



# laetus in praesens

Alternative view of segmented documents via Kairos

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## Eliciting Patterns of Global Consensus via Tensional Integrity

### Interweaving agreement and disagreement coherently with force-directed layout tensegrity

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#### Introduction

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## Introduction

Much is made of the need for consensus in global affairs, most notably with respect to major crises such as climate change. Efforts are made to engineer a form of consensus, as is evident in the current initiative of the World Health Organization with respect to any future risk to human health in the light of the controversially orchestrated pandemic response (*Pandemic prevention, preparedness and response accord*, WHO, 28 June 2023; *Hell No to the WHO Pandemic Treaty*, *Global Research*, 4 November 2022; *The Case Against a Pandemic Treaty*, *Think Global Health*, 26 November 2021). Of particular concern are the unforeseen environmental challenges which may be deemed to be a risk to health -- thereby triggering an inappropriate response. Climate change may be considered in this light.

**Consensus?** Despite the articulation by the UN of the set of 17 [Sustainable Development Goals](#) (SDGs), the UN now intends to seek a higher order of consensus through the Secretary-General's vision for the future of global cooperation in the form of a report titled *Our Common Agenda* (2021) -- "to get the world back on track by turbocharging action on the Sustainable Development Goals". This is presented with a view to the formulation of an action-oriented *Pact for the Future* which is expected to be agreed by Member States through intergovernmental negotiations on issues they decide to take forward on the occasion of the [UN Summit of the Future](#) planned for 2024. *Our Common Agenda* builds on the *12 commitments contained in the Declaration on the commemoration of the 75th anniversary of the United Nations*.

Curiously it is far from evident what is meant by consensus and the urgent need for unity as variously expressed -- faced as it is by the recognition of diversity and its cultivation. How has this played out in the use by UNESCO of [consensus decision-making](#)? (Emmanuel Ifeanyi Ani, *What Exactly is Voting to Consensual Deliberation?* *Philosophical Papers*, 50, 2021, 1-2; Darcy K. Leach, *When Freedom Is Not an Endless Meeting: a new look at efficiency in consensus-based decision making*, *The Sociological Quarterly*, 57, 2021, 1; Claudia Liuzza (*The Making and UN-making of Consensus: institutional inertia in the UNESCO World Heritage Committee*, *International Journal of Cultural Property*, 28, 2021, 2)

**Symbols?** As an evocative inspiration for the peoples of the world, considerable effort is made to embody a sense of global unity and consensus by using the iconography of the globe in multiple forms -- as previously implied by that of the circle. It remains completely unclear how any such symbol "translates" into the practicalities of a world in turmoil with conflicting preoccupations -- a challenge carefully neglected. This difficulty of "translation" is similarly evident when a sense of consensual unity and harmony is articulated in the subtleties of music and song, as with the [Anthem of Europe](#) (*A Singable Earth Charter, EU Constitution or Global Ethic?* 2006; *Reversing the Anthem of Europe to Signal Distress*, 2016). The pattern is evident when the focus is on its negation, as in the much-appreciated painting of *Guernica* (1937) -- but seemingly without any concern or capacity with regard to any necessary revision of that

insight (*Reimagining Guernica to Engage the Antitheses of a Cancel Culture*, 2022).

The **geodesic dome** tends to be featured as a global symbol on the occasion of world events. Partially inspired by that widely recognized geometry, the concern in what follows is with the relevance of the principles enabling that seemingly improbable design -- demonstrably inherently "sustainable".

Expressed succinctly, **how improbable does viable consensus need to be in practice** -- in contrast to the more comprehensible forms upheld as models of what is desirable. The status of cathedrals, temples, mosques, and the like, would seem to be inadequate to the challenge of the times -- especially to the extent that they embody world views in conflict with each other -- each deeming itself to be primary.

**Tensegrity**: The exploration here follows from earlier arguments with regard to that possibility (*From Networking to Tensegrity Organization*, 1984; *Implementing Principles by Balancing Configurations of Functions: a tensegrity organization approach*, 1979). Consideration has been given to such a possibility from the perspective of management cybernetics by Stafford Beer and his promotion of a **viable system model** and syntegegration (*Beyond Dispute: the invention of team syntegegrity*, 1994; John Coghlan, *Reflections on the Book, Beyond Dispute: a syntegegration in Switzerland*, 2016). Some consideration of the possibility featured in articulation of the preoccupations of the Rio Earth Summit which gave rise to *Agenda 21* (1992) as the precursor to the UN's later pattern of SDGs (*Configuring Globally and Contending Locally: shaping the global network of local bargains*, 1992).

The further development of this possibility follows from arguments regarding the relevance of tensegrity principles to psychosocial dynamics and the clues it offers to clues to collective strategic resilience and unshackling knowledge (*Transcending Psychosocial Polarization with Tensegrity*, 2021). Based as tensegrity is on polyhedral symmetry, such development follows from *Identifying Polyhedra Enabling Memorable Strategic Mapping* (2020) with its vital implications for collective memorability (*Memorable Packing of Global Strategies in a Polyhedral Rosetta Stone*, 2023).

Of current interest, with the development of web technology and augmented reality (or virtual reality) is the potential relevance of **force-directed layout** to the design and visualization of tensegrity structures, anticipated by its application to eliciting coherent patterns of preoccupations in 3D (*Interactive Polyhedral Configuration of Preoccupations*, 2023).

**Artificial intelligence?** With respect to the requisite "improbability" of strategic designs of relevance to a chaotic future -- and their comprehensibility -- the rapidly developing possibilities offered by artificial intelligence merit considerations. Given the alarm evoked by such possibilities, it is appropriate to note the **AI for Good Global Summit** (2023) organized by the International Telecommunication Union (ITU) -- the UN specialized agency for information and communication technology -- in partnership with 40 UN sister agencies and co-convened with the government of Switzerland.

The ITU is positioned as the leading action-oriented United Nations platform promoting AI to advance health, climate, gender, inclusive prosperity, sustainable infrastructure, and other global development priorities (*Artificial Intelligence for Good*, ITU Council, 2023; *Global summit on AI takes action to ensure artificial intelligence benefits humanity*, ITU, 20 June 2023; *ITU Statement on the closing of the 2023 AI for Good Global Summit*, 7 July 2023). A valuable contextual perspective on the ITU initiative has however been provided (Ville Aula and James Bowles, *Stepping back from Data and AI for Good: current trends and ways forward*, *Big Data and Society*, May 2023). There is as yet no trace of how problematic UN "summit dynamics" may have been enhanced by AI at the ITU event -- or envisaged there as a vital requirement for future global governance.

The innovations evident from neural learning have been well-publicized with respect to the strategic achievements of AI in chess and the game of go. In the form of ChatGPT, indicative examples of guidance in such matters are provided in the following exploration. Were the debates at the ITU Summit used as a means of "training" AI -- and if not, why not? (*Use of ChatGPT to Clarify Possibility of Dialogue of Higher Quality*, 2023).

**Consensus of "higher order"?** It is appropriate to emphasize that the patterns of design enabling forms of consensus of a higher order may be quite distinct from the simpler models of unity which tend to be promoted as credible -- despite their demonstrable inadequacy. The complexity of society clearly calls for new ways of interweaving agreement and disagreement, as implied by the coherence of biodiversity in which every species is necessarily "someone else's lunch" (*Using Disagreements for Superordinate Frame Configuration*, 1992). In this sense tensegrity has been recognized as fundamental to the coherence of cellular architecture (Donald E. Ingber, et al, *Tensegrity, cellular biophysics, and the mechanics of living systems*, *Reports on Progress in Physics*, 77, 2014, 4). From the perspective of biomimicry, it might be assumed that its principles could be of relevance to global organization.

The following exercise assumes that use of force-directed layout in engendering a tensegrity may be especially suggestive of the manner in which global coherence may well be intimately related to some form of **self-organization**, namely a process where some form of overall order arises from local interactions between parts of an initially disordered system. This perspective is in fundamental contrast to any conventional assumption that such order must necessarily be designed or planned -- inspired by consensus.

**"Two-dimensional strategies"?** With respect to any "higher order" of consensus, there is therefore a case to be made for the limitations of representation of strategic plans in two-dimensional iconography in a period when the challenges are global, and therefore minimally three-dimensional as argued with respect to the potentially hidden facets of global strategy of NATO potentially highlighted through polyhedra (*Envisaging NATO Otherwise -- in 3D and 4D?* 2017).

The conventional restriction to "planar strategies" visualized in 2D can be readily understood as reinforcing a "flat earth" perspective unsuited to "global" navigation. The problem is evident in the 2D iconography of the most recent strategic articulation by the Club of Rome with respect to the pentagram of "five turnarounds", as previously discussed and illustrated (*Application of force-directed layout to Club of Rome reports*, 2023).

**Psychosocial "disconnect"**: Although there is an extensive literature on tensegrity from a mathematical, architectural and aesthetic

perspective, those preoccupations extend to only a limited degree to their relevance to strategic issues of knowledge management and psychosocial and organization. This "disconnect" is unfortunately evident in exploring the adaptation of much-studied polyhedral configurations to the possibility of the representation of tensegrity structures in force-directed representations. This is despite the degree to which that modality may be readily held to be reflective of the principles in question. Force-directed layout has however been extensively adapted to the representation of social networks -- although their cognitive significance for governance and collective comprehension appears to have remained elusive.

**Weaving and braiding patterns?** The focus in what follows is therefore on the **practicalities of representation of force-directed tensegrities in a web environment** -- in order to enable exploratory interaction with them worldwide, given the support and innovation to be expected from AI. There is a particular irony to such practicality in that the conceptual challenges from a rational perspective (potentially trivial for some relatively obscure disciplines) are compensated by a considerable degree of familiarity with their comprehension from the perspective of weaving, knitting and basket-weaving.

The bridging discipline is **braiding**, curiously a focus in its own right from a mathematical perspective -- as with juggling -- evoking recognition of their implications for governance (*Warp and Weft of Future Governance: ninefold interweaving of incommensurable threads of discourse*, 2010; *Governance as "juggling" -- Juggling as "governance"* 2018; *The Future of Comprehension: conceptual birdcages and functional basket-weaving*, 1980).

There is a degree of irony to the metaphoric role attributed to "baskets" -- highlighted by the four "baskets" of issues into which *The Helsinki Final Act* was divided on the occasion of the *Conference on Security and Cooperation in Europe* (1975). The metaphor has been employed in framing Sino-US relations (*Differences buried in 'basket' of issues*, *South China Morning Post*, 26 October 1997). More recently the metaphor has featured in discussion of UN reform (*Member States Move Towards a "Basket" Approach*, *Global Policy Forum*, 21 March 2008). Could articulation of strategies indeed be fruitfully explored in terms of "basket-weaving"?

Curiously global governance could be recognized as associated intuitively with "spherical braiding", exemplified by the challenges of constructing the balls that are central to the ball games which are such a focus of global attention. Both the **association football** and that of **sepak takraw** (kick volleyball) follow the pattern of the truncated icosahedron fundamental to a molecular configuration -- the **C<sub>60</sub> fullerene** -- esteemed to be of considerable significance in the light of its stability (*Sustainability through Global Patterns of 60-fold Organization*, 2022). The seam pattern of the tennis ball and the baseball follow an analogous geometrical pattern (*Game ball design as holding insight of relevance to global governance?* 2020).

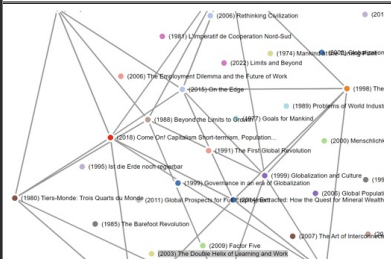
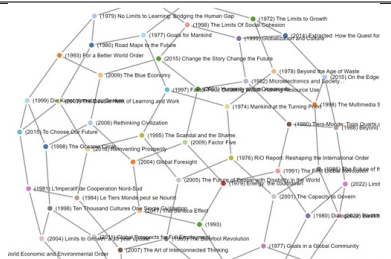
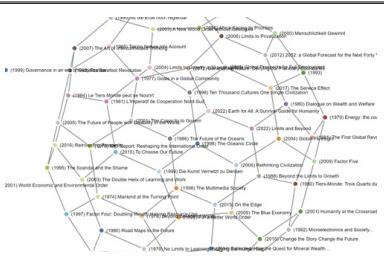
Given the focus on practicalities, a degree of emphasis is given in what follows to the propensity for error -- as would be the case with weaving and juggling. This propensity is of particular relevance if viable governance is to be understood metaphorically in terms of viable weaving -- with errors made as understanding of the requirements for viable consensus and unity develops.

## Procedure and tools enabling construction of a force-directed tensegrity

Given its strange relationship to the design of the balls widely familiar in sport, a point of departure was consideration of the **truncated icosahedron** as being of sufficient complexity -- in contrast with simpler or more complex polyhedra. This has 32 faces, 60 vertices and 90 edges (Hidenori Murakami, et al, *Static and dynamic characterization of regular truncated icosahedral and dodecahedral tensegrity modules*, *International Journal of Solids and Structures*, 38, 2001, 50-51). Of related interest, is the icosahedron, fundamental to syntegrity as originally explored by Stafford Beer -- with the **tensegrity polyhedron** upheld as the most widely known. The focus here is on the **icosidodecahedron** of 32 faces, 30 vertices and 60 edges, notably because of the relation of the tensegrity variant to the other two -- of which there are **many images**.

It is appropriate to note that the software enabling generation of a variety of polyhedra typically makes no provision for the generation of associated tensegrity models. This is notably due to the fact that such software distinguishes only one form of line in polyhedra, whereas the viability of a tensegrity depends on the balance between the forces associated with two forms of line -- distinguished in architectural terms as **flexible tension elements** and **rigid compression elements**. The website of one polyhedral software application does however include examples of manual tensegrity construction (*Tensegrity Models*, Antiprism Polyhedron Modelling Software). The **STEDY** software package (based on MATLAB), enables researchers familiar with tensegrity to simulate the dynamics of such structures.

**Use of Club of Rome reports:** Curiously there seems to be no use of force-directed layout to elicit such polyhedra -- or their tensegrity variants -- despite the fundamental principles of tensegrity embodied in that representational modality. In a previous exercise, that technique was used as a means of suggesting the coherent ordering of a variety of issues as a key to their memorability as a set (*Interactive Polyhedral Configuration of Preoccupations*, 2023).

Experimental use of polyhedra offering a contrasting focus to Club of Rome preoccupations		
Icosahedron	Truncated icosahedron	Icosidodecahedron
 <p>Interactive variant</p>	 <p>Interactive variant</p>	 <p>Interactive variant</p>

In those exercises force-directed layout of contrasting polyhedra was used experimentally to elicit different degrees of memorable order from the pattern of reports cited. Aside from the questionable assumptions in the use of the Club of Rome data set, the more complex polyhedra clearly offered a greater degree of coherence. However, **in contrast with the approach explored below, that polyhedral framing was imposed on the data -- effectively as a lens through which the data could be viewed. In what follows the quest is for comprehensible order to be elicited through a form of self-organization.**

Missing however, as illustrated in the use of the approach with more complex data sets, was the manner in which the repulsion between incommensurable issues might be related to any attractive force pulling particular issues together in terms of their degree of correlation. Such relationships tend to be completely obscured by the conventions of citation analysis which may either ignore perspectives (deemed irrelevant) or cite them in disapprobation. The pattern of likes and dislikes in social media comes closer to reflecting the dynamics in play, although this is not a focus of any form of citation analysis.

**Schematic representation?** An early request to ChatGPT sought to determine how the pattern of interweaving of great circles in a tensegrity polyhedron could be best understood. The response suggested use of the [Schlegel diagram](#) of the icosidodecahedron. One example of many is offered by A. V. Silant'ev (*Energy spectrum and optical properties of C60 fullerene within the Hubbard model*, *The Physics of Metals and Metallography* 118, 2017, 1). Schlegel diagrams are not sufficiently explicit with regard to the interweaving.

An early representation in 2D of the pattern of a tensegrity icosidodecahedron is presented below right. The **shaded pentagons** are distorted progressively away from the centre but are all the same size as are the **shaded triangles**. The edges of these areas are the **connectors**. The **separators** are shown in thickened black lines, again distorted in length away from the centre. The five outermost shaded portions fold up together (like petals) to form the twelfth pentagon. (Note that right- and left-handed versions of such tensegrities may be constructed. Comments on the lettering are given with the original presentation)

Clues to tensegrity formation from polyhedra?		
120-cell Schlegel diagram	Approximation to a Schlegel diagram of icosidodecahedron	Initial representation in 2D of icosidodecahedron
Generated by <a href="#">Stella4D</a> .		Reproduced from <a href="#">Implementing Principles by Balancing Configurations of Functions: a tensegrity organization approach</a> (1979)

**Adjacency lists:** The previous exploration required the identification of [adjacency lists](#) whereby the nodes in any polyhedral network are specified. Although of obvious value, these are not however readily available. They may however be derived from [OFF file](#) representation of polyhedra specifying nodes in relation to the edges of the polygonal faces of the 3D forms. Such OFF files can be exported from [Stella4D](#), but then require a conversion to the format of adjacency lists (nodes with links between them) basic to representation by force-directed layout. No such conversions, which are otherwise simple but tedious, are readily available. A program was developed for that purpose.

Such adjacency lists are to be distinguished from the coordinates of nodes more commonly used to specify the geometry of polyhedra in 3D. The focus on force-directed layout assumes that it is the forces in play between the nodes which will ensure that the polyhedral form is elicited (as indicated by the models above).

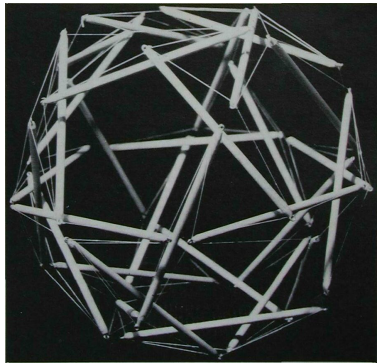

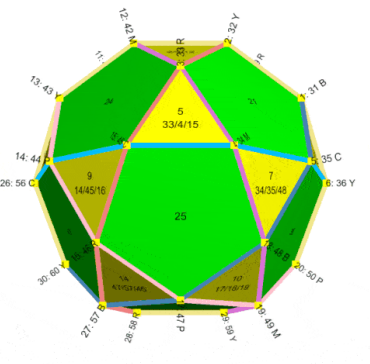
For the purposes of these explorations, the adjacency lists were held in a [json file](#) called by the force-directed application ([d3.js](#)) embedded in a standard web page. The program to convert OFF files was extended to the generation of json files for a range of polyhedra -- notably the icosidodecahedron.

**Tensegrity json files:** A key difference between the polyhedral format and the corresponding tensegrity format is the fact that each node of the polyhedron must be described as two distinct nodes in what Buckminster Fuller described as a "kiss touch" relationship in the case of geodesic dome architecture. Links to are made to one or the other in forming the tensegrity. The "pure" polyhedron form is therefore implied by the pattern rather than featuring as an explicit physical reality as may be understood from the image on the left below.

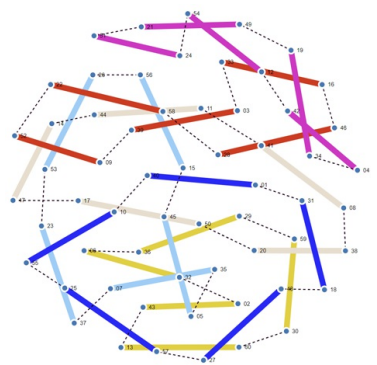
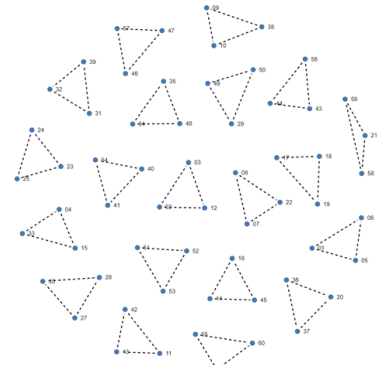
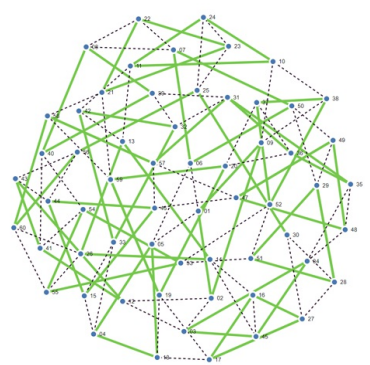
A key to this transformation in the case of the icosidodecahedron is associating a second number to each of the 30 nodes, establishing a pattern of 60 nodes (thus relating it to the 60-node truncated icosahedron).

**Renumbering of nodes:** The procedure used for this purpose was to accept the node enumeration of the icosidodecahedron in [Stella4D](#) and to add a second number to it by the addition of 30. Node 24 is thus accompanied by node 54. The pattern is evident in the following where the lower number for each node is that of [Stella4D](#), with the higher number as a "second" node at that location in "kiss touch" relation to it. The second nodes (with higher numbers) can be understood as the ends of the links originating from the nodes of lower numbers.

In the animation on the right, the colouring of links between nodes distinguishes the 6 great circles around the icosidodecahedron. A colour code for each is added to the node identification (blue, cyan, mauve, pink, red, yellow). The faces of the polyhedron are distinguished by the numbers attributed by Stella4D -- followed by an indication of the nodes associated with the framing of the triangular faces.

Contrasting representations of icosidodecahedron		
indicating double numbering of nodes and the pattern of 20 triangular faces and 12 pentagonal faces		
Icosidodecahedral model	Icosidodecahedral great circles	Double numbering of nodes
		
Reproduced from <i>Implementing Principles by Balancing Configurations of Functions: a tensegrity organization approach</i> (1979)	Animations produced from <i>Stella4D</i>	

For the purpose of this exercise the 6 great circles of the icosidodecahedron were deconstructed into the 5 lines ("struts") by which they are delineated. Their circular connection is provisionally indicated in the image on the left below. A subsequent stage was to identify the 20 triangular patterns of links by which the struts are bound together in the tensegrity. These are indicated in the central image. Corresponding to these triangular links are a set of 12 pentagonal links indicated on the right. There it may be seen that any pentagonal pattern of links is itself held together by intervening links of a triangle -- as partially clarified by the image above left.



"Reverse engineering" of icosidodecahedron		
6 great circles "deconstructed" and provisionally linked	12 triangles alone	12 "pentagons" (green links) implied with connecting triangles
		
<a href="#">Interactive variant</a>	<a href="#">Interactive variant</a>	<a href="#">Interactive variant</a>

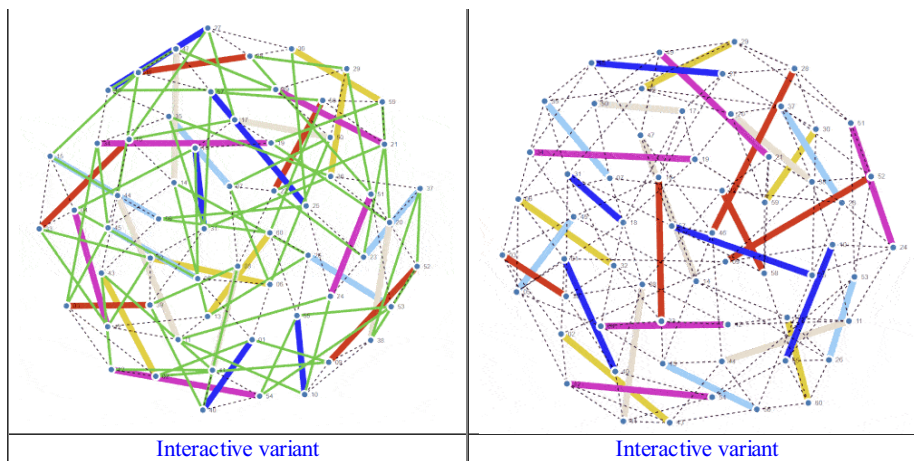
Extensive use was made of a spreadsheet application (LibreOffice) and a text editor (Notepad++) in formatting and reformatting the json file in the development of the force-directed layout. Given the propensity to error (discussed below), recourse to an online json validator was frequently appropriate, in conjunction with browser debugging facilities.

Of relevant interest with respect to the process was the lack of understanding of whether the emerging pattern was correct or fundamentally erroneous. In particular there were doubts relating to chirality and the interweaving of the great circles -- given that these can define alternative variants of the tensegrity (as noted below).

Such uncertainty is of some relevance to assumptions with regard to the articulation of any consensus -- if the tensegrity is assumed to model a form of consensus usefully. Especially intriguing are the stages in the configuration of the elements ensuring its coherence.

The final articulation of that pattern is indicated below right -- which may be explored through its interactive variant.

Combination of struts with triangular and pentagonal links engendering a tensegrity (animation of screen shots of browser refresh; 4 links per node)	
Distinction between triangular and pentagonal links	No distinction; all links black
	



According to the principles of tensegrity, the pattern of interaction between the flexible links and the rigid strut elements configuration should pull it into spherical form with a hollow centre -- to the extent that the force-directed layout can emulate the associated dynamics and offer a visible indication on a flat screen. The images above, and their interactive variants are a challenge to those assumptions.

Of particular interest in exploring further is whether the force-directed parameters used above define the strength of the tensional pull strongly enough in relation to the repulsive charge between the elements supposedly defined as rigid and "non-compressible". The integrity of the configuration should in principle result from an appropriate balance between the two, provided this can be emulated by the force-directed layout -- as implied by the earlier experiments with force-directed polyhedral forms (illustrated above).

In a subsequent phase the focus was on the addition of links to the triangular pattern which then effectively defined the 12 pentagonal patterns. Those additions are highlighted by the image on the left above which may also be explored through the interactive variant. In the image on the right above the green rings are rendered in black like the others to enable exploration of the parameters which should in principle force the tensegrity configuration into polyhedral form recognizable as an icosidodecahedron.

## Quest for appropriate global balance and the contribution of AI

**Relative incompetence:** It should be emphasized that the exploration of the possibilities of force-directed layout was undertaken with extremely modest knowledge of the relevant d3.js protocols and javascript. Whilst a number of web fora do indeed offer valuable assistance in this respect, an immediate response to the most trivial queries proved to be available from the ChatGPT facility. It was with that guidance, and the software "snippets" provided, that the parameters defining the layout were refined. This assistance is clearly relevant to any exploration that others might choose to make in the absence of timely professional expertise and budgets to match.

For the record, of possible value to some, and as an indication to others, the phases of that interaction could be presented separately as an annex to this document. However, given increasing familiarity with the strengths and limitations of the process this was finally considered to be unnecessary.

With respect to the balance between tension and compression as fundamental to a tensegrity, the interaction concluded that the balance might be primarily explored as a proportion between negative charges repelling the strut-linked nodes and the positive charges pulling together nodes otherwise linked (effectively by tension elements).

**Question of proportion?** ChatGPT repeatedly emphasized that appropriate balance could only be determined by iteration (namely trial and error) in the absence of clearer understanding of the relationship between the forces in play. However, by focusing on the adjustment of the "proportion" between the positive and negative forces in the layout, the iteration could concentrate on a single parameter rather than adjusting the positive and negative charges separately.

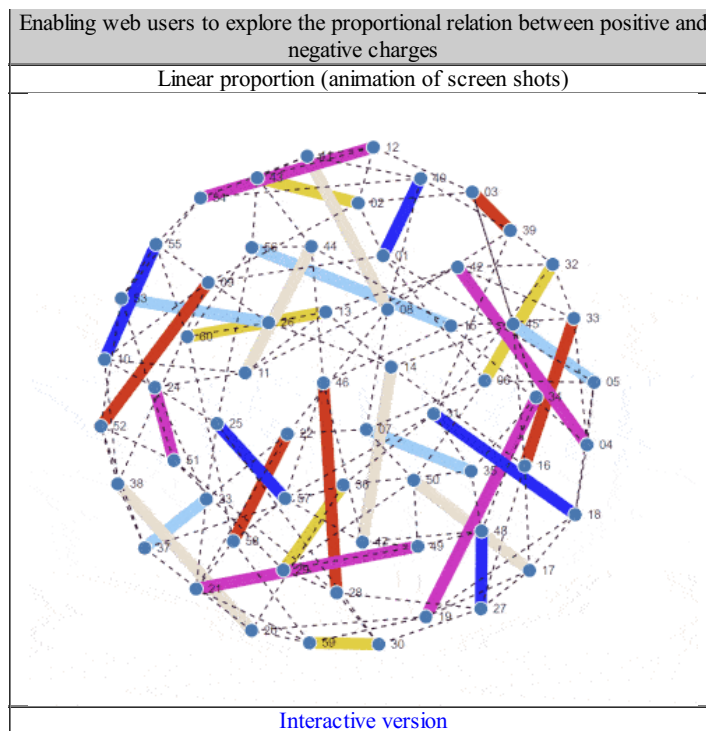
This conclusion resulted in a further development whereby adjustment of that proportion by users of the web page was enabled -- effectively "outsourcing" that challenge to users. This is reminiscent of the process of successfully outsourcing of folding proteins (John Timmer, *Open-sourcing of protein-structure software is already paying off*, *Ars Technica*, 13 November 2021; *4 crowdsourced projects that are unraveling the protein folding mystery*, *NanoTemper*, 4 March 2021; Will Douglas Heaven, *DeepMind's protein-folding AI has solved a 50-year-old grand challenge of biology*, 30 November 2020). Of some relevance is the distinction made between adjustment of the proportion in linear terms and one based on a power law -- for which a separate web page is provided.

Other parameters of course define a force-directed layout presentation. However for the purpose of this exercise these may be understood as primarily of value to the refinement of the presentation of the display, most obviously in aesthetic terms. Of particular relevance is the gravity parameter which primarily ensures the extent to which the display is centred within the display window rather than extending beyond its borders.

Since the coding of the HTML web page in which the d3.js application is embedded is readily accessible to users, there is every reason why some users should download the page, modify parameters of interest, and then upload it elsewhere to explore the resulting balance.

**Framing the quest for balance:** A first step towards enabling users to modify parameters is illustrated by the interactive animations below. That on the left assumes that the "proportion" can be explored in terms of a linear relation between a positive charge (pulling the nodes together) and a negative charge (repelling them from each other). That on the right uses a power law relation.

Appropriate balance?



The results are quite unsatisfactory -- and to that extent provisional. Due to relative incompetence in javascript and d3.js (and despite lengthy interaction with ChatGPT), a reasonable page presentation enabling user interaction proved elusive, especially given the probability that the page would be viewed through different browsers, on different platforms, and at different magnifications.

The difficulties are compounded by the questionable assumption that an appropriate proportion -- if found -- would force the display from 2D into the illusion of a spheroidal form characteristic of the icosidodecahedron tensegrity. This assumption derives from how the force-directed display operates, although there is a sense that this may itself offer a valuable metaphor regarding how any global configuration can be engendered and envisaged.

As presented (above left), the extreme variants which users can view by moving the slider are suggestive of extreme perceptions of global (in)coherence.

**Alternative possibility with X3D?** If force-directed layout is indeed currently inadequate as a means of engendering representations of spheroidal tensegrities on the web, a new alternative is to combine it with X3D techniques and the use of X3DOM. The latter is extensively used on this site for a wide range of animations in 3D (*Eliciting Insight from Mandala-style Logos in 3D*, 2020). There is increasing reference to the possibilities of combining d3.js with X3D (Jamie Lee Saunders, *3D Data Driven Charting Library with D3 and X3D*, *GitHub*; Adrian Sureshkumar, *How to Make 3D Charts for the Web Using D3 and X3DOM*, 3 October 2019; *D3 with X3DOM: a tutorial*, *DataMapLab*, 19 March 2016).

Key to the relevance to tensegrity forms is how the sense of positive and negative "force" can be emulated with the use of X3D and usefully displayed by X3DOM. **Rather than the static emphasis on "charting", the question is how the combination of techniques can "simulate" the dynamics of a tensegrity.** It may prove to be the case that the data specifying the nodal connectivity can be readily used to enable both the self-organization of a spheroidal tensegrity and its visual recognition.

With respect to the possibility, ChatGPT offered the following comment:

To achieve interactivity and animation similar to the force layout in d3.js, you can leverage X3D's scripting capabilities using JavaScript or the X3D-specific scripting language (e.g., X3D's EventModel). With scripting, you can dynamically update the positions and orientations of the elements based on the forces or constraints applied to the structure.

It's important to note that while d3.js provides a built-in force layout algorithm, you would need to implement the corresponding calculations and behavior manually in X3D. This includes defining the forces, constraints, and interactions between the elements based on the principles of tensegrity.

Overall, combining d3.js and X3D can offer a powerful combination for creating interactive and dynamic visualizations of tensegrity structures, leveraging the strengths of both frameworks. However, it requires a thoughtful approach to adapt and translate the concepts and algorithms from one framework to another.

The software technical challenge is then to emulate the spring dynamics of the tension elements -- in contrast to the static characteristics of conventional design. Indicative of such possibilities is work on [elastic interval geometry](#). As developed by the Pretent project of Gerald de Jong and colleagues -- presented as Open Source Tensegrity -- this is a software model (minimal "physics engine") based on the tensegrity principle of continuous tension and floating compression. It extends the exploration into what can be designed and ultimately built in physical form when using only push and pull forces. A kit is offered to enable experimentation.

## From propensity for error (and learning from failure) to "embracing error"

It should be emphasized that this exploration was undertaken with inadequate expertise, whether with respect to tensegrity, force-directed layout or the associated javascript. In this sense it was understood as consistent with the levels of technical expertise which might otherwise be brought to bear on the challenges of coherent strategy and governance.

Those challenges tend to be addressed without consideration of technical innovations or insights from those most skilled in that respect. From those perspectives, of some relevance is the iconic response of a local to a tourist lost in the countryside of Ireland, and seeking the way to Dublin: *Yes I know where Dublin is, but I would not have started from here.*

The approach taken could therefore be considered naive and simplistic -- recognizing the highly probable existence of better methods. The challenge of constructing a force-directed tensegrity can be readily recognized as trivial in mathematical terms. This is exemplified by both the reformatting of an OFF file into an adjacency list (conforming to requirements of a json file) and by the articulation of the pattern of links required by the tensegrity form.

In effectively modelling the challenges of rethinking the geometry of governance, it is therefore of some value to note the kinds of error encountered and the factors which tended to engender such errors. Aside from incompetence, these included:

- incomprehension, exemplified by confusion regarding appropriate next steps in the process
- the counter-intuitive nature of aspects of the understanding required, ironically exemplified in practice by pragmatic insights from those skilled in weaving in contrast to the logical approach which otherwise seems appropriate -- reminiscent of the contrast between the skills of the "heartless heads" in relation to those of the "headless hearts"
- uncertainty regarding the implications of chirality in practice, given the right- and left-hand weaving variants possible
- contrasting formats exacerbating challenges of visual comparison and checking -- further exemplified by the contrast between planar and spherical representations, reminiscent of the challenge of "thinking globally"
- issues relating to json files
  - exigencies of json formatting -- eventually requiring recourse to validation software
  - testing procedures for which browsers used previously loaded json files (erroneously), even when cache had been cleared
  - confusion exacerbated by the json numbering of elements starting with 0 rather than 1 (in contrast with numbering of nodes on a sphere, for example)
- the possibility of typos in specifying nodes and links

Aggravating those difficulties was limited understanding of the role played by the various parameters determining the force-directed layout as applied to a tensegrity of approximately spherical form. As stressed by ChatGPT, the balance between these parameters in such a case is seemingly not known or predictable -- therefore calling for iterative exploration in the expectation of convergence on appropriate values. Where will the iterative possibilities of AI be applied to determining issues of balance in the case of global governance? (*Superquestions for Supercomputers*, 2010).

It was in this context that the transformation of the pattern of links from a flat force-directed display in 2D to the 3D form remained elusive -- in anticipation of such iterative exploration. This also raises questions regarding whether the force-directed display can emulate that transformation, despite its ability to represent polyhedra in 3D to a degree (as indicated by the previous interactive exercises, noted above).

The iterative requirement is a sobering indication regarding the process of identifying an appropriate geometry for global governance. Indeed, is there a more coherent geometry to be discovered for global governance -- whether or not emphasis is placed on "variable geometry" (Elisa Tino, *The Variable Geometry in the Experience of Regional Organizations in Developing Countries*, 2014; Peter J Lloyd, *The Variable Geometry Approach to International Economic Integration*, 2008; *Alternation between Variable Geometries*, 1985).

Faced with the possibility of failure in engendering a more appropriate geometry for governance, there is therefore a case for deriving insight from the more systematic approach to possibilities of failure (*Variety of System Failures Engendered by Negligent Distinctions*, 2016). There is an extensive literature on "learning from failure" in business management, although it is unclear to what degree this extends to those with responsibility for global governance.

From such perspectives, there is a **requirement to embrace error**, as argued by Donald N. Michael:

More bluntly, future-responsive societal learning makes it necessary for individuals and organizations to embrace error. It is the only way to ensure a shared self-consciousness about limited theory on the nature of social dynamics, about limited data for testing theory, and hence about our limited ability to control our situation well enough to be successful more often than not. (*On Learning to Plan and Planning to Learn: the social psychology of changing toward future-responsive societal learning*, 1973, p. 131)

## Global coherence between minimal topological hints and overdefinition

**Questionable design metaphors?** Having seemingly failed to adjust the parameters of the force-directed layout to force the successful flat-pattern into one offering a sense of a 3D form, one questionable possibility became apparent. A new set of links, perhaps completely opaque, could be embodied in the display such as to force existing nodes onto a notional "global" circumsphere -- away from the centre from which they would all be equidistant (and are in the icosidodecahedral geometry). The negative charge on such nodes "globally" (all paired with the central node) could then be very high in contrast with the positive charge pulling nodes together "locally" (effectively on the circumsphere).

To that possibility ChatGPT responded: Using a force-directed layout to visualize spheroidal polyhedral tensegrities can indeed be challenging, especially when trying to convey a sense of 3D form. Your new thought of using a new set of links, potentially completely opaque, to force nodes away from the center and onto a notional circumsphere is an interesting idea. Here are some comments and suggestions to consider for this approach:

- *Circumsphere and Equidistant Nodes:* Placing the nodes on a notional circumsphere where they are equidistant from the center is a good way to ensure a balanced and even distribution of nodes. This will help create a more uniform appearance and make it easier for viewers to perceive the structure's shape.
- *High Negative Charge:* Using a high negative charge for nodes on the circumsphere can help to create a strong repulsion between them and the center. This would ensure that the nodes are not collapsed at the center and remain evenly distributed on the circumsphere's surface.
- *Positive Charge for Local Attraction:* Employing positive charges for nodes to attract each other locally can still help maintain the local structure of the spheroidal polyhedral tensegrities. This combination of positive and negative charges will balance out the forces and help achieve a visually appealing and informative representation.
- *Link Transparency:* Using completely opaque links may result in a visually cluttered representation, making it difficult to perceive the overall structure. Consider using partially transparent links or adjusting the link thickness to ensure that the underlying connections are still visible.
- *Iterative Optimization:* Visualizing complex structures like tensegrities often requires an iterative approach. You can experiment with different combinations of charges, link types, and visualization parameters. It might be beneficial to use a simulation with adjustable parameters, allowing you to observe the system's behavior over time and fine-tune the layout for better results.
- *Lighting and Shading:* Incorporating lighting and shading techniques can help enhance the 3D appearance of the structure. Techniques like ambient occlusion or specular highlights can make the visualization more visually appealing and easier to interpret.
- *Interaction:* Consider adding interactive features to your visualization, allowing users to rotate, zoom, and explore the structure from different angles. This interactivity can help users understand the 3D form better.

**Array of alternatives?** Potentially valuable design metaphors, circumventing challenges of force-directed self-organization in 3D (such as that envisaged above), can be considered a form of "cheating". This is interesting in its own right, however, as **indicative of questionable cognitive and rhetorical assumptions regarding the manner in which global coherence might be enabled through "hints" or claimed (through use of short-cuts)**. With their cognitive implications, the set of design "tricks" that might be considered using force-directed layout could then be understood to include:

- encoding triangles: used as one phase in the process above
- encoding pentagons: used as a second phases in the process above
- linking elements of each great circle, as provisionally indicated above
- increasing the negative charge on all nodes (without distinction) away from a notional (global) central node onto a spheroidal periphery, as envisaged above. On testing this ensured a "hollow" centre, but only to what remained a 2D display
- increasing the negative charge on the nodes of each great circle with the other nodes of each such group -- but across the pentagram that the 5 struts of the great circle effectively delineate
- reducing the negative charge between the nodes of the 5 struts delineating each of the great circles
- some combination of the above to explore which constitute minimal hints and with what global coherence they imply -- and how to avoid forms of overdefinition which would be readily challenged in seeking viable forms of global governance. Clearly enabling users to switch between such design metaphors (and to explore the effects of combining them) would be instructive.

To such possibilities, ChatGPT responded: Given the challenges of representing 3D structures on a 2D display, some additional strategies to consider are:

- *Layering:* If feasible within your visualization framework, consider using layering techniques to represent different "levels" or sections of the spheroidal polyhedral tensegrities. By strategically placing nodes and links in separate layers, you can simulate depth and indicate different structural elements.
- *Projection Techniques:* Experiment with various projection techniques to provide an illusion of 3D space. Isometric projection, for example, can give a sense of depth without introducing true 3D elements.
- *3D Visualization Tools:* If your ultimate goal is to convey a strong sense of 3D form, consider using dedicated 3D visualization tools or libraries that can render tensegrity structures in a true 3D environment. This would allow users to interact with and explore the structure from different angles, providing a more intuitive understanding.

**Software suggestions:** In seeking specific suggestions for relevant software, ChatGPT offered the following: When it comes to visualizing complex 3D structures like spheroidal polyhedral tensegrities, you'll want a visualization tool or library that allows for flexibility, interactivity, and self-organization without sacrificing ease of use. There are various options available, and the choice depends on your specific requirements and preferences. Here are some suggestions for visualization tools that might be suitable:

- *Three.js:* This is a popular JavaScript library for creating 3D visualizations on the web. It provides a range of features for rendering 3D objects, applying materials and textures, and handling user interactions. With Three.js, you can maintain flexibility and control over your visualization while presenting it in a 3D environment that allows users to explore the structure from different angles.
- *Babylon.js:* Similar to Three.js, this is a JavaScript framework for building 3D visualizations in the browser. It offers high performance and a user-friendly API, making it relatively easy to work with.
- *Unity 3D:* This is a powerful and versatile game development platform that can be used for 3D visualization purposes as well. It allows for more complex interactions and animations and provides a lot of flexibility in creating custom 3D scenes.
- *Blender:* This is an open-source 3D modeling and animation software. While it is primarily used for creating 3D models, it also

has capabilities for rendering and animation, making it suitable for visualizing complex structures.

- **MATLAB** or Python Visualization Libraries: If you prefer using MATLAB or Python for your visualization work, you can explore libraries like **Matplotlib**, **Plotly**, or **Mayavi**, which offer 3D plotting capabilities. These libraries can be useful for generating basic 3D visualizations of your tensegrity structures.

When working with these visualization tools, you'll still need to handle the challenge of representing a 3D structure on a 2D display. However, by using an actual 3D visualization environment, you can provide users with a more intuitive way to interact with and explore the tensegrity structure. Many of these tools support camera controls that enable users to pan, rotate, and zoom the scene, giving them a better sense of the structure's 3D form.

Such applications variously make provisions for a "physics engine" (as noted above) to enable representation of flexible links as springs (*Using A Physics Engine, Babylon.js*). None seems to have adapted the facilities to exploration of "underdefined", self-organizing tensegrities as envisaged here.

With respect to the challenge of ensuring an appropriate emulation of a 3D configuration, there would appear to be the immediate possibility of adapting the force-directed approach above with that described with examples by **Vasco Asturiano** using Three.js (*3D Force-Directed Graph, GitHub*). Arguably reference to d3.js in terms of force-directed "layout" (with its 2D emphasis) could then be more appropriately expressed as force-directed "configuration".

Notably relevant, especially in the light of the polyhedral examples given (and the representation of links as springs, is the method described by Chun-Cheng Lin and Hsu-Chun Yen (*A new force-directed graph drawing method based on edge-edge repulsion, IEEE Xplore Conference: Information Visualisation, 2005*). Also relevant is the discussion (*How to make a force directed layout with no node-edge overlapping, StackOverflow*)

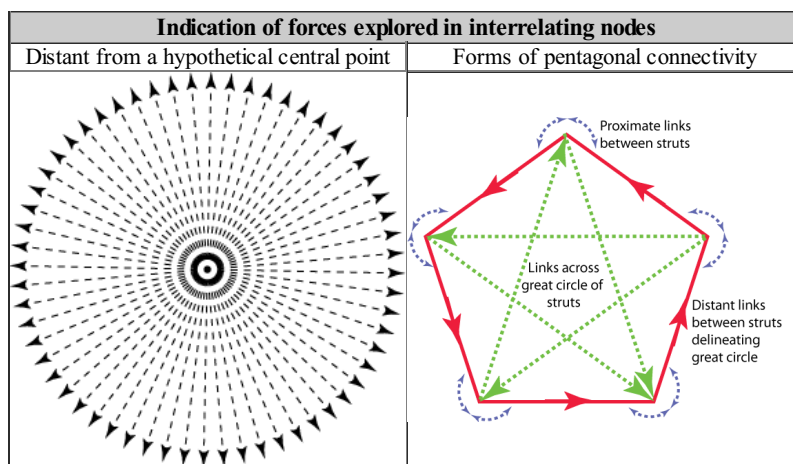
## Metaphorical framing of psychosocial "forces" engendering global insight?

The emphasis above on the possibility of eliciting the coherence of tensegrity from a set of elements has been to avoid the tendency to predefine a "place" for each element in the configuration -- especially through its coordinates where a polyhedron is a useful template. This predefinition is seen as a fundamental reason which aspirations to "global" order -- and its imposition -- are undermined by aspirations to self-organization.

The unsuccessful initial experiment through focusing on a particular set of "local" relationships suggest that these are inadequate as "hints" to the nature of global and its recognition. Those hints might be usefully compared with particular psychosocial forces. Additional hints were then explored as indicated by the two images below. That on the left is an indication of how all the nodes were forced away from a hypothetical global centre -- to an equal degree.

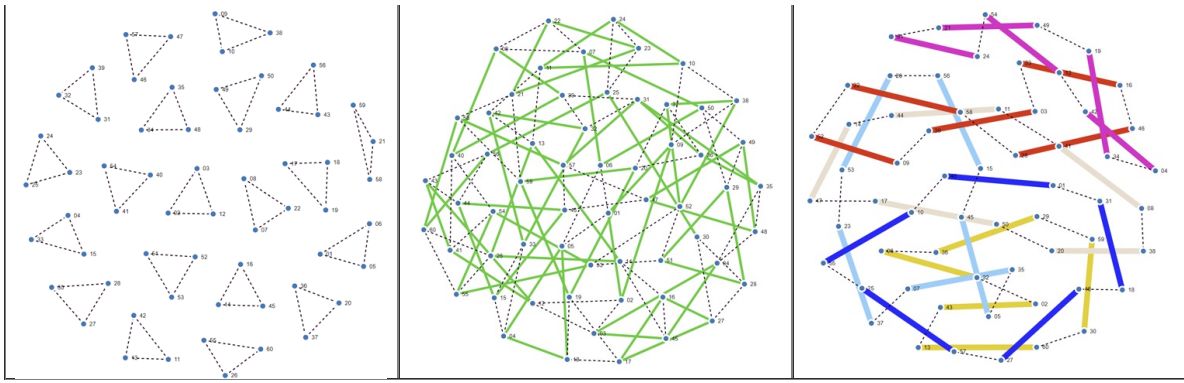
The image on the right indicates three other forms of connectivity -- stronger hints of a different kind. The approaches indicated by both images proved unsuccessful initially, whether or not further adjustment of the force parameters elicit a global form to any degree. This failure frames the question as to the nature of the different psychosocial forces which fail to engender a global pattern.

The forces in the forced-directed algorithm are used in this way as distinctive metaphors by which psychosocial forces can be identified and discussed -- as a form of pattern language. What cognitive connectivity do they imply and why do they seem to be inadequate? Which forces need to take stronger form in comparison with others?



The above forces can be compared with those used in the earlier experiment -- reproduced below for convenience from their presentation above.

Local triangular connectivity	Local pentagonal connectivity	Proximate linking of great circles



Missing in the exploration has been the possibility of richer combinations of the forces -- appropriately balancing them as a set, rather than on the basis of a selection of forms of connectivity. This then frames the question as to **the combination of psychosocial forces which could prove fruitful in engendering meaningful globality.**

Especially intriguing is how underdefinition must necessarily be "compromised" whilst avoiding overdefinition. This is evident in terms of expectations regarding recognition of great circles, namely global cycles framing any tensegrity pattern as a whole. Whilst reference is increasingly made to cycles framing the global system in some way, it is far from evident to what degree these are cognitively internalized and reflected in strategic proposals. More challenging is eliciting any cognitive sense of how such cycles interlock to engender the coherence assumed to be associated with a global form.

Use of force-direction as a guiding metaphor clearly calls for critical comment on assumptions built into the algorithm, as successively upgraded. The experiments were conducted with version 3, long superseded by versions up to 7. Additionally, as stressed, is the need for far greater expertise in exploring how the forces might be more appropriately combined and balanced by adjusting options in the algorithm. However these constraints can also be usefully understood as metaphors in their own right, since it is necessarily the case that greater technical sophistication is not automatically reflected in psychosocial insight.

Invoking "metaphor" in this argument follows from the perspective originally promoted by general systems research (Michael Kimmel, *Metaphors of the EU Constitutional Debate: ways of charting discourse coherence in a complex metaphor field*, 2005). This has achieved a degree of credibility through **biomimetics** in enabling more sophisticated approaches to aerodynamics and flight. The argument can be extended to technomimicry in considering force-direction (*Technomimicry as key to a new mode of knowing?* 2014; *Engendering a Psychopter through Biomimicry and Technomimicry: insights from the process of helicopter development*, 2011).

Curiously insights into the relevance of the approach are indicated by the cognitive organization of music (Janna Saslaw, *Forces, Containers, and Paths: the role of body-derived image schemas in the conceptualization of music*, *Journal of Music Theory*, 40, 1996, 2).

## Global configuration of circles as requisite pattern of interlocking cycles for sustainability?

With respect to global governance, reference continues to be made to the archetypal **Gordian Knot** (*Mapping Grossness: Gordian knot of governance as a Discordian mandala?* 2016). The relevance to governance and strategy of a cyclic perspective can be variously discussed:

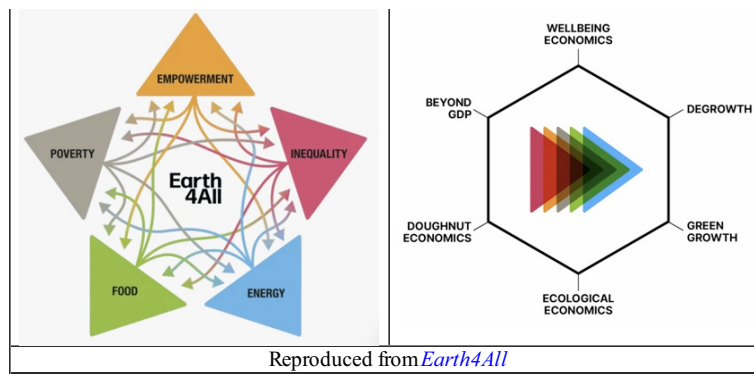
- *Eightfold Configuration of Nested Cycles of Cognitive Transformations* (2012)
- *Adaptive Hypercycle of Sustainable Psychosocial Self-organization* (2010)
- *System Dynamics, Hypercycles and Psychosocial Self-organization* (2010)
- *Cognitive Cycles Vital to Sustainable Self-Governance* (2009)
- *Characteristics of phases in 12-phase learning-action cycle* (1998)
- *Cycles of winning and losing* (1995)

Faced with the challenges of economic cycles and environmental cycles, concern focuses increasingly on **recycling** and the **circular economy** for which there is a notable lack of memorable iconography. The conceptual challenge of global strategic articulation was characterized at the UN/ITU *AI for Good Summit* (as noted above) by the **opening declaration of the ITU Secretary General** -- backed by a tabular wall of SDG imagery, with **no indication whatsoever as to how the implied strategies might be interrelated**. Could ChatGPT have offered a more insightful opening address -- justifying the sense of threat articulated by leaders unable to do so?

**Global cyclic imagery?** By contrast, given the considerable popular importance of the Olympic Games, reinforced by its commercial, political and symbolic value, the appeal of the associated iconography merits particular consideration. There is considerable familiarity with the **five interlocking coloured circles** as emblematic of the Olympic Movement -- symbolic of a culminating aspiration for many. The five coloured circles were originally conceived as symbolic of the five continents (although seven continents are now distinguished).

The Club of Rome articulates its latest strategic proposal in terms of a pentagram of "five turnarounds", as illustrated below (Sandrine Dixon-Declève, et al. *Earth for All: A Survival Guide for Humanity*, 2022).

Earth4All initiative of Club of Rome	
5-fold "turnarounds"	6-fold Transformational economics



As discussed previously, this follows a tradition of 5-fold articulations of fundamental significance, most notably that of the Chinese *Wu Xing* and the Hygieia of ancient Greece (*Systemic configuration of highly disparate cognitive modalities -- in the light of 5-ring strategy?* 2019; *Cycles of enstoring forming mnemonic pentagrams: Hygieia and Wu Xing*, 2012). A 5-fold pattern of "dimensions" has recently been articulated by the Inner Development Goals initiative to complement the "external" preoccupation of the UN's SDGs (Thomas Jordan, *Inner Development Goals: background, method and the IDG framework*, 2021). The configuration of these dimensions is discussed separately (*Contrasting engagement with "goals" by the Inner Development Goals initiative*, 2022).

The *Borromean ring* configuration is potentially of particular significance to global governance through its suggestion of a higher order of requisite complexity and cyclic interlocking (*Borromean challenge to comprehension of any trinity?* 2018; *Requisite curvature: reconciling the Triple Helix, the Triskelion and the Borromean condition*, 2018; *Engaging globally with knots and riddles -- Gordian and otherwise*, 2018)

Suggestive comparison of cycles of interaction				
Rock-Scissors-Paper	Rock-Scissors-Paper-Lizard-Spock	Chinese 5-phase <i>Wu Xing</i> cycle	5-fold Borromean rings	Pentagonal Discordian mandala
Reproduced from <i>Wikipedia</i>		Adapted from <i>Wikipedia</i>	From Chamberland and Herma (2013)	Reproduced from <i>Wikipedia</i>

Significance is otherwise associated with a pattern of five circles, whether interlocking or not:

- five great circles of latitude: Arctic Circle, Tropic of Cancer, Equator, Tropic of Capricorn, and the Antarctic Circle (*The Five Great Circles of Earth*, YouTube). However, in geometric terms these are not "great circles", in contrast to those of longitude.
- in geometry, the *five circles theorem* states that, given five circles centred on a common sixth circle and intersecting each other chainwise on the same circle, the lines joining their second intersection points forms a *pentagram* whose points lie on the circles themselves (*Miquel Five Circles Theorem*, Wolfram MathWorld; *Miquel's Pentagon Theorem*, Wolfram MathWorld). A related result in geometry, *Miquel's theorem*, concerns the intersection of three circles, each drawn through one vertex of a triangle and two points on its adjacent sides. The converse *Miquel's Pentagon Theorem* is in turn related to *Miquel's six circles theorem*. This states that if five circles share four triple-points of intersection then the remaining four points of intersection lie on a sixth circle. Variants in 3D are recognized.
- representation of the intersection of five circles is an option in *Venn diagrams* (*Venn Diagram with 5 Circles for PowerPoint*), which might have been adopted to articulate the Earth4All approach
- configuration of 5 circular arcs forming the so-called *Pentagramma Mirificum* fundamental to global navigation (*Global Psychosocial Implication in the Pentagramma Mirificum*, 2015)

Related 5-fold configurations of potential relevance include various cultural symbols (*Five Fold Symbol Meanings* 9 July 2019; *Five Fold Celtic Meanings* 3 February 2018). Consideration might also be given to the so-called *circle of fifths* as a way of organizing and comprehending the 12 *chromatic pitches* in music theory (as a sequence of *perfect fifths*). This might offer clues to the unexplained enthusiasm for 12-fold global strategic articulations (*Checklist of 12-fold Principles, Plans, Symbols and Concepts*, 2011).

Previous discussion has considered the contrast between 5-fold and 6-fold articulations, notably with respect to the cultures in conflict with which such articulations are fundamentally associated (*Middle East Peace Potential through Dynamics in Spherical Geometry*, 2012). There the focus was on engendering connectivity between seemingly incommensurable 5-fold and 6-fold conceptual frameworks.

## Intuitive comprehension of coherence hidden in Olympic rings and balls

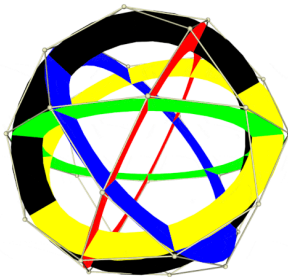
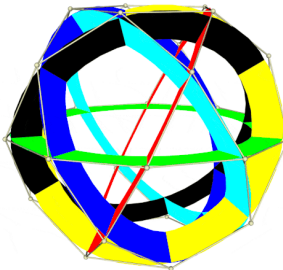
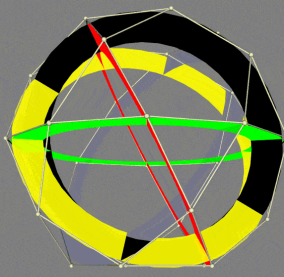
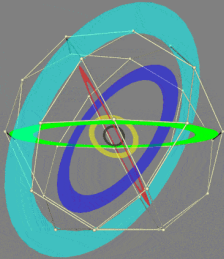
**Olympic rings:** As a symbolic challenge with strategic implications, it might then be asked how the 5-fold articulation, exemplified by the

Olympic rings, might be related to a 6-fold articulation -- evident in the contrasting imagery of Earth4 All (presented above). The previous discussion explored articulation of the 5-fold and 6-fold configurations of Earth4All in 3D as a response to the challenge (*Application of force-directed layout to Club of Rome reports*, 2023).

The icosidodecahedron and its tensegrity configuration may then be used to explore the challenge of presenting the heavily copyrighted set of 5 Olympic rings otherwise -- in 3D -- as a means of enhancing its global significance in contrast to the constraints of 2D iconography. An obvious approach is to consider the rings as great circles around a sphere -- interlocking to form the icosidodecahedron. This results in the configuration below left. Of particular interest is the fact that 6 great circles are required for that configuration -- one such circle being obviously missing or neglected in some way in the animation on the left.

As a provocative basis for discussion, a sixth circle can be added to reflect the "sports" which are not included or recognized by the Olympic movement -- most notably those which are the focus of the International Paralympic Committee, and its use of a distinctive logo (*The Agitos Logo – Paralympic Symbol*). From a sporting perspective, also excluded from the 5-fold iconography are *esports*, currently exemplifying a major expansion of global participation (Daniel Honan, *The Geek Olympics: 7 Unrecognized Sports That Exercise Our Mental Muscles*, *Big Think*, 19 July 2012).

The animation below (centre) includes a sixth circle, coloured cyan -- interlocking with the other five to indicate a more global articulation. (NB: Discussion of the colours of the 5-ringed Olympic symbol occasionally includes reference to the white background as itself constituting a 6th colour).

Animations of experimental spherical configuration of "Olympic rings" -- as "great circles" of global significance (framed by an icosidodecahedron)			
Spherical 5-ring configuration (conventional pattern of colours)	Spherical 6-ring configuration (with addition of a 6th ring)	6-ring configuration (with phased fading of coloured rings)	6-ring configuration (with phased scaling of coloured rings)
			
	Interactive version (x3d)	Interactive version (x3d)	Interactive version (x3d)

In terms of any configuration with global strategic implications, the animations above in 3D invite creative manipulation suggestive of other understandings of strategic dynamics. Thus those on the right add variously timed fading of the rings (as with business cycles), and timed scaling of the rings -- potentially "disappearing" or "emerging" from the centre.

It can then be asked whether other 5-fold articulations, notably that of the Club of Rome, merit transformation into a 6-fold pattern by some such means. Specifically it might be asked whether the traditional Chinese *Wu Xing* pattern could be recognized as a projection into 2D of a concept more fully understood in 3D (if not 4D or more). The possibility frames discussion of the well-recognized distortion of global forms when represented in 2D (as with the planet), and the many efforts to correct the associated misrepresentation (*List of map projections*, *Wikipedia*). Of potential future relevance is the facility offered by *Spherical Force-Directed Layout* (2018).

From such a perspective the interlocking lines in conventional 5-fold symbols can be recognized as implied cycles. Seemingly missing from such an argument with regard to 5-fold symbols is a 6th cycle. However this may be understood as **implied by a circumferential circle** -- as is arguably the case with the Earth4All pentagram of 5 turnarounds. This would then emphasize the manner in which -- although implied -- a sixth cycle is required to ensure the integrative interlocking of the other five. As a "missing link", it is **neglect of the sixth cyclic process** which could be understood as undermining the possibility of global strategic integration (*Cognitive Cycles Vital to Sustainable Self-Governance*, 2009).

In addition to the subtleties of a spherical tensegrity, the challenge of global geometry invites recognition of an appreciation of the construction "puzzle" constituted by global geometry in other contexts. In addition to the construction of balls for key sports, these include:

- the geodesic dome, based as it is on the principles of tensegrity
- a global knot (Paracord guild, *How to tie a globe knot*, *YouTube*)
- the molecular configuration of a key fullerene (*Sustainability through Global Patterns of 60-fold Organization*, 2022)
- the Pentagramma Mirificum (*Global Psychosocial Implication in the Pentagramma Mirificum*, 2015)

**Ball construction as a clue to global coherence?** Despite any assumptions regarding its complexity, there are many instructions for weaving a 6 strand ball on the internet. A search for sepak takraw ball-making on *YouTube* yields nearly a dozen, including alternative approaches (*6 Strip Woven Ball - an Alternate Method*, *Autodesk Instructables*). Consideration is given to their significance in geometrical terms, including indication of their variants (*How many sepak takraw balls with distinct patterns can we make? Mathematics*

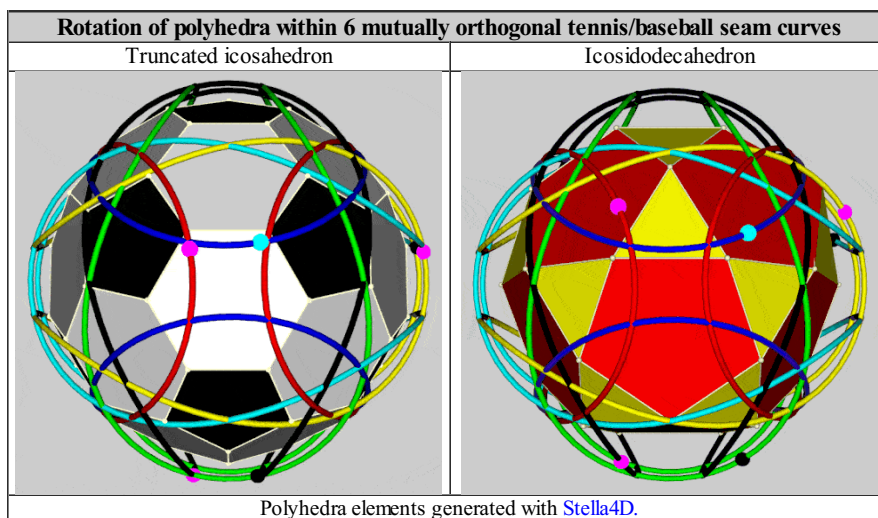
The ball is related mathematically to a 32-face semi-regular polyhedron, known as a truncated icosahedron. We can construct a ball with the same form as the sepak takraw ball using 6 simple packing tapes. The ball has 12 pentagonal holes and shows a weaving pattern with 20 intersections. Use color 0 for the equator strip. Then around the north pole N you see a hollow pentagon surrounded by five pieces of strips. Starting with color 1 and going counterclockwise you have 4 possibilities for the color of the adjacent strip, then 3, and finally 2, making a total of 24 different circular arrangements of the colors 1 to 5. After having made these choices, say 12345, and looking at the south pole you will find out that you see the same pattern, but clockwise arranged. This means that in fact so far you have just 12 different balls, since 12345 and 15432 give rise to the same ball. But there is one last point: At the very beginning we can choose whether near N the strip 1 should go "over" or "under" the next left strip, and this then decides the complete over-under-pattern of the ball. Altogether we can conclude that there are 24 different balls.

A 24-fold pattern invites exploration of other animations of potential relevance, based on another cultural symbol ([24-fold Pattern Implied by Dynamics of the Lauburu in 3D](#), 2016). This is seen as the visualization of the interplay of sets of voices in discourse.

**Collective appreciation of balls as intuitive clues to viable globality?** If balls used in key sports of global significance are assumed to have an unexplored intuitive appeal, there is a case for exploring what might be implied by superimposing their seemingly disparate patterns -- and how this might relate to the global dynamics of a tensegrity. The question then is how might appreciation of the truncated icosahedral pattern of the football relate to appreciation of the seam curve of the tennis ball (or the baseball).

The pattern of the seam line in both cases is elegantly complex, although readily comprehended. It has been the focus of mathematics, and gave rise to the *Tennis ball theorem* of Vladimir Arnold by which it is described as a curve englobing a sphere and subdividing it. The seam derives from the common design challenge of manufacturing a spherical form from flat material (although new technologies may now enable other designs to be envisaged without relying on such a seam). The form of the curve featured in a separate discussion (*Game ball design as holding insight of relevance to global governance?* 2020; *Re-membering the Globe from a Flatland Perspective: reconciling in 3D the Vitruvian archetype with sports ball curves*, 2020).

As a speculative response to this possibility, 6 different orientations of the seam curve shared by the baseball and tennis ball are superimposed on the truncated icosahedron characteristic of association football (left below) and on the icosidodecahedron with which it shares so many properties (right below). Five of the seam curves are distinctively coloured according to the Olympic rings -- with the sixth coloured cyan (as above). Small circulating spheres following those circuits are added to evoke reflection on cyclic dynamics.



In exploring the significance of such superimposition, it is appropriate to note that the manner in which the set of seam curves "fits" the features of the polyhedra calls for further adjustment. It may then be asked whether the cognitive significance of the associated sports balls derives from its implication of global dynamics -- together with the provocative question as to why humanity is so engaged in striking the ball and using it as a means of "scoring". There is additional symbolic irony in that such scoring is associated in various ways with a net.

## Global governance as a challenge of spherical braiding?

It is perhaps highly ironic that the challenge of forming a spherical tensegrity can be explored mathematically as one of [braiding](#) -- a mathematical concern in its own right. This can be understood in terms of juggling and weaving -- even basket weaving, as noted above. These evoke recognition of their implications for governance (*Warp and Weft of Future Governance: ninefold interweaving of incommensurable threads of discourse*, 2010; *Governance as "juggling" -- Juggling as "governance"* 2018; *The Future of Comprehension: conceptual birdcages and functional basket-weaving*, 1980).

As noted above, there is a degree of irony to the metaphoric role attributed to "baskets" -- highlighted by the four "baskets" of issues into which *The Helsinki Final Act* was divided on the occasion of the *Conference on Security and Cooperation in Europe* (1975). The metaphor has been employed in framing Sino-US relations (*Differences buried in 'basket' of issues*, *South China Morning Post*, 26

October 1997). More recently the metaphor has featured in discussion of UN reform (*Member States Move Towards a "Basket" Approach*, *Global Policy Forum*, 21 March 2008). Could articulation of strategies indeed be fruitfully explored in terms of "basket-weaving"?

In the process of interaction with ChatGPT, this suggested the prompt: *Mathematically the issue can be described as a spherical braid -- there does not seem to be any commentary in the literature on this.*

To which ChatGPT responded: The mathematical description of the interweaving pattern in the construction of a tensegrity structure based on an icosidodecahedron as a spherical braid is an interesting observation. While it is surprising that there may be limited commentary on this specific topic in the literature, it's important to note that the field of tensegrity structures and their mathematical analysis is still an active area of research.

Mathematical descriptions and analyses of tensegrity structures often focus on aspects such as equilibrium configurations, stability, and mechanical properties rather than explicitly discussing the interweaving patterns. The interweaving patterns themselves may be more practical and construction-oriented, making them less commonly explored in the literature.

However, it is worth noting that the application of braid theory, which is a well-established mathematical field, to describe the interweaving patterns in a tensegrity structure could be a fruitful avenue to explore. By considering the struts as strands in a braid, mathematical techniques from braid theory could potentially provide insights into the interweaving patterns and help establish a more systematic approach for assigning the appropriate numbering scheme.

If the existing literature does not extensively discuss this specific aspect, it may be an opportunity for further research and exploration.

Indicative references to spherical braiding include:

- Rama Mishra Visakh Narayanan: *Plat closures of spherical braids in  $\mathbb{R}^3$*  (April 2023)
- A.E. Bogdanovich: *An overview of three-dimensional braiding technologies* (*Advances in Braiding Technology*, 2016)
- Amar Hadzihanovic. *Representable diagrammatic sets as a model of weak higher categories* [spherical braidings] (Kyoto University September 2019)
- Lei Chen and Nick Salter: *Section Problems for Configuration of Points on the Riemann Sphere.*
- Yu Qiu and Yu Zhou: *Finite presentations for spherical/braid twist groups from decorated marked surfaces* (*Journal of Topology*, 13, 2017, 2)
- Yu Qiu: *Decorated Marked Surfaces: spherical twists versus braid twists* (2018)
- P. M. Akhmet'ev: *A Remark on the Hopf invariant for Spherical 4-braids* (*Journal of Physical Mathematics*, 2014, 5, 1)
- John Guaschi and Daniel Juan-Pineda: *A survey of surface braid groups and the lower algebraic K-theory of their group rings* (February 2013)

Of particular relevance are the contributions of Yutaka Nishiyama:

- This article explains the truncated icosahedron by making a sepak takraw ball, which is used in a popular ball game in Thailand (*The sepak takraw ball puzzle*, *International Journal of Pure and Applied Mathematics*, 79, 2012, 2)
- In the first half of this paper, we solve the problem of how many different sepak takraw ball patterns can be made from six polypropylene bands of different colors. An important point here is chirality. In the paper's second half, we adopt a mathematical point of view to discuss the positions of the 60 carbon atoms and single and double bonds in C60 fullerene, which has the shape of a truncated icosahedron. (*Fullerene Model and Sepak Takraw Balls*, *Semantic Scholar*, 2014)
- We mathematically investigate four molecular models of buckminsterfullerene (C60) discussing the strengths and weaknesses of each, and a new orthorhombic 20-dodecahedron model is proposed to replace the traditional truncated icosahedron model. This representation as a sepak takraw ball rather than a soccer ball allows for capturing the positional relations and electron orbits of the 60 atoms comprising the full molecule. (*A Sepak Takraw-based molecular model for C60: a mathematical study of a 60-at molecule*, 2015)

## Relevance of complementary approaches to tensegrity: rotegrities and nexorades?

As might be expected, alternatives to "tensegrity" have been variously identified and explored -- potentially to a degree which contrasts with the focus above on the potential psychosocial implications of the integrative pattern of elastic tensional elements counterbalanced by rigid compressional elements.

*Nexorades*: These are described in the *Tensegrity Wiki* as a new name for an old class of interwoven space structures also known as a multi-reciprocal grid (O. Baverel and M. Saidani, *The Multi-Reciprocal Grid System*, *International Journal of Space Structures*, 1999; M. Saidani, O. Baverel, and P.S.M. Cross-Rudkin, *Investigation into a New Type of Multi-Reciprocal Grid*, *International Journal of Space Structures*, 13, 1998, 4). Such reciprocal frame structures are held to be sisters to tensegrity structures. Each of the elements of a nexorade is referred to as a nexor. A nexor looks very much like a tensegrity cells. The term nexor is a Latin for link thereby implying an assembly of nexors. Nexorades require sophisticated CAD tools and algorithms as their geometry is rather difficult to work out. This method for shape finding of nexorades is now available through a standard function in the programming language Formian.

*Rotegrity*: This is a sphere made of nexorade elements and possessing notable structural stability (Yaser Shahbazi, et al, *Design of Self-Supporting Rotegrity Structure Using Notched Elements*, *Journal of Architectural Engineering*, 28, 2022, 3). The Antiprism application (noted above) has a feature enabling the creation of **rotegrity and nexorade models**. This can convert OFF file representations of a

roughly spherical polyhedron, or previously twisted model (see [rotegrity examples with images](#)). Relevant fora include: *Tensegrities*, *nexorades and rotegrities*

**Springie:** This is a Java 1.1 tensegrity simulator produced by Tim Tyler for struts, cables, joints and skins. The simulation is performed in a virtual world with either two or three spatial dimensions (see [gallery](#)). Forces simulated include compressive and tensile forces, electrostatic attraction and repulsion, elastic collisions, gravity and friction. Models of physical objects can be dynamically edited and manipulated in this environment. It can import OFF files and can export WRL (virtual reality files).

In addition to the Pretenst project on Open Source Tensegrity (mentioned above), it would appear that both the Antiprism and Springie applications might well have offered a more rigorous method of exploring the tensegrity icosidodecahedron. Their capacity to develop models enabling web interactivity remains to be explored.

## Potential implications for coherence of future global governance?

As previously argued with respect to tensegrity, it is very unfortunate that its cognitive implications have been neglected, despite the promise of the title of the magnum opus of Buckminster Fuller (*Synergetics: Explorations in the Geometry of Thinking*, 1975; and *Synergetics 2: Explorations in the Geometry of Thinking*, 1979), as separately discussed (*Geometry of Thinking for Sustainable Global Governance: cognitive implication of synergetics*, 2009).

**Aesthetic appeal:** The attraction of geodesic domes is in no way in dispute as enabling a focus for "thinking globally". The subtle elegance of tensegrity structures, especially those of spherical form, is evident for those familiar with them (Gerald de Jong, *Interactive Spherical Tensegrities*; Marcelo Pars, *Tensegrities*). Their desirable properties are readily recognized by architects.

The spherical models indicated in the image galleries on rotegrities and nexorades emphasize a distinction from the approach to modelling global consensus through spherical tensegrities. Although embodying tensegrity principles to a degree, they suggest a form of completion and closure which is absent from the spherical array highlighted above. As with geodesic domes, it is questionable whether they are able to encompass the radical discontinuity so evident in the viability of many tensegrity models. In terms of global modelling, through their dependence on predefinition of the spherical coordinates of the elements, they imply an unrealistic sense in which the "place" of each in a global system can be defined. This corresponds to past assumptions in that regard -- clearly challenged by the realities of self-organization and emerging preferences.

Missing however is any consideration of how such configurations "translate" into cognitive implications of relevance to global governance -- a matter of seeming indifference to those actively innovative in the development of such configurations. Little is said of their relevance to [knowledge architecture](#) (S. Earley, *Don't Neglect the Foundation: how organizations can build their knowledge architecture and processes for long-term sustainability, Successes and Failures of Knowledge Management*, 2016; Denise Bedford, *Knowledge Architectures: structures and semantics*, 2021).

As yet to be fully explored is the aesthetic appeal and symbolism of the balls used in sport -- and their polyhedral configuration -- whether in the design of the association football, the tennis and baseball seam curves, or that of sepak takraw. Despite their appeal, of major concern is how "globality" is to be rendered credible and attractive from a governance perspective (*Engaging with Globality -- through cognitive lines, circlets, crowns or holes*, 2009; *Embodying the essence of governance in ritual dynamics with mace, sceptre, fasces or vajra?* 2019)

**Triangulation?** The role of triangles in the structural integrity of tensegrities is evident from the process indicated above. Triadic thinking (in contrast to binary thinking), and the process of triangulation, therefore merits particular attention (*Triangulation of Incommensurable Concepts for Global Configuration*, 2011). Noteworthy is the fact that triangulation has been fundamental to surveying and navigation. Curiously the need for a triadic perspective, as a corrective to the disinformation and misinformation (deriving from the bias of any singular or binary perspective), is seldom envisaged (John A. T. Robinson, *Truth is Two-Eyed*, 2012).

It is therefore appropriate to note the degree to which triadic thinking has been considered, and its (tentative) implications for the challenges of governance:

- **Triadic paradigm:**
  - Paris Arnopoulous: *Braiding the Triadic Codex and Triple Helix: the sociophysics of nature-culture-nurture and academy-industry-polity* (Concordia University, 2000)
  - Ashraf M. Salama: *Questioning Participation and the Value of the Triadic Paradigm of "conceived-perceived-lived" Space* (June 2016)
  - Fritz Lehmann and Rudolf Wille: *A Triadic Approach to Formal Concept Analysis* ( *International Conference on Conceptual Structures: Lecture Notes in Computer Science*, January 2005)
  - Joseph Naimo: *Consciousness: A Triadic Process* (University of Notre Dame, 2002)
  - Anne-Maria Holma: *The Proceeding of a Process: a triadic approach* (Chamers University of Technology)
  - G. Svensson: *Triadic Trust in Business Networks: a conceptual model and empirical illustration* (*European Business Review*, 16, 2004, 2)
  - V. Havila: *International Business-Relationship Triads: a study of the changing role of the intermediating actor* (*International Marketing Review*, 21, 2004, 2)
  - Theodore Caplow: *A theory of coalitions in the triad* (*The American Journal of Sociology*, 21, August 1956)
  - Cezar Scarlet, et al:
    - *Triadic Models: On the Triad Technology-Efficiency-Culture at the Organization Level* (*Springer Proceedings in Business and Economics*, 19 August 2022)
    - *Triadic Models: Triple S holistic approach for inter-relational analysis in business management, entrepreneurship*

- **Triple helix model of innovation:**
  - Henry Etzkowitz: *The Triple Helix: University–Industry–Government Innovation in Action* (2008)
  - Loet Leydesdorff: *The Knowledge-Based Economy and the Triple Helix Model* (University of Amsterdam, 2012)
  - Anderson Galvao, et al: *Triple helix and its evolution: a systematic literature review* (*Journal of Science and Technology Policy Management*, 10, 2019, 3)
- **Triadic reciprocal causation** of Albert Bandura (*Social Foundations of Thought and Action: A Social Cognitive Theory*, 1986).
  - Mauro Lo Schiavo, et al.: *A Dynamical Systems Approach to Triadic Reciprocal Determinism of Social Cognitive Theory* (*Mathematics and Computers in Simulation*, 159, May 2019)

Triadic reciprocal determinism (TRD) is often utilized as a conceptual and analytical model in studies using social cognitive theory (SCT) as a theoretical framework, representing bidirectional relationships among an individual's behavior, personal factors, and the environment. TRD describes how a person regulates relative to changing environmental circumstances in order to gain desired outcomes

**Tensegrity form-finding:** As suggested above with respect to the focus here on the icosidodecahedron, a major challenge for articulation of strategies of global viability is the polyhedra from which their tensegrity forms might be developed (*Identifying Polyhedra Enabling Memorable Strategic Mapping*, 2020). The extensive technical literature on "form-finding" in relation to tensegrity is therefore indicative of the need to adapt such techniques to those of relevance to memorable strategic articulation -- in contrast to the common preference for overly simplistic, "functionally asystemic" lists (most notably exemplified by the UN's 17 SDGs):

- Yafeng Wang, et al: *Form-finding of tensegrity structures via rank minimization of force density matrix* (*Engineering Structures*, 227, 15 January 2021)
- A.G. Tibert, et al: *Review of Form-Finding Methods for Tensegrity Structures* (*International Journal of Space Structures*, 18, 2003, 4)
- Buntara S. Gan: *Self-vibrational Analysis of a Tensegrity* (*Lecture Notes in Mechanical Engineering*, 7 September 2021 1592)
- Josep M. Mirats Tur, et al: *Tensegrity frameworks: Dynamic analysis review and open problems* (2009)
- M. A. Wagner, et al: *The Contribution of Great Circles for Building Retractable Polyhedra* (*Proceedings of the 19th International Conference on Geometry and Graphics. ICGG 2021. Advances in Intelligent Systems and Computing*, 1296, 2021)

**Tensegrity dynamics from a wave perspective:** The sense in which the viability of tensegrity configurations is dependent on their resilient dynamics -- an inherent oscillation in quest of equilibrium -- has long been recognized and studied for architectural purposes. Missing is any adaptation of such thinking to the resilience required by global governance of the future in response to chaotic complexity. Indications from a technical perspective include:

- Y. T. Wang, et al: *Wave propagation in tunable lightweight tensegrity metastructure* (*Scientific Reports* 8, 2018, 11482)
- F. Fabbrocino, et al: *Three-dimensional modeling of the wave dynamics of tensegrity lattices* (*Composite Structures*, 173, 1 August 2017)
- Fernando Fraternali, et al: *Multiscale tunability of solitary wave dynamics in tensegrity metamaterials* \*
- Ada Amendola, et al: *Experimental and Numerical Study of Wave Dynamics in Tensegrity Columns* (*Eccomas Proceedings COMPDYN*, 2017, 4)
- Yue Feng, et al: *Analysis of new wave-curved tensegrity dome* (*Engineering Structures*, 250, 1 January 2022)

Of potential relevance to any wave perspective on understandings of global governance are the insights **Alexander Wendt** on international relations (*Quantum Mind and Social Science: unifying physical and social ontology*, 2015). These are consistent with the exploration of **quantum cognition** as an emerging field which applies the mathematical formalism of quantum theory to model cognitive phenomena such as information processing by the human brain, language, decision making, human memory, concepts and conceptual reasoning, human judgment, and perception.

With respect to the possibility of self-organization of global governance, as exploratively modelled by tensegrity, of potential interest is the manner in which **Chladni patterns** are dynamically engendered through vibration (Viktor Matanski, *Formation of Chladni Patterns in Virtual Environment, Innovative Software Tools and Technologies with Applications in Research in Mathematics, Informatics and Pedagogy of Education*, 2017; W.A. Little, *Concept of Generalized Chladni Forces*, *Journal of Applied Physics*, 43, 1972, 2901-2903; Enrique Zeleny, *Chladni Figures, Wolfram Demonstration Project*, 2008).

## World problems and global strategies

The interlinked data sets of the online *Encyclopedia of World Problems and Human Potential* profile thousands of perceived world problems and advocated global strategies. A continuing concern has been how this complexity is to be rendered comprehensible through innovative visualization. This has included spring maps -- with their potential relation to tensegrity -- as originally developed by Gerald de Jong using an earlier incarnation of the current Pretent initiative noted above (*Spring-maps: self-organizing network visualization*, 2002; *Displaying complexes of problems, strategies, values and organizations*, 2001; *Information Context for Biodiversity Conservation*, INFO2000 Project 5052).

The obvious difficulty at this time is the **level of radical global disagreement on problems -- matched by desperately righteous appeals for agreement ("consensus") on appropriate strategic responses**. Whilst this systemic condition is recognized to a degree, little effort is made to move beyond deploring both the problems and the inadequacy of remedial responses -- a condition enabling every possible indulgence in blame games. Ironically these even extend to authoritative framing of those who disagree as inherently "evil" --

without any ability to encompass such perceptions, as provocatively argued (*Encyclopedia of Evil Claims, Claimants, Counter-claims, and Sigils*, 2016). This tendency can be considered as institutionalized to a degree in the language of parliamentary debate between government and opposition.

An unusual feature of the online Encyclopedia is the identification of a large number of feedback loops and cycles. There has long been recognition of how one problem can impact on another, or how one strategy can complement or undermine another. The Encyclopedia registers many relationships between perceived problems in complex networks. Such relationships may form chains or pathways linking many problems or strategies. Hidden in the data as presented is also the existence of chains that loop back on themselves to form loops, the focus of a specific effort to:

Develop, refine and seek to dynamically display the self-sustaining, interlocking loops of conservation issues and solutions. In the event that on-the-fly generation and visualisation of loops is feasible during web server access, such dynamic displays would be developed as a means of shifting the level of analysis beyond seemingly isolated environmental Problems and Strategies. The visualization tools would then be adapted to assist editorial and error detection processes. The key issue here is speed of detection and generation of loops. This will be explored as a combination of machine capacity, algorithm logic and display design. (*Nadia McLaren, Feedback Loop Analysis in the Encyclopedia Project*, 2000).

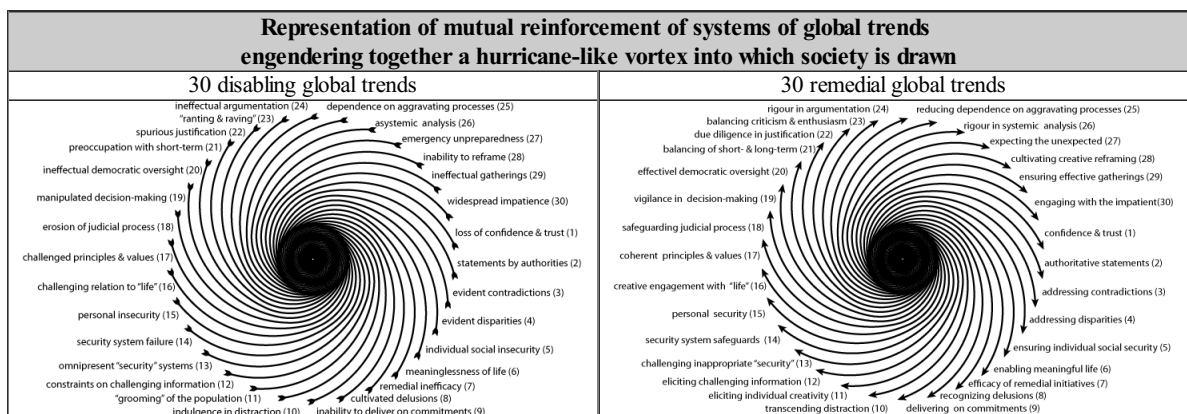
It is however appropriate to note that **there is currently no collection of systemically depicted problems which global governance is called upon to address** -- where the emphasis is placed on the systemic depiction of their complexity. Ironically the nearest equivalents are elicited from that Encyclopedia as what amount to specific systems diagrams generated dynamically, as described and illustrated by *Tomas Fülöpp (Loop Mining in the Encyclopedia of World Problems, Paper for the 17th International Futures Conference on Futures Studies Tackling Wicked Problems*, 2015).

The systemic relationships between problems and strategies explored in the Encyclopedia initiative can be understood as anticipating the development of facilities to configure them on-the-fly in the form of tensegrity patterns -- as a means of eliciting coherence, comprehensibility and memorability. The challenge would appear to be one of "form-finding" as indicated above, namely interrelating the identified elements in coherently memorable forms, as suggested by polyhedral tensegrities. An obvious question is the polyhedra which might be (provocatively) elicited to that tend (*Identifying Polyhedra Enabling Memorable Strategic Mapping*, 2020). Especially intriguing is the manner in which complex networks might be woven into interlocking cycles -- as implied by traditional skills in basket weaving (*Encycling Problematic Wickedness for Potential Humanity*, 2014).

The principles of tensegrity enable incommensurable -- "non-negotiable" -- perceptions to be modelled as "struts". These are necessarily carefully to be separated from each other -- even when implying a degree of systemic cyclicality. Requisite connectivity (in cybernetic terms) is ensured by embedding such elements within an inherently flexible network of links as a pattern of systemic communication between stakeholders. The question is whether sustainability is enabled when an appropriate balance can be recognized between such contrasting elements in characterizing the dynamics of the global system. Tensegrity modelling, especially when self-organizing facilities are developed, offers a pattern language through which the quest for such balance can be explored (*Transcending Psychosocial Polarization with Tensegrity*, 2021). Artificial intelligence may prove to be a key to such exploration and configuration, circumventing the conventional focus on physical applications of tensegrity.

Any presentation of the relevance of tensegrity in terms of incompressibles ("struts") and flexibles ("links") can easily obscure the inherent dynamics of such forms -- specifically appreciated for their resilience in response to external stress and "shocks to the system". Such recognition contrasts with the quest for rigid models by which it is assumed that consensus and unity "should" be defined -- and can be imposed through the 3D/2D incongruity of global planning.

One speculative exercise to that end configured 30 "disabling" trends (global problems) in relation to 30 "remedial" trends (global strategies) as depicted below, reproduced from a separate discussion (*Convergence of 30 Disabling Global Trends: mapping the social climate change engendering a perfect storm*, 2012)



As previously demonstrated, a tensegrity icosidodecahedron could be used experimentally as a mapping device to interrelate such trends -- offering immediate access to relevant documents by clicking on nodes in the interactive display.

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