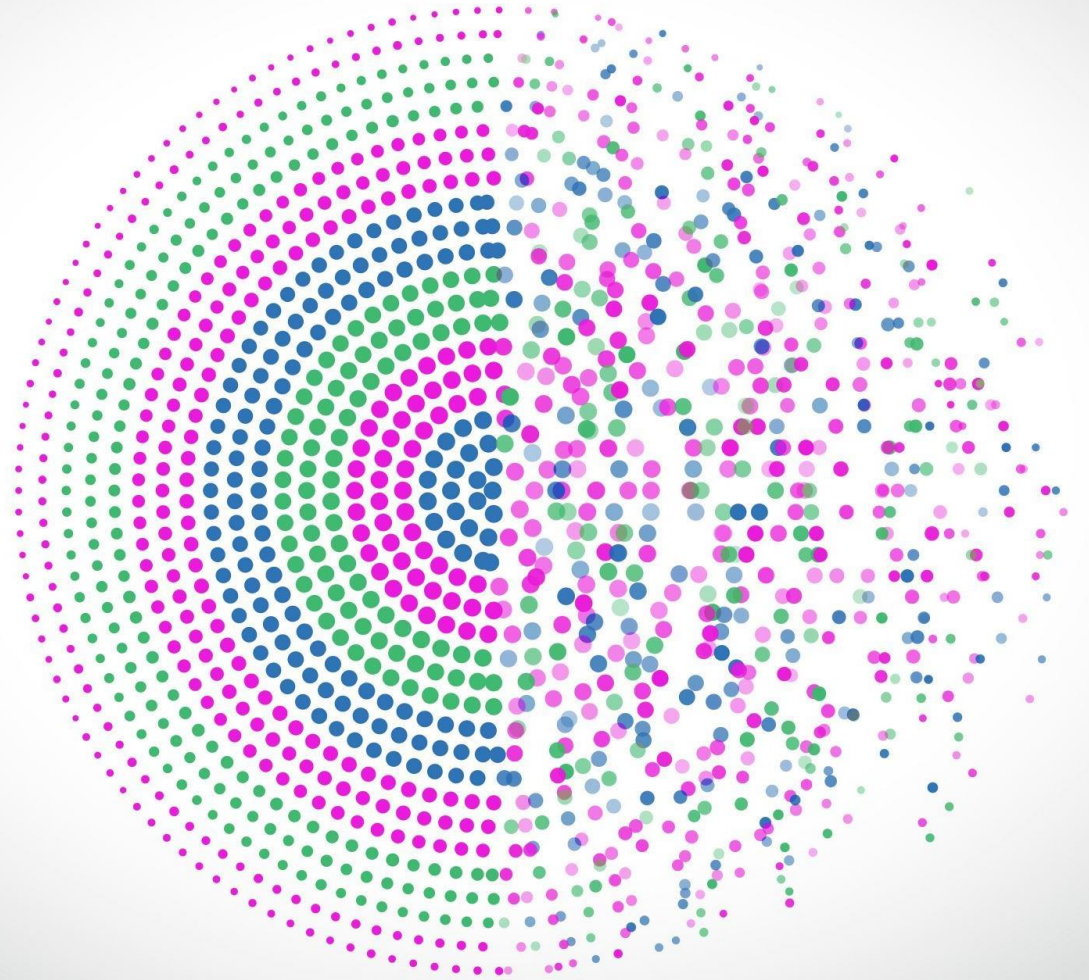


# MRI Presentation

REDUCE IDLE TIME OF MRI  
MACHINES BETWEEN SCANS

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# Improving MRI Department Efficiency

Problem:

The MRI scanner sits idle 31% of the time during hours of operation (42% idle with no allotted 5-minute gap)

Goal:

If we take the steps to decrease the idle time, we can solve the wait time issue for MRI scans in Halifax

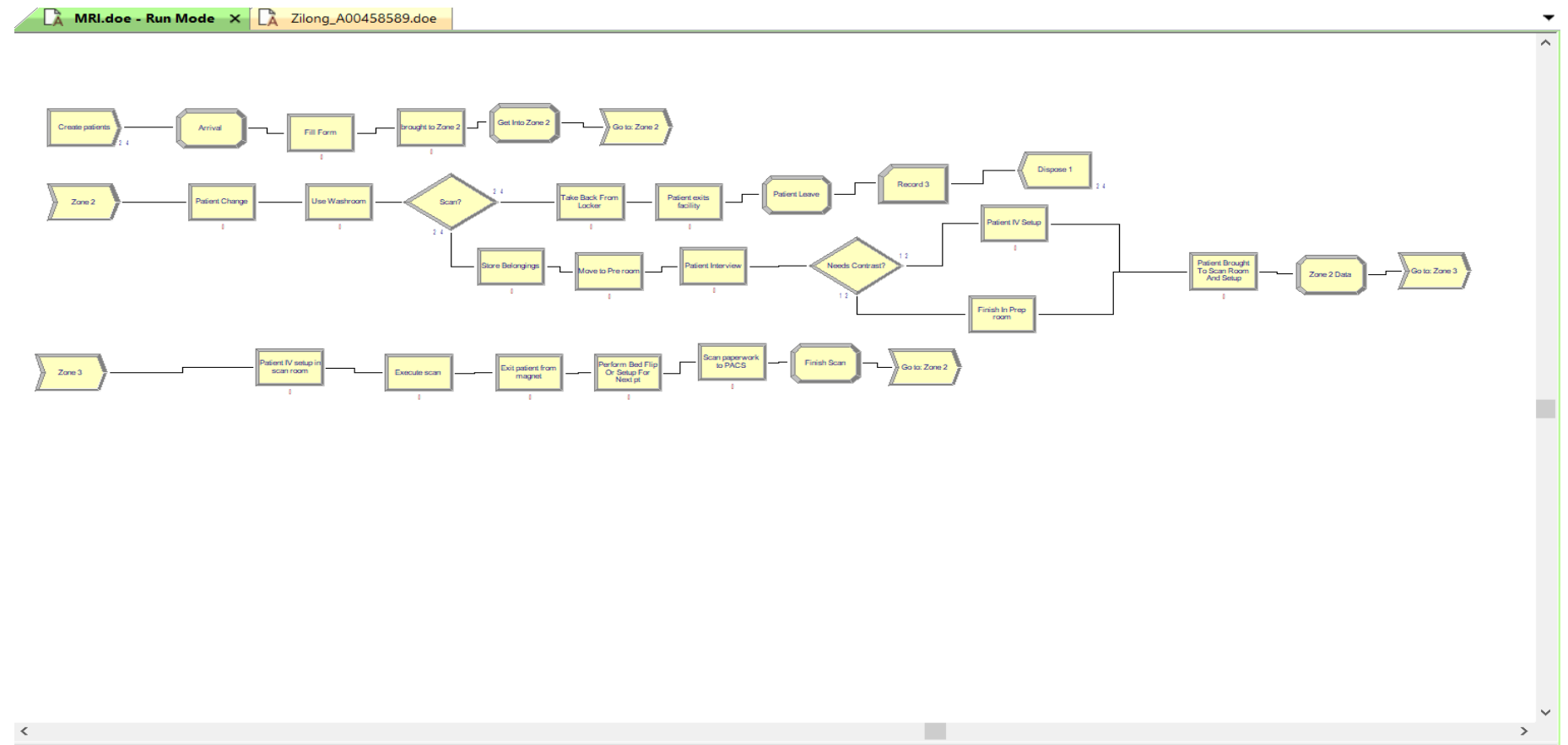


# Modeling / Optimization Steps:

- Step 1: Defining Staff Roles
  - Establish clear responsibilities for the 6-staff model
  - 2 scan techs, 2 backup techs, an administration TA, and the dedicated MRI porter.
- Step 2: Identify Idle Time Drivers
  - Lay out all steps that each staff member and patient perform
  - Tie up resources and delay patient movement/create idle time.
  - Include a backup staff member to cover breaks and low-probability events.
- Step 3: Workflow Creation
  - Create an effective workflow
  - MRI safety zones and patient movement.
- Step 4: Testing and Adjustment
  - Test out the workflow model and make adjustments based on staff comments, patient comments
  - Time it takes for staff and patients to perform each step

# Current System Modelling

- Arena Simulator:



# Modelling Results (Stats)

- Arena Simulator:

	O	P	Q	R	S	T	U	V	W	X	Y			
1	Continuous-Time Statistics (Time Persistent)													
2	Project Name				Name	Type	Source	Average Of Replication Averages	Half-Width	StDev Of Replication Averages	Min Replication Average	Max Replication Average	Overall Min Value	Overall Max Value
3	Unnamed Project				Execute sca	Number Wai Queue		0.00864571	0.006175315	0.008632495	0	0.024301786	0	
4					Exit patient	Number Wai Queue		0	0	0	0	0	0	
5					MRI machir	Instantaneous Utilizati		0.301513518	0.047642997	0.066600318	0.218368774	0.384534621	0	
6						Number Bus Resource		0.301513518	0.047642997	0.066600318	0.218368774	0.384534621	0	
7						Number Sch Resource		1	0	0	1	1	1	
8					MRI machine 2			1	0.045809428	0.064037165	0.20683231	1	0	
9					Move to Pri	Number Wai Queue		0	0	0	0	0	0	
10					Patient	WIP	Entity	1.159145708	0.181235985	0.253350438	0.857311559	1.531479175	0	
11					Patient Bro	Number Wai Queue		0	0	0	0	0	0	
12					Patient Cha	Number Wai Queue		0	0	0	0	0	0	
13					Patient IV s	Number Wai Queue		0.019116537	0.012788223	0.017876703	0	0.048548543	0	
14					Patient Inte	Number Wai Queue		0	0	0	0	0	0	
15					Perform Be	Number Wai Queue		0	0	0	0	0	0	
16					Scan paper	Number Wai Queue		0	0	0	0	0	0	
17					Use Washrc	Number Wai Queue		0.000104595	0.000236611	0.000330759	0	0.001045953	0	
18					brought to	Number Wai Queue		0	0	0	0	0	0	
19					change roo	Instantaneous Utilizati		0.034445717	0.005883632	0.00815863	0.023541922	0.047181014	0	
20						Number Bus Resource		0.034445717	0.005883632	0.00815863	0.023541922	0.047181014	0	
21						Number Sch Resource		1	0	0	1	1	1	
22					change roo	Instantaneous Utilizati		0.036763497	0.005883465	0.008224517	0.024517381	0.049577971	0	
23						Number Bus Resource		0.036763497	0.005883465	0.008224517	0.024517381	0.049577971	0	
24						Number Sch Resource		1	0	0	1	1	1	
25					change roo	Instantaneous Utilizati		0.035278256	0.004553818	0.006365798	0.024784631	0.043716469	0	
26						Number Bus Resource		0.035278256	0.004553818	0.006365798	0.024784631	0.043716469	0	
<	>	...	AcrossReplicationsSummary											
<	>	...	DiscreteTimeStatsByRep											
<	>	...	ContinuousTimeStatsByRep											
<	>	...	CounterStatsByRep											
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I guess the utilization of MRI machine is around 30%



# Optimization Techniques

- Spatial and Flow Optimization (Zones)
- Structural Optimization (Roles)



# Spatial and Flow Optimization (Zones)

- Use Zone 1 to your advantage –
  - Patients can take their time filling out the screening form here, as they do not need to be supervised.
  - This prevents them from taking up resources in the main department.
- Utilize the Prep Room (Zone 2) as the Ideal Wait Area –
  - The patient is screened here to ensure they are fully prepared for their scan or ready to switch magnets if needed.
  - Limit Patients in Zone 2
  - Maintain a maximum of 3 patients in Zone 2: 2 patients being prepped and 1 exiting the magnet, to manage flow without creating bottlenecks.
- Focus on High-Time Tasks:
  - Time for patient preparation ~ 16 mins,
  - Time to complete scan ~ 30 mins.



# Structural Optimization (Roles)

- Scan Tech
  - Follows the current patient through their care until scanning is complete.
- Backup Tech
  - Priority is to prep the next patient.
  - Assists with patient set up, finishes paperwork [~ is available for administration questions?]
- Administrative TA
  - Manages the clinical calendar, handles inpatient appointments, outpatient fluctuations
  - Facility calls, freeing up technologists for clinical tasks.
- Dedicated Porter
  - Communicates with the administrative TA to transport patients to and from the MRI department.
  - Handles stocking, cleaning, and initial patient instructions (should be allocated some more TA tasks post scan)
- Staffing Model:
  - Ensure patients are not waiting for resources [change rooms, bathrooms, lockers, and prep rooms]
  - Prepped for the scan before it is ready for them.





# Key Takeaways for Efficiency

- Spatial (Zone) optimization and Structural Optimization
- Especially in a 2-bay suite which handles double the patients and staff
- Operational Success Factors
  - Consistency in data collection is vital for successful workflow improvement
- Workflow improvements must account for the fact that the type of exam changes the workflow
- MRI Staff Scheduling Optimization and MRI Patient Scheduling Optimization



# Alternative Technology to run Simulation

- SimPy – For Simulation
  - Environment
  - Entity – Events – States
  - Processes (wait, interrupt)
  - Resources (allocation, release) – Resources Container
- Streamlit – For FE/Visualization and Deploy
- Statistics Collection – Warm Up Period (To avoid Bias)
  - KPIs – Cycle time, Wait time, Throughput Rate
  - Mean, SD for various Simulation



# Thank you!

Any Questions?!