

Set-Based Requirements, Technology, and Design Development for SSNX

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Preparing for SSNX

SSN 688



SSN 21



SSN 774



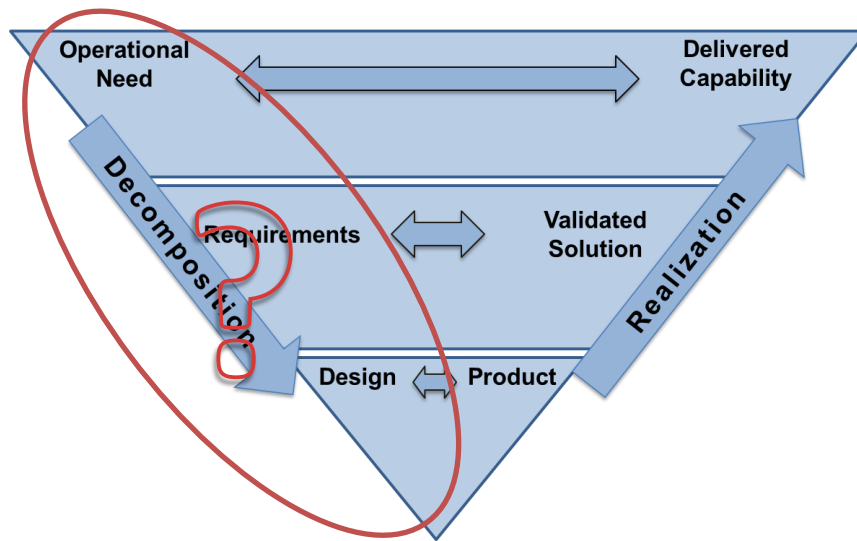
10 Years

Construction Start

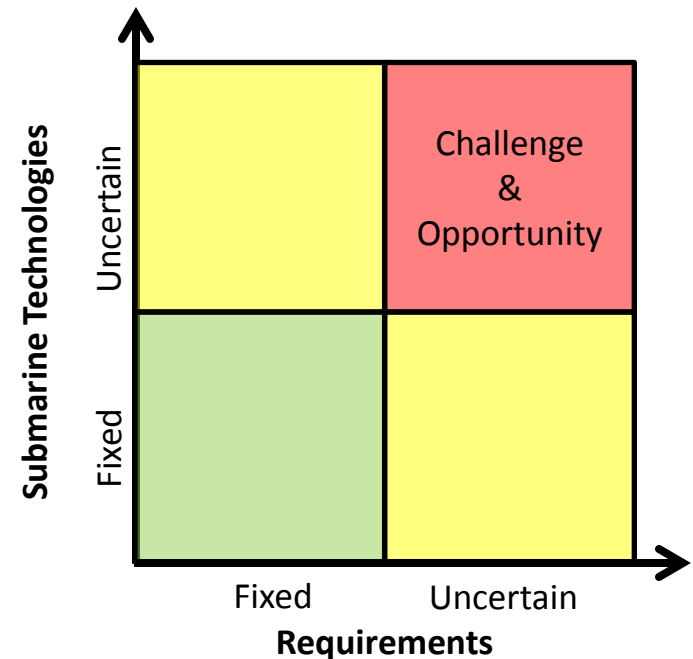
- The U.S. Navy shipbuilding plan starts construction of the next generation submarine in 2034
- Historical trends show that design development needs to begin at least 10 years prior to construction start

A New Era in Undersea Warfare

- Future requirements and technologies are yet to be defined
- The global pace of technology development is accelerating

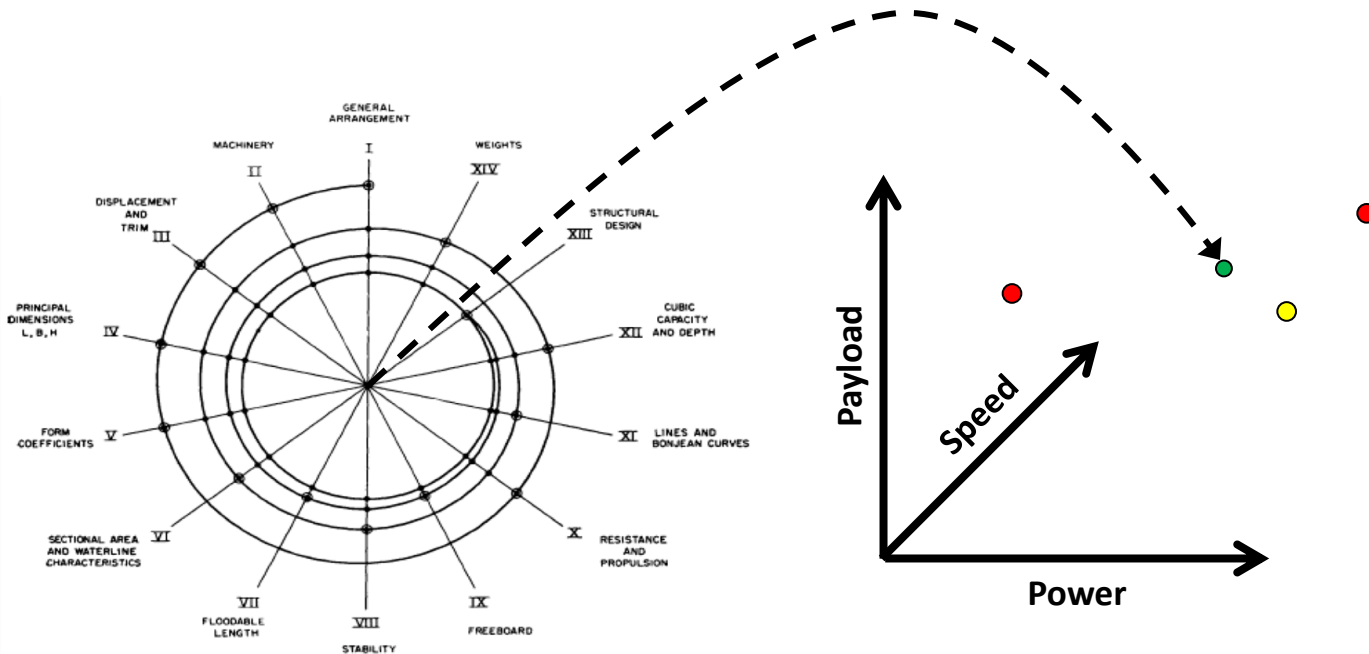


Defense Acquisition Guidebook - <https://acc.dau.mil>



The Classic Design Paradigm

- A manual point-based design spiral approach is flexible and accurate, but very slow and manpower intensive
- Few design points can be evaluated, meaning limited understanding of requirement impacts
- Not ideal when requirements are uncertain or coupled

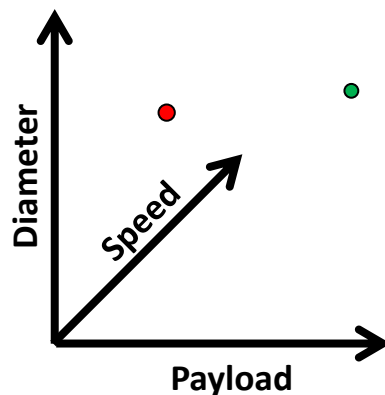


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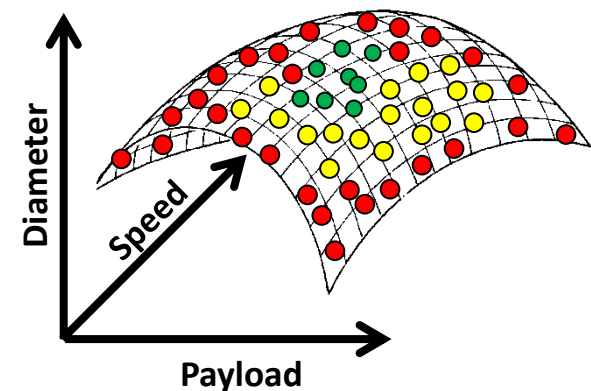
Motivation for Set-Based Design

- Pre-Milestone A decisions are very influential; the majority of costs are committed well before they are incurred
- Set-based design is about making the right decision the first time by **methodically** understanding tradeoffs prior to commitment
- Experience and theory show that this results in a shortened development cycle, at lower cost, with higher quality

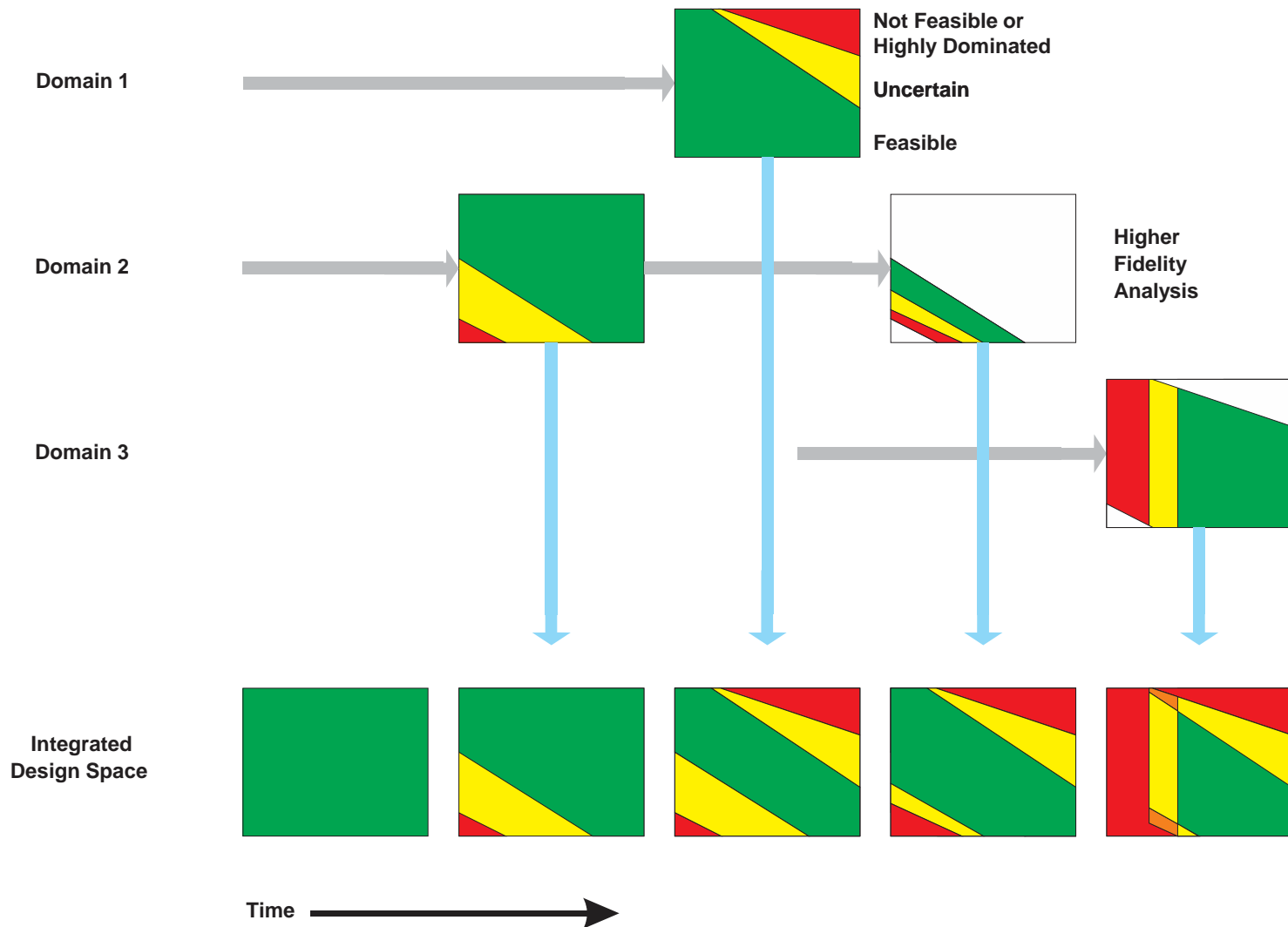
From limited investigation of relatively few design points



To robust understanding of concepts throughout the design space

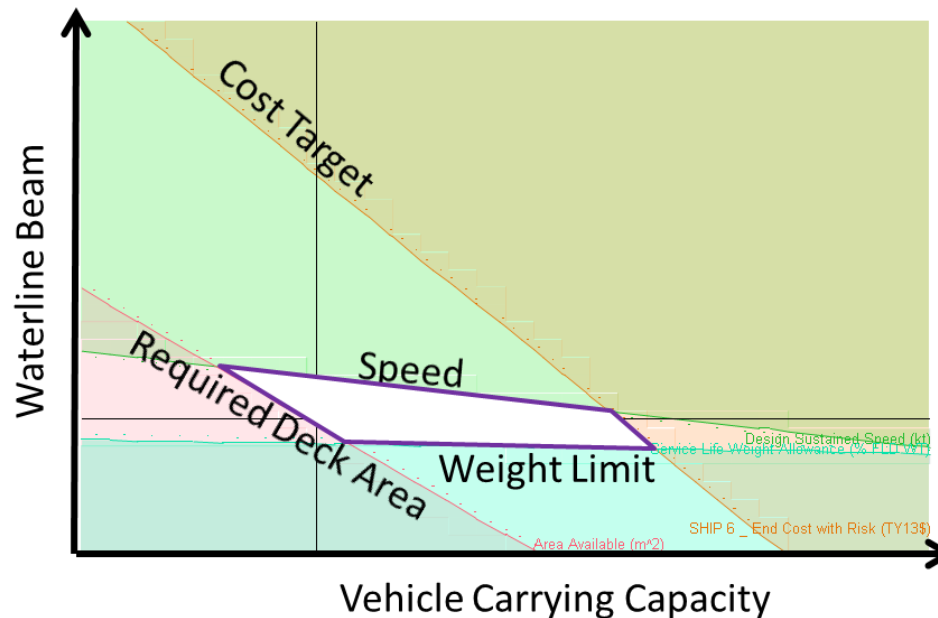


The Set-Based Design Method



U.S. Navy Applications of Set-Based Design

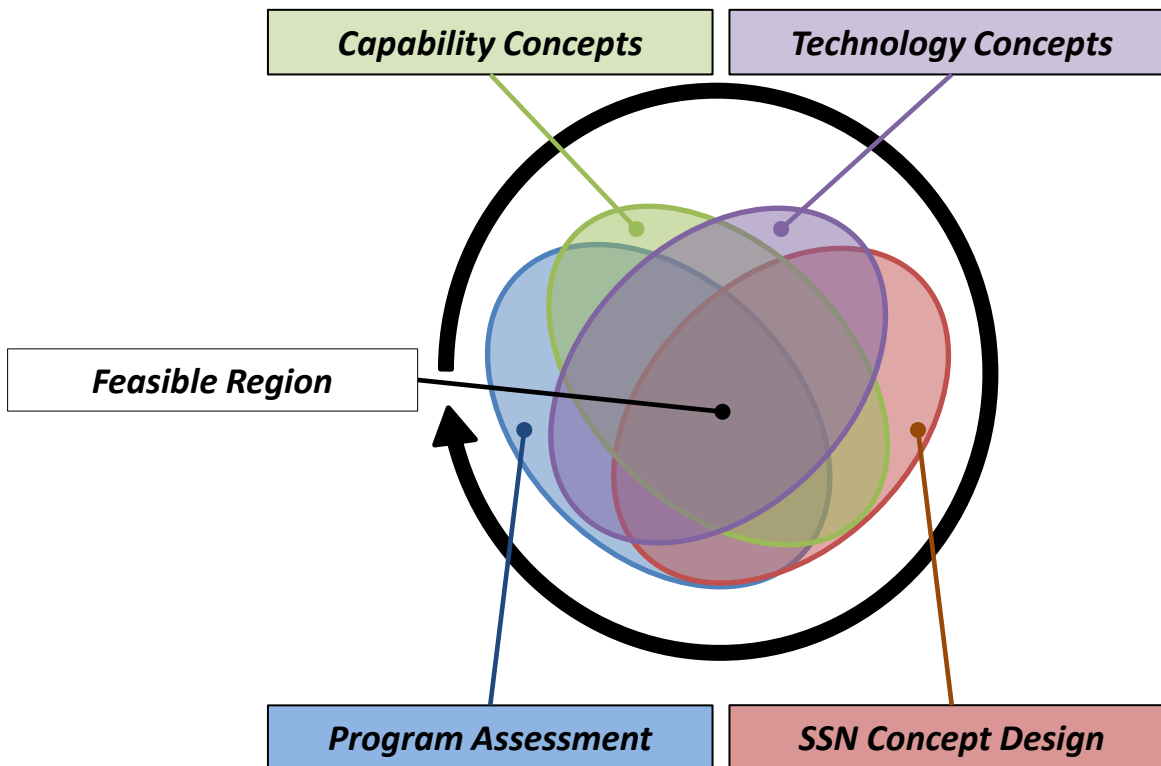
The ultimate objective has been to enable informed and defensible decisions by clearly presenting tradeoff information between cost, schedule, and capability.



http://www.navy.mil/navydata/our_ships.asp

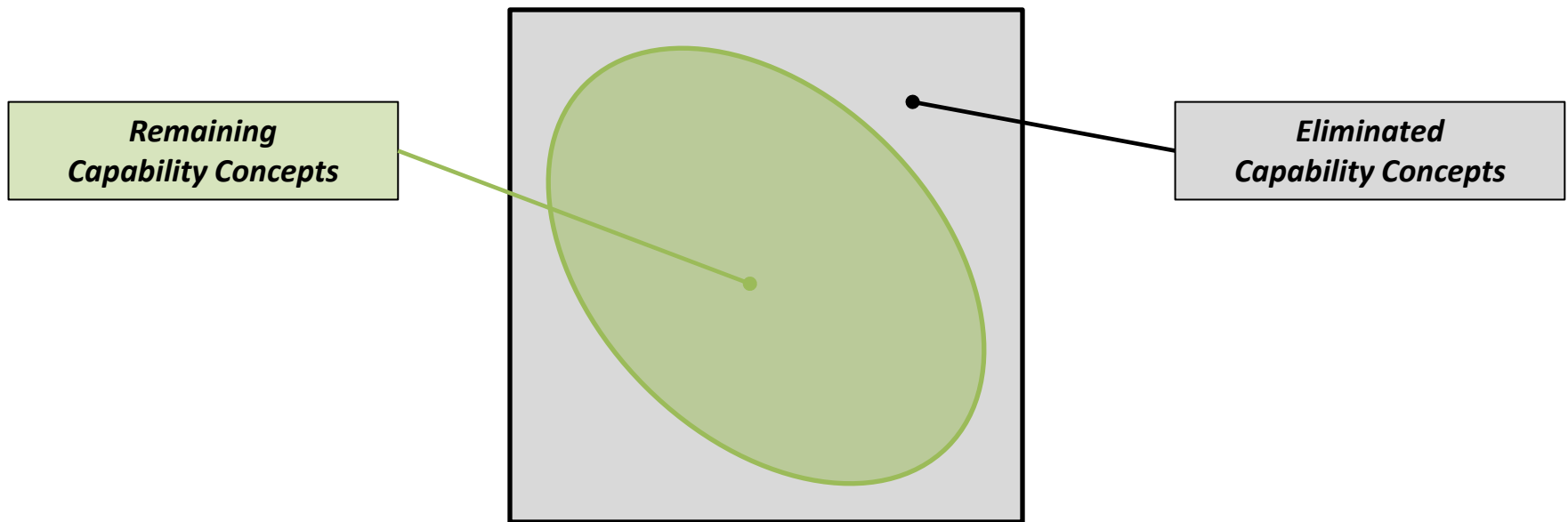
Set-Based Design for SSNX

- The trade space for future submarines includes both Block development for the VIRGINIA Class and SSNX
- The trade space spans near, mid, and far term time horizons



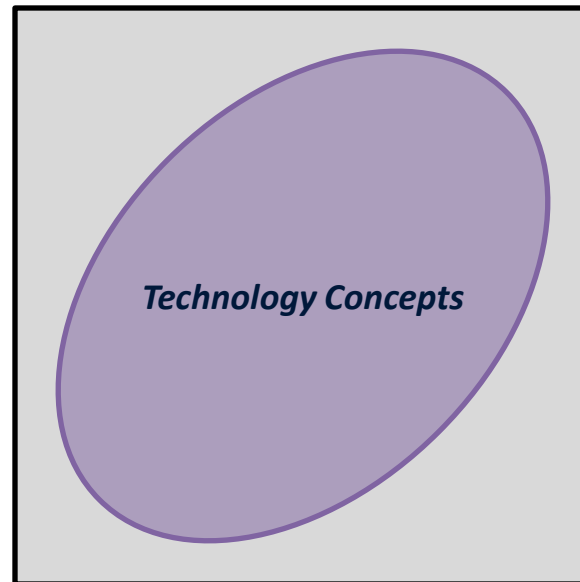
SSNX Capability Concepts

- The set of capability concepts is defined with historical data, alternative futures studies, future threat assessments, mission engineering, and war gaming
- Infeasible or inferior alternatives are eliminated through documented and defensible analysis



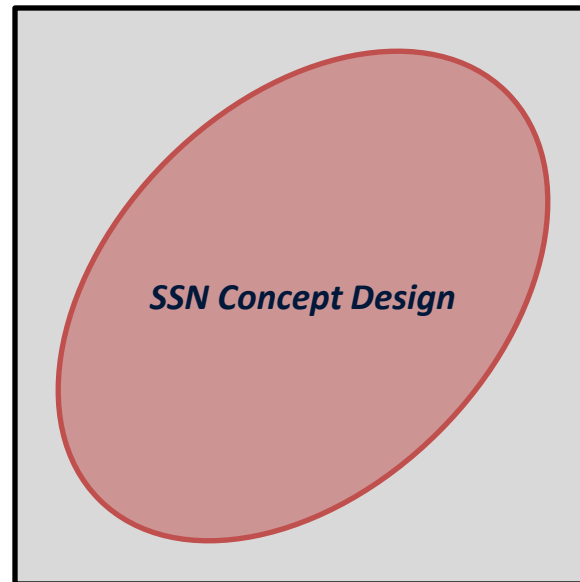
SSNX Technology Concepts

- The set of technology concepts is defined by science and technology frontiers, research and development frontiers, and current technology
- Infeasible or inferior alternatives are eliminated through documented and defensible analysis



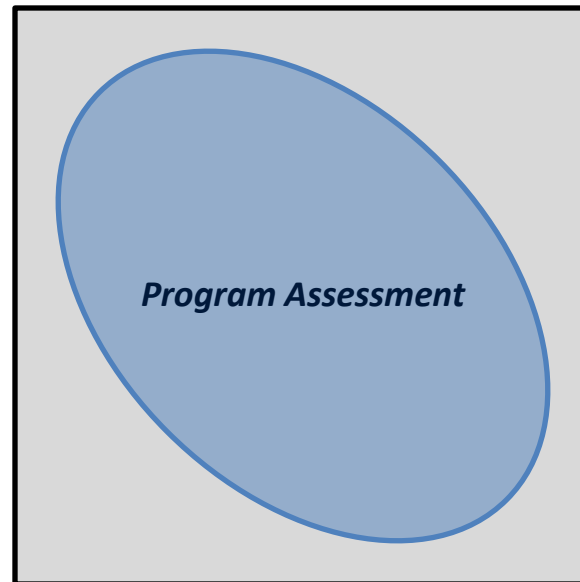
SSNX Concept Design

- The set of SSN concept designs is defined by the naval architectural characteristics and boundaries for future SSN hull, mechanical, and electrical systems
- Infeasible or inferior alternatives are eliminated through documented and defensible analysis

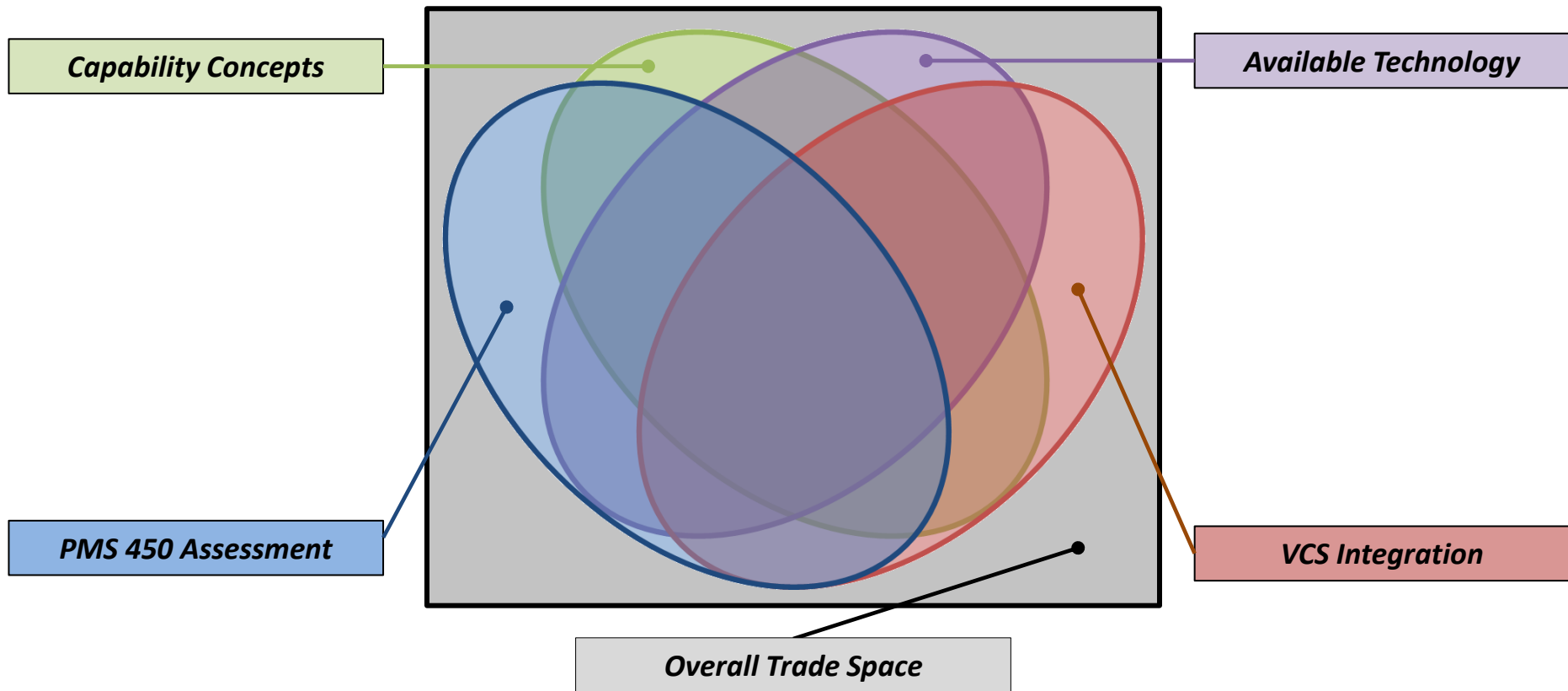


SSNX Program Assessment

- The set of program options is defined by the range of acquisition strategies, cost, industrial base limits, and design and build timelines applicable to future submarines
- Infeasible or inferior alternatives are eliminated through documented and defensible analysis

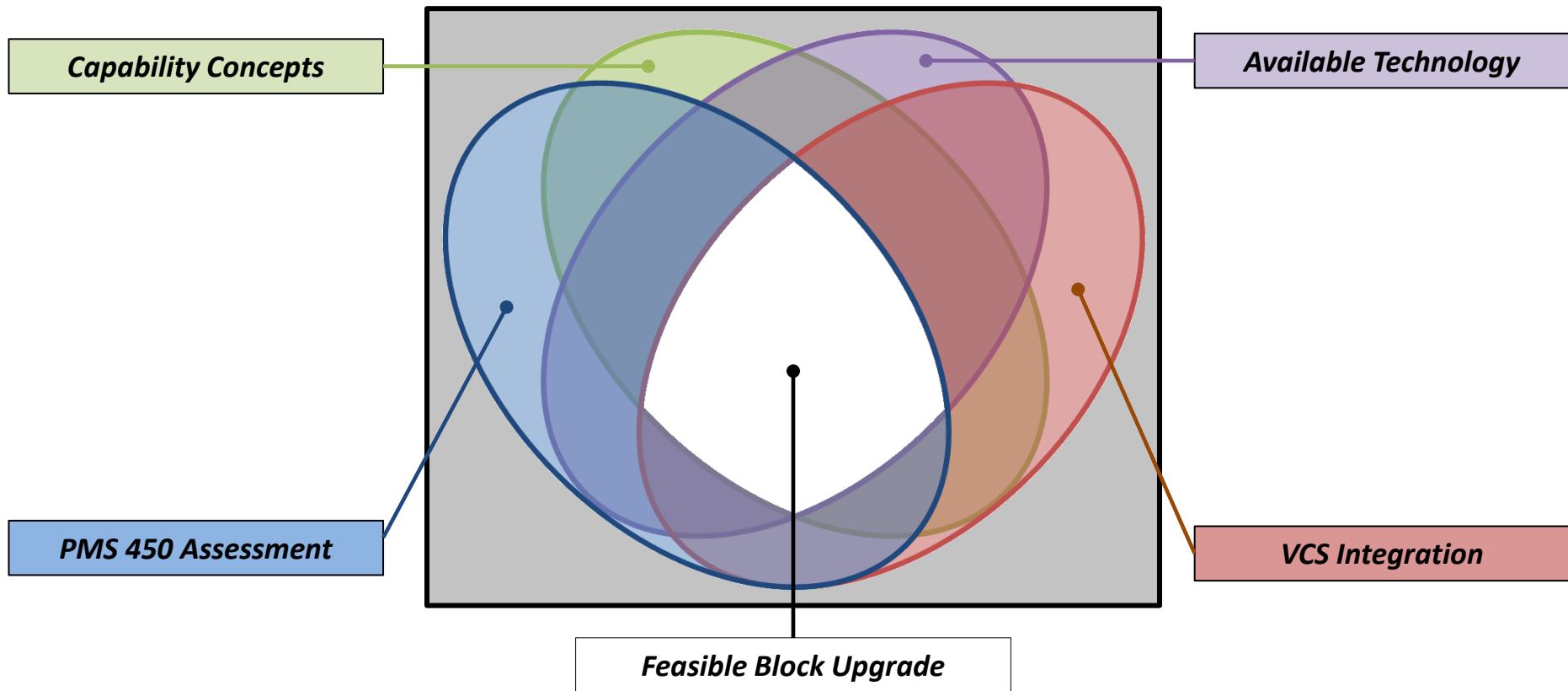


VIRGINIA Class Block Upgrade Example



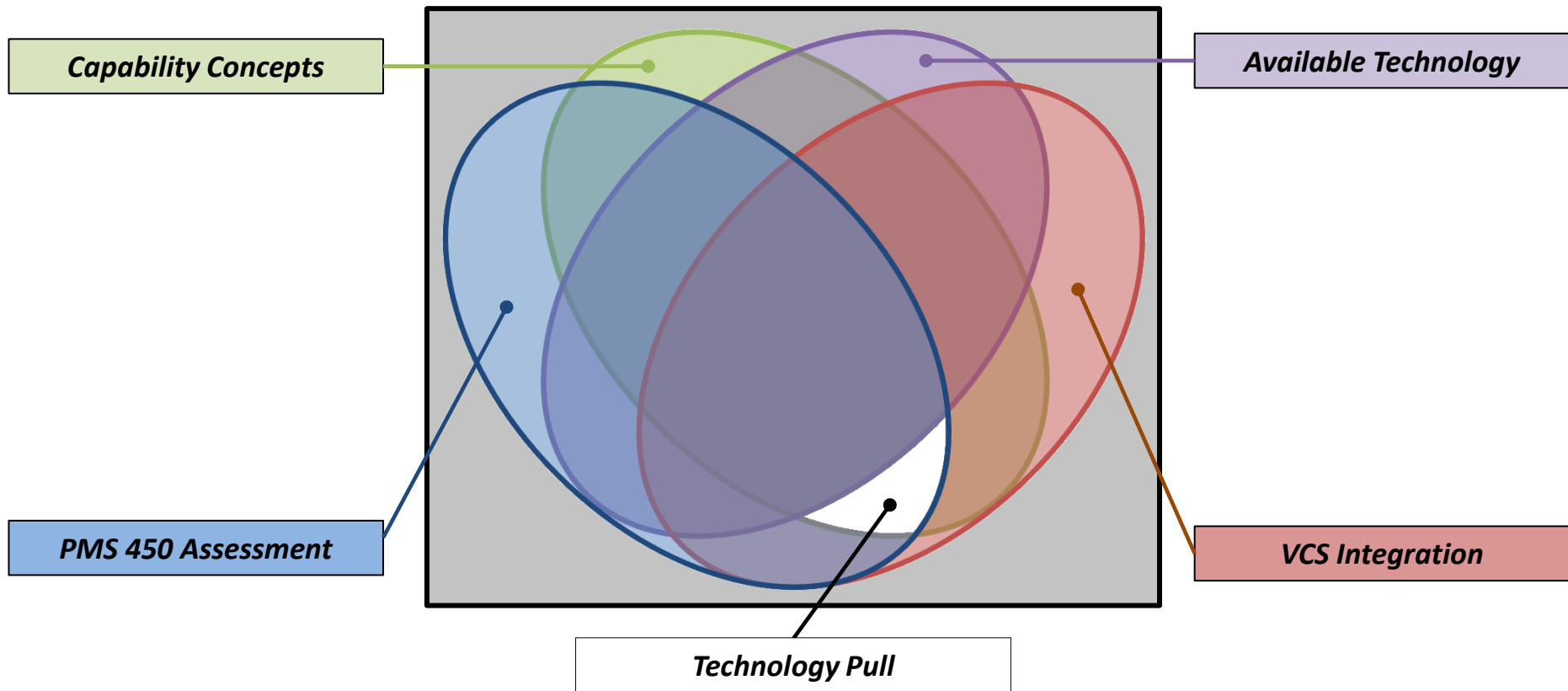
A block upgrade imposes a specific set of technology, platform, and programmatic constraints. However, the capability concepts and overall trade space are not constrained.

Feasible Block Upgrade



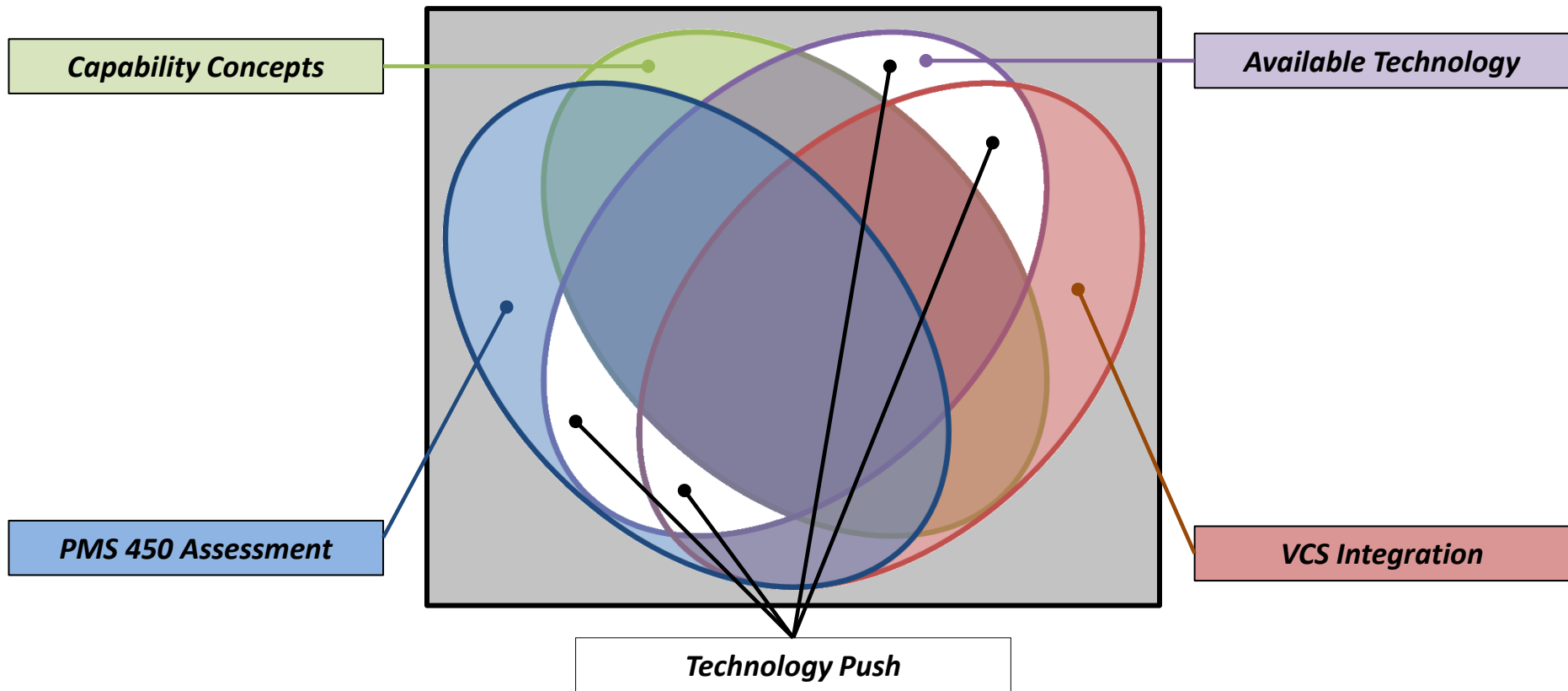
A feasible region for a block upgrade exists if sufficient capability can be provided with available technology and within existing platform and programmatic constraints.

Technology Pull



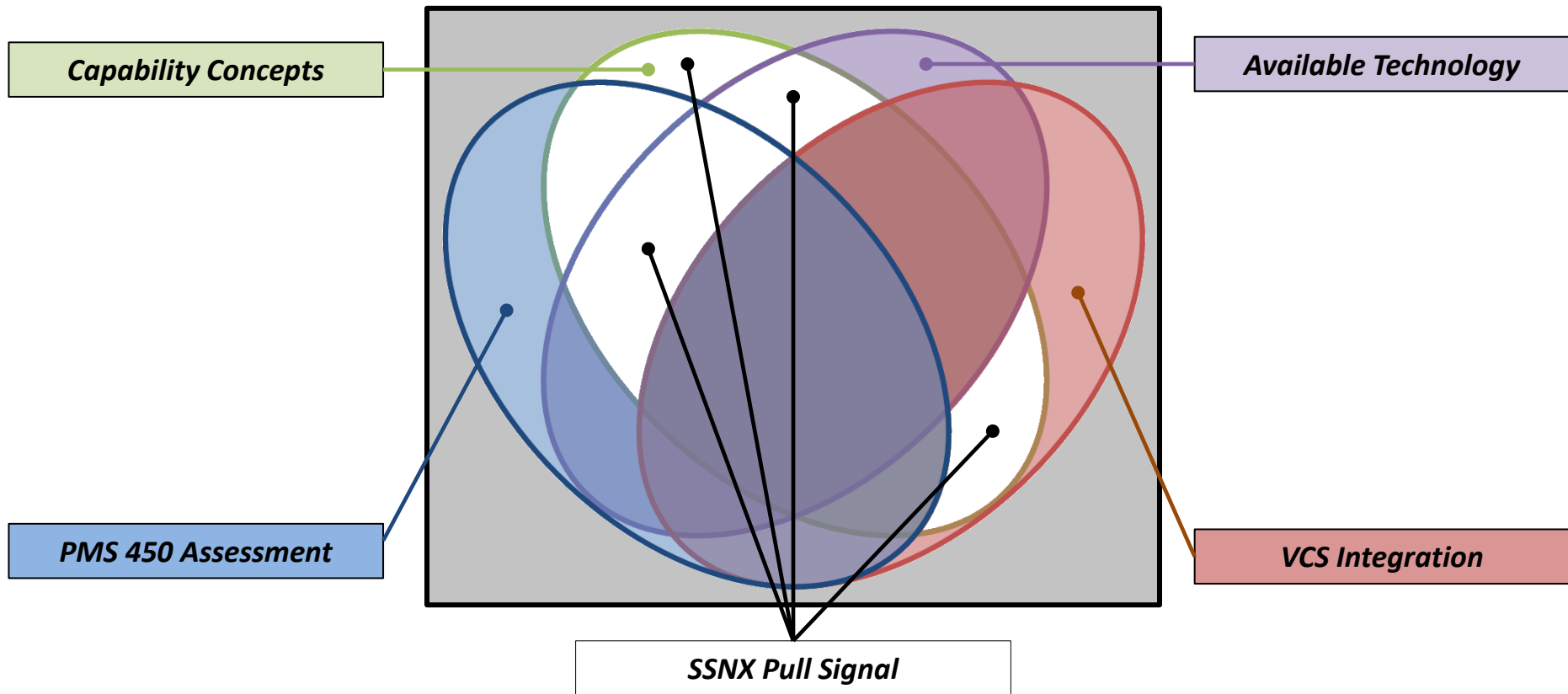
Block upgrade technology investment is required if sufficient capability cannot be provided with available technology, but the existing platform and programmatic are sufficient.

Technology Push



The capability concept set may expand if technology is available outside the initial bounds.

SSNX Pull Signal



A new class is required if sufficient capability cannot be provided within existing platform or programmatic constraints; technology investment needs will also be apparent.

Conclusion

- An aggressive timeline and broad uncertainty around design requirements has led the U.S. Navy towards a set-based strategy for requirements, technology and design development for SSNX
- The purpose of using a set-based strategy is to make the right decisions the first time by methodically understanding tradeoffs prior to commitment
- The benefit of good decisions during the early-stages is better designs at lower costs on shorter schedules