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Organizational Capabilities in a Government R&D Enterprise

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Question

Can systems engineering methodology help with managing and evolving Government R&D Capabilities?

Broad challenges

- The ability to understand the enterprise well enough to identify likely impacts of contemplated decisions

- The ability to coordinate planning and decision making amongst stakeholders across the enterprise

The nature of government R&D organization (1/2)

- Unpredictable workload
  - Projects can access renowned experts from many disciplines as they plan and execute the work
  - Workload unpredictability can make it challenging to cultivate top notch / unique talent
- Ongoing sustainment costs
  - Obligated to sustain readiness with respect to the department's primary mission, even in the programmatic lulls
  - This "mortgage" can limit the funding available to cultivate new capabilities
- Competing requirements
  - Funding requests exceeds the DOE's ability to underwrite
  - Funding priority is legacy systems that must be sustained far beyond systems in most other domains

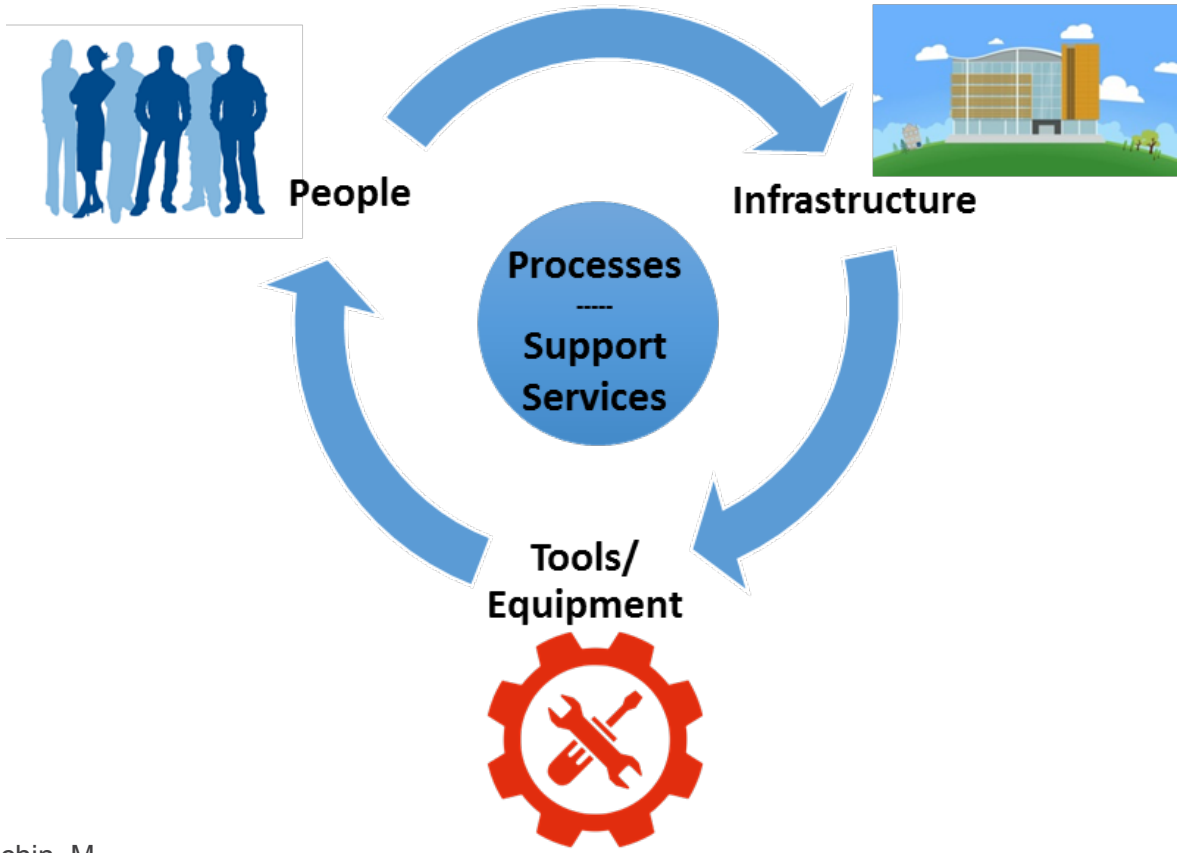
The nature of government R&D organization (2/2)

- Diffuse decision making
  - DOE organizations operate with a large degree of independence, each managed by different contractors
  - Government oversight relies heavily on the expertise of the organizations it oversees
- Complex dynamics
  - Portfolio of capabilities are quite diverse and unique
  - Mission level dependencies across the enterprise is difficult to access and maintain
- Political context
  - External influences - changing political priorities or financial disruptions owing to Congressional budget
  - Political influence / world events can suddenly disrupt decisions long advocated and planned
- Statutory constraints
  - Federal rules that limit the ability adopt certain capability management best practices
  - Statutory constraints limits the degree to which the enterprise's organizations can diversify

Worldviews

Our organization

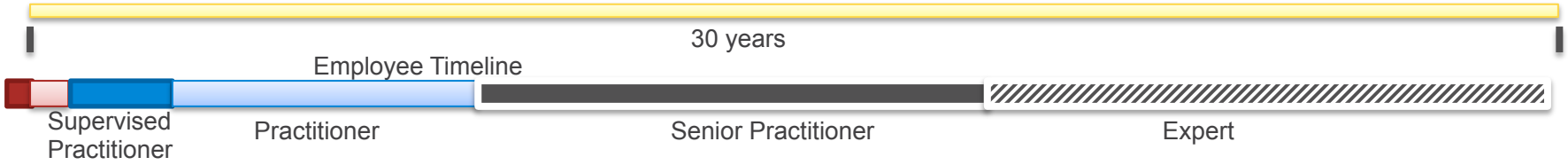
- “has capabilities”
- “manages interdependencies between capabilities”
- “reconfigures available assets, people and processes quickly to meet current circumstances”
- “decides/balances in which capabilities to invest”
- “describes solution independent requirements”



Components of Capabilities

Henshaw, M., Kemp D., Lister, P., Daw, A., Harding, A., Farncombe, A., and Touchin, M., 2011.“Capability Engineering – An Analysis of Perspectives”, INCOSE International Symposium, June 2011

Nominal career progression for researchers



Stage	Description	Nominal Duration
Pre-hire	The time from when the need is identified and a potential posting is possible until the time that someone is actually located on site and initiated into the organization (HR matters, training, clearances, etc.)	6-18 months (Lyons, 2012), the need for clearances in the government R&D context can drive this closer to 18 months end of the spectrum
Supervised Practitioners	The time that the person is learning about the specific research conducted at the organization, the missions supported, the experts in their area, and the limits of the capabilities that are part of the organization.	18-36 months, in some specialties within the author's organization, staff may work even longer before being able to function unsupervised.
Practitioner	The time during which the researcher is building their specialty and performing largely as an individual contributor. They are publishing internally and externally as much as possible.	5 to 10 years
Senior Practitioner	During this time the researcher is leading projects and potentially bringing in projects. They are formulating the direction of the research and are contributing less as an individual contributor, but are still publishing often as a lead author with a team of researchers.	7 years or more (possibly to the end of a career), depending on how successful and unique the research contributions are to the organization.
Expert	This stage is reserved for about 10 % of the population of researchers. The Experts are the staff that is well known for their research and often have patents that contribute to corporate royalty accounts.	Mid to late career

Capability components

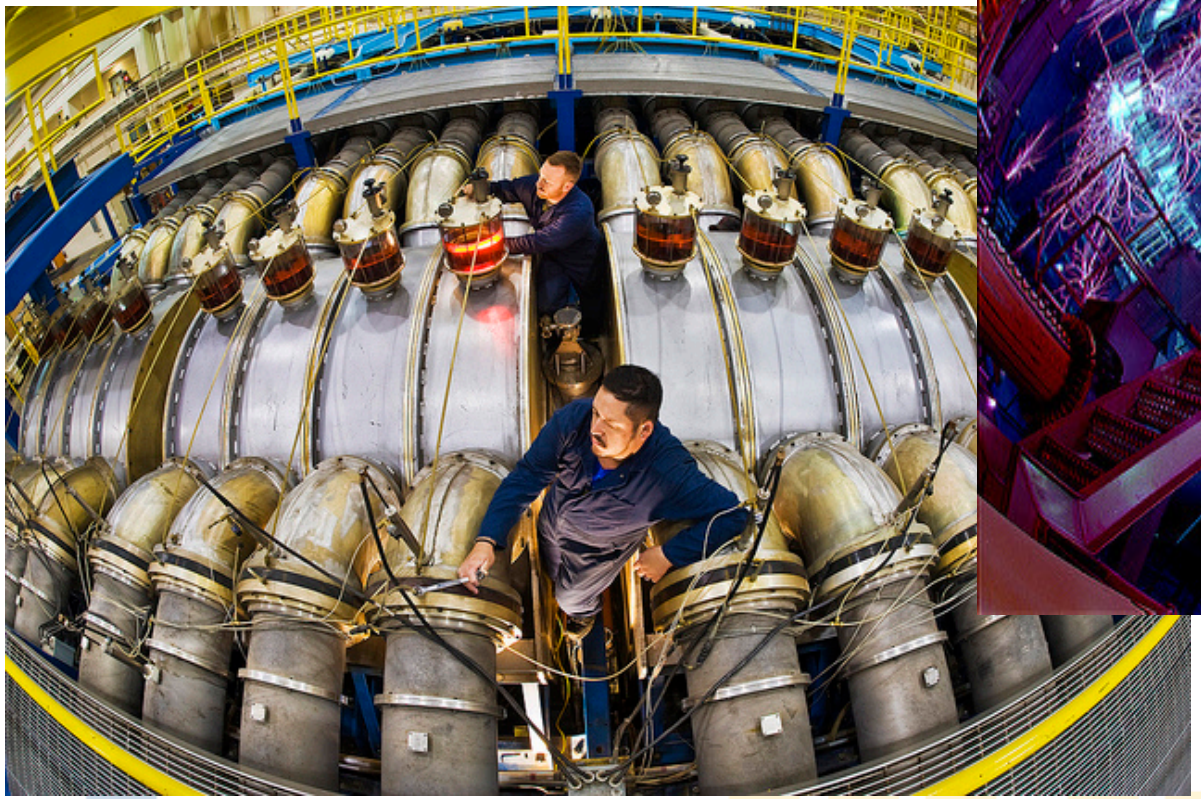
- People
  - Pipeline – retention especially for developing capability (Senior Practitioners & Experts)
  - Instability in funding
  - Highly specialized staff versus fungible
  - Deliberate succession planning

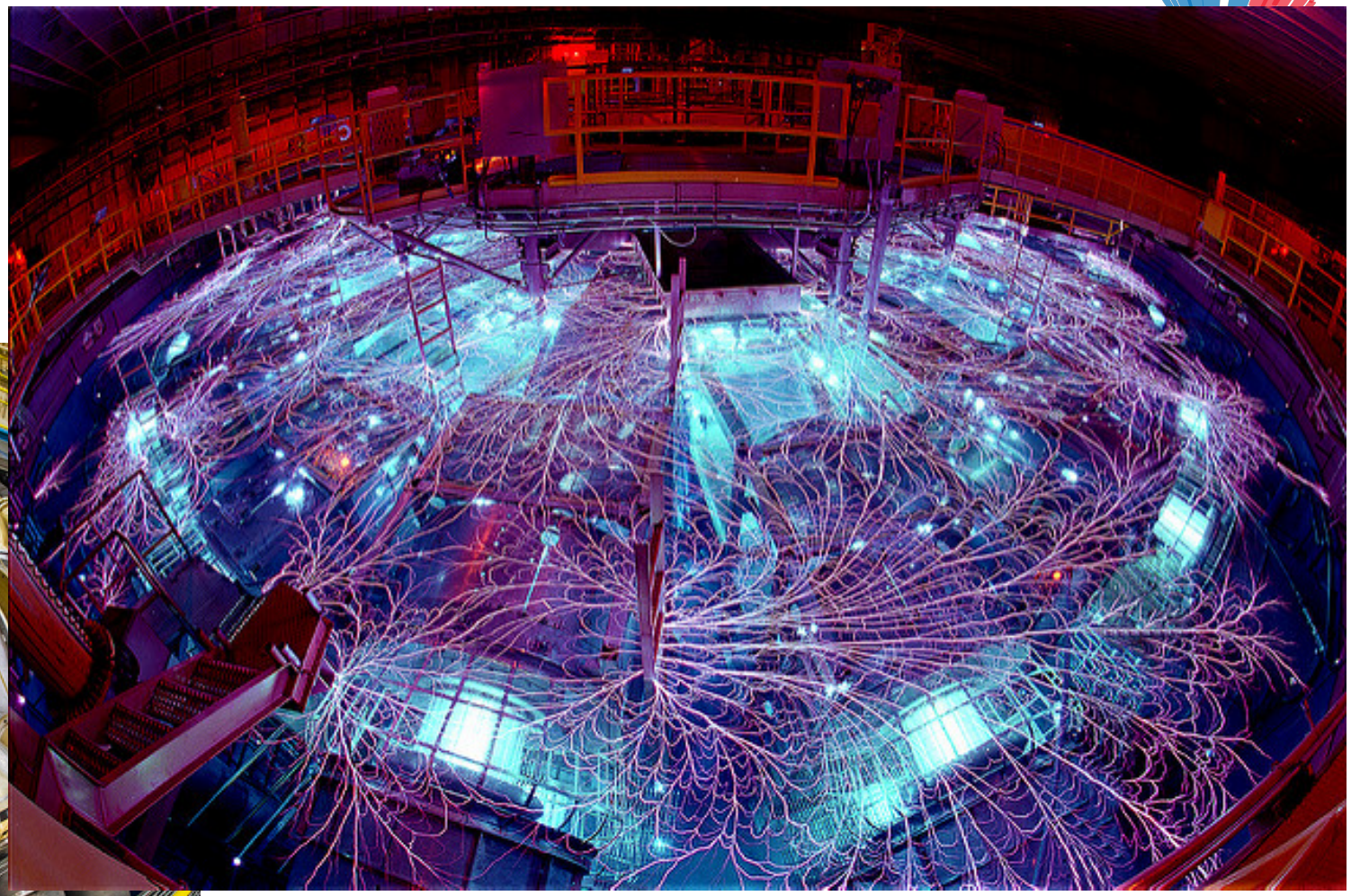
- Tools/Equipment
  - Large variation in cost and condition of tools/equipment for fundamental capability
  - Unique capability is very expense, sometimes more expensive than the facilities

- Infrastructure
  - Once approved, it takes 5-10 years to follow the defined process
  - Funding for sustainment has historically been insufficient

Example Capability

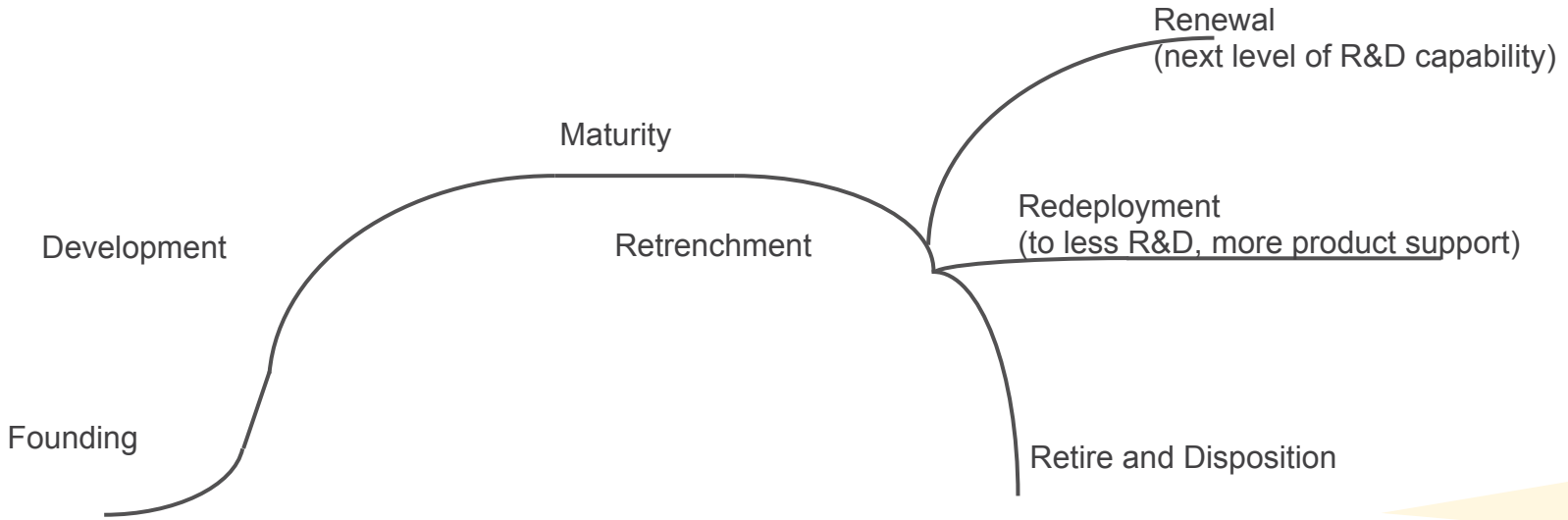
5 MOST POWERFUL Technologies That Exist | Top 5 Countdown





The Z Machine - Can We Make A Star?

Government R&D capability lifecycle view

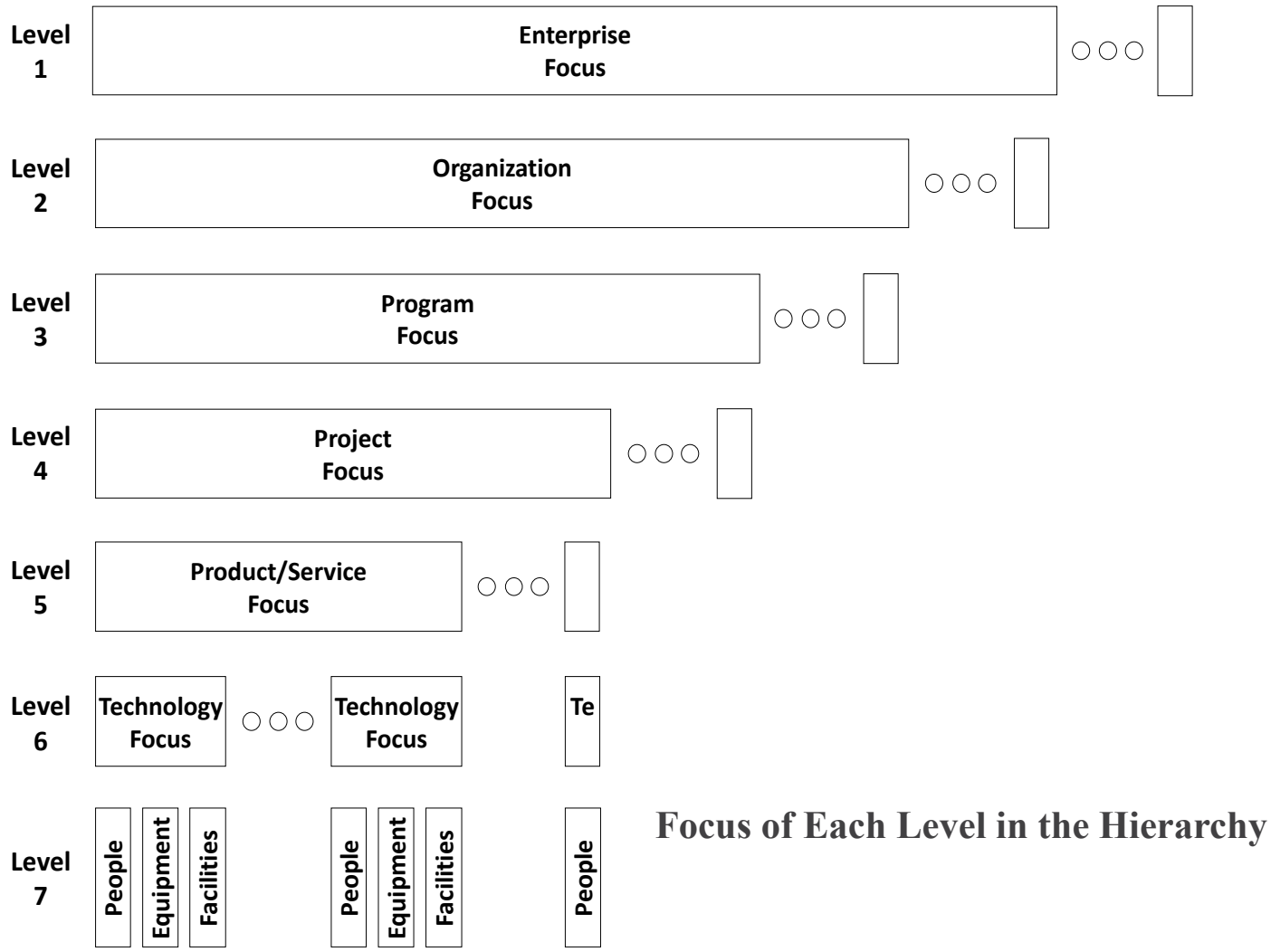


Divestment decisions are very rare

Helfat, C. E. and Peteraf, M. A., 2003. “The dynamic resource-based view: Capability Lifecycles. Strategic Management Journal”, 24:997-1010, 2003

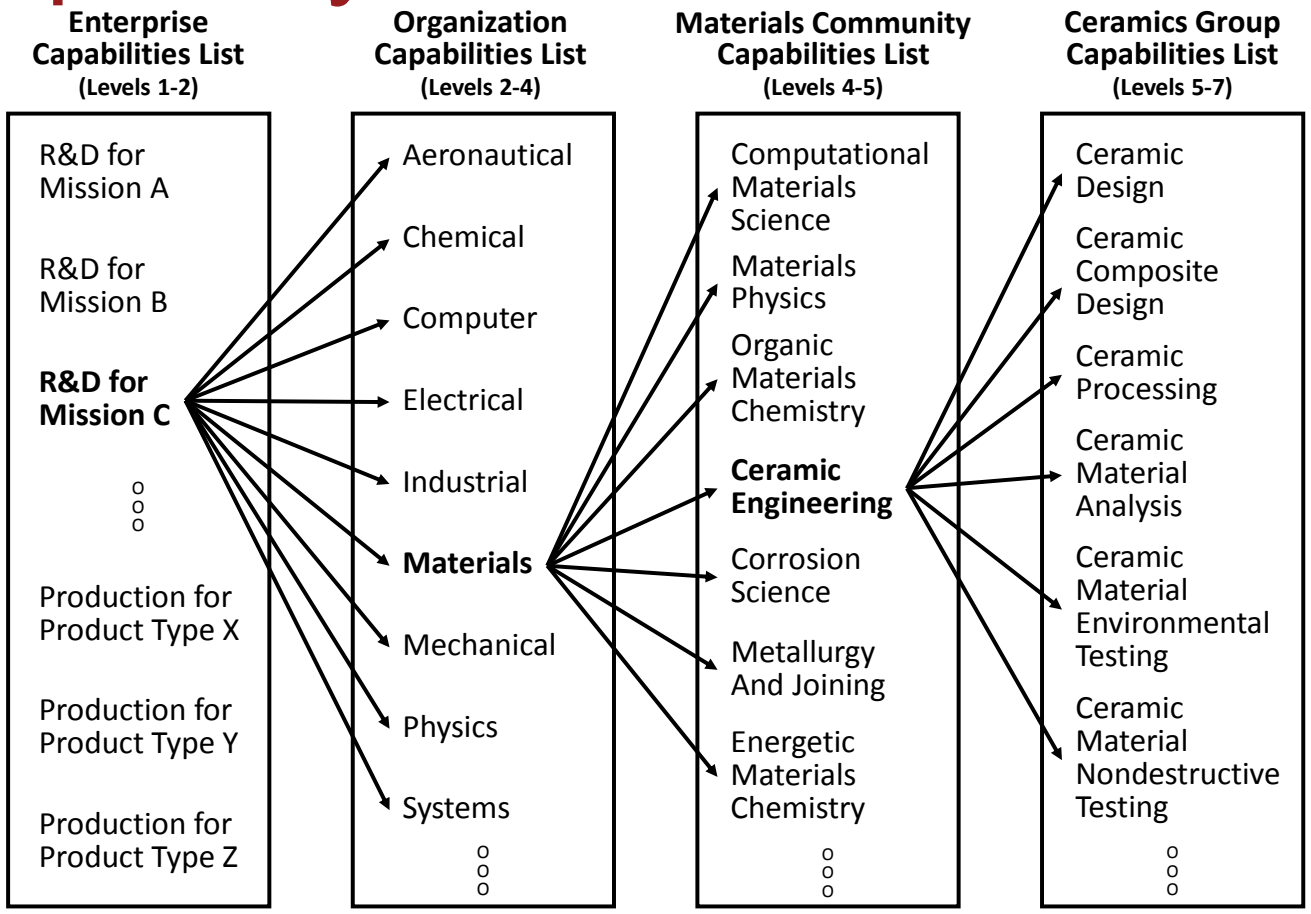
The challenge of perspective - hierarchy

1-Focuses on mission and securing long-term viability of capabilities to support the nation
2-Focuses on long-term direction and the collective health of the R&D across the organization's programs and capabilities
3-Focuses on programs that manage portfolios of projects; current project work, acquisition of future work, and future direction of the program
4-Focuses on projects, customers, and concerns itself with resourcing & monitoring work over the life of a project and managing cost & schedule
5-Focuses on orchestration of Level 6 capabilities to deliver particular scientific or engineering products or services
6-Focuses is on effective and efficient delivery of individual technology-focused capabilities that the staff and assets from Level 7 enable
7-Focuses on readiness of staff / physical assets and on their sustainment and development



Focus of Each Level in the Hierarchy

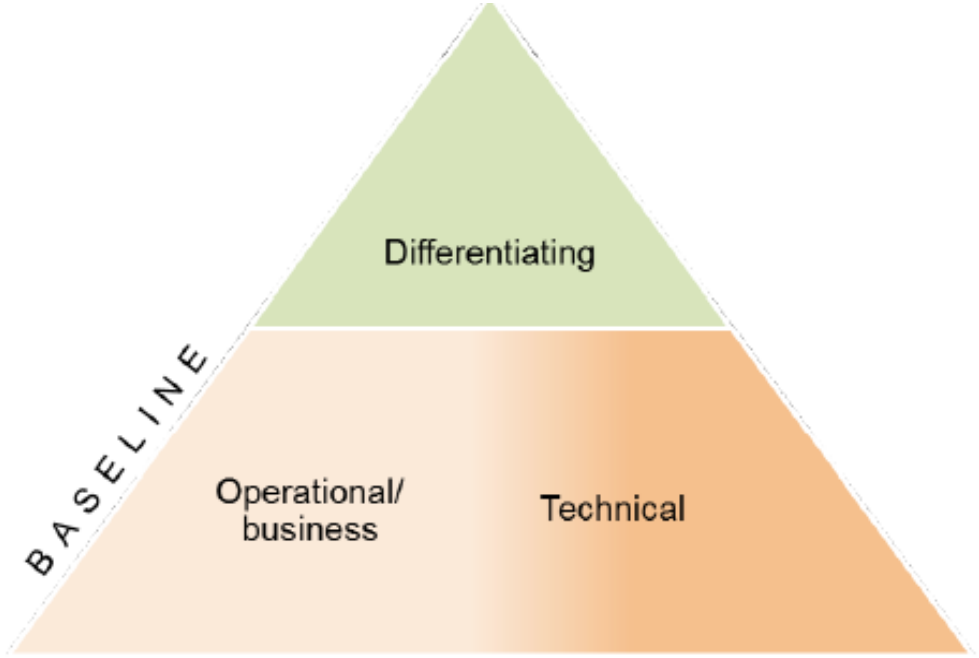
The challenge of perspective – defining capability



Capability Hierarchy

- Different groups are responsible for different kinds of assets, including equipment and facilities
- There is no guarantee that the priorities of these different groups align with each other
- There are also divisions based on mission lifecycle or major program funding line-items

Current approaches to managing and evolving capabilities



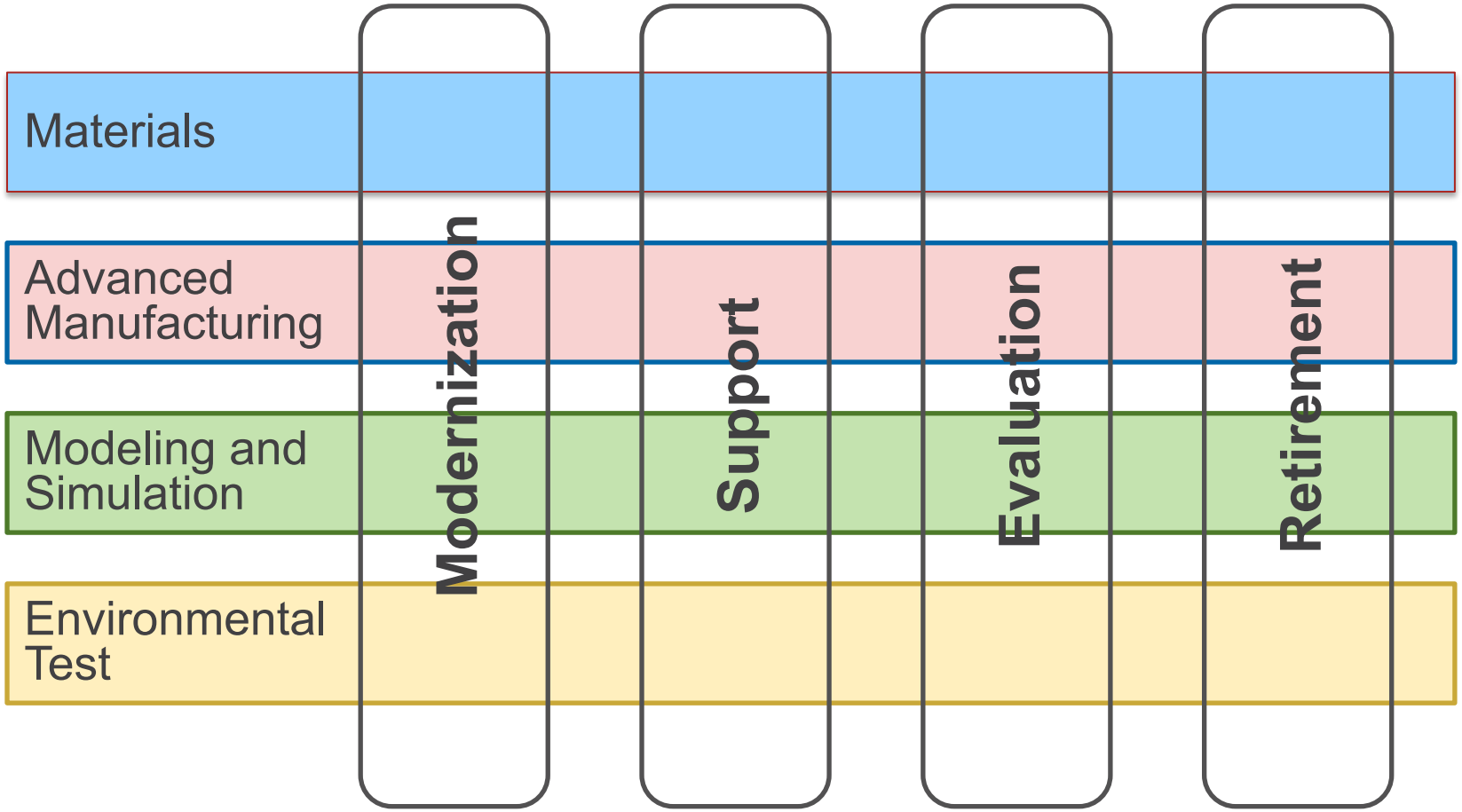
Top-level of Baseline and Differentiating Capabilities

Numerous attempts at defining “capabilities”
- Most top-down

Current state
- Managing and reporting by shear horse-power
- Information collection is fragmented and distributed (facilities, human resources, etc.)

Future state
- Collaborative analysis and planning across hierarchy and functional lines
- Bottom-up and top-down approach (current pilot)

Notional Concept – Mission / Capability



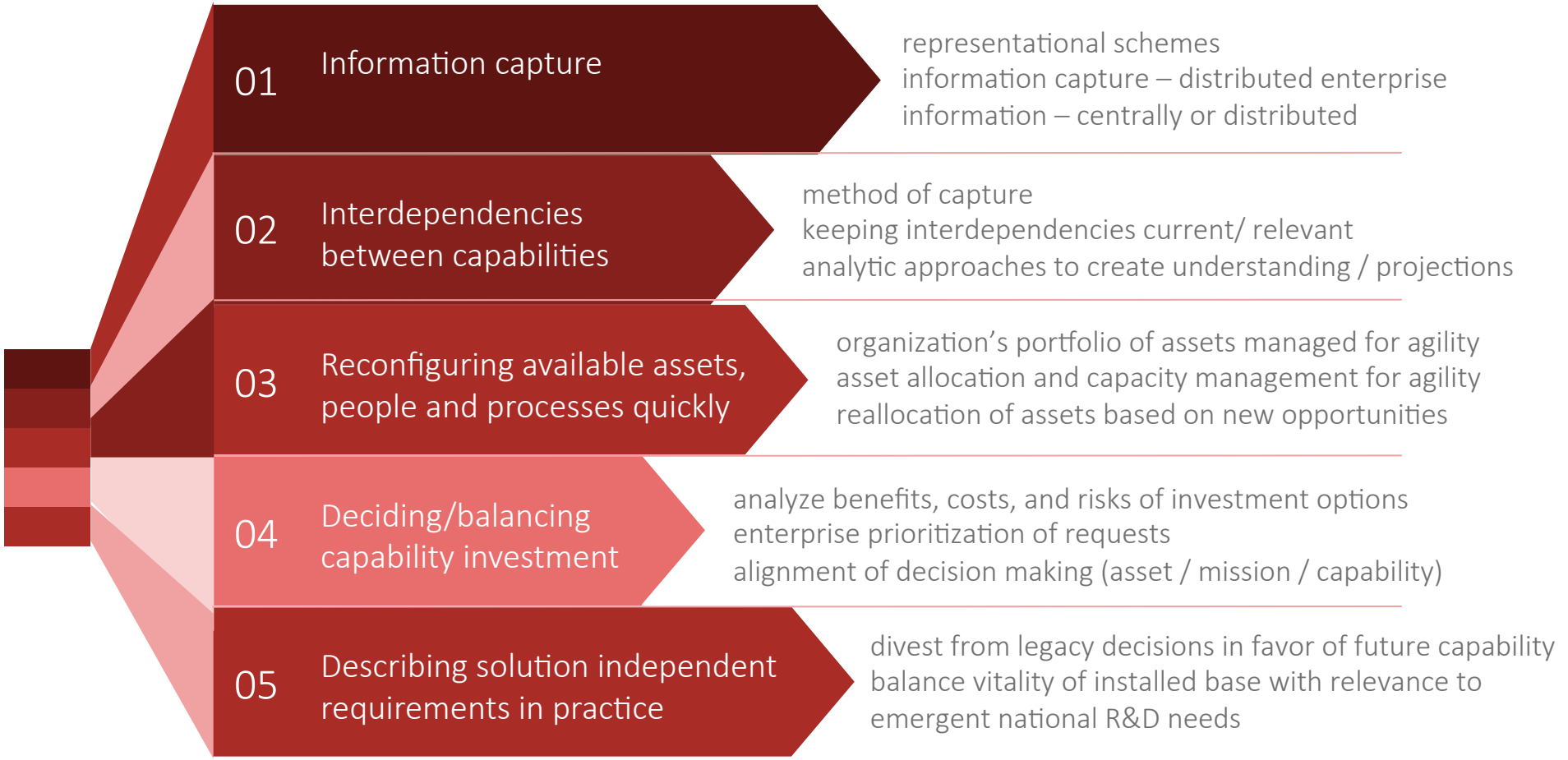
Mission use cases
- Elaborated down the hierarchy
- Touch-points with capabilities identified

Structure and roll-up of capabilities made explicit
- Models supported by database

Research Questions

Large Enterprise

Composed of multiple government R&D organizations



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