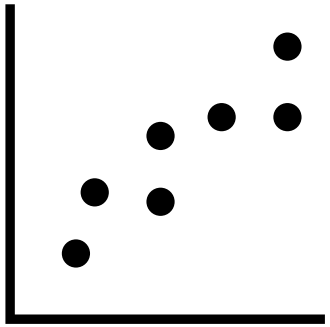
SSC/IA



Capturing Partner Nations' Space Capacities in a Number

Background Research: RAND Corporation

- Backed by the Office of the Sec of Def (OSD) → RAND executed and published research to analyze the effectiveness of US DoD security cooperation (SC) amongst the COCOMS.

OUTCOMES:

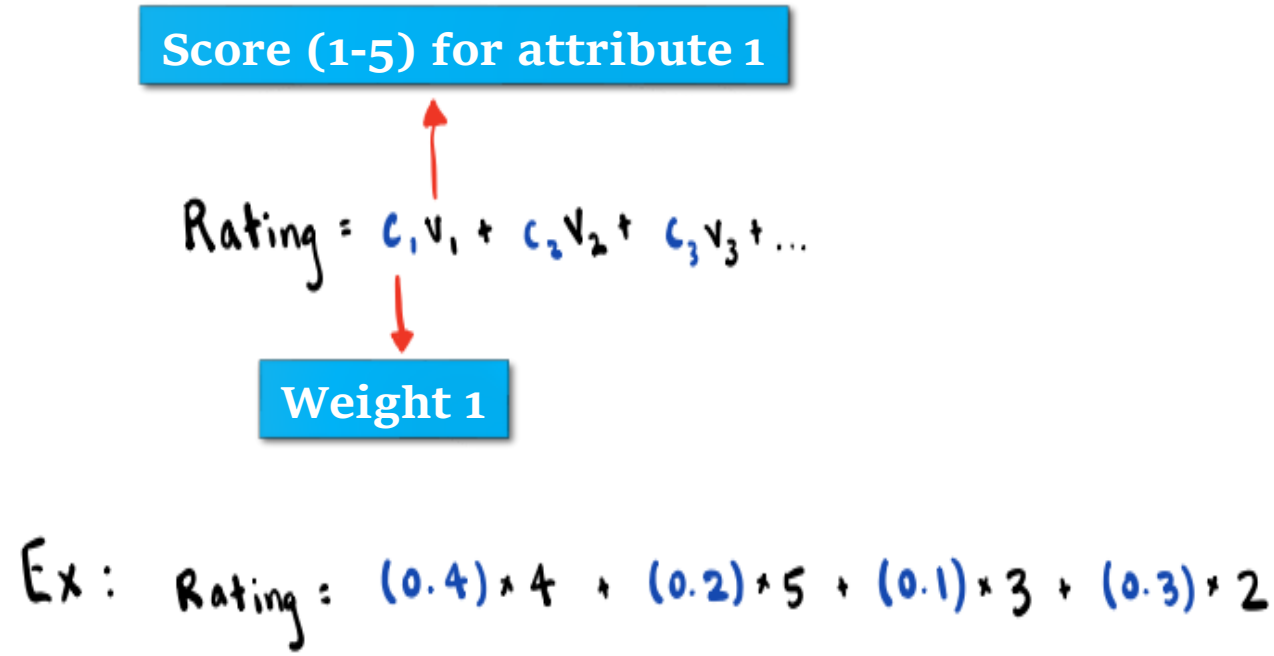
- A.M.E. (Assessment, Measurement, Evaluation) method for analyzing SC projects.
- SC rating mechanism in which project attributes are *scored* (by CCMD personnel and somewhat informed by data), *weighted* according to "senior leader preference", and finally *summed* to yield a final rating.
- These SC project ratings are intended to define priority of evaluation given the DoD's limited resources and massive SC project pipeline.
- Some recommended attributes: Priority LOE, Project Cost, and Innovativeness of Concept

Background Research: The Formula Visualized

Table 4.7
Notional Evaluation Weighting and Scores

Measure	Source	Scale	Weight
Security cooperation and/or OSD planning guidance	Security cooperation and/or OSD planning guidance	5-point scale	40%
Priority LOE	CCMD data or rating	5-point scale	30%
Importance of project to partner nation	CCMD rating	5-point scale	15%
Cost of project	G-TSCMIS planning data	$40 million or greater = 5 $30–39 million = 4 $20–29 million = 3 $10–19 million = 2 Less than $10 million = 1	10%
Innovativeness of concept	CCMD rating	Binary: 5 or 0	5%

NOTE: This table assigns a possible five points to each country for strategic priority, though no point system currently exists for this purpose. The prioritization scheme would require points to be assigned to each country consistent with security cooperation and/or OSD planning guidance.



SSC/IA - Partnership Capacity Metric

- Drawing on the RAND Corp's rating mechanism, the Partnership Capacity (PC) metric is designed to numerically aggregate a (potential) partner nation's attributes that are relevant to space military partnerships.

<u>Two Major Adaptations of RAND's Rating Model:</u>

- **Country Focused –** attributes in the PC model pertain to countries (not projects) i.e. *Space Military Budget, Space Capability Breadth, In-Orbit Payload Counts, etc.*
- **Attribute Scoring is Objective –** rather than having SSC personnel score attributes (exposing the metric to non-numerical bias), attributes' scores are computed using percentiles.
  - Ex: (If we assume a 6-tier system) Suppose Germany's Space Mil Budget is the 78th percentile of all potential partner countries. Germany would then be assigned to tier 5 for this attribute since tier 5 countries fall between the 67th and 83rd percentiles. By design, we split 100 possible percentiles into 6 groups; the 5th tier becomes the 2nd highest range of values out of those 6 groups.

Partnership Capacity Metric - Upside & Dynamic Utility

Upside:

- Incorporates *multiple* attributes (attributes = sub-metrics) into a *singular numerical profile* to measure nations against other nations or groups of nations in terms of space partnership capacity.
- Easy to add, remove, or change attributes according to the determined relevance and *data availability*.
- This model fundamentally supports *relative* comparisons of nations due to the use of percentiles in the tiering procedure. HOWEVER, this model is adaptable to support *absolute* comparisons or a hybrid of both relative and absolute sub-metrics.

Dynamic Utility:

- This model supports multiple perspectives on partnership capacity with the ability to *modify weights* attached to attributes. For example, FMS might assign greater weight to the financial health attribute of a nation than other teams like the CAWG.

Initial Findings

The 3 attributes I used were those that were publicly available, reliable (source of data being a gov body or associated body), and indicative of space-faring bandwidth. In other words, these *general* attributes are intended to provide an *initial & broad overview* of the landscape and are by no means concrete.

Attribute 1: The nation's military budget divided by their GDP

Attribute 2: The proportion of indigenous capabilities possessed by a nation out of SSA/SDA, PNT, ISR, SATCOM, and Launch (AATS)

Attribute 3: A count of the nation's in-orbit payloads

Arbitrary weights initially assigned: Attribute 1 – 20% ; Attribute 2 – 50% ; Attribute 3 – 30%

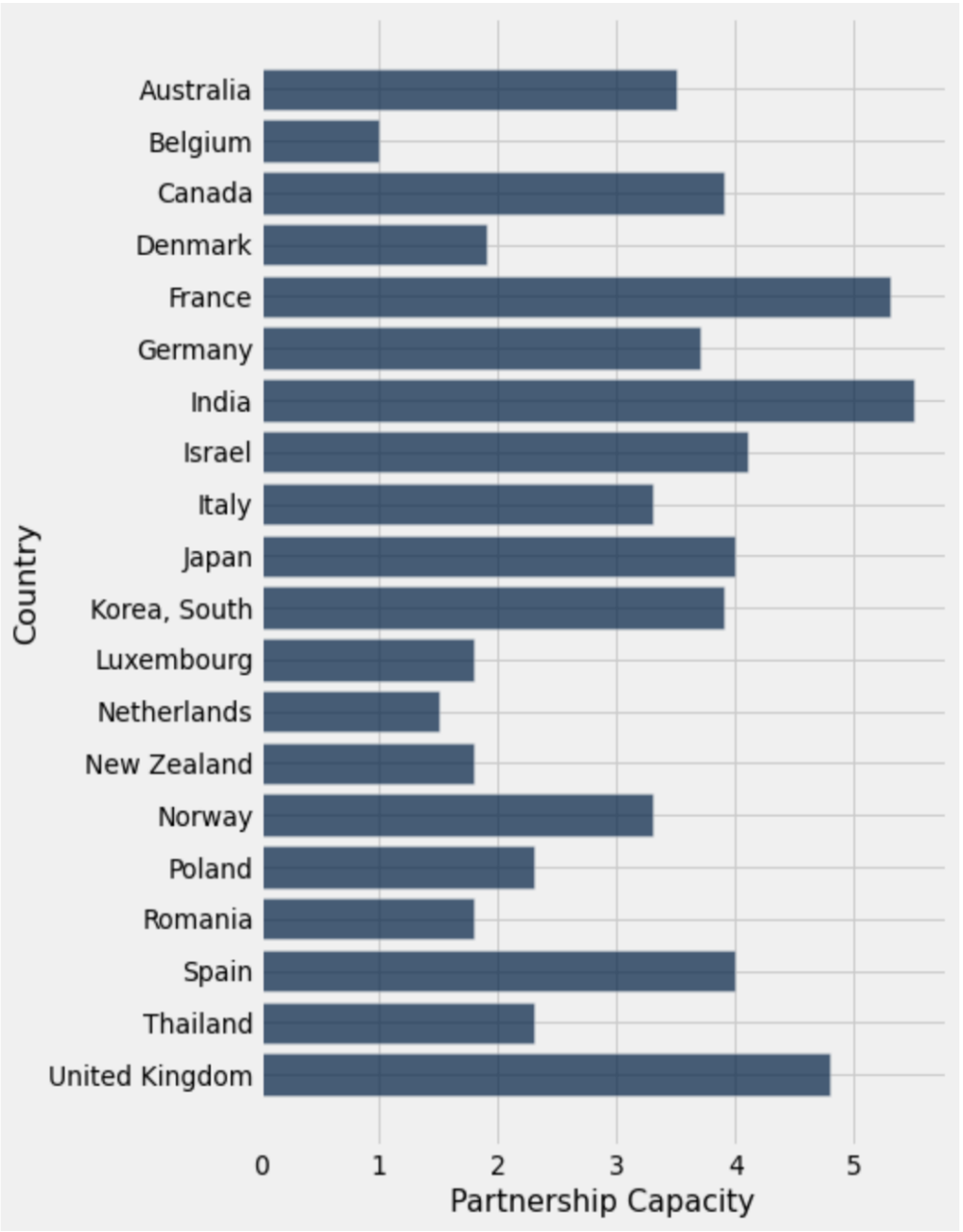
Initial Findings

Using python, I created and groomed a database containing attribute data by country

Next, I designed functions to compute countries' tiers using percentiles

Finally, I computed the first edition of the partnership capacity metric for each country and displayed the results →

Country	Partnership Capacity
Australia	3.5
Belgium	1
Canada	3.9
Denmark	1.9
France	5.3
Germany	3.7
India	5.5
Israel	4.1
Italy	3.3
Japan	4
Korea, South	3.9
Luxembourg	1.8
Netherlands	1.5
New Zealand	1.8
Norway	3.3
Poland	2.3
Romania	1.8
Spain	4
Thailand	2.3
United Kingdom	4.8



PC Metric - Downsides & Automation Potential

Downsides:

- This metric is designed to aggregate several attributes under a single number. Inherently, this model is not conducive to evaluation on the basis of a unique (or singular) attribute.
- For the sake of simplicity, this model defines a *linear* relationship between PC and its component attributes. It would be worth investigating whether PC would be more accurately constructed through non-linear (or non-tiered) attributes (I.e. quadratic, exponential, etc.).

Automation Potential:

- Upon my limited experience (2 years of academic exposure) with statistical and mathematical programming, I found this metric relatively straight forward to compute. With more data, machine learning (ML) techniques could be implemented to improve the output of this model.

Sources

RAND Corp Study:

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Military Budget and GDP Data:

https://sipri.org/sites/default/files/2021-04/fs_2104_milex_0.pdf

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https://fred.stlouisfed.org/

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In-Orbit Payload Data:

https://aerospace.csis.org/data/space-environment-total-payloads-launched-by-country/

https://spacefund.com/launch-database/

Other (Secondary):

Internal SSC/IA reports