).

US 'space security' should be 'securing' American military and commercial satellites and the United States' ability to access and use space for the ends of its policies, *but from the threat of the denial of these space systems from another political entity*. This is an

[14] David A. Baldwin, 'The Concept of Security', *Review of International Studies* (23:1, 1997) pp. 8-12
[15] Buzan et al, *Security: A New Framework...* p. 5
[16] Baldwin, 'The Concept of Security'... p. 13
[17] Ibid.
[18] Buzan et al, *Security: A New Framework...* p. 24

alteration of the *Space Security Index*'s definition of space security: "the secure and sustainable access to, and use of, space and freedom from space-based threats ."[19] Rather than interpret any disruption to US satellites as a security issue, it is the intentional disruption, destruction, or negation of satellites by a political adversary that constitutes a threat to US space security. The term security conjures images of the state securing itself from the threats it perceives from the military capabilities of and political relations with the other states of Earth:

> "...security, as with any other concept, carries with it a history and set of connotations that it cannot escape. *At the heart of the concept we still find something to do with defence and the state*. As a result, addressing an issue in security terms still evokes an image of threat-defence, allocating to the state an important role in addressing it."[20]

Barry Buzan may claim that simply stating a referent object is not enough, as the search for the referent object must be found alongside a search for the necessary conditions for its security; David Baldwin counters by saying that this conflates conceptual specification with empirical observation – the choice of the referent object depends upon the research question that is addressed.[21] One can uncontroversially go further and claim that one's own views and concepts about security can affect interpretations of the empirical world. To turn around David Baldwin's logic, the referent object can also influence the question that is addressed. As seen in chapter four, the traditional security concept may yield different international political outcomes to ADR systems to a widened concept of security which refers to 'international security', or the security of all actors in space.

[19] Cesar Jaramillo (ed.) *Space Security 2011* (Kitchener: Pandora Press, 2011) Available at www.spacesecurity.org, accessed 24/05/2012, p. 7
[20] Waever, 'Securitisation and Desecuritisation'... p. 47. Italics added.
[21] Baldwin, 'The Concept of Security'... p. 13

The term 'national security' is an ambiguous concept which may have different meanings to different people. The subjective nature of 'national security' is laden with values, as Wolfers correctly claims.[22] As this project is an analysis of whether orbital debris should be a security issue from an American government perspective, it does not adopt a transformative agenda; security may be an elitist or statist concept. "The language game of security is… a *jus necessitatis* for threatened elites, and this it must remain."[23] Whether one has a transformative agenda - vis-à-vis the state system or who is allowed to define 'security' within them - or not, the issue of orbital debris and the potential of the Kessler syndrome can adversely affect the many boons of modern civilisation derived from space systems. Furthermore, the dissertation does not aim to clarify what will make the United States feel 'secure' – rather, it is over what dangers should come under the security rubric.

When dealing with policy problems or pressing issues in any given domain in empirical reality, how we think of, conceptualise, and operationalise security can have significant impacts on humans and the systems we depend upon. An example that comes to mind is the security-development nexus; how human development policies have become counterinsurgency (COIN) operations through securitisation.[24] Discussing the meaning of 'security' matters, particularly if one can foresee different policies, outcomes, dangers, or opportunities emerging from them.

III – Broadened and deepened space security

Some academics have been generous in their widening of 'security' when discussing 'space security'. One of the most substantive and directly relevant academic works on space politics, security, and the space environment to date is James Moltz's *The*

[22] Arnold Wolfers, ' "National Security" as an ambiguous concept', *Political Science Quarterly* (67:4, 1952) p. 481, 483
[23] Waever, 'Securitisation and Desecuritisation'... p. 56
[24] Maria Stern and Joakim Ojendal 'Mapping the Security-Development Nexus: Conflict, Complexity, Cacophony, Convergence?', *Security Dialogue* (41:1, 2010) p. 23

Politics of Space Security.[25] Moltz presents a compelling historical narrative of the Cold War space powers' military restraint from overly testing and deploying weapons in space due to their ability to learn about the harmful environmental consequences from doing so.[26] Moltz is correct to stress the importance of the space environment, as it constrains or enables the very actions and purposes space actors have in using it in the first place. However, Moltz uses this environmental significance to understand (offensive) military restraint to push for an 'environmental security' approach as the most 'useful' framework for understanding the past, present, and future of politics in space.[27]

According to Moltz, military calculations alone do not determine space security as the environment plays such an important role in it, and that the referent object in space security should be the space environment itself.[28] This is deepening security, as the environment in space affects all users of space and is characterised by transboundary problems which is beyond the control (and perhaps remedies) of a single actor. There is no surprise that Moltz also broadens the term 'space security' beyond traditional military conceptions of 'security':

> "Space security depends on overcoming both man-made and natural threats… Space security [is] the *ability to place and operate assets outside the Earth's atmosphere without external interference, damage, or destruction*."[29]

Under Moltz's vision, anything that can disrupt or destroy satellites is a security concern in space to all space actors. Aside from a passing mention to the transboundary nature of environmental space issues, Moltz does not engage in a conceptual discussion with environmental security. However, one can establish some common thoughts between

[25] James Clay Moltz, *The Politics of Space Security: Strategic Restraint and the Pursuit of National Interests* (Stanford: Stanford University Press, 2008, 1st edition)
[26] Ibid., p. 46
[27] Ibid., p. 7
[28] Ibid., pp. 40, 44
[29] Ibid., p. 11. Italics original.

Moltz and environmental security concepts. Simon Dalby uses Richard Ullman's wider conception of security to encompass threats that endanger the quality of life for citizens of a state over a relatively short period of time, and the amount of policy options available for any relevant actor. In environmental security, the referent objects of security are "the planetary attributes necessary to sustain civilisation."[30] This resonates with the resources of outer space, as space systems provide the everyday life of citizens of developed and developing countries essential services such as navigation, telecommunications, emergency responder guidance, and countless luxurious or non-essential profitable services. Indeed, man-made problems such as debris, electromagnetic pulse (EMP), and excited radiation in the Van Allen belts threaten modern civilisation's benefits and opportunities derived from space, as well as natural hazards such as solar storms and near-Earth objects (NEO). These can endanger key military capabilities in Western militaries. Given the disadvantage militaries and economies will be at should space systems be degraded or disabled, it is easy to make an issue such as debris a 'security' issue given that space is a part of critical infrastructure.

In another text, Moltz makes an analogy of increasing space traffic and usage with the explosion in rail travel in the 19th Century, and the standards of time, safety, and conduct which it brought with it to imply that space is now at a similar point – space is increasing in the amount of traffic it sees and the number of actors in it. Space needs a regularised framework for operation. Concordantly, the many powers and actors which use space need a 'broader' and 'common' definition of 'space security' to operate safely in space.[31]

[30] Dalby, *Environmental Security...* pp. 5-7. Dalby refers to: Richard Ullman, 'Redefining Security', *International Security* (8:1, 1983)
[31] James Clay Moltz, 'Next steps towards space security', in John M. Logsdon, James Clay Moltz, Emma S. Hinds (eds.) *Collective Security in Space: European Perspectives* (Washington, D.C.: Space Policy Institute, 2007) pp. 124-126

James Moltz is not the only academic to widen 'space security'. Two multi-author volumes by the Washington, D.C.-based think tank Space Policy Institute adopted the *Space Security Index*'s definition of 'space security': the secure and sustainable access to, and use of, space from space-based threats.[32] Not all authors in these two volumes necessarily follow that line as will be shown below. Nancy Gallagher wrote of a 'space security system' which is constituted of legal conventions, customs, and norms, which should further the goal of 'global security' in space and as a result better serve American security interests in space.[33] Gallagher does not discuss her own conceptions of security in any great detail. One can reasonably deduce that her vision of a rules-based regime for regulating outer space activities and preventing unilateral offensive military policies from the United States should serve the United States' own 'security' interests - by securing its space assets from a negative response from the other space powers on Earth. According to Gallagher's logic, the use of space without rules to prevent offensive military deployments would create a less secure space environment, not only for the United States but for all. Importantly, she argues that an issue like space debris should be considered a security issue because achieving cooperation on space endeavours outside the 'security realm' would remain isolated and perhaps ignored.[34]

For Gallagher, a securitised cooperative approach to tackling space debris may spill over into more cooperative ventures in 'space security'. However, Kiran Nair argues the opposite; making headway in non-military aspects of space security may spill over

[32] John M. Logsdon, Gordon M. Adams, 'Foreword', in John M. Logsdon, Audrey M. Schaffer (eds.) *Perspectives on Space Security* (Washington, D.C.: Space Policy Institute, 2005) p. iii, and: John M. Logsdon, James Clay Moltz, 'Introduction', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives* (Washington, D.C.: Space Policy Institute, 2008) p. 1
[33] Nancy Gallagher, 'Towards a Reconsideration of the Rules for Space Security', in John M. Logsdon, Audrey M. Schaffer (eds.) *Perspectives on Space Security...* pp. 1-3, 27, 38
[34] Ibid., pp. 33

into cooperation into more sensitive military space issues.[35] Yet Kiran Nair also broadens her conception of security by speaking of *non-military aspects of space security*. If we were to use the traditional approach to security, there would be no aspect of space security that is not military. But there would be dangers to space assets that would not be considered security threats. In a similar vein, Peter Hays claims that tackling the issue of space debris may provide the US with the best transparency and confidence building measure (TCBM) opportunity, to ultimately achieve his loosely widened idea of 'sustainable space security.'[36]

Xavier Pasco widens his notion of 'space security' by referring to the European Union's (EU) 'balanced' and 'holistic' approach to space security. Pasco believes many policy problems that face the EU cannot be dealt with only through military approaches, and must be dealt with a 'security' orientated policy instead.[37] 'Military' and 'security' are two terms that have very separate meanings for Pasco – tackling a problem like space debris may increase collective security for all in space, as opposed to some military policies which may jeopardise collective security in space. Indeed, he implies that the "international community" has security interests.[38] Bertrand de Montluc echoes this by claiming that European countries have gradually developed an approach to security in space which includes more than a preoccupation with military capabilities.[39] Unfortunately, the themes or policy areas of Pasco's or Montluc's 'military' and 'security' are not spelled out, perhaps Pasco's conception of 'military' is addressing offensive

[35] Kiran K. Nair, 'Space Security: Reassessing the Situation and Exploring Options', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives*... p. 85
[36] Peter L. Hays, *Space and Security: A Reference Handbook* (Oxford: ABC-CLIO, 2011) p. 90
[37] Xavier Pasco, 'Enhancing Space Security in the Post Cold War Era: What Contribution from Europe?', in John M. Logsdon, Audrey M. Schaffer (eds.) *Perspectives on Space Security...* pp. 57-60
[38] Ibid., p. 61
[39] Bertrand de Montluc, 'Space Security: A non-US point of view', in John M. Logsdon, Audrey M. Schaffer (eds.) *Perspectives on Space Security...* p. 80-81

capabilities by adversaries, and the 'security' is a general adoption of the *Space Security Index*'s broad meaning of 'space security'.

Rajeev Lochan slightly adjusts the *Space Security Index* definition of 'space security' to mean "secure, sustainable, and denial-free access to and use of space for peaceful purposes and for one and all."[40] In other words, every actor has the right to use space, and no-one has the right to deny its use to anyone. Lochan refers to all space-faring actors as the referent points of this 'space security,' and the threats include man-made and natural threats to space systems, which are viewed as critical infrastructure components.[41] Dipankar Banerjee also adopts this view, claiming that India views unfettered access to space and the operation of space systems as critical infrastructure and key to India's 'space security.'[42]

Zhong Jing wishes for a new security concept to be developed for outer space, as the zero-sum security concept he accuses the US of employing is jeopardising everyone else's security in space. Zhong Jing claims that conceiving of an enemy as the main threat in space will result in no progress and greater risks in orbit, whereas (deductively), Jing believes that the main threats to the space security of all actors comes not from enemies but perhaps the environment and the pollution human activity is depositing there.[43]

Boutwell, Hitchens, and Moltz collectively argue that instigating and maintaining cooperation across space sectors (such as military, commercial, and scientific) and actors is a good way of achieving 'space security'. Because so many space activities across sectors and actors are interrelated and interdependent, Boutwell, Hitchens, and Moltz all call for

[40] Rajeev Lochan, 'Some Reflections on Collective Security in Space', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives*... p. 34
[41] Ibid, p. 36
[42] Dipankar Banerjee, 'Indian Perspectives on Regional Space Security', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives*... p. 125
[43] Zhong Jing, 'China and Space Security', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives*... pp. 77-83

an 'integrated' concept of space security to facilitate greater cooperation among space actors.[44] Again, like so much of the literature mentioned in this chapter, there is little to no reflection as to what the three authors' conceptions of security actually entail – both in what they may think the concept of 'space security' means today and what they think it should mean in future.

Exhibiting a similar tendency, D. Narayana Moorthi attempts to use human security to broaden and deepen a concept of space security:

> "[Using the concept of human security] enables a broadening of our notion of space security from its traditional conception in military terms, to encompass other threats (including those emanating from poverty, lack of education, health hazards, environmental degradation and natural disasters). It also emphasizes that we deepen the concept of security from the state down to the individual level and up to the regional and international level."[45]

Using human security, according to Moorthi, allows us to see the non-military threats to 'peace and security,' which may be alleviated with space systems which provide development tools which may improve human security capabilities. It is no revelation that space systems are key tools in human development. However, whether 'development' through space should be securitised is a question that is not addressed by Moorthi.

IV - Keeping space security 'traditional'

Space development is a theme touched upon by James Moltz in his book *The Politics of Space Security*; space should be developed rather than 'defended' or 'secured'.[46] This appears to be a move away from securitising outer space activities. Moltz's opinion here is in stark contradiction to the main drive seen earlier in the same book as elaborated

[44] Jeffrey Boutwell, Theresa Hitchens, James Clay Moltz, 'Enhancing space security by improving stakeholder cooperation', *Astropolitics* (2, 2004) p. 106
[45] D. Narayana Moorthi, 'What 'Space Security' means to an emerging space power', *Astropolitics* (2, 2004) p. 263
[46] Moltz, *The Politics of Space Security...* p. 321

above. How can one call for an environmental security concept as a useful foundation for understanding the politics of space whilst at the same time encouraging space activities to be viewed as standard development practices? Rather than securitising many or all aspects of space activity, perhaps space should indeed be desecuritised, or at least 'space security' should instead only refer to the intentional political-military (i.e. strategic) challenges posed to one's own space systems by other space powers and vice versa.

Daniel Deudney warned that appending 'security' onto environmental issues may serve as an attention-grabbing device with unfortunate consequences. Thinking in 'national security' terms over environmental issues risks forcing an organisation equipped to deal with threats from violence to engage with a different kind of threat posed by environmental hazards where zero-sum or self-serving statist thinking may not be the best way to address such problems.[47] Two points raised by Deudney strike a chord when critically assessing Moltz's use of environmental security: first, it is analytically misleading to think of environmental degradation as a national security threat because the traditional focus of such thinking has little in common with global environmental problems and their solutions; and second, mobilising an awareness of environmental problems through the emotive power of nationalism may be "counterproductive by undermining globalist political sensibility."[48] Indeed, Moltz attempts to pry his version of the concept of security away from a single state as a referent point, and loosely refers to orbital space itself and all states and actors in the space environment as referent objects of security. However, if Waever's claims that security has certain connotations that it cannot escape, Moltz's attempt at securitising the space environment and the threats it contains may indeed backfire along Deudney's logic and warnings. This would be risky if future US national

[47] Daniel Deudney, 'The case against linking environmental degradation and national security', *Millennium* (19:3, 1990) pp. 461-469
[48] Ibid., p. 461

security space policy was to adopt Moltz's views and incorporate space debris as a national security threat, and potentially take its own unilateral action in spite of international fears, suspicions, and doubts. This becomes increasingly worrisome if ADR systems are introduced to the problem of space debris, as unpopular unilateral action with ADR systems may not reassure other space powers which may see it as a cover for ASAT weapons deployment due to the dual-use nature of ADR systems. This is examined in greater detail in chapter four.

Joan Johnson-Freese asks whether protecting satellites with technology is a viable means to an end.[49] Her policy prescription encourages the US to rely on diplomatic, political, and legal manoeuvres to outlaw attacks on satellites and the technologies that enable them.[50] This better serves the United States' space security, and the conception of security at that point of her argument falls easily within a traditional framing. Again, a discussion of 'security' itself is largely absent within the book. This is unfortunate as towards the end of it Johnson-Freese begins to simultaneously deepen space security and exhibit a desire to desecuritise space by preferring the term 'space sustainability' to 'space security' in the context of the globalised and largely peacefully-intended uses of space today.[51] This resonates with Moltz's claims to simultaneously tout the merits of using environmental security and claim the greater adequacy of viewing space through a (sustainable) development lens.

As an illustrative example, some academics tend to retain their definitions of 'space security', or 'security' in space, to the military realm as a point of contrast to the literature above. Scott Beidleman discusses the Galileo versus Global Positioning System (GPS) debate in terms of Galileo's potential threat to US national security, and that Galileo

[49] Joan Johnson-Freese, *Heavenly Ambitions: America's Quest to Dominate Space* (Philadelphia: University of Pennsylvania Press, 2009) p. 2
[50] Ibid., p. 63
[51] Ibid., pp. 133-135

is a manifestation of the EU's desire to acquire 'security apparatus' independently of NATO.[52] Peter Hays mostly adheres to a traditional security approach despite a passing reference to 'sustainable space security', as his book mostly focuses on political-military threats to US space activity.[53] These are but two examples of a wider academic literature which focuses on traditional security in space, or space-focused strategic studies/defence policy texts. This dissertation's approach is loosely aligned to these, however it does differ in that it elaborates its concept of security and attempts to criticise the uncritical, cascading, widening of the term 'space security'.

Gerard Brachet and Setsuko Aoki appear to be able to talk about some non-military/political dangers or risks in space without having to refer to the term 'security'. Gerard Brachet laments the deadlock in international discussion on arms control in space; and has worthy concerns over the necessity of reliable access to space and a cleaner and safer operating environment to space. Space access and a safe operating environment are not only defence issues; they are directly relevant to all uses of space. As civilian and military users all share the same orbital paths, it may be beneficial for them to jointly develop "rules of the road," a Code of Conduct (CoC), for the benefit of all kinds of space actors of all state origins.[54]

Setsuko Aoki takes this logic further by explicitly referring to 'space safety' as a distinct concept separate from 'space security.' ""Space safety" is a concept similar to space security, but the focus is placed on the measures to accomplish safer conduct in

[52] Scott W. Beidleman, 'GPS vs Galileo: Balancing for position in space', *Astropolitics* (3, 2005) p. 119-120
[53] Hays, *Space and Security...* pp. 79-81
[54] Gerard Brachet, 'Collective Security in Space: A key Factor for sustainable long-term use of space', in John M. Logsdon, James Clay Moltz, Emma S. Hinds (eds.) *Collective Security in Space: European Perspectives...* pp. 8-11

space activities by various methods."[55] A large number of different actors now use space, and the need for a safer and more regulated operating environment in orbit is greater today than before. Aoki elaborates on a space traffic management (STM) system as an example of space safety measures, defined as "the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio- frequency interference."[56] It should be added that in 'space safety', physical and radio-frequency interference with satellite systems should be taken to mean the unintentional or accidental kind – intentional interference may be a hostile act of space warfare or sabotage which is a traditional security concern. For Aoki, realising space safety is a 'realistic' (or more plausible in the short-term) goal as safeguarding against accidental disruptions to space systems is an agreeable is a common goal of all space users. Passing measures for this end may not require arms control treaties or proposals, thus circumventing deadlock at the Conference on Disarmament (CD) and the Committee on the Peaceful Uses of Outer Space (COPUOS).[57]

The tension between widening security on one hand, and pushing for a developmentalisation of space activities on the other, is possibly a result of the complacency among the academics cited here with their conceptions of security. Without reflecting on the use of the term 'security', one can unintentionally follow Waever's logic of securitising topics and end up wishing to desecuritise them[58] after intuitively realising the dangers of self-interested national security thinking in a domain where every actor's actions easily adversely affects the other. Perhaps this desire to refer to global space activities (every kind of activity in space from every kind of actor) through developmental

[55] Setsuko Aoki, 'Japanese Perspectives on Space Security', in John M. Logsdon, James Clay Moltz (eds.) *Collective Security in Space: Asian Perspectives*... p. 52
[56] Ibid.
[57] Ibid.
[58] Waever, 'Securitisation and Desecuritisation'... pp. 57-58

terms is a result of the lack of a concept of international security.[59] As already referred to, Moltz and Johnson-Freese appear to step back from a widened 'security' concept in space due to their inability to escape the connotations of the state, defence, force, and self-interest that may accompany the term 'security'.

One cannot disagree with desires to see a safe operating environment in space for all users which partake in the world system if one has no radical transformative agenda for the global political economy as we know it. Therein lays the crucial point of difference: *safety*. environmental degradation poses a risk to the safe operation of assets in space. Putting unintentional environmental hazards into the same mental framing as intentional targeting of satellites for strategic reasons conflates the differing issues at hand and risks the conflation of space development and security interests in orbit.

Securitising space development may put too much political self-interest on the part of the space powers for something that should be done in normal conditions. 'Normal' is taken here to mean conditions of peace, or the absence of openly hostile behaviour between two or more space powers. Conversely, a condition of war or an act of aggression is taken to mean an 'abnormal' or 'exceptional' state of affairs. This helps fill a gap in *Security: A New Framework for Analysis* by defining a possible condition of normality. Like air and maritime traffic, global regulations exist for the efficient and safe passage of civilian and military vessels. Atmospheric turbulence or turbulent seas may not be considered security threats; why should environmental disturbances in space be any different? Securitising space debris may attempt to make the normal, or needed behaviour to manage human space systems, 'exceptional'. Securitising space debris may make unilateral national-security action more palatable for policymakers.

[59] Ibid., p. 48

V - Space Security

This is a hypothesis that will be tested in chapter four: using a widened concept of security in space endangers the potential of ADR systems to mitigate or even resolve the burden of orbital debris. This is opposed to keeping environmental hazards free of security language, and in the absence of national security-framed thinking there may be more potential for reassuring moves to use ADR systems without raising international fears of an ASAT weapons deployment. As a conclusion of the literature survey and the critique of widened notions of space security above, the pursuit of space security should be taken to mean an actor's attempts to protect its access to and use of space and the relevant satellite systems from intentional threats (physical and/or electronic) by other actors in space. Before testing the hypothesis, current US space policy with regards to security and debris must be examined alongside a briefing on the problem of debris itself and proposed ADR systems. After all, this dissertation attempts to make itself relevant to empirical reality. The next chapter illustrates US policy and the debris problem and possible solutions before combining the theoretical inquiry constructed in this chapter with empirical reality in chapter four.

3: Policy and Debris

I - Introduction

This chapter examines US policy with regards to the use of 'security' in space, the problem of orbital debris, and illustrates some active debris removal (ADR) system proposals. To what extent have non-military hazards or risks in space been securitised? This chapter presents an interpretation of the language seen in the policy documents used. Doing this serves two purposes: the first is that it is important to know what the US is thinking about space as it is our referent object of security, second, some non-military dangers to US National Security have been or are dangerously close to being 'securitised' in print. This warns of the potential that the environmental hazards of space *could* be securitised in US policy, and academic widening of security may exacerbate this risk.

Official documents are chosen as virtually the only indicator of government thinking in this study for four reasons: (a) the documents used are publically available and offer an easily accessible common point of reference for researchers on government policy; (b) a comprehensive analysis of oral statements by a myriad of government officials is beyond the scope of this study; (c) such documents are the outcome of policymaking among the bureaucracies and interested parties, and are able to show in one way to what extent non-military risks have been securitised in a carefully-worded document; and (d) open policy documents in the security field are (ideally clear) communications to external actors which can influence the perception of US actions in foreign capitals.

The Kessler syndrome is a scientific model, and only the conclusions of scientific studies are used; the finer workings of the Kessler syndromes and predictive debris modelling are not explored to any great degree. Rather, the Kessler syndrome is posed as

a looming problem, and the ADR proposals are idealised as a way to tackle a runaway growth in orbit.

II - US policy and space security

For the most part, US policy documents at the meeting point of space and security refer to US national security. Despite the 2010 National Space Policy's (NSP) introduction nodding towards the notion of a multi-actor political space environment and stating an intent to work for the benefit of all in space, the American insistence that the "peaceful purposes" of space includes "national and homeland security activities" remains largely unchanged.[60] The 2010 NSP does not single out any particular threat to the US, both from and in space. The NSP is document which covers a broad range of factors of US space policy, such as the space industrial base, space science, and national security missions. It considers the interdependence of all users of space with each other, and presents a desire to minimise risks in orbit (such as debris mitigation practices and space situational awareness (SSA) improvement).[61]

Towards the end of the document the national security uses of space systems are highlighted. The US plans to "maintain the capabilities to execute the space support, force enhancement, space control, and force application missions."[62] These are traditional US military requirements of space. The NSP largely adheres to a statist referent point as it uses the term national security. It wishes to utilise national security space assets, in accordance with foreign powers 'if necessary', to "detect, warn, characterize, and attribute *natural and man-made* disturbances to space systems of U.S. interest."[63] As a 'disturbance',

[60] US Government, 'National Space Policy of the United States of America', 28/06/2010, Washginton, D.C., available online: http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf (accessed 02/07/2012) pp. 1-3
[61] Ibid., p. 4
[62] Ibid., p. 14
[63] Ibid. Italics added.

the emotive power of the word 'threat' is avoided; disturbances such as solar storms and debris are not explicitly referred to as security threats to 'space systems of US interest.' This notion of 'disturbance' is in stark contrast to the definition of 'space security' as proposed by the *Space Security Index* which defines "space security" as "the secure and sustainable access to, and use of, space and freedom from space-based threats."[64] Here, solar storms and debris can easily take on the emotive exceptional notion of 'threat', as opposed to everyday routine potential of disturbances. In the previous chapter, we have seen the *Space Security Index*'s definition of space security gain significant mileage within academia; in contrast the 2010 NSP does not appear to explicitly link non-military space issues as security issues.

In more general terms, there is a perceived shift in space policy between the Bush Jnr and Obama administrations. The Obama administration appears to believe (at least to a greater extent than the previous administration) that the USA cannot "do everything on its own."[65] There may be a shift from unilateral language to more inclusive terms, but they may only be shifts of rhetoric.[66] The 2010 NSP "is an outward looking policy aimed at international cooperation and responsible behavior in space."[67] This is not surprising as the NSP has to account for more than the military aspects of space activity. But what is of note is that a more multilateral approach (in declared policy) is

> "...in rather stark contrast to the unilateralist path to leadership articulated in the 2006 Bush administration space policy. It also recognizes that in the space arena other nations and groups of nations have developed, and are continuing to develop, world-class space capabilities, and

[64] Cesar Jaramillo (ed.) *Space Security 2011*... p. 7
[65] Marcia S. Smith, 'President Obama's National Space Policy: A change in tone and a focus on space sustainability', *Space Policy* (27:2011) p. 20
[66] Ibid., p. 21
[67] Ibid., p. 23

> that unless they are engaged with the USA as they pursue their own objectives, other poles of space leadership will emerge."[68]

This will remain relevant for ADR systems and how they may be presented to the space actors of Earth should the United States begin develop them. A diplomatically open channel may yield better responses than a unilateral American approach, and such an approach may be partly determined in how orbital debris is framed – as a security issue or a space development problem. Also, ADR technologies cannot be assumed to be under an American technological monopoly, especially as we consider long-term future of space activity. Indeed, a future US administration may have to deal with the problem of a foreign ADR deployment.

Space is mentioned in the 2010 National Security Strategy (NSS) within the context of Washington's attitude to the global commons. Space, alongside other global commons such as international airspace, seas, and cyberspace, will be safeguarded "from those who would deny access or use them for hostile purposes."[69] This resonates with the NSP's declaration to maintain capabilities to enable space control and force application. Space is seen by the NSS as the avenue of 'asymmetric' attack, alongside the cyber realm, and believes that space and cyber systems are vulnerable to attack. With these statements, it may be that what the United States sees as the most pressing danger to its space systems is that of intentional attack from another actor, as opposed to unintentional dangers such as environmental degradation or turbulent solar storms.

Looking at the NSS beyond its perception of space puts the NSP in a wider context. The United States' national security priorities are nuclear proliferation and (jihadi) terrorism. Space provides crucial support roles in addressing these security issues.

[68] John M. Logsdon, 'Change and continuity in US space policy', *Space Policy* (27, 2011) p. 2
[69] US Government, 'National Security Strategy', May 2010, Washington, D.C. Available online: http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf (accessed 02/07/2012), p. 50

However, the NSS also refers to its economic well-being, 'food security', 'global health', 'sustainable development', and climate change as non-traditional problems that are a priority for the United States to deal with, among other issues.[70] This is a linking of security to 'broader' non-military issues. Also, there is a hint of a deepening of security to the global level as "the United States of America will continue to underwrite global security."[71] Perhaps the United States equates its security with global security, or that the US homeland means the globe.[72] 'Food security' is defined in the NSS as an initiative to "combat" hunger and help governments provide food for their people.[73] "Cybersecurity" is singled out in the NSS; it is applied to action taken against any actor which has nefarious intent towards US interests in or via the cyber realm.[74] This shows that the US may consider criminal and state-sponsored hackers as security threats. These examples show that the broadening and deepening of 'security', whilst in no way absolute, is present to varying degrees within US policymaking and public communication. This is a cause for concern with the potential to make orbital debris a security issue.

The NSS can be seen as a manifesto of the United States' perception of the most pressing dangers facing it. A traditional security mandate would instinctively not be concerned with including space debris in a security policy debate – but the NSS has included a wide range of non-military problems into a debate laden with national security motivations, as it is designed to. It is difficult to assert in any objective manner to what extent the NSS accurately portrays what the US government truly considers to be the most important of issues. But it shows through one window what is on the mind of policymakers. These documents can be taken as one of the outcomes of the various

[70] Ibid., pp. 4-5, 33, 39,47
[71] Ibid., p. 1
[72] David Grondin, 'The (power) politics of space: The US astropolitical discourse of global dominance in the War on Terror', in Natalie Bormann and Michael Sheehan (eds.) *Securing Outer Space* (London: Routledge, 2009), p. 113
[73] US Government, 'National Security Strategy', p. 39
[74] Ibid., pp. 27-28

pushing and pulling of bureaucratic politics and the aggregation of public and private interests.[75]

The US Department of Defense's (DoD) 2011 National Security Space Strategy's (NSSS) main message is that the US is operating in a "*congested, contested*, and *competitive*" strategic environment in space.[76] Space is increasingly populated by a greater number and diversity of actors, with greater numbers of actors potentially possessing space denial capabilities, and greater international competition over the space market. Space debris is given the opening shot of the NSSS' chapter on the 'strategic environment' of space, citing China's 2007 anti-satellite (ASAT) weapons test and claims that there are approximately 22,000 trackable man-made objects in orbit. 1,100 of those objects are satellites; the rest are debris. Untrackable debris objects number in the hundreds of thousands. A graph showing the growth of the debris population in orbit since the dawn of the space age is shown to dramatic effect (reproduced as figure 1 below). The NSSS also cites the competition over radio frequency slots as a congestion issue.[77] Other than a desire to be prepared to operate in a degraded environment in space in the event of open hostilities, the 2011 NSSS is unremarkable as it is aligned with the broader 2010 NSS and NSP. If nothing else, it shows that non-military elements of the space environment may be in an elevated position in the minds of policy makers. Also, the NSSS hints at the possibility of adopting a CoC for promoting *safe* practices in space:

[75] Eligar Sadeh and Brenda Vallance, 'The Policy Process', in Damon Coletta, Frances T. Pilch (eds.) *Space and Defense Policy* (Abingdon: Routledge, 2010) pp. 125-127
[76] US DoD, 'National Security Space Strategy: Unclassified Summary', January 2011, Washington, D.C., available online: http://www.defense.gov/home/features/2011/0111_nsss/ (accessed 24/05/2012) p. 1. Italics original.
[77] Ibid., pp.1-2

> "We believe setting pragmatic guidelines for safe activity in space can help avoid collisions and other debris-producing events, reduce radiofrequency interference, and promote security and stability in the space domain – all of which are in the interests of all nations."[78]

This does not necessarily link radiofrequency allocations to a concept of 'security' – it appears that 'security and stability' are *additional* topics of consideration for a CoC. As far as the NSSS is concerned, a condition of 'security' need not necessarily follow from mitigating debris and resolving frequency slot allocation issues. Based on this reading of the Obama Administration's views, as an authority in defining what national security issues are through a speech act, we can reasonably ascertain that there is no overt case of linking traditional notions security with non-military problems such as orbital debris or solar storms. However, non-military problems are raised frequently alongside the need for 'national security space systems' to carry out their tasks. In relative terms to academic discourse on 'space security', the US government has not overtly securitised non-military problems in outer space. This is still a cause for concern if there are risks in securitising ADR systems and the problem of debris.

III – Space junk off the starboard bow!

The trigger for this study now needs to be briefed in greater detail than what was said in the introductory chapter. Crucially, ADR proposals need to be presented as it is the possible perception these systems in the future which the results of the conceptual debate manifest themselves in social reality. ADR systems do not exist as of yet, but they may well do in the years ahead. It is particularly important to remember when we consider the dual-use potential of ADR systems that ASAT weapons can still be political and have international effects even when they are only on the drawing board.[79]

[78] Ibid., p. 6
[79] Joan Johnson-Freese, *Heavenly Ambitions...* p. 67

'Space debris' is an umbrella term taken to mean any man-made object that is up in orbit which does not serve a useful purpose. Defunct satellites, spent rocket bodies, fragments of hardware, and general junk as a result of launch activities all come under the term 'debris'. However, a precise and agreed upon definition of debris objects does not exist.[80] Space debris such as these orbit the Earth at tremendous speeds (from just above 3 km/s to approximately 7.8km/s.[81] At these velocities, the kinetic energy from objects as small as flecks of paint can cause damage to spacecraft upon impact, and larger ones can destroy upon impact. Furthermore, impact events create more debris, increasing the number of debris in orbit and, consequently, the chances of more debris events. If this were to occur enough times, it is feared that a runaway growth in debris and the mitigation of the utility of space for modern civilisation. This is the Kessler syndrome. This is further compounded by the fact that orbital debris takes a very long time to fall back to Earth – objects at 380km altitude take decades to deorbit and come down to Earth; at the geosynchronous orbit (GEO) altitude of approximately 35,800km (where most communications satellites are located), deorbiting takes literally millions of years.[82] As a result, the debris population has continued to grow since the dawn of the space age (see figure 1).[83]

[80] Michael Listner, 'Legal issues surrounding space debris remediation', *The Space Review*, 06/08/2012, http://www.thespacereview.com/article/2130/1 (accessed 17/08/2012)
[81] Jeff Root, 'Orbital speed', *Freemars.org*, 18/09/2004, http://www.freemars.org/jeff/speed/index.htm, (accessed 15/07/2012)
[82] Ibid.
[83] Graph taken from: US DoD, 'National Security Space Strategy...', p. 1

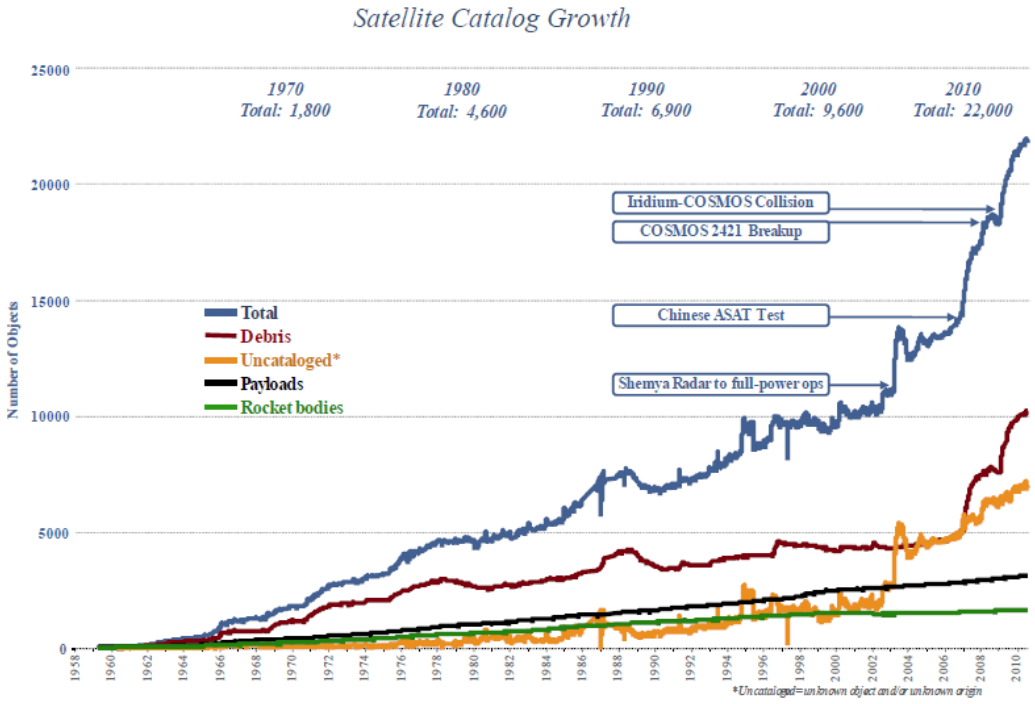


Fig. 1: (US) Satellite catalogue growth

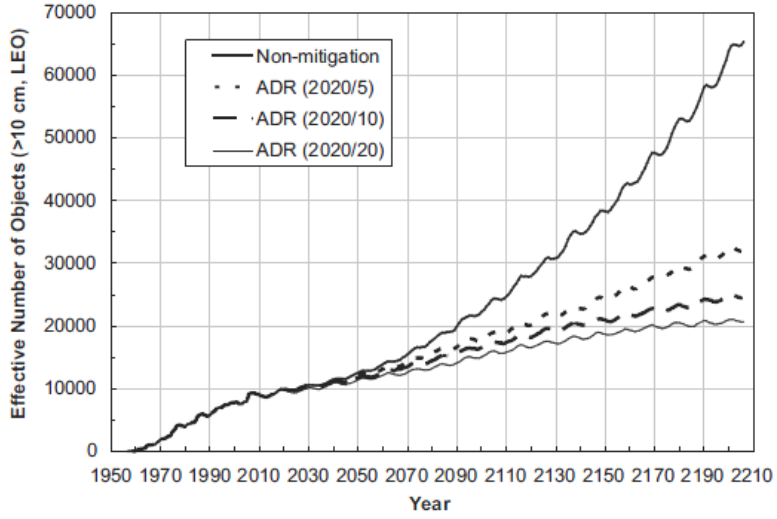
Significant exacerbation of the space environment has already occurred the recent past. In 2007 the People's Liberation Army (PLA) tested an anti-satellite missile on one of China's satellites. The event increased the amount of debris in orbit below 2,000km by one fifth.[84] The Russian satellite Cosmos 2251's accidental collision with an American Iridium satellite in 2009 has created over 1,200 pieces of tracked debris.[85] The number of detected and tracked debris objects from these two debris events is over 5,500, and they make up 36% of *all* objects residing in or passing through LEO.[86] Only 10% of the debris generated has deorbited. These numbers only include the debris that can be tracked by space surveillance networks (SSN), which are usually greater than 10cm in diameter. Smaller pieces are thought to have proliferated even more, but are exceedingly difficult to track with contemporary space radar capabilities. The United States possesses the most capable

[84] Cesar Jaramillo (ed.) *Space Security 2011...* p. 30
[85] Ibid., p. 31
[86] National Aeronautics and Space Administration (NASA), *Orbital Debris Quarterly News* (16:3, 2012) http://www.orbitaldebris.jsc.nasa.gov/newsletter/pdfs/ODQNv16i3.pdf, p. 2

SSN and the most comprehensive single debris catalogue on Earth; there is no comprehensive and publically available catalogue.

As troubling as this growth in debris over the past decade is, the Kessler syndrome predicts that Earth orbit will become more heavily populated by debris even should all launches into space end immediately. This is not to degrade the significance of the adoption of the IADC debris mitigation guidelines,[87] but mitigation alone does not resolve the problem envisaged by the predictions of the Kessler syndrome:

> "Recent numerical simulations on the evolution of orbital debris population in low-Earth orbit (LEO, 200–2000 km altitude) indicate that the population has reached a point where the environment is unstable and population growth is inevitable. The main conclusion from the two studies is that even if no further space launches were conducted, the Earth satellite population would remain relatively constant for only the next 50 years or so. Beyond that, the debris population would begin to increase noticeably due to the production of collisional debris."[88]



LEGEND-simulated LEO debris populations (objects 10cm and larger) between 1957 and 2006 (historical), and between 2007 and 2206 (future projection). Each curve represented the average of 100 Monte Carlo runs.

Fig. 2: Forecast of the number of debris objects in LEO which are larger than 10cm in diameter up to the early 23rd century

[87] IADC, 'IADC Space Debris Mitigation Guidelines'...
[88] J. C. Liou, Nicholas L. Johnson, 'A sensitivity study of the effectiveness of active debris removal in LEO', *Acta Astronautica* (64, 2009) p. 236

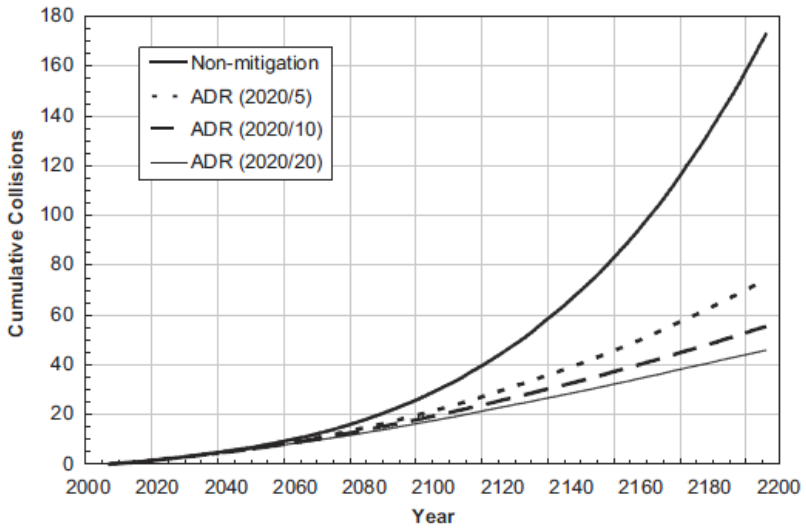


Fig. 3: Forecast of the cumulative collisions in LEO up to the early 23rd century.

Cumulative collisions of the LEO population (objects 10 cm and larger) as functions of time from the four test scenarios. Each curve is an average of 100 Monte Carlo runs.

If the sobering forecasts of figures 2 and 3[89] are correct, and should the Kessler syndrome be realised, the space powers of the 2060s will begin to see a runaway growth in the number of collisions and debris in LEO. Liou and Johnson studied the effectiveness of four scenarios: (a) non-mitigation, where nothing is done to actively remove debris, (b) ADR 2020/5, where debris removal begins in the year 2020 with a rate of 5 of the most 'likely-to-collide' objects removed per year; (c) ADR 2020/10, which is the same but with 10 objects removed per year, and (d) ADR 2020/15 with fifteen objects removed per year. Liou and Johnson did not analyse the possible techniques of ADR, but it does not detract from their significant conclusion that removing as few as five of the most troublesome pieces of debris per year may massively ameliorate the Kessler syndrome.

According to figure 2, removing five troublesome debris objects every year will mean that the large debris population at the dawn of the 23rd century may be halved from approximately 60,000 to 30,000. This model assumes ADR begins in 2020, but if it begins at

[89] Ibid., pp. 239, 238. LEGEND is a NASA debris modelling system, which stands for *LE*O to *G*EO *En*vironment *D*ebris model.

a later date, the perceived value of ADR will only increase with time. The data is based on ADR which instantly removes the debris, but in reality de-orbiting debris may take some time (which varies with the technique). ADR via a foam method is an example of a 'delayed' ADR: a satellite encases the target debris (between 1-10cm in diameter) in foam which increases the atmospheric drag over time, shortening the lifespan of the debris' orbit.[90] In other words, increasing the size of the debris increases the friction it creates against the residual particles of the atmosphere between 500km and 1000km altitude and hastens its return to Earth.[91] Removing large debris objects is a long-term goal; and removing objects between 1-10cm is a shorter term goal.[92] Removing large objects (greater than 10cm) will ameliorate the cause of smaller debris pieces. Space will become a much more hazardous environment for space operations, including military space support, treaty verification and global communications; a clear *danger* to military capabilities and provides some justification for including debris as a threat to national security. Whether or not debris is thought of as a security issue, active debris removal needs to be considered.

IV - ADR methods

If we can reasonably assume from the data above that removing no less than five priority orbital debris objects per year (which are over 10cm in diameter), is a worthwhile goal, we can ask: which ADR methods or systems can be developed to achieve this task? Also, it is worthwhile to ask which systems may be used to remove objects between 1-10cm in diameter as they are short-term goals which may appeal to space powers as they directly protect space assets from the most likely cause (in the numerical sense) of

[90] M. Andrenucci, P. Pergola, A. Ruggiero, 'Active Removal of Space Debris Expanding foam application for active debris removal', University of Pisa/European Space Agency, 21/02/2011. Available at: http://www.esa.int/gsp/ACT/doc/ARI/ARI%20Study%20Report/ACT-RPT-MAD-ARI-10-6411-Pisa-Active_Removal_of_Space_Debris-Foam.pdf (accessed 28/07/2012) p. 4
[91] Liou and Johnson, 'A sensitivity study...' pp. 241-243
[92] Brian Weeden, 'Overview of Active Debris Removal', Active Debris Removal Symposium, Leiden, Netherlands, June 21, 2012. http://swfound.org/media/84419/BW-ADR-Leiden-Jun2012.pdf (accessed 27/07/2012)

collision. Figure 4[93] shows a selection of ADR concepts and which kind of debris in which orbital altitudes they are designed to tackle. Also, the degree of potential damage risk from the size of debris is included.

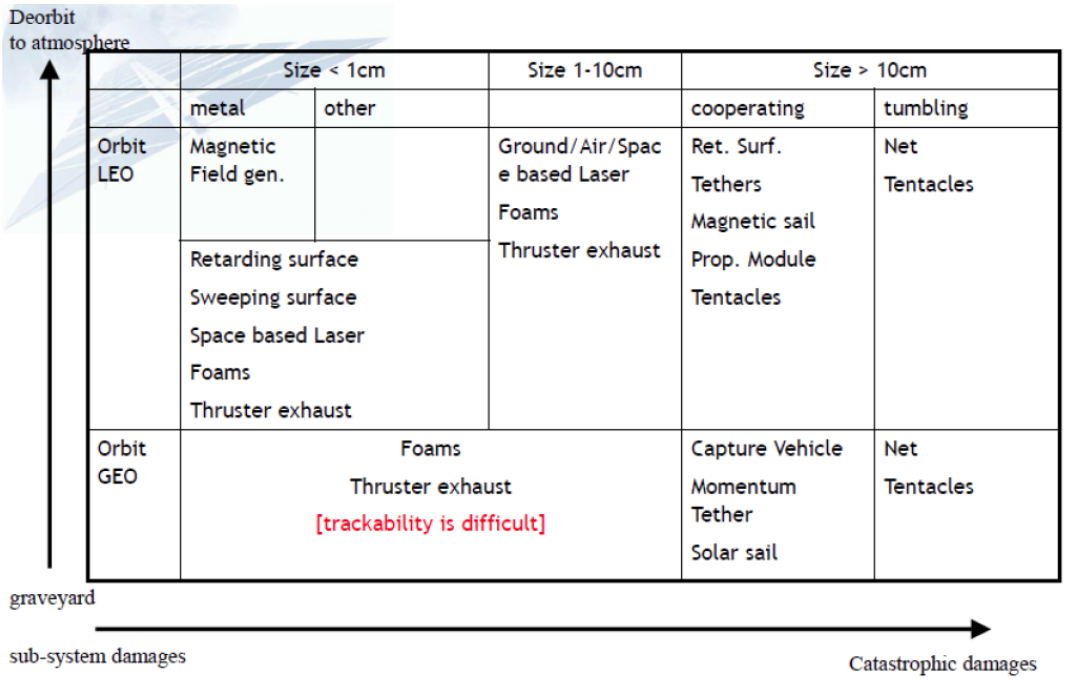


Fig. 4: Table showing sizes and locations of debris and the kind of ADR systems needed to tackle them.

ADR in LEO works through accelerating the natural decay process (such as the foam method above) with pieces below 10cm in diameter, and rendezvous operations with larger pieces. Rendezvous operations could be done either by dedicated satellites or a satellite which launches smaller propellant modules to attach to targeted debris. Laser ablation is a 'promising' technology which may allow the acceleration of the orbital decay of small pieces of debris.[94] Ground, air, or space-based lasers could enact some thrust and momentum on debris through ablation. A repetitively pulsed laser beaming onto a

[93] Brian Weeden, 'Overview of the legal and policy challenges of orbital debris removal ', *Space Policy* (27, 2011) p. 39. Original table from: Olympio J, Summerer L, Naja G, Leitner J. Powerpoint presentation at the European workshop on active debris removal: "Towards a better understanding of active space debris removal options", vol. 22; June 2010. Paris, France.
[94] Ibid.

satellite over multiple windows of opportunity aims to slow the target by up to 200 metres per second (m/s).[95] This would trigger a deorbiting of the debris.

A laser orbital debris removal (LODR) system is proposed to remove the 300,000 objects that are between 1-20cm in diameter within two years of becoming operational. Objects of these size are claimed to be able to be ablated enough in one passing above a ground-based laser installation, with a price tag of $330 per object deorbited. The same proposal aims to remove 2,000 large debris objects within five years of operation, totalling a total mass of de-orbited objects at 3 kilotons (kt) with an estimated cost of over $1.5bn, or $500,000 per object removed.[96] The elaboration of the laser system does not serve as a debate on the technical or economic feasibility of such systems, but rather as an illustration of what is being proposed as a means of ADR in order to discuss their potential political implications in the next chapter.

Other systems envisage more exotic methods such as Japanese plans[97] for electrodynamic tethers (using Lorentz force theory[98]) which could convert electrical energy along a tether, attached to an ADR satellite, from the Earth's magnetic field into kinetic energy and unleash it upon the target object. Another method is netting and tentacles (including ADR missions in GEO) – the European Space Agency has commissioned studies on the feasibility of ROGER (RObotic GEostationary orbit Restorer) since 2002.[99] Another method is altering the spin of unstable debris via exhaust heat from

[95] Phipps and Lander, 'What's New for Laser Orbital Debris Removal?'... pp. 340-341
[96] Ibid., p. 345
[97] Satomi Kawamoto, Yasushi Ohkawa, Shoji Kitamura, Shin-Ichiro Nishida, 'Strategy for Active Debris Removal Using Electrodynamic Tether', *Transactions of Space Technology Japan* (7:26, 2009)
[98] Carmen Pardini, Toshiya Hanada, Paula H. Krisko, 'Benefits and risks of using electrodynamic tethers to de-orbit spacecraft', Inter-Agency Debric Coordination Committee (IADC), IAC-06-B6.2.10. Available on-line: http://www.iadc-online.org/Documents/IADC-06-08.pdf
[99] European Space Agency (ESA), 'RObotic GEostationary orbit Restorer (ROGER)', http://www.esa.int/TEC/Robotics/SEMTWLKKKSE_0.html, last update 02/11/2011. (Accessed 30/07/2012)

satellites; a patent has been filed in the US for this purpose.[100] Stabilising debris would make it easier for other ADR systems to operate. With this brief sketch of certain ADR methods, it shows that scientific minds across the world are researching, and some agencies are promoting, ADR systems. The political implications need to be considered alongside pre-existing technical and economic discussions. All ADR systems are tasked with interacting with objects in space. Clear dual-use capabilities are evident in that an ADR system is not inherently restricted to targeting debris – working satellites could also be targeted.

V - Conclusion

The crux of the matter is in the politics surrounding ADR systems and not in the finer technical workings or economic feasibilities of particular ADR systems. How these systems factor into space security considerations can now be considered in the light of the conceptual case for keeping 'security' traditional in space set out in chapter two, and the realisation that although 'security' has not been explicitly widened in US policy, there is a risk of 'mission creep' as evidenced by a tendency to refer to 'global security' and non-military dangers in national security documents earlier in this chapter. Chapter 4 analyses the political implications of ADR and its dual-use nature, as well as how certain concepts of security may alleviate or exacerbate the dual-use conundrum.

[100] US Patent Office (USPTO), 'Stabilization of unstable space debris', Patent No. 8,226,046, USPTO Full-text and Image Database, http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO2&Sect2=HITOFF&p=1&u=%2Fnetahtml%2FPTO%2Fsearch-bool.html&r=1&f=G&l=50&co1=AND&d=PTXT&s1=8226046&OS=8226046&RS=8226046, 24/07/2012. (Accessed 30/07/2012)

4: Duality

I – Introduction

This chapter brings together the conceptual discussion in chapter two and the empirical study in chapter three to present a normative argument that space debris should not be considered a security issue. It tests the hypothesis spelled out in chapter two: using a widened concept of security in space endangers the potential of ADR systems to mitigate or even resolve the burden of orbital debris. In effect, this is an anticipation of the politics of ADR systems, and ideally serves as a preventative argument against any supporter of ADR systems attempting to justify action against debris on the grounds of 'national security'. This is done through a counterargument against widening the term 'space security', which is so often used but seldom analysed.

This chapter begins by describing two political challenges that are posed by ADR systems. The first is in their development and deployment, the second is in their operation. These challenges are born of the inherent dual-use (also referred to as 'duality') potential of ADR systems. Thereafter, two differing interpretations of security are used to argue how the dual-use problem may be exacerbated by an all-encompassing 'threat' perception by the United States if and when ADR systems are actively developed and perhaps one day deployed. Finally, the chapter connects the two security concepts to the problem of duality and the potential of deploying potential ASAT systems without significant political fallout.

II – I'm a janitor, not a soldier!

Focusing on the political dimensions of ADR is possible without too much of a focus on the technical and economic details of each particular kind of ADR system is

designed to interact with *objects* in orbit in one way or another by altering their orbital paths. Be it ESA's ROGER, Switzerland's 'CleanSpace One',[101] JAXA's (Japan Aerospace Exploration Agency) electrodynamic tether, or laser installations on the ground, all can be construed as systems capable of targeting and interfering with operational satellites as well as debris.

The first, and most problematic, political challenge posed by ADR systems is that they run the risk of being seen as ASAT weapons by external actors. This is an extremely important issue to bear in mind with any ADR system any space actor may wish to develop and deploy, because space weapons bear a large political significance beyond 'just another weapons system'.[102] For example, if an American space-based ADR system is viewed as an ASAT weapon system in Beijing, the diplomatic and political fallout may be costly; it is not unreasonable to expect political costs following ASAT weapons deployment following Russian and Chinese initiatives via the Draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force Against Outer Space Objects (PPWT).[103] The PPWT aims to ban all 'weapons' placement in space, going further than the 1967 Outer Space Treaty (OST) which bans only the placement of "weapons of mass destruction" in space.[104] Curiously, the PPWT does not

[101] *Lifeslittlemysteries.org*, 'Switzerland to build 'janitor' satellite to clean up space', 15/02/2012, http://www.lifeslittlemysteries.com/2165-janitor-satellite-cleanspace-space-junk.html accessed 31/07/2012.
[102] Michael O'Hanlon, *Neither Star Wars nor Sanctuary: Constraining the Military Uses of Space* (Washington, D.C.: Brookings Institution Press, 2004) p. 21
[103] Treaty document: Victor Vasiliev, 'THE DRAFT TREATY ON THE PREVENTION OF THE PLACEMENT OF WEAPONS IN OUTER SPACE, THE THREAT OR USE OF FORCE AGAINST OUTER SPACE OBJECTS', Published in Security in Space: The Next Generation—Conference Report, 31 March–1 April 2008, United Nations Institute for Disarmament Research (UNIDIR), 2008. http://unidir.org/pdf/articles/pdf-art2822.pdf (accessed 01/08/2012)
[104] United Nations Office for Outer Space Affairs (UNOOSA), 'Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies', http://www.oosa.unvienna.org/oosa/SpaceLaw/outerspt.html, accessed 01/08/2012.

ban Earth-to-space weapons, as it defines space weapons as weapons based in space.[105] Earth-based weapons targeted at space can be categorised as 'space weapons' if we define them as any system whose use destroys or damages working satellites in or from space. This definition paraphrases Moltz's, but crucially changes the word 'object' to 'satellite'.[106] By this definition, the PPWT would not ban all 'space weapons' – and would not affect already existing space weapons such as pre-existing American and Chinese kinetic-kill missiles and Earth-based lasers.[107] The word 'object' in the PPWT also raises the possibility of banning ADR systems as their behaviour is almost identical to ASAT weapons if a distinction is not made between systems which target working satellites and debris. Ergo, space weapons should be defined in separate terms to that of ADR systems so that ADR systems are not consigned to the same restrictions as ASAT weapons from any potential PPWT-style treaty in the future. As a side-note, ground-based LODR systems may be less politically sensitive if Russian and Chinese definitions of 'space weapons' do not change, but may not be as effective in removing the largest and most troublesome debris objects. However, any LODR which was capable of removing large objects could easily alter the orbits or even disable large functional satellites in LEO.

[105] Alexei Arbatov, 'Preventing an arms race in space', in Alexei Arbatov and Vladimir Dvorkin (eds.) *Outer Space: Weapons, Diplomacy, and Security* (Washington, D.C.: Carnegie Endowment for International Peace, 2010) p.85
[106] Moltz, *The Politics of Space Security...* p. 43
[107] *The Economist*, 'Satellite Wars: Endangered birds', in *Technology Quarterly*, Q4, 2010, 09/12/2010. http://www.economist.com/node/17647639 (accessed 01/08/2012)

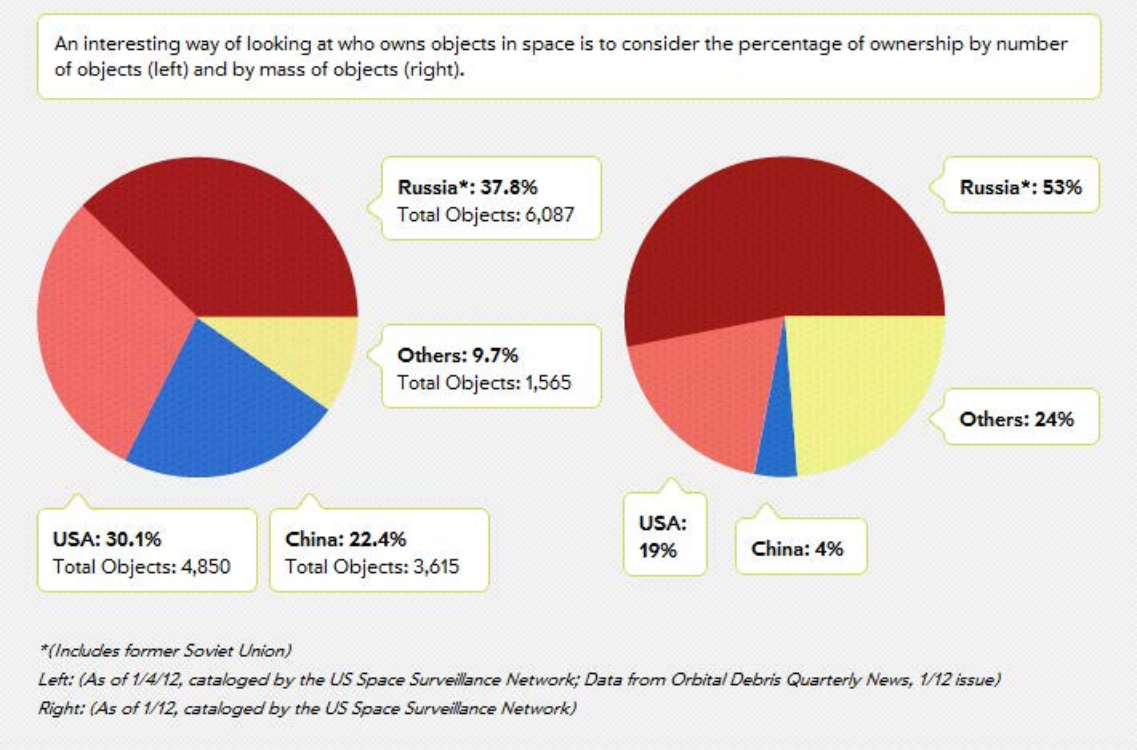


Fig. 5: The ownership of trackable space debris.

The second political challenge posed by ADR systems is in their operation. As discussed in the previous chapter, the models for projecting the debris population after ADR operations begin is based on categorising certain debris objects that are most likely to cause more debris-generating events. These models do not take into account the politics of removing such objects.

Figure 5 shows who 'owns' the most debris (in both number and mass) in orbit.[108] There are legal difficulties surrounding ADR: there are no legal obligations among launching states to register debris objects; because of the lack of obligation of registry, on many occasions a launching state cannot be identified as many of the catalogued and uncatalogued debris are not in the UN debris registry - a situation of legal ambiguity exists over who should remove the debris; the launching states own the debris they create and there is no legal right from any other party to remove them; there are no conventions

[108] Kathy Jones, Krista Fuentes, David Wright, 'A Minefield in Earth Orbit: How Space Debris Is Spinning Out of Control [Interactive]', *Scientific American*, 01/02/2012, http://www.scientificamerican.com/article.cfm?id=how-space-debris-spinning-out-of-control&WT.mc_id=SA_CAT_SPC_20120202# (accessed 01/08/2012)

in place for the liability of ADR operations' mishaps or accidents; and closely scanning space objects for the purposes of ADR may endanger intellectual property rights and give away trade secrets to the scanning actor. The political difficulties arise from: the imbalance of debris ownership (as seen in figure 5) coupled with the prioritisation of debris removal (object mass times collision probability) which would make any ADR attempt along such mathematical guidelines alone may seem highly politically motivated; as there is no obligation of declaration of debris, an ADR system could remove what may appear to be a defunct satellite but could turn out to be a dormant satellite for ulterior purposes and such a removal could be construed as an act of aggression; and finally, the duality of ADR systems could cause 'instability' and suspicion.[109]

III – Widened space security *vs.* traditional space security

The two problems of development and operation are significant enough before we consider how a widened concept of security can exacerbate them. As established in chapter two, the hypothesis tested is that widening 'space security' is detrimental to tackling the issue of orbital debris in a politically amiable way between the space powers. The two concepts of security under scrutiny are: on the one hand we have **a traditional security concept** where the pursuit of space security (or security in space) should be taken to mean an actor's attempts to protect its access to, and use of, space and the relevant satellite systems from intentional threats (physical and electronic) by other actors in space; and on the other we have **a widened notion of space security** which is taken to mean any threat (i.e. any risk of disruption, damage, or destruction) to all uses and users of space, epitomised by the *Space Security Index* and evidenced in the academic literature in chapter two.

[109] Weeden, 'Overview of the legal and policy...' pp. 40-42

As Nair stated, perspectivism is important, if not essential, in thinking about security and what constitutes a threat.[110] This is no less true of security in space and ADR systems. What do these two concepts do to the two problems above? If we first apply the widened space security approach to a US space policy perspective, orbital debris is considered a security issue for every actor as it threatens the use of systems in space, and should the Kessler syndrome grow even more acute, access to space would be threatened as well with fewer safe launch windows from Earth. The argument could be made that orbital debris will threaten the national security uses of space for all actors and will require 'urgent' action to remediate the situation. There is some merit in this argument – a large enough piece of debris will have similar consequences if it hits a crucial satellite as would the kinetic-kill vehicle in a hostile ASAT weapons system. Indeed, there is a congruence between a nationalist thinking of emergency (albeit measured over decades) with the need for action, and a globalist environmental position on orbital debris with alarming visions of the future environment.[111]

However, as argued in brief in Chapter 2: Section IV, using the national security lens to deal with the problem of orbital debris and in deploying ADR systems may be counterproductive, according to Daniel Deudney's logic. Using a widened security concept may not work even if the deepened referent point of security was carried through in security policy. Indeed, as seen in chapter two, environmental hazards in space has pushed numerous scholars to refer to humanity as a whole or all space actors as the referent points of their widened space security concepts. It is true that environmental hazards in space are threats to all space-faring actors, and Deudney captures well how this logic widening of space security's referent point came about:

[110] Nair, 'Space Security: Reassessing the Situation...' p. 84
[111] Deudney, 'The case against linking...' pp. 466-467

> "… existing 'us *vs.* them' groupings in world politics match very poorly the causal lines of environmental degradation. At its most basic level, the environmental problem asks us to redefine who 'us' encompasses. Coping with global problems and new forms of interdependence requires replacing or supplementing national with other forms of group identity."[112]

In theory, widening may be logically sound. In practice, there are risks to attaching the word 'security' to what is a global problem. An American belief that it is acting on behalf of all space actors' "space security interests", or even the space environment, may be difficult to convey without foreign suspicion because ADR systems can be seen as ASAT weapons.

National security bureaucracies may contaminate ADR removal protocols by determining, according to their own calculi, which debris objects are more likely to interfere with their own satellites, rather than the objects which would pose a greater risk of increasing the debris population and poses a more immediate threat to another actor's satellites or orbital paths. Conversely, a choice could be made not to remove debris which poses a more immediate threat to a potential adversary or the other party in a political dispute. In other words, securitising debris may elevate or even lower the priority of the solutions needed for the Kessler syndrome, but only on a self-interested national basis rather than a global commons approach, where ADR systems would ideally clean up orbit for all users, rather than useful orbits for US national security satellites and purposes. Organisations which protect from violence are different to those which are meant to manage environmental problems in that military organisations are hierarchical and secretive, remove debate away from vast swathes of civil society, and are trained in the arts of killing and destroying. Environmental issues, such as orbital debris, may require

[112] Ibid., p. 468

the opposite approach and "behaviour modification *in situ*."[113] Human behaviour needs to change by introducing routinising orbital clean-up operations; this is contrary to the possible effect of securitisation exceptionalising measures when they should be routine.[114]

What this means for orbital debris' solution is that ADR systems, as part of a transparency and confidence building measure (TCBM) to alleviate fears over the duality of ADR, should be more open and not locked away in the bowels of the American military-industrial complex (MIC) with departments such as the Defense Advanced Research Projects Agency (DARPA). Securitising debris may push ADR systems down the path of defence procurement, which may exacerbate fears over the duality of such technological research to the other space powers. Furthermore, ADR should not be viewed in the context of a 'supreme' problem or the mass urgency required to defend against something akin to military aggression, where the political life or values of a state or any political actor capable of violence is threatened by the politically motivated violence of another actor. In security discourse, a problem may be presented as a supreme problem in need of urgent action.[115] One can easily maintain a sceptical attitude towards the possibility of US security policy discourse deepening its referent point of security; there may only be merely a broadening of 'security' in space to include non-military risks, but viewed through the lens of the dangers such risks pose to, first and foremost, the United States and the naïve belief US security confers 'security' to everyone in the system.

Using the traditional concept of security in space helps to answer the question whether orbital debris is better addressed through 'panic politics' or 'normal politics'?[116] As defined in chapter 2, 'normal politics' is a condition of peace or planning action that is not aggressively intended towards a particular actor. The point here is that orbital debris

[113] Ibid., pp. 464-465
[114] Dalby, *Environmental Security...* p. 10
[115] Buzan et al, *Security: A New Framework...* p. 26
[116] Ibid., p. 34

is not 'dealt with' by a traditional security concept in space. Orbital debris simply does not come into the space security threat analysis under a traditional concept of security as orbital debris and the dangers of the Kessler syndrome are not intentionally deployed offensive weapons systems by any actor, and they are indiscriminate in their targets.

'Space security', according to a traditional understanding, would be more concerned with strategic studies and the conduct of military operations in, from, and through space. Michael O'Hanlon's call for a hedging strategy with latent ASAT weapons research but a restraint on deployment is his answer to the United States' perceived uneasiness with the potential security threat Chinese military capabilities and the proliferation of (counter) space technology poses.[117] Joan Johnson-Freese wishes to see US space security improved via political and legal measures, as opposed to deploying systems to protect satellites from physical attack.[118] The point here is not over the conclusions of their studies, but on their topic areas. Geographical and environmental factors are taken into account – but that does not lead to a widening of 'space security' or security in space for the United States. Indeed, any sound strategic planning has to take into account the terrain and the geographical context.[119] An aversion to the risks generated by debris events, borne of an appreciation for the environmental risks of space warfare with hit-to-kill ASAT weapons, may force space warfare down the path of ground-based laser blinding and cyber operations to disable/deorbit/hijack satellites. Indeed, there has reportedly been a case where the United States lost control of a satellite to an unknown hacker which had accessed the relevant systems needed to issue commands to a NASA

[117] O'Hanlon, *Neither Star Wars...* pp. 21, 90, 133-137
[118] Johnson-Freese, *Heavenly Ambitions...* pp. 32, 63
[119] David J. Lonsdale, *The Nature of War in the Information Age: Clausewitzian Future* (London: Frank Cass, 2004) pp. 86-90, 94, 196, 203

satellite.[120] If space warfare goes down an environmentally 'cleaner' path, debris may become a problem more associated with routine operations in space, rather than as a catastrophic consequence of a major physical conflagration in orbit.

By keeping 'space security' concerned with strategy, conflict, and the traditional connotations of 'security', orbital debris and ADR systems may be seen as (for lack of a better term) space development issues, rather than security ones. Space development here means the pursuit of cheaper, safer, and more reliable access to, and use of space, for all uses of space such as military, scientific, economic, observation, and so forth.[121] Orbital debris is indeed not just a risk for the national security purposes of space, but for all uses of space.[122] This brings back the notion of 'normality' to the debate over securitising orbital debris. Just the same as utilising SSNs for the safety of space assets to avoid collision is a routine operation, removing debris from orbit *should* also be a routine operation.

This normative assertion can be elaborated through a hypothetical scenario where space has been 'sanctuarised' from warfare.[123] Orbital paths around Earth would still become polluted – the debris population has been increasing in the absence of overt military confrontation and before the 2007 ASAT test. Pollution would still be occurring in orbit regardless of the military significance an actor may be attaching to it. If polluting orbits is a normal and routine consequence of all human activity in outer space, cleaning up space should also be a routine operation to preserve the continued utility of space should the Kessler syndrome be realised. If ADR operations can be routinised and

[120] Nicole B. Johnson, 'Report: Cyber attacks targeted US satellites', *Defense News*, 28/10/2011, http://www.defensenews.com/article/20111028/DEFSECT01/110280301/Report-Cyber-Attacks-Targeted-U-S-Satellites (accessed 03/08/2012)
[121] Nader Elhefnawy, 'Economic growth and space development over the long haul', *The Space Review*, 29/09/2008, http://www.thespacereview.com/article/1220/1 (accessed 03/08/2012)
[122] Brachet, 'Collective Security in Space...' pp. 8
[123] John J. Klein, *Space Warfare: Strategy, Principles, and Policy* (Abingdon: Routledge, 2006) p. 16-18

regulated among the space powers, the myriad of legal ambiguities and difficulties listed by Brian Weeden above can plausibly be overcome via a CoC or similar memoranda of understanding which did not insist on including clauses about ASAT weapons.

However, if debris is not considered a 'security issue', it may not get the funding attention it needs. Lobby groups in the United States may indeed want to attach 'security' to raise its political profile[124] in order to get ADR systems the funding and action needed to develop them. This may be a problem posited by the American policymaking environment, as the presentation of environmental problems as 'threats' rests on a recurrent conflation of threat with risk (which is evidenced in chapter two). Environmental security, or the encroachment of 'security' upon environmental risks, may be a symptom of the highly politicised assessment of risk in US policymaking, rather than a relatively more objective or scientific account of non-political risks.[125] To contextualise Jon Barnett's claims, 'threats' posed by politically motivated actors in space are conflated with routine risks of operating in the space environment. Whilst no objective measurement of the Chinese *threat* to American space assets can be achieved, by contrast, the Kessler syndrome is more of an objective *risk* to space operations. Even though precise debris prediction models may vary within the scientific community, there does not seem to be much deviation from the generally accepted wisdom that debris removal needs to commence or space will become an increasingly degraded environment.

IV – An impasse

Now that the possible effects of widened and traditional security concepts upon the debris issue has been elucidated, there appears to be an impasse between the arguments for and against the widening of 'space security'. Widening space security, to

[124] Dalby, *Environmental Security...* p. 9
[125] Jon Barnett, *The Meaning of Environmental Security: Ecological Politics and Policy in the New Security Era* (London: Zed Books, 2001) p. 89

securitise orbital debris, appears to be able to confer a heightened prominence to the risks of debris and lobby policymakers to move ahead with ADR development in a sense of urgency as the Kessler syndrome does indeed make for grim forecasting on the space environment. Meanwhile, at the other end of this impasse, keeping space security traditional allows the MIC to stay in its defence and traditional security domains and concentrate on the threats of politically-motivated hostilities. This allows space debris to be categorised as something routine as a consequence of normal actions and accidents in space, and as a result ADR systems can be viewed as a necessary part of sustaining the viability of space for the uses of human civilisation.

At first glance this may not seem like much of an impasse, or at least an inconsequential one. A 'widener' of space security may ask 'what does it matter how it is viewed? If it gets the funding, why not attach space debris onto the space security agenda?' The intentions are agreeable; action is needed. However, when the problems of duality as substantiated above and the risks of security policy's contamination of an environmental issue are realised we can appreciate the significance of this impasse, and a possible resolution.

Should ADR systems be developed in haste, or in 'panic politics' mode, Earth's space-faring actors may indeed view a hasty development as a cover for ASAT weapons. Duality is hardly a novel problem. Weapons are ambiguous symbols,[126] and many intended non-aggressive space systems can be considered a threat. Some ADR techniques have been present in ASAT weapons programmes concepts, such as on-orbit servicing and rendezvous. The military funding and general secrecy of development surrounding technologies associated with space situational awareness (SSA) and ADR serve to fuel

[126] Ken Booth and Nicholas J. Wheeler, *The Security Dilemma: Fear, Cooperation, and Trust in World Politics* (Basingstoke: Palgrave Macmillan, 2008) pp. 42-45

paranoia from abroad.[127] This may be a phenomenon that may not be changed in the foreseeable future. For example, the National Reconnaissance Office's (NRO) requirements for space sensors and the use of NASA-derived and USAF-operated X-37B Orbital Test Vehicle[128] shows how NASA is linked with the MIC. Advanced sensor technologies from the NRO may indeed be required for enhanced ADR capabilities – this casts doubts on sharing ADR technology among states. Having the risks of orbital debris and ADR systems appear in security policy documents may only exacerbate the paranoia of the other space powers concerning US ASAT weapons development. Another significant risk of securitising debris and ADR systems, and the consequent risk that Russia and China may view such American systems with paranoia and label them as ASAT weapons, is that the PPWT may be pushed even further as an attempt to stall a *perceived* US attempt at weaponising space. As stated above, the PPWT refers to space weapons as systems based in space that interfere with space objects – rendezvous operations and other space-based ADR systems would be banned under the PPWT treaty. Securitising debris risks banning space-based systems from interacting with satellites for repair or debris for genuinely benign purposes. DARPA's Phoenix Satellite Servicing programme is an example of space-based repair and building techniques which are essential for the further development of outer space, but is being developed within the MIC.[129]

If widening 'space security' carries these risks, does keeping security traditional reduce the risks of negative political consequences for an American ADR deployment? It is not asserted here that widening space security is *certain* to result in greater dual-use

[127] Brian Weeden, 'Dealing with Galaxy 15: Zombiesats and on-orbit servicing', *The Space Review*, 24/05/2010, http://thespacereview.com/article/1634/2 (accessed 03/08/2012)
[128] Brian Weeden, 'X-37B Orbital Test Vehicle Fact Sheet', *Secure World Foundation*, 19/05/2010, http://swfound.org/media/1791/x-37b_factsheet.pdf (accessed 03/08/2012)
[129] DARPA, 'Phoenix', http://www.darpa.mil/our_work/tto/programs/phoenix.aspx (accessed 17/08/2012)

fears over ADR development, but it increases the *risks* of it happening, particularly if US security policy continues to regard itself as the referent point of security and may take unilateral action by removing debris which may belong to other space powers. Conversely, even if debris is not considered a security issue, the problems of operation still exist and may trigger diplomatic crises should customary or written laws not be created.

Taking the 'security' out of the orbital debris debate allows a sustainable development point of view to grow – the United States could frame its ADR in development terms and stress its 'janitor' credentials. A certain degree of openness may be required as a TCBM gesture – but the physics behind ADR may allow ADR systems to look non-threatening. Unlike a weapons system which may need a constant global presence in space for missions such as space blockade,[130] an ADR system need not necessarily be the same. The previous chapter established the possibility that LEO could be made much safer by taking out as little as five troublesome debris objects per year. With legal agreements on removal forged between the three most polluting space powers, such a small number of ADR events could be regularised – indeed normalised – into the running of the global commons of space. ADR systems, unlike ASAT systems, need not be constantly deployed in orbit, as there would be a rationale and orbital path in mind to remove selected debris. Such a system could be notified to all users of space as a TCBM – and not even one satellite (be it ADR or ASAT) would pose much of a threat should it have hostile intentions. Indeed, China and the United States already possess the capabilities to remove or disable satellites in LEO. Stationing ADR systems in orbit may be too far a leap of faith between the space powers today – but regular and accessible launch dates and timetables for ADR could earn the acceptance of the other space powers should

[130] Klein, *Space Warfare...* pp. 29, 91-99

the USA deploy ADR systems. Indeed, a routinisation of ADR operations is what Deudney refers to as 'behaviour modification *in situ*' – for humans to continue reaping the benefits of space, our behaviour needs to change from its present shape and begin to clean up orbit.

V – Conclusion

This chapter has shown how securitising orbital debris may entail greater risks to addressing the problems posed by the Kessler syndrome. Widening space security may be risky because the intended referent point of security (all users of space and the environment) may not be carried through into security policymaking in Washington. A self-interested and unilateral approach to debris and ADR systems may exacerbate concerns over the duality of such systems and may result in greater efforts by other space powers to ban the technologies that both ASAT and ADR systems depend upon. In contrast, desecuritising debris and ADR systems may result in greater chances of reassuring the other space powers over genuine benign intentions with ADR systems by making such numerically small ADR operations routine (which are feasible) and a part of normal life for any space-faring actor.

The hypothesis has an answer: widening space security may increase the risks of negative international political consequences from developing and deploying ADR systems, and therefore endangering hopes of cleaning up orbit. Keeping 'space security' traditional improves the chance of a routinisation and normalisation of ADR activities and may prove more politically amiable should ADR be distanced from the American MIC and security policymaking.

5: Conclusion

This dissertation has argued that widening space security to incorporate referent points beyond the state (deepening) and non-military risks to space access and use (broadening) may exacerbate the risks inherent in deploying ADR systems because of their duality as 'janitors' and 'soldiers' in Earth's orbits. Aligning efforts to develop and deploy ADR systems to ameliorate the Kessler syndrome with security discourse, policy, and organisations may trigger negative global political reaction for the United States as ADR may be seen as a cover for ASAT weapons deployments.

Chapter two challenged and critiqued the cascade of academia's runaway widening of 'space security'. Rather than adhere to a common definition of space security as all kinds of threats to all users of space, a traditional security-orientated definition of space security was put forward instead. From this, the 'threats' of traditional space security are the political-military threats that space powers may pose to one another. Environmental hazards were jettisoned from traditional space security thinking – but its importance has been substantiated through chapter three's study of policy thinking about space debris and studies regarding the Kessler syndrome's predictions of cascading collisions and runaway debris growth in orbit. Chapter four argued that there are risks to securitising debris and ADR systems which are not accounted for in academia, and perhaps the problem of orbital debris should be considered one of space development. Indeed, regardless of the politics surrounding outer space activities, debris will be generated.

Space debris is not inherently a political product of space – but one borne of humanity's *routine* use of it. It is a 'normal' phenomenon given the technologies humans use to get into orbit. There is indeed a growing pressure to take action before the Kessler

syndrome becomes acute, but panic politics and securitisation may not be the best way to approach debris and ADR systems. Space development is a growing approach to outer space, particularly with the emergence of private companies (admittedly embryonic and often dependent on governments) planning to either provide access to space or harvest potential economic bounties from the solar system. Virgin Galactic is intent on entering the microsatellite market with a radically different and potentially cheap launch system, as well as providing sub-orbital tourist trips.[131] Planetary Resources hopes to be able to profit from space cartography and mining missions.[132] Despite access to space costing between $10,000 and $20,000 per kilogram sent into orbit which has not changed since the Apollo era,[133] individuals are thinking of harnessing space's resource-economic potential. Earth is not a closed system for human resources and habitation: James Vedda bemoans the lack of species-survival and economic thinking behind the US government's approach to space exploration and development.[134] Ken Murphy dreams of a cislunar econosphere for human civilisation.[135]

If such grand economic visions are to be realised, cleaning up space and keeping it clean will be a requirement just as much as environmental regulations for all sorts of activities on Earth. The Kessler syndrome must indeed be addressed for any such plans to have a chance of success, or insurance premiums may add another inhibiting factor to already extremely high launch costs! However, attempts at securitising debris should be

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[131] *Space Daily*, 'SST US collaborates with Virgin Galactic to offer radically cheaper options for small satellites', 12/07/2012, http://www.spacedaily.com/reports/SST_US_collaborates_with_Virgin_Galactic_to_offer_radically_cheaper_options_for_small_satellites_999.html (accessed 14/08/2010)
[132] *Planetary Resources,* 'Mission', http://www.planetaryresources.com/mission/ (accessed 14/08/2010)
[133] Martin Elvis, 'After Apollo: Creating an economically robust space policy by learning from the American West', *The Space Review*, 13/08/2012, http://www.thespacereview.com/article/2137/1 (accessed 14/08/2012)
[134] James A. Vedda, *Choice, Not Fate: Shaping a Sustainable Future in the Space Age* (Xlibris, 2009) pp. 3-5, 122, 155-165
[135] Ken Murphy, 'The cislunar econosphere (part 1)', *The Space Review*, 20/02/2012, http://www.thespacereview.com/article/2027/1 (accessed 14/08/2012)

resisted because it may exacerbate paranoia due to the duality of ADR systems, and the potential of anti-space weapons treaties such as the PPWT to ban the technologies and systems needed for them.

When considering an all-encompassing view of human activity in space, it is not one of 'global space security' as is so often seen in academia. It is space development or space safety – like regulating air and maritime traffic or venturing to a distant continent for mineral riches. It is hoped that this may trigger some self-reflection among academics (at least) and policymakers (at best) with regards to their use of the concepts of security with the crucial and often used but seldom analysed term, 'space security', lest we as a species close off space to any further useful development because of our polluting activities.

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