Global Coherence by Interrelating Disparate Strategic Patterns Dynamically

Topological interweaving of 4-fold, 8-fold, 12-fold, 16-fold and 20-fold in 3D

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References

The following presentation follows from discussion of the Coping Capacity of Governance as Dangerously Questionable: recognizing assumptions and unasked questions when facing crisis (2019), and specifically from the closing section (From disorderly "collapse" to orderly "renaissance", 2019). The focus there was on exploring mnemonic aids to comprehension of 16-fold patterns, as exemplified by the 16 binary truth functions, but characterized by a wide range of other uses of 16-fold patterns, whose potential relationships appear to merit attention with respect to governance (Deprecation of potential correspondences: 16-fold patterns? 2019).

Any 16-fold pattern is a provocative challenge to comprehension, given the constraints on human capacity with respect to the complexity of any such pattern as a whole (Conceptual clustering and cognitive constraints, 2014). This is especially the case when such a pattern is used by the United Nations to frame an overriding strategic preoccupation for global governance -- with an explicit call for widespread credibility. The challenge is all the greater when 16-fold patterns are upheld by physics as of fundamental significance to the organization of reality and by logicians to the distinction in discourse between truth and falsehood.

How is the imposition of strategic patterns beyond average comprehension capacity to be interpreted? Who has a cognitive grasp of such patterns as a whole -- with an ability to remember all their elements? Does the situation bear comparison with a cognitive analogue to the Peter Principle -- promoting the requirement for comprehension beyond the competence for such comprehension? Is this then related to the so-called "Belgian Compromise" -- with complex issues being settled by conceding something to every party concerned, through an agreement that is usually so complicated that nobody completely understands all its implications? Faced with such deliberately manipulative patterning complexity -- a form of global "cognitive violence" -- should individuals then explore for themselves what might be termed Personal Globalization (2001)?

The challenge to comprehension of logical connectives was presented in the introductory paper as relating to both a mapping of the 16-fold pattern of the standard model of particle physics and to that of the 16-fold pattern of the United Nations Sustainable Development Goals (SDGs). The assumption made is that there are well-recognized fundamental constraints on human ability to comprehend patterns of coherence. There are qualifiers in topological terms to recognition of 16-fold, exemplified by the Higgs boson (a 17th particle in the standard model), and by the 17th SDG (coordinating the other 16). It was suggested that both cases are characterized by their elusive nature. Variants of such "qualification" are evident with respect to the pattern of logical connectives.
The polyhedron identified as of particular interest to any such mapping was the so-called "simplest torus" (12 sides, 16 vertices, 28 edges), and more specifically its dual (16 sides, 12 vertices, 28 edges). The 16-fold pattern also recalls that of the Earth Charter (as it emerged from Agenda 21) and presumably influenced the configuration of both the 16 (+1) SDGs and the 8-fold pattern of the UN Millennium Development Goals. The simplest torus also has 8-fold features.

Also of interest are the 12-fold features of that form, given their relevance to previous explorations (Checklist of 12-fold Principles, Plans, Symbols and Concepts: web resources, 2011; Clarifying the Unexplored Dynamics of 12-fold Round tables: visualization of patterns of sustainable discourse between 12 systemic archetypes, 2019; Eliciting a 12-fold Pattern of Generic Operational Insights: recognition of memory constraints on collective strategic comprehension, 2011). These can be discussed in relation to the 12-fold pattern of the Flag of Europe (Experimental Visualization of Dynamics of the European Parliament in 3D, 2019).

Of further interest are the 20-fold features evident in the first stellation of that toroidal polyhedron, given previous discussion with respect to that pattern (Requisite 20-fold Articulation of Operative Insights? Checklist of web resources on 20 strategies, rules, methods and insights, 2018; Memetic Analogue to the 20 Amino Acids as vital to Psychosocial Life? 2015). Of potential relevance is the 40-fold organization of Agenda 21 and that of a recent 40-segment strategic report to the Club of Rome, as reviewed separately with possible polyhedral mappings (Exhortation to We the Peoples from the Club of Rome, 2018).

With the focus here on mnemonic aids to comprehension, the question is what kinds of "stories" can be elaborated with regard to the intertwining of these patterns in a toroidal form with unusual properties suggestive of helical organization. These are reminiscent of both the paradoxical Möbius strip and current preoccupation with the Triple Helix model of innovation. More provocative, but of significance to far wider comprehension, is the sense in which the toroidal form in 3D can be seen as implying an expanded variant of what is appreciated in the conventional 3x4 patterns of the triplicities and quadruplicities of the zodiac in 2D. However, potentially far more provocative, is the manner in which the form is reminiscent of the NATO logo, as previously discussed (Envisaging NATO Otherwise -- in 3D and 4D? Potentially hidden faces of global strategy highlighted through polyhedra, 2017).

The possibility of mapping the 16-fold standard model of particle physics onto such a form is intriguing in the light of the cognitive integrity it would then exemplify to a higher degree than in its tabular form. As with the other 16-fold patterns, of further interest is the extent to which the relationship between the elements are then understood dynamically rather than statically -- forming some analogue to a resonance hybrid (Configuration of alternatives as a resonance hybrid, 2008).

Current relevance of the "simplest torus"?

From the perspective of logical geometry, as noted previously, the 16 Boolean connectives are reduced to 14 -- enabling them to be configured on the vertices of a rhombic dodecahedron. Given the apparently fundamental significance of 16-fold patterns, whether in that respect, or in the standard model of particle physics, there is a case for exploring what polyhedra might be suitable (if only for mnemonic purposes) to display such a pattern -- rather than as a checklist, a matrix or in tabular format. Potentially this is of relevance to the 16 (+1) Sustainable Development Goals by which global governance is purportedly framed at this time. NB: For convenience, this introductory section is reproduced from the conclusion of the more extensive previous discussion.

It is therefore of interest to note what has been termed the "simplest torus", together with its dual -- as shown in the following animations. The dual appears not to have been named, although it bears a degree of relationship to what has been named as a star torus (itself distinct from the preoccupation of astronomers with the possibility of a "toroidal star" and toroidal magnetic fields). The dual, as explored through its variants below, could well be more appropriately named as a star torus.

Of particular interest is the less than obvious notion of "face" in each case, since some faces have two seemingly separate components when passing from inside the model to outside, or being contiguous (but not separate as appears). This is most evident from the colouring of the faces in both models. Each "double" face exhibiting such characteristics is coloured the same -- although parallel faces across the model may use the same colour. This confusing characteristic is clearest in the case of the simplest torus, rather than its dual.

These unusual forms then raise the question as to how they may be used to map 16-fold patterns, rather than the 14-fold discussed above. Most obviously, in the absence of any mapping worthy of the challenge to governance in the case of the 16 Sustainable Development Goals, what valuable counter-intuitive meaning is derived from the use of mapping surfaces which have an "inside" and an "outside" -- with such faces being continuous within the model (despite appearances). An initial attempt to apply the standard thumbnails for each of the 16 Goals to the relevant surfaces in the dual model proved problematic with the application package. Appropriately perhaps, the image was reversed when slid across the face from "outside" to "inside", for example.

<table>
<thead>
<tr>
<th>Rotation of simplest torus (faces visible and transparent)</th>
<th>Rotation of dual of simplest torus -- a &quot;star torus&quot; (faces visible and transparent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(16 vertices and 12 faces: 4 hexagonal, 8 square)</td>
<td>(12 vertices and 16 faces: 8 triangular, 8 square)</td>
</tr>
</tbody>
</table>

Animations prepared with Stella Polyhedron Navigator
A further clarification, using the thumbnail images of the 16 Goals, suggested the mapping in the following animations. Here it is to be noted that 2 opposing clusters of points (of the 4) are each used for 8 such mappings. The 2 intermediary clusters of points have faces which are extensions of those on the other 2 (as indicated by the similar colouring of the faces). As before, parallel faces are of the same colour. The thumbnails images are arbitrarily oriented. The inner surfaces of the torus do not seemingly have any images on them -- since those faces are an extension of those visible on the outside. These various subtleties invite recognition of the subtler relationships between the Goals and alternative mapping conventions -- perhaps with the images shifting between positions of the surface.

| Animations showing experimental mapping of 16 UN Sustainable Development Goals onto 16 faces of dual of "Simplest Torus" (with 12 vertices) |
| "Vertical" rotation | "Horizontal" rotation |
| ![Vertical Rotation Animation](image1.png) | ![Horizontal Rotation Animation](image2.png) |

Animations prepared with Stella Polyhedron Navigator

Note: In exploring variants of the "star torus" in what follows, there is a distinction to be made from a variant form of self-crossing toroidal polyhedra, namely what are more widely recognized as crown polyhedra (or butterfly polyhedra). Also termed a stephanoid, this is a toroidal polyhedron which is also noble, being both isogonal (equal vertices) and isohedral (equal faces). Crown polyhedra are self-intersecting and topologically self-dual. The construction of crown polyhedra is possible if prisms or antiprisms are used as a base -- the vertices of which are connected by the edges of crossed quadrilaterals, as discussed further below. Examples are given by Ulrich Mikloweit (Facetings of uniform polyhedra with crossed quadrilaterals, Polyedergarten). The models shown there were created by the same software used in the above animation.

### Clarifying subtle complexity and a necessary "cognitive twist"

Especially in the case of the dual of the "simplest torus", the animations and colouring above do not make fully clear the subtle complexity of the model. This can be explained more clearly with the following variant which is coloured somewhat differently.

| Animations of experimental colouring of 16 faces of dual of "Simplest Torus" -- a "star torus" (with 12 vertices, 28 edges, 16 faces) |
| Faces non-transparent | Faces transparent |
| ![Non-transparent Colouring Animation](image3.png) | ![Transparent Colouring Animation](image4.png) |

Animations adapted from Stella Polyhedron Navigator using X3D-Edit

The following assumptions are made in colouring the faces on the left:

- the faces coloured yellow and green are each understood as continuous in the following sense:
  - although not obvious, the two seemingly distinct faces converging to meet at a single white vertex in fact constitute a single face in the geometry of the form (4 yellow and 4 green)
  - the white vertex at their junction derives from the first stellation and is not present in the base model (see above, nor is the white edge linking such vertices)
  - this raises interesting questions for mapping purposes as to how the apparently separate faces are to be understood as continuous through a vertex
- the faces coloured blue and red (on the sides) raise a different issue:
  - where they appear to intersect on the outer side at a white edge, the latter is an effect of the first stellation and is not present in the base model (see above)
  - at their intersection those faces effectively pass through each other on the outer side to emerge on the inner side as
indicated by the continuity of the colouring

- the face on the outer side is therefore continuous with the face on the inner side and is counted as a single face in the geometry of the model (4 blue and 4 red)
- when images are applied to such a face on the outer side, they are reversed when slid across the face to the inner side (as indicated above), raising the question as to whether this is merely an effect of the software or whether it has significance for mapping purposes

- the faces, going by appearances alone, total 32 however:
  - 8 distinct faces on "upper" surface (yellow)
  - 8 distinct faces on "lower") surface (green)
  - 8 distinct faces on "outside" surface (blue and red)
  - 8 distinct faces on "inner" surface (blue and red)

- with respect to the 20 vertices shown:
  - there are 12 vertices coloured yellow, corresponding to that of the base model
  - there are 8 vertices coloured yellow on the inner side of the form
  - there are 8 vertices coloured white (deriving from the first stellation), not present in the base model
  - 3 vertices (coloured yellow) are associated with each of the 4 "points" of the form as a whole

- with respect to the 32 edges shown:
  - distinctive colours (mauve and cyan) are used for the edges on each "surface" of the model (12 mauve, 12 cyan)
  - those linking the surfaces (on the inner side) are coloured black (4) and white (4), the latter being an effect of the first stellation (and not a feature of the base polyhedron)
  - the very thin edges on the (inner) faces of the transparent version should be ignored (as a software effect of surface colouring of squares by triangulation)

Since each surface could be argued to have two sides, the 32 distinguished by appearances, might then be understood as constituting 64 -- outer and inner surfaces.

Coherent mapping possibilities on the simplest torus?

In addition to the 16 binary truth functions, which were the point of departure for this investigation, other features which could explored for the relevance of their mapping onto the simplest torus include listed separately as indicated above:

- 8-fold: Cognitive and mnemonic associations to (and from) the Noble Eightfold Path of Buddhist doctrine, the Eightfold Way of particle physics and the so-called Eightfold Path of policy analysis, as discussed separately (Experimental configuration of nothingness as an "eightfold way", 2012; Fractal comprehension of coherence requiring an 8-fold uncertainty principle? 2019). Of potential interest is the existence of references such as the following (The Eight Ox Herding Pictures, 2012; The Eight Ox Herding Pictures: a Chan/Zen allegory).

It is potentially helpful to note the following distinctions with respect to comprehension, in that "failure of comprehension" of the patterns of higher order can be understood as associated with failure to recognize the higher bit positions. Thus 8-fold comprehension is effectively reduced to 4-fold by inability to recognize the distinction implied by the "first" bit position (thereby reducing 101 to 01, for example).

<table>
<thead>
<tr>
<th>2^n</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2²</td>
<td>2x2</td>
</tr>
<tr>
<td>2³</td>
<td>2x2x2</td>
</tr>
<tr>
<td>2⁴</td>
<td>2x2x2x2</td>
</tr>
<tr>
<td>2⁵</td>
<td>2x2x2x2</td>
</tr>
<tr>
<td>2⁶</td>
<td>2x2x2x2</td>
</tr>
<tr>
<td>2⁷</td>
<td>2x2x2x2x2x2</td>
</tr>
<tr>
<td>2⁸</td>
<td>2x2x2x2x2x2x2</td>
</tr>
</tbody>
</table>

The 64-fold pattern is of course fundamental to the set of codons in the genetic code -- and therefore "known" and "understood" in some fundamental biological sense. The pattern is also characteristic of the 64 hexagrams of the I Ching. Use of a distinctive polyhedron has been explored with respect to their coherent mapping (Proof of concept: use of drilled truncated cube as a mapping framework for 64 elements; Mapping attributions: preliminary assumptions from patterns of codons; Complementary mapping of I Ching hexagrams, 2015)
Curiously it is Indian tradition that has given a degree of popular credibility to the 64-fold pattern through the Chatushashti Kalas and the positions of intercourse of the Kama Sutra (What were the 64 skills that gurukulas trained the people of the ancient India? Quora; Reframing the Dynamics of Engaging with Otherness: triadic correspondences between Topology, Kama Sutra and I Ching, 2011).

Arguably a trace of the 128-fold, and its elusive nature, is evident in Dunbar's number -- of people with whom an individual can maintain stable social relationships, "knowing" them to some degree. Proposals that this lies between 100 and 250 (with a commonly used value of 150) are indicative of a potential extension to 256-fold, to the extent that the pattern in somehow understood as a whole. There is some irony to the fact that a 32-fold pattern of types of solid waste has been recognized by China -- which has recently given focus to banning 16 types in 2018, and a further 16 types in 2019 (China to ban 16 types of solid waste from end of 2018, EFE, 19 April 2018).

Cognitive dilemma: mapping "inside-out" versus "outside-in"

Arguments of a range of authors can be presented for the transformation of worldview from "inside-outside" to "outside-inside", with reality to be recognized as being as much "inside" as "outside" (World Introversion through Paracycling: global potential for living sustainably "outside-inside", 2013; Existential Embodiment of Externalities: radical cognitive engagement with environmental categories and disciplines, 2009). This can be explored as an analogue to the interface challenge of form of osmosis (Cognitive Osmosis in a Knowledge-based Civilization; interface challenge of inside-outside, insight-outsight, information-outformation, 2017).

Of relevance here is how conventional strategic patterns are then to be apprehended, given their primary (if not exclusive) focus on "outside" -- with only the vaguest allusions to "inside" in terms of the implications of values and "well-being". The question is all the more relevant in that individuals are somehow expected to find such strategies credible to the point of eliciting their engagement, whatever that may be held to mean in psychological terms rather than in terms of their action as citizens. How do individuals "identify" with strategies? The question is especially relevant in relation to appeals for action in response to climate change or with respect to the sympathy for migrants and others in distress. Other than through associated promotional campaigns and propaganda -- however vigorous -- such conventional strategies make no provision for alienation and increasing indifference (compassion fatigue and psychic numbing).

In an earlier speculative exercise the strategic framework of 15 Global Challenges identified by the Millennium Project was "adapted" for illustrative purposes to a hypothetical self-reflexive ("inner") preoccupation of a conference as indicated below (Embodying Strategic Self-reference in a World Futures Conference: transcending the wicked problem engendered by projecting negativity elsewhere, 2015).

The unusual features of the dual of the simplest torus above may therefore lend themselves to a form of mapping which is able to hold both the conventional "external" focus of strategies and the implication of "internal" considerations normally held to be secondary, irrelevant, and negligible. The polyhedral form can then be understood as holding the presence of a paradoxical interface between outside and inside -- potentially consistent with an understanding of cognitive osmosis.

There is a case for exploring the range of global strategies for traces of their personal psychological implication and how account can be taken of these within the administrative environments with mandates and expertise for an external focus alone.

Faced with such a mix of global strategies, does the nature of the global challenge call for reframing in some subtler manner, especially in the light of the ways it can be rendered superficial, as argued separately (Global Challenge of the Global Challenge: ¿ In-quest of a decision-making framework appropriate to a world in crisis? 2016).
Questionable confusion in configuring strategic frameworks: "fudging" self-reflexivity?

It is curious to note a subtle degree of confusion with respect to frameworks fundamental to (Western) organizational archetypes. This is most obvious with respect to 12-fold patterns, exemplified by the Knights of the Round Table of Arthurian legend and the Last Supper, as cited previously (Clarifying the Unexplored Dynamics of 12-fold Round tables: visualization of patterns of sustainable discourse between 12 systemic archetypes, 2019). There is an irony to the fact that it was the Christian monastic orders, that were at the origin of most modern democratic processes and their terminology ("assembly", "commission", etc).

With the Knights and their Round table, as symbolic echoes of the organization of the Last Supper (the final meal of Gospel account), it is readily assumed that the number seated were 12. The archetype has given rise to 12-fold juries and many "round table" gatherings of the wise. Given the mythical framework cultivated through these symbols, there is a case for recognizing the extent to which the quest for global sustainability can be fruitfully compared with that for the Holy Grail (In Quest of Sustainability as Holy Grail of Global Governance, 2011; In-forming the Chalice as an Integrative Cognitive Dynamic: sustaining the Holy Grail of global governance, 2011). As a metaphor, the myth continues to be exploited in the world of finance (Larry E. Swedroe, The Quest for Alpha: the Holy Grail of investing, 2010).

Formal "fudging"? The difficulty with respect to both archetypes is the range of commentary on the number seated (typically with primary emphasis on symbolism) -- in contrast to the 12 too readily assumed:

- In the case of the Knights, various sources have suggested: 13 (Didot-Perceval); 24; 36; 50; 60; 72; 130; 140; 150; 250; and 1,600 (David Nash, Knights of the Round Table). One question is whether King Arthur was himself assumed to have a seat at the table. Another is the particular importance attached to the 13th seat -- the Siege Perilous, namely a vacant seat at the Round Table reserved by Merlin (according to the legend) for the king who would one day be successful in the quest for the Holy Grail.
- In the case of the Last Supper, at which 12 disciples (at least) are held to have been gathered, it is less than evident whether Jesus occupied an additional 13th seat, and the seating of Judas Iscariot, as his betrayer (Seating at the Last Supper, Bible Study, The Seating Plan at the Last Supper, Community in Mission, 4 April 2012; Actual Seating Arrangement of The Last Supper, 24 August 2010).

The issue of whether it is indeed 12 plus-one can be seen as related to that discussed in the introductory paper with respect to the reduction of the pattern of 16 logical connectives to 14, to enable the standard mapping onto a rhombic dodecahedron of 14 vertices, from a 4-dimensional hypercube of 16 vertices.

As noted there, the reduction from 16 to 14 can indeed be considered a well-argued "standard" -- given instances of tautology and contradiction --- but which could otherwise also be considered to be an appropriate "fudge". What does "tautology" imply in cognitive terms -- given the manner in which it features in discourse?

Potentially intriguing in the case of the symbolism of the number of "knight at the Round table" is how it might be understood as relating to patterns of sustainable human relationships, as indicated by reflection on the Dunbar number of 100 to 250, as noted above.

Strategic sets: With respect to the set of strategic frameworks currently "on the table" globally, civilization (and individuals) are faced with the following, for which no systemic justification whatsoever is seemingly provided:

- 16 (+1) Sustainable Development Goals of the United Nations
- 16-point framework of the Earth Charter
- 16 Global challenges identified for the Government of Canada on the basis of an extensive literature survey (Policy Horizons Canada, The Next Generation of Emerging Global Challenges, Horizons, 19 October 2018)
- 15 Global Challenges of the Millennium Project

It is appropriate to recall that the 17 SDGs replaced the 8 Millennium Development Goals, whether or not the elaboration of the 17 SDGs was inspired in any way by the 16-fold Earth Charter or its advocates.

How is this mish-mash of sets to be distinguished from the desirability of coherence for "global sensemaking"? The set of 17 SDGs, for example, has been described as a "mess" and "worse than useless" (The 169 Commandments, The Economist, 26 March 2015). Adding to the confusion is the recognition of 12-fold and 8-fold strategic sets (as noted above) -- with many such strategic articulations relatively quickly forgotten. There is a strange possibility that the coherence of a 17-fold pattern might be related, if only unconsciously, to the so-called wallpaper group (or plane symmetry group). This is a mathematical classification of a two-dimensional repetitive pattern, based on the symmetries in the pattern; such patterns occur frequently in architecture and decorative art, especially in textiles and tiles as well as wallpaper. It has been proven that there are only 17 distinct groups of possible patterns. Cynically it could however be argued that the 17 SDGs can be understood as "global wallpaper" for decorative purposes.

Implication of the observer: self-reference and self-reflexivity? The sets could however be contrasted in systemic terms with recognition of the ascending recursions of a viable system model, with each autonomous 5-4-3-2-1 metasystem enlarging and acquiring more variety, as variously discussed in the light of the work of Stafford Beer (Charles Herring and Simon Kaplan, The Viable System Model for Software, Semantic Scholar; Mark Johnson and Loet Leydesdorff, Beer's Viable System Model and Luhmann's Communication Theory: 'organizations' from the perspective of metagames, Systems Research and Behavioral Science, 2013).

Given the compatibility of skill sets, and sympathy for such a systems perspective, it might be asked how an international group of leading technological thinkers identified (in systemic terms) the Grand Challenges for Engineering in the 21st century -- the 14 game-changing goals for improving life on the planet (14 Grand Challenges for Engineering in the 21st Century, National Academy of Engineering, 2008). Curiously no such systemic perspective is apparent from their presentation. As with other sets of goals, there is a
sense of their having been "picked out of a hat". With respect to strategic goal identification, it could be asked where the observer is located and what kind of bias is thereby introduced. The argument has been developed by Pierre Bourdieu for whom the homo scholecticus or homoi academicus is an observer who is questionably "placed outside the context of urgency of a practical situation" and is able to "produce practices or utterances which are context free" (The Scholastic Point of View, Cultural Anthropology, 1990; Rebecca Adler-Nissen, Bourdieu in International Relations: rethinking key concepts in IR, 2012)

As illustrated by a 12-fold pattern, exposure to it necessarily implies a 13th position -- that of the observer. The role of the observer in quantum physics is considered fundamental. Arguably there is then a degree of confusion between the following:

- the observer as an outsider, namely not part of the gathering (of the 12)
- the observer as critique, namely evaluating the gathering in terms of a wider framework (potentially alien, if not threatening, to those assembled)
- the observer as traitor, namely with subversive motivations at variance with those assembled, raising questions as to who defines the nature of "treachery" (as currently exemplified by the ambiguities of the case of Julian Assange)

More intriguining is the sense in which an additional function is of systemic relevance in terms of self-reference, in the light of arguments such as those of Hilary Lawson (Reflexivity: the post-modern predicament, 1985). This relates to issues of higher cybernetic orders of self-referential feedback than can be engendered by the functions as conventionally assembled (at a "comfort zone" gathering). Such a function is variously evident to a degree in the role of a mediator, a minute writer, or an expert analyst (of dialogue, for example).

What is the significance of one more or one less? Is the "King" (or "Jesus") present or absent from the gathering? Is the coach to be understood as effectively a member of an 11-person football team, or of a 15-person rugby team? To what extent does a "chairperson" embody a 13th meta-function in a 12-person gathering? What of the Siege Perilous?

Also of interest is the extent to which there is a "shadow" to the table in psychological terms -- a collective shadow calling for an additional sense of perspective.

"Geometry" of self-reference? The question is then how any additional perspective might be reflected in relation to a mapping of the functions gathered "at a table". Positioning that perspective orthogonally to the plane of the table ("axially") is an obvious possibility. This could then be understood as a single position above the table (+1) or associated with an axis through the table (+2) to a second position below it?

Arguably this offers a means of considering the relation between the 14 vertices of the rhombic dodecahedron and the 16 of the hypercube -- with the "hyper" dimensions suitably indicative of the additional dimensionality of a perspective beyond the framework of the former.

The "reduction" of the hypercube to a rhombic dodecahedron, held to be "standard", can then be understood as a process of "normalization" (as favoured in mathematics) or approximation -- rather than deprecated as a "fudge" (however appropriate).

The challenge of self-reference was raised above with respect to a professional gathering of futures researchers. How is the futures perspective of participants integrated into the discourse of those assembled, as would follow from the arguments regarding scholastic bias of Pierre Bourdieu: (The theory of dispositions and scholastic bias, 2018). Potentially more productive is the question as to how those professionally concerned with geometric models of oppositional logic at a conference integrate into their discussions the manner in which they agree or disagree. The question is especially relevant to organization of the periodic World Congress on the Square of Opposition -- notably in the light of the three-dimensional models which feature in the discussion.

Cognitive constraints in comprehending strategic coherence

Memory constraints: Much has been made in the literature regarding human cognitive constraints and chunking for memorability, dating from the famed paper of George Miller (The Magical Number Seven, Plus or Minus Two: some limits on our capacity for processing information, Psychological Review. 63, 1956, 2).

More recent comments of relevance include:

- Nelson Cowan: George Miller's Magical Number of Immediate Memory in Retrospect: observations on the faltering progression of science (Psychological Review, 122, 2015, 3).
- J.-L. Doumont: Magical numbers: the seven-plus-or-minus-two myth (IEEE Transactions on Professional Communication, 45, 2002, 2)
- John S. Nicolis and I. Tsuda: Chaotic Dynamics of Information Processing with Relevance to Cognitive Brain Functions (Kybernetes, 14, 1985, 3); Chaotic Dynamics of Information Processing: the "Magic Number Seven Plus or Minus Two" revisited (Bulletin of Mathematical Biology, 47, 1985, 3, pp. 343-365)

Given the confusion with regard to such chunking, the provocative question could be raised -- in the light of the self-referential perspective -- as to whether attention could then be usefully accorded to "14 plus-or-minus-2" rather than "7 plus-or-minus-2". This would neatly encompass the range of strategies from 12 to 16 at least.

Auspicious and inauspicious configurations of sets? Not to be taken lightly is the considerable sensitivity to auspicious configurations and those considered unlucky in some way. Table arrangements of 13 would tend to be avoided, just as skyscrapers in Western countries may well omit a 13th floor. This raises questions regarding assumptions about both the legendary Knights of the Round table and the Last Supper. Do 8, 12, 14, and 16 frame what amounts to "comfort zones" for those operating within such frameworks -- then necessarily disrupted by 9, 13, 15 or 17?
This is especially evident in Chinese culture -- even in the world of finance (James T. Areddy, *Chinese Investors Crunching Numbers Are Glad to See 8s, The Wall Street Journal*, 24 May 2007). Whilst an 8-fold set like the Millennium Development Goals would be esteemed as auspicious there, it is extremely doubtful that the 17-fold set of SDGs would be similarly valued. Similarly, there is little chance that a 13-fold set of strategies would be formally articulated in the West.

It is therefore appropriate to ask whether this sensitive issue has at any stage been meaningfully explored with respect to the uptake of SDGs by China. Curiously however it is quite possible that, as in the world of finance, the matter has been reframed by totalling the digits of 17 to reframe the pattern as appropriately 8-fold.

Feeling right? Understanding any such auspiciousness -- as "feeling right" in the design of a set -- can be explored further through the arguments of Christopher Alexander. He could be said to have described it in the following terms with respect to a "central quality without a name" within well-designed environments, as discussed separately (Pattern of transformations as a dynamic quality without a name, 2012). For him, a "place to be" in a building or a town is only viable to the extent that it is governed by the "timeless way" (*The Timeless Way of Building*, 1979). Alexander summarizes this as follows:

- It is a process which brings order out of nothing but ourselves; it cannot be attained, but it will happen of its own accord, if "we" will only let it.
- There is a central quality which is the root criterion of life and spirit in a man, a town, a building, or a wilderness. This quality is objective and precise, but it cannot be named,
- The search, which we make for this quality, in our own lives, is the central search of any person, and the crux of any individual person's story. It is the search for those moments and situations when we are most alive.
- In order to define this quality in buildings and in towns, we must begin by understanding that every place is given its character by certain patterns of events that keep on happening there.
- These patterns of events are always interlocked with certain geometric patterns in the space. Indeed, as we shall see, each building and each town is ultimately made out of these patterns in the space, and out of nothing else: they are the atoms and the molecules from which a building or a town is made. (*A Pattern Language: towns, buildings, construction*, 1977)

Planetary boundaries and a "place to be"? Is there a "timeless way" to be recognized in articulating sets of strategies -- in order to frame a "place to be" for humanity? A sense of the latter notion is intimated by the subtitle of a report by a team of scientists to the Club of Rome (Johan Rockstrom and Will Steffen, *Planetary Boundaries: exploring the safe operating space for humanity* 2009), as reviewed separately (Recognizing the Psychosocial Boundaries of Remedial Action: constraints on ensuring a safe operating space for humanity, 2009). The sense in which any set "feels right" could also be explored in relation to the recent study by Jeremy Lent (The Patterning Instinct: a cultural history of man's search for meaning, 2017), as separately discussed with respect to its 5-fold assumptions (Patterning Intuition with the Fifth Discipline, 2019).

Alexander (and his team) identified 254 interlinked patterns as providing one such language -- possibly to be understood as subject to a "Dunbar constraint" on familiarity. The approach could be extended to cognitive environments, as argued separately (5-fold Pattern Language, 1984), with the possibility that "planetary boundaries" could then be interpreted in the light of polyhedral forms. Ironically there is a sense in which the denial of physical boundaries is implied by the subtitle of the book form of the report to the Club of Rome (Anders Wijkman and Johan Rockström, *Bankrupting Nature: denying our planetary boundaries*, 2012) -- perhaps to be extended to "bankrupting human nature", if a psychosocial dimension is acknowledged, as environmentalists have such difficulty in doing (Are Environmentalists and Climate Scientists in Denial? Climate change recognized as primarily a psychological challenge, 2019).

Of potential interest, with respect to the values in terms of which sets of strategies and goals are claimed to be articulated, is the identification in the Human Values Project of "value polarities" -- pairs of values in opposition, as potentially "constructive" or "destructive". The exercise identified 224 such polarities, then "condensed" to a set of 135 presented in a 5x9 matrix of 45 "value types". The project was intended as a means of framing the question as to how many values merited recognition in strategies and how problems (addressed by such strategies) are implied by their neglect or misapprehension. Clearly such a systematic approach also includes values which may be neglected (or only elusively implied) by a given set of strategies.

Mapping as superimposition, superposition or superstition?

Superimposition versus Superstition? As conventionally framed, sets of strategies and goals place their primary emphasis on the tangible. Any reference to the intangible is by implication, if at all. This is evident with respect to planetary boundaries in contrast to Alexander's far subtler notion of a "place to be" (as noted above) and to any understanding of "well-being".

There is a sense in which the harder sciences and the more "hard-nosed" politicians can treat those indications as effectively superstition, possibly to be cultivated in public information campaigns -- as with auspicious and inauspicious constraints (as noted above). This attitude is evident in allowing for such superstition in the world of finance (where appreciation by the Chinese is sought), or in architecture and otherwise (with the common omission of a thirteenth facility).

Superposition? In curious contrast it is appropriate to note the reference in the introductory paper to the potential implications of emerging insights into quantum reality with respect to future framing of international relations, as argued by Alexander Wendt (*Quantum Mind and Social Science: unifying physical and social ontology*, 2015). That possibility highlights the extension of truth tables and computer logic gates. These call upon an understanding of quantum superposition. This holds that a physical system -- notably an electron -- exists partly in all its particular theoretically possible states simultaneously. When measured or observed, however, it gives a result corresponding to only one of the possible configurations. An associated notion, equally "fantastic", is that of quantum entanglement.

Such "superposition" merits comparison with "superstition" to the extent that both can be understood as privileging one sense of "place" -
that, if information is not presented "flat", it cannot currently be communicated, comprehended or considered to be of any relevance to "Flat Earth" comprehension of what is otherwise upheld as being of a global nature. The point could be stressed more emphatically in printed page, most notably in academic and strategic comprehension of its coherence. Use of 3D polyhedral forms offers a valuable contrast to the conventions of 2D. The constraints of the Functional dynamics of a 16-fold configuration of strategic goals

Framing an operating context of 16 "dimensions"

There is a case for recognizing the extent to which any 16-fold set of global goals or strategies frames the context for global navigation - and the dimensional space within which choices must be made. Use of the navigation metaphor recalls the traditional array of compass points, as presented in the image on the left below. That array is central to the emblem of the CIA, and presumably considered appropriate to the worldview of that agency and its strategic preoccupation with ensuring full-spectrum dominance in order to create a "safe space" for humanity, as understood from that perspective (Embodying Global Hegemony through a Sustaining Pattern of Discourse: cognitive challenge of dominance over all one surveys, 2015).

The challenge of this argument is however one of holding, and representing more comprehensibly a 16-fold configuration -- beyond the "Flat Earth" tradition -- and notably of the pattern of logical connectivity with which coherence could be understood as associated. Rather than involving emulation of an extra dimension (as with the remarkable animation of the hypercube on the right below, it is appropriate to note that the simplest torus (the dual of the form discussed here, and displayed above) has 16 vertices which could be used for that purpose. It does indeed reflect the form of the hypercube, but without requiring its extra dimension (except by implication). Of interest is any representation of an "axial" 17th "meta-perspective" from which the 16 are "observed".

<table>
<thead>
<tr>
<th>Comparison of mapping of 16 dimensions in 2D, 3D and 4D</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 Compass points</td>
</tr>
<tr>
<td>Traditionally represented</td>
</tr>
<tr>
<td>![Image](16 Compass points.png)</td>
</tr>
</tbody>
</table>

Reproduced from Wikipedia | Prepared using Stella Polyhedron Navigator by Jason Hise [CC0], via Wikimedia Commons

It is noteworthy that traditional Chinese culture makes particular metaphorical reference to the compass points as being associated with functions readily understood as systemic.

Functional dynamics of a 16-fold configuration of strategic goals

The emphasis above is with respect to the challenge of representing a 16-fold complex in a memorable manner which enables enhanced comprehension of its coherence. Use of 3D polyhedral forms offers a valuable contrast to the conventions of 2D. The constraints of the printed page, most notably in academic and strategic documents, could be said to be an unfortunate reinforcement of the traditions of "Flat Earth" comprehension of what is otherwise upheld as being of a global nature. The point could be stressed more emphatically in that, if information is not presented "flat", it cannot currently be communicated, comprehended or considered to be of any relevance to
It is however one thing to achieve a more credible mapping, and another to shift beyond the static implications of such a mapping -- in a context which is inherently dynamic, as argued separately (Dynamic Transformation of Static Reporting of Global Processes: suggestions for process-oriented titles of global issue reports, 2013; From Statics to Dynamics in Sustainable Community: navigating through chaos by playing on polarities as attitude correctors, 1998).

A dynamic perspective can notably be explored in two ways in relation to the dual of the simplest torus -- with respect to the faces, and with respect to the edges.

**Using polyhedral edges as indicative of feedback loops:** Use of Stella Polyhedron Navigator indicated that a pattern of edges was associated with an embedding of the star torus within a set of 6 great circles (shown below). Omitting the faces, four of these circles are slightly oriented to the principal plane of the torus, coloured below according to 4 rhombic "circuits" of edges (rendered more pronounced as cylinders in contrast to the representations above).

In the screen shots below, small spheres circulate around each such circuit -- coloured according to the circuit. Two additional circles (coloured green below), out of the plane of the form, are orthogonal to each other. What could be considered a 7th great circle would lie in the plane of the form, passing through the four points most distant from its centre.

<table>
<thead>
<tr>
<th>Movement of spheres on rhombic circuits of edge cylinders of dual of simplest torus -- a &quot;star torus&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen shot</td>
</tr>
</tbody>
</table>

Animations adapted from Stella Polyhedron Navigator using X3D-Edit

Such dynamics then raise the question as to what circulates in this way around the polyhedral form, and what speeds of movement of the spheres would be most suggestive of that (Circulation of the Light Essential metaphor of global sustainability? 2010). How should those movement be phased in relation to one another -- possibly with multiple spheres for each circuit? Clearly the aesthetics of the representation can be variously adjusted (preferably interactively) to suggest different possibilities.

What feedback processes are required to ensure the integrity and viability of a 16-fold set of strategies? How do these relate to the functional considerations of the viable system model? The image above restricts the movement of each sphere to the rhombic circuit with which its colour is associated. An alternative possibility would be to allow the spheres to move between those rhombic forms.

Of some interest, is the manner in which the 4-edged rhombic forms are paired, therefore together constituting two sets of 8 edges. The emergence of each rhombic form resulted however from treating together the two colinear edges composing each of the rhombic edges in the original form (one shorter than the other). Understood in that way, the two sets of 8 edges imply double that number, namely 32 (as 4x8), which contrasts with the geometrical definition where such discontinuity is not be a feature of the base polyhedron (as noted above). This approach ignores the edges passing around the narrow radius of the torus, and aligned with the great circles coloured green.

**Using polyhedral faces as suggestive of flow processes:** Distinctive flow processes can be envisaged, of which those presented in the animations below are some examples. Note, as mentioned above, the separation marked by the white vertex is an effect of the first stellation of the form and (although indicative) can be considered as absent from the base polyhedron.

In the animation on the left, a flow is envisaged as emerging from the point of convergence of the faces at the point marked by the white vertex -- or sinking into that point. On the other hand, it is assumed that the flow is continuous across the edges at the junction of the faces between the yellow vertexes. The same would occur on the lower set of faces (not visible in the image on the left).

In the animation on the right, it should be recalled that the face visible on the inner side is continuous with that on the outer side, and that parallel faces are similarly coloured. There is therefore assumed to be a continuous flow from inner side to outer side (or vice versa) through the intersection between the two white vertexes. Consideration could be given to the source of that flow at the other end of the face, on the inner or outer side.

<table>
<thead>
<tr>
<th>Animations suggestive of flow processes over the surface of the dual of the simplest torus -- a star torus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Possibilities on &quot;upper&quot; and &quot;lower&quot; set of faces?</td>
</tr>
</tbody>
</table>

In the screen shots below, small spheres circulate around each such circuit -- coloured according to the circuit. Two additional circles (coloured green below), out of the plane of the form, are orthogonal to each other. What could be considered a 7th great circle would lie in the plane of the form, passing through the four points most distant from its centre.
One indication of such a hypothetical flow process, at the point of convergence, is offered by the following animations (left and centre) using a horn torus. (Further programming would be required to indicate the process as suggested by the arrows above). In relation to the horn torus, Wolfgang Daeumler comments on the presentation of Lissajous curves on the surface (below right), that the visual form of these curves is often suggestive of a three-dimensional knot, and indeed many kinds of knots, including those known as Lissajous knots, project to the plane as Lissajous figures. The animation below is somewhat reminiscent of the hypersphere animations suggestive of higher-dimensional brain functioning, as discussed separately (Transforming vehicles of identity between global and toroidal forms, 2016).

<table>
<thead>
<tr>
<th>Horn torus flow-related animations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow sinking into convergent point</td>
</tr>
<tr>
<td>Flow emerging from convergent point</td>
</tr>
<tr>
<td>Animation of Lissajous curve</td>
</tr>
</tbody>
</table>

Animations developed with Antiprism by Adrian Rossiter (reproduced with permission)
Reproduced, with permission, from Wolfgang Daeumler (Horn Torus)

Of further interest is how the various flows might be understood as continuous across the torus as a whole. Other colour effects could be used to suggest shifts in phase at the various "source" and "sink" positions as points of inflection. From a strategic perspective, what indeed flows to engender strategic integrity? Do the various points of "inflection" represent zones of "concentration" or "compression" (through "pumping") or filtering -- of information or energy?

In mathematics, especially in the area of mathematical analysis known as dynamical systems theory, a linear flow on the torus is a flow on the n-dimensional torus. This is related to understanding of a completely integrable system.

Modifying the form: unfolding, exploding, stellation, morphing

**Unfolding / Folding of the star torus**: The animation on the left below illustrates the recognized process of unfolding a polyhedral form, then refolding it. The separation into "bird-like" forms is usefully reminiscent of the manner in which individual strategies in a set may well "fly off" in different directions -- fragmenting into their parts before coming together again through some sense of integration ("flocking")? A relevant comparison, given the use of the wing metaphor in politics can be further explored (Coordination of Wing Deployment and Folding in Politics: bird flight and landing as complementary metaphors of global strategic coherence, 2018; Counteracting Extremes Enabling Normal Flying: insights for global governance from birds on the wing and the dodo, 2015).

**Augmentation: Explosion / Excavation of the star torus**: The animation (below centre) indicates a process through which the dual of the simplest torus can be "augmented" through placing 8 pyramidal forms on the triangular faces and then "exploding" them away from the form as separate structures -- prior to "excavating" them into and through the form.

**Stellation of the dual of the simplest torus**: The stellation of a polyhedron, in this case the dual of the simplest torus, is a new polyhedron which has faces that lie in the same planes as the faces of the original model. Starting with the base polyhedron, the process extends specific elements such as its edges or face planes, usually in a symmetrical way, until they meet each other again to form the closed boundary of a new figure. The new figure is a stellation of the original. There are different criteria for this purpose. In the following case (below right) the more limited set of main-line rules has been used.
Morphing between simplest torus and its dual: Various methods of morphing are indicated below. The question of relevance are the
cognitive analogues, potentially to be explored in the light of the preoccupations of René Thom (Structural Stability and Morphogenesis:
an outline of a general theory of models, 1972), in terms of archetypal morphologies understood as related to elementary catastrophes.

<table>
<thead>
<tr>
<th>Varieties of morphing transformation between the simplest torus and its dual -- a star torus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sizing</td>
</tr>
<tr>
<td><img src="image1.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Animations prepared with Stella Polyhedron Navigator

Modifying the cyclic symmetry of the star torus

The emphasis above is on the mapping possibilities of the dual of the simplest torus alone, especially in relationship to 16-fold, 12-fold
and 8-fold patterns of strategies. The Antiprism application offers a means of increasing the cyclic symmetry of that basic polyhedron.
This is of interest in various respects, succinctly suggested by the following animations from 4-fold to 20-fold and from 4-fold to 18-fold.

<table>
<thead>
<tr>
<th>Animations of different patterns of N-foldness -- varieties of star torus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animation 4-fold to 20-fold</td>
</tr>
<tr>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N</th>
<th>faces (Nx4)</th>
<th>edges (Nx7)</th>
<th>vertexes (Nx3)</th>
<th>N</th>
<th>faces (Nx4)</th>
<th>edges (Nx7)</th>
<th>vertexes (Nx3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-fold</td>
<td>16</td>
<td>28</td>
<td>12</td>
<td>4-fold</td>
<td>16</td>
<td>28</td>
<td>12</td>
</tr>
<tr>
<td>8-fold</td>
<td>32</td>
<td>56</td>
<td>24</td>
<td>5-fold</td>
<td>20</td>
<td>36</td>
<td>15</td>
</tr>
<tr>
<td>12-fold</td>
<td>48</td>
<td>84</td>
<td>36</td>
<td>7-fold</td>
<td>28</td>
<td>49</td>
<td>21</td>
</tr>
<tr>
<td>16-fold</td>
<td>64</td>
<td>112</td>
<td>48</td>
<td>9-fold</td>
<td>36</td>
<td>63</td>
<td>27</td>
</tr>
<tr>
<td>18-fold</td>
<td>72</td>
<td>126</td>
<td>54</td>
<td>14-fold</td>
<td>56</td>
<td>98</td>
<td>42</td>
</tr>
<tr>
<td>20-fold</td>
<td>80</td>
<td>140</td>
<td>60</td>
<td>15-fold</td>
<td>60</td>
<td>105</td>
<td>45</td>
</tr>
</tbody>
</table>

Images for animations generated from Antiprism (freely downloaded).

Single command line instruction for the generation of those above, and immediately below, for interactive 3D viewing (change NN to
number required, eg 8 or 16):

```
off_util null-A v2,1,0 -A v2,-1,0 -A v1,1,1 | poly_kscope -s D4 | off_util -Ma -A f2,4,6,3,7,9 -A f0,2,9,1 | poly_kscope -s D4h | off_util -Ma | pol_recip | to_nfold NN | off_color -f U | antiview
```

<table>
<thead>
<tr>
<th>Screen shots from a selection of 3D star torus models, with and without indication of symmetry elements</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image11.png" alt="Image" /></td>
</tr>
</tbody>
</table>

Images generated from Antiprism

The models above can be exported from Antiprism in VRML format. However, in order to benefit from some facilities in Stella
Polyhedron Navigator, they were exported in OFF format from Antiprism and imported into the Stella application. Images of both the
model and its dual are presented below in each case.

<table>
<thead>
<tr>
<th>Screen shots from a selection of 3D star torus models, with indication of symmetry elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>(dual variant above)</td>
</tr>
<tr>
<td>5-fold</td>
</tr>
<tr>
<td><img src="image" alt="5-fold model" /></td>
</tr>
<tr>
<td>20 faces, 36 edges, 15 vertexes</td>
</tr>
<tr>
<td><img src="image" alt="15-fold model" /></td>
</tr>
<tr>
<td>15 faces, 36 edges, 20 vertexes</td>
</tr>
</tbody>
</table>

Images generated with Stella Polyhedron Navigator

The animations below illustrate use of the models for mapping purposes:

- 5-fold: Use is made of the Chinese WuXing pattern in this case. The case for 5-foldness is discussed separately with other examples (Patterning Intuition with the Fifth Discipline, 2019). This includes sections on: Possible cognitive implications of 5-foldness; Requisite fifth-order thinking?; Clues to systemic implications of 5-fold cognitive organization? The argument is a critical review of The Patterning Instinct: a cultural history of man's search for meaning (2017) by Jeremy Lent.

- 8-fold: The set of labels derives from the Chinese BaGua pattern, as one example. The labels in this case, and as used for the 5-fold, are of particular relevance to the current global environmental crisis and its comprehension, notably as separately argued (Weather Metaphors as Whether Metaphors, 2015; Enhancing Strategic Discourse Systematically using Climate Metaphors, 2015; Cognitive implication in a Chinese system articulated through weather-related metaphors, 2015). The BaGua pattern offers a more systematic pattern of interrelationships than that of the UN's Millennium Development Goals.

- 12-fold: Many sets of labels could have been used as examples (Checklist of 12-fold Principles, Plans, Symbols and Concepts: web resources, 2011). Given the emphasis here on interrelationship between the functions mapped, the example used here is that derived from the study by Arthur Young (Geometry of Meaning, 1976), as separately discussed (Geometry of Meaning: an alchemical Rosetta Stone? 2013; Typology of 12 complementary dialogue modes essential to sustainable dialogue, 1998; Typology of 12 complementary strategies essential to sustainable development, 1998; Characteristics of phases in 12-phase learning / action cycles, 1998). Unfortunately no functional distinctions are made between the 12 stars of the Flag of Europe which would have been an obvious alternative. More symbolic examples, in the light of the above argument, would have been the 12 Knights of the Round table, or the 12 Apostles at the Last Supper -- if their functions could be distinguished as with the 12-fold pantheons of Greece and Rome.

- 16-fold: Many possible examples have been listed separately (Deprecation of potential correspondences: 16-fold patterns? 2019). Preference was given here to the set of UN Sustainable Development Goals. An obvious alternative ould have been the set of 16 logical connectives discussed earlier. Note that the 17th SDG is potentially more appropriately implicit in the vertica central axis in the 16-fold images above.

<table>
<thead>
<tr>
<th>Illustrative use of geometry of star torus for mapping purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(use browser facilities to enlarge animations and labelling)</td>
</tr>
<tr>
<td>5-fold</td>
</tr>
<tr>
<td><img src="image" alt="5-fold animation" /></td>
</tr>
</tbody>
</table>

Animations generated with Stella Polyhedron Navigator
In terms of systemic viability, there is a case for comparing such models in the light of multi-armed starfish. Research has noted the advantages of the 5-armed variety (Liang Wua, et al, The Advantages of the Pentameral Symmetry of the Starfish, 2012). Curiously in the light of the extant strategic sets above, some species have six or seven arms and others have 10-15 arms. From the perspective of systemic viability, consideration could also be given to the 8-armed octopus and the 7-armed variant.

**Imagining further implications: helical coil, toroidal knot or crown?**

**Reminiscent of an archetypal crown?** The argument was introduced with reference to the Knights of the Round table, engendered according to legend by King Arthur -- as a symbolic echo of the Last Supper. The crown symbol is implied both with respect to the strategic role of Arthur and to the tragic irony of the Crown of Thorns immediately following the Last Supper. The latter has come to be associated ambiguously with a Crown of Martyrdom and a Crown of Immortality (Mike Aquilina, The Crown of Martyrdom, Catholic Exchange).

The dual of the simplest torus -- the star torus -- could be seen as recalling the form of the simplest crown, whether adorned with "jewels" (at the vertices of the form), or their recognition as "thorns". A crown can be understood as indicative of the strategic integration with which royalty has been traditionally associated as the integrative focus of governance. It is traditionally "packed" with symbolic elements -- whose nature is readily forgotten -- even long forgotten, following the deprecation of that function in a secular world. The metaphor continues to be valued through the process of "crowning" those appointed to positions of leadership -- or through the laurel wreath -- in recognition of excellence (Game-playing, bull-leaping and laurel wreaths, 2014). The emblem of the United Nations, for example, continues to recall this.

There is therefore a case for decoding any toroidal crown or circlet in terms of the integrative strategic significance it can carry, as separately argued (Engaging with Globality through Cognitive Crowns, 2009; Implication of Toroidal Transformation of the Crown of Thorns: design challenge to enable integrative comprehension of global dynamics, 2011). Given reference to "Knights", it is appropriate to note the analysis of the strategically relevant "knight's move" of chess in the latter (Predictability and pattern-breaking: the Knight's move, 2011).

The point was made above that the star torus as discussed here is with some difficulty to be distinguished from the so-called crown polyhedra. To further clarify the distinction, the following are presented. A principal distinction is that the crown polyhedra are self-intersecting and self-dual in contrast with the star torus, as noted above. Further exploration might establish, for that reason alone, that crown polyhedra (being more noble in geometric terms) could indeed be more appropriate for mapping a set of strategies.

**Indications of crown polyhedra as distinguished from forms of the star torus**

<table>
<thead>
<tr>
<th>Indications of crown polyhedra as distinguished from forms of the star torus</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-fold</td>
</tr>
<tr>
<td><img src="image1.png" alt="4-fold" /></td>
</tr>
<tr>
<td>Models variously produced with the aid of Antiprism, Meshlab, X3D-Edit and Stella Polyhedron Navigator</td>
</tr>
</tbody>
</table>

**Helical coil or toroidal knot?** First inspection of the simplest torus in its dual form raises the question of whether the pattern of edges forms a circular coil. Use of software to explore the interior of its toroidal "tunnel" offers the illusion of traversing a 3-walled tube. There are in fact 4 interlaced lines of edges (suggestive of being interwoven) -- as rendered obvious by some images above. The question remains as the extent to which the pattern constitutes a form of coil or knot of the simplest kind -- whether in topological terms or as an effect of constrained perception.

Possibilities for consideration include:

- Understood as a kind of helical coil, this recalls current preoccupation with the Triple Helix model of innovation, as discussed separately (Embedding the triple helix in a spherical octahedron, 2017; Contrasting the implications of "triple helix" -- cognitive and otherwise, 2017). The interlaced rhombic forms of the star torus (shown above) suggest the extension of this approach to such patterns beyond the 4-fold, possibly in the light of the experimental approach to nonagons (Concordian Mandala as a Symbolic Nexus: insights from dynamics of a pentagonal configuration of nonagons in 3D, 2016; Visualization in 3D of Dynamics of Toroidal Helical Coils -- in quest of optimum designs for a Concordian Mandala, 2016).

- Given that work on the Triple Helix model has inspired exploration of a quadruple variant of strategic relevance, the interweaving of the four rhombic forms could be considered in that light (Systemic closure: fourth helix -- and beyond?, 2017; Embedding the quadruple helix in a spherical cube, 2017).

- Given current references to the strategic challenge of the times as meriting comparison with the riddle of the Gordian knot, could the polyhedral form be recognized as such a knot (Mapping grossness: Gordian knot of governance as a Discordian mandala? 2016, Engaging globally with knots and riddles -- Gordian and otherwise, 2018).

- The paradoxical nature of such a knot might be usefully explored in the light of the study by Douglas Hofstadter (I Am a Strange...
Rather than "I" being such a loop, does the world merit recognition as a "strange loop" -- if only in terms of the many vicious cycles of violence, and the inability to encompass cognitively and strategically the cyclicity of the adaptive cycle?

Toroidal dynamics? It is potentially remarkable that the form of a torus is so significant to astrophysical dynamics, whether with respect to toroidal stars, planets, or the shape of the universe. This should suggest an approach to understanding the "shape of civilization" other than as simply global. More immediately intriguing is the possibility that strategic mappings onto an N-fold star torus could derive insights into the dynamics of governance from the extensive studies of astrophysical models. Curiously, with a significant shift of time scale, the spherical planet through its annual cycle could well be perceived as of toroidal form -- if slightly elliptical.

There is a degree of irony to such possibilities in that the consideration of N-fold sets of strategies at global summits (G7, G20, and the like) could be understood from a toroidal perspective -- given both the circular seating arrangements and a caricaturization of their outcomes as taking the form of smoke rings. The irony is all the greater in that participants are framed as the "stars" of the global system -- typically faced with a strategic "back hole" (at least in financial terms) around which they gravitate.

<table>
<thead>
<tr>
<th>Dynamics of strategic round tables as suggested by stellar dynamics?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic field from a charged rotating torus</td>
</tr>
<tr>
<td><img src="image1" alt="Magnetic field from a charged rotating torus" /></td>
</tr>
</tbody>
</table>

Such dynamics merit consideration in the light of the remarkable insights of Nikola Tesla into the rotation of magnetic fields (Reimagining Tesla's Creativity through Technomimicry: psychosocial empowerment by imagining charged conditions otherwise, 2014). Related insights can be sought from the design constraints of the International Thermonuclear Experimental Reactor currently under construction (Enactivating a Cognitive Fusion Reactor: Imaginal Transformation of Energy Resourcing (ITER-8), 2006). Consideration could notably be given to the fact that 18 toroidal field coils are considered appropriate to the containment of plasma in order to achieve fusion. It is highly probable that 18 were chosen on the basis of very careful investigation of the dynamics of the system -- a degree of understanding unrecognizable in the case of the sets of global strategic goals currently on the table.

Toroidal "wave" implication? The pattern of faces and edges around the dual of the simplest torus could be explored as indicative of one or more spiral waves interweaving around the form -- as such emblematic of cognitive dimensions of strategic integration. This could follow from the implications of the study by Alexander Wendt (Quantum Mind and Social Science: unifying physical and social ontology, 2015), as discussed separately (Quantum consciousness implications of fundamental symbol patterns, 2017; On being "walking wave functions" in terms of quantum consciousness? 2017).

In emphasizing dynamics rather than statics, does global strategic integration call for a much more extensive exploration of wave patterns -- of which a toroidal form might be a particular approximation (Encountering Otherness as a Waveform -- in the light of a wave theory of being, 2013; Being a Waveform of Potential as an Experiential Choice: emergent dynamic qualities of identity and integrity, 2013). One justification is the insightful use of "wave" in relation to public opinion and change -- "waves of change"?

Cognitive implications of aesthetic options? The remarkable opportunities offered by software include facilities to modify the aesthetics of visual renderings -- possibly interactively -- suggesting a variety of alternative ways of understanding any pattern of strategies. Examples are illustrated by the following. That on the left is a variant of the crown polyhedron presented above, but with faces rendered one-sided, as is particularly evident on rotation. The others are variants of a 16-fold model presented above, exaggerating features reminiscent of a fortress of times past.

<table>
<thead>
<tr>
<th>Indications of aesthetic options of cognitive significance for representation of strategic configurations</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-fold (one-sided faces)</td>
</tr>
<tr>
<td><img src="image4" alt="4-fold (one-sided faces)" /></td>
</tr>
</tbody>
</table>

Hexagram and tetragram encoding? Of further interest is the manner in which the 6 great circles could be "turned on" or "turned off" in an animation, by emphasizing the lighting or rendering them partially transparent. This technique could instead be variously applied to the 4 rhombic forms with which 4 of the great circles are associated. The traditional lines of a hexagram would thereby be converted...
into stacked cylindrical rings -- if not stacked tori.

This would give the option of encoding the $2^6$ possibilities which are a feature of 16-fold organization. Extending the approach to the green circles would of course then give $2^4$ possibilities, namely the pattern held by the 64 hexagrams of the I Ching. Such a combination of 8-foldness is necessarily consistent with auspicious appreciation in Chinese culture.

### Three-fold and two-fold patterns -- by contrast?

This argument has focused on patterns of 4-fold configuration and higher. Given the facility offered by the Antiprism application, any contrast with a 3-fold and 2-fold configuration is therefore potentially of interest.

**Three-fold:** Separate consideration has been given to 3D representation of triadic symbols (Cognitive Implications in 3D of Triadic Symbols Valued in 2D: representations of the triskelion in virtual reality and implications for quantum consciousness, 2017; Psychosocial Learnings from the Spiral Form of Hurricanes: implications of the triple helix and the 3-fold triskelion as "cognitive cyclones"? 2017). As noted above, such consideration merits particular attention in a period of preoccupation with the Triple Helix model of innovation.

The following animations result from generating models according to the procedure described above.

<table>
<thead>
<tr>
<th>Animations 3-fold patterns derived from the 4-fold simplest torus (faces visible and transparent)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3-fold star torus</strong> (12 faces, 21 edges, 9 vertexes)</td>
</tr>
<tr>
<td><strong>3-fold dual of star torus</strong> (9 faces, 21 edges, 12 vertexes)</td>
</tr>
</tbody>
</table>

Generated by Antiprism as an OFF file, with animations displayed by Stella Polyhedron Navigator

**Two-fold pattern:** The possibility of a 2-fold pattern consistent with the process explored above is far from evident. It was therefore a surprise to discover that a "non-polyhedral" form could be generated by the Antiprism application as a VRML model, which could then be manipulated by a 3D viewer. The model as shown below appears "flat" -- as might be expected. The most instructive feature of the model is that two of the faces are coplanar -- meaning that they lie in the same plane, even though distinct colours have been attributed to the four faces of the form (however that is to be comprehended).

As a consequence, when the pattern is moved in any way, the four colours (red, blue, green, yellow) generate unpredictable interference patterns in the central portion of the model. This phenomenon only applies to the centre of the form, not to the extremes whose colours are not modified. Note that the edges, like the face planes, do not intersect as might be otherwise inferred from superficial inspection of the model -- but only at the vertex points. Note also that edges bounding the central (red) zone as it appears, are each coincidental (co-linear) -- hence the total of 10 edges rather than 8 (as appears).

A further issue of particular interest is the manner in which the software generates such a form for display in 3D (such as VRML). Since the display expects convex polygons, by default it will triangulate polygons. For a crossed quadrilateral (as in this case), this will involve adding an extra vertex, and hence more edges -- thereby modifying their indicated counts. With or without triangulation, display issues may be evident. It is for this reason that three display variants are presented as animations.

As a focus for further discussion, also presented below is the dual of the star torus -- of box-like form (as was evident in the 4-fold and other variants above).

<table>
<thead>
<tr>
<th>Experimental animations of 2-fold star torus pattern showing interference effects when displaced (note variation in numbering according to remarks above; numbering starts at 0, not at 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dual variant shown below in each case</strong></td>
</tr>
<tr>
<td>Triangulation before displaying (with no extra triangulation)</td>
</tr>
<tr>
<td>Triangulation with display (labels with original edge numbers, but displaying a triangulated model)</td>
</tr>
<tr>
<td>No triangulation (does not display correctly)</td>
</tr>
</tbody>
</table>

| ![Triangulation before displaying](image1) | ![Triangulation with display](image2) | ![No triangulation](image3) |
Psychosocial significance of representational constraints and interference effects? Display issues, and any modifications to the count of faces, edges and vertexes, can be understood as valuable to the use of such models as an illustration of challenges to comprehension -- the underlying purpose of the above argument. Perhaps remarkable is the fact that much metaphorical use is made of such terms from geometry in strategic discourse (points, lines, sides, etc), as discussed separately (Engaging with Globality -- through cognitive lines, circles, crowns or holes, 2009; Engaging with Globality through Cognitive Realignment: making points and aligning a target, 2009; Engaging with Globality through Cognitive Circles: learning/action cycles, 2009; Engaging with Globality through Cognitive Crowns: all-encompassing, well-rounded experience, 2009; Engaging with Globality through Knowing Thyself: embodying engagement with otherness, 2009).

In considering the challenge of representation in 2D (as so widely preferred), with respect to any constraints and "effects", there is a case for recalling the much-cited remark of Marshall McLuhan: the medium is the message.

Curiously the interference effects across the central zones of the 2-fold star torus help to make a basic point of this argument in stressing the value of a three-dimensional configuration of strategies rather than using 2D modalities. The confusing interference effects could be said to be characteristic of the chaotic relationships between distinctive strategic initiatives usefully representative of "violence".

This is evident when the pattern as a whole is seen from different orientations -- despite vigorous denial of any possibility of confusion on the part of their advocates (when committed to a binary perspective). The strategies can indeed be recognized as coherent "locally" (at the extremes of the form) -- when not subject to such interference in the "global" context to which they are claimed to apply. This is consistent with the argument above regarding conventional reinforcement of a "Flat Earth" perspective with respect to issues otherwise claimed to be "global". The merit of 4-fold and higher articulations is that such "violent" interference effects are reduced in ways which merit further consideration.

The presentation of the interference effects above is only indicative (and deprecated by developers of visualization software). However those effects recall the extensive studies, originated by Ernst Chladni, of so-called Chladni patterns. Given the potential relevance of wave-based theory for international relations (as indicated above), such figures are indicative of further possibilities for investigation (Theory behind patterns formed on Chladni plates? Physics Stack Exchange).

Square of opposition and Crossed quadrilaterals: the cognitive challenge?

Square of opposition: The argument was notably introduced by the preoccupation of logicians with truth tables, logical connectives and the geometrical representation of oppositional logic.

The square of opposition has long framed in diagrammatic form the relations between the four basic categorical propositions -- making the distinction between two oppositions: contradiction and contrariety. The term continues to symbolize the arena of professional logical preoccupation through the periodic International Congress on the Square of Opposition and its proceedings -- also named as the World Congress on the Square of Opposition.

As previously, themes at the most recent event have been extended to include: cubes, hexagons and stars, octagons and decagons, polyhedra and polytopes, n-opposition theory, and borromean. The Greimas semiotic square, derived from the logical square of opposition, is a tool used in structural analysis of the relationships between semiotic signs through the opposition of concepts, such as feminine-masculine or beautiful-ugly, and of extending the relevant ontology. The metaphorical emphasis is strangely reminiscent of the traditional symbolic preoccupation of Freemasonry with being "on the square" (Jean-Yves Beziau and Giunfranco Basti (Eds.), The Square of Opposition: a cornerstone of thought, 2017).

As an exercise in formalism, the relevance of such preoccupations to the tragic contexts of violent opposition in global affairs is strangely not a focus of concern. Indeed it would be difficult to trace much influence of these insights in fruitfully framing those dynamics (Fabien Schang, Making Sense of History? Thinking about International Relations, In: Leonid Grinin, et al (Eds.), Globalistics and Globalization Studies. Aspects and Dimensions of Global Views, 2014). In a period when global summits are edging towards the archetypal round table format, does emphasis on the square metaphor serve notably to reinforce a questionable pattern of governance (Reframing the Square (Wheels of Global Governance: transcending vain hopes of squaring the circle in global decision-making, 2017)?

Crossed quadrilaterals: Curiously, in geometric terms, the square of opposition and the Greimas square (as diagrams) feature what could be recognized as crossed quadrilaterals. Quadrilaterals are typically simple, namely not self-intersecting, or complex (self-intersecting) -- then known as crossed. The latter are also known as butterfly quadrilaterals or bow-tie quadrilaterals (see Crossed quadrilateral properties).

Such quadrilaterals have been variously acknowledged as an embarrassment by mathematicians, as most usefully described by Michael de Villers (I have a dream... Crossed Quadrilaterals: a missed Lakatosian opportunity? Philosophy of Mathematics Education Journal,
This paper starts with a bit of prose that satirizes the current practice of excluding crossed quadrilaterals from the math curriculum. It then briefly discusses how crossed quadrilaterals can be used by teachers to address the misconception that mathematics is an 'absolute science' by showing students how definitions often have to be changed and adapted in mathematics due to the discovery of so-called 'monsters'. Such a simple, accessible Lakatosian learning experience of modifying, adapting and reformulating a definition and a theorem can help tremendously to combat the pervasive myth that definitions and theorems are always static and fixed. So it is quite sad that generally the potential of engaging with crossed quadrilaterals, and examining their properties, is ignored by textbooks and, hence, by classroom teachers also.

Given the preoccupation with the geometrical representation of opposition and logical connectives, most obviously in the square of opposition, the question here is whether the quadrilaterals it embodies are to be considered crossed. This may indeed depend on the circumstances under which the diagram is used and understood -- especially in learning situations. When this is the case, the question is then whether there is an unrecognized degree of avoidance of their implication, as argued by Michael de Villiers. Is this avoidance evident in the use of polyhedral forms in which such crossings are less evident, even though they may be of greater complexity -- as with the hypercube?

<table>
<thead>
<tr>
<th>Crossed quadrilaterals implied by squares of opposition?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Square of opposition</strong></td>
</tr>
<tr>
<td>Greimas semiotic square</td>
</tr>
<tr>
<td>Crossed quadrilaterals of antiparallelogram</td>
</tr>
<tr>
<td>Crossed quadrilaterals in star torus</td>
</tr>
</tbody>
</table>

| Watchduck (a.k.a. Tilman Piesk) [Public domain], via Wikimedia Commons; | EmmaSofia515 [Public domain], via Wikimedia Commons | Prepared with Stella Polyhedron Navigator |

**Cognitive challenge**? With the concern in this argument for more comprehensively coherent mapping of complex strategic relationships, as "maps" the square of opposition (and the semiotic derivative) raise the question as to how appropriately they take account of the cognitive challenge implied by the crossed quadrilaterals they may be held to embody. Such crossings are indeed a feature of the star torus, as otherwise described above, and as can be recognized in the animation.

There seems to be no consideration of the potential implications of crossed quadrilaterals with respect to oppositional geometry, although in his widely cited thesis, Alessio Moretti notes in passing that:

> A logical square can be seen as composed of two crossed bi-partitions, a specular (i.e. symmetric) horizontal one (affirmative/negative) and a hierarchic (i.e. asymmetric) vertical one (universal/particular). (The Geometry of Logical Opposition, 2009, p. 81)

Succinctly expressed, is the challenge of crossed quadrilaterals irrelevant to oppositional geometry? If not, how is cognitive engagement to be discussed regarding mappings having such features?

**Problematic visual renderings**? There is a further aspect to the embarrassment in that the software enabling visualization of polyhedral forms characterized by such features is faced with technical problems of representation of such elements. Whilst evident to a degree in the earlier animations in this presentation, these are especially evident in the animations of the 2-fold variants of the star torus as generated by Antiprism. The argument here is that these seemingly embarrassing technical constraints offer valuable clues to a cognitive challenge.

A provocative insight is offered by the strategic challenge of engaging with the adaptive cycle, as mentioned above, as a focus of the Resilience Alliance. It is featured in a study by Thomas Homer-Dixon (The Upside of Down: catastrophe, creativity, and the renewal of civilization, 2006). Visually this can be depicted in ways which variously imply a cognitive crossing or twist, as presented below -- potentially to be associated with a circuit of such crossings around a star torus..

**Representation of adaptive cycle in complex systems**

(with many variants available via Google images)

(adapted from a variant of Thomas Homer-Dixon, The Upside of Down, 2006) 
(as reproduced from Panarchy, as described by The Sustainable Scale Project)
Much may depend on the manner of engagement with any such mapping, notably the nature and degree of cognitive identification with its features in discourse. The distinction could be understood in terms of that made by Douglas Hofstadter and Emmanuel Sander (Surfaces and Essences: analogy as the fuel and fire of thinking, 2013).

An indicative peculiarity, as stressed by Michel de Villiers, is that the angles at the crossing point do indeed total 360 degrees (superficially observed) – consistent with a “flat” perspective. Understood otherwise, and potentially far more appropriate to a global perspective, they total 720 degrees. The crossing point may then be experienced as a paradoxical nexus. That nexus is the place of “cross-purposes” and merits greater recognition as such with respect to the coherence of global strategy.

Shifting between strategic patterns: transmission systems and gearing

The fixation with particular patterns of strategies, whether the Sustainable Development Goals or the Millennium Development Goals, detracts attention from the possible need to shift between patterns according to circumstances. There is considerable familiarity with this need in terms of the mechanics of the variety of transmission systems, gearing and gearboxes. Arguably there is a uni-modal trap to be avoided. A case can be made for "conceptual gearboxes", possibly understood through other metaphors (The Future of Comprehension: conceptual birdcages and functional basket-weaving, 1980). The argument may be relevant to use of a succession of distinct patterns of strategies in the case of project "startups", the related startup ecosystem, and the notion of "gearing up".

Following the argument above, some sense of this can be presented through a set of crown polyhedra, as in the following animations using patterns from 2-fold to 20-fold. Those on the left derive from a model that is is not closed like a polyhedron, as it has edges that only lie on one face and can take the form of visible gaps.

Other mnemonic aids may be sought by associating orb and sceptre, as closely related symbols of integrative governance -- together with the crown. The argument with respect to the sceptre and its continuing symbolic importance (most obviously in the coordination of marching bands) is presented separately, from which the animations below are reproduced (Imagining local-global connectivity through innovative mace and vajra design, 2019). In the form of the globus cruciger, the orb has long been a symbol of authority. Of interest here, as illustrated by the following, is how such symbols could be related to comprehension of the integration of disparate strategies by rendering them in dynamic form. The mace/sceptre is of some relevance to the primary axis of symmetry of the crown, as discussed above with respect to the 16 (+1) Sustainable Development Goals. In that sense it can be understood as the central axis of any orb-like presentation.
Arguably there is a need for a mnemonic aid to the relationship between N-fold patterns, as is somewhat ironically suggested by the following Christmas song, used over centuries, whether or not it can be understood as having various levels of meaning, as explored by David Emery (Does "The Twelve Days of Christmas" Have a Hidden Meaning? Liveaboutdotcom, 18 July 2018). Clearly the pattern in the song on the left would need to be extended from 12 to 20, to encompass the 15-fold and 16-fold patterns mentioned above.

Of interest with respect to the gear metaphor, a bicycle may have 16 to 18 usable gear ratios. A truck may have 10 or more gears (9, 10, 13, 15 and 18 Gears - Shifting Theory | Drive Truck, Smart Drive, How to Shift an 18 Speed Transmission like a Pro, Smart-Tracking, 7 December 2018; How to use an 18 Speed Roadranger, TruckSales, 16 August 2018). Is the current global strategic challenge to be compared to this description of driving a 15-speed truck:

Now I’ll just touch on what a 15-speed is for a moment. If you get in a truck and it’s got a blue button in it, it’s a 15-speed. Now this is not a splitter in a 15-speed transmission. This is what is called deep reduction. And the best way to explain deep reduction on a 15-speed is that essentially you’ve got three tiers of five gears. Five gears way down in the basement, five gears on the main level, and five gears upstairs. Most of the time you’re going to drive a 15-speed like a ten-speed. 1,2,3,4,5, flip up the range selector, back over to low - and for those of us who drive 13s and 18s and then get into 15- that’s very weird for us to go back to low - but back to low 1,2,3,4,5 shift it like a ten-speed.

Now if you get into a gravel pit or something like that you need deep reduction, the best way to understand deep reduction in a 15-speed is like four-wheel drive low and four-wheel-drive hi. That’s the difference. And it’s not sequential, so if you’re in deep reduction in 15-speed you can’t go one, two, three, four, five and then split up to the next gear and go the other five. It’s more like up to five in the low low and then up to three on the next level. So it’s a little bit strange, but if you ever get into a 15-speed, just kind of play around with it and you’ll get use to it. But know that if the splitter is blue it’s a 15-speed; if it’s red, it’s 13; and if it’s grey, it’s 18. And in this day and age of non-synchronous transmissions, most of them are going to be 18-speeds. (9, 10, 13, 15 and 18 Gears - Shifting Theory)

Automobiles have a variety of relatively simple gear shift patterns with which many are familiar. Whilst there is considerable familiarity with shifting between many gears in vehicles of different types, this familiarity would appear to be totally lacking in the case of strategic patterns. It could be imagined that truck drivers have mnemonic aids with respect to learning the complex gear shift patterns, as shown below-centre. Curiously, however, there are many references to the "Truck Driver's Gear Change" as descriptive of modulation in music -- but not as a mnemonic device.

What appears to be required is some recognition of the value of the set of contrasting "strategic gears" as a whole (8-fold, 12-fold, 15-fold). The metaphor is also suggestive with respect to the relation between the strategies in any set -- as is so evident in driving a 15-gear truck. Driving in one gear only would be considered ridiculous. The question would then be what are the analogues to enable shifting between strategic patterns according to circumstances -- or to shifting between strategies within any one such pattern (as suggested below right).

### Mnemonic aids to a set of contrasting strategic patterns?

<table>
<thead>
<tr>
<th>Suggested by a well-known song?</th>
<th>As suggested by a gear shift pattern in trucks</th>
<th>Single pattern: UN SDGs as &quot;strategic gears&quot;</th>
</tr>
</thead>
</table>
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