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Managing Multidimensional International World With Spatial Grasp Model

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"Multidimensional international world" refers to understanding the world through multiple dimensions beyond traditional economic or political measures, fostering cross-cultural collaboration, and creating systems that balance global integration with local needs. This also includes management of global business operations across diverse cultures in a multipolar international landscape. The paper briefs the developed and already tested in numerous applications high-level Spatial Grasp Model and Technology (SGT), which can help investigate and manage complex systems with a holistic spatial approach effectively covering various physical and virtual dimensions, their interrelations, and integration as a whole. Different areas will be investigated with examples of practical solutions in them and their combinations in a high-level Spatial Grasp Language (SGL), the key element of SGT. This allows for the creation and distributed management of very large spatial networks with different orientation which can be self-spreading, self-analyzing, self-modifying, and self-recovering in complex terrestrial and celestial environments, and also organize dynamic multi-networking solutions supporting global evolution and integrity.

Keywords: multidimensional world, Spatial Grasp Technology, Spatial Grasp Language, distributed network operations, dimensions investigation and management, collective spatial solutions, global integrity

1. Introduction

The word "multidimensional" in relation to human societies may have different nuances, expressions, and particular meanings, including the following.

Multidimensional society is one that recognizes and analyzes complex issues through multiple perspectives, rather than a single-factor view. It moves beyond a simple or one-dimensional understanding to consider interconnected economic, social, cultural, and individual factors. For example, a multidimensional view of poverty looks at disadvantages beyond income, such as health, education, and access to resources (Kranzberg, 1970).

Multidimensional international relations recognize that global interactions involve diverse facets beyond politics and war, encompassing economic, cultural, technological, legal, social, and environmental dimensions. It highlights the complex, interconnected nature of these interactions between states, international organizations, non-governmental organizations, and multinational corporations, demanding a multidisciplinary approach to understand and address global challenges effectively (Shehu, 2024).

Multidimensional diplomacy: States often negotiate with each other over more than one issue at the same time. Unlike unidimensional bargaining, states can send costless signals about their resolve that have dramatic effects

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on other states' beliefs and actions. One reason is that when states claim a willingness to fight over an issue they in fact are not willing to fight over, they may lose the opportunity to get what they really want without conflict (Trager, 2011).

Managing international multidimensional worlds involves navigating of complex factors that impact multinational corporations, virtual teams, and global supply chains. This task requires expertise in strategic management, cross-cultural leadership, and risk mitigation to balance global integration with local adaptation. And managing the future is not just about managing the business, but also managing people and relationships (Medium.com, 2022).

The aim of this paper is to review and explain how the distributed international world is organized as a set of interacting, cooperating or even conflicting dimensions, and investigate potential applicability of the developed and tested in numerous applications Spatial Grasp Model and Technology (SGT) for effective management of this extremely large and complex multidimensional system.

The rest of the paper is organized as follows. Section 2 reviews different international dimensions, including political, economic, security, legal, cultural-social, and technological. Section 3 describes basics of SGT, SGL (Spatial Grasp Language), and their distributed implementation. Section 4 shows examples of distributed network operations in SGL which may be useful for the multidimensional management. Section 5 briefs the concepts of new project oriented on multidimensional world management under SGT, with an example of solving practical problem between two dimensions. Section 6 concludes the paper, and also names some other multidimensional features. References cite the publication sources used in different sections.

2. Different World Dimensions

Different international world dimensions will be briefed and explained with examples of related figures.

Political Dimension

The "international political dimension" refers to the various factors that shape the interactions and relationships between countries, including ideology, geopolitics, security, economics, and human rights. It encompasses the complex interplay of state and non-state actors on the global stage, influencing policies, alliances, and conflicts. Key aspects include power dynamics, diplomacy, trade agreements, and the impact of globalization on national sovereignty and governance (Dennana.in, 2024a; Mail.google.com, n.d.; Researchgate.net, n.d.a). An example of political network (Researchgate.net, n.d.b) is in Figure 1.

Economic Dimension

The "international economic dimension" refers to how countries interact through economic activities like trade, investment, and finance. It encompasses the study of how these interactions are shaped by factors such as supply and demand, international institutions, capital flows, and exchange rates. This dimension is crucial for understanding global patterns of trade, financial integration, and the economic consequences of international cooperation or conflict (Sanders, 1989; Wikipedia, n.d.; Sidenko, 2004). An example of trade network (Researchgate.net, n.d.c) is depicted in Figure 2 using a sample of all trades in 2011. Node sizes and edge thicknesses are proportional to degree and edge weight, respectively. The countries in the same community are depicted using the same color.

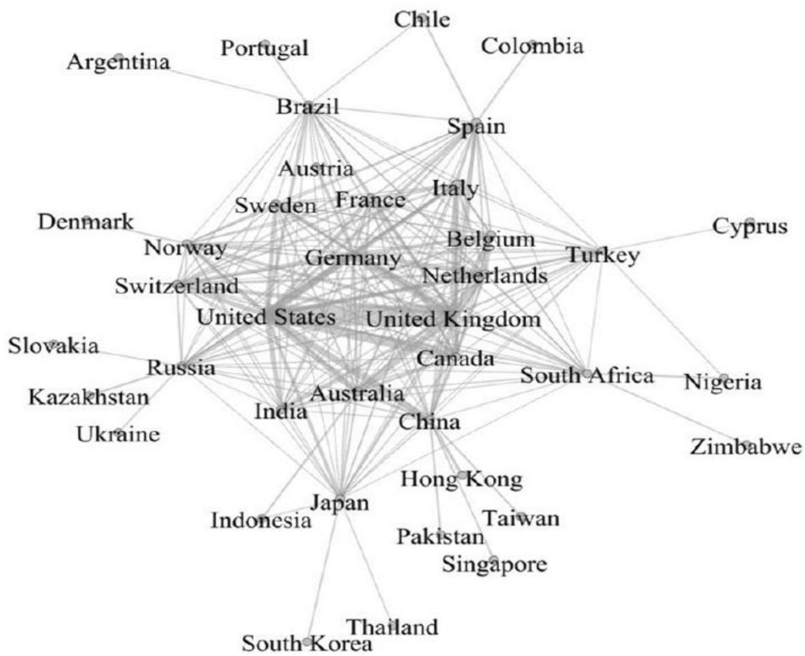

Figure 1. Political dimension example.

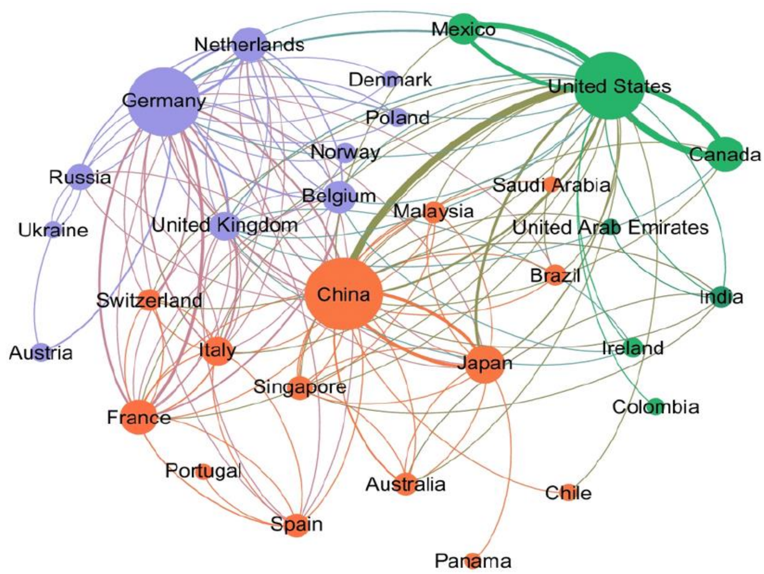

Figure 2. Economic dimension example.

Security Dimension

The term "international security dimension" refers to the various aspects and areas of global security, which include but are not limited to military, political, economic, environmental, informational (cyber), humanitarian, and biological dimensions. These dimensions are interconnected and cover a wide range of threats, from traditional armed conflicts to new challenges like climate change, terrorism, and cyberattacks. Addressing these challenges requires international cooperation and comprehensive strategies (Gasteyger, 1985; Mahabbat, 2024; Ganesh, 2025). The areas of largest military alliances (Pawlak, 2025) (in different colors) are in Figure 3.

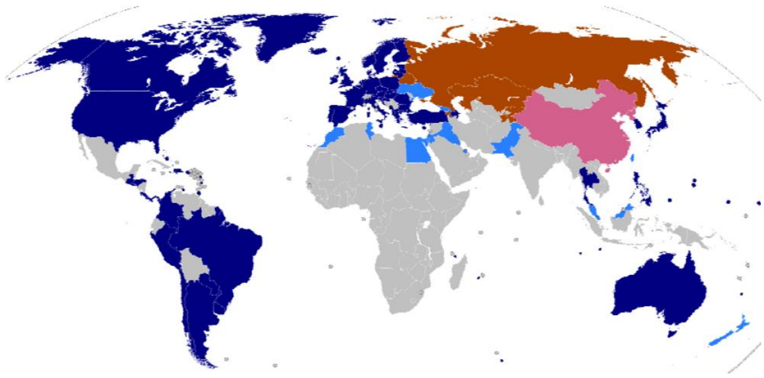

Figure 3. Security dimension example.

Legal Dimension

The “international legal dimension” refers to the legal framework governing the interactions between states, international organizations, and individuals across national borders. It includes a wide range of issues such as international humanitarian law, human rights law, trade, and environmental protection. This system relies on treaties, customary law, and principles of law to establish rules and norms for global conduct, and its enforcement depends on factors like state consent, diplomacy, and international institutions rather than a single global authority (Manton, 2018; Zabara, 2017; Murphy, 2012). An example of legal dimension network (Researchgate.net, n.d.d) is in Figure 4.

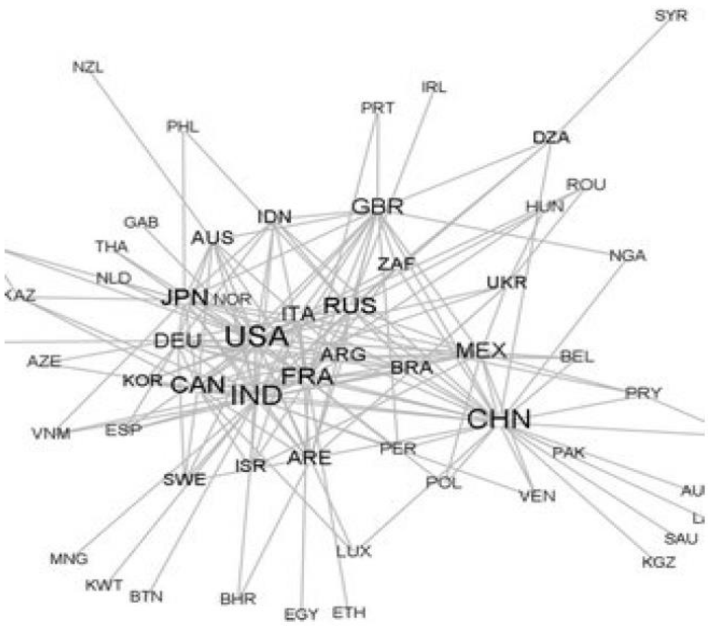

Figure 4. Legal dimension example.

Cultural and Social Dimension

The “international cultural and social dimension” refers to the interconnectedness of people, societies, and cultures across the globe, shaped by the movement of ideas, knowledge, and people. It encompasses the shared values, beliefs, and practices that link or differentiate cultures, and includes aspects like globalization’s impact on social structures, the rise of hybrid cultures, and the way social and cultural factors influence global interactions and policies. It also involves the study of how cultures adapt and merge, creating new forms of expression and identity in an increasingly interconnected world (Manton, 2018; Zabara, 2017; Murphy, 2012). A symbolic global cultural and social network image is in Figure 5.

Figure 5. Symbolic cultural and social dimension network.

Technological Dimension

The “international technological dimension” refers to the global nature of technology’s generation, diffusion, and application across borders, impacting international business, cooperation, and competition. It involves studying the global distribution of research and development, the international flow of technology, and the role of technology in globalization and global challenges. This dimension can be analyzed through metrics like technology achievement indices and by examining international collaborations, technological competition, and the use of technology to manage global operations and supply chains (Dennana.in, 2024b; Narula & Zanfei, 2023; Farahat, 2001). An example of topological structure of scientific collaboration network (Gui, Liu, & Du, 2019) is in Figure 6.

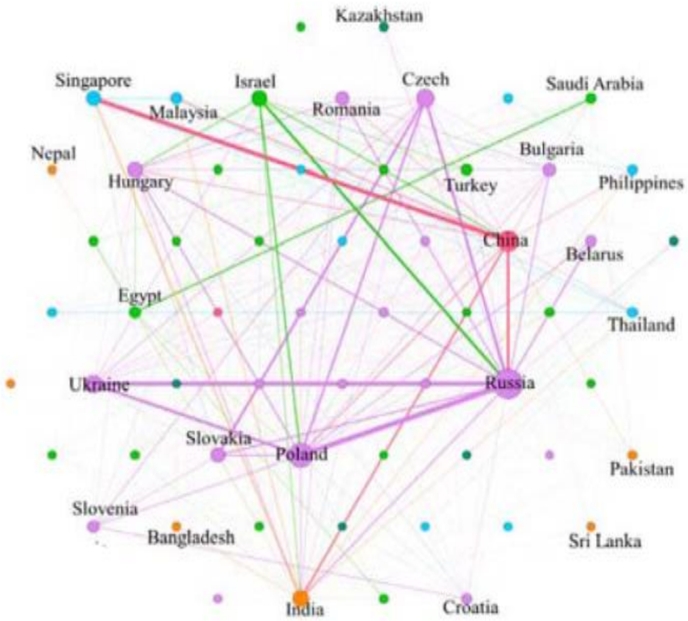

Figure 6. Technological dimension example.

3. Spatial Grasp Model and Technology

General Issues

Within Spatial Grasp Model and Technology (SGT) (Sapaty, 1993; 1999; 2005; 2017; 2018; 2019; 2021; 2022; 2023; 2024a; 2024b; 2024c; 2024d; 2024e; 2025a; 2025b; 2025c), a high-level operational scenario expressed in recursive Spatial Grasp Language (SGL), starting in any world point or points, *propagates, covers, and matches the distributed environment in parallel wavelike mode*, as symbolically shown in Figure 7. Such propagation can result in returning and analyzing the reached states and data which may be arbitrarily remote, to be used for launching more waves, also jointly in both cases.

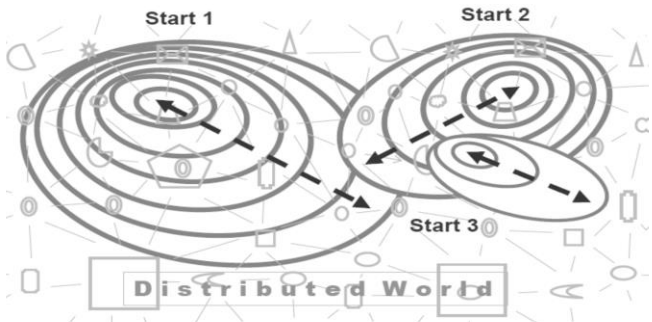

Figure 7. Parallel recursive world coverage with Spatial Grasp Model.

The distributed worlds this model is effectively covering, conquering, and managing may be of different types: *Physical World (PW)*, considered as continuous and infinite where each point can be identified and accessed by physical coordinates; *Virtual World (VW)*, which is discrete and consists of nodes and semantic links between them, and *Executive World (EW)*, consisting of active doers, which may be humans or robots, with advanced communication possibilities between them. Different kinds of combinations of these worlds can also be possible within the same formalism.

Spatial Grasp Language (SGL)

The SGL allows for organizing direct space presence and operations with unlimited powers and parallelism. Its universal recursive organization, with operational scenarios called *grasp*, can be expressed by a single formula:

grasp → *constant* | *variable* | *rule* ({ *grasp*, })

The *rule* expresses certain action, control, description, or context accompanied with operands, which can be any *grasps* too. Other top SGL details can be expressed as:

constant → *information* | *matter* | *custom* | *special*
variable → *global* | *heritable* | *frontal* | *nodal* | *environmental*
rule → *type* | *usage* | *movement* | *creation* | *echoing* |
verification | *assignment* | *advancement* | *branching* |
transference | *exchange* | *timing* | *qualifying*

The rules, starting in certain points, can organize navigation of the world sequentially, in parallel, or any combinations thereof. They can result in the same application points or cause movement to other world points with obtained results left there or returned. The final points reached can become starting ones for other rules. The rules, due to recursive language organization, can form arbitrary operational infrastructures expressing sequential, parallel, hierarchical, centralized, up to fully decentralized and distributed algorithms.

SGL Interpreter Organization

The SGL interpreter consists of specialized modules working with specific data structures, serving SGL scenarios or their parts happened to be inside this interpreter, also organizing exchanges with other interpreters for distributed SGL scenarios. Each interpreter copy can process multiple active scenario code propagating in space and time. Communicating SGL interpreters can be in arbitrary number of copies effectively integrated with other existing systems and communications, representing altogether *powerful spatial engines* operating without central resources or control. Hardware or software SGL interpreters, shown in Figure 8 as universal control and processing units effectively working with spatial graph and network data, can be installed, also runtime created, in proper physical or virtual world points.

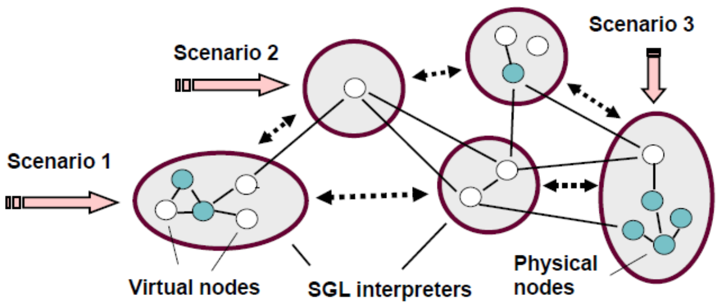

Figure 8. SGL distributed networked interpretation.

As both backbone and nerve system of the distributed interpreter, its self-optimizing *Spatial Track System* provides hierarchical command and control, also remote data and code access. It supports spatial variables, which can be mobile, and merges distributed control states for making decisions at different organizational levels. This spatial infrastructure, effectively supporting global integrity of distributed solutions, is automatically distributed between active components (humans, robots, computers, smart-phones, satellites, etc.) during SGL scenario self-evolution in space and time.

4. Examples of Network Operations

We will consider here only some basic operations on distributed networks in SGL (with many more in previous publications (Sapaty, 1999; 2005; 2017; 2018; 2019; 2021; 2022; 2023; 2024a; 2024b; 2024c; 2024d; 2024e; 2025a; 2025b; 2025c)), which may be useful for dealing with different world dimensions like those mentioned in Section 2 (using networks as effective models for dealing with large collections of points and their complex interrelations).

Network Representation, Creation

A network example in the form of a graph with named nodes and links is shown in Figure 9.

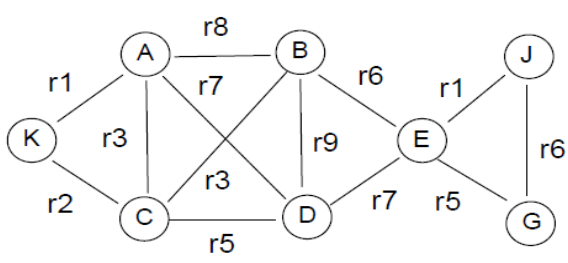

Figure 9. Representation of distributed network topology.

Compact textual representation of this network assigned to variable “Top” (with node names followed by lists of named links leading to named neighbors) may be as follows.

```
Top = (K:(r1:A, r2:C), A:(r1:K, r8:B, r7:D, r3:C),
      C:(r2:K, r3:A, r3:B, r5:D), B:(r8:A, r3:C, r9:D, r6:E),
      D:(r5:C, r7:A, r9:B, r7:E), E:(r6:B, r7:D, r1:J, r5:G),
      J:(r1:E, r6:G), G:(r5:E, r6:J))
```

Creating full topology in parallel (with named nodes and named links to other nodes) can be done by the following scenario (resolving competition of neighboring nodes attempting to create the same link between them).

```
Top = …;
align(split(Top); frontal(NN) = VAL[2]; create_node(VAL[1]));
split(NN); NAME > VAL[2]; linkup(VAL[1], node(VAL[2]))
```

Finding Any Path Between Two Nodes

We may, starting in some node like “K”, reach any other node like “G”, by the following SGL scenario navigating the network in wavelike mode, i.e. stepwise, in parallel, and without cycles.

```
hopfirst(K); frontal(Path = NAME);
repeat(hopfirst(all_links); Path &&= NAME;
if(NAME == G, done_output(Path)))
```

This, for example, may give: (K, A, D, E, G) for Figure 9.

Shortest Path Tree (SPT) From a Node to All Other Nodes

We may easily create Shortest Path Tree (SPT) from a node to all other nodes, and the following scenario can accomplish this with re-registering the SPT predecessor nodes in variable “Up” in all nodes except the starting one, which is chosen here as “A”.

```
nodal(Dist, Up); hop(A); Dist = 0; frontal(Far);
repeat(
hop(links_all); Far += 1;
or(Dist == nil, Dist > Far); Dist = Far; Up = BACK)
```

SPT will be embedded into the network structure with variable “Up” in all nodes.

Shortest Path Between Two Nodes

Starting in any node of the obtained SPT, say “J”, and following the records in variable “Up” in nodes, we can easily receive shortest path to it from the head of the SPT, i.e. “A” in our case.

```
hop(J); Spath = NAME;
repeat(hop(Up); Path = NAME && Path); output(Spath)
```

A possible result will be: (A, B, E, J) for Figure 9.

Finding Strongest Sub-networks, or Cliques

The following scenario is finding all cliques in parallel in the network of Figure 9 with the number of nodes not less than four (only one such clique can be found in the figure).

```
hop_nodes(all); frontal(Clique) = NAME;
repeat(
```

```
hop_links(all); not_belong(NAME, Clique);
yes(and_parallel(hop(links_any, nodes(Clique))));
if(PREDECESSOR > NAME, append(Clique, NAME), blind));
count(Clique) >= 4; output(Clique)
```

This scenario, starting in all nodes and following their links to other nodes in parallel, is collecting node names in new individual hops which have links with all previously collected nodes unless such nodes cannot be found, declaring the collected set of node names in the frontal variable "Clique" as a new clique (if the number of nodes in it four or more).

Result: (A, B, C, D).

Discovering Weakest, or Articulation Points

Weakest or articulation points, when removed, split the network into disjoint parts (like node "E" in Figure 9). Next is parallel and fully distributed solution for finding all articulation points in the network, by which each network node tries to navigate and mark the whole network from it (via a single neighbor only), while excluding itself from this spatial process.

```
hop_nodes(all); IDENTITY = NAME;
hopfirst_node(current);
stay(hopfirst_random_choise(links_all);
repeat(hopfirst(links_all)));
if(hopfirst(links_all), output(NAME))
```

The answer will be "E", as the only articulation point in the network considered.

5. Multidimensional Management Under SGT

Different international areas are being investigated under SGT with the help of SGL, oriented on finding useful practical solutions in them and their combinations. The general view of this project organization is depicted in Figure 10, consisting of overlaying and communicating spatial dimensions, and Global Management (GM) system allowing for entering, analyzing, and optimizing different dimensions and their interactions as the unified whole.

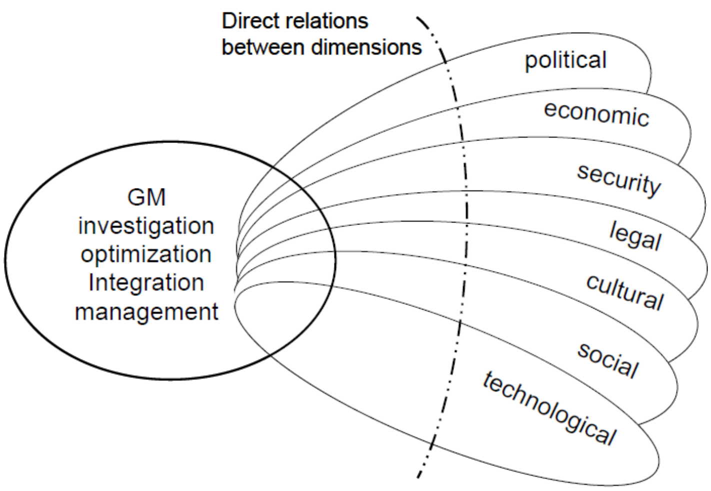

Figure 10. Multidimensional management project.

The following examples can show how to enter different dimensions, investigate and solve problems in them, and how the solutions found can influence operations and results in other dimensions, altogether benefitting the whole system organization, improvement, and management.

Entering Dimensions From GM

1. Entering particular dimension: enter (political).
2. Entering a number of dimensions in parallel: enter (political, cultural, ...).
3. Entering all registered dimensions in parallel: enter (all).

These movements can originate from the central GM "office", or from the already reached points inside some dimensions. Reaching these areas, you can enter any nodes in them and operate any needed scenarios, like following:

enter(political); hop_nodes(name_1, ..., name_n); <operate>

But if staying in a node in some dimension, and eager to directly convert into *the same named node* (or nodes) in other dimensions (if such nodes exist) and operate there, thus avoiding the return to GM, you may use special through-dimensional operation shift for this, as follows.

<staying in a node>; shift(economic, technological, ...); <operate>

An Example of Multidimensional Optimization

We will consider here an example of how the findings in one dimension can influence a related solution in other dimension, considering for this a possible interplay of political and economic dimensions in international systems.

1. Finding *most powerful economic countries* using network example of Figure 11, which symbolically reflects economic powers of different countries by sizes of the respecting nodes, taking into account that the countries of interest for this request should have personal economic "POWER" exceeding some "threshold".

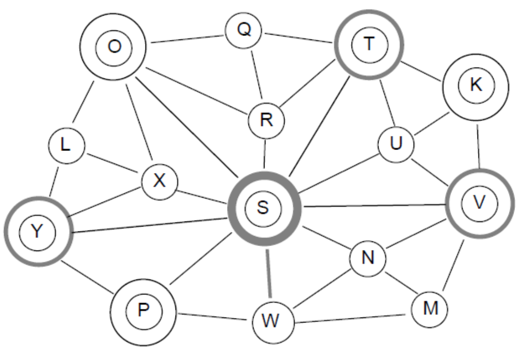

Figure 11. Node powers in economic dimension network.

Initially staying in GM, entering the "economic" dimension with the registered countries-nodes in it, and then returning to GM the found results with proper node names collected together in the variable "Nodes", the solution in SGL may just look like follows:

Nodes = (enter(economic);

hop(all_nodes); POWER > *threshold*; NAME)

2. Having received the list of names of powerful economic nodes (i.e. exceeding in "POWER" the given "threshold"), supposedly including nodes "S, T, V, Y" of Figure 11, we will be trying now to *establish additional economic-political relations between same named nodes* within the political dimensions network (as shown with

dotted links in Figure 12). This is in hope that such new links may be useful for developing both economic and political cooperation between these countries, thus benefitting the global development and prosperity.

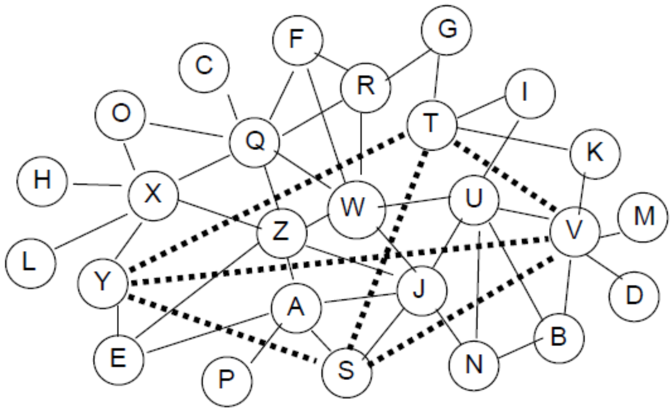

Figure 12. Adding new economic-political relations in the political network.

The full integral solution involving the sequence of operations in both dimensions will be as follows, with "eco_policy" as the name of new economic-political relations in the political network:

frontal(Nodes) = (enter(economic);
hop(all_nodes); POWER >= *threshold*; NAME);
enter(political); hop(Nodes); split(Nodes);
if(NAME > VALUE, linkup(eco_policy, node(VALUE)))

More dimensions may need to be considered for such a solution, rather than just two, including others mentioned in Section 2 like cultural, legal, security, and technology. Otherwise, it may happen not so useful for the global system, and could potentially lead to problems or even conflicts. This may also depend of the globality of networks of Figures 11 and 12, where considering only two networks may be sufficient for a separate country, but growing number of dimensions may happen to be needed if moving to groups of countries, continents, up to the global international world.

Other important things, as follows. We have found and organized the inter-dimensional solution each time starting from and returning to the same GM. But it may also happen to be very useful when the inter-dimensional analysis and solutions are organized as self-penetrating, self-evolving, and self-organizing recursive spatial scenarios *directly propagating between different dimensions*, and not each time via the GM. And such scenarios may be solving very important and complex security or defense tasks, with any numbers of them operating collectively and in parallel. All this can be organized with the use of SGT and SGL in a distributed and combined physical and virtual environment, as mentioned in Section 3 about how and when this spatial paradigm can operate.

Different such solutions are being investigated and planned within this new SGT-based multi-dimensional project, and will be presented in the following publications, a planned new book too.

6. Conclusions

The paper confirms the necessity and high importance of understanding the distributed international world through its multiple dimensions, which needs detailed investigation separately and collectively to guarantee the proper world development. It also confirms suitability and efficiency of the developed SGT-SGL paradigm for investigating, modifying, and improving different dimensions and their holistic integration and management, where effective operations and solutions for the networked dimensions can be organized in parallel and fully distributed mode. Moreover, such solutions, potentially multiple and simultaneous, can self-spread in a super-virus mode, *providing the international world with powerful flexibility, security, and self-recovering features*. The latest SGL version can be effectively and quickly implemented in traditional environments and recommended to different local and global institutions, UN including, for the support of stability and evolution of the international community.

More multidimensional features can be investigated and managed under SGT, including the following. *Multidimensional danger* refers to a complex risk or threat that has multiple, interrelated facets, impacting different areas simultaneously rather than being a single, isolated problem. It is applied in fields like finance, cybersecurity, and risk assessment for disasters (Hammond & Hyslop, 2018). *Multidimensional crisis* is a complex and interconnected set of risks and challenges that simultaneously impact various facets of society, such as public health, the economy, social structures, and politics, involving compounding risks that amplify one another (Dinan, Nugent, & Paterson, 2017). *Multidimensional stress* is also a multidimensional construct that comprises exposure to events, perceptions of stress, and physiological responses to stress. Research consistently demonstrates a strong association between stress and a myriad of physical and mental health concerns (Dorsey, Scherer, Eckhoff, & Furberg, 2022).

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