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Toward a Living Web of Plans

Knowledge Systems for Coalition Operations Conference

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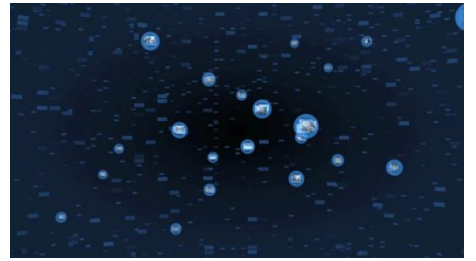
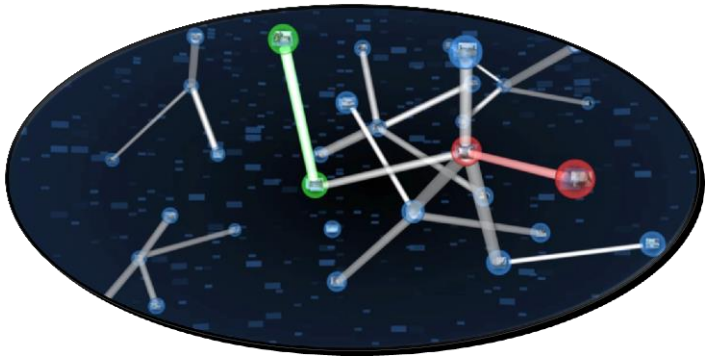
  - **Vision, CONOPS, & Technology Roadmap**

A Plan Ecosystem

- **Maximize operational agility in complex operational environments by helping commanders achieve a greater *unity of effort* out of *diverse, decentralized* planning efforts**
  - **Necessary plurality, heterogeneity, autonomy**
    - division of labor, specialized expertise, processes, tools, & artifacts
    - span of control, security, change localization/management
    - security
  - **Many teams/planners**
    - multi-domain (air, cyber, space, land, maritime, coalition)
    - other USG, NGOs, IGOs, etc. – “unified action”, cooperative/non-cooperative participants
  - **Many different kinds of plans and tools**
    - MS Office, specialized tools AI planners
  - **Plan “ecosystem”**
    - more distributed planning / plans – many be hard to find
    - different stages of refinement/execution
    - continual change / (re)planning (“Living Plans”)
  - **Recent trends: distributed control for contested, degraded environments**





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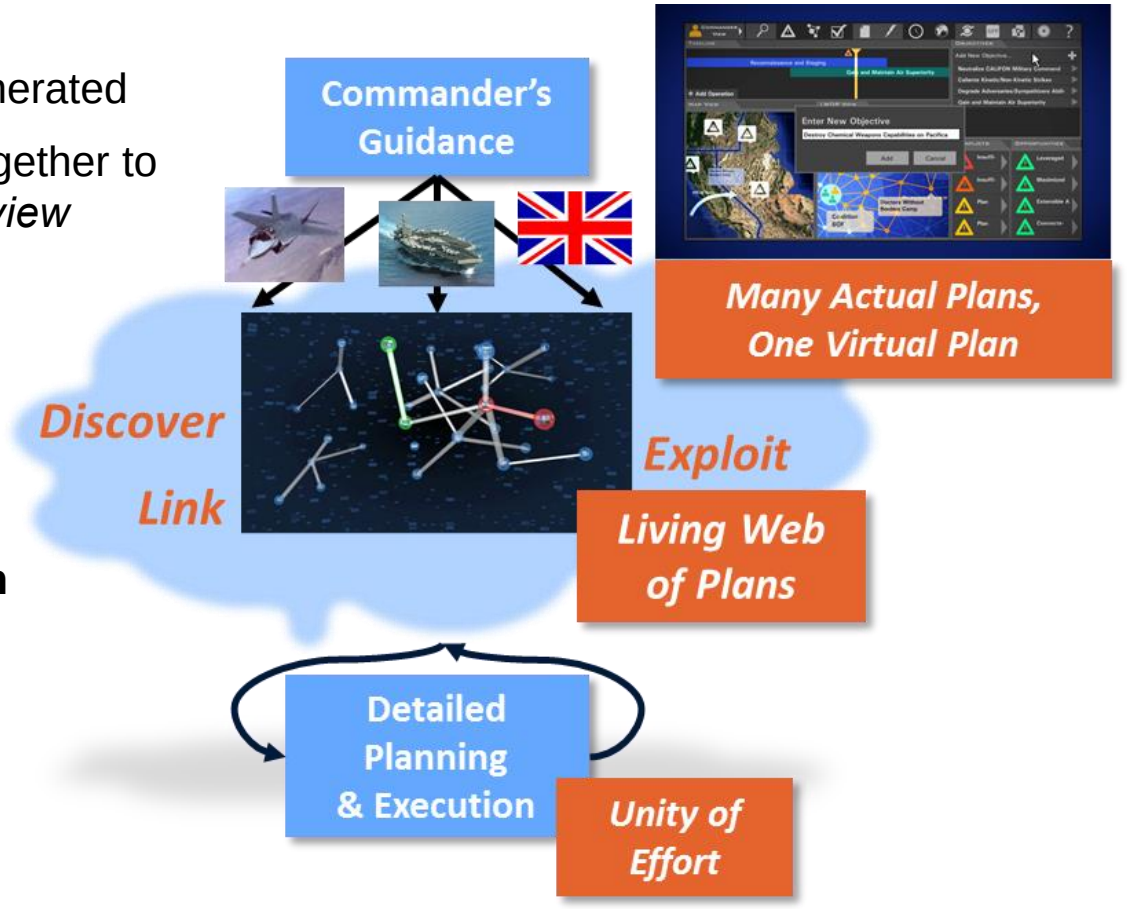
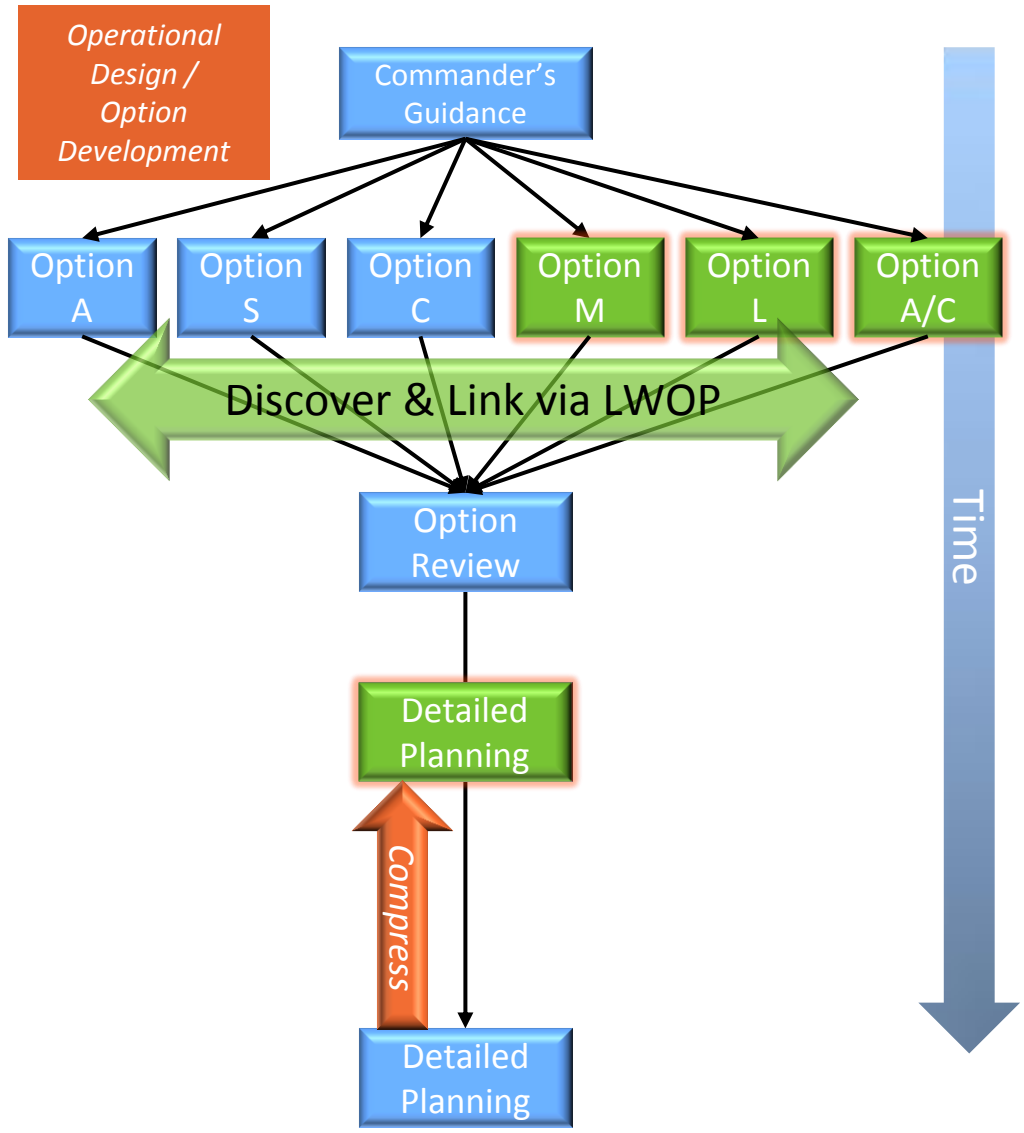
Integrated Planning/C2 Vision

- **Embrace the plurality, but foster unity of awareness & action**
  - planners discover all relevant plans, as they are being generated
  - commanders understand how plans (parts) are coming together to achieve their objectives (whole) – "*Topsight", virtual plan view*
- **More integrated, hybrid options available to commanders**
  - cross-domain elements
  - developed earlier in the planning process
  - **early (cheaper) discovery and resolution of cross-plan interactions – conflicts & synergies**
- **Dynamic planning teams**
  - rapidly formed to work an objective
  - focus on lines of operation/effort
  - dream teams – the best available people (cross-organization, cross-domain, etc.)



Planning Today

- **Planners independently develop options for commander**
  - swimlanes, time constraints, etc. limit options under consideration
  - option integration occurs later (if at all)
  - above implies fewer options for consideration and potentially longer planning time
- **Diverse planning teams and planners**
  - rigid planning processes (e.g., CAOC/ATO)
  - ad hoc coordination across (liaison officers)
- **Limited visibility across the planning ecosystem by planners and commanders**
  - cross-plan conflicts and opportunities typically detected late in the process (if at all) => more expensive to resolve, less optimal
  - redundancies, inefficiencies across plans
  - inefficiencies in planning effort



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Living Web of Plans

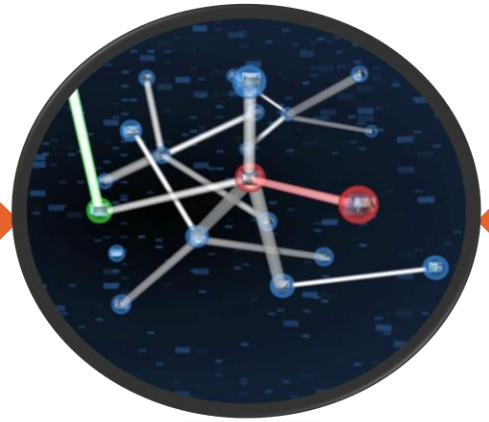
Discover

Distributed, Dynamic Plans

- Many plans – many sources; heterogeneous tools, & formats
- "Come as You Are" planning – planners work in own tools

Link

Plans -> Web of Plans



- Identify implicit relationships & dependencies
- Exploit plan/planning context & rationale
- Loosely Coupled <-> Tightly Coupled

Exploit

the Web of Plans

- Understand early on how the parts are coming together
- Proactively identify & resolve cross-plan problems & opportunities

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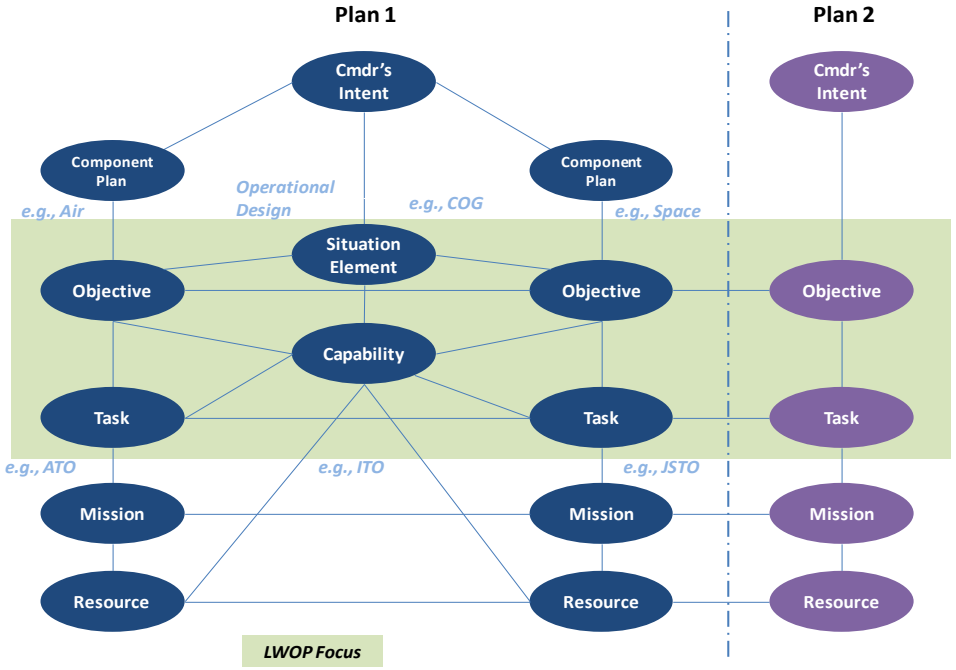
Bringing a Web Stance to Planning

Capability	Worldwide Web	Living Web of Plans
Distributed Resources	Web pages, apps on WWW	Plans (docs, apps)
Distributed Resource Discovery	Crawlers, keyword search, rank by popularity	Crawlers, search (content, metadata, context). Ranking by relevance, timeliness, proximity
Understand & Index Resources	Exploit text, metadata. Text indexing.	Text & semi-structured. Multi-dimensional indexing (geo, temporal, objective, battlespace entity)
Machine Under-standability	e.g. Semantic Web, Linked Open Data	Ontologies for plans, etc.
Collaboration	Social networking & sharing, collaborative authoring (wikis)	Plan mash-ups, other tools

Horizontal & Vertical Plan Linkages

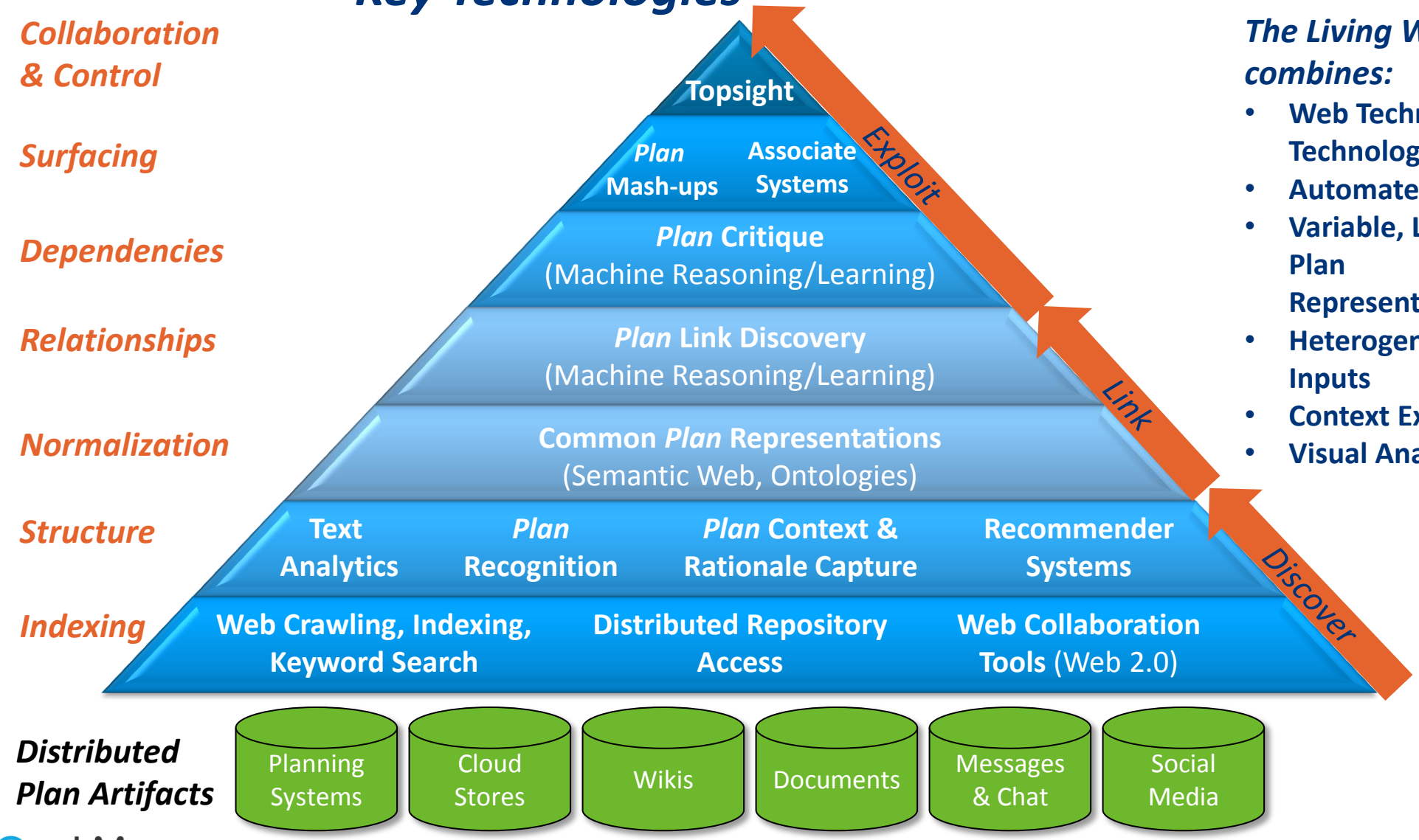


Linking techniques:

- **Spatio-temporal correlation**
- **Functional association**
- **Named Entity correlation**
- **Organizational, doctrinal, & process associations**
- **User Context inference and association**

Enabling the Living Web of Plans

Key Technologies



The Living Web of Plans combines:

- **Web Techniques & Technologies**
- **Automated Reasoning**
- **Variable, Lightweight Plan Representations**
- **Heterogeneous Plan Inputs**
- **Context Exploitation**
- **Visual Analytics**

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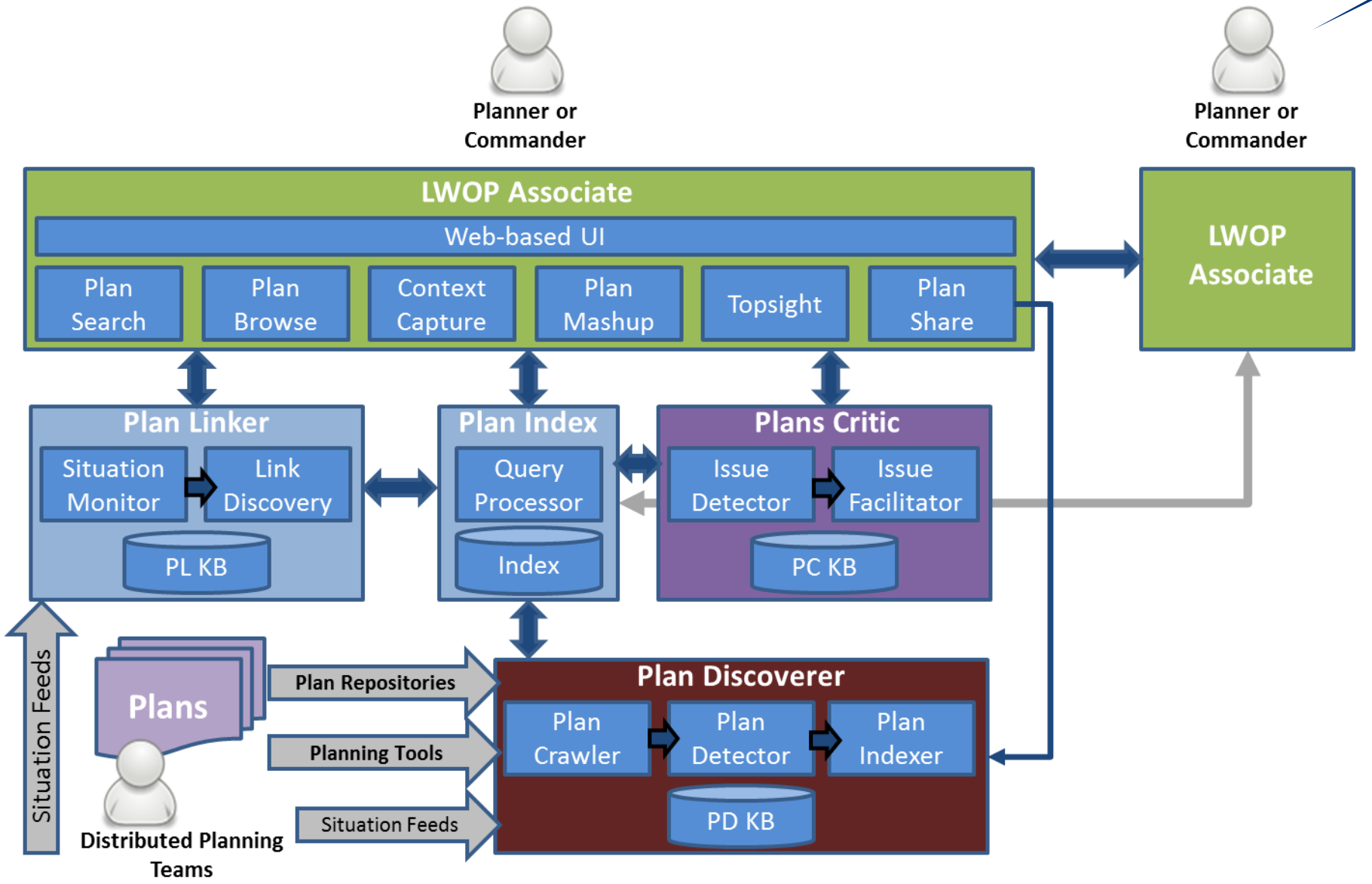
Prior Work

Prior Planning Tools (1970s-2000s)	Living Web of Plans Approach
One plan, known	Many (distributed) plans, some known & some discovered
Fully-automated plan generation	Semi-automated plan critique
Standardized plan authoring tool	Multiple plan authoring tools (including MS Office, etc.), formats – “Come as You Are Planning”
Plans must be fully understood by system	Can work with plans not fully understood by system
Unified, deep plan representations	Lightweight representations of varying depth
Little or no exploitation of plan metadata or context	Exploits plans’ metadata or context
Deep domain knowledge from SMEs required	Deep domain knowledge not required for shallow indexing/linking, but can be exploited if available

Notional Functional Architecture



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Conclusions

- **Living Web of Plans**
  - supports and fosters plan ecosystems: more plans, more distributed
  - promotes operational agility, higher operations tempo, synergy/conflict identification, and plan awareness
  - “come as you are” planning: embraces heterogeneity (e.g., coalition ops)
  - scalable, web-based approach
  - exploitable by humans and machines
  - builds on extant and emerging technologies
- **Future Work**
  - plan indexing of cloud-based repositories
  - plan understanding/linking technologies (e.g., NLP, machine learning)
  - change management as plans evolve
  - exploitation tools: Topsight, plan search, plan mash-ups, etc.

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