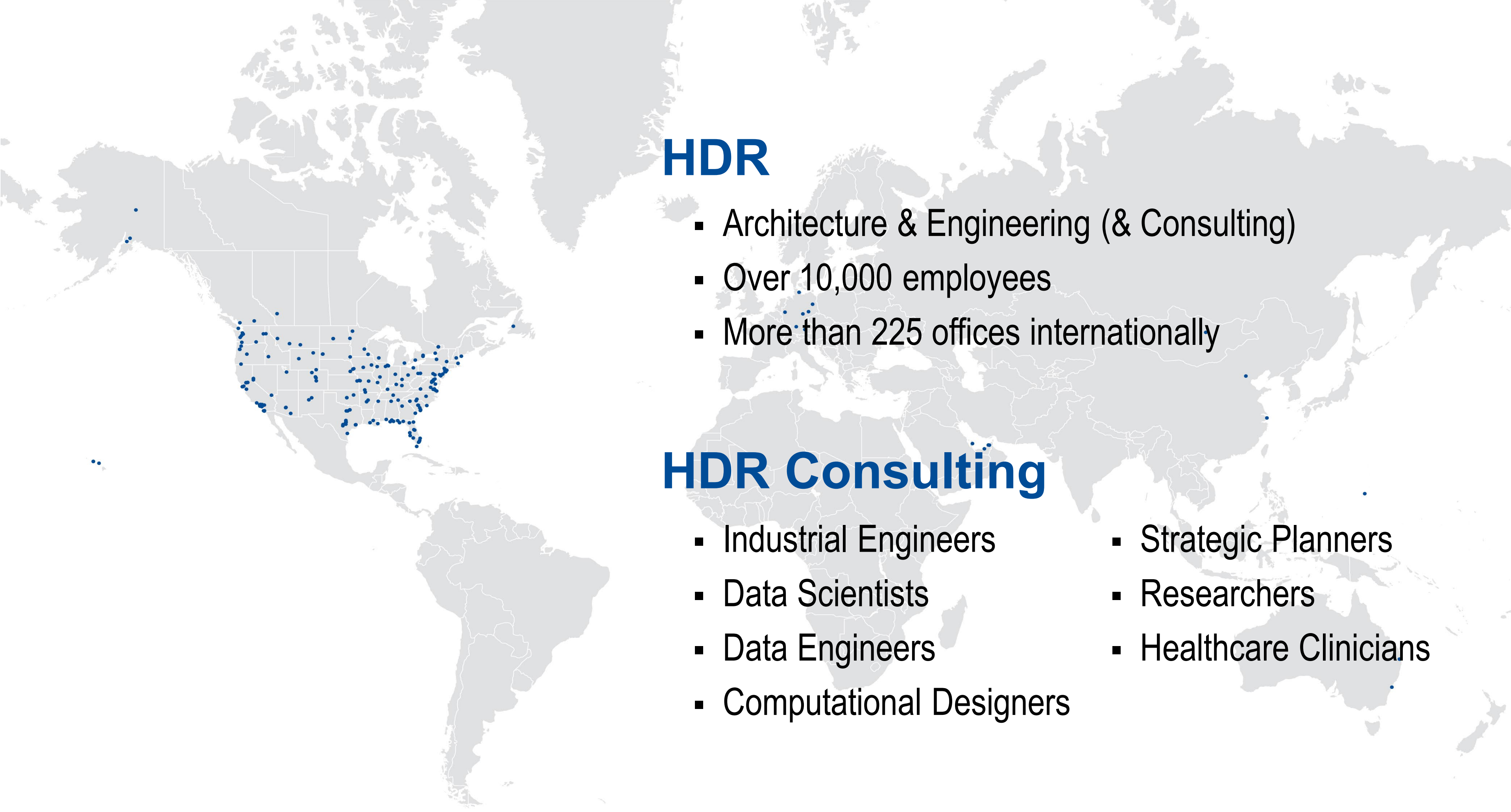
# Surgery Center Planning & Efficiency Study in an Architectural Practice

**Olivia Pewzer + Sean Carr**

*May 14th 2019*


# 01 HDR & Data-Driven Design



# HDR

- Architecture & Engineering (& Consulting)
- Over 10,000 employees
- More than 225 offices internationally

# HDR Consulting

- Industrial Engineers
- Data Scientists
- Data Engineers
- Computational Designers
- Strategic Planners
- Researchers
- Healthcare Clinicians

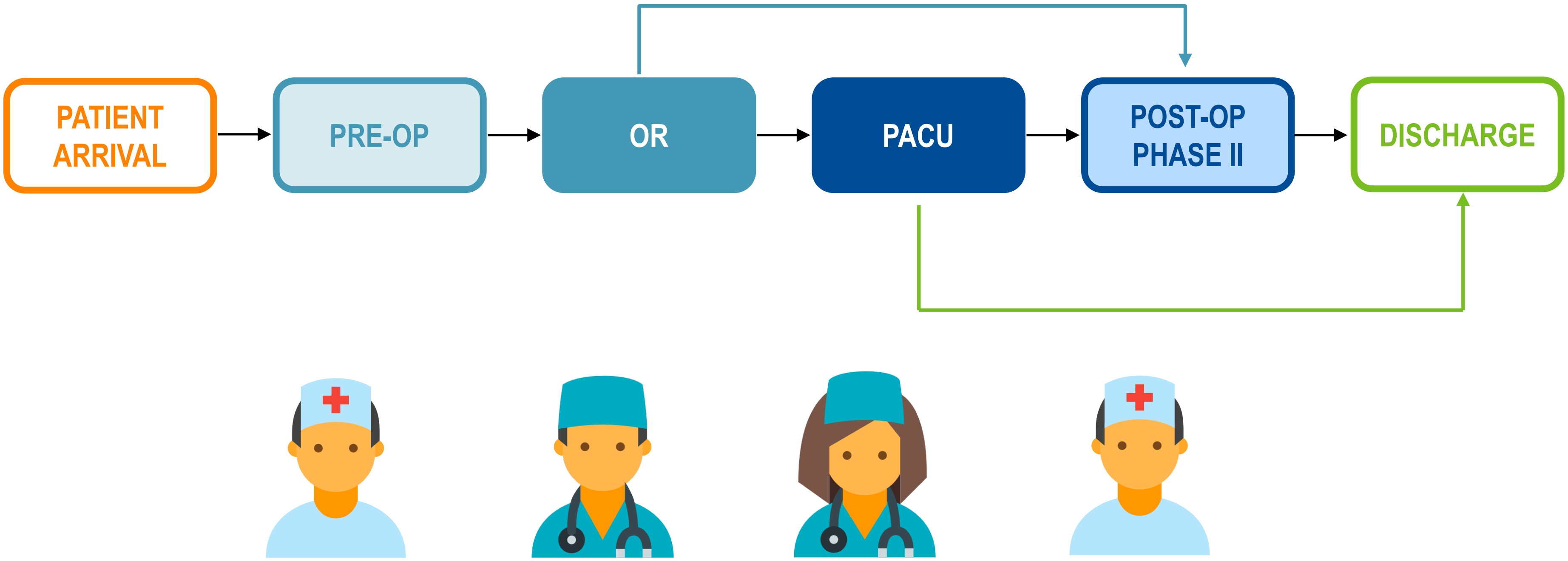
# 02 Background

# Background & Key Questions From Clients

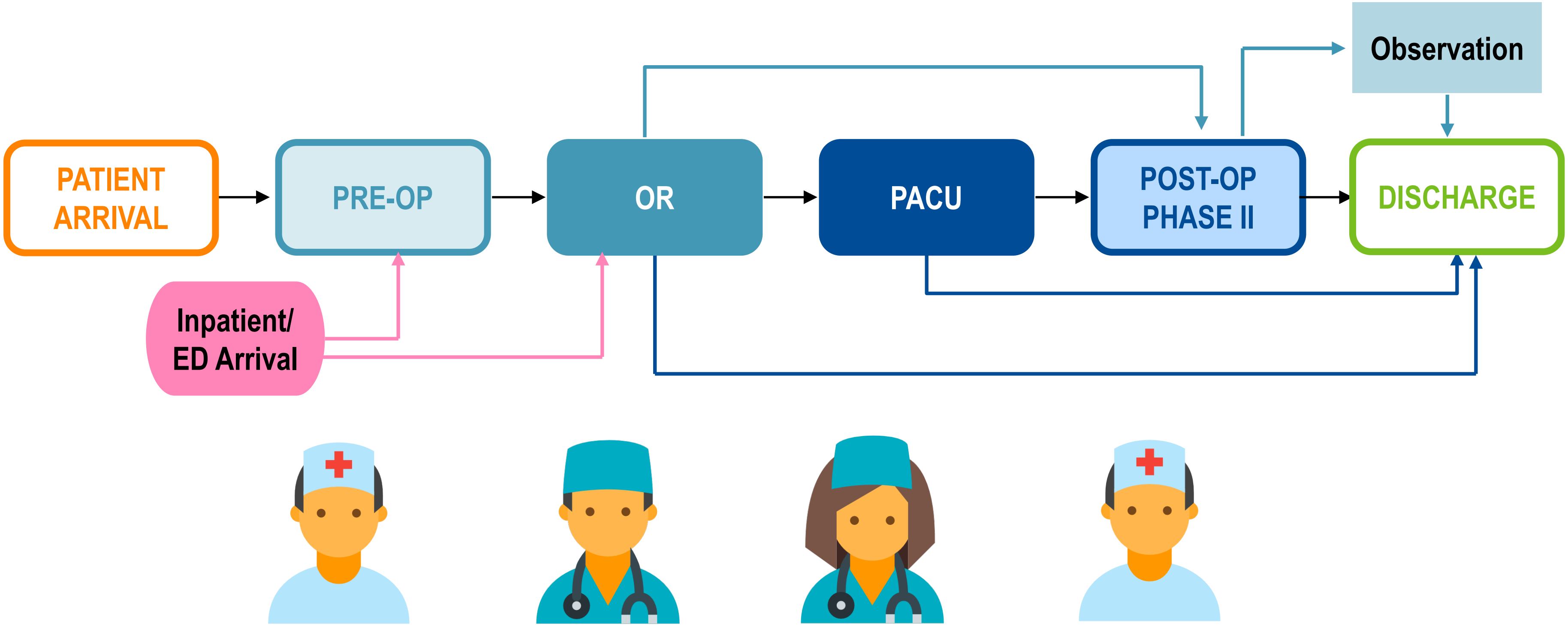
- Context: New or existing surgical suite

- How can we be more efficient in a surgery environment?
- How to plan the space efficiently?
- "We want to be LEAN!"
- Help us determine the right way of operating to maximize our patient experience

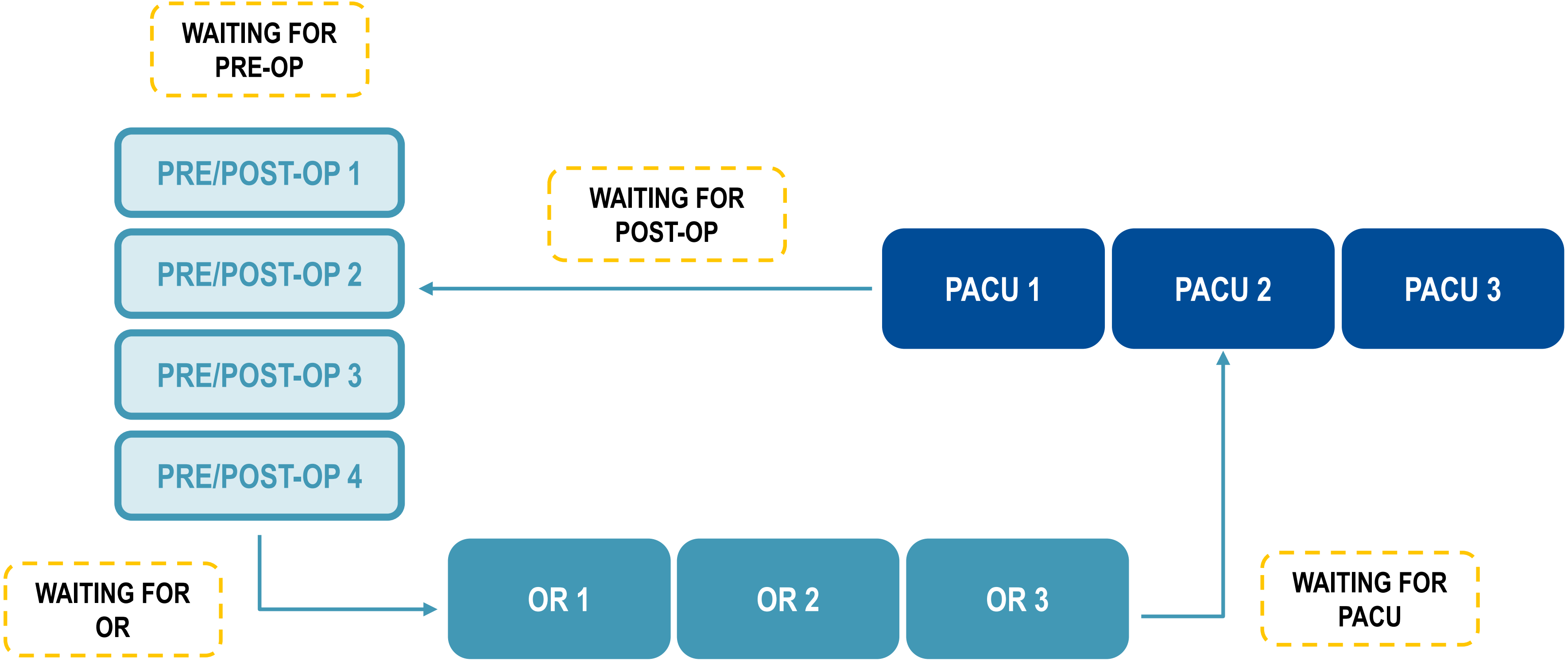
# High-level Baseline Process



# High-level Baseline Process – Additional Details



# High-level Space Type



# Why SIMIO?

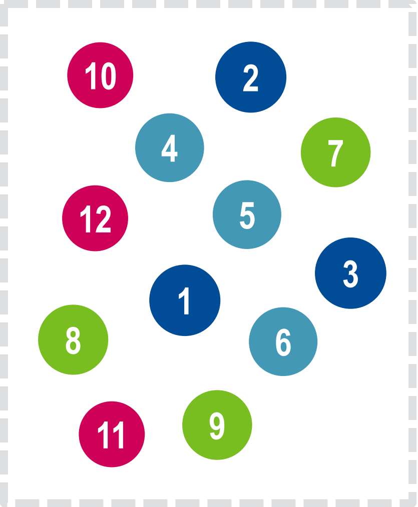
- DES offers the ability to test various scenarios before live piloting

- Simio offers
  - Advanced DES capabilities
  - Minimized modeling effort with pre-set functions
  - Ability to import architectural drawings
  - 3D view to achieve quicker client buy-in
  - Outputs are easy to visualize both in/outside of Simio


# 03 OR Scheduling & Modeling

# OR Scheduling

# Surgery Scheduling / Future State

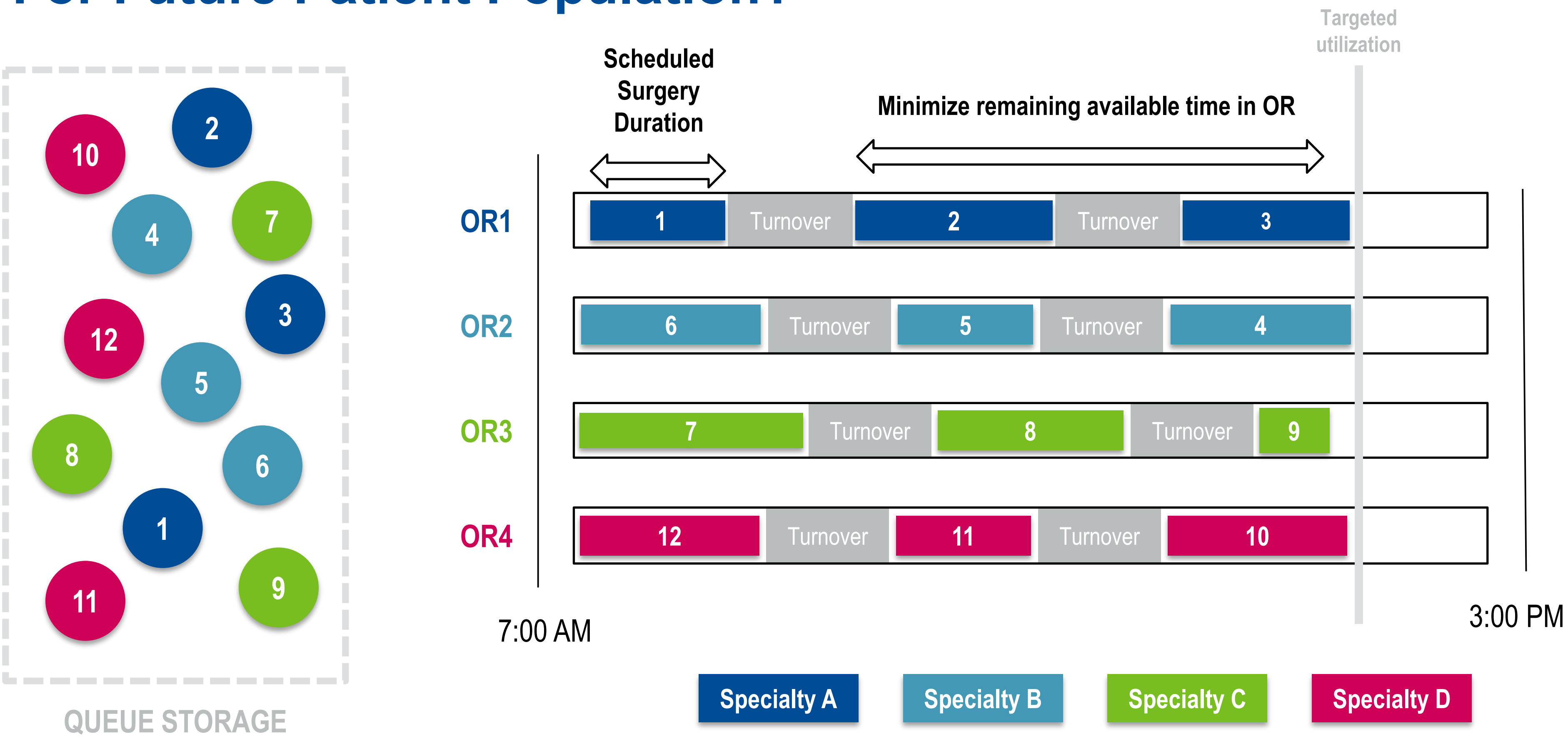



Past Patient Population

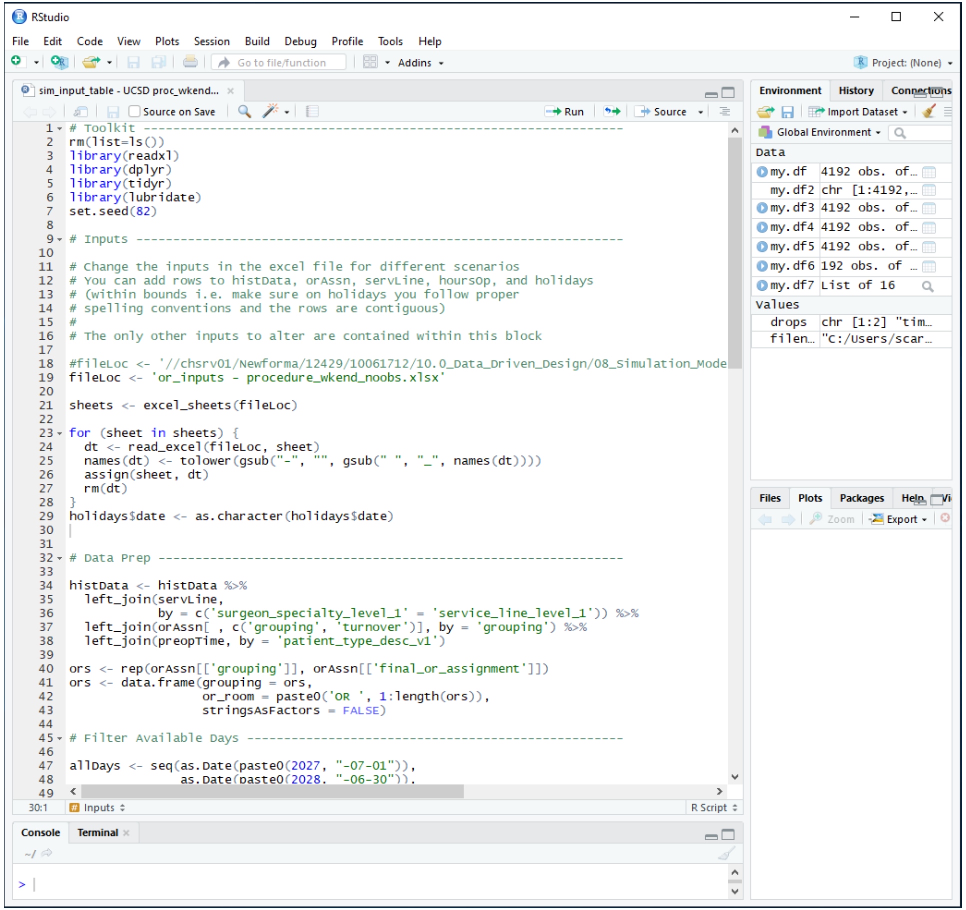
| Growth by Specialty | IP | OP |
|---|---|---|
| 1. Ortho | 1% | 3% |
| 2. Neuro | -2% | 2% |
| 3. Ophthalm. | 0% | 3% |
| 4. ENT | 0% | 4% |
| 5. Vascular | -1% | 1% |
| 6. Urology | -5% | 5% |
| Total | -1% | 3% |

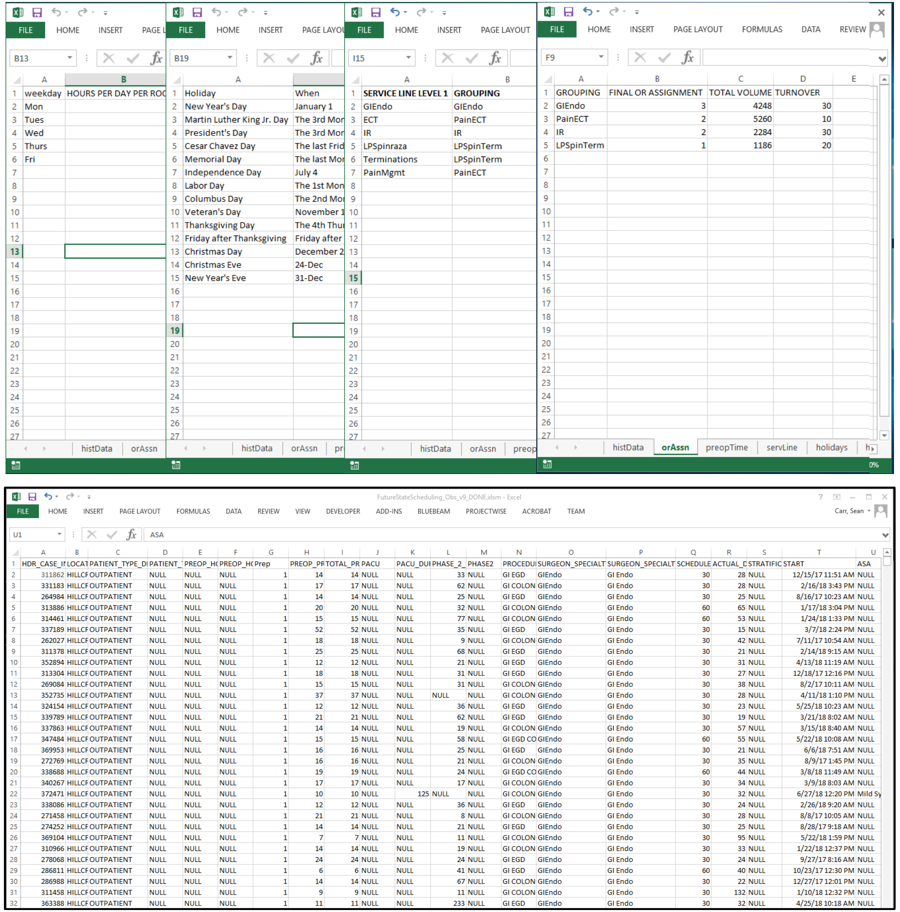

Future Patient Population

# How Does Surgery Scheduling Work For Future Patient Population?



# Scheduling the Operating Rooms



# OR Modeling

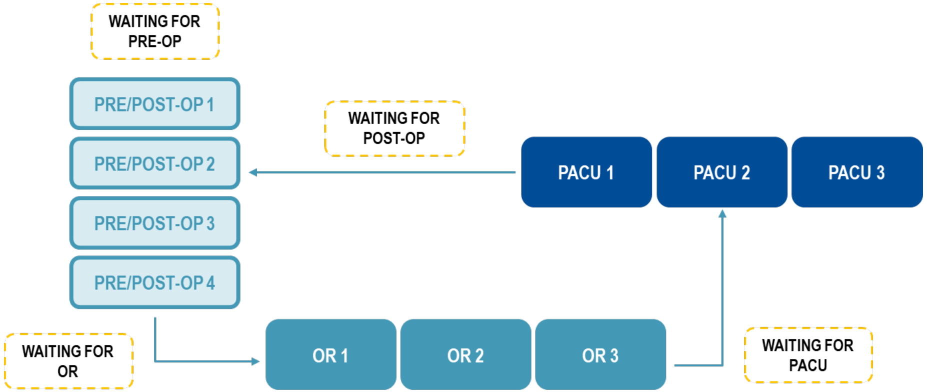
Approach & Outcomes

# Modeling Functionality (Model Properties)

Pre/Post-op & PACU Interchangeable

Patients maintain "ownership" and return to same pre-op space after surgery

Data-Driven (Scheduled) Duration



# Model Outputs / Performance Indicators

1. Total Patient Waiting Time for each phase (Pre-op, OR, etc.)

→ **Indicates lack of available capacity and operational inefficiency; correlated with patient experience**

2. OR Room Utilization

→ **Target 75% average over time**

3. Last Case Start/End Time (*Overtime*)

→ **Indicates overloaded system, delays and variability**

4. Prep/Recovery Room Utilization

→ **Typically less utilized on average due to uneven scheduling patterns**

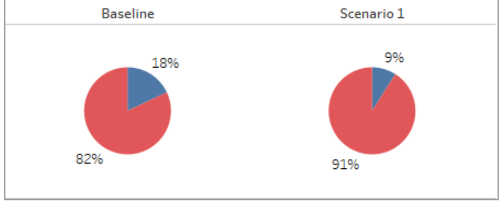
# Surgery Suite - Dashboard Example

FY18 Case Volume: 5,000

FY28 Case Volume: 7,500

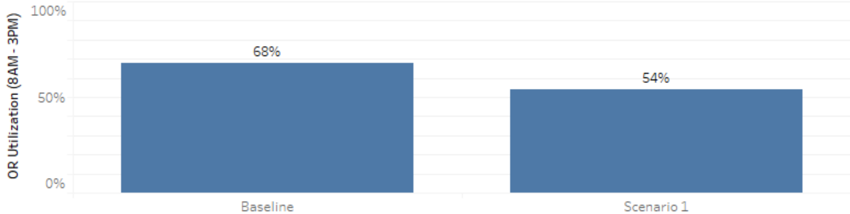
**Space Capacity:**
**3 ORs**
**9 Prep/Recovery Rooms**
**9 PACU Bays**

## Patient Value-Added Time

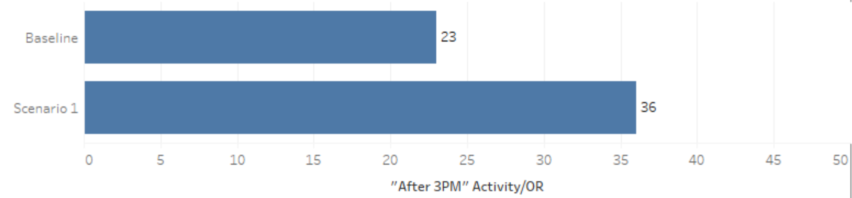



**Value-added**
- Patient Non Value-Added Time
- Patient Value-Added Time

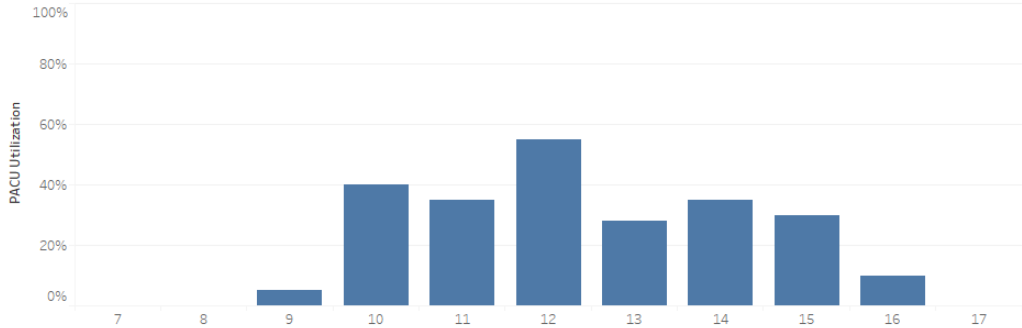
## FY28 OR Utilization (from 7AM to 3PM) - 3 ORs



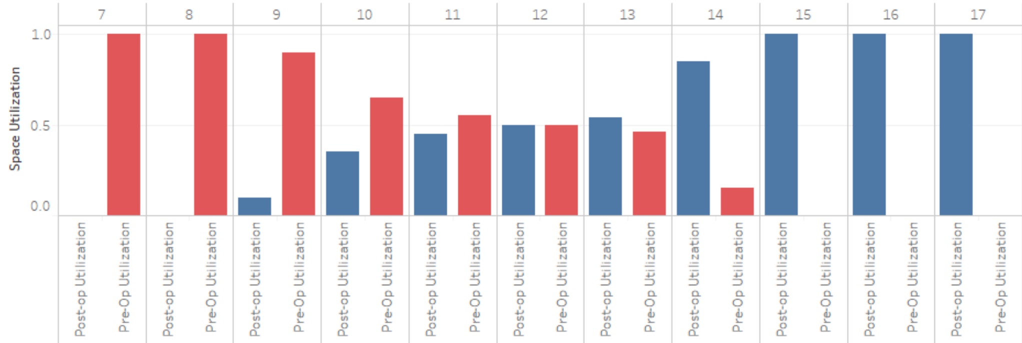

## After 3PM Activity/OR (minutes) - 3 ORs




## PACU Utilization Throughout a Typical Day




## Pre-Op & Post-Op Utilization Throughout a Typical Day



# Limitations and Areas for Improvement

1

**Scheduling script fills in from the start of the day, leaving gaps at the end of the day.**
Actual schedules may have gaps within each day.

2

**Simulated scheduling works from a full bank of patients.**
Actual scheduling occurs over time as patients get referred to surgery.

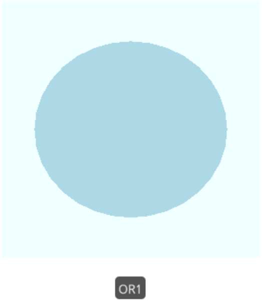
3

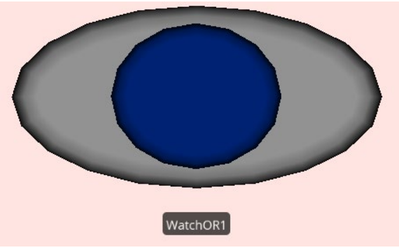
Regenerating a new schedule every time the number of ORs changes

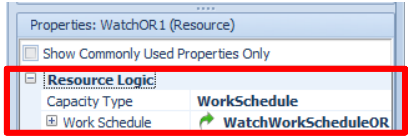
# 04 Simio Techniques

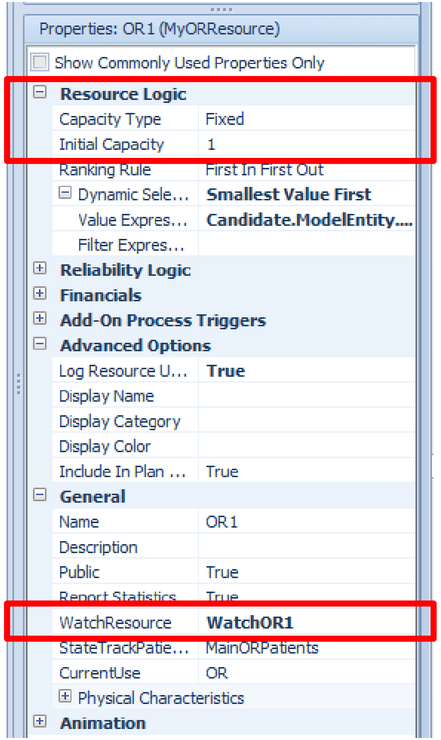
# “Watch” Resources For Utilization Metrics

- Allows resource utilization metrics to be computed based on scheduled operating hours
- Fixed-capacity room resources allow service to continue until all surgeries are complete
- “Watch” resources go on/off-shift based on schedule and allow Room resource has fixed capacity



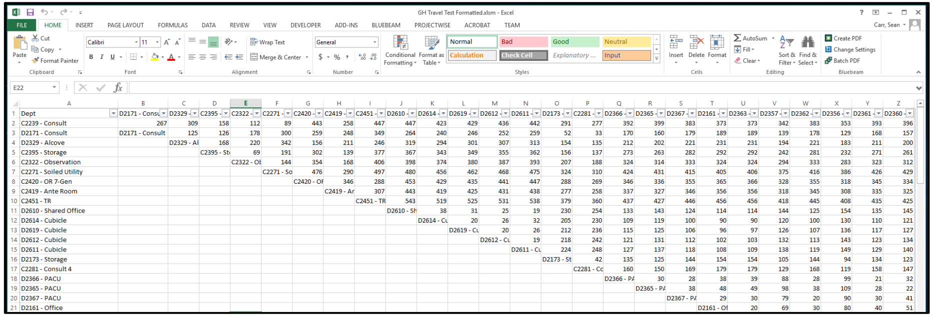



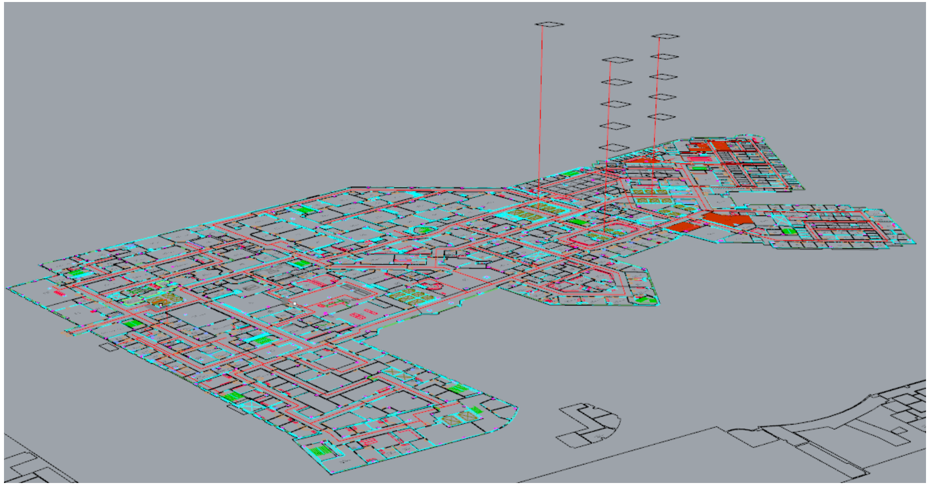



# Data Tables To Incorporate Scale

- Many times, models we build are at first conceptual in nature
- Data tables are set up in Simio to incorporate travel distances once the physical space and scale is determined
- Scripting in the design software allows us to export distances between points of interest (using shortest path or other algorithms) and “paste” into Simio model



| | Dept | D2171 - Consu | D2329 - | C2395 - | C2322 - | C2271 - | C2420 - | C2419 - | C2451 - | D2610 - | D2614 - | D2619 - | D2612 - | D2611 - | D2173 - | C2281 - | D2366 - | D2365 - | D2367 - | D2161 - | D2363 - | D2357 - | D2362 - | D2356 - | D2361 - | D2360 - |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | C2239 - Consult | 267 | 309 | 158 | 112 | 89 | 443 | 258 | 447 | 447 | 423 | 429 | 436 | 442 | 291 | 277 | 392 | 399 | 383 | 373 | 373 | 342 | 383 | 353 | 393 | 396 |
| 3 | D2171 - Consult | D2171 - Consult | 125 | 126 | 178 | 300 | 259 | 248 | 349 | 264 | 240 | 246 | 252 | 259 | 52 | 33 | 170 | 160 | 179 | 189 | 189 | 139 | 178 | 129 | 168 | 157 |
| 4 | D2329 - Alcove | | D2329 - Al | 168 | 220 | 342 | 156 | 211 | 246 | 319 | 294 | 301 | 307 | 313 | 154 | 135 | 212 | 202 | 221 | 231 | 231 | 194 | 221 | 183 | 211 | 200 |
| 5 | C2395 - Storage | | | C2395 - St | 69 | 191 | 302 | 139 | 377 | 367 | 343 | 349 | 355 | 362 | 156 | 137 | 273 | 263 | 282 | 292 | 292 | 242 | 281 | 232 | 271 | 261 |
| 6 | C2322 - Observation | | | | C2322 - Ob | 144 | 354 | 168 | 406 | 398 | 374 | 380 | 387 | 393 | 207 | 188 | 324 | 314 | 333 | 324 | 324 | 294 | 333 | 283 | 323 | 312 |
| 7 | C2271 - Soiled Utility | | | | | C2271 - So | 476 | 290 | 497 | 480 | 456 | 462 | 468 | 475 | 324 | 310 | 424 | 431 | 415 | 405 | 406 | 375 | 416 | 386 | 426 | 429 |
| 8 | C2420 - OR 7-Gen | | | | | | C2420 - OI | 346 | 288 | 453 | 429 | 435 | 441 | 447 | 288 | 269 | 346 | 336 | 355 | 365 | 366 | 328 | 355 | 318 | 345 | 334 |
| 9 | C2419 - Ante Room | | | | | | | C2419 - Ar | 307 | 443 | 419 | 425 | 431 | 438 | 277 | 258 | 337 | 327 | 346 | 356 | 356 | 318 | 345 | 308 | 335 | 325 |
| 10 | C2451 - TR | | | | | | | | C2451 - TR | 543 | 519 | 525 | 531 | 538 | 379 | 360 | 437 | 427 | 446 | 456 | 456 | 418 | 445 | 408 | 435 | 425 |
| 11 | D2610 - Shared Office | | | | | | | | | D2610 - Sh | 38 | 31 | 25 | 19 | 230 | 254 | 133 | 143 | 124 | 114 | 114 | 144 | 125 | 154 | 135 | 145 |
| 12 | D2614 - Cubicle | | | | | | | | | | D2614 - Cu | 20 | 26 | 32 | 205 | 230 | 109 | 119 | 100 | 90 | 90 | 120 | 100 | 130 | 110 | 121 |
| 13 | D2619 - Cubicle | | | | | | | | | | | D2619 - Cu | 20 | 26 | 212 | 236 | 115 | 125 | 106 | 96 | 97 | 126 | 107 | 136 | 117 | 127 |
| 14 | D2612 - Cubicle | | | | | | | | | | | | D2612 - Cu | 19 | 218 | 242 | 121 | 131 | 112 | 102 | 103 | 132 | 113 | 143 | 123 | 134 |
| 15 | D2611 - Cubicle | | | | | | | | | | | | | D2611 - Cu | 224 | 248 | 127 | 137 | 118 | 108 | 109 | 138 | 119 | 149 | 129 | 140 |
| 16 | D2173 - Storage | | | | | | | | | | | | | | D2173 - St | 42 | 135 | 125 | 144 | 154 | 154 | 105 | 144 | 94 | 134 | 123 |
| 17 | C2281 - Consult 4 | | | | | | | | | | | | | | | C2281 - Cc | 160 | 150 | 169 | 179 | 179 | 129 | 168 | 119 | 158 | 147 |
| 18 | D2366 - PACU | | | | | | | | | | | | | | | | D2366 - PA | 30 | 28 | 38 | 39 | 88 | 28 | 99 | 21 | 32 |
| 19 | D2365 - PACU | | | | | | | | | | | | | | | | | D2365 - PA | 38 | 48 | 49 | 98 | 38 | 109 | 28 | 22 |
| 20 | D2367 - PACU | | | | | | | | | | | | | | | | | | D2367 - PA | 29 | 30 | 79 | 20 | 90 | 30 | 41 |
| 21 | D2161 - Office | | | | | | | | | | | | | | | | | | | D2161 - Of | 20 | 69 | 30 | 80 | 40 | 51 |




# 05 OR Scheduling Support

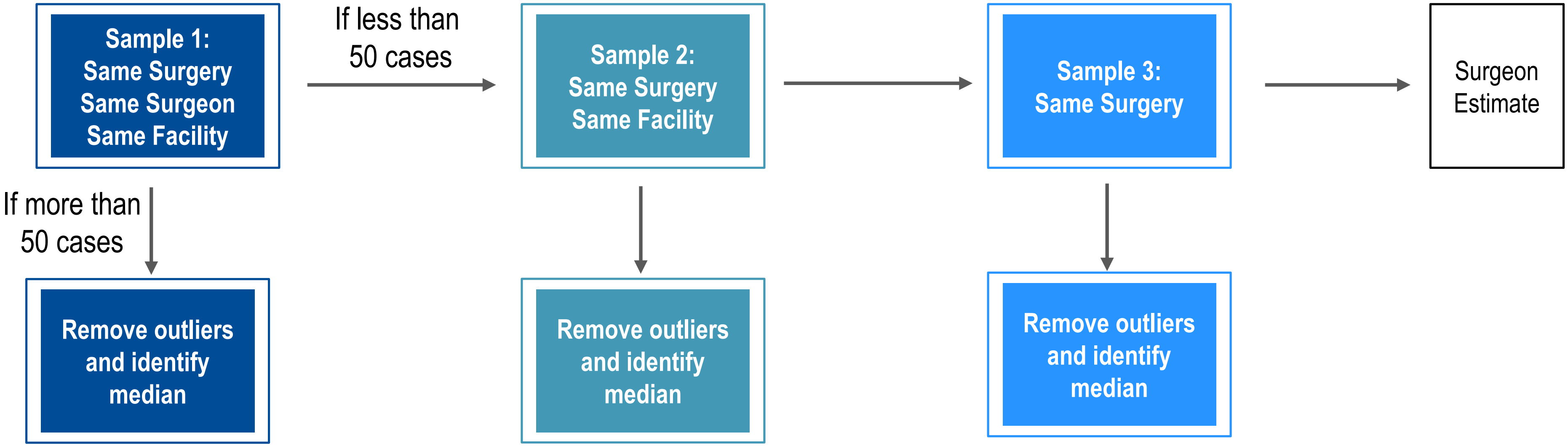
# Real-Life Application: Surgeon Estimates

Concept: Surgeon estimates "scheduled surgery duration"

| | |
|---|---|
| Surgeon Estimation | Scheduled Surgery Duration = 2 hours |
| **Option 1**: Under-estimation: | Actual Surgery Duration = 3 hours |
| **Option 2:** Over-estimation: | Actual Surgery Duration = 1 hour |
| **Option 3:** On-time: | Actual Surgery Duration = 2 hour |

# Real-Life Application: Data-Driven Duration Algorithm

Concept: Determine median (actual duration) of specific historical data samples to determine "scheduled surgery duration"



# Real-Life Application: Data-Driven Duration Algorithm

Concept: Determine median (actual duration) of specific historical data samples to determine "scheduled surgery duration"

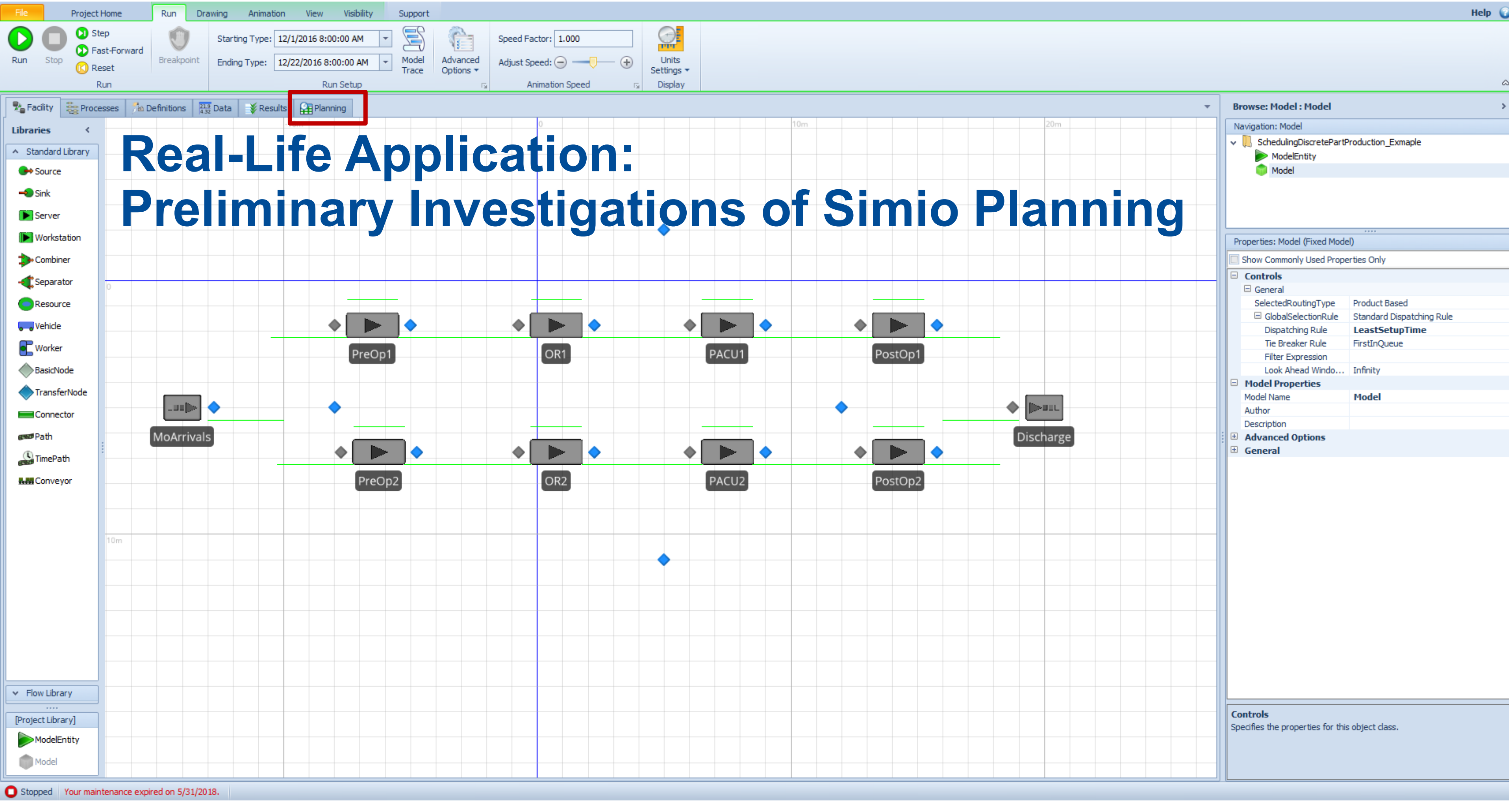
Sample 1 - Median: Data-Driven Scheduled Duration = 1.5 hours

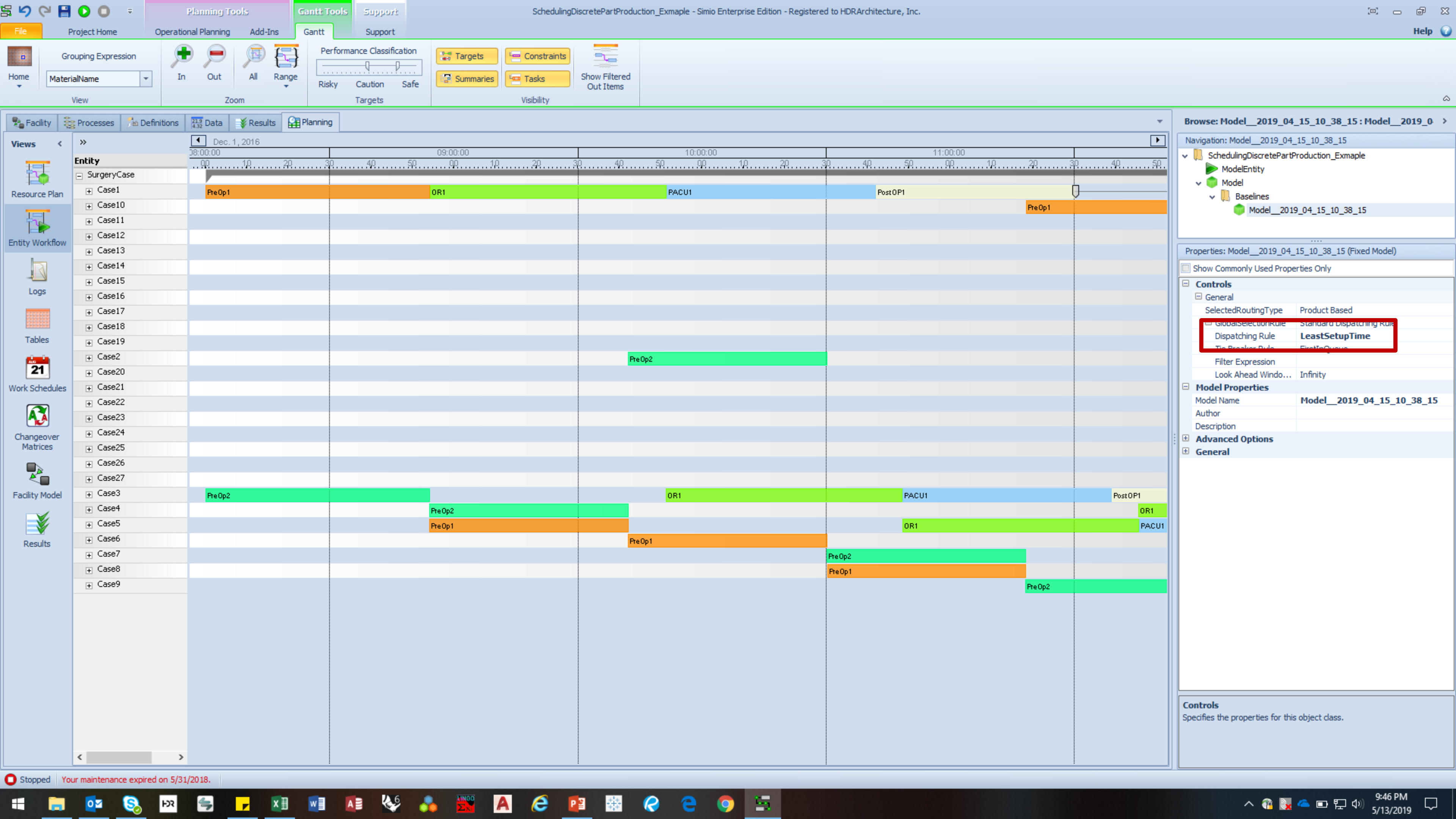
**Option 1**: Under-estimation — Actual Surgery Duration = 3 hours

**Option 2:** Over-estimation — Actual Surgery Duration = 1 hour

**Option 3:** On-time — Actual Surgery Duration = 1.5 hour

# Real-Life Application: Preliminary Investigations of Simio Planning

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Project Home
Operational Planning
Add-Ins
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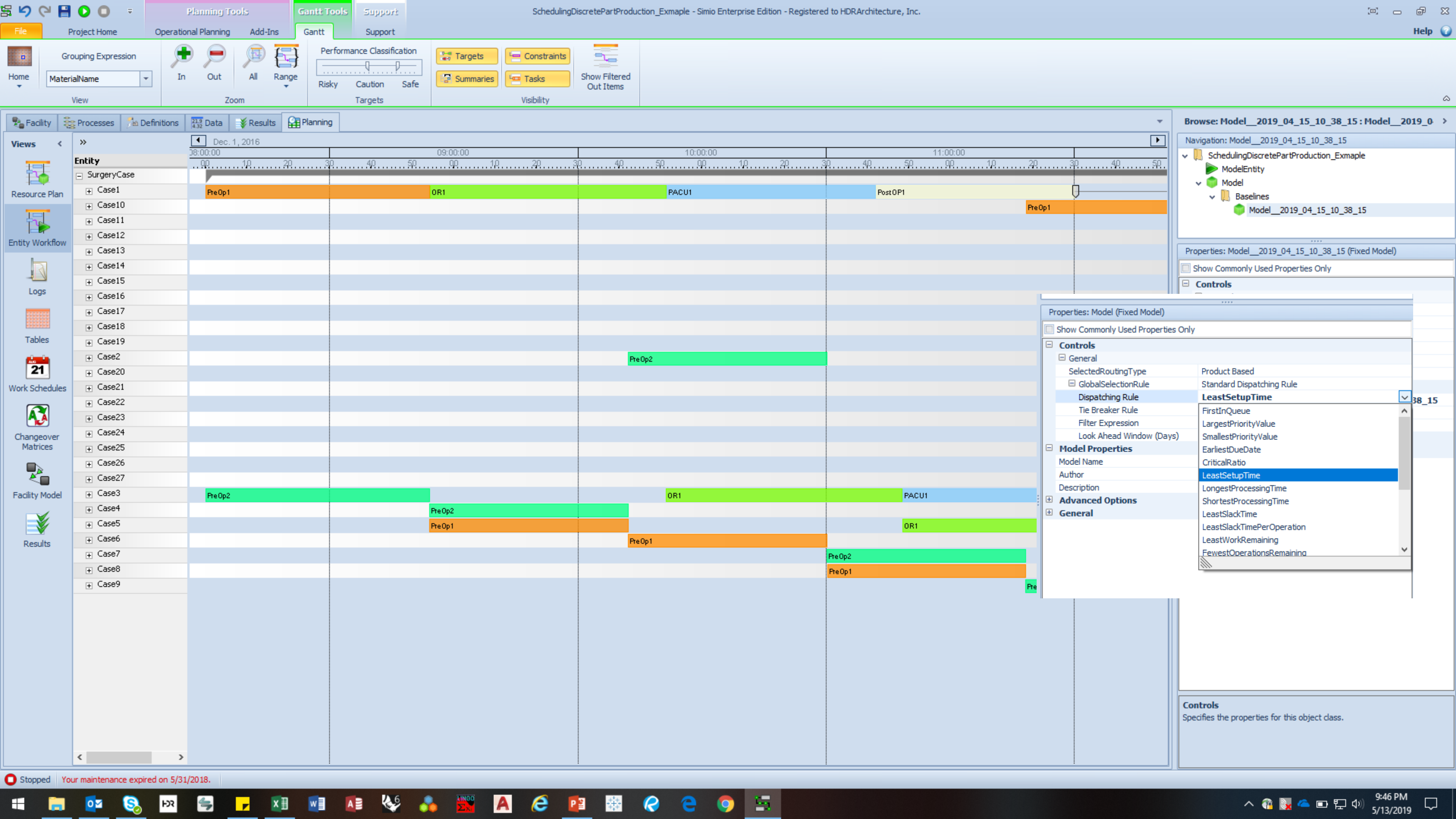
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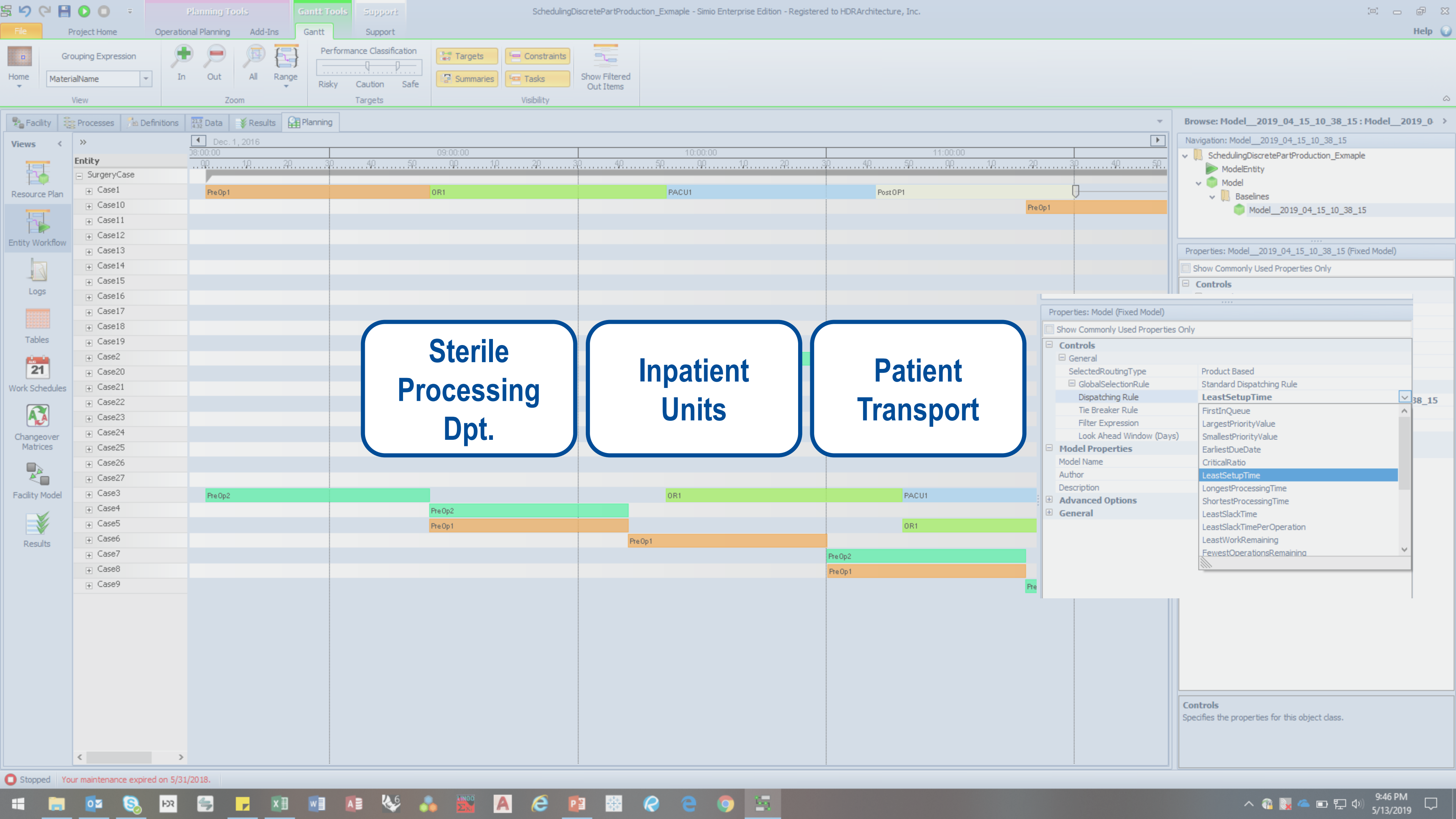
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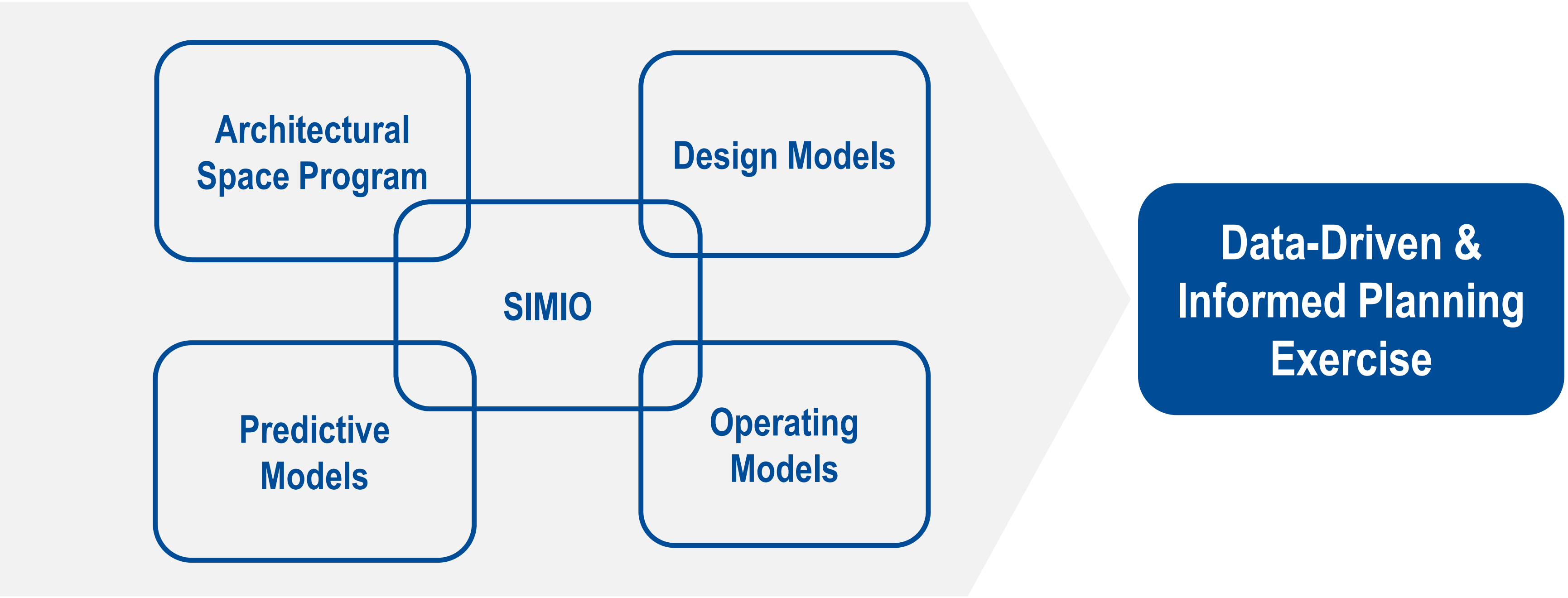
# 06 Conclusion

# Conclusion


Architectural Space Program
Design Models
SIMIO
Predictive Models
Operating Models
Data-Driven & Informed Planning Exercise