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Indigeneity In Space Governance Discussions: Centering Indigenous Knowledges Beyond Earth

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INDIGENEITY IN SPACE GOVERNANCE DISCUSSIONS: CENTERING INDIGENOUS KNOWLEDGES BEYOND EARTH

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To all the little kids with big dreams…
don’t let anyone say you can’t reach for the stars.
Space is for *everyone*.

Ad Astra, nerds!

ABSTRACT

Space policy and space law are expanding fields given the recent boom of commercial space flight, yet we hear less about space governance. These conversations are happening, but the discussions generally replicate western democratic practice with little input from other knowledge traditions, despite recent socio-political strain seen in senior democracies.

This work focusses the discussion on missing voices. Those of the many Indigenous cultures that have routinely been silenced from terrestrial governance discussions. These voices, however, reflect thousands of years of collective knowledge of managing societies in a holistic manner. Some of these societies have developed in areas considered extreme environments and established practices that may prove more conducive to fostering sustainable communities off-Earth.

A comparison between IK informed governance and western governance methods facing complex problem-sets such as climate change, is used as a broad proxy assessment of each modality's resiliency, sustainability, and adaptability to change in complex environments such as space.

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Context

It is not possible, nor would it be appropriate to attempt to condense thousands of years of cultural knowledge and practice from myriad Indigenous societies into a single thesis. What this work hopes to do in the most respectful way possible, is to present different knowledge to offer a diverse lens through which we can imagine a space governance discussion. I am an outsider to Indigenous cultural practice, a mixed-race settler of Scottish, Welsh, Swedish, and Caribbean descent, but recent revelations about hundreds of unmarked graves at residential schools (CIRNAC, 2022) made this work more earnest. Western society (from which I am descended) has treated these cultures at best as quaint mythological tradition from which we appropriated information on how to survive on this landmass, and at worst threats to economic development and nation building not worthy of rights, dignity, or life.

The biased and euro-centric governance practices must be interrogated before we send it to space. The roughly 400-year-old post Enlightenment roots of our current socio-political and governance systems still bear the marks of a troubled past as I write this in 2022. We must have these conversations before governance practice on other worlds takes root, replete with the same bias with which it was conceived.

If we are to take to the stars as a global society, governance practice from non-western cultures must also be a part of the discussion. Ironically, it may not be new space technology but the Knowledge from tens of thousands of years of eco-social governance in some of the most difficult climates on Earth that may hold the key to humanity's success in off world societies.

Problem Statement

While human space flight and the development of the technology needed to explore near-Earth bodies continues at pace, the discussion of how we might choose to govern ourselves on these new worlds lags. Much of the discussion borrows heavily from or relies exclusively upon the wholesale export of American democratic practice. These conversations simply adapt the model for the uniqueness of the space environment with added titles and legislation to ensure liability can be apportioned and wealth protected. Fewer discussions focus on de-colonial approaches to neo-liberal democracies. Worryingly though, democracies are under threat of backsliding with the erosion of certain rights and protections. Democracies are under significant strain from protracted wars, social unrest, rapid environmental change, crushing national debts, and recently global health crises (Gora & de Wilde, 2020). So, if our most common and mature governance modalities theorized for export are already strained on Earth, are they ready for the rigours of a space society?

I therefore assert, that the narrow breadth of the space governance discussion that does not include Indigenous Knowledges (IK) anchored in tens of thousands of years of eco-social sustainability, resiliency, and holistic egalitarianism lacks the robustness required to adequately theorize a culture living sustainably in such novel, remote, and harsh conditions requiring extremely careful management of resources and strong social cohesion. A comparison between IK-informed governance and western governance methods facing complex problem-sets such as climate change will be used as a broad proxy assessment of each modality's stability, resiliency, ability to manage sustainability, and adaptability to change in complex environments such as space.

Terminology

The reader should note that for the purposes of this thesis, the term Indigenous is used primarily as a collective term for the original peoples of North America and their descendants. In Canada this includes First Nation peoples, Inuit, and Métis (Canada, 2021b) as defined by Section 35 (2) of the *Constitution Acts* of the Government of Canada (1982). While these cultures and many other Indigenous cultures share similar concepts such as holism and relationality, we acknowledge there are myriad unique histories, protocols, and customs in how these values are expressed. It is recognized that this term is imperfect and does not apply to all Indigenous people as each culture may choose to self-identify outside of any legal definitions.

Assumptions

While the many scholarly works completed on the topic of space governance do cover several governance modalities from communism to authoritarianism, the most prevalent governance practice in these discussions is western democratic of some form. As such, for the scope of this project it is assumed space faring societies will likely continue with democracies as a governance style for nascent settlements off Earth and we will start from this presupposition.

The intent of this project is mainly to introduce concepts of governance practice from Indigenous culture to the existing discussion of democracies in space as this Knowledge is largely absent and it may yield new findings.

This project does not critique all types of governance and their individual suitability for human culture in space.

Methodology

This study was completed primarily via secondary qualitative documentary analysis, limited discourse analysis, and comparison of available scholarly work within space governance,

historical and contemporary western democratic structure, political philosophy, political science, ecology, sustainability studies, and Indigenous studies. This research is interdisciplinary in nature but best nested within space law and policy sub-fields.

Works were obtained from multiple sources including database or records searches via online libraries such as the First Nations University of Canada, X̱wi7x̱wa Library of the University of British Columbia, Nunavut Arctic College, and the University of North Dakota. Online journal databases were used to source journals and articles from various fields using keyword or author name searches. The use of some of these sources tended to concentrate inquiry on Indigenous cultures within North America as these research libraries often more heavily specialize on the cultures and communities proximate to the physical location of the main university.

It should be noted that much of the salient information about how Indigenous cultures exist is language or protocol based and practiced within community. This information is not always transcribed, making research into some aspects of community governance difficult without participant interviews. These were not completed for this study due to time constraints. However, there is significant collaborative scholarship in sustainability and ecology fields regarding Indigenous stewardship protocols, resource management, and community decision-making in these contexts, therefore these sources were leveraged heavily.

Indigenous writing style guides informed some of the presentation choices and Indigenous research methods were consulted in the formation of this work. While there exists large amounts of textual information on Indigenous lifeways, some of these works were extractive in nature. Many were completed without the consent of the persons being studied and not in keeping with Indigenous principles of knowledge formation and sharing, nor in line with contemporary ethnographic research. A concerted effort was made to source information from Indigenous

scholars or researchers that listed a decolonial approach to knowledge production to avoid perpetuating the lateral violence seen in the appropriation of these Knowledges. This limited the availability of some sources and some were discarded based on this factor.

The governance models theorized and projected as options for use in space in this thesis were selected for two reasons. One, current cooperative agreements for space referenced in international law were developed in a democratic fashion within the United Nations, thus many participating member countries are expected to continue to act in a similar way in the near future. Secondly, the similarities of resource scarce and harsh environments of some Indigenous cultures bear a close resemblance to the inimical and isolated environments of nascent space settlements. As such, governance methods from these cultures constitute a viable option for comparison in this context.

General stability, resiliency, and adaptability to change of the governance model when faced with shocks (climate change and resource management/sustainability issues) were used as a broad proxy assessment of the governance models as practiced currently. This is due in part to the absence of the ability to test in an analog environment and due to a lack of comparable datasets.

Climate change and related resource management issues were selected as a basic comparison protocol as there is a large body of contemporary scholarly work available for both IK and western governance models in social ecology and resource management fields. Additionally, the outcome of these studies is often measured in sustainable system outputs.

There are limitations to this work that bear mentioning. The first and most considerable is scale of use of the governance model being assessed. Democracies of some form are considerably more prevalent worldwide than IK governance systems. The comparison of IK governance in small local settings versus several million people within many democratic countries also adds

uncertainty to the assessment. The scalability of IK-informed governance is not assessed within this work but is an important consideration. IK-informed governance models are rarely practiced in a manner that allows for a perfect comparison as most still fall within jurisdictional control of an overall governing body that places limits on the full use of an alternate method, as is the case in Canada. Data measuring governance health in IK models is nearly non-existent in comparison to an entire sub-field of political science dedicated to researching and measuring (both qualitatively and quantitatively) the health of democracies globally. This factor limited available means for a direct comparison using similar datasets and required the reliance on a proxy assessment leveraged from social ecology.

The result of this assessment is broad and imperfect, however, the qualitative outcome of general measures of stability are important in the space context as it does open a supportable new line of inquiry for future work into governance methods in space societies and challenges some existing assumptions.

Bias in this research manifests as mainly selection bias of the works and data used in the completion of this project and potentially value preference. The author's own liberal and humanist views, previous exposure with various forms of democratic processes, and government employment (including military service) also introduce experiential and process bias. While these biases are hard to correct, they are not deemed as critical barriers to the development of this work largely due to the broad nature of the data collected and the exploratory nature of the outcome. The limitations of a documentary-only approach to research does make the determination of the problem statement outcome difficult. As such, it is recommended that further research might include small-scale and long-term analog human experiments that trial different governance and leadership forms anchored in Indigenous frameworks in complex environments.

Literature Review

Where we are in the Space Governance Debate

Initially, it is important to situate the reader in the current debate regarding space governance. It may come as no wonder that much of the debate is between western scholars and mostly focuses on western governance practice, constrained between the extreme political left and right of those practices. This is hardly surprising given the supremacy the west has enjoyed in the space sector for decades. What is interesting, however, is how narrow the debate appears to be and how many scholars have simply pre-supposed the outcome of an off-Earth migration of humanity will automatically be democratic. This is despite being offered, as Charles Cockell (2015) points out, "the unusual opportunity in human history to deliberate and discuss human institutional arrangements prior to the settlement of a new environment" (p.3).

In Cockell's 2015 edited collection *Human Governance Beyond Earth*, contributing scholars vary in their approaches to governance from wholesale replication of American republicanism to libertarian outposts, to tightly controlled totalitarian approaches to governing. Many warn of the ease with which societies could become authoritarian because of the requirement to tightly control resources, pre-supposing a Hobbesian view on the basic nature of humans. Almost all rely on market capitalism as the main driver and indeed the sole intent for human expansion into the cosmos. We also see many of the articles both in this edited work and others reference settling North America as a mostly un-examined justification for space exploration.

Mukesh Bhatt's 2015 article *Constituting Outer Space: The Governance of Planetary Settlements and Artificial Habitats* found in the aforementioned edited collection, is perhaps the best example of the mid-point of the current governance discussion. We find that the more popular

approach is cautiously using US constitutional law and the foundational American version of capitalist democracy as a framework upon which near-future space societies could build.

Bhatt (2015) critiques constitutional frameworks proposed for space and introduces his article by outlining the critical point at which society currently finds itself, about to venture out beyond the confines of Earth and into the solar system. Yet, without a concrete understanding of how this new space society ought to govern itself as it expands. Bhatt (2015) further frames the problem by reiterating the treacherous environment which humans will face as they begin to migrate off Earth. Bhatt (2015) states that such inimical environments will place certain constraints on governance and the rights of the individual in that, "any individual activity can affect the collective safety of the general population . . . human habitats, whether on Earth, or established off it, all require a form of administration according to some set of rules" (p.115). Interestingly, it is inferred here that these rules and administrations become more important as the lethality of the environment increases.

Bhatt (2015) begins by defining constitutionalism. He states that it, "supposedly lays out in quasi-religious terms the values of collectivity: what should be, rather than what is, regarding the governance and behaviour of the population . . . a constitution is a document that states . . . the rights, duties, responsibilities, privileges, obligations and prerogatives" (p.152). Bhatt (2015) continues that constitutions, "define persons, institutions and authorities within the society, their form and structure, and the relationship between these separate persons, institutions, and authorities and in a sense, by defining who belongs to the social polity, forms a person in that society…limits or extends the powers of individuals, institutions and authorities" (p.152).

From here Bhatt (2015) importantly highlights potentially dangerous assumptions about constitutionalism as he states that though the group drafting a constitution may be representative

of the collective whole, constitutionalism does not appear to guarantee democracy. Namely, because framers of these documents have often not been elected to hold the authority they confer in themselves (Bhatt, 2015). This self-imposed power to exclude/include and indeed decide whom they determine to be a person has had implications for the equity within such documents.

Constitutionalism in the space context has been discussed for quite some time we learn but Bhatt (2015) asserts those discussions remained fairly limited in scope. Here, Bhatt (2015) cites a series of workshops in the mid-eighties wherein framers drafted a space constitution. Bhatt (2015) notes a distinct lack of criticality in these conversations wherein, "cultural recidivism is rampant, being used to establish the legal foundations and social constructs available off Earth, based on the Earth's indigenous historical values, principles, and motives, however useless they may be to new societies and civilizations formed in hostile, artificial or alien life support environments" (p.156).

Bhatt (2015) notes that the discussions of self-governance very often use the US constitution as exemplar, but some have taken an opposing view via manifestos which Bhatt (2015) describes as flagrantly libertarian, and equally as anchored in western thought practice (p.157). However, most include a means for citizenship and ownership and include some mechanism for controlling the authorities of the governance body.

Along that line, like in many discussions of space governance, Bhatt (2015) encounters questions of jurisdiction over celestial bodies and space itself, all of which create issues for the legal status of these various proposed entities as they have nothing to declare themselves separate from. Here, Bhatt (2015) reiterates the need for a more robust discussion of how society wishes to proceed within the current 1967 *Outer Space Treaty* framework.

Now, quite interestingly Bhatt (2015) discusses one reasonable though roundly defeated mechanism for self-governance in which the drafters attempted to put into law, US jurisdiction

over US space settlements. The 1981 *Northwest Ordinance for Space* was intriguing as it stated that US settlements, "shall be entitled to the protection of the Constitution of the United States", and uniquely amongst other such proposals this bill included a title that would allow for any US space colony at an appropriate time to, "hold a convention that may establish a constitution and to decide its form of self-government as long as that colony has a minimum population of 20, 000" (Bhatt, pp.153-154). Bhatt (2015) concludes that the American constitutional approach is familiar and functional, remaining as a popular starting point in space governance discussions.

Moving left from the center point argument we do find other interesting approaches to space governance. While less immediately practical they do lend an important perspective from which to theorize future governance as they start to address the myriad inequities we find in modern democracies.

Tony Milligan's 2015 article *Rawlsian Deliberation About Space Settlement* attempts to systematically deconstruct various opposing arguments for authoritarian and constrained democratic governance styles in space settlements. Importantly, the author begins by acknowledging the significant western bias involved in deliberations about governance currently. Further, Milligan (2015) argues that without more discussion our governance systems off Earth will simply, "form some kind of political organization which will be a descendant of our own flawed political practices and institutions" (p.10). Milligan (2015) continues, "to some extent they will bear the stamp of our own imbalanced political world just as our own institutions bear the imprint of the world of Locke and Rousseau" (p.10).

He continues that governance cannot simply be an offshoot of current political practice and should be reimagined entirely though does not venture too much into why he thinks this is so. Milligan (2015) begins by first tackling the authoritarian option and here admits this is sometimes

considered a viable governance method. It is justified by some given the extreme vulnerabilities humans face in space which require tight controls and thus would potentially lean into authoritarian pressures for the sake of stability. Milligan (2015) argues it may seem to be a justifiable option only initially, but that solely authoritarian control is likely unstable as experimentation with Soviet era policies in enclosed living spaces with similarly tight controls has often led to a collapse of the system.

Moving to a less controlled style, Milligan (2015) briefly discusses constrained democracies, or as he describes, democracies with an authoritarian constitutional backstop. Though not explicitly explained by Milligan (2015), many democratic governance systems retain an ability to remove law making powers from the legislative branches in order to suspend the rights of individuals, conscript individuals, or expand administrative powers into areas of free enterprise (Rossiter, 1948, p.294). Along this vein, Rossiter (1948) continues that this constitutional dictatorship is a state of functioning that he contends makes democracies in-flexible or unstable. Rossiter (1948) explains a reversion to a concentration of power into a small emergency cabinet or in some cases a single person is required for the state to handle emergencies. As such, there always exists the possibility that they may not revert back to democratic control once the emergency has passed (Rossiter, p.295). Milligan (2015) continues, while this may be a legitimate solution a nascent space government would need to closely guard its institutions echoing Rossiter (1948), to not, "overstep its proper bounds without damaging the overall prospects for social cohesion and settlement survival" (Milligan, 2015, p.13).

Bounding once again into an even less controlled version of democratic governance, Milligan (2015) introduces the post-modernist concept of "ideal free hope" (p.14) within democracies. This method is conceptualized as a more direct approach to democracy without the

trappings of grand state narratives. Milligan (2015) argues this could allow society to make moment-to-moment decisions presumably without any preconceived political goals (p.14). The difficulty here being any democratic structure would have to face certain tests which in moment-to-moment style decision making may be chaotic, especially when it comes to divisive topics such as bodily integrity. Therefore, a need for a tie-breaking mechanism is indicated but these appear to often lean into authoritarian or dictatorial methods to force a compromise. Rather than allowing this fact to erode the legitimacy of his future ideal free hope democratic settlement theory, Milligan (2015) attempts to utilize a non-authoritarian tie breaking mechanism. Here, Milligan (2015) pivots to John Rawls' Veil of Ignorance thought experiment applied to space. Albeit, with amendments as the participants would have some baseline knowledge of their condition and environment.

For the reader unfamiliar with the Veil experiment, it is a thought device used for deliberations about social justice and resource allocation but heavily controlled for bias amongst participants. Participants are not made aware of their station, class, gender, abilities, and interests in the deliberation process nor know the station, status, or occupation they might occupy after deliberating the rules of that society (Oxford Reference, 2021). By removing previous bias, Rawls (1999) suggested that one could eliminate the usual selfishness, egoism, and concerns of effect to personal circumstance in decision making which normally tends to skew to the maximum gain for the individual. In this theory, a society designed using this method would tend to maximize personal freedoms by generally adhering to two main principles. Firstly, that of equal liberty which gives each person the right to as much freedom as it is compatible with the freedom of others. Secondly, by way of the 'maximin' principle which tends to allocate resources such that the benefit of the least advantaged person is maximized as far as possible (Oxford Reference, 2021).

The theory used in the manner Milligan (2015) described does have a strong advantage in that, "it provides a way of making sense of what individual rights we should acknowledge without appeal to classical Lockean political theory and to the idea of natural rights" (p.18). This allows us the opportunity to evaluate different rights in a space context that we cannot yet conceive of on Earth that may be more amenable to a future space society.

While the proposed built-in equitability of this reasoning would appear to be favorable, Milligan (2015) unfortunately leaves open to interpretation exactly how a Rawlsian adaptation would be more effective at solving the feared political impasses of divisive social issues he criticized the standard democratic processes for being incapable of managing without reversion to less democratic means. However, Milligan's (2015) use of the Veil does lend itself to more proximate and immediate concerns of a space settlement such as the distribution of resources rather than an improved tie breaker mechanism to ensure consensus for more abstract societal concerns in a space society. Yet, it is a valuable means with which to view a different type of space democracy.

Several authors, including myself, have inferred that human experiments with approaches to governance and leadership in analog missions may be warranted to better evaluate how humans might choose to organize themselves and perhaps reveal to us what our preferred method of collective administration might be in these unique environments.

While not a controlled study and only tangentially related to space, John Carter McKnight's 2015 article *Space Polities: Self-Governance Lessons from Virtual Worlds* and further doctoral work into the self-determining nature of virtual spaces provide us with some interesting insights. Curiously, we see slight leanings to more controlled governance methods with his research, which

was surprising given that the theoretical body of knowledge generally skews presumptively democratic.

McKnight (2015) begins his article by outlining his novel research into virtual worlds to study human interaction and governance in frontier type conditions. He argues virtual spaces share sufficient qualities with potential distant space settlements namely because they are free from the ideological limitations imposed on traditional off-line spaces justifying a study in this context.

His five-year mission into these on-line spaces provided some thought-provoking insight into collective governance in what amounted to mostly ungoverned and presumptive techno-libertarian spaces. McKnight (2015) addresses limitations to his research from the outset by stating that, "virtual worlds were far from a complete analog for space settlements . . . participation was voluntary and rarely 24/7, with negligible barriers to exit" (p.104). This is very much unlike space analog missions which are often comprised of specially selected members for tightly controlled missions of fixed lengths (NASA, 2021).

However, his research does challenge some of the presumptions of frontier/libertarian ideologies as a default governance modality. Such methods are advocated for by some researchers and settlement governance theorists. Much of the article critiques the fictional foundations of the "frontier of liberty" (McKnight, 2015, p.105) and libertarian ideological assumptions upon which some of the contemporary space governance theory has been built and aspects of Reagan era space policy. He reasons that the modern linkage between space settlements and the libertarian movements began in the 1930s. During this time, science fiction writings such as J. Williamson's 1931 *Birth of a New Republic*, and that similar novels in the genre including the Gemini era 1966 book *The Moon is a Harsh Mistress* by R. Heinlein were extremely influential in terms of notions of liberty as applied to extraterrestrial settlement ideation.

Though in intervening years, McKnight (2015) contends there has been a split between those theorists and authors in favour of American exceptionalism/statism with regards to exploration efforts and those who are decidedly libertarian. For both approaches, however, analogies to conquering the wild American west are commonplace. Regardless of the ideological differences, both approaches have been largely influential in shaping actual extra-planetary governance research (discussed later). The futuristic 1976 work by Gerard K. O'Neil *The High Frontier* was described by McKnight (2015) as a foundational work in space settlement advocacy and remained a touchstone for these activities for several decades. This included the creation of very active national lobby groups such as the National Space Society and the Space Frontier Foundation (p.105). McKnight (2015) writes that the latter group, "rose to prominence in the late 1990s advocating for a capitalist, libertarian approach to spaceflight at the time of the dotcom boom" (2015, p.107) and at this juncture, McKnight (2015) introduces the virtual worlds which he studied that were part of that frontier on-line boom.

He stresses that the 1990s saw the notion of libertarian beliefs applied to the frontier of the newly created internet and the start of the techno-libertarian movement. This movement drew a large part of its cultural heritage from the counter-culture American technocratic movements of the 1960s wherein it was believed that software and technological solutions held the key to solving social discord, prevalent in 1960s America. It is in this context that companies such as Linden Labs and their hugely successful online persistent 3D graphical environment and fully immersive virtual world eventually emerged. Unlike many on-line and massive multiplayer games, Second Life had no set objectives, campaigns, or goals.

Within this unique framework McKnight (2015) sought to shed light on, "socio-political behaviour in a transhumanist environment, in which material scarcity and bodily needs would be

obviated by technology" which he argues had, "potential to model certain O'Neil/Nozick visions of space settlement in which large numbers of people sought to leave the status quo of terrestrial life for a "new frontier" of personal reinvention" (2015, p.112).

McKnight (2015) expands on the unique potential that this platform offered, "unlike national and local government experiments in 'democracy', virtual worlds offered relatively free flows of value, information, and people; potential new tools for decision making, resource allocation . . . ." (2015, p.112) without the confines of legacy systems in what appeared to be a deliberate techno-libertarian design.

Despite an environment seemingly rich with potential for the uptake of libertarian values or any other means of anti-authoritarian self-governance, McKnight (2015) reports he found only a few practicing examples of self-governance within the program. He notes one group was interestingly, "populated by transhumanists and space exploration advocates (which held one vote, to abolish the democratic experiment and transition to a managerial model)" (2015, p.114).

McKnight (2015) continues that members of the online communities regularly turned to powerful overlord type entities to resolve issues within their communities, but those positions were very few and frequently avoided as most members saw such positions within the game construct as overly burdensome and time consuming. McKnight (2015) expands that even more commonplace were software solutions to social problems, which in one popular manifestation would simply redistribute resources more equally but was never used to solve greater governance issues. "Hierarchy prevailed . . . and competed in a liquid market for low-level followers, who found themselves in an almost ironic version of Nozick's libertarian utopia . . . such that an active free market in government could take place, but one in which the only type of government, the feudal/corporate hierarchy, was on offer." (2015, p.114). McKnight (2015) writes, the

resoundingly popular choice for tens of thousands of participants over several years within the Second Life platform, was universally accepted familiarity and delegation of responsibility via hierarchical and managerial systems.

Here, McKnight (2015) draws some interesting conclusions from his work. He discovered the preference of gamers to choose managerial controls and the socio-cultural disconnect that became very apparent between the game designers and the end user's interpretation and implementation of the technology. The designers were described by the author as highly skilled and do-it-yourself types that were somewhat counterculture. These designers expected the users to behave similarly within the space created for them. However, the users as McKnight (2015) states, "tended to value aesthetics, social interaction, consumerism, and conspicuous consumption/status display" (p.116). McKnight (2015) contends that this might be more than a simple disconnect between designer and end user in a game space. He reasons that there is some need to be wary of governance designers and end user relationships in space settlement development as well. The mismatch between the type of person that designs space settlements and their attendant administrative practices as opposed to the type of person who inhabits them, could produce significant differences in the values expected versus the values practiced, which McKnight argues could lead to settlement instability.

The author closes with an interesting proposal and one that is largely absent from the space governance literature. McKnight argues that a deeper examination of Indigenous governance practices for long term sustainability is warranted. He reasons that these cultures had largely existed successfully for thousands of years and some in very harsh climatic conditions with limited resources. McKnight (2015) specifies that these lessons, "may be key to reshaping space settler's cultures so as not to propagate a dynamic shown to be problematic in analogous environments"

(p.117). He continues, these new space communities could, “turn to set of best practices honed over millennia by Indigenous communities around the world as inspiration for our future settlements beyond Earth” (McKnight, 2015, p.117).

Despite significant limitations to his ethnographic research within on-line communities, McKnight (2015) offers very intriguing and timely observations about the depth of the assumptions upon which much of settlement governance research has been built. Importantly, he weaves into his argument a need for Indigenous practices research to be incorporated into further discussions. This study was all based on passive analog observation, which among his peers in this sector of academe is quite novel. Additionally, McKnight (2015) offers an important warning to designers, governance scholars, and lawmakers in that the designer or drafter’s vision versus the end user of an idea, structure, or concept is something to be considered in the process of governance theory development.

When taken in aggregate, these papers best illustrate the current discussion in the space governance domain at this time. Next, we look at how this is reflected in current space policy.

The Final Frontier and the American Ideology in Space

It is perhaps best at this juncture to discuss the sociopolitical climate within which contemporary space policy began and take a brief look at that climate now. Namely, the current state of the democracies that many are hoping to replicate off Earth.

> What we may be witnessing is not just the end of the cold war, or the passing of a particular period of postwar history, but the end of history as such: that is, the end point of mankind’s ideological evolution and the universalization of western liberal democracy as the final form of human government. (Fukuyama, 1989)

Francis Fukuyama's above quote from his essay *The End of History?* has been hotly debated since its publication in the National Interest in 1989. However, it does a lot to capture the well-entrenched presumption of western exceptionalism without question at the time. A time where neo liberal democracies began to reign supreme under America's Ronald Reagan and the UK's Margaret Thatcher, setting the conditions for contemporary space policy. Fukuyama (1989) points to the collapse of Soviet era socialist regimes and the distribution of capitalism throughout China as examples of the primacy of capitalist democracy. Further, Fukuyama (1989) proclaimed the fledging European Union (then still a theory) as what an ideal end state democracy could look like. While it was insistent and hopeful and perhaps captured what many scholars and politicians alike thought as fact in the early 1990s, his essay seems woefully out of touch as we look upon the state of democracies, collective decision making, and equity within many democracies then and now.

We learned previously from Bhatt (2015) that much of the initial discussion of space policy and governance was happening in the 1980s in mostly US academic and government circles. This was a formative time for American democracy as it was being reinvigorated by Ronald Reagan's particular brand of conservatism, appealing to American heritage with an infectious excitement about the future. We learn from John M. Logsdon's 2019 book *Ronald Reagan and the Space Frontier* that his administration had earlier inherited a severely indebted America, government deficits, difficult geopolitical circumstances, and a population disenfranchised with the American political class after successive turbulent administrations with presidents Nixon and Carter. The space program played an essential part in his administration's ability to maintain American's interest in politics. Reagan routinely used investment (though these investments were hard fought for by NASA) in the space program as equivalent to investment in a uniquely American frontier

conquering vision (Logsdon, 2019). This exceptionalist vision is perhaps best captured in his 1988 speech:

> Leadership on Earth will come to the nation that shows the greatest leadership in space. It is mankind's manifest destiny to bring our humanity into space; to colonize this galaxy; and as a nation, we have the power to determine whether America will lead or will follow. I say that America must lead. (Johnson Space Center, 1988)

A fixture of Reagan's space goals was to start to push America further into the cosmos, as he also hoped this would spur the public to achieve more on Earth too. As such, a grand technical achievement such as a permanent presence in space was an administration priority. Though budget minders were rarely keen on the vastly expensive proposals, Logsdon (2019) explains. However, policy frameworks and stepwise budget allocation for space station research is nonetheless a legacy of the Reagan era, but the effectiveness of the language in the various policies is contentious. The re-establishment of America's place as a space leader is not controversial and many credit Reagan's constant vocal support of space activities publicly and in congress as a major cause. We note again however, there was often a lack of budget to back up hopeful speeches due to vague purpose and direction behind the statements to which budgetary offices could latch. Interestingly, we note the percentage of GDP devoted to space programs remained roughly steady in the eight years he occupied the Whitehouse (Logsdon, 2019).

Central to Reagan's image throughout his time in office was the concept of the final frontier in space. What's striking reading Logsdon's work is how central this language was to the administration, how important Reagan thought this concept was to his image of America, and how much the idea of the frontier shaped his thinking and leadership. Reagan often used the space

program as the ultimate example of American greatness. Troubling though, is the fact that the frontier myth perpetuated and paramount to his administration (and others) is a concept we recognize now as deeply flawed and controversial. Roger Launius a former NASA historian is quoted in Logsdon's book, "the construct of the frontier as a positive image of national character and of progress of democracy has been challenged on all quarters and virtually rejected as a useful ideal in American postmodern, multicultural society" (p.391).

Reagan did much to ensure sustainable international partnerships on long term projects, a practice that is now both vital and common place in human space flight. However, we do learn from Logsdon (2019) that much of the reasoning to pursue these alliances (at least from some of his staff) came from fear of losing primacy and a deep notion of exceptionalism, rather than a genuine desire to work cooperatively. His administration also did much to privatize parts of the American space sector and helped set the conditions for the new space economy. So, while Reagan left America with faith and a renewed interest in a space program effectively resuscitating it in many ways, the deeply colonial nature and language now baked into the policy frameworks is still something we must unpack today.

The colonial nature of Reagan's space policy base is dangerous to continued cooperative space efforts we learn from Logsdon's (2019) investigation. He states that the frontier myth is often used as a nostalgic metaphor but is closer to a pejorative reflection that is in-fact marked by conquest and displacement of people, environmental exploitation, and political corruption amongst other issues.

Dr. Linda Billings in her work elucidates the depth and breadth of the colonial narrative not just in space flight but so too woven into the notion of America as a national ideology. On this ideology that has informed the intent of space flight and space policy she writes, "an ideology of

space flight draws deeply on a durable American cultural narrative - a national mythology – of frontier pioneering, continual progress, destiny, free enterprise, rugged individualism and a right to life without limits" (2007, p.483). Billings (2007) continues that an ideology of Americans constructed in this way establishes a governance method. That method Billings (2007) reasons, is a capitalist democracy with the requirement to fulfill this ideology of relentless progress, that in turn, fuels the cause of extractivist liberal democracy and exceptionalism. Billings (2007) argues in her paper that the foundational concept of relentless progress in democracies is not new but became more prominent in western worldview in 1850-1900. She summarizes this concept by stating that relentless progress served as a developmental context to link other foundational ideologies, such as freedom, declarations like the right to use the earth however we wish, and rights to property of all kinds (2007, p.486).

Billings (2007) then weaves in Robert Wright's argument that relentless progress is an ideal from colonial Victorian England stating this ideal, "of moral advancement . . . has evolved into an ideal of material improvement. This belief in progress performs the mythic function of providing moral justification for material accumulation" (2007, p.486).

We see this theme repeated time and again by officials in more recent administrations too. The Clinton administration insisted that space exploration had become integral to national identity (Dick, 2007). While more recently NASA Administrator Michael Griffin (2005-2009) was quoted by Linda Billings in *Societal Impact of Space Flight*, saying of space exploration:

> We want their culture to be Western . . . [it is] the best we've seen so far in human history . . . North Americans are the way we are because of the challenges of the frontier . . . I believe that Western thought, civilization and ideals represent a superior set of values (p.494).

The Bush administration followed a similar line of exceptionalist reasoning, writes Billings (2007). She quotes from Bush administration documents, '"America's space program is what civilization needs . . . our success will be guided by the American spirit – that same spirit that tamed the North American continent and built enduring democracy"' (Billings, 2007, p.494).

It is evident from the above discussions that some of these problematic foundational concepts of national identity found their way into space policy and later into governance discussions as well, especially with personalities like Reagan who personally embodied this ideology. Billings (2007) expands:

> Historically and presently the rhetoric of space advocacy advances a conception of outer space as a place of wide-open spaces and limitless resources – a space frontier. The metaphor of the frontier, with its associated images of pioneering, homesteading, claim-staking, and taming, has been persistent in American history. In the rhetoric of spaceflight advocacy, the idea of the frontier is a dominant metaphor (p.486).

When taken in aggregate, we have established that the concepts of relentless progress, exceptionalism, and the frontier are key foundational aspects not just to space activities but to how America governs itself and its affairs. The question now is how enduring are these democracies built on these colonial foundations? How suitable, stable, or flexible are they to be the only option for space settlements as many government and space officials have suggested?

Democracies: Are They Ready for Blast Off?

Previously, we investigated the climate within which much of our current space policy developed and the overwhelming presumption that western democracies based on their frontier myth remain the most suitable for use on off-Earth settlements of the future. However, taking a

quick look at many democracies around the world, we find some unsettling trends despite a relatively short history of the governance methodology.

We learn from a Freedom House Organization report that 2021 marks the 15th consecutive yearly decline of world democracies according to their indicators (Repucci & Slipowitz, 2021). In this study we learn 54 nations are considered not free which accounts for 38% of the global population, partly-free nations have remained almost the same, while 'free nations' decreased from 89 to 82, and that this is the lowest since the decline was first noted in 2006 (Repucci & Slipowitz, 2021).

The Economist Intelligence Unit's *2020 Democracy Index* also provides an interesting snap-shot of the state of 165 independent state's governance health around the world. It should be noted here that the COVID-19 health crisis was unprecedented in the time these statistics have been kept (for both organizations). As such, it provided a unique peacetime test to many senior democracies and how they handled civil liberties and limits to emergency powers during such crises. In this vein, the report notes, "the withdrawal of civil liberties on a massive scale . . . fueled an existing trend of intolerance and censorship of dissenting opinion" (The Economist Intelligence Unit, 2021, p.3).

For reference to the reader, the Economist's index is broken down into five categories. They are, electoral process and pluralism, functioning of government, political participation, political culture, and civil liberties. Then a range of indicators within these categories are scored and each country is classified as either (from most free to least): a full democracy, flawed democracy, hybrid regime, or authoritarian regime (2021, p.56).

Notably, America retained its flawed democracy status in 2020. This was partly explained by the pandemic and the contentious lockdowns to contain the virus, but the report explains more important factors in the scores:

> Low levels of trust in institutions and political parties, deep dysfunction in the functioning of government, increasing threats to freedom of expression, and a degree of societal polarisation that makes consensus almost impossible to achieve. Social cohesion has collapsed, and consensus has evaporated on fundamental issues—even the date of the country's founding (2021, p. 7).

Repucci and Slipowitz (2021) also noted worrying trends of democratic decline in the US and has moved the ranking of the country from adjacent to peer democracies such as France and Germany, to adjacent Romania and Panama according to their rating systems. This organization also cites social discord, gerrymandering, weakening of oversight, the concentration of power, poor wealth distribution, discrediting of journalistic criticism, and vitriolic rhetoric as major factors in the decline of the US democracy.

We learn that in Europe, large founding democracies have also not fared well either, beleaguered by similar social cohesion issues. The Economist Intelligence Unit (2021) noted France was downgraded in 2020 to a flawed democracy. Perhaps more troubling is the serious instabilities of democracies across the European zone and the resultant threat of breakdowns of cooperative agreements over the past number of years, which the reader is reminded were lauded by Fukuyama (1989) as the ideal end state democratic model. Importantly, we note here that the United Kingdom departed the European Union in 2020 (the first country to do so in the Union's history) after a close vote. Those in favour of separating overwhelming stated they did so for better control over immigration and borders citing fears of England becoming less British, asserting

immigration was responsible for the social and economic ills of the country (Adam & Booth, 2018). This echoes similar rhetoric often cited in the US (Human Rights Watch, 2021a) and increasingly in Canada (Human Rights Watch (2021b) as a means to justify certain contentious border control measures. However, even before this historic separation, the Euro Zone had been experiencing instability as we hinted to earlier. Some scholars termed this instability as backsliding and that is, a characteristic decline in the democratic quality while under a democracy (Gora & de Wilde, 2020, p.12).

What we note from Anna Gora and Pieter de Wilde's 2020 paper *The essence of democratic backsliding in the European Union: deliberation and rule of law*, is that the major source of instability is an increase in non-constructive rhetoric and a rapid decline in the quality of deliberation. The authors describe quality as reasoned justification, references to the common good, and consultation with the public (p.12). This decline was stated as being driven by a decrease in the extent to which politicians, " . . . provide justification for their arguments and by growing disrespect for counter argument . . . ." (p.12). Gora and de Wilde (2020) continue their analysis, "Citizens are confronted with a changing political climate, where opposing political elites increasingly see each other as enemies to be destroyed, rather than as adversaries to be defeated in elections" (p.12).

The paper concludes that politicians challenging each other's legitimacy or indeed their very right to exist in democracies is creating dogmatic division within groups and polarization within society at large. This we find, is a significant factor in the backsliding and instability of democracies. These complex set of factors is creating tension within the European Union and places the basic democratic functioning of the body politic in jeopardy (Gora & de Wilde, 2020).

Perhaps the most extreme examples of the interplay of intolerance of dissenting opinion, vilification of counter narratives, roll backs of many civil liberties, dismantling of executive powers and oversight, vote rigging, threats to journalistic institutions, and other democracy eroding activities are apparent in Hungary and Poland. Some fear these nations are slipping into autocracies and now function as democracies in name only (Rhodes, 2020 and Zeller, 2020).

Attempts to export, foster, fund, and grow Western democracies around the world have been contentious over the past few decades. Iraq falls into the authoritarian category, with a deeply dysfunctional federal system, ranking 118th by the Economist (2021) after 30 years of modern Western intervention and attempts to establish democracy in the region (Iddon, 2020). At the time the report was published, Afghanistan was ranked 139th but while preparing this research in August of 2021, we witnessed the absolute collapse of that country as subsequent provinces fell to the Taliban terrorist group within days of the announced US and western withdrawal from the area. This terrorist group has now laid claim to the country and its starving inhabitants seemingly overnight and seeks legitimacy of their totalitarian rule through international channels wiping out meager democratic gains made in 20 years of contemporary western intervention, a staggering $2.26 trillion USD, and thousands killed (Helmand & Tucker, 2021).

It appears that the overall health of democracies including many senior and previously stable democracies are experiencing a weakening of core principles around the globe, accelerated at least in some cases by vitriolic rhetoric, or outdated beliefs that do not reflect the current population's ideals, and new complex stressors such as pandemics and climate change.

This we note was a cursory, macro-level evaluation but the results are telling none-the-less and should provide us some pause in considering whether unexamined democracies as practiced

now are indeed fit for export to space with the added burden of the unforgiving conditions of the space environment.

Though they have formed much of the world we know today, and we have seen a great deal of societal improvement within democracies around the world, we have so far established that there are some potentially serious flaws to our currently practiced democracies that when applied to a typical space environment could be catastrophic, or at the very least not sustainable in the long term. That is not to say this author recommends a wholesale abandonment of our current system. There are obvious and significant merits to the aspirational main tenets of the ideal democratic model, whatever that may be in practice: freedom, inclusiveness, equality, and decisions based on the interests of the people the government is supposed to represent.

However, some elements of modern liberal democracies such as threats to social cohesion, class stratification, divisiveness, and relentless extractivisim that has now taken an unprecedented ecological toll (IPCC, 2021a) makes these trying times for the governance model. This asks us to at least reconsider other options for space settlements while we have the time to do so.

Democracy as it is currently practiced interwoven with capitalism, is also a potential factor in the unstable social construct. Though, it is another topic worthy of its own exploration it does bear mentioning in this context. Of this growing imbalance Nancy Fraser (2019) writes, “While social life as such is increasingly economized, the unfettered pursuit of profit destabilizes the very forms of social reproduction, ecological sustainability and public power on which it depends” (p.138). One can infer here that the massively unequal outcomes and opportunities based on class and wealth is a sign of instability of the public sphere. She continues, “financialized capitalism is an inherently crisis-prone social formation. The crises complex we encounter today is the increasingly acute expression of its built-in tendency to destabilize itself” (Fraser, 2019, p.138).

Off Earth migration is a near term reality and these permanent settlements (be they on space stations, the Moon, Mars, or near-Earth asteroids) will face similar hardships due to the unique inimical environment unlike anything on Earth. This environment is categorized by the lack of breathable atmosphere, a lack of liquid water, a lack of or reduced gravity, significant physiological effects, and severe isolation in a small closed ecological system.

Western science by its nature tends to break these into distinct issues or independent variables and has done so in the research on how to deal with each of these show-stopper problems in long duration space flight. A similar approach exists in our responses to Earthly management of equally as important issues and resources such as the management of fisheries, agriculture, education, healthcare, and similar. These are often federalized or broken down into distinct government portfolios or departments with different aims, goals, funding priorities, and lobby interests that do not necessarily work laterally. The resulting in-efficiencies of this method is potentially adding to the stress to the equitable functioning of governments.

The western governance centric responses to perhaps our generation's most pressing issue, anthropogenic interference, also known as climate change, has been similarly handled, or (completely denied) in a partitioned manner with differing approaches to national targets for carbon emissions limits that have so far left the global community at steadily increasing risk according to a new IPCC report (IPCC, 2021b).

So then, are these common models of governance the best suited to respond to this complex problem-set? While the settlement of new worlds and climate change are vastly different in scale, they are both extremely complex and sustainability forward problem-sets that will require adaptive, flexible, and resource management focused governance as hypothesized in the problem statement.

In the following section, we will briefly examine different approaches to complex problem-sets via an investigation into Indigenous Knowledge, cognition, and worldview using climate change and sustainability issues as a broad proxy assessment of adaptability and resilience facing future space governance modalities in complex environments. We undergird this assessment, by leveraging Lee et al.'s (2019) comprehensive sustainability study:

> The concept of social-ecological resilience offers a theoretical basis for assessing the capacity of governance systems to achieve both social and ecological sustainability. Resilient Social Ecological Systems (SES) have the capacity to adapt or transform in the face of often unexpected disturbances in ways that continue to support human well-being. (2019, para.2)

Indigeneity and Approaches to Cognition, Law, and Adaptive Governance

For those unfamiliar with the concept, LaDonna Harris succinctly explains Indigeneity in this quote:

> Indigeneity assumes a spiritual interconnectedness between all creations, their right to exist and the value of their contributions to the larger whole. At the core of Indigenous thinking is that coexistence relies on the ability of all peoples' and living things' voices to be heard and heard equally (n.d.).

Increasingly, and partly in response to the wicked predicament we have found ourselves in due to anthropogenic interference, federal governments, and global organizations such as the United Nations have started to take notice of Indigenous Knowledges (IK), Traditional Knowledge (TK) or Traditional Ecological Knowledge (TEK). These terms are often used interchangeably, as they pertain to some ecological and social issues. While there exists no one definition of these terms, they are related by way of their similarities in the production, transmission, and use of

knowledge. von Der Porten, De Loë, and McGregor (2016) paraphrase an International Council for Science definition, being that IK describes, "a cumulative body of knowledge, know-how, practices and representations maintained and developed by peoples with extended histories of interaction with the natural environment. These sophisticated sets of understandings, interpretations and meanings are part and parcel of a cultural complex" (p.218). von Der Porten et al., note here that the very term knowledge is indeed a western notion and that its closest equivalent in many Indigenous cultures would be better described as a 'way of life'. They continue to situate the term within a broader holistic context by referring to this type of knowledge as Indigenous Knowledge Systems (2016, p.218).

Acknowledging that there are some variances within the definitions, for the purposes of this work we will refer to the term Indigenous Knowledge (IK) as it is more commonly referred to in Canadian publications amongst Indigenous scholars.

Reasons for a global pivot to IK is multi-fold but part of that reasoning is that many of the world's Indigenous peoples are particularly sensitive to the withering effects of climate change and in many cases constitute a generally lesser resourced and greater at-risk segment of the global population (UNESCO, 2017). From a 2017 UNESCO climate change policy report, "Many small island, rural and indigenous peoples are already facing the first impacts of climate change. Their increased vulnerability relates to their reliance upon resource-based livelihoods and the locations and configurations of their lands and territories" (para. 1).

A particularly devastating example of this vulnerability are those faced Arctic Inuit communities across northern Canada, the USA, Greenland, and Russia. Sheila Watt-Cloutier, former Canadian president of the Inuit Circumpolar Council describes what she heard from Inuit community members as she traveled the North during her advocacy work in her 2015 book *The*

Right To Be Cold. Watt-Cloutier writes, "As our Arctic temperatures have edged upward, the top layers of permafrost have begun to melt . . . As a result, what was once terra firma is now unstable, slumping terrain. This soft, loose earth is vulnerable to erosion . . . ." (2015, p.91). She notes throughout her work how the changing environment and unpredictability of permafrost and ice thickness has begun to change Inuit food production and storage requiring community level adaptation in these isolated areas. Along this vein, Watt-Cloutier (2015) writes that Inuit lives are intimately connected to the unique geography they have occupied for several tens of thousands of years and even subtle changes are impactful. This is not exclusive to the Inuit but to a great many Indigenous cultures around the world. This trans generational, geographically linked, culturally embedded interconnectedness within a semi closed system, and reciprocal eco-social relationships has informed the ability of many of these cultures continuous adaptation over such long-time scales (Marsden, 2021, p.15).

This ability to adapt to changing environments versus attempting to control them, is drawing significant critical attention to Indigenous Knowledges and IK-informed processes in international fora. From UNESCO (2017), "Indigenous, local, and traditional knowledge systems and practices, including indigenous peoples' holistic view of community and environment, are a major resource for adapting to climate change" (para. 6). This concept is further reinforced by Georgia Magni's 2017 article on IK informed adaptability and resilience:

> Their [Indigenous people's] diverse forms of knowledge, which are deeply rooted in their relationship with the environment and cultural cohesion, have allowed many of these communities to maintain sustainable use and management of natural resources, protect their environment and strengthen their resilience, whilst facing new and complex circumstances (p.438).

The Canadian Government has been taking a more active role in attempting to formalize the incorporation of IK into regulatory and policy development to adopt a more holistic approach to resource development and climate change efforts. This is in contrast to the standard consultation that is now required for some development projects. From the Government of Canada's introductory policy paper, "Indigenous knowledge improves federal decision-making and strengthens the rigour of project reviews and regulatory decisions . . . It enhances the understanding of the potential impacts of projects, and its consideration, as demonstrated in past projects, has led to improved project design" (Canada, Environment and Climate Change, 2019).

While this is a commendable approach by governments and international organizations, it is important at this stage to contrast these knowledge systems and how they are applied in these differing worldviews in combatting complex problem-sets.

As mentioned briefly in the previous section, western knowledge tradition stems from the post Enlightenment shift in cognition to logic and reason informed processes. Fukuyama (2022) writes that overtime these paradigms became rationalist, positivist, and post positivist modes that are employed today as the globally accepted standard scientific method. This method requires reduction, classification, categorization, and the repeatability of information to arrive at a single truth (Fukuyama, 2022). This has been widely held as the best way to understand, conceptualize, and manipulate the external world.

In the most basic terms, this form of cognition requires the removal of pieces from the whole system and studying or applying them in isolation. Western governments and socio-economic structures are similarly siloed or federalized into provincial or lesser departments and portfolios that are removed from the whole and managed in isolation. Fukuyama (2022) contends that from this mode of cognition, humanity was able to manipulate nature to produce the modern

economic world to such a point that continued near exponential growth is expected. This method has led to great advancements in science that have vastly increased human longevity for example and sent us to space! However, it has also conferred in states massive military advantages that have been used to conquer and exploit. Fukuyama (2022) writes, "Modern science, in other words, was strongly associated with power, perhaps symbolized to greatest effect by the mushroom cloud exploding over Hiroshima in August 1945" (p.87). This mode of cognition then is strongly associated with the concept of conquering nature and others through science and reason, "using the latter to bend the given world to suit human purposes" (Fukuyama, 2022, p.87).

Indigenous Knowledge and cognition differ in several keyways. In general, Indigenous Knowledges often favour a total system understanding that is integrative and circular. Gregory Younging (2018), an Opaskwayak Cree scholar explains that while western thought practice still attempts to dismantle the whole, silo information, and manage pieces, IK more properly addresses the entirety of the system at once. He writes, "Indigenous Knowledge is not only 'technical' but also empirical in nature. Its recipients' integrative insights, wisdom, ideas, perceptions, and innovative capabilities pertain to ecological, biological, geographical, and other physical phenomena. It has the capacity for total systems understanding and management." (2018, p.112).

Younging (2018) continues that Indigenous pedagogy is heavily based on shared personal observations and experiences with the natural world and apprenticed relationships with community Elders over a lifetime. The lateral distribution of knowledge, experience, skills, understanding, and reflections are important sources of community strength, engagement, and resilience over time (2018, p.114). Younging (2018) writes that the single most important precept of the Indigenous worldview is that the world in its own way is alive, conscious, and flowing with knowledge.

Shawn Wilson (2008), also an Opaskwayak Cree scholar, expands on this point stating that knowledge production is a community affair that is relational and shared with all creation and is considered a sacred relationship with the cosmos, animals, plants, and the earth. In this manner and in contrast to western tradition, parts of this knowledge cannot be removed from the whole for further investigation. Echoing von Der Porten et al. (2016), Wilson (2008) continues that it is more properly understood as a way of life as each member of a community in all aspects of their life is responsible to all creation. As such, the deliberate conquest over the natural world is not desirable nor respectful most especially within limited geographical areas. Fikret Berkes (2017) summarizes this concept as well, "Since relations are reciprocal, or two-way, many indigenous peoples believe that respectful use [of resources] is necessary for sustainability" (p.128). Berkes (2017) further contends that in general a common concept shared amongst Indigenous cultures is to manage relations with their environment versus managing the resources specifically. Speaking of the total systems concept Berkes (2017) expands with the following, ". . . the Indian economy, took what we would today call an ecosystem approach and treated the environment as a portfolio of resources and services that supported livelihoods. The other economy, that of the colonist, turned the environment into commodities, exploited sequentially one resource after another following market demands, and caused depletion and environmental degradation in the process" (p. 31).

For many Indigenous communities the culturally embedded holism, with emphasis on deep feedback learning that considers large volumes of qualitative data, and the incorporation of uncertainty (versus control of it) appears to some to drive these unique adaptability characteristics (Berkes, 2017, p.220).

Referencing our proxy problem-set of climate change, western scientific methods have collected large amount of data quantitatively, catalogued, and recorded it to model, track, and

attempt to proffer solutions to national and international governance and policy bodies. However, many Indigenous cultures have found other means to gather, store, and transmit similar data for centuries while adapting to changes.

On this concept, Berkes (2017) references a form of fuzzy logic used by the Inuit that describes their ability to collect and disseminate large amounts of qualitative data. Berkes (2017) continues that this method of accretional and in-depth qualitative observation provides insight into how Indigenous holism is constructed and then used to make community-based decisions on complex issues such as, adaptation to contaminants in local food sources in the Arctic (p.220). As mentioned previously in Watt-Cloutier's (2015) account of the north, the Arctic has been undergoing significant environmental change. Inuit communities have been noting these changes in the patterns, health, and behaviour of common animal and plant food sources, weather, and the surrounding environment for several decades. These data are largely observational and distributed amongst communities but has been quantitatively verified by scientists of late (p.220). Berkes (2017) continues:

> Indigenous knowledge works in the fuzzy logic sense to the extent that (1) there is a large amount of information, (2) it is collected continuously, and (3) changes are incorporated into the collective mental model as new information flows in. Herein lies the essential similarities of indigenous knowledge to fuzzy logic. (p. 221).

In this manner, data are collected but comparisons made are language-based rather than numerical and therefore mental model formation, "follow patterns consistent with the language used, as language shapes terms and concepts" (Berkes, 2017, p.221). Fuzzy logic models often

rely on language-based information that is converted into simple mathematical expressions that can be manipulated to inform corollaries in complex systems.

Berkes (2017) writes that the fuzzy logic and holistic thinking used by the Inuit (and other Indigenous cultures) is possible because exact categorizations are avoided. He continues, "if all the concepts embedded in a holistic term were to be specified, the whole idea would become unmanageably complex" (p.221).

When dealing with community survival in sometimes harsh conditions in the real world, precise quantitative analysis of the behavior of complex systems are not likely to have much relevance, argues Berkes (2017). Therefore, this culturally embedded and adaptive systems thinking (or total systems knowledge Younging referred to from his personal cultural experience) appears to be key to building a holistic understanding of the environment. This is done by monitoring many variables over a long period of time, accumulating, and accessing large amounts of qualitative data, and building an intra-community mental model of a healthy environment.

This knowledge can be transmitted through language, dance, song, or protocol is then formulated as a holistic picture that, "can then be used to assess change, without reducing the observed world into discrete (and quantifiable variables) . . . indigenous knowledge has been to find ways of perceiving the continuum of nature and working with it" (Berkes, 2017, p.225). These methods of Knowledge formation, storage, and transmission then drives a unique adaptability to changes in the environment nourishing a deep resilience of many of these communities because so much information can be shared amongst all members of the community, allowing for best informed decision making by those closest to the change.

Governance models overlain on the holistic worldview would then also be thought to have similar adaptive structures to reflect the cultural norms therein. Biggs et al., (2012) in a preliminary

study broke down this concept of adaptive governance into seven principles that when considered holistically, they have shown, lead to increased resilience within complex systems (or socio-ecological systems, SES, in some circles). Biggs et al., (2012) deemed these necessary for regulatory, governance, or management entities when dealing with a changing climate. The authors describe SES as being made up of various eco-system services (ES) to sustain a culture:

> All social ecological systems (SES) produce a "bundle" of ES, including provisioning (e.g., freshwater, crops, meat), regulating (e.g., flood and climate regulation), and cultural services (e.g., recreation, spiritual values). Extensive and rapid global changes, including urbanization, growing human populations, rising consumption, and increased global connections, have led to a large and growing demand for provisioning services . . . Enhancing the resilience of ES that underpin human social and economic well-being is therefore of substantial policy interest (p.423).

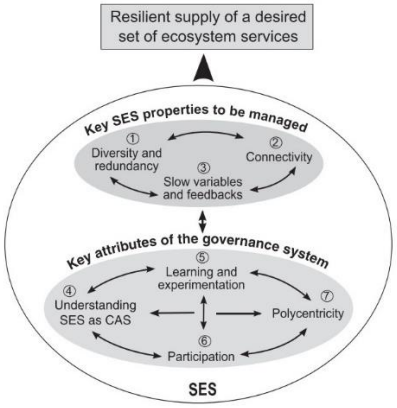
Biggs et al. (2012), argue that governance and management models within such systems under stressors like climate change, must follow an integrative approach to managing change and foster resilience by considering the following seven SES theoretical principles:

1. Maintain diversity and redundancy,
2. Manage connectivity,
3. Manage slow variables and feedbacks,
4. Foster complex adaptive thinking,
5. Encourage learning and experimentation,
6. Broad participation and,
7. Promote polycentric governance.

Biggs et al. (2012), state that when these factors are then nested between governance (the social and political process of defining goals for management and resolving trade-offs within a system); and management (the actions taken to achieve the goals by monitoring and implementation), they produce a circular and holistic system that manages variables to produce a resilient output as depicted in the graphic below from Biggs et al., (2012):

Figure 1

Nested SES Principles



Note. Seven SES principles grouped by governance and management

By way of a worldview that involves respectful use of resources, a culturally embedded fuzzy logic to manage large amounts of variables, what Younging (2018) referred to as a total systems knowledge to manage change, and an obvious alignment to SES principles Indigenous Knowledge could be concluded to be a resilient framework upon which to construct a governance model in any complex environment. Lee et al. (2019), expand on this; “In many cases, indigenous values, stewardship protocols . . . sustained local and regional resource use over centuries and millennia highlight the fundamental role of place based indigenous knowledge and traditional stewardship in fostering SES resilience today” (para. 4).

In their work, Lee et al. (2019), then compare the seven theoretical principles of SES to Indigenous Knowledge from the Skidgate Haida and Heilstuk First Nations frameworks to illustrate the inherent adaptability and resilience of these Nation's governance and management methods of local natural resources. We see a strong correlation between IK and SES in all categories versus that of Canadian federal governance thus indicating that these methods are likely more adaptable over time versus more rigid and hierarchical systems place in many western governance models amongst space faring nations (Lee et al., 2019).

At the beginning of this chapter, we began an investigation into different approaches to managing complex problem-sets via a brief examination into Indigenous Knowledge, cognition, and worldview using climate change and sustainability issues as a broad proxy comparison of adaptability and resilience facing future space governance modalities. With the high degree of alignment between Indigenous governance systems and theoretical resilience principles outlined by Lee et al. (2019) we can conclude that incorporating Indigenous holistic thinking, resource management protocols, and SES governance into existing structures could facilitate greater sustainability and resilient community centric outcomes in complex environments.

An important point to consider as we think about the community-based nature of IK and its application to governance is that while IK is intensely placed based, many scholars suggest that IK informed (holistic worldview) practices are common amongst many cultures within different eco systems, that they could rightly be considered principles (Berkes, 2017 and Marsden, 2021).

Berkes (2017) writes that from the Inuit sustainably managing scarce country food ways in the Arctic, the Dene managing caribou in the sub arctic, Haida Nation and the Coast Salish managing ocean food sources along the coast of British Columbia (Lee et al., 2019), and the sustainability focused harvesting systems of the Maori of Aotearoa (New Zealand), indicates the

potential for creating universal management principles from locally developed practices. These principles could be potentially applicable in any complex system, including space communities.

So, what would an IK informed space community look like in practice?

Indigenous Knowledges to Inform New Space Communities

Dawn Marsden, an Anishinaabe scholar, writes of this worldview informed from her own culture and academic practice in public health, leadership, and space science sub fields. She states similarly to the aforementioned authors, that it utilizes a total system understanding and because of this culturally embedded interconnectedness with all living things over long time scales in geographically restricted areas, it has driven a unique flexibility and adaptation ability of her cultural group. Marsden (2021) also argues that this unique adaptability is particularly relevant to isolated space communities that will also have to occupy closed ecological systems.

Her 2021 book *Starship Citizens: Indigenous Principles for 100yr Interstellar Voyages* outlines Indigenous principles for a community on a multi-generational interstellar voyage and a framework for a sustainable ship informed by the author's experience within her own Indigenous cultural practices. Marsden (2021) contends that a closed ecological system like those in the space environment bear a great deal of resemblance to geographically restricted and isolated Indigenous communities. She writes, "Both Indigenous societies and starship communities require complete socio-ecological systems, including all those environmental, biological, and social systems necessary for intergenerational survival and fulfillment" (2021, p.19).

Marsden (2021) refers to her practiced Indigenous Knowledge System and explains how much of it is parallel to a closed ecological system on a starship. This offers us an interesting social governance method to consider as potentially applicable to off Earth. Important considerations she references include unifying concepts such as holistic egalitarianism that include core principles

like interconnectedness and environmental experience. Personal development principles including returning gifts (reciprocity) and self-sufficiency. Lastly, she covers community-oriented practices such as restorative justice, resilience, and cohesion.

Marsden (2021) analyzes aspects of governance practice on a hypothetical starship wherein she explains three important parts of IK governance practice including circle talk, consensual decision making, and leadership from below. Marsden (2021) argues that in a community that is based on holistic egalitarianism, most day-to-day decisions that relate to functioning of the community are made by individuals with a strong sense of self-determination and an equally strong sense of the needs of the community. By informal commitments to the overall community's survival, there exists in this type of community an innate understanding that each member is part of the whole and has responsibilities to ensure individual and collective survival. Community decision-making for larger issues such as justice, environmental stewardship, and defense would utilize a form of circle talk. Marsden (2021) explains talking circles as:

> A formalized meeting process that enables personal self-determination and holistic, egalitarian discussions and decision making. Historically, circles have been used for restorative justice, healing, ceremony, education, community governance, and more recently, for research. Sometimes circles are nested, so that special interest groups can meet before they add their voice to the larger collective (Marsden, 2021, p. 57).

Marsden (2021) relates this to a spaceborne community, as a means to effectively solve problems while engaging everyone in the process. Marsden (2021) argues that this method was shown to be particularly adept at fostering resilience and social cohesion through self-determination, inclusivity, compassion, and respect. Marsden (2021) concludes that "Circle talk

would be an effective tool for inviting strong citizen engagement on a starship and ensure that the observations and expertise of the whole community are utilized and integrated for community sustainability" (p.58).

Earlier, we looked at forms of tie breaking for difficult collective decision making. Be it with Rawls' veil experiment, allowing a managerial structure to make the decisions on behalf of the people, or a more authoritarian approach where a single person makes the final decision whether there is consensus or not. Marsden (2021) advocates for a consensual decision-making process when timely decisions are not necessary. She argues, this approach allows for the wisdom and experience of the entire community to be heard, incorporated, and applied equally with fewer impacts to cohesion that we see in hierarchical structures (Marsden, 2021). For this to work however, everyone must be involved including children, Elders, and others as they may offer unique perspectives that have not yet been considered. Disagreements are considered essential to the process and community members are invited to state their disagreement, withdraw, or re-engage as needed in the process. Disagreement in this manner Marsden (2021) argues, has not been practiced traditionally to deliberately derail the search for consensus and was not meant to be combative, antagonistic, or for personal gain. The community as part of a larger whole remains the priority during any deliberation. On this, Marsden (2021) concludes that this particular process of direct democratic communication practices:

> Would result in an increasing understanding of collective expertise, resulting in best-informed decision making, planning, and execution for any community event or issue. This in turn would build security and solidarity and, over time, increase the ability to mobilize quickly and respond effectively to any socio-ecological situation (2021, p. 60).

The last of Marsden's (2021) pillars of governance is leadership from below which is in stark relief from the typical western hierarchical, top-down leadership styles found in most spheres of society. The problem with this approach she contends is the concerns of those on the ground, or 'front lines' who are often most affected by the policy or decision are rarely considered to any great effect. In Marsden's (2021) own Anishinaabe culture during community or intra community decision making, leaders or *Pontiacs* would be invited to share based on the experience and specific knowledge required for the task at hand. In some cases that was a community Elder but not always, this engaged everyone in the community to offer expertise. Marsden explains:

> Leaders were chosen for their qualities but were limited to the specific roles and tasks delegated to them; they were followers. They could not make arbitrary decisions or speak for anyone except themselves, other than as specifically instructed by the community. This is known by some as *leadership from below* (2021, p.62).

This bottom up, intra-community (polycentric), accountability building, and inclusive approach Marsden (2021) argues is an effective structure for space society governance as it can, " . . . address issues dynamically without the destabilizing dissension, sabotage, or lateral violence seen in some hierarchical leadership structures" (p.63).

We might note here that leadership from below as described by Marsden (2021) does bear some resemblance to the idea of servant leadership in modern western paradigms. While western leadership processes often rely on top down and coercive methods which Marsden (2021) described as potentially corrosive to cooperation, servant leadership is different in that it is focused on serving the interests of the group collectively using persuasion and trust building (Spears, 2010). So, in this instance perhaps does not warrant critique in the same manner.

The method has seen some renewed interest since originally conceived by R.K. Greenleaf in the 1970s to improve collaboration in working groups at AT&T (Spears, 2010). However, the increased use of this method to incentivize greater output from employees and to surge productivity in all manner of industries, does seem to both highlight differences in worldview and re-emphasize the western rationalist focus on production and labour. Albeit, in a significantly more collaborative manner.

Cautiously We Could Move Forward Together

While it seems that IK and IK-informed SES governance appears to be a good fit for changing and dynamic environments of new space communities, there is some reason for caution. Deborah McGregor (2021) elaborates on what she terms the extraction paradigm, the practice of Western scholars and policy makers to cherry pick parts of IK. On this phenomenon McGregor (2021) writes, "there is a substantial difference between considering Indigenous knowledge as a packageable and transferrable item and recognizing such knowledge instead as an integral and inseparable component of Indigenous knowledge systems" (p.6). McGregor (2021) specifically cautions that, "By continuing to focus on incorporating Indigenous knowledge rather than on collaborating with Indigenous peoples to fully recognize IKS, governments . . . are explicitly excluding the broader systems of knowledge since these may well directly challenge the purpose and intent" (p.6).

Within this extraction paradigm, the process of only taking the parts and pieces of IK that governments and international organizations see as equivalent to western science or policy, lies a significant risk of IK losing context and efficacy. In this process it becomes counter-productive to the final aim, which in the case of this thesis is a stable off Earth community. Utilized in this way,

IK becomes “advisory and facilitative data points rather than constitutive and the means by which new social trajectories are plotted”, argue Latulippe and Klenk (2020, p.7).

The Canadian government (and other such entities) have had trouble integrating different knowledge into the federal body politic, caught in the gaps created by positivist legal perspectives with the western system unable to classify the Indigenous information in a legal manner that would validate and then legitimize its meaning and function in western governance practice (de Beer & Dylan, 2015). Attempts to do so using existing legal mechanisms like intellectual property law or copy right law have so far fallen short due to issues validating most sources of Indigenous law; calling into question whether integration is indeed the best approach (de Beer & Dylan, 2015).

The long, complex, and at times violent legal and treaty negotiations from the time pre and post the confederation of Canada have resulted in a pluralistic legal regime. Some sources of Indigenous law have been recognized and partly incorporated into common law (generally relating only to property and adoption) but in practice this has required the translation and categorization of some Indigenous legal practices into terms, “cognizable to the non-aboriginal legal system” thus converting it to “a modern legal right” (Haida Nation v B.C., 2004 SCC 73 in Reynolds, 2018, p.180) which in turn distorts, dilutes, or constrains the original Indigenous legal intent.

However, there have been some attempts to better collaborate on the legal way forward in Canada with reference to international laws. After years of debate over the act’s suitability for incorporation into law, in 2021 the *United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) Act* received Royal Assent and came into force in Canada. For reference, UNDRIP came about at the UN due to the overwhelming reports of discrimination faced by Indigenous peoples over several decades and studies that outlined the oppression, marginalization, and exploitation suffered by many Indigenous peoples around the globe (UN, 2021).

The declaration was adopted by 143 States in 2007 with four States voting against, including Canada. The main opposition being concerns over requirements of the right to self-determination of Indigenous peoples and the control over natural resources existing on Indigenous Peoples' territorial lands (UN, 2021), a process with significant impact to the Crown.

However, after an eight-year national inquiry into the mistreatment of Indigenous peoples in Canada throughout its history, the conclusion of the Truth and Reconciliation Commission (TRC) Report and 94 Calls to Action (CIRNAC, 2022) was that the Act be shaped for incorporation into Canadian domestic law. The intent of the Act is to advance the implementation of the main concepts within UNDRIP in collaboration with Indigenous peoples. The Act establishes accountability and a legislative framework to ensure continued efforts to uphold the human rights of Indigenous people and provides a vision for the future to ensure federal laws better reflect the standards set out by the Declaration, (CIRNAC, 2022).

Despite significant progress, these examples elucidate issues with incorporation of legal concepts from differing worldviews or forcing a worldview into contemporary western structures. While there may be no way to eliminate this issue of the extraction paradigm, many scholars and Indigenous leaders have suggested that to mitigate, collaboration, co-management, and community discourse (like circle talk) more in line with Indigenous methods need to be given more weight in the policy making process. Latulippe and Klenk (2020) use the term 'making room' meaning a process that begins, "to value Indigenous ways of knowing, being, and doing on their own terms and to create culturally relevant, appropriate spaces for Indigenous scientific research to flourish within existing knowledge production infrastructure" (p.9). They write that this process:

> . . . includes honest knowledge exchange between Indigenous researchers, scholars and traditional Knowledge keepers, and practitioners, encouraging

> sponsorship, capacity building, and most importantly that Indigenous people in these initiatives feel safe within multiple levels of the institution, up to and including senior administration and governance; and rather than being extractive is collaborative, fostering equity and empowerment during knowledge production (Latulippe & Klenk, 2020, p.9).

Finally, the pair conclude that to be transformative (which in the case of imagining governance in unique and novel environments is suggested) is to "expand and fundamentally transform ways of knowing and being in the world — including western research itself, through meaningful contact with Indigenous knowledge paradigms" (Latulippe & Klenk, 2020, p.9).

This meaningful contact is happening in small pockets such as the Anishinaabe Law Camp with the Osgoode Hall Law School where law students spend time with Chippewa of the Nawash First Nation and the Sto:Lo Field School, learning from Indigenous legal practitioners (Borrows, 2019, p.161). Similarly, in some provincial legal regimes we see the incorporation of community circles and IK informed restorative justice such as Cree circuit court in northern Saskatchewan, and First Nations Court in British Columbia (Reynolds, 2018 p. 184). We also see extensive IK inclusive co-management methods for sustainable resource management (Lee et al., 2019, and Berkes, 2017), and these principles being trialed in preventative public health care initiatives in Ontario (Makanda, 2022).

Early in this work we read space governance theorist Charles Cockell (2015) suggest that we had the unique opportunity in human history to deliberate and discuss human institutional arrangements prior to the settlement of a new environment. Bhatt (2015) wrote that we should be wary of the simple replication of current regimes given issues with cultural recidivism. Billings (2007) argued that true global cooperation and a fundamental de-colonial re-assessment of the

values we wish to bring with us as a species moving off Earth are essential for success in these new spaces to avoid dangerous divisions. McKnight (2015) in his research into tangentially related online gaming communities exposed a salient factor in that while we may do our best to design an elaborate governance system with a specific intent and purpose that it may not be at all how that system is utilized. Latulippe and Klenk (2020) and McGregor (2021) cautioned that we must be careful not to extract IK or simply incorporate pieces of it lest it lose its efficacy, suggesting meaningful contact and transformative thinking is what is required of us in developing new methods of governance. We have seen international bodies and federal structures alike try to wrestle with changes and shocks with varying degrees of success. However, we know that IK informed holistic community level thinking with culturally embedded mental models of larger contexts combined within SES frameworks offer a solution to stable governance practice in complex environments (Lee et al., 2019).

Recognizing the tensions and strains in democracies today and the rigid nature of many legal instruments in federal bodies or international organizations indicates that these may not be the best tools for constructing a new model for governance in space environments to manage the community level day-to-day processes. We have learned that trying to apply large and ready-made institutional frameworks, may simply be too inflexible and lack resiliency for the unique environment of space as they have trouble resolving unforeseen variables and changes potentially leading to instability.

However, soft law is an intriguing and non-binding international legal instrument that has recently found increased popularity amongst environmental and space lawyers to manage novel legal matters for several reasons. Namely, the inherent flexibility in the process allowing the content to adapt to new requirements and changing technology in a way that treaty law finds

challenging and time consuming, (Lyall & Larsen, 2018). Other benefits of this practice are the consensual nature of the development and the emphasis on common understanding that can build regularity of practice, combined with the fact that it is based on mutual compliance rather than enforcement leads to trust amongst participants, (Lyall & Larsen, 2018). Importantly, we note here that this form of consent and respect-based development of law, bear resemblance to a key Indigenous governance principle that Marsden (2021) described as circle talk.

Intriguingly, unlike some international legal processes, non-binding soft law allows for non-state actors, private citizens, and the like to participate in compliance mechanisms and development of soft law, which as Shelton (2008) notes is significantly more challenging in treaty law. This could open the door for Indigenous groups or Non-Governmental Organizations (NGOs) and those whom the law may most directly affect to participate in its development throughout all stages. This is a form of meaningful engagement which Latulippe and Klenk (2020) noted was imperative in the development of transformative policies to meet new governance challenges. This would also allow for the broad participation requirement, one of the critical sustainable governance principles theorized by Biggs et al., (2012) and Lee et al, (2019).

Overall, non-binding instruments are faster to adopt, easier to change, and more useful for technical matters that may need swift or continuous revision such as those one might encounter in a sustainability focused space society (Shelton, 2008). When the legal concepts being developed are novel, complex, or uncertain they may not be ready or a good fit for the more rigid treaty standard. In these instances, soft law text may be the only option left to consider from a legal sense (Shelton, 2008). However, rather than no action at all or potentially conflict, soft law may help lessen disagreement, resolve crises by keeping processes moving, thus avoiding stalemates and stalled action in more stringent, binding forms of law.

The outputs of soft law texts can take numerous forms from complex international declarations or resolutions such as those mentioned previously. This over time may become customary, or in the case of UNDRIP become binding treaty and eventually ratified into individual State legal practice, a process we note took approximately 38 years from resolution to Act in Canadian law.

Other forms include less complex memoranda of understanding, like that used to manage multi-national activities (confidentially) on the International Space Station, working arrangements, recommendations, informal standards, guidelines, and best practices (Aust, 2010).

While treaty law may be too complex and rigid to implement initially, the aspirational language and intent of many treaties in use today including the 1948 *Universal Declaration of Human Rights*, and the 1967 *Outer Space Treaty* can provide us context and a nearly universal set of agreed upon values from which to anchor more informal, discourse-based, simple, and flexible frameworks. Both these treaties (and many national charters and constitutions) encourage cooperation, respect, equality, maintaining peace, and fostering understanding as main tenets amongst signatories.

Though perhaps unnerving to policy makers, administrators, and lawyers the reader is asked to finally consider a radically stripped-down approach to governance, that is by way of amendments to current space treaty allowing the population in-situ to work collaboratively to develop their own governance framework, informed by the environment they are in initially based on simple guidelines, not a formal and fixed set of rules or laws.

However, by embedding the values mentioned above and leveraging IK as collaborative guidance on holism, sustainability, and adaptability practices we can use soft law as a vehicle to collaboratively establish a simple set of guidelines. The guidelines, however, would be developed

not by international bodies but by the diverse members that would constitute the population of the nascent space settlement as they will be the most affected by the outcomes and must be able to live effectively within the framework developed to maintain social cohesion.

A settlement first and foremost able to maintain resilient outputs (ES) from a balanced and IK-informed Social Ecological System, with a commitment to rigorous discourse, and community-based consensual decision making the population could organically develop a series of novel protocols that suits the unique environment they are in. Importantly, a social construct created this way could change dynamically, fostering resiliency, and a deep sense of community. This process would be unencumbered by systems conceived here by institutions that may have little to no relevance in practice.

This unique process may create custom that strays from international norms as such some margin must be permitted given the uniqueness of the environment and to allow primarily for settlement survival. Overtime, this group may begin to formalize or harden protocol into custom or treaty and re-integrate into larger international frameworks.

While this leaves sovereignty, jurisdiction, and economics mostly unaddressed (each of which are significant topics on their own) these factors are secondary concerns at a community level, as the settlement off Earth must first survive and take root before larger and more complex domains can be addressed.

Conclusion And Future Work

In this research we have looked at various proposed forms of space governance that narrowly surround some version of western democracy but as we learned all is not well with this form of governance in 2022. The presumption that simply cloning this method in an even more inimical space environment likely not the best method given the instability forming within senior

democracies currently without the added burden of additional variables from a space environment. We have examined how venomous rhetoric and other eroding actions has led to backsliding in some senior democracies around the world, causing us some concern for their suitability for simple replication and use in space communities where the unique environment poses some special and difficult tests to the governance modality as it is practiced today. We have noted albeit in a cursory manner, that this modality has some difficulty managing stressors and shocks without the requirement to revert to more authoritarian methods, and that adapting to change within these systems is a time-consuming process.

We have learned, however, a significant interest in Indigenous Knowledge from policy makers and administrators at all levels to help bolster current regimes in many areas as we face increased threats from climate change. These worldviews comprised of holistic and eco-social approaches to handling many variables simultaneously and managing change in complex environments over long time scales has driven substantial research into the areas of law, resource management, ecology, sustainability, and resilient community building.

In this investigation we learned that to produce resilient outputs from Social Ecological Systems requires an integrative approach to governing and managing key variables and that this framework is aligned with many common Indigenous values and community-based practices. Combined, these findings reveal a potentially exciting avenue to consider for community governance in new space environments.

Future work should consider analog studies into how these IK informed frameworks could be implemented within controlled testing environments. These should include experiments in community deliberation on abstract issues and emergencies to test the ability of the egalitarian aspects of the frameworks to handle immediate crises. More work is also indicated into building

out the practical application of the SES model informed by IK as an administrative structure and its feasibility for day-to-day processes. This could, however, potentially be done in a closed ecological system analog as well.

The scalability of an IK informed governance method is a significant factor left undetermined in this work. Further studies should consider an investigation into the applicability of IK-informed governance SES frameworks within large populations as it is assumed that settlements will eventually grow into regional sized communities and beyond. While it could be argued that democracies at a certain size begin to suffer inefficiencies due to the weight of their own administration, it is unknown how size would affect the unique IK aspects of this proposed model and how effective they would remain as the population is increased dramatically, as such it warrants further investigation.

Lastly, this work necessarily had to limit the Indigenous governance methods that could be researched and used for comparison for the limited scope of this project. Further work should consider expanding the theorized universality of some of the IK concepts by including governance research from other cultural practices.

Organizations such as NASA, CSA, JAXA, and the ESA could immediately start collaborating with Indigenous leadership from their respective nations in forums, astronaut selection, analog missions, and mission concept development. The organizations could then begin to Indigenize many of these processes to build in new, deeply collaborative, and transformative methods.

Selected members trained in understanding that maintaining resilient outputs from an IK informed Social Ecological System, with a commitment to rigorous and inclusive discourse, who are focused on community-based consensual decision making could begin to build a dynamic

governance method in-situ. A method that is informed by the environment, has learned from the mistakes of the past, and that collaboratively charts a new way forward among the stars with everyone's voice heard and heard equally.

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