2022

Applying Generative Construction Technology to Nuclear Deactivation & Decommissioning

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LAGRANGE ALICE TECHNOLOGIES Project Controls EXPO Washington, DC - USA

Agenda

- Introductions
- Overview of Generative Construction
- Project Description
- Case Study
- Questions and Answers

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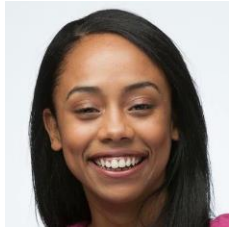

Marveliz Santos
Project Manager
ALICE Technologies

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What is Necessary to Build a Useful Schedule?

- A Universal WBS that ties to the project approved cost estimate
- Tasks, logic, and durations
- A detailed quantity and unit rate-based estimate with labor, material, & equipment
- A crew mix to distribute hours to and the number of crews that are available
- Resource load the schedule
- Baseline Schedule Review and Approval

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Challenges with Traditional Scheduling?

- CPM schedules limit a planner's ability to explore new sequences and options to overcome delays
- Incredibly difficult to keep track of and maintain numerous constraints
- Decision making is informed by outdated data due to latency and schedule maintenance effort
- Schedule problems are hard and complex – communication between stakeholders breaks down quickly

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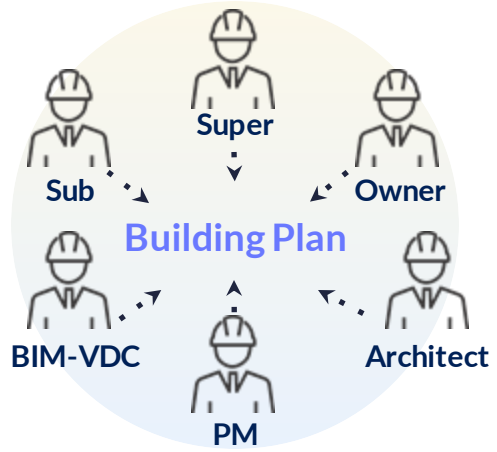
Current Situation: Scope, Schedule, and Cost Are Siloed

Today: Inefficient Planning

Information is lost during silo transitions due to scope, scheduling, and estimation each happening independently

Lack of coordination increases costs and delays on projects

ALICE : Integrated Planning



Integrated planning approaches to construction can improve productivity by 70%[1]

1 – McKinsey (Improving Construction Productivity, July 2017)

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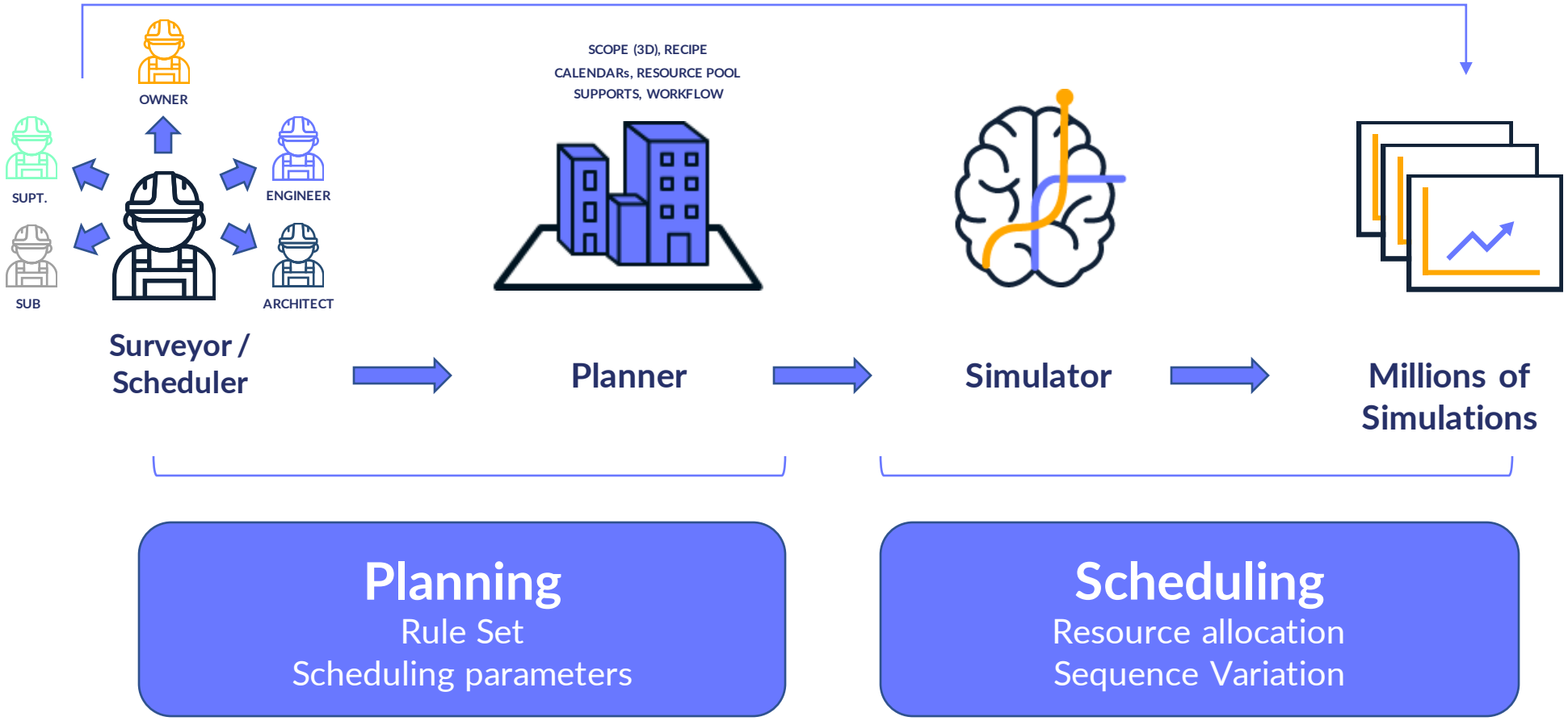
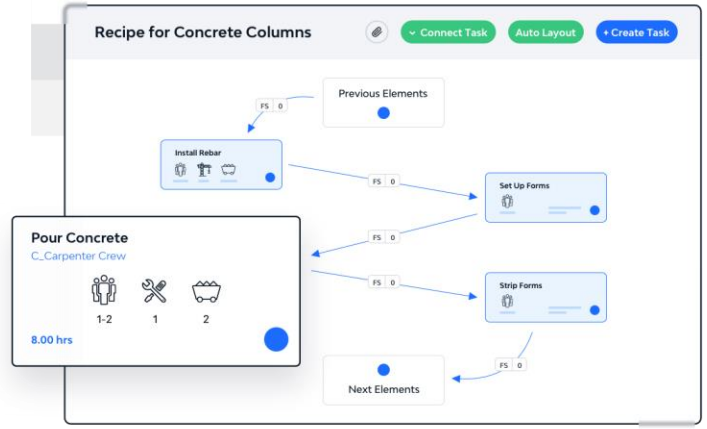
What is Generative Construction?



ALICE is a Parametric Rules-Based Engine

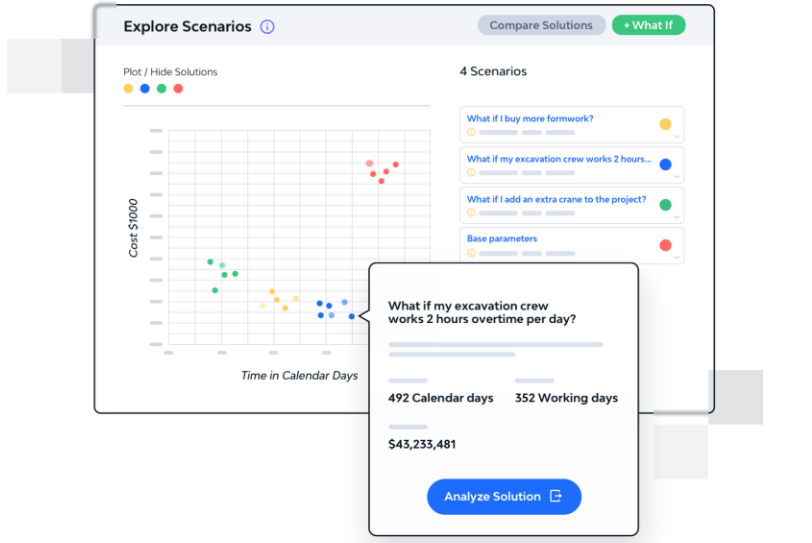
Recipes = logic, resources, constraints



AI-Powered: patented algorithms rapidly propagate parameters and resolve all constraints

Simulation: shuffles resources through space and time to generate millions of options

Optimization: presents scenarios to optimize and execute a project – accelerate, mitigate, control costs, grow margins



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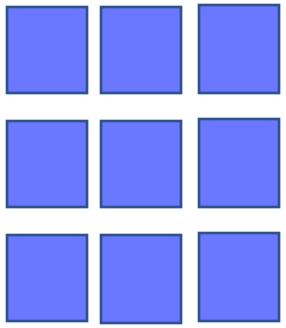
Here's a simple example:

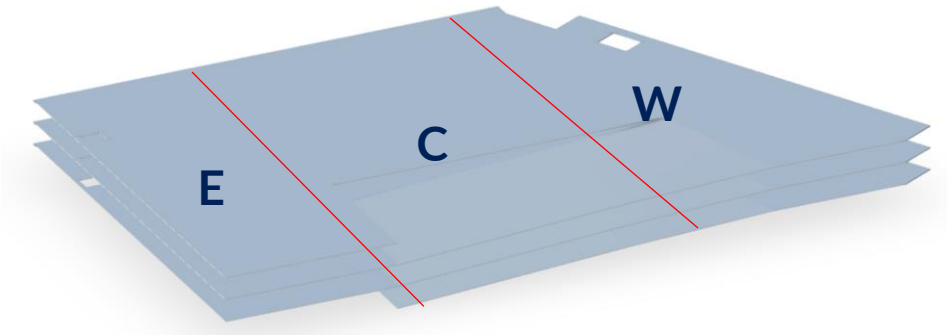
- Generative Construction Simulates the millions of ways to build a project
- A basic 3x3 series of columns can be built in 362,880 different sequences!



9! = 362,880

Now for a more complex scenario:

- A concrete deck split into 3 sections: East, Center, and West



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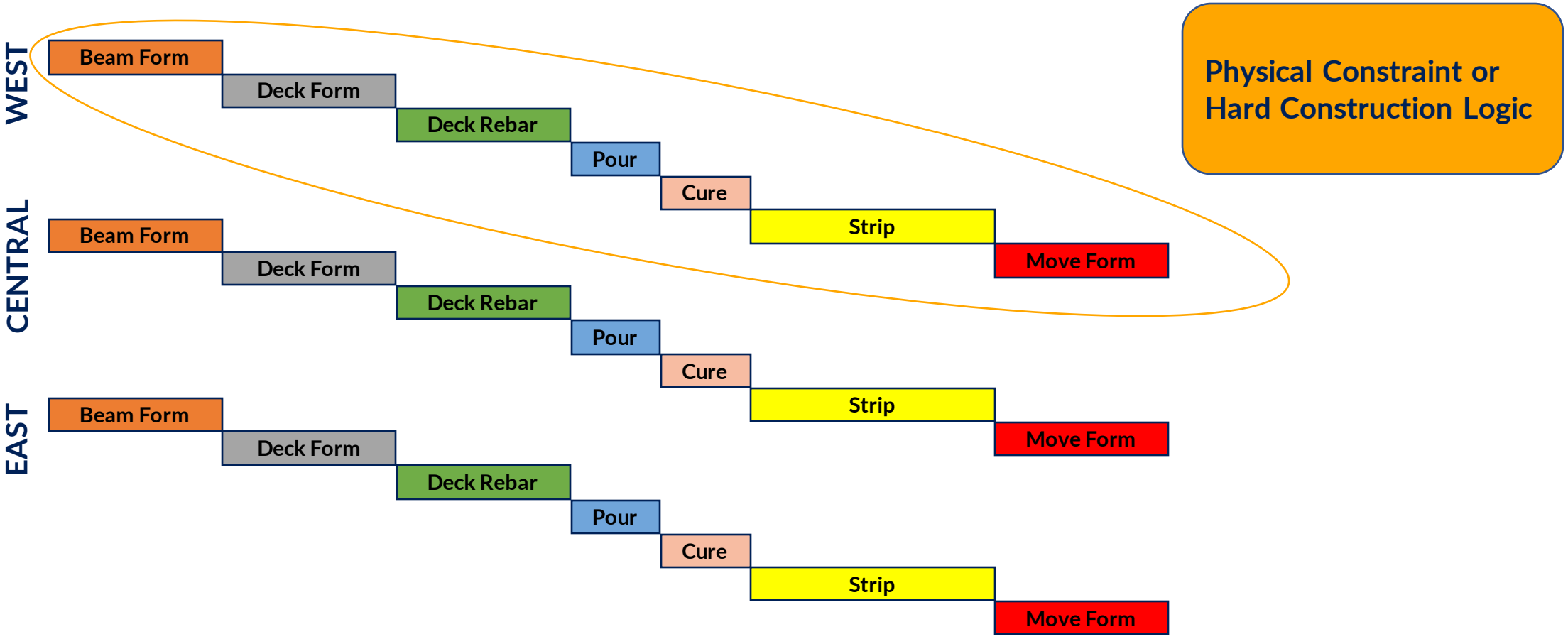
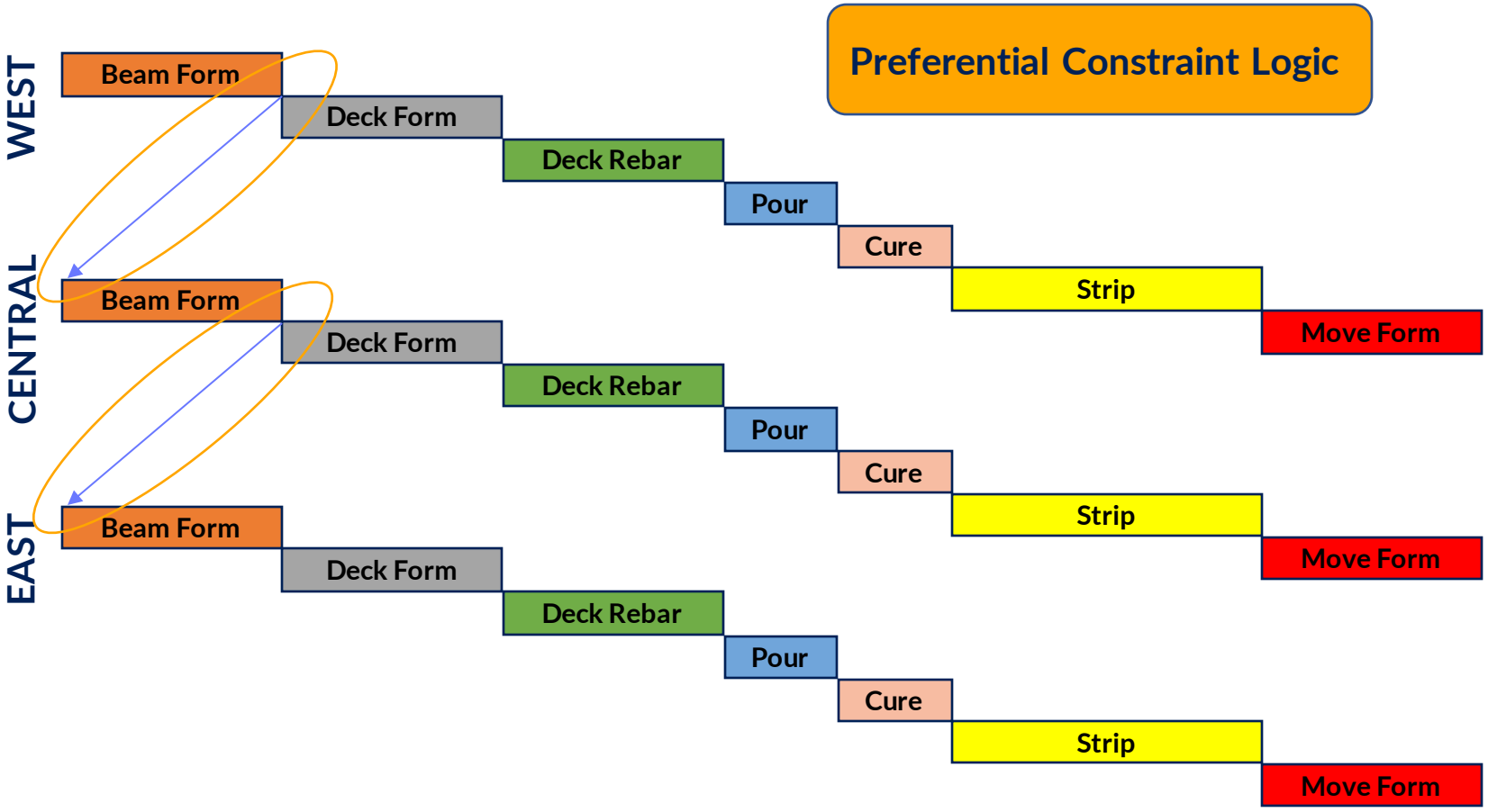
Traditional Schedule Resource Constraint Evaluation

Baseline



Traditional Schedule Resource Constraint Evaluation

One Beam Form Crew



Traditional Schedule Resource Constraint Evaluation

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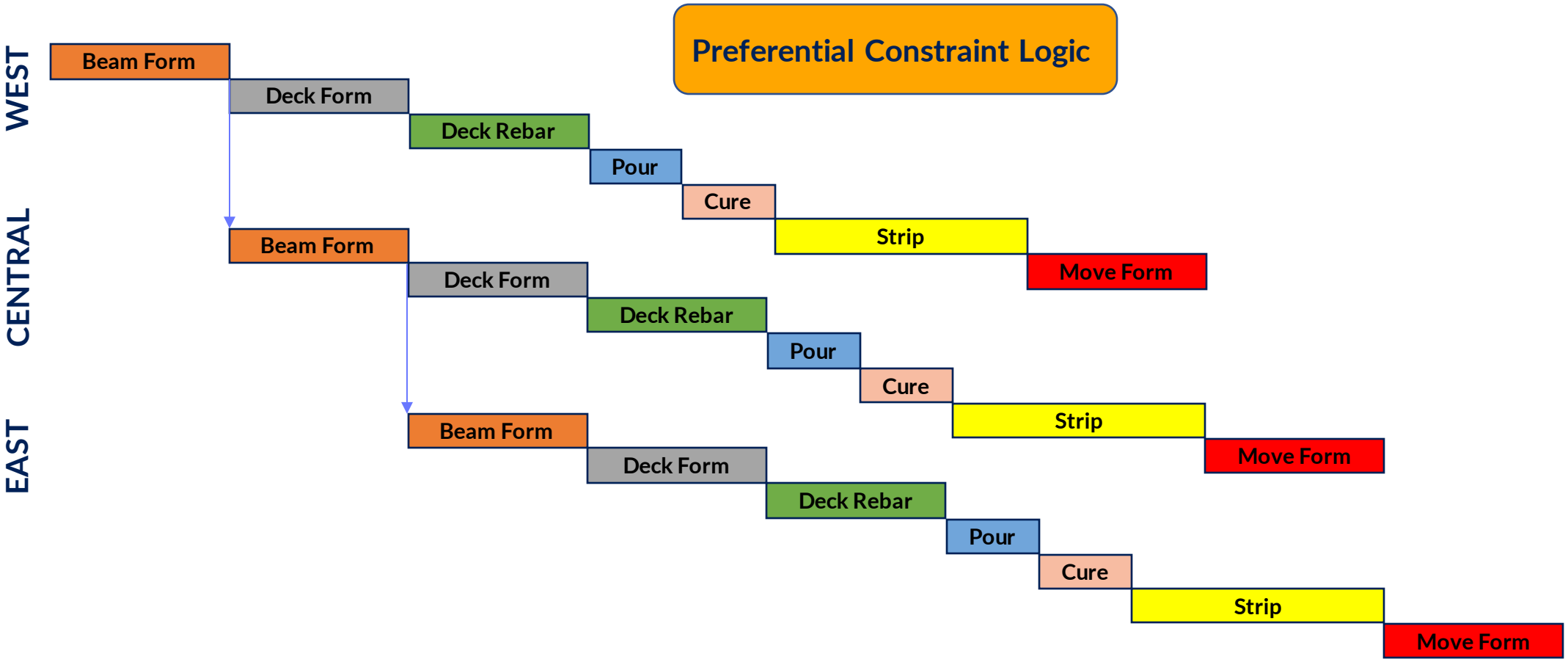
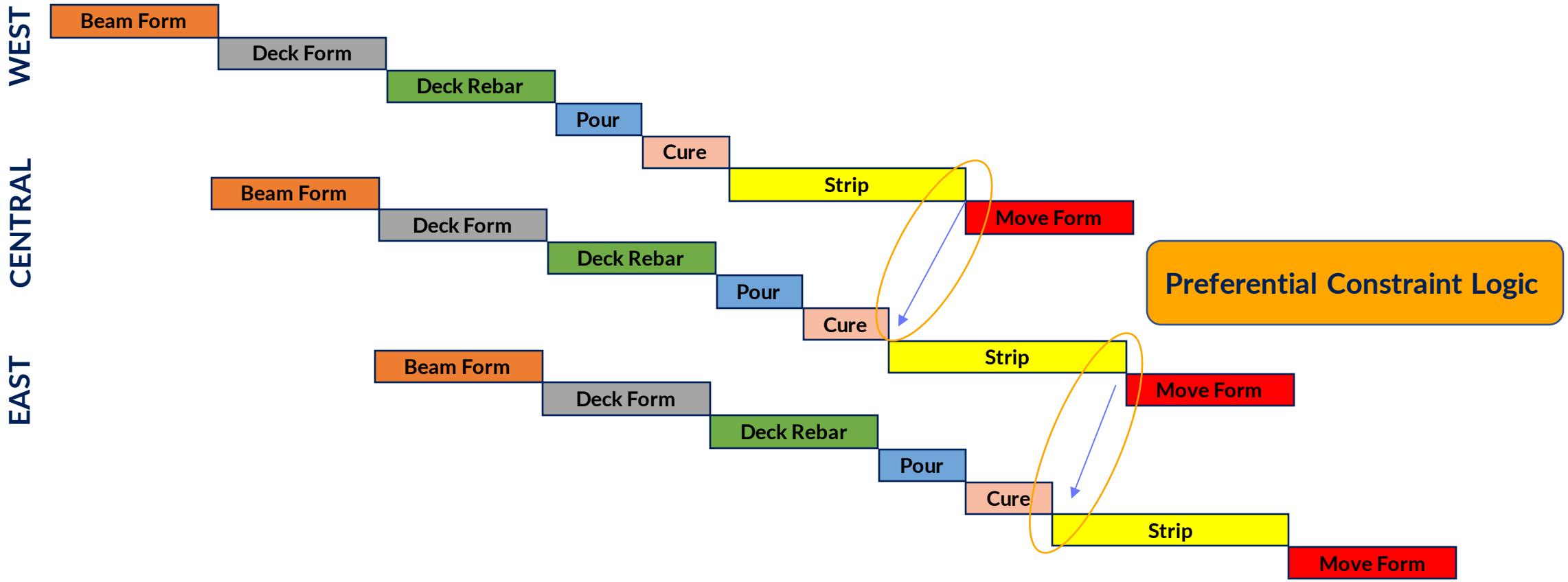


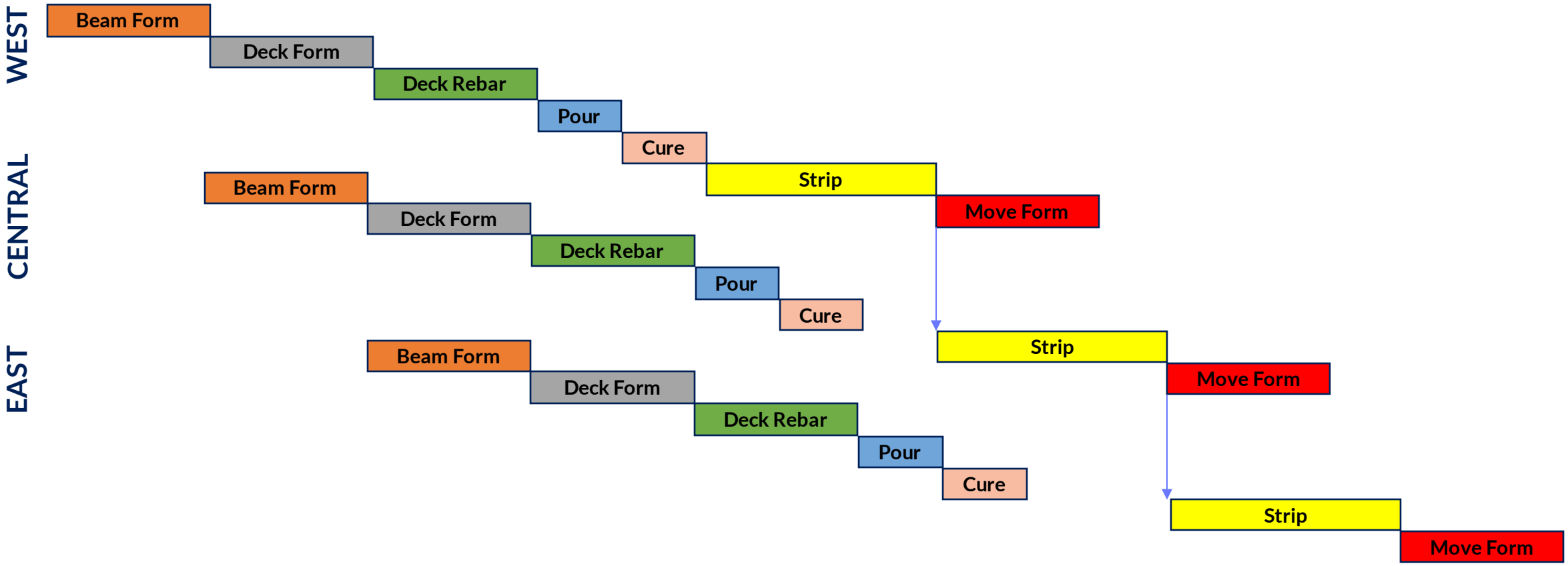
Traditional Schedule Resource Constraint Evaluation

One Beam Form Crew + One Dec Form Crew



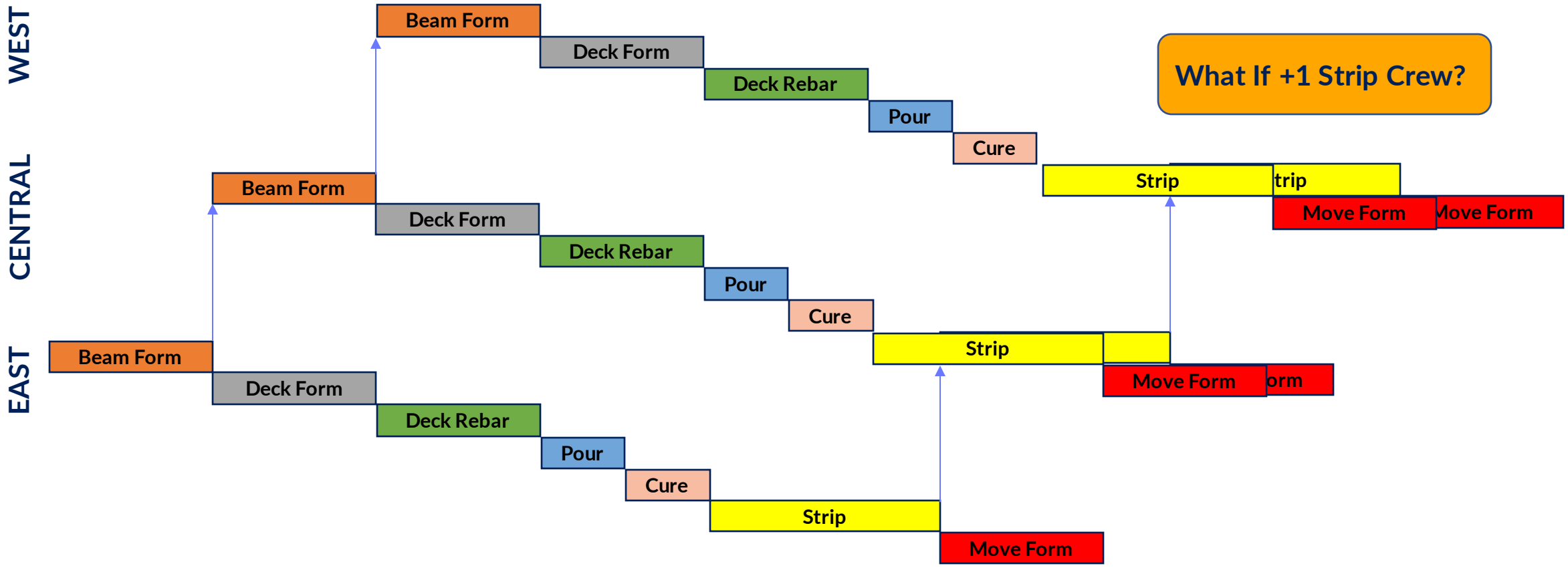
Traditional Schedule Resource Constraint Evaluation

One Beam Form Crew + One Strip Crew



Traditional Schedule Resource Constraint Evaluation

One Beam Form + One Strip Crew – Alternate Scenario



Traditional Schedule Resource Constraint Evaluation

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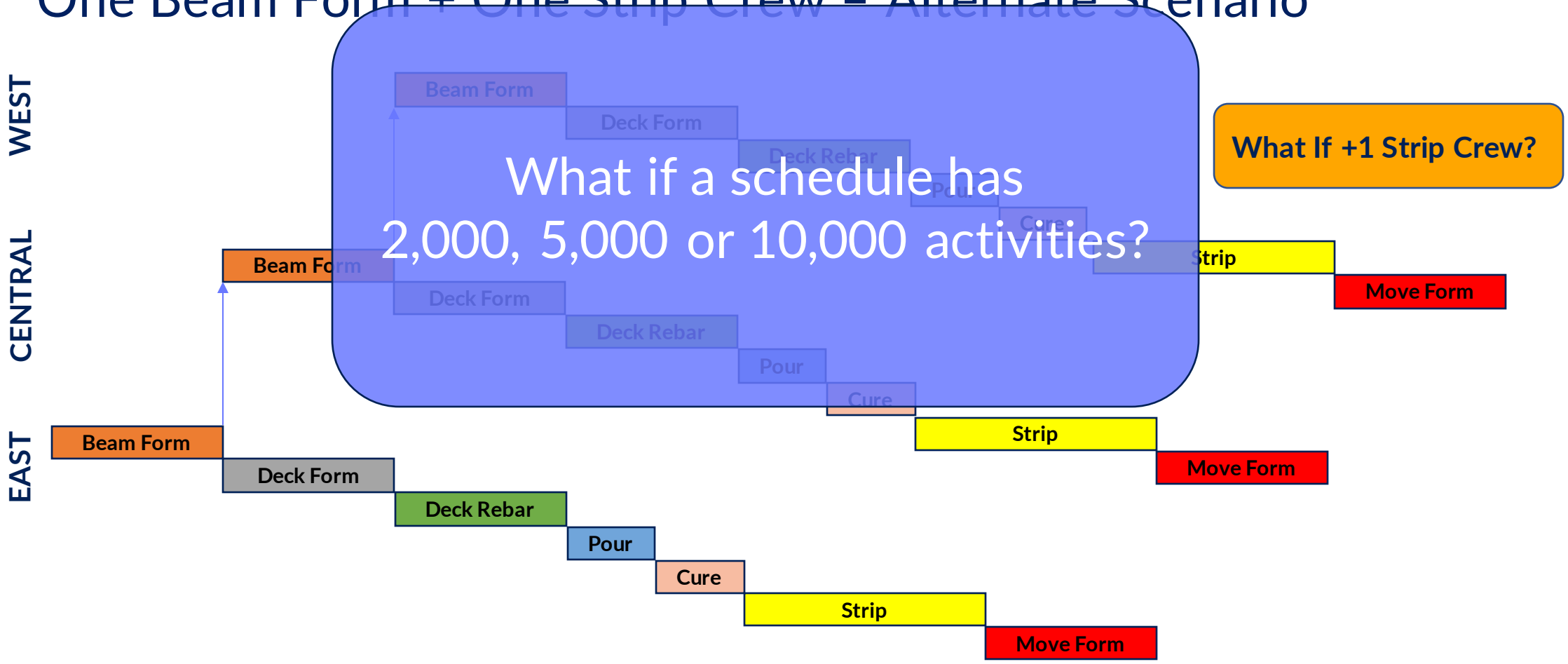

Nuclear Research Facility Deactivation and Decommissioning Project

- Deactivation of a nuclear research facility in Canada.
  Project includes:
  - Remediation and demolition of above-ground structures
  - Retrieval of radioactive waste via FOAK robotic manipulator
  - In-situ decommissioning of a 60 MW reactor
- $1Billion CAD Project
- 21,000 Activity Schedule
- Forecast to be completed in 2027

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How Did the Project Use Generative Construction?

- Generative Construction is being used to develop a rebaseline schedule for the Project
- The larger project is being split into 7 sub-project to be developed and merged into one larger project for optimization
- Goals:
  - **Reduce Duration:** Find a way to ensure project will be complete within contractual completion date
  - **Reduce Cost:** Identify cost optimization or avoidance opportunities

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Example Model Constraints

Physical:

- Spatial constraints (e.g., work in proximity to waste retrieval system)
- Resource Constraints
  - Training time
  - Labor / equipment / operators etc.
- Utility services

Regulatory:

- Procedure documentation and approvals
- Etc.

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Example Outcome: Stand Pipe and Bunker Waste Retrieval System (SBWRS) Optimization:

- The Project performed a cost benefit analysis to measure the impact of going faster v. security cost avoidance
- Results in 4 hours

Scenario	Duration	Standpipe Priority Duration	Cost	$ Saved
1 Optimize for Overall Duration (Fastest)	2268	1982	$185,014,921	--
2 Optimize for Overall Duration (Lowest Cost)	2478	1982	$163,893,520	**$21,121,401**
3 Optimize for Standpipe Prioritization (Fastest)	2269	1157	$153,766,747	**$31,248,174**
4 Optimize for Standpipe Prioritization (Lowest Cost)	2271	1160	$152,722,591	**$32,292,330**

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Questions?

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Thank you

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Transformational Paradigm Shift

Traditional Framework
"What Do We Need To Meet The Date"

1-2 weeks

1. Concept / Idea
2. Bias / Benchmarks
3. Predictable Solution
4. Reactive Execution

Result:
"I Wish I Could Do That Again"
"Hindsight Is 2020"

Schedulers & Planners Become Execution Strategists

ALICE Framework
"How Fast Can We Go?"
Start with the Fastest Theoretical Schedule

Less than a day

Rapid

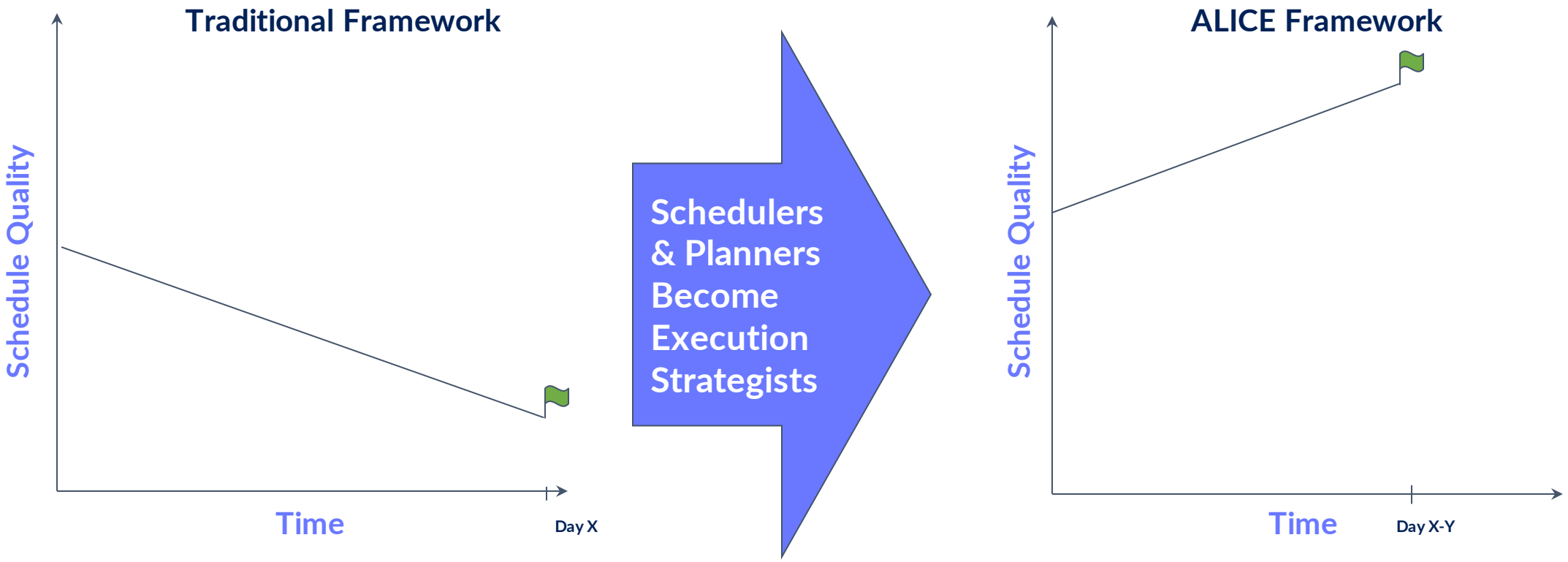
1. Concept / Idea
2. Data-Driven ALICE Model
3. Simulate In ALICE
4. Practical Solution
5. Proactive Execution

Iteration

QA/QC Builds Trust

Finish with the Best Value
Result:
Data-Driven Decisions
Tested Hypotheses
Increased D.O.F.

Paradigm Shift Increases Schedule Quality



Manually generated schedules often experience quality deterioration because schedulers force desired execution plans with gamed dependencies and durations.

ALICE schedules improve over time because initial assumption are replaced by actual observed field performance coupled with continuous data-driven decision making.