



# **TAKTING THE PARADE OF TRADES: Use of Capacity Buffers to Gain Work Flow Reliability**

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# IGLC 28

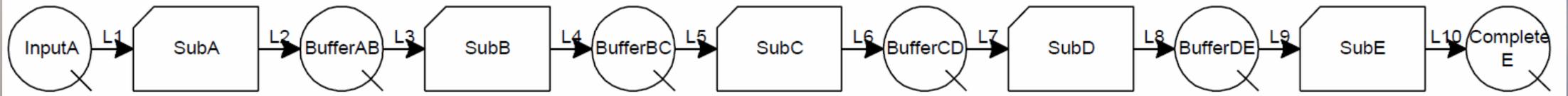
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# Parade of Trades

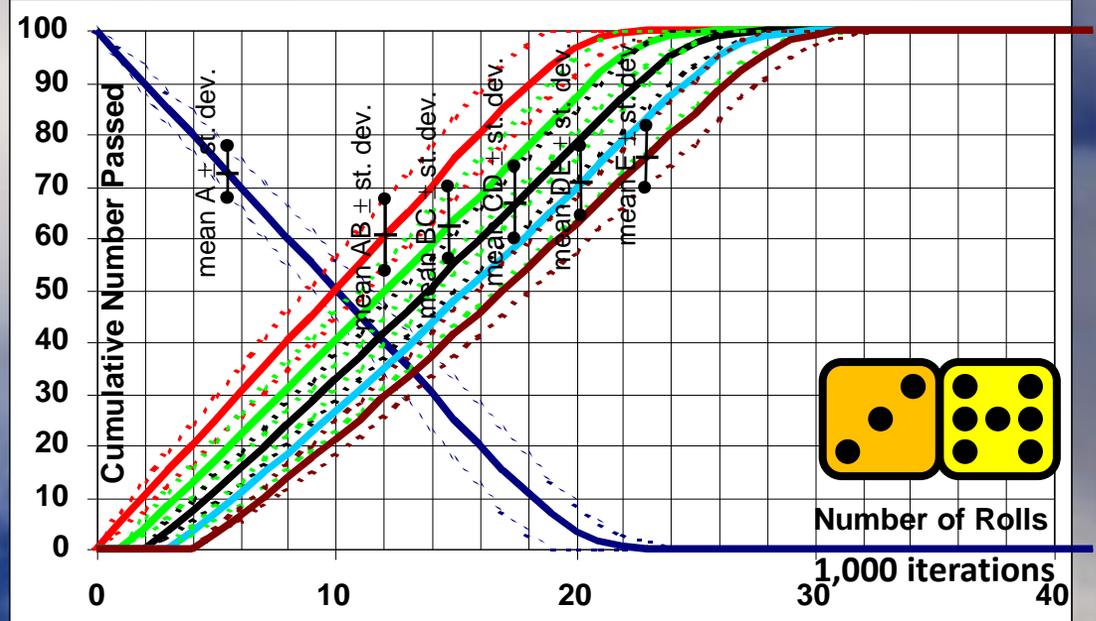
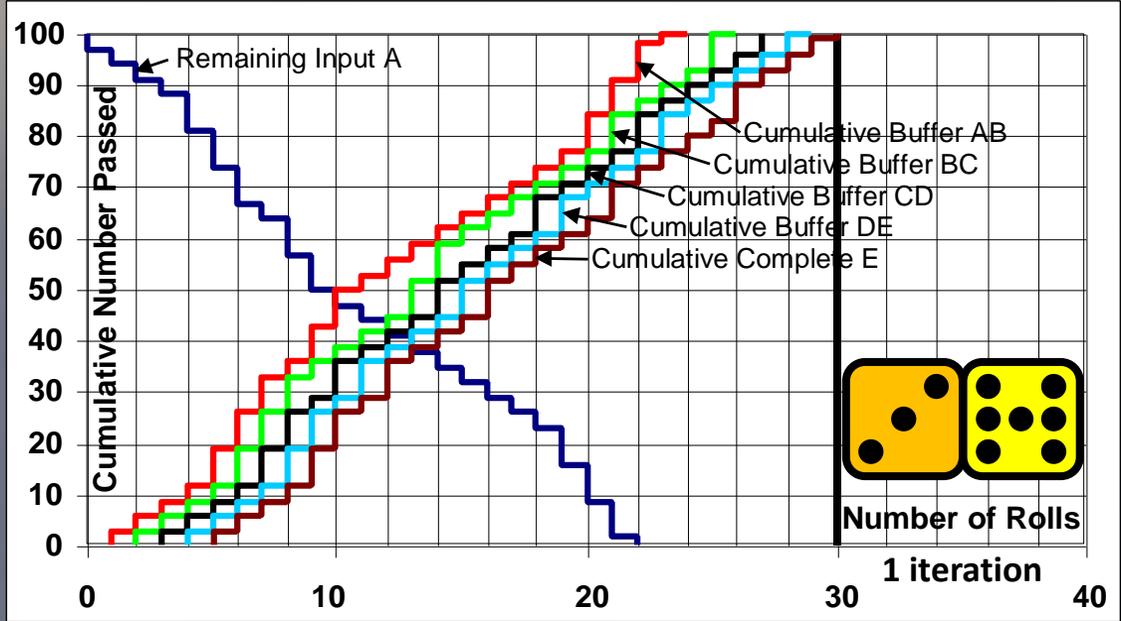
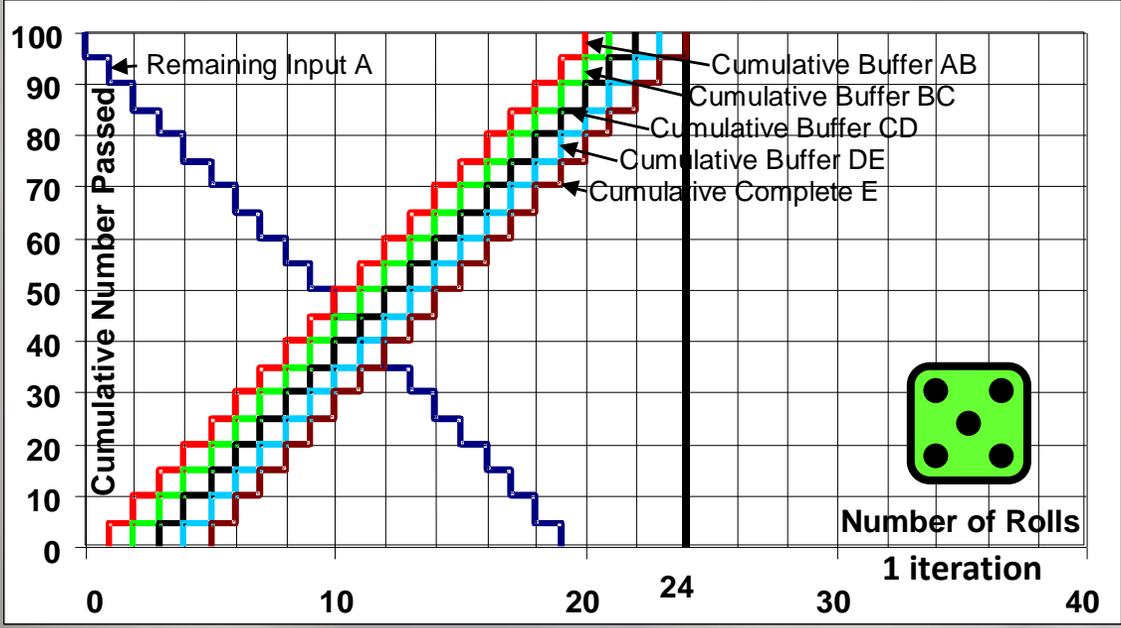


How many rolls will it take to pass 100 tokens when using

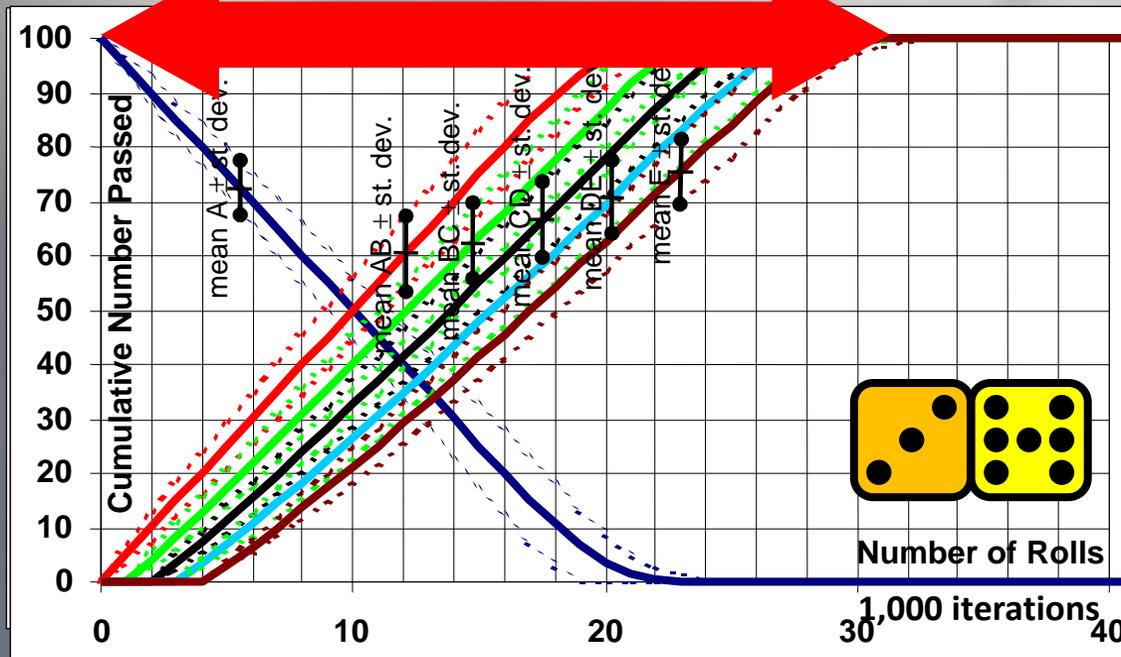
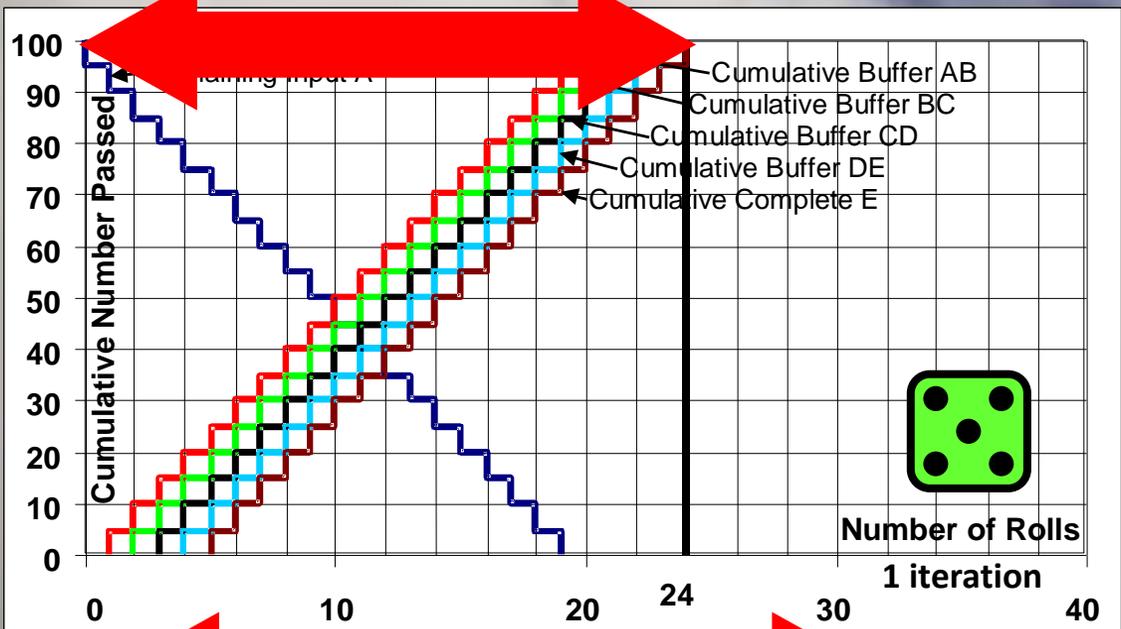
1. ... an all-  die?
2. ... a   die? It has the same average as the  die.
3. If you could choose a die to play with (to deliver your project), which one would you choose?



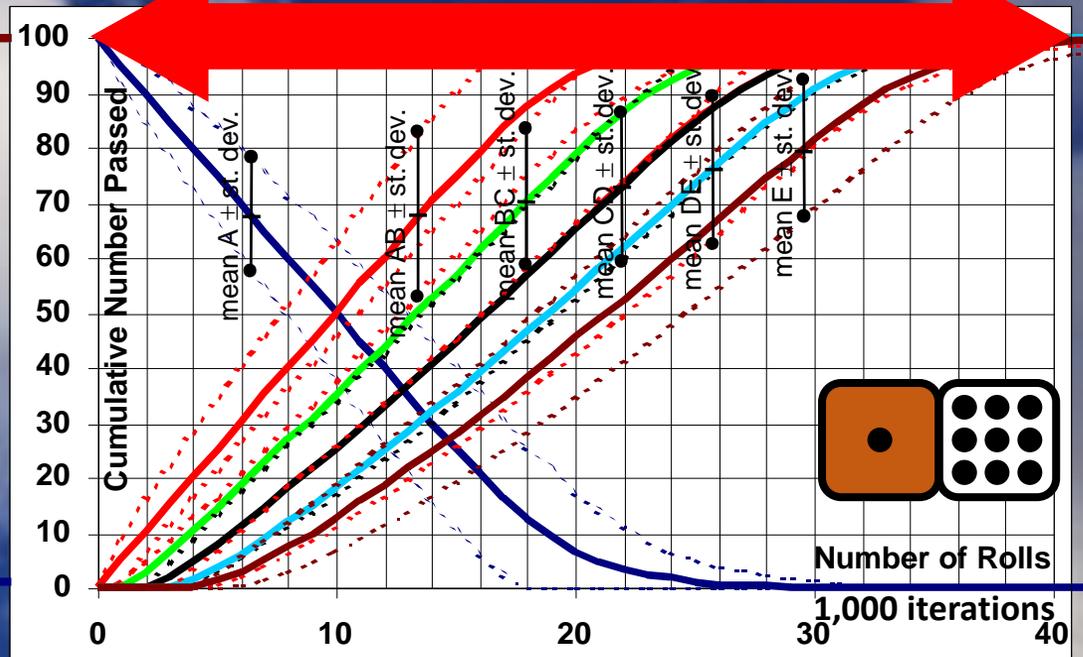
Tommelein, I.D., Riley, D., and Howell, G.A. (1999). "Parade Game: Impact of Work Flow Variability on Trade Performance." ASCE, J. of Constr. Engrg. and Mgmt., 125 (5) 304-310, Sept/Oct.

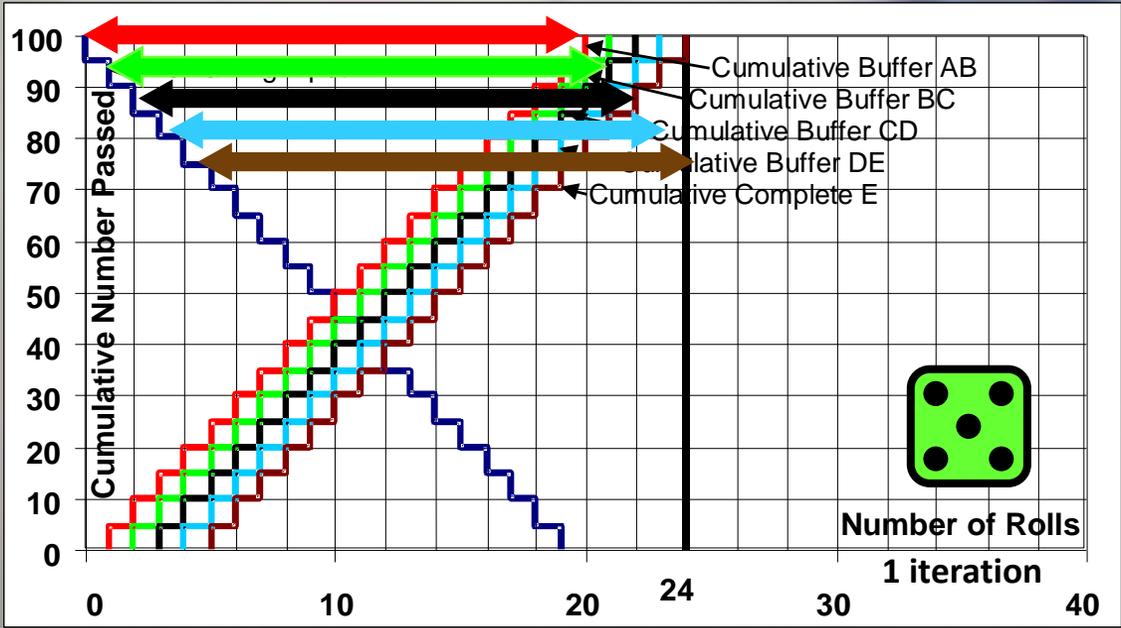


Tommelein, I.D., Riley, D., and Howell, G.A. (1999). "Parade Game: Impact of Work Flow Variability on Trade Performance." ASCE, *J. of Constr. Engrg. and Mgmt.*, 125 (5) 304-310, Sept/Oct.

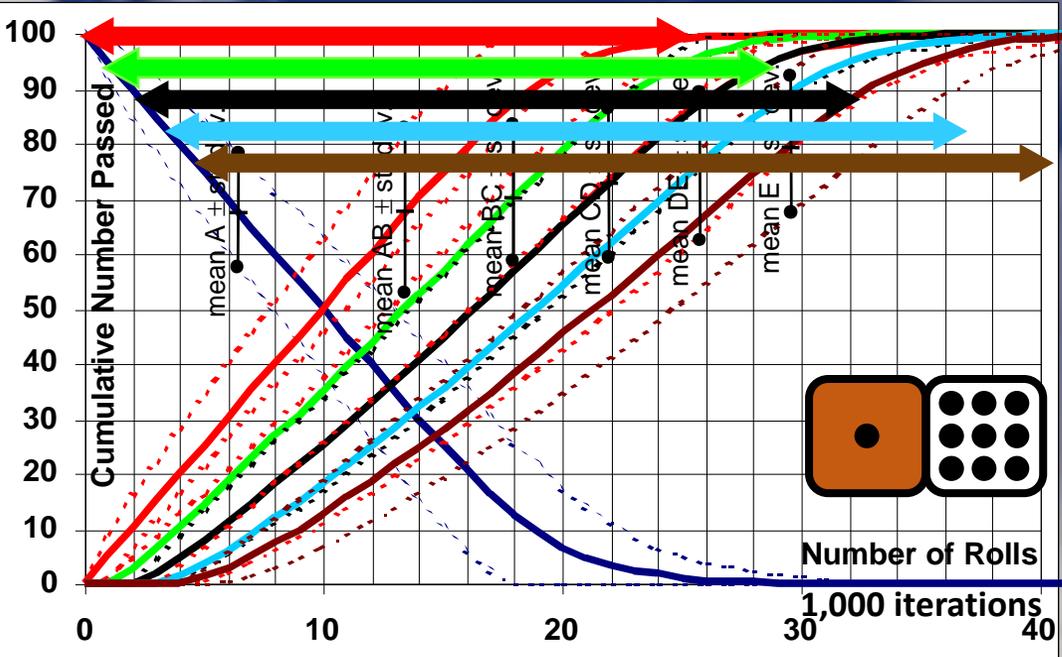
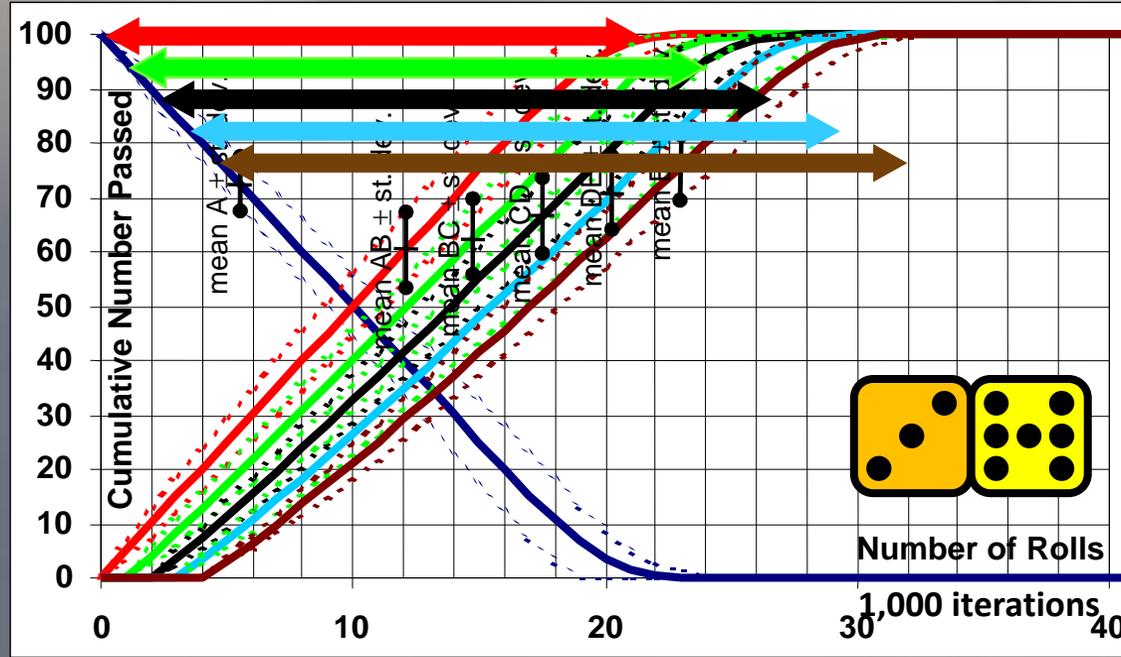


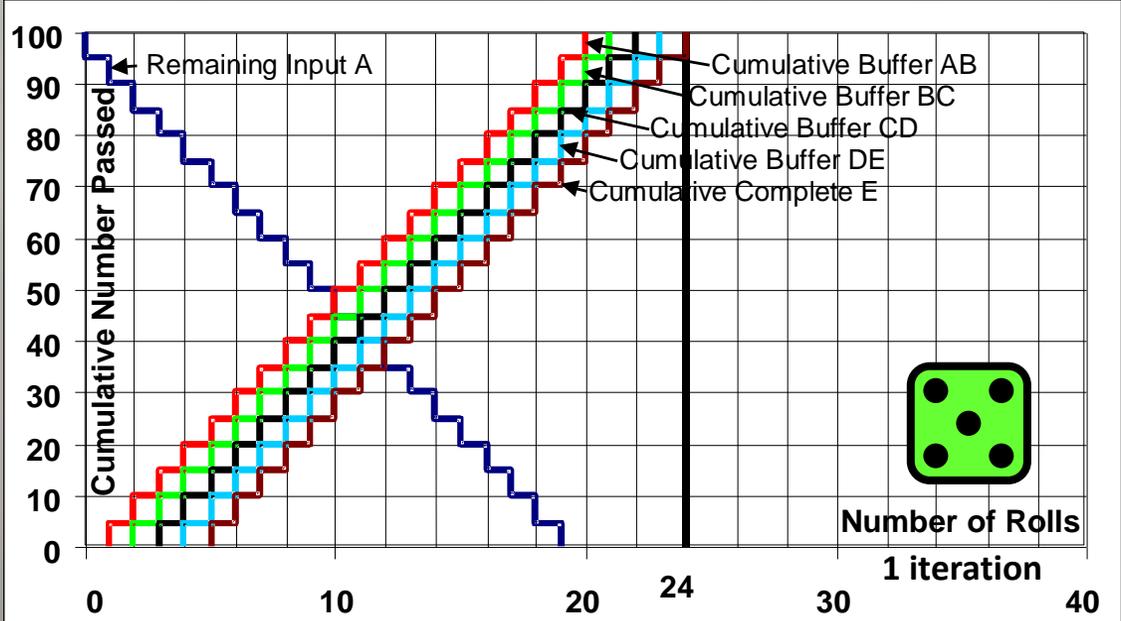
# Project Duration



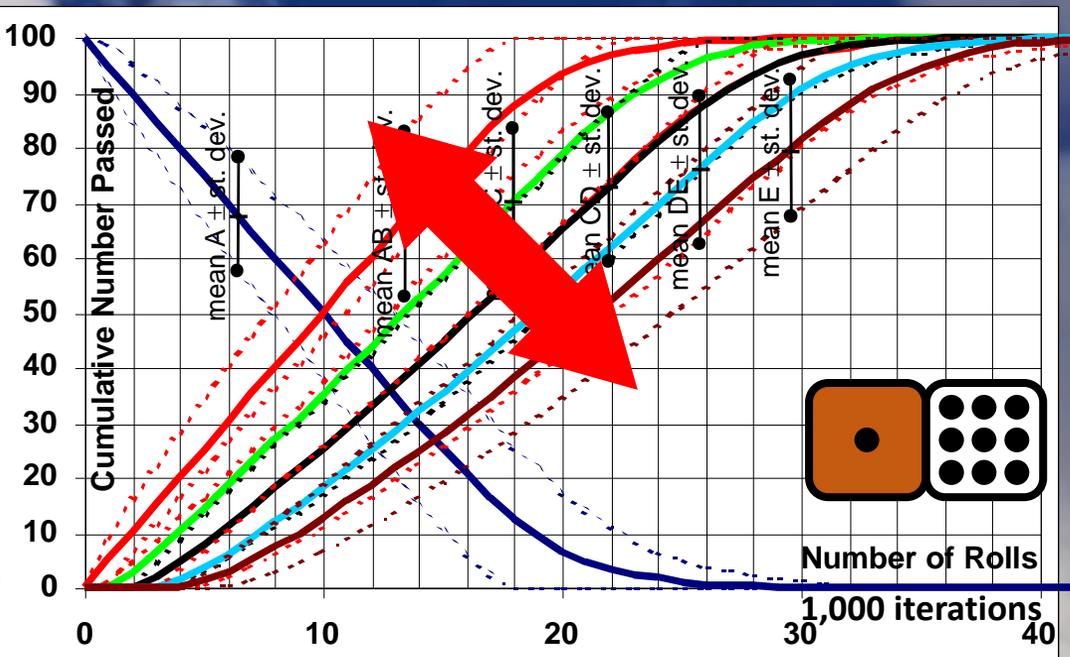
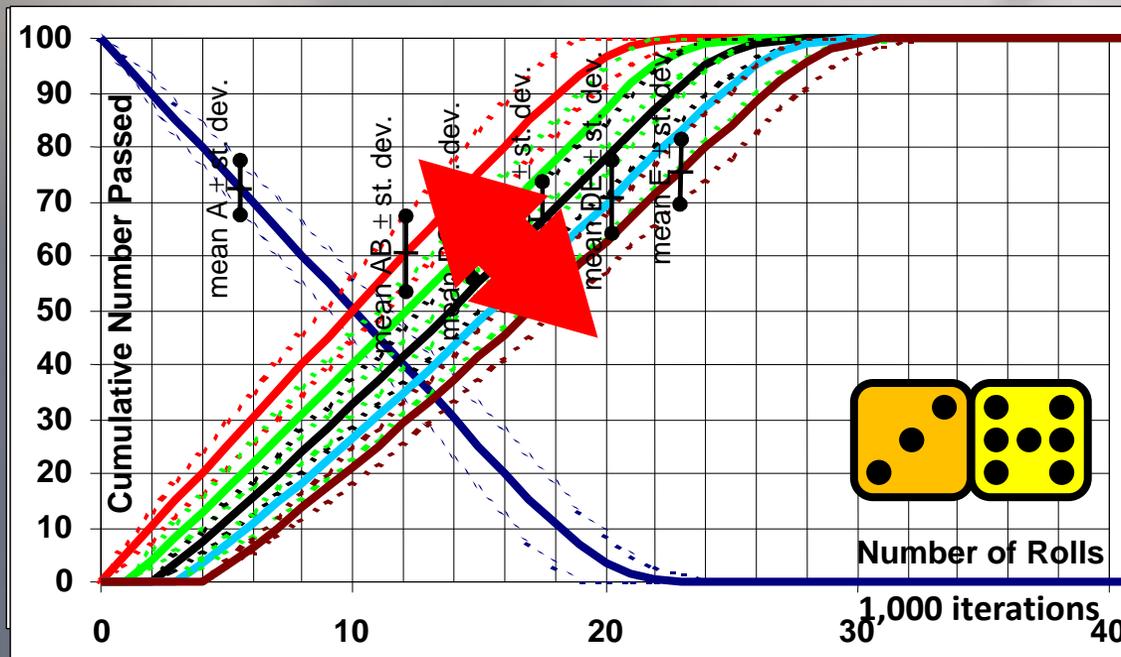


# Trade Time on Site





# Wasted Capacity



# Production System Design with Takt



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## Why design the production system with takt?

- Cost and time are not deterministic outcomes, but outcomes associated with some degree of likelihood (risk).
- Takt helps to predictably complete a project in terms of cost and time.

### 1. How would you takt the Parade of Trades?

### 2. What metrics to use to gauge performance of the Parade?

e.g.,

2.1 Project duration

2.2 Time on site for each trade

2.3 Cumulative lost capacity for each trade

# Buffer Management



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## 6 Resources

1. Materials / Information
2. People
3. Machines
4. Time
5. Money
6. Space

## Buffer Types

1. Inventory: Physical / Virtual
- 2 & 3. **Capacity**
4. Time
5. Contingency
6. Space



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# Process Capability

## Current Condition?



**process capability:** the probability distribution describing the variability in the output of a process under normal operating conditions



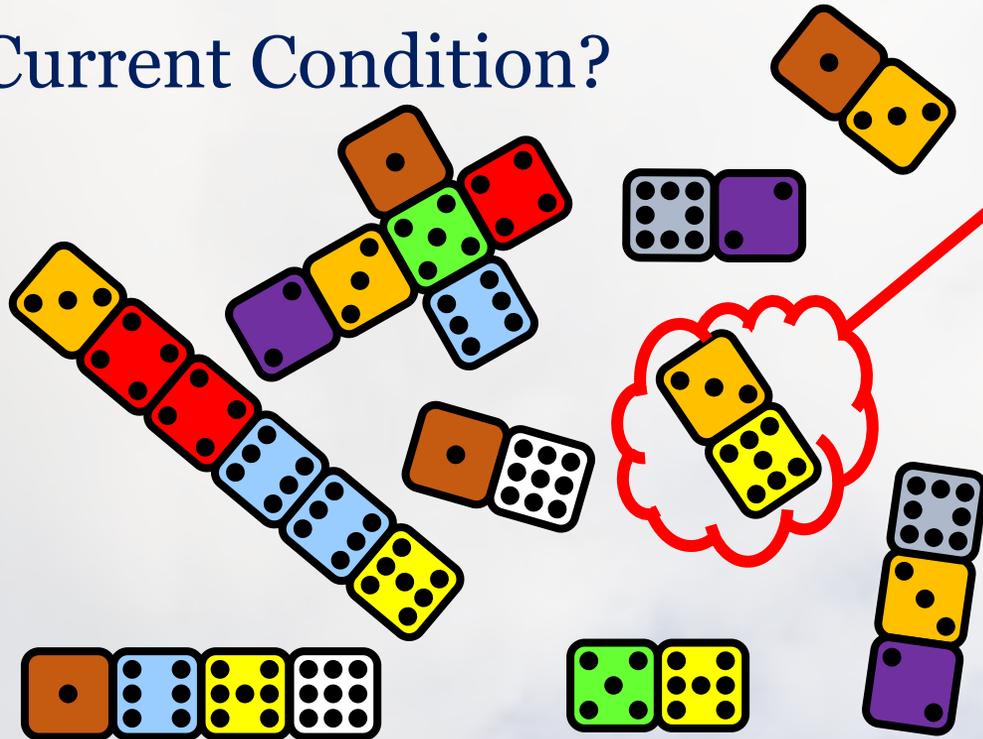
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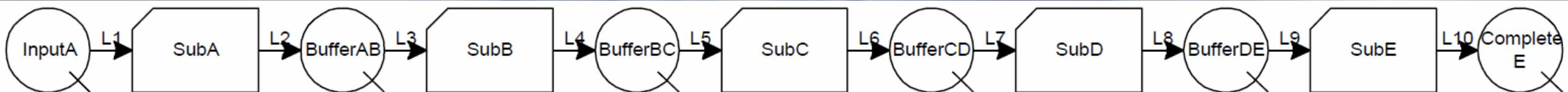


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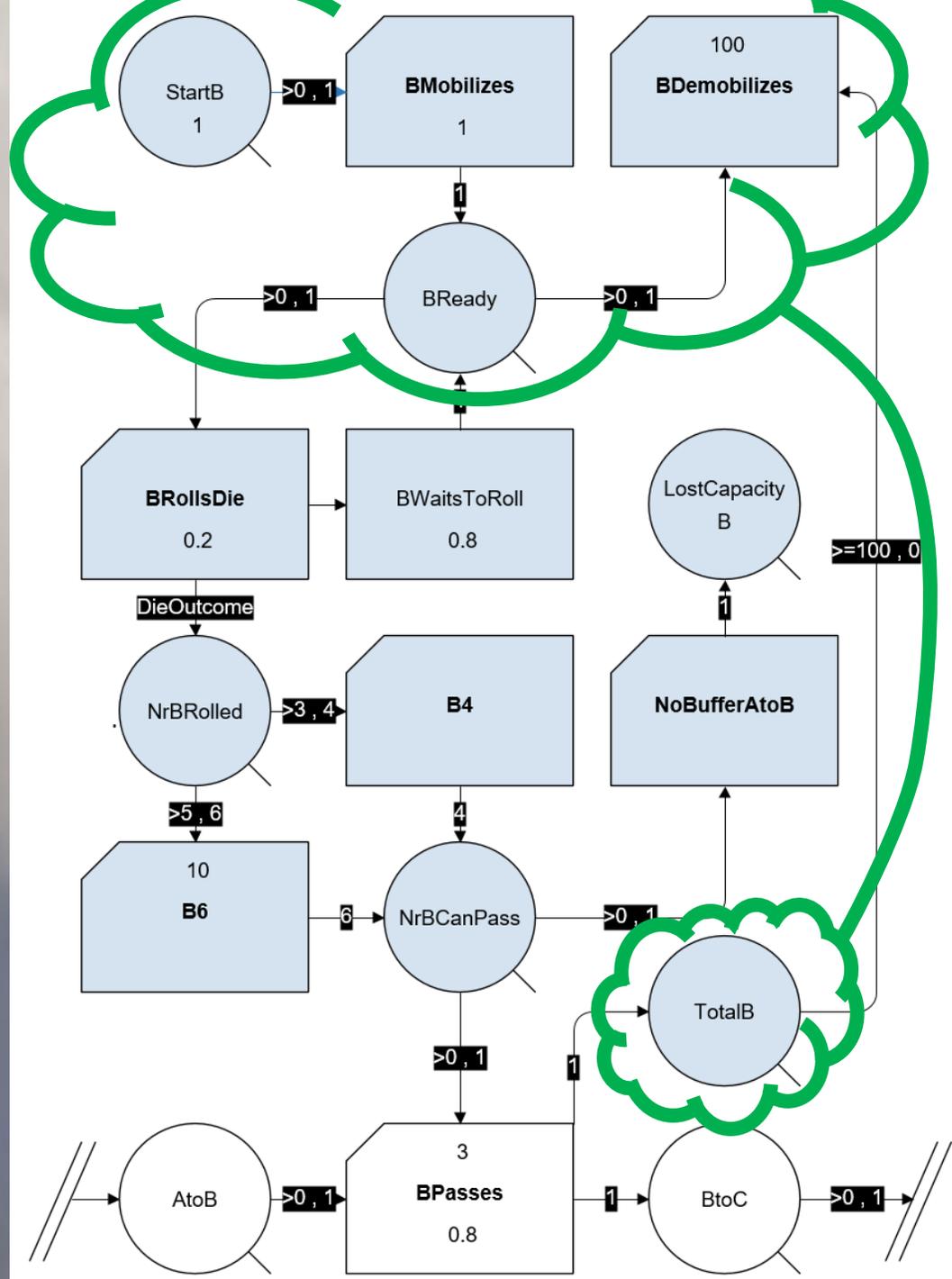
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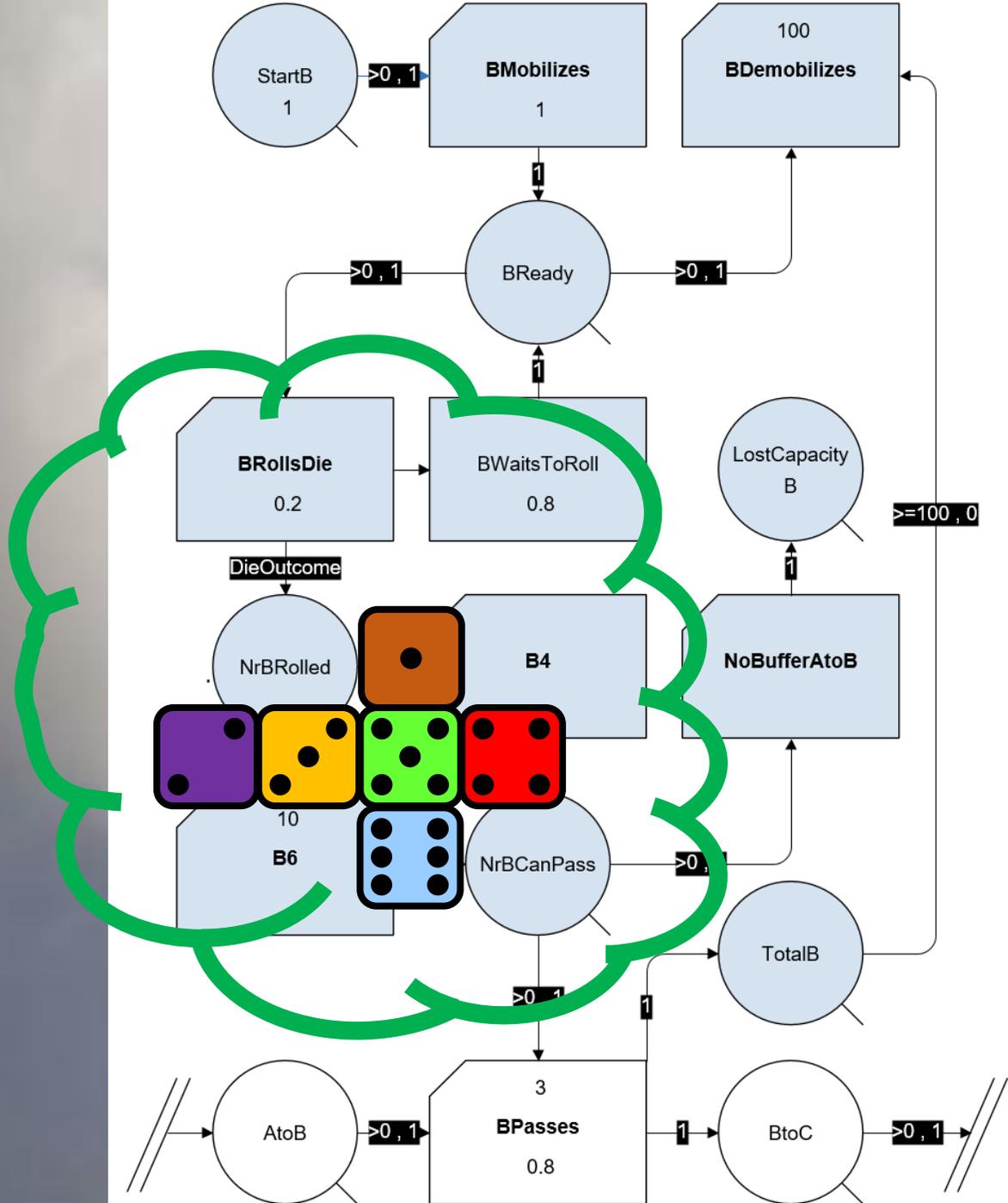
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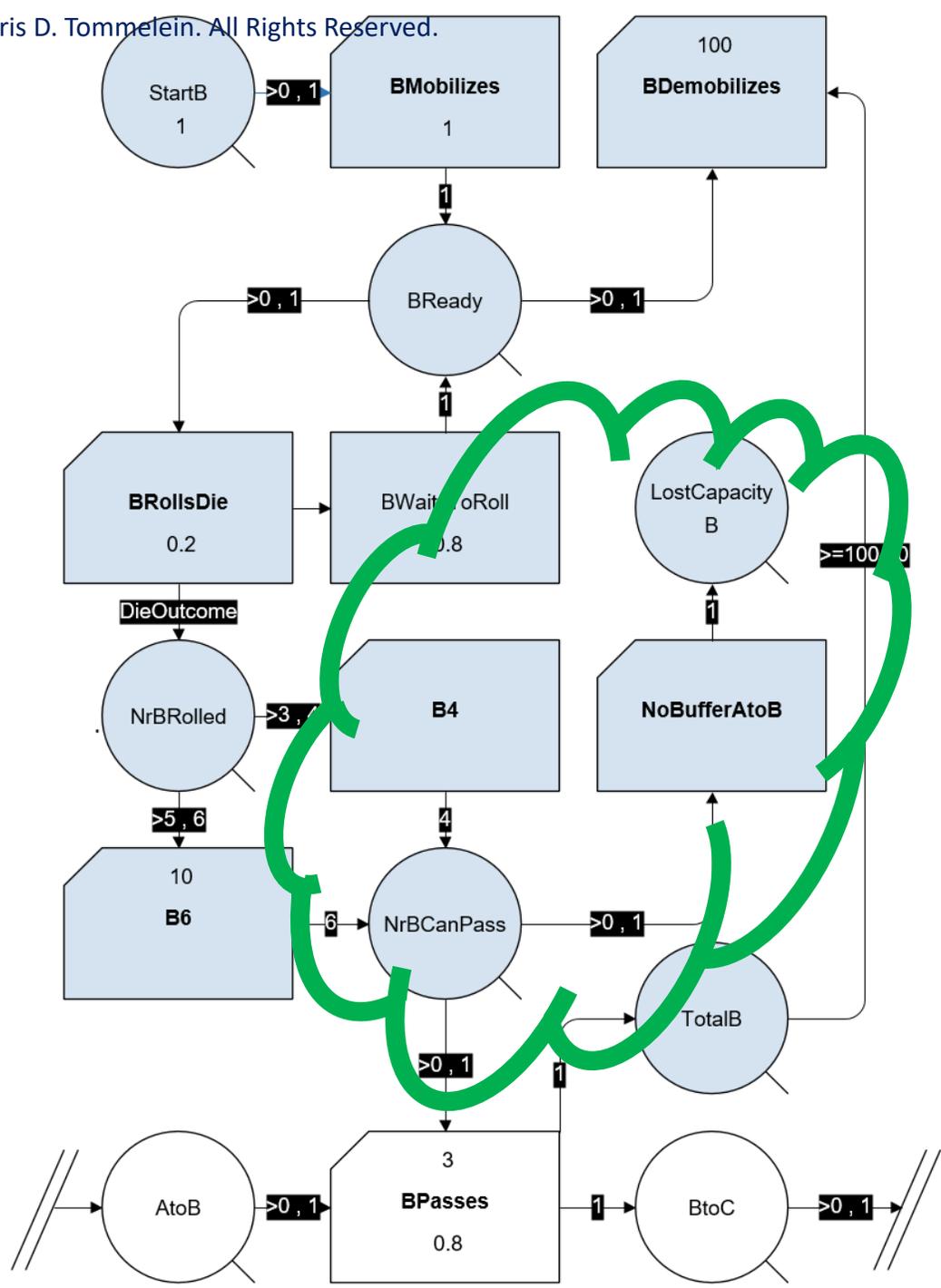
# Taktet Parade of Trades





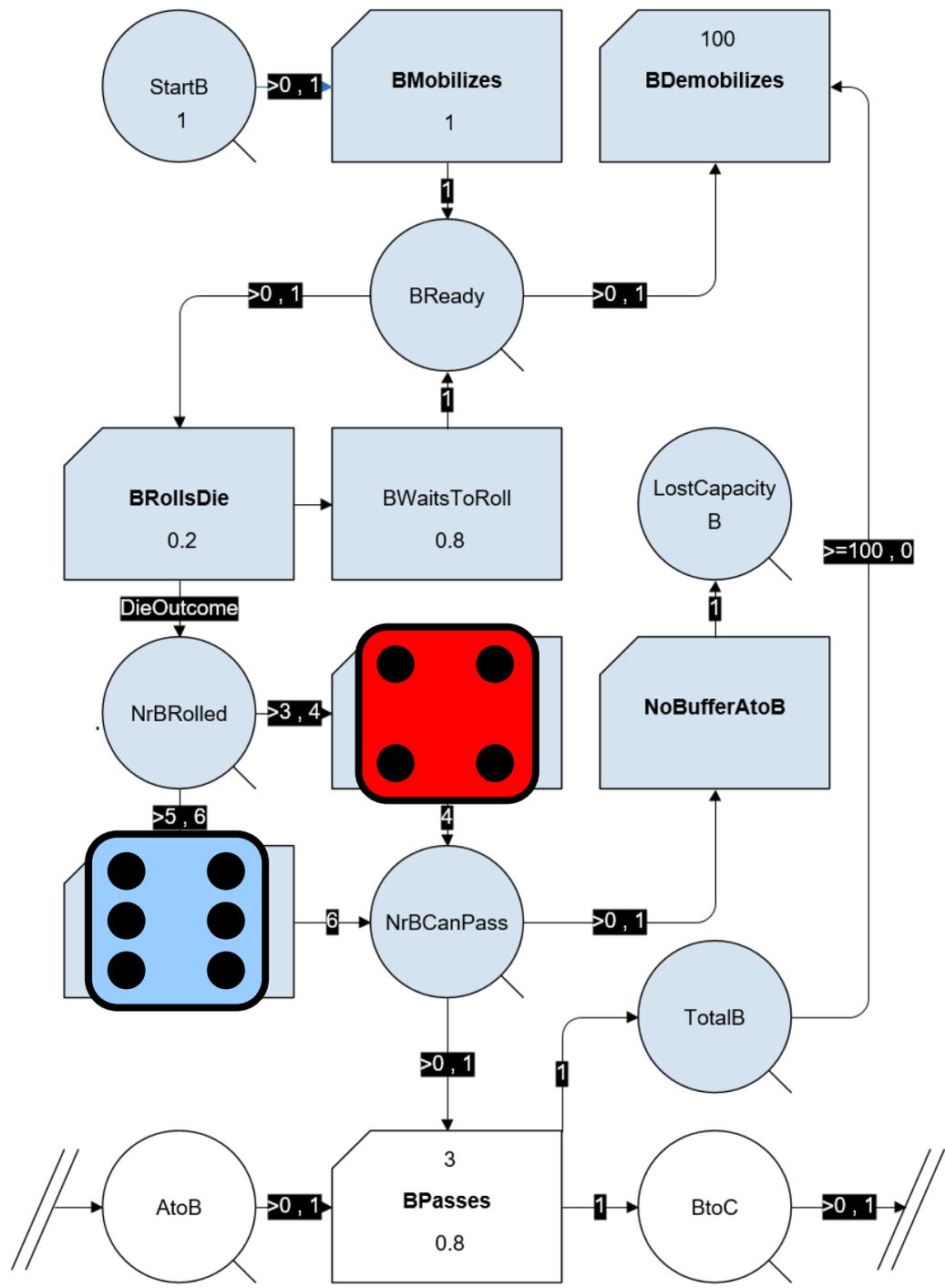






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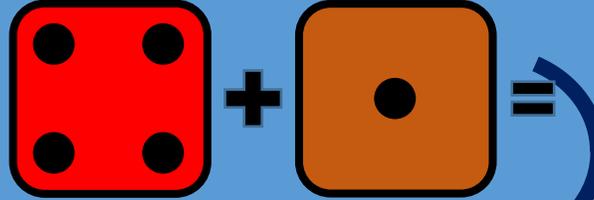


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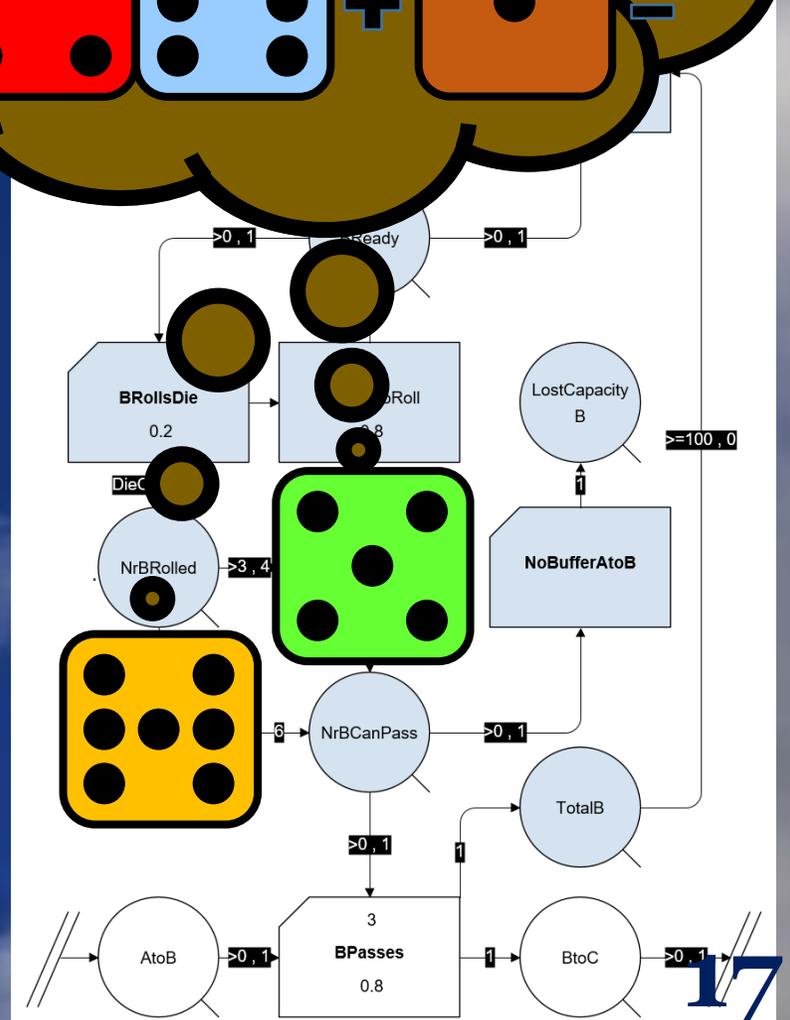
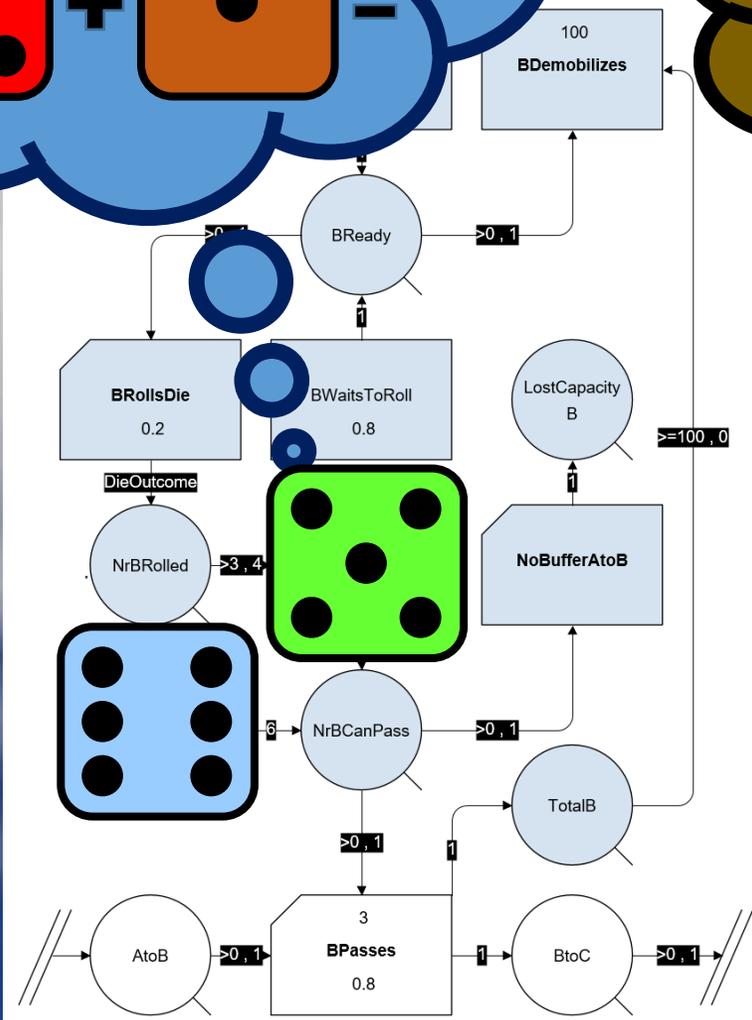
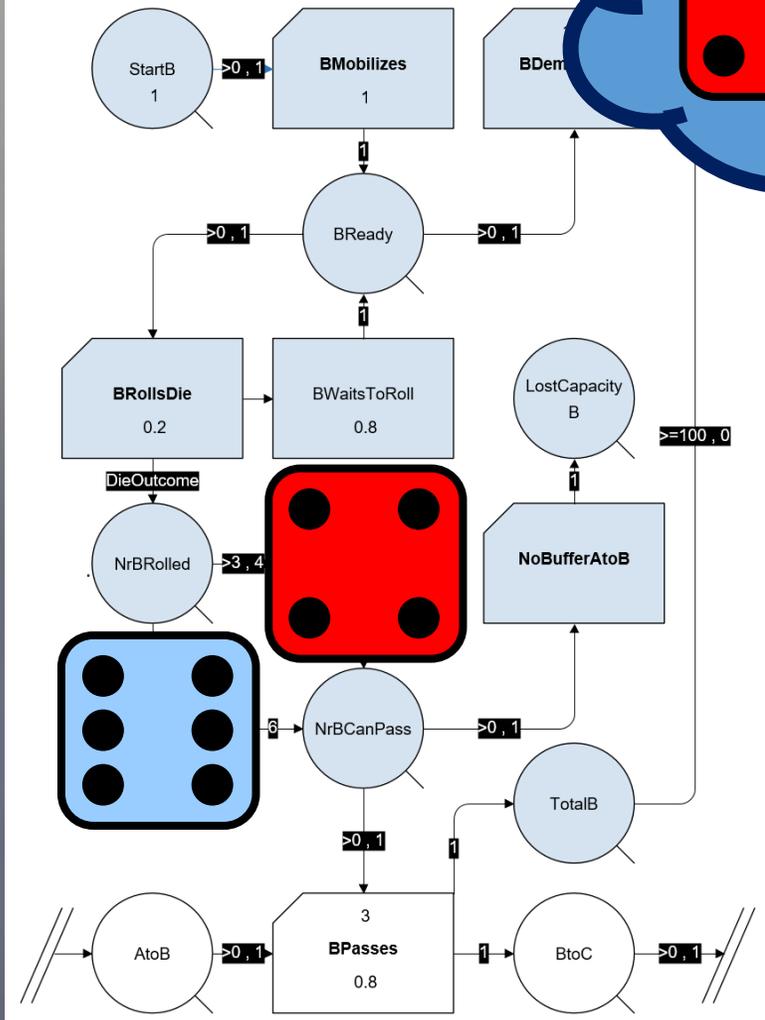
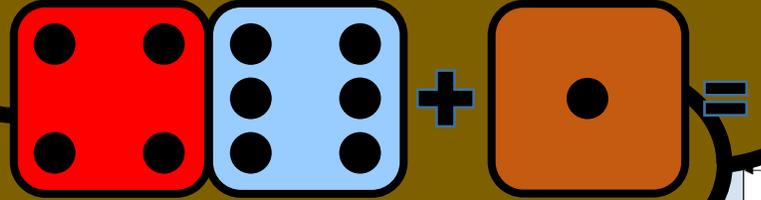
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## LOW ROLL STANDBY CAPACITY



## ANY ROLL MORE CAPACITY



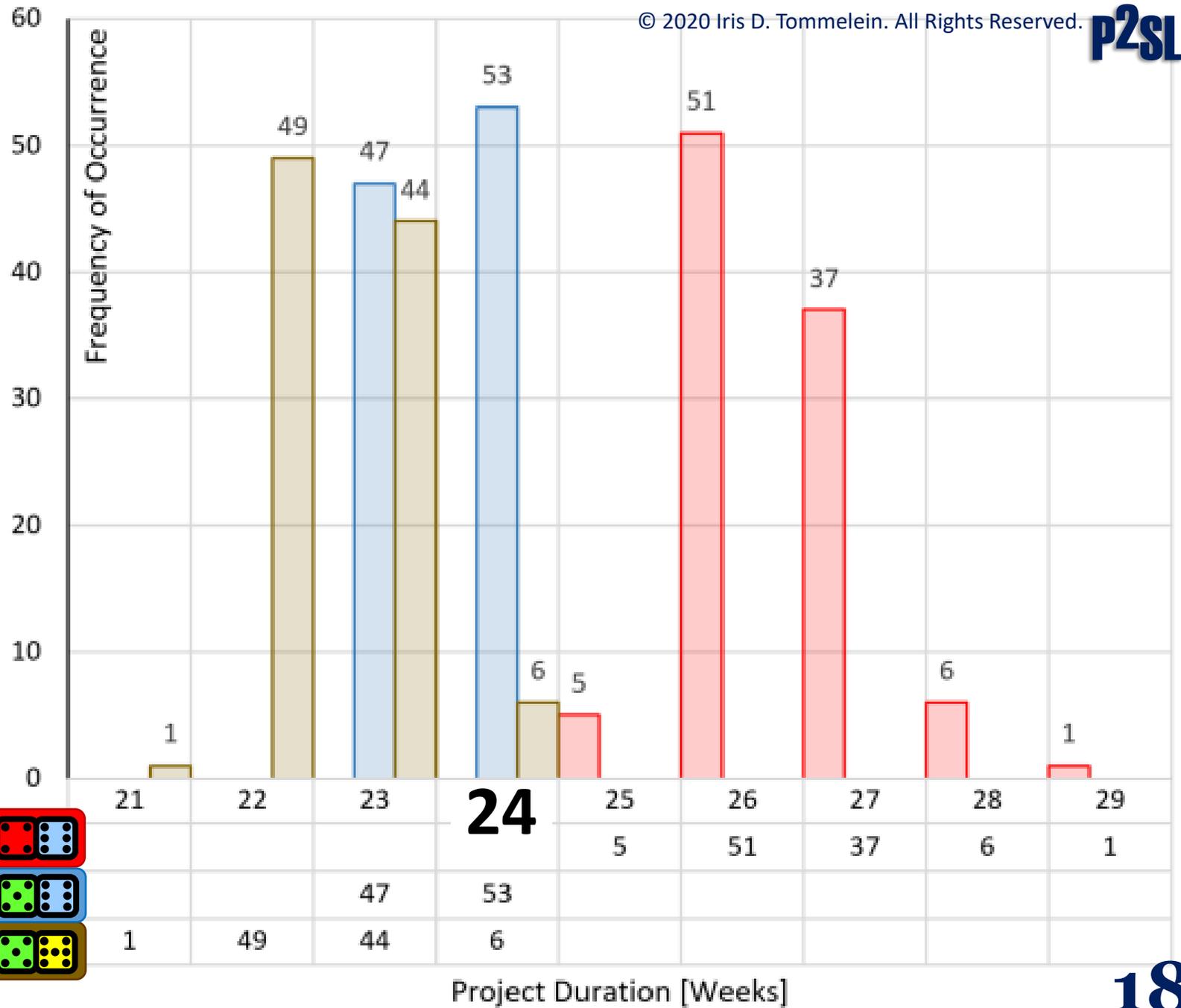


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## Project Duration



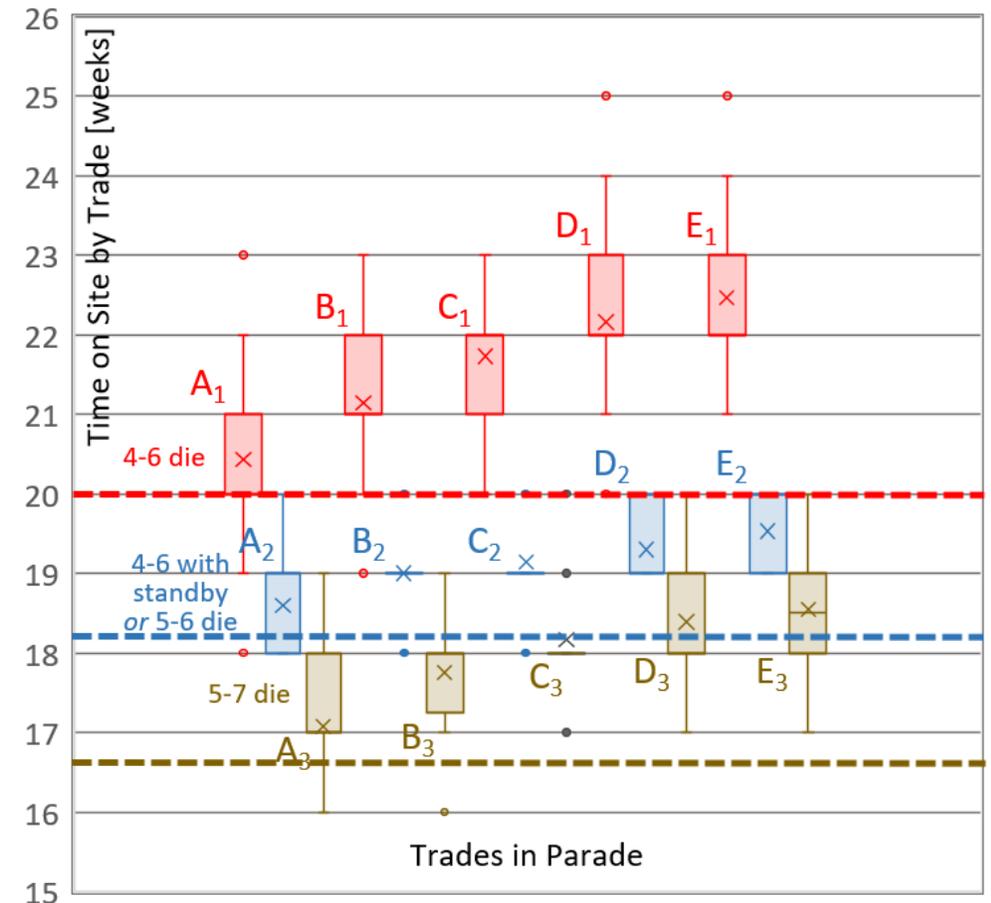
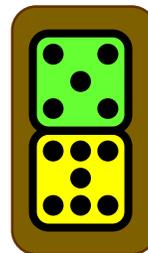
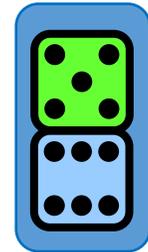
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## Trade Time on Site

Trade	A	B	C	D	E
<b>Scenario 1: 4-6 Die (Average 5)</b>					
Average	20.43	21.14	21.73	22.16	22.47
Std Dev	0.93	0.82	0.76	0.81	0.73
Minimum	18	19	20	20	21
Maximum	23	23	23	25	25
<b>Scenario 2: 4-6 Die with Standby Capacity (like a 5-6 die, Average 5.5)</b>					
Average	18.6	19	19.14	19.3	19.53
Std Dev	0.51	0.43	0.40	0.46	0.50
Minimum	18	18	18	19	19
Maximum	20	20	20	20	20
<b>Scenario 3: 5-7 Die (Average 6)</b>					
Average	17.07	17.75	18.16	18.39	18.55
Std Dev	0.76	0.56	0.58	0.63	0.63
Minimum	16	16	17	17	17
Maximum	19	19	20	20	20



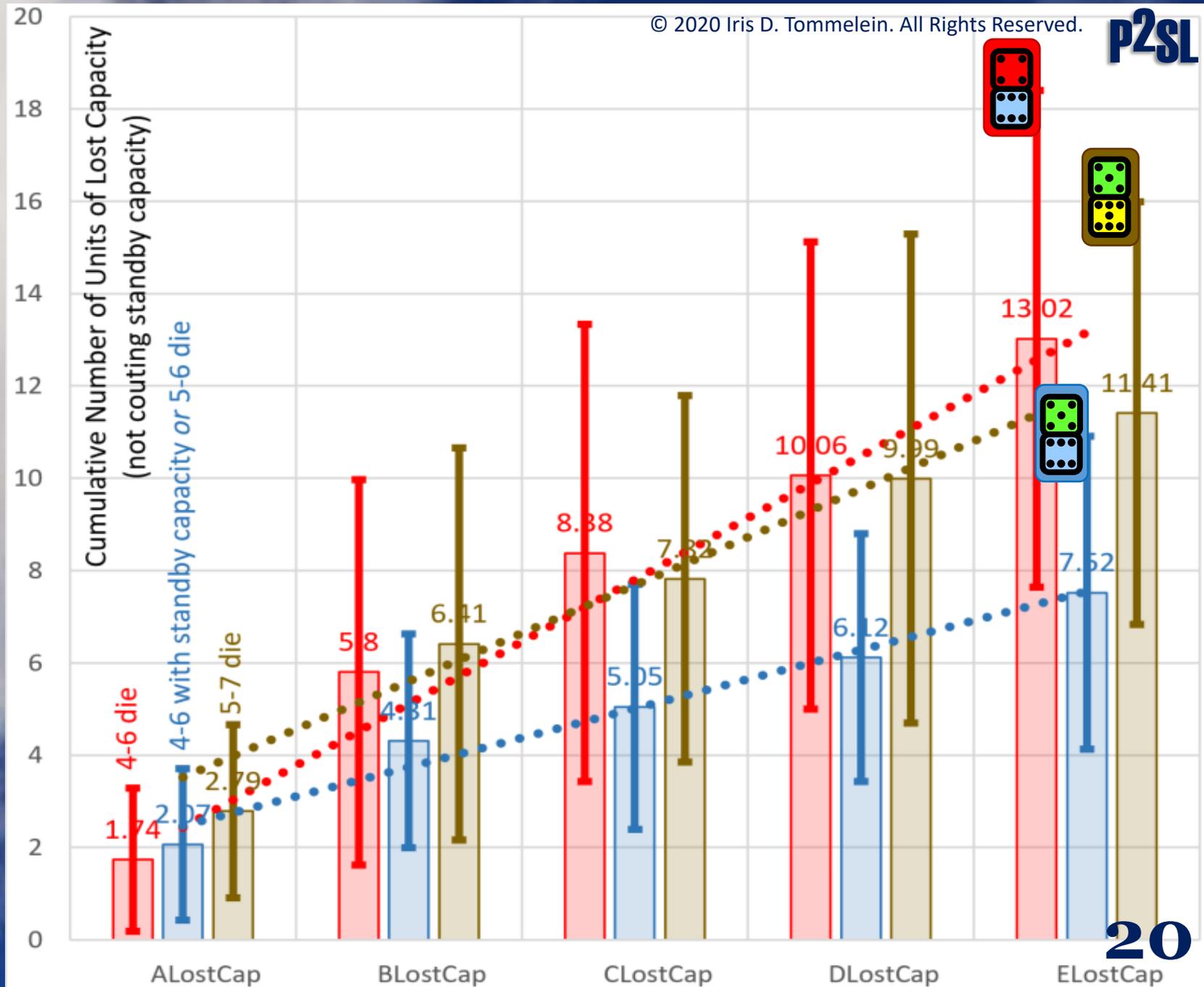


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## Cumulative Number of Units of Lost Capacity by Trade





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## Discussion

... not **IF**, but **WHEN** shall we pay for variability in the system?

- Identify desirable / undesirable variability in products / processes
- Invest in eradicating undesirable variability
- Design the project production system, considering:
  - Customer value and project requirements as they inform what value to select for takt:      or ...
  - Trade process capability
  - Project network topology, i.e., hand-offs between trades
  - Use of inventory, **capacity**, time, contingency, and space buffers



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# Conclusions

1. Extend use of the Parade of Trades to teach concepts fundamental to Lean Construction
2. Spur discussion about capacity buffers in production systems
3. Develop methods for takt planning

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Questions?  
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The ideas presented here are described in:

Tommelein, I.D. (2020). “Taktung the Parade of Trades: Use of Capacity Buffers to Gain Work Flow Reliability.” In: Tommelein, I.D. and Daniel, E. (eds.). *Proc. 28<sup>th</sup> Annual Conference of the International Group for Lean Construction (IGLC28)*, Berkeley, California, USA, [doi.org/10.24928/2020/0076](https://doi.org/10.24928/2020/0076), online at [iglc.net](https://iglc.net).



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