IDA

Keyword Analysis of DoD Command and Control-Related Science and Technology Efforts

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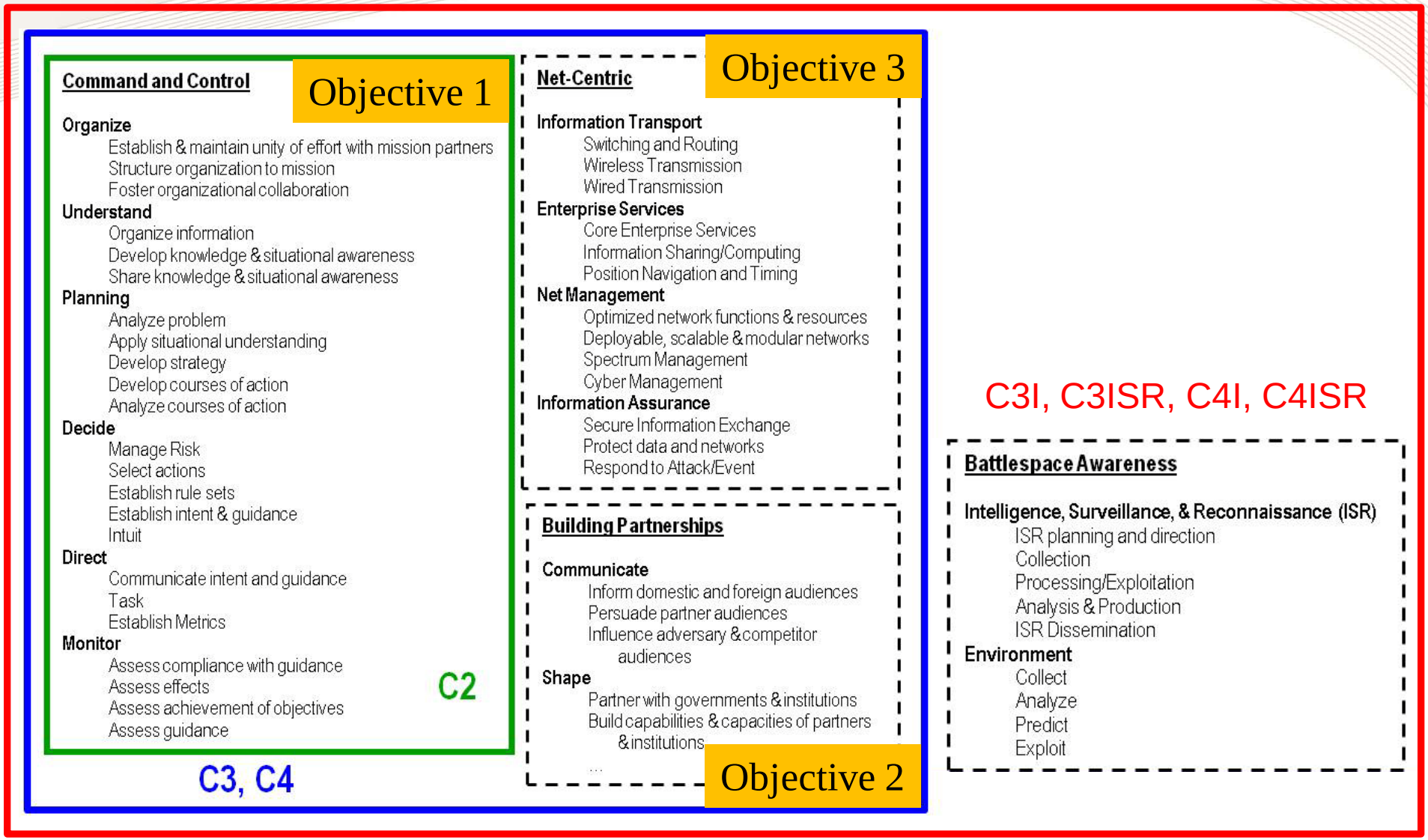
- Research and Development supporting Command and Control (C2) varies widely:
  - From communication tools to data fusion to war-gaming, etc.
- Gap analysis and funding advice is difficult to provide– no office has overarching view of all research activities
- DoD C2 Strategic Plan identifies major goals to support the warfighter
  - Want to provide quantitative analysis of the alignment of R&D with the established goals

- To provide quantitative analysis, we compiled an extensive database of research programs in DoD
- We have thoroughly analyzed the content of the research using a variety of categorization schemes
  - Identifying C2-related programs and categorizing within that specification by use of keywords

IDA | DoD C2 Strategic Plan

- Objective 1: *to provide the capabilities necessary to effectively support organizing command structure and forces, understand situations, plan and decide upon courses of action, and direct and monitor execution across the range of DoD operations*.
- Objective 2: *to enable military forces and mission partners to conduct integrated operations across the range of DoD operations at all echelons of command*
- Objective 3: *to maximize assured sharing of information and services and synchronized implementation of collaborative C2 capabilities*
- Objective 4: *to optimize C2 capability investments across the range of DoD operations*
- Objective 5: *to achieve agile and responsive development, acquisition, fielding, and sustainment of C2 capabilities across the DOTMLPF spectrum*

IDA | Joint Capability Areas



As defined by Joint Staff, 2008

IDA | Database- Sample Entries

- Collected data on all RDT&E funded programs
  - DTIC provides RDT&E R2 Budget Justification Sheets in xml format. We parsed data using python, produced csv files

PE Number	Title	Service/ Agency	Budget Activity Number	Funding 2010 ($M)	Funding 2011 ($M)	Funding 2012 ($M)	Mission Description, Accomplishments, Activities and Plans
0302168E	Wireless Innovation Fund	DARPA	2	-	-	100	Building upon DARPA's legacy in developing information and communications technology and command, control and communications systems, DARPA will seek to develop technologies to create breakthroughs that can solve core security, analytic, sharing, and reliability challenges…
0303310 D8Z	Countering Weapons of Mass Destruction Systems (CWMD)	Office of Secretary Of Defense	3	-	-	7.788	CWMD Systems Development and Integration: Develop a CWMD common operating picture system that integrates C4ISR, multi-modality intelligence, and other data to support simultaneous operations…

- Includes non-C2 related programs and all budget activity levels (all RDT&E funded programs)

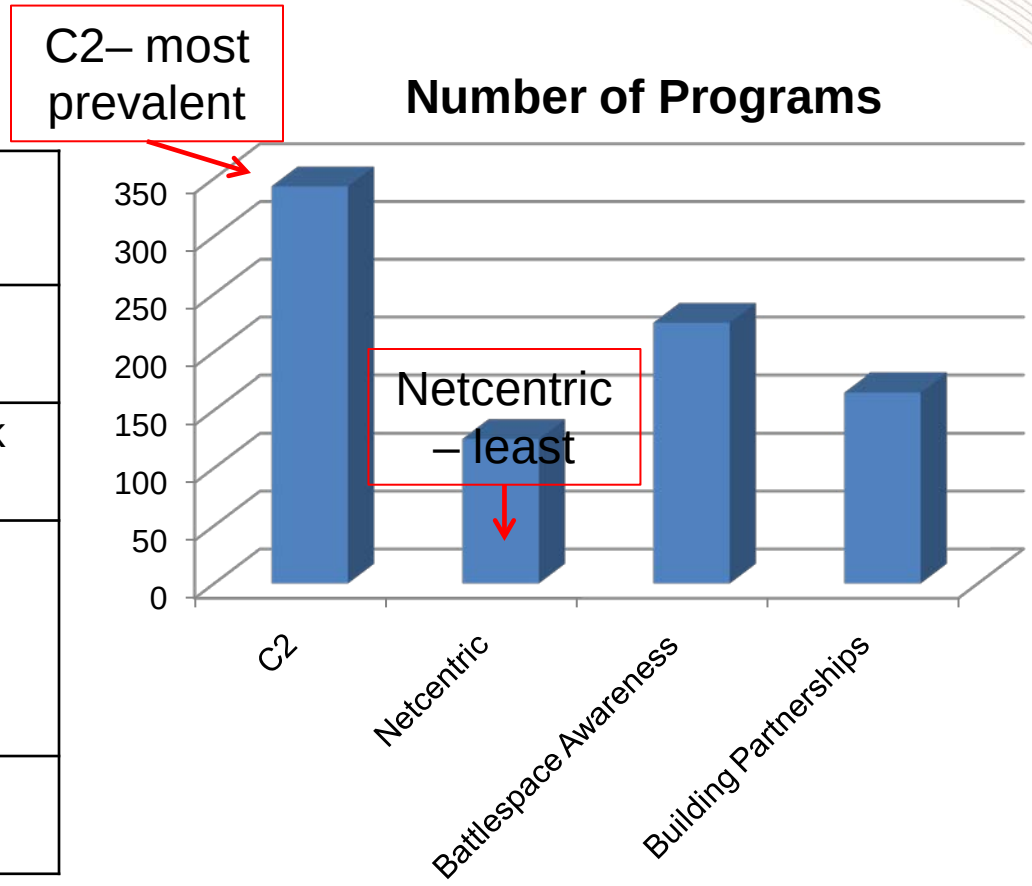
- Categorization Schemes:
  - Joint Capability Areas Level 1 and 2
  - Technical Areas
  - There can be overlap between JCAs and between Technical Areas
- Keyword search performed using Python
  - Keywords selected from literature, discussion
  - XML data parsed, analyzed and output as csv file. Results can be further analyzed in spreadsheet or database programs (ex. excel or access).

IDA | Joint Capability Areas Level 1

- Level 1: C2, Netcentric, Battlespace Awareness, Building Partnerships

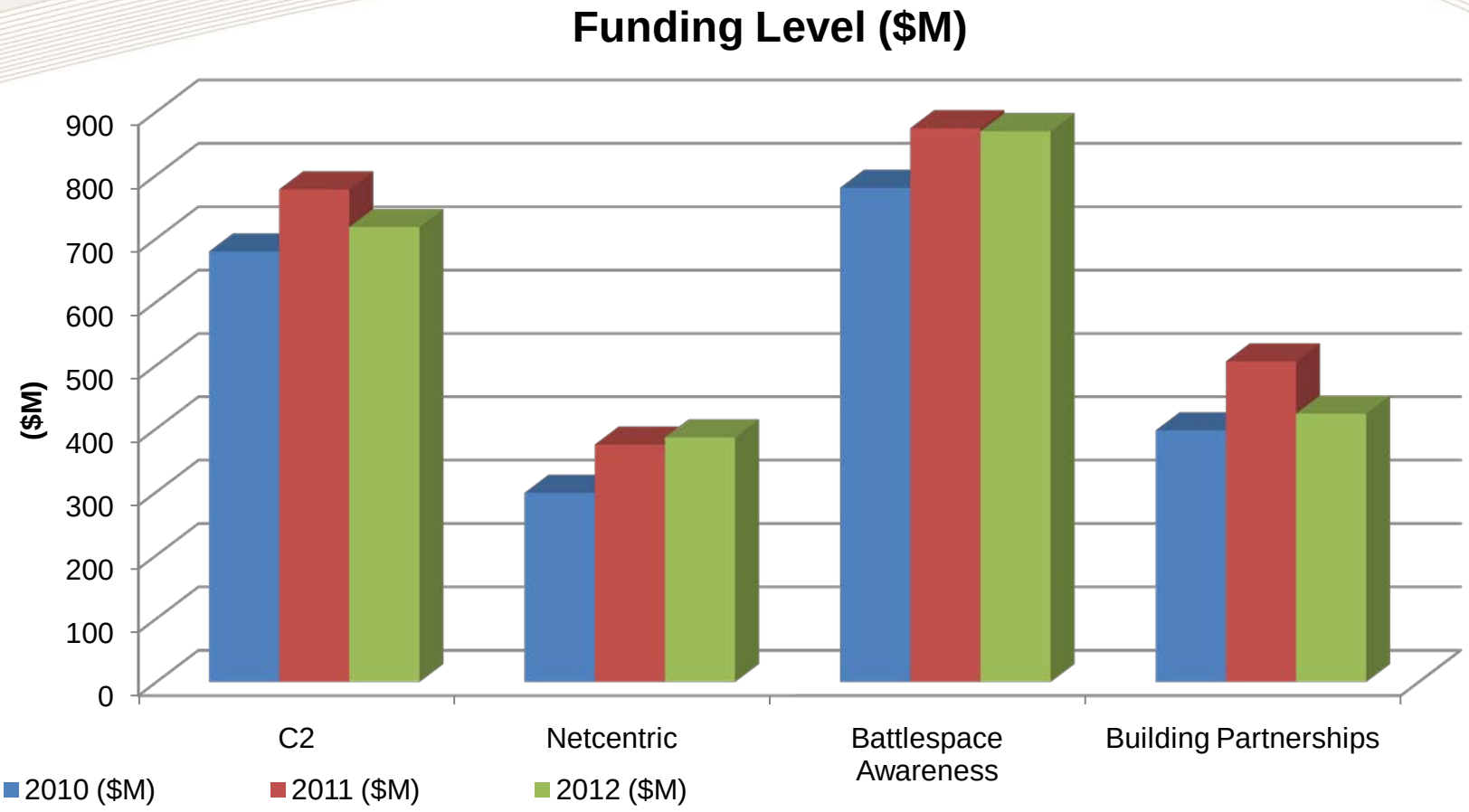
Keywords Used

Joint Capability Area Level 1	Keyword
C2	Command and Control; C2
Netcentric	NetCentric; Network & Centric
BSA	Battlespace & Awareness; Intelligence & Surveillance; ISR
Building Partnerships	Coalition; All(y)(ies)(ied)



- JCA Level 1 identified programs make up 11% of BA 1-3 programs.
- C2 has highest number of programs, followed by BSA, last is Netcentric
- Note—there can be overlap

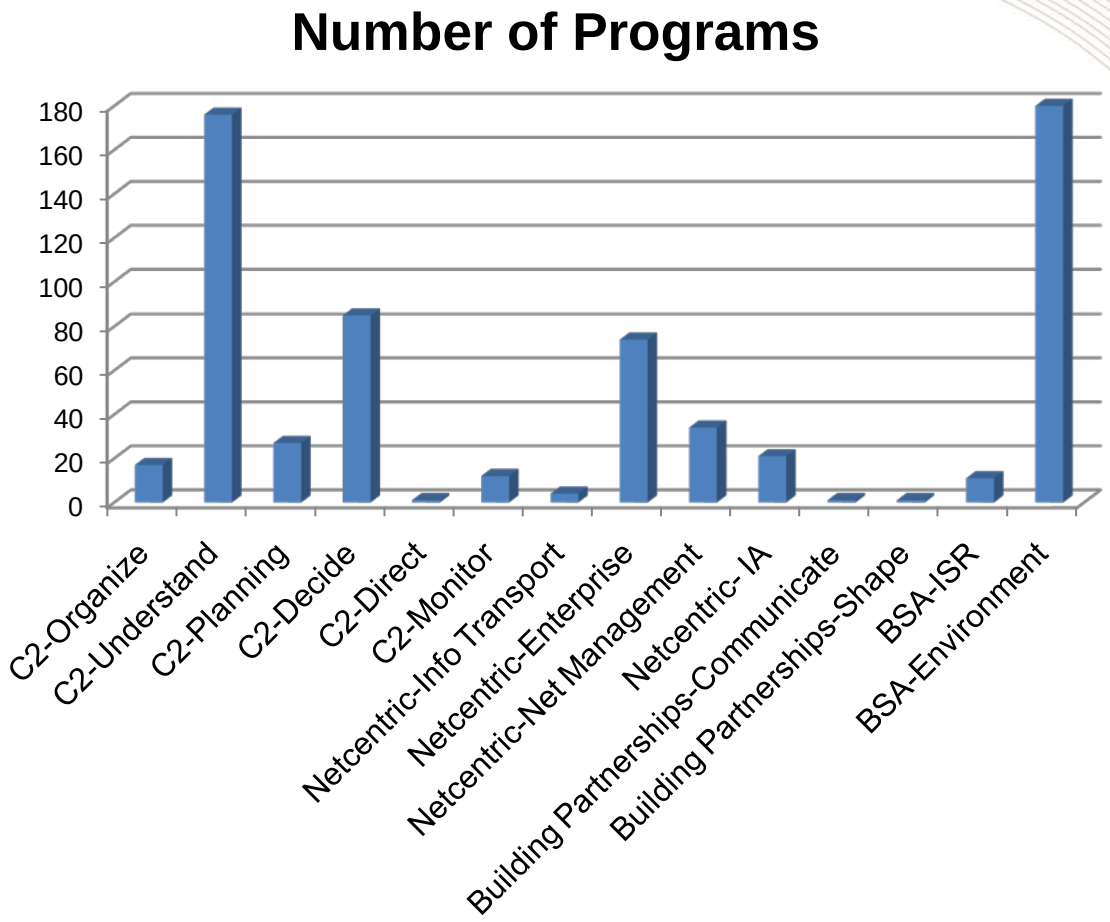
IDA | Joint Capability Areas Level 1– Funding



- JCA Level 1 identified programs make up 13 % of BA 1-3 dollars
- C2 and BSA are highest funded– Netcentric appears to be the lowest
- Underscores an issue with keyword analysis (programs must self-identify)

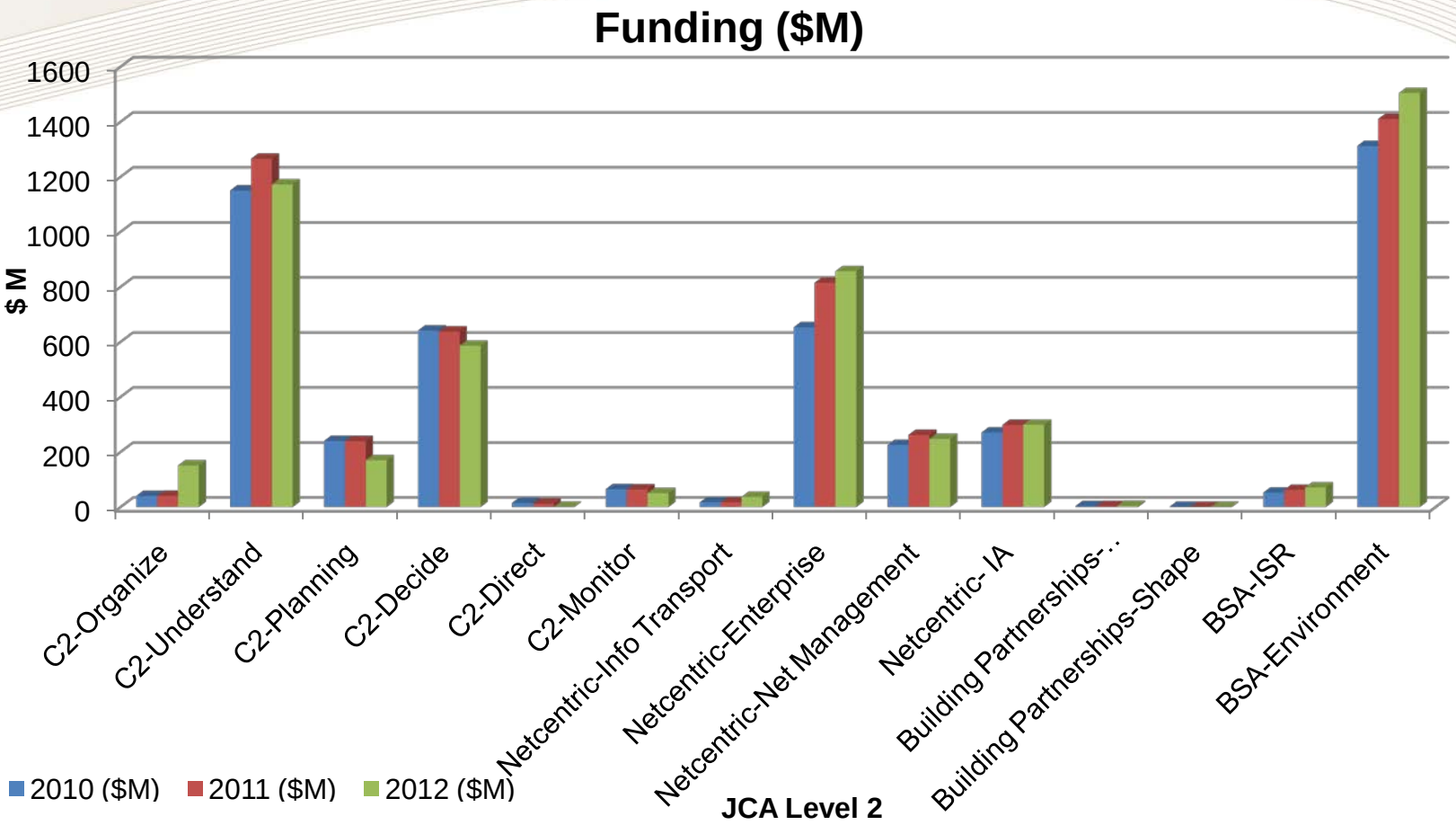
IDA | Joint Capability Areas– Level 2

Joint Capability Areas Level 2	
C2	Organize
	Understand
	Planning
	Decide
	Direct
	Monitor
Netcentric	Information Transport
	Enterprise Services
	Net Management
	Information Assurance
Building Partnerships	Communicate
	Shape
Battlespace Awareness	ISR
	Environment



- JCA Level 2 identified programs make up 20 % of programs, 27% of funding dollars

IDA | Joint Capability Areas– Level 2



- C2-Understand, Decide, Netcentric-Enterprise, and BSA-environment dominate
- Added depth does not sufficiently increase clarity and introduces uncertainty

IDA | JCA Level 2– Keywords

Joint Capability Area Level 2	Keyword
C2 – Organize	Organize
C2 – Understand	Situational Awareness
C2 – Planning	(Planning & Strategy); Course of Action; COA
C2 – Decide	Decision & Support
C2 – Direct	Direct & Communicate
C2 – Monitor	Monitor & Effects
Netcentric Information Transport	(Wireless & Transmission); (Wired & Transmission); (Switching & Routing)
Netcentric Enterprise Services	Enterprise
Netcentric Net Management	(Network & Management); (Spectrum & Management); (Cyber & Management)

- Such broad keywords are not optimal when looking at *top-down* (i.e. goal-oriented) categories

IDA | JCA Level 2– Keywords (cont.)

Joint Capability Area Level 2	Keyword
Netcentric Information Assurance	(Information & Assurance); (Security & Protect)
Battlespace Awareness - ISR	(ISR OR (Surveillance & Reconnaissance)) & (Planning OR Collection OR Processing OR Exploitation OR Analysis)
Battlespace Awareness - Environment	Environment & (Collect OR Analyze OR Predict OR Exploit)
Building Partnerships - Communicate	(Domestic & Foreign); Partnership & Adversary; Partnership & Competitor
Building Partnerships - Shape	(Partner & Foreign) AND (Government OR Institution)

Limitations of JCA keyword analysis

- JCAs are intent-based (goal-oriented)
  - Very difficult to capture these categories in keywords
  - Mission descriptions and achievements/ program plans are not conducive to this type of search
- A technical (bottom-up) approach to categorization would enable use of more directed keyword searches
  - Technical areas can be mapped to JCAs

IDA | Technical Areas

Technical Area	Short Description
Decision Support	Pertaining to the overall specific decision support tools and theory of decision making
Planning	Specific focus on the planning process within the decision process
System Architecture	Design and analysis of combined HW/SW systems
Network Architecture	Focus on the networking and communication aspects
Organization Architecture	Design and analysis of the types of C2 organization (e.g., edge, distributed, hierarchical, etc.)
Collaboration	Focus on organizational and multinational cooperation
Information Sharing	Focus on information sharing aspects of collaboration
Situation Awareness	Methods of obtaining situation awareness and developing a Common Operating Picture
Interoperability	Standards and techniques to achieve interoperable systems at syntactic and semantic levels
Intel Analysis	Specific design and analysis of intelligence processing

- Technical areas identified by analysis of previous ICCRTS papers, interviews with experts, and workshops conducted at IDA
- Technical Areas improve both resolution and confidence of analysis

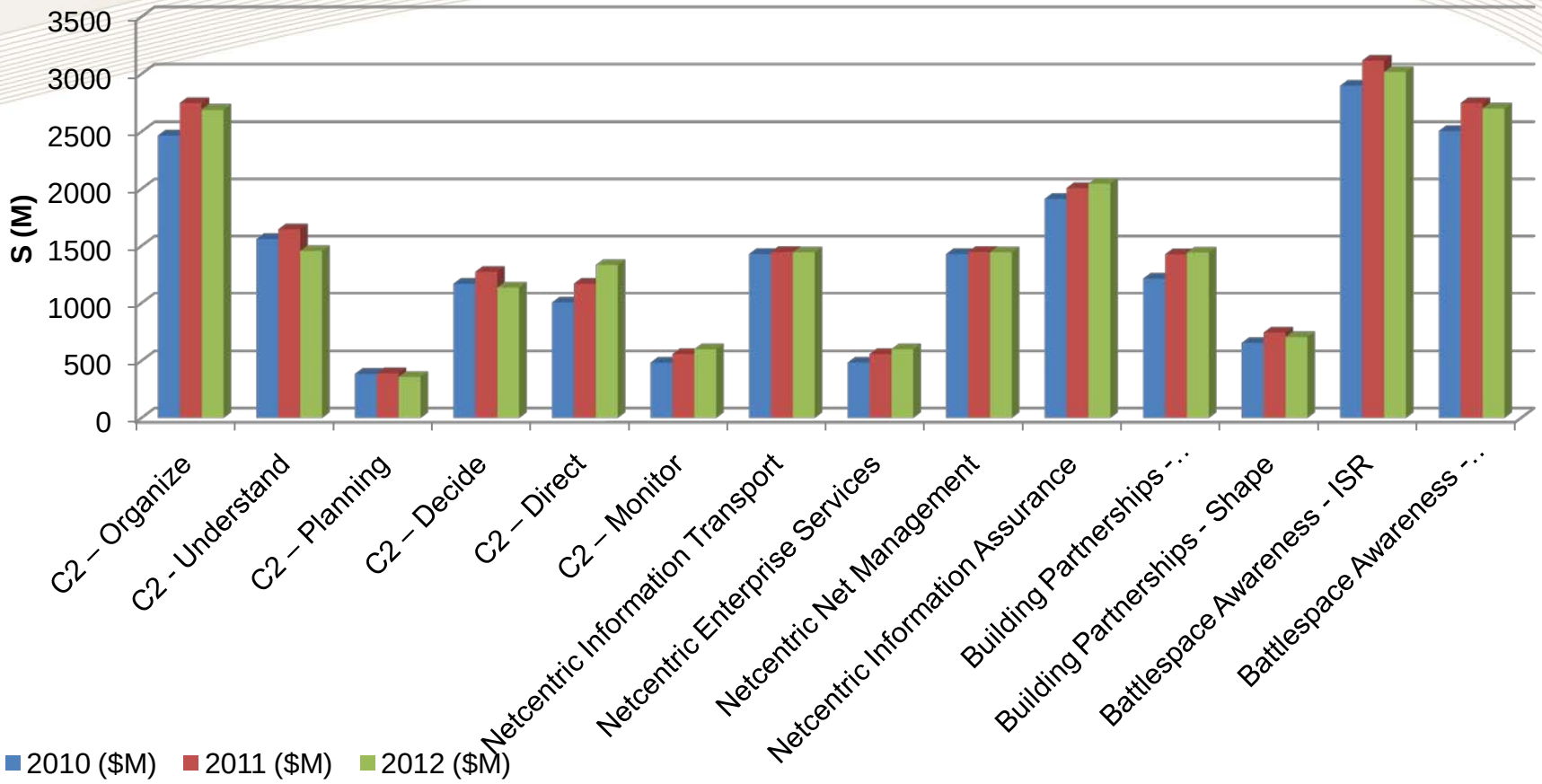
IDA | Mapping Technical Areas to JCAs

Joint Capability Area Level 2	Broad Technical Area
C2 – Organize	Organizational Architecture, Decision Support, Collaboration
C2 - Understand	Decision Support, Intel Analysis
C2 – Planning	Planning
C2 – Decide	Decision Support
C2 – Direct	Organizational Architecture, Information Sharing
C2 – Monitor	System Architecture,
Netcentric Information Transport	Network Architecture
Netcentric Enterprise Services	System Architecture

IDA | Mapping Technical Areas to JCAs (cont.)

Joint Capability Area Level 2	Broad Technical Area
Netcentric Net Management	Network Architecture
Netcentric Information Assurance	System Architecture, Network Architecture
Building Partnerships - Communicate	Information Sharing, Collaboration, Interoperability
Building Partnerships - Shape	Collaboration
Battlespace Awareness - ISR	Situation Awareness, Intel Analysis
Battlespace Awareness - Environment	Situation Awareness

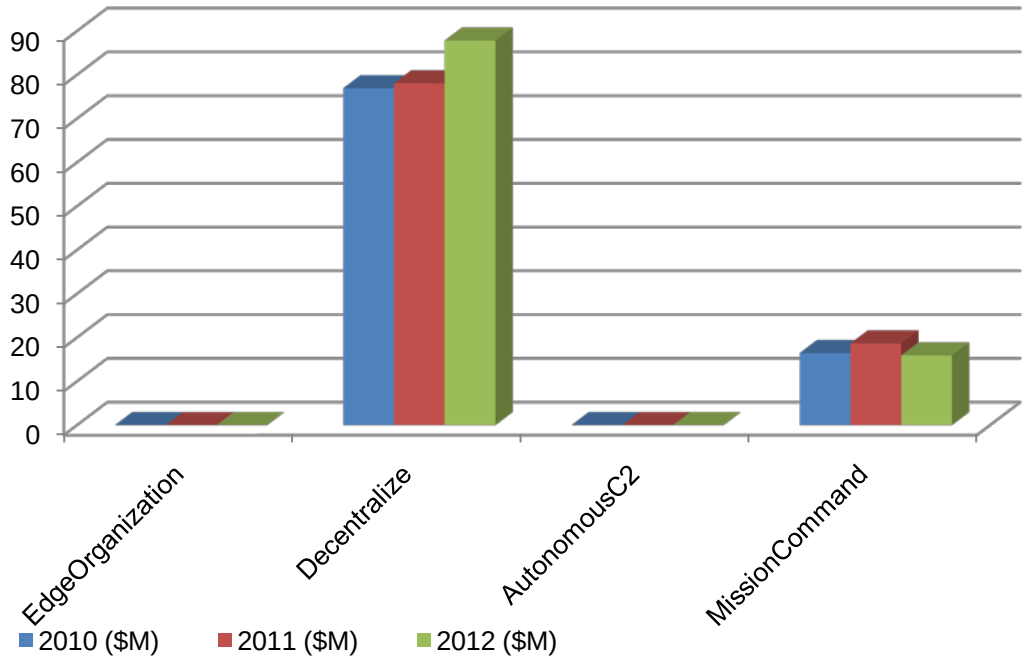
IDA | Results of Technical Area Mapping



- Technical area identified programs make up 30% of programs, and 38% of funding dollars.
- Roughly balanced distribution of JCA support as identified by technical area

IDA | Trends– Decentralization (net-centric)

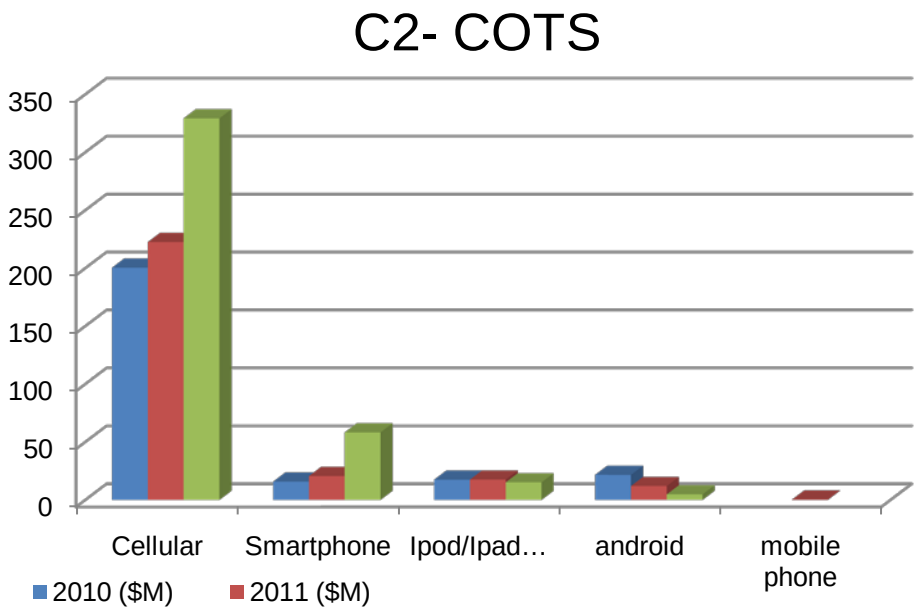
- Trends in C2 were identified by literature surveys, attendance at conferences and discussions with service-members



- Driven by
  - Complexity of Endeavors
  - Smaller, more independent units of action
  - Mission Command doctrine
  - Nimble, decentralized behavior of some adversaries
  - Ubiquity of advanced ICT
  - Top-level strategic guidance
- However, our analysis doesn't show explicit concordance with words common in the rhetoric…
  - Use of the terms may lag behind the development of technology
  - Cultural resistance to the transition exists at mid-levels in the US military; technologies enabling decentralized C2 may be in the process of research and development without being identified as such

IDA | Trends– Commercial Off The Shelf

- Adoption of commercial off the shelf technology (COTS) is trending in many areas, including C2



- Broad availability of cheap, advanced, commercial ICT has greatly increased ability to create, process and disseminate information
- Cellular technologies are definitely being adapted & developed by DoD, but few specific references are made beyond “cellular”

- Research may fail to reference– pilot studies often not described in detail in budget documents

Both trends require more in-depth investigation to identify actual level of effort

IDA | Conclusions

- Research interpretable as being C4ISR-related occupies nearly 40% of DoD R&D budget
- DoD's C2 Strategic Plan appears to be implemented fairly evenly in S&T
- *Situation Awareness* technologies & development of *Network Architecture* for communications figure prominently
- Broad technical area of *Organization Architecture* could receive more attention
  - Topics such as information quality, trust, & fundamental behavior of sociotechnical networks
- Influence of trends toward decentralization and commercial technology adoption partly discernible
- Database should be maintained and activities and accomplishments tracked for cohesive, over-arching view of C2 S&T.