Reducing Handoffs between Sequential Trades: A Simulation

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The Challenge

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- **In modern construction, we see more complex projects and large scale projects and many general contractors act only as a contract broker**
  - a large number of subcontractors, and crews leads to a high number of handoffs
  - effective communication management has come more important than before
- **Projects tend to fail at the intersection of contracts** (Lichtig 2004)
  - No contractual agreements between subcontractors (Tommelein and Ballard 1997)
  - Each subcontractor arranges & schedules its crew for its own convenience & productivity

Handoffs

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- **Impact workflow**
- **Wait time between trades**
  - Time-gate phenomenon (Bashford et al. 2002)
  - "Next-day time-gate robs the overall process of the gains implied by the specialization" (Walsh et al. 2003)
- **Increased number of RFIs** (Tommelein and Ballard 1997)
  - **Excessive mobilization & demobilization**
  - Influenced by distance between home office and construction site -> transportation waste

Simulation

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Purpose:

- To demonstrate how project workflow could be improved by reducing handoffs between disciplines

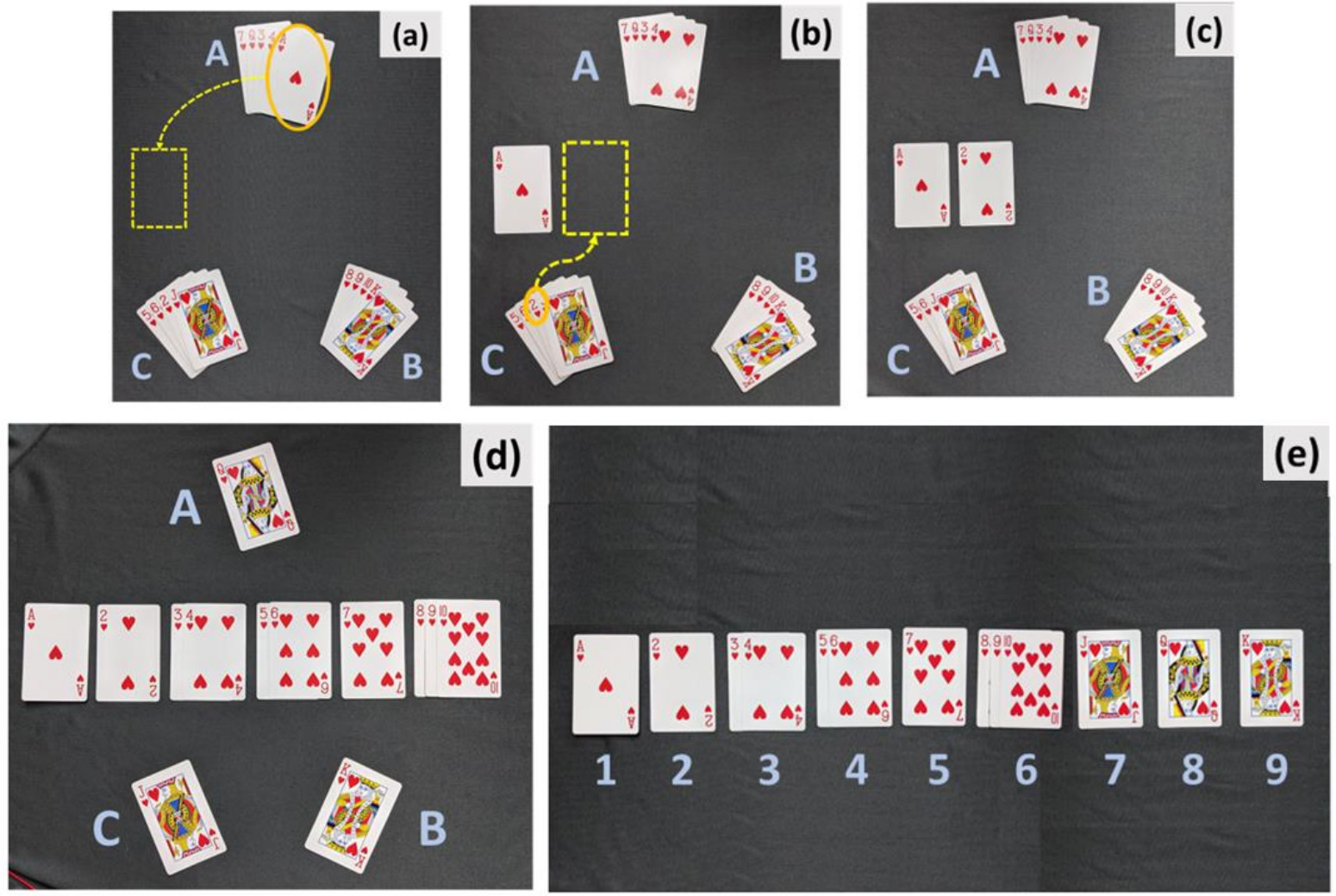
Materials:

- 1 facilitator
- One deck of playing cards
- At least 3 participants per suit of cards
- Writing materials

Procedure:

- Form teams of 3 players each
- Each team receives a set of playing cards of the same suit
- Each player within a team receives 4 to 5 cards in hand that are in random order within a particular suit

Game instructions - Round I



Game instructions - Round II

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- Similar to Round I + one extra step
- Before game starts, each player is allowed to initiate a card swap once with another player in the team
- Must be a mutually agreed exchange of cards between players
- Goal of the game remains the same

Player	Can swap with
A	Either B or C
B	Either A or C
C	Either A or B

Round II

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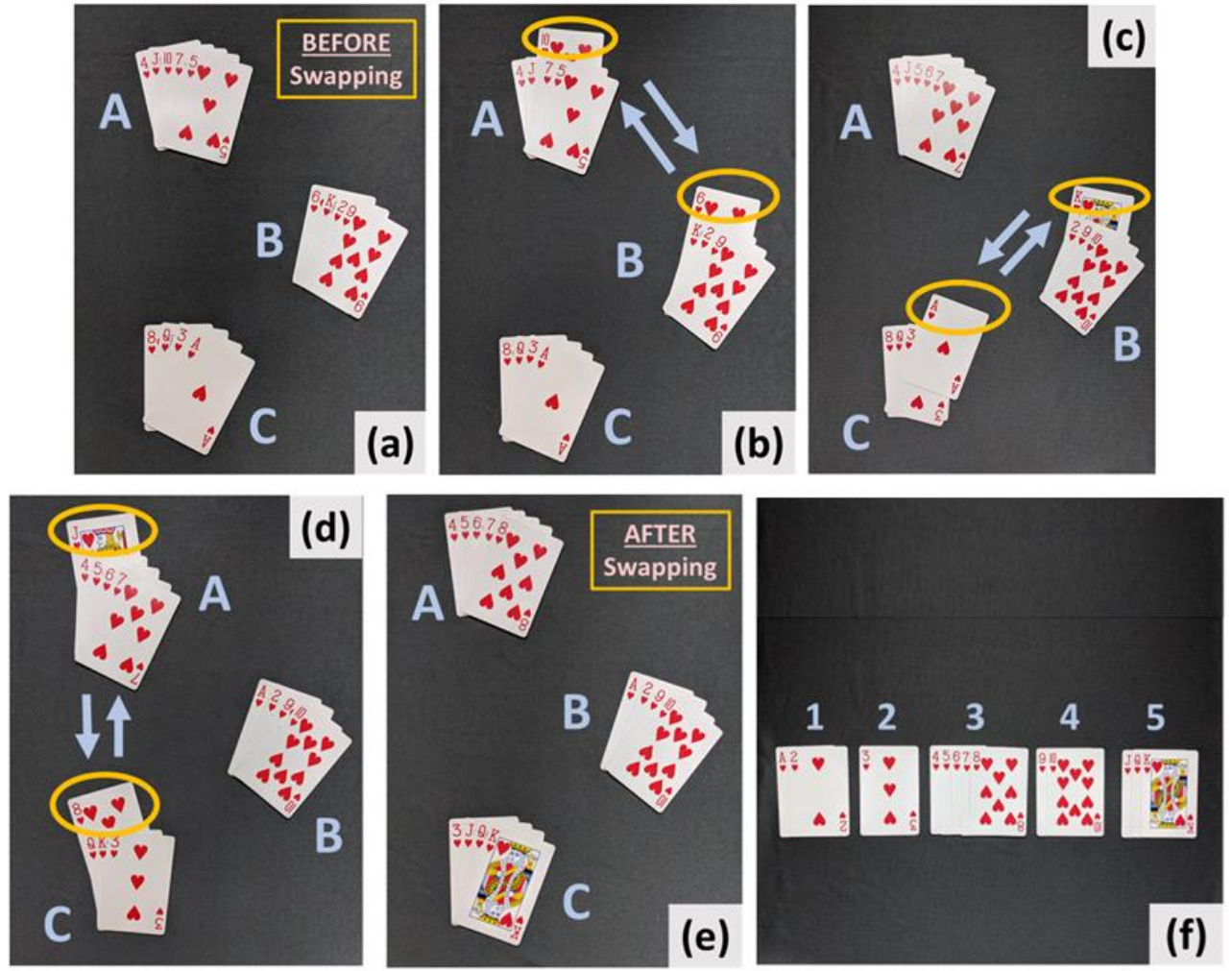

First run study

- January 16, 2020
- 30 graduate students at Texas A&M University
- 10 teams

Results

Teams	Number of Turns		% difference ($Turns_{II}$- $Turns_{I}$) / $Turns_{I}$
	Round I	Round II	
1	8	4	-50
2	12	3	-75
3	11	3	-73
4	11	4	-64
5	10	5	-50
6	12	5	-58
7	12	3	-75
8	11	4	-64
9	9	3	-67
10	11	5	-55
Average	**10.70**	**3.90**	**-63**

Discussion

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How do we resolve the tension in Lean to reduce batch sizes while also reducing the errors and mobilization costs that can come with a large number of handoffs?

- **Sequential multiskilling**
  - Round I -> hyper-specialization of trades
  - Round II -> sequential multiskilling
- **Collaboration and Integration - IPD**
  - Round I -> traditional Design-Bid-Build projects
  - Round II -> Integrated Project Delivery
- **Prefabrication**
  - Round I -> Every trade performed onsite
  - Round II -> Each cluster of consecutive cards = a prefabricated component

Time-gating & Multiskilling

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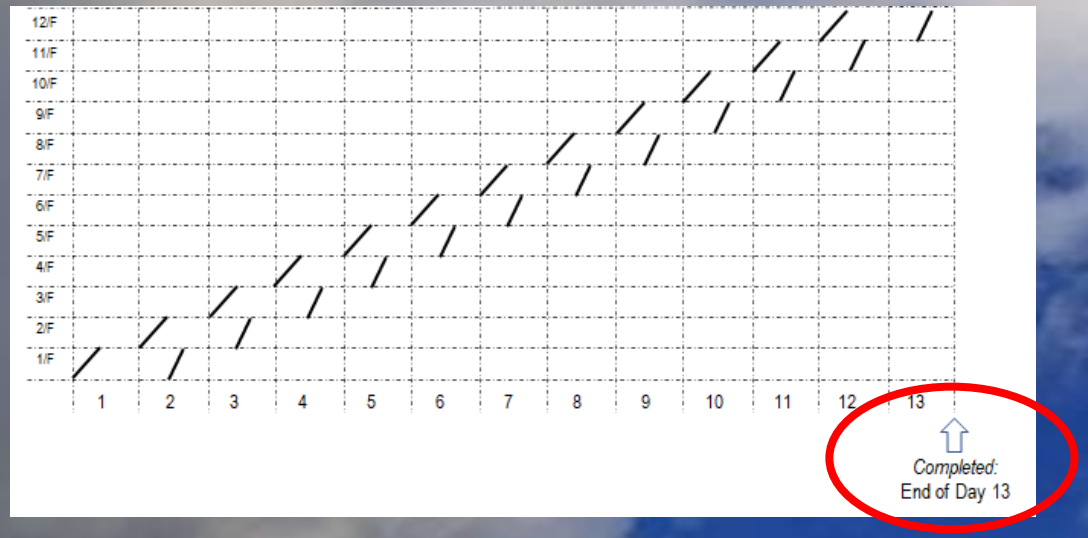
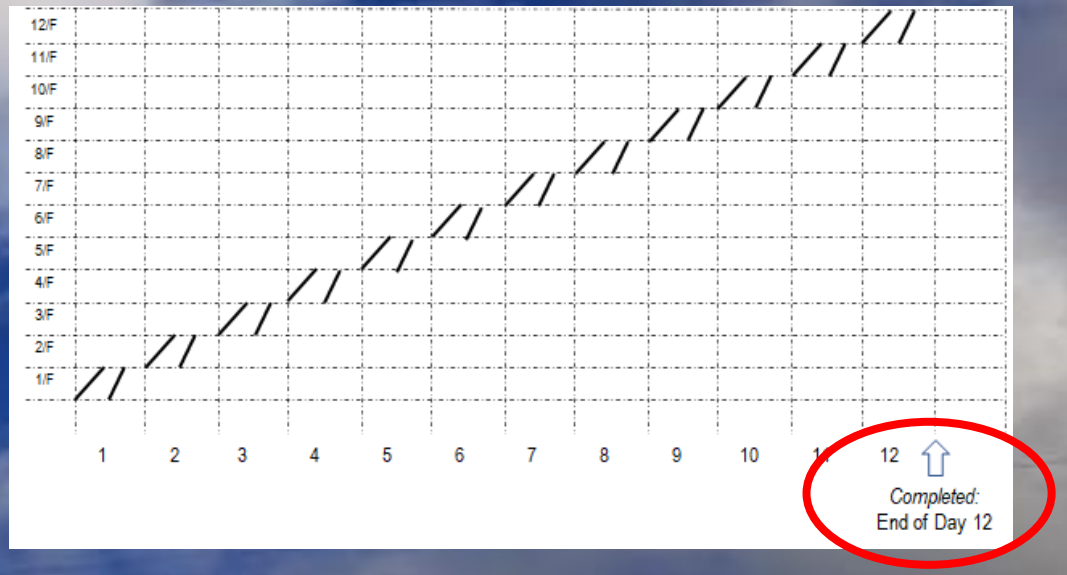
Left fig: Time-gating

Excessive amount of wait time between tasks



Right fig : Multi-skilling

Less time buffer between tasks



Conclusions

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We explored ways to resolve the tension in Lean to reduce batch sizes while also reducing the errors and mobilization costs that can come with a large number of handoffs:

- **Development of a lean simulation game**
- **Impact of handoffs on project workflow**
- **First run study results**
  - Improvement in workflow (reduction in number of turns) when participants took the initiative to enhance "cohesiveness" between sequential tasks
- **3 different methods to reduce handoffs**
  - Multiskilling, collaboration and integration, and prefabrication

Acknowledgements

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