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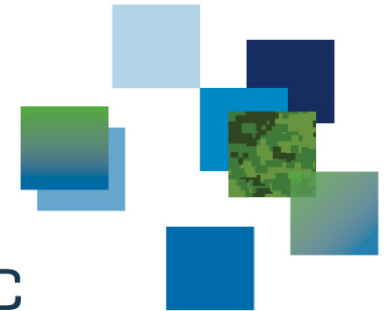
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# Schedule Risk Analysis of Capability Development Initiative Portfolios

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DRDC | RDDC



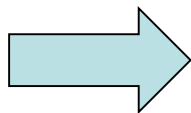
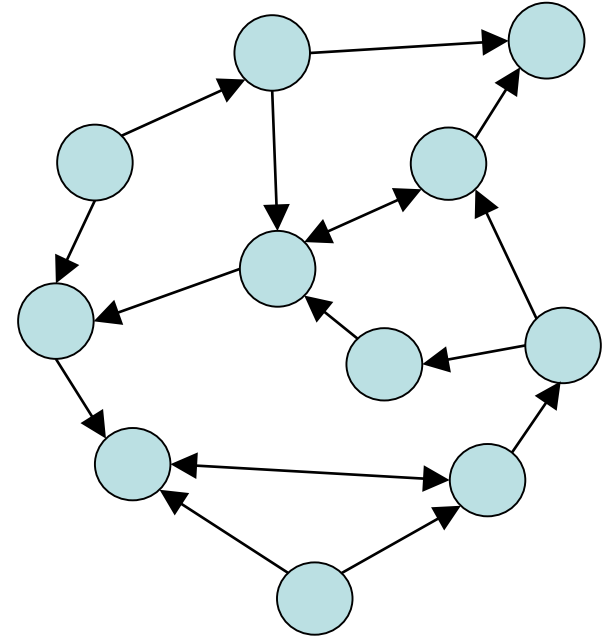
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# Outline

- Introduction
- Model
- Algorithm
- Examples
- Lessons learned
- Conclusion

# Introduction (1/2)

- The development of capabilities required by armed forces involves a large number of interrelated Capability Development Initiatives (CDIs).
- Changes, delays and cancellations in any one of these CDIs can have significant first and second order impact throughout the CDI Portfolio (CDIP).
- Important to identify areas of higher risk and the potential impact early in order to inform decision making and enable the determination of mitigation measures.

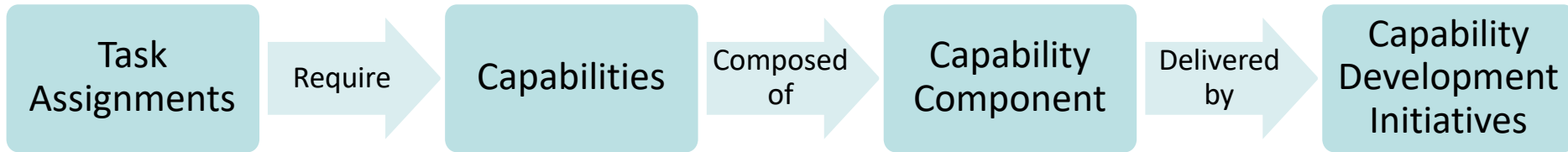


Risk analysis at the portfolio level

## Introduction (2/2)

- In support of the Canadian Army (CA), the DRDC Centre for Operational Research and Analysis developed a model and prototype tool to assess schedule risk in the Army CDIP (ACDIP).
- The prototype is called AVA (ACDIP Visualization and Analysis).
- Client requirements:
  - Determine impact of potential CDI delays on readiness of CA to deliver on assigned tasks; and
  - Need as little data as possible in order to limit level of effort required to collect and update it.

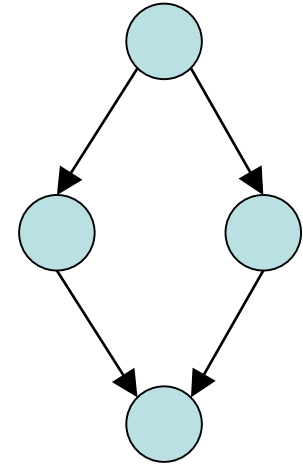
## Model (1/3)



- **Task assignment:** military unit, time period and capabilities required.
- **Capability:** “ability to create an effect through employment of an integrated set of aspects categorized as doctrine, organization, training, materiel, leadership development, personnel, facilities, and interoperability” (NATO AAP-06).
- **Capability component:** doctrine, organization, training, materiel, etc.
- **CDI work plan:** described as sequence of high-level steps, including delivery of capability components, with possible branches and merges.

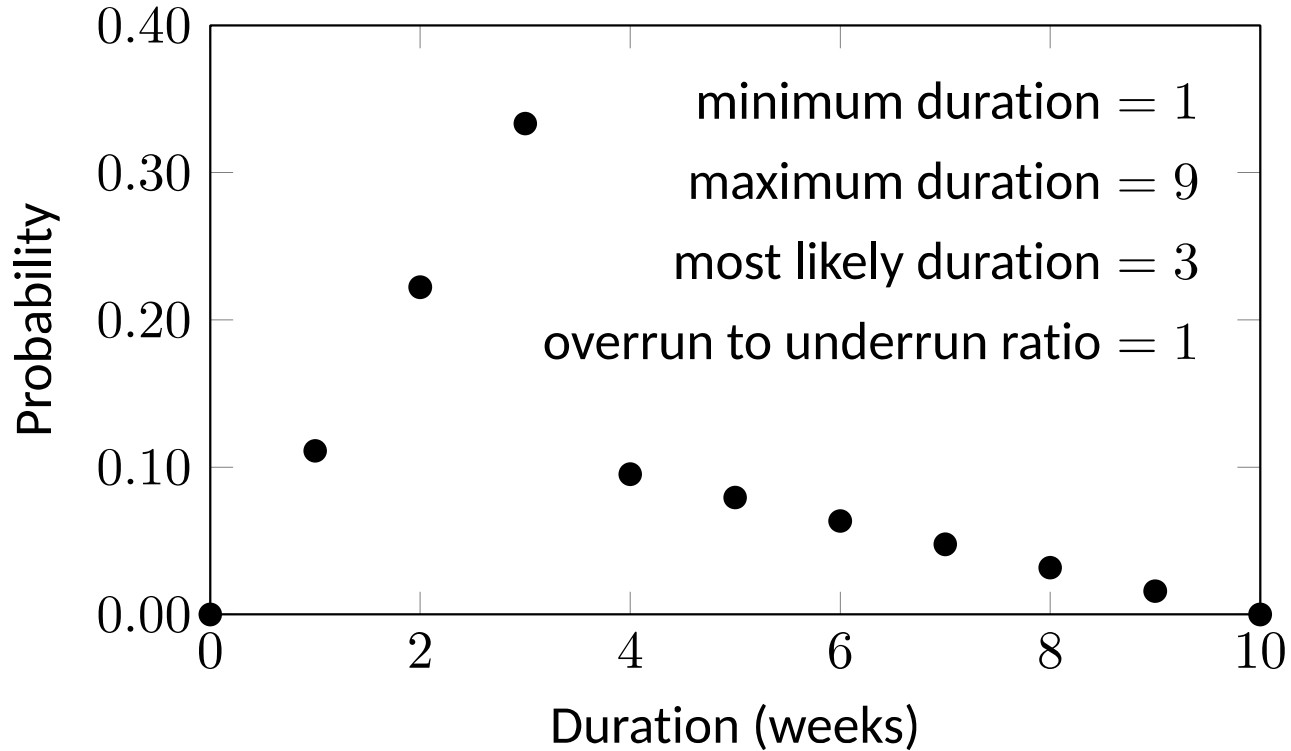
## Model (2/3)

- Entire CDIP described as a single Directed Acyclic Graph (DAG):
  - **Graph:** abstract representation of relationships among a group of entities (work plan steps);
  - **Directed:** each relationship has a direction indicating which step of the work plan must come before another; and
  - **Acyclic:** no step can be reached from itself by following the step relationships.
  
- DAG also encompasses:
  - Availability of capabilities; and
  - Task assignments enabled by these capabilities.

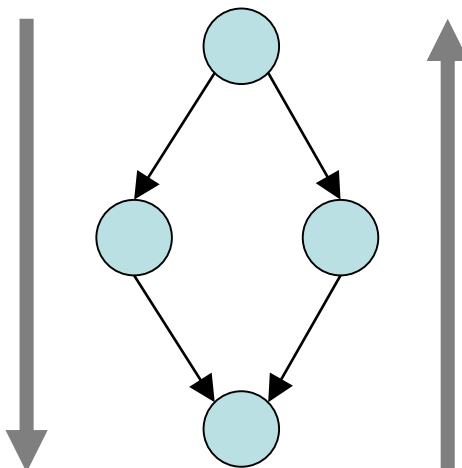


## Model (3/3)

- Step duration modelled using integer double-triangular distribution.

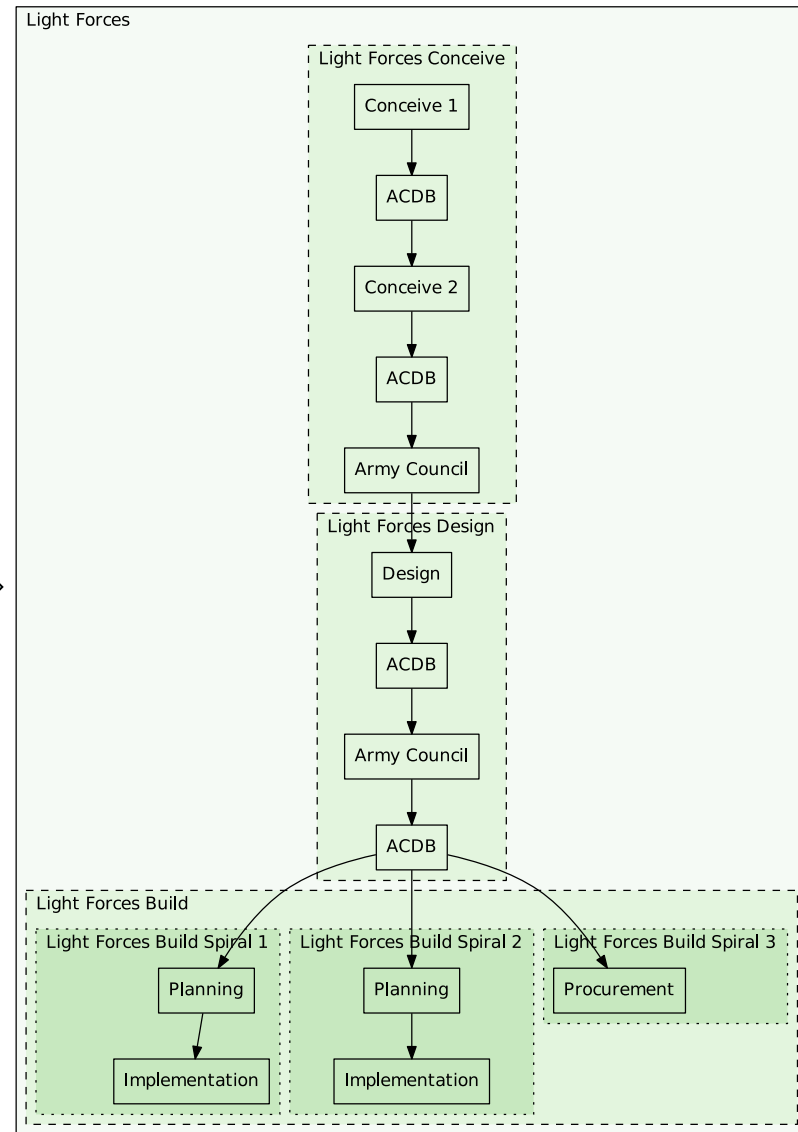
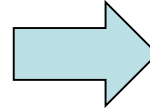
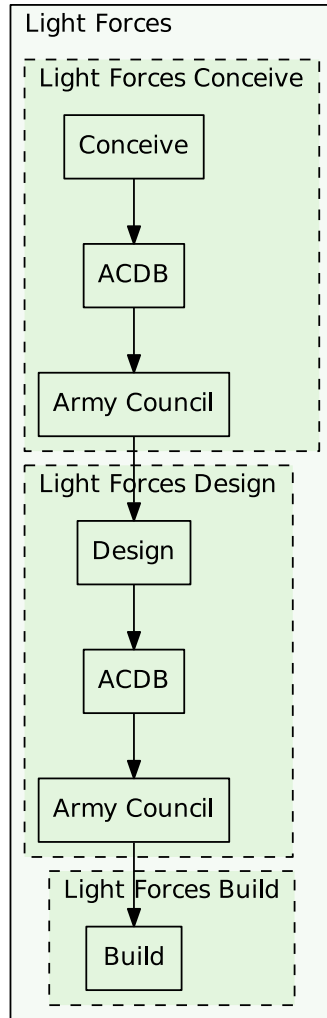
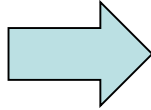
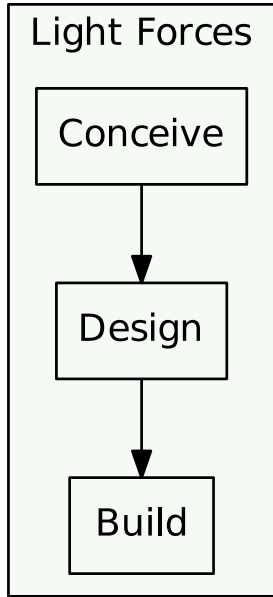


# Algorithm

- Sample double-triangular distribution for each work plan step duration.
  - Walk DAG forward:
    - Start and end dates of each work plan step;
    - Availability date of each capability;
    - Fulfillment date of capability requirements for each task assignment.
  - Walk DAG backward:
    - Deadline for each of those dates.
- 
- ```
graph TD; A(( )) --> B(( )); A --> C(( )); B --> D(( )); C --> D(( ))
```

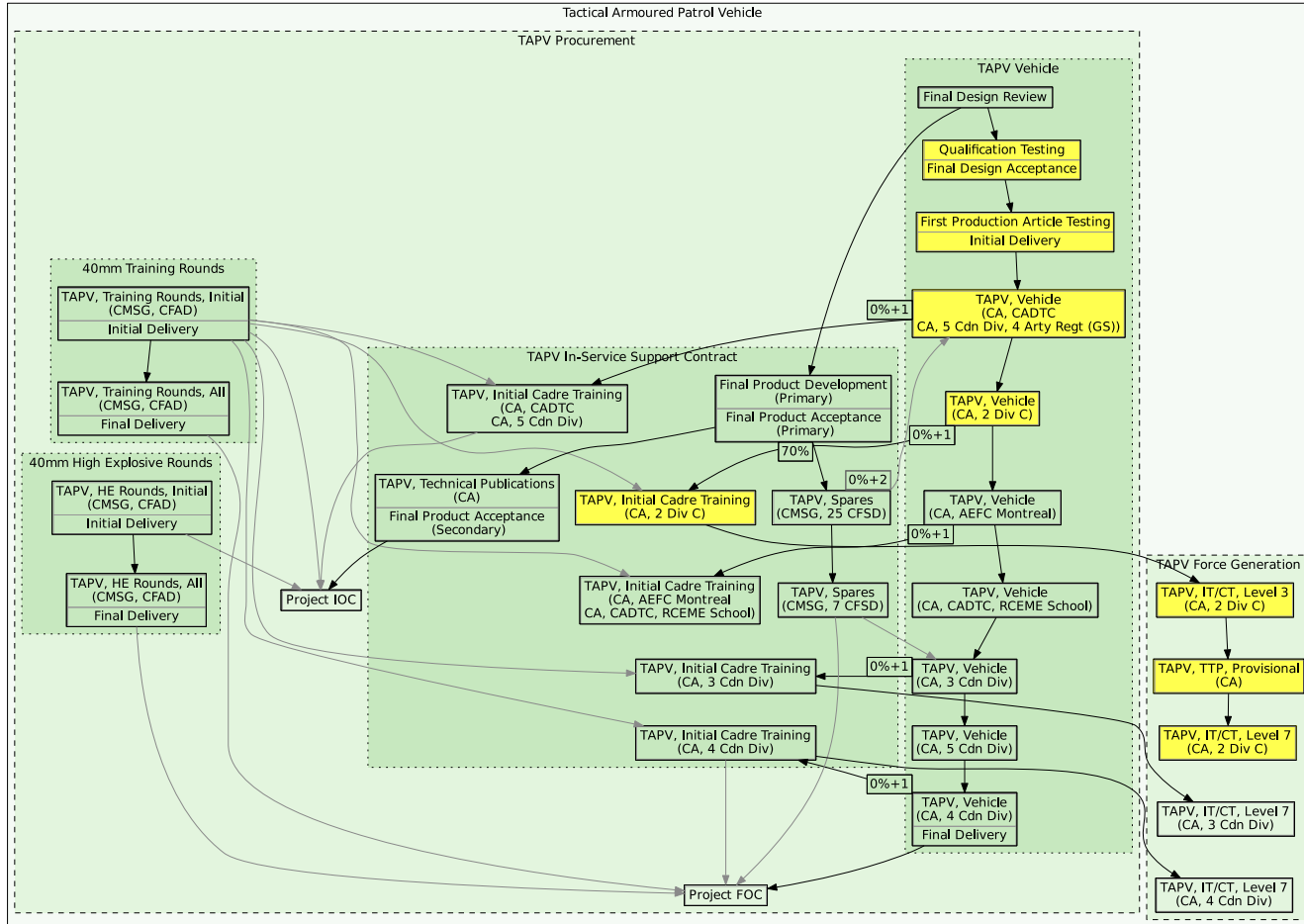


# Work plan chart: example 1

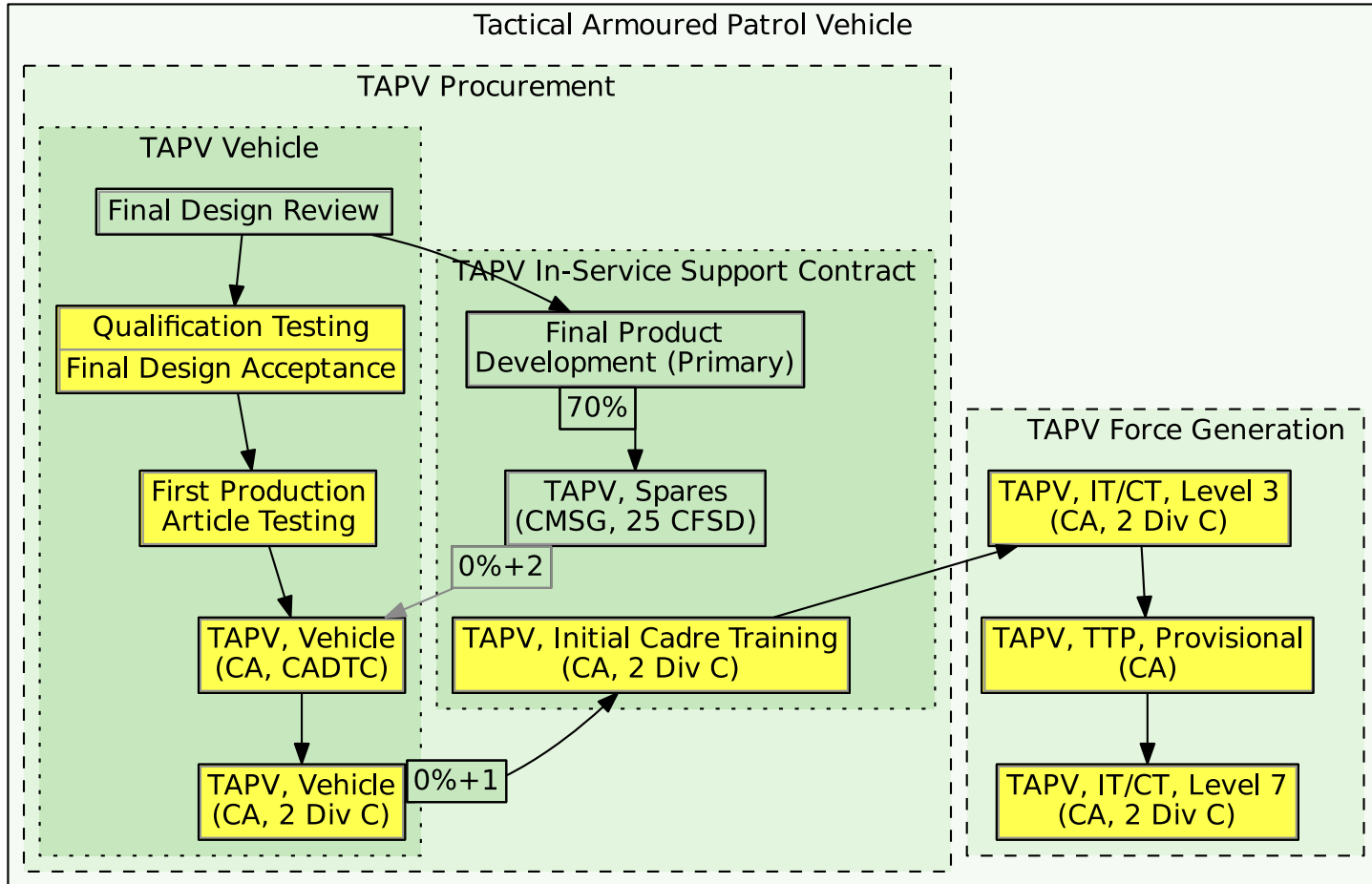


ACDB: Army Capability Development Board

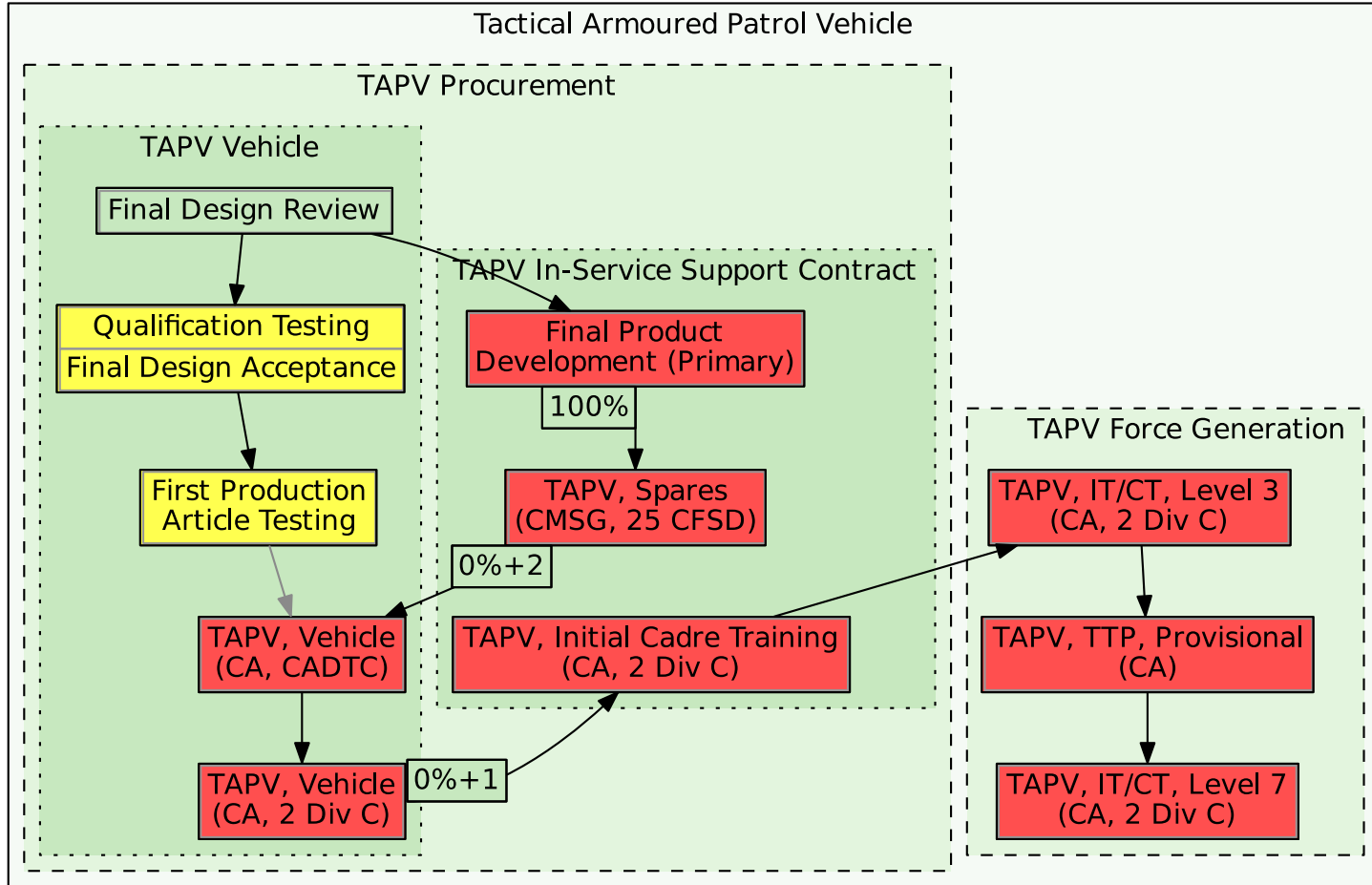
# Work plan chart: example 2



# Work plan chart: example 2 – subset



# Work plan chart: example 2 – alternate scenario



# Lessons learned

- Minimization of data requirements:
  - If level of effort is too high, it can act as a deterrent to performing a formal schedule risk analysis.
  - Better to start with high-level work plan and to add details only as required.
- Accuracy of duration estimates:
  - Must be based on expert judgment rather than official plan.
  - Requires support from chain of command.
- Displaying results:
  - Flowcharts are the most concise way of displaying a work plan, but a lack of linear timeline makes them harder to interpret and they can become unwieldy as the level of detail increases.

# Conclusion

- DRDC CORA developed a model and prototype tool for portfolio schedule risk analysis tool in support of the Canadian Army.
- The model captures relationships between task assignments, capabilities, capability components and capability development initiatives.
- Focused efforts required to stay high-level and obtain accurate duration estimates.
- The prototype, based on the model, provides estimates of:
  - When capabilities should become available; and
  - The probability that capability requirements will be met on time.



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