

HOSPITAL PROPOSED LAYOUT VALIDATION USING FLEXSIM HEALTHCARE

Brittany Quinn

FlexSim Software Products, Inc.
1577 North Technology Way
Building A, Suite 2300
Orem, Utah 84097, USA

ABSTRACT

An architectural firm needed to confirm that currently planned surgical suite resources distributed over three floors, in regard to perioperative bays and waiting room chairs, were sufficient to meet planned patient and family volumes. A simulation model was constructed involving over 100 unique patient types, and a full year of expected hospital activity was simulated. Using the data collected from the model run, a custom output file was created that showed how many people were in each area during each hour of every day of the year, and was then analyzed to determine whether the resources were sufficient. The model indicated that, based on the clinical assumptions developed and supplied by the facility and architectural design team, several floors were reaching peak capacity in their respective waiting room areas for a few hours each day. In regard to the perioperative units which were designed to flex from pre-op to post-op depending on need and time of day, the model showed that in one case where the perioperative units are located adjacent to one another, one unit was reaching maximum capacity on a daily basis while the adjacent unit was underutilized. The study was able to confirm for the clinical institution that these two units will be able to manage the daily flux operationally, which allowed the design (specifically the total number of perioperative bays on the floor and the adjacency of the units) to be implemented as planned.

1 INTRODUCTION

An architectural firm needed to confirm whether the current number of perioperative bays and waiting room chairs planned for a large medical facility was sufficient to support the proposed procedural volumes based on assumptions about the type and number of procedure rooms and projected patient/family volume. It was requested that an animated computer simulation of the three procedural floors, including post-procedure extended observation beds (up to 24 hours), waiting room chairs, and perioperative (“periop”) bays, combined with a set of custom outputs, be used for model validation purposes.

The model simulated the daily activities on each of the three procedure floors and also factored in the impact of the resource extended observation bed located on the fourth floor. The model was based on a set of operational assumptions that the hospital provided. The model tests whether the proposed facility design will accommodate, as currently planned, the assumed flow of patients over the course of the day and the illustrated usage.

2 PROCEDURE

Each floor was built individually as separate models, making it easier to lay out the periop bays, procedure rooms, observation beds, waiting rooms, and network paths in their proper locations. All objects and areas were named in order to distinguish them from one another and to make it easy to identify which floor they

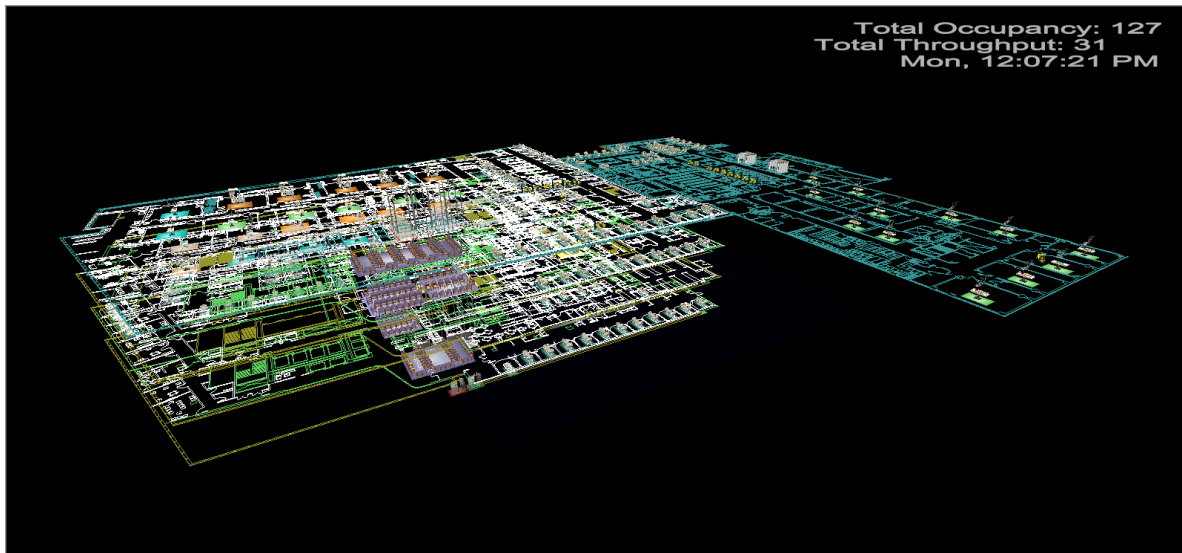


Figure 1: Sample proposed layout of facility.

were located on. Once the floors were built they were imported into one model, where each floor and its objects were positioned at the appropriate heights. The resulting model can be seen in Figure 1.

2.1 Patient Track

For this model, there were over 100 unique patient types. Typically, this could mean that there would be over 100 different patient tracks, as each patient had different process times and process locations. Through the use of code we were able to reduce the number of base patient tracks down to two, each populated with markedly different activities.

The first patient can be seen in Figure 2. For this track, the patient started by determining if they were required to go to the waiting room for a certain period of time prior to being admitted. If so, the patient traveled to a specific waiting room for a specified period of time. The patient then traveled to a specified periop bay to be prepped for their procedure and wait there for a defined prep time. Once this prep time was complete, the patient traveled to a defined procedure location and remained at that location for the defined procedure time. The clinical staff then decided if an initial or first stage recovery was required for that procedure. If the first stage recovery is required, then the patient traveled post-procedure to the appropriate periop bay based on a probability; they remained in this location for a specified recovery time. Following the first stage recovery time, the clinical staff determined if the patient required transferring somewhere else for a second stage recovery time. If so, they again traveled to a second specified location for a second stage recovery time. Once the second stage recovery time elapsed, the patient exited the model.

The second patient track included some of the same initial activities as the first patient track. The patient first determined if they were required to go to the waiting room for a certain period of time prior to being admitted. If so, the patient traveled to a specific waiting room for a particular time period. The patient then traveled to a specified periop bay, where they remained for a defined amount of time. This time included prep time, procedure time, and recovery time; all three activities were included in this block of time as the activities are performed at the same location. Once this time is elapsed, the patient left the model. This patient track can be seen in Figure 3.

To ensure that the visual elements of the model included both adults and pediatrics, these two tracks were copied three times. When both unique patient tracks were included for each age combination, the final result was eight tracks, as seen in Figure 4.

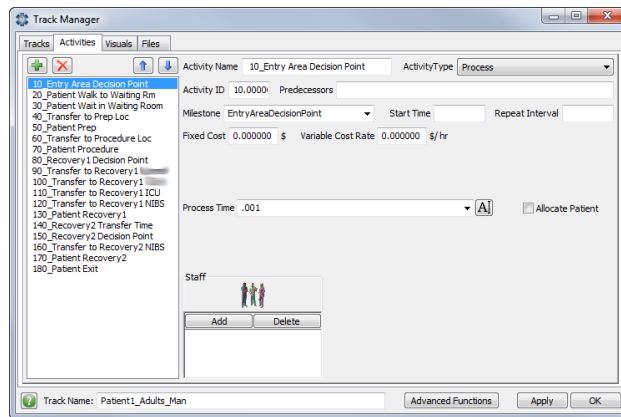


Figure 2: First base patient track.

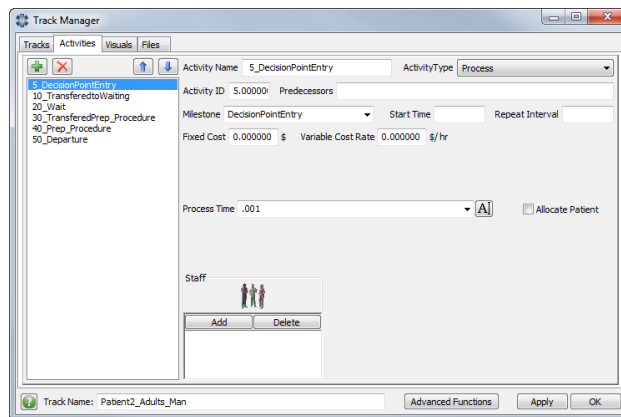


Figure 3: Second base patient track.

To simplify this process, two global tables were set up that contain the key components relating to the specific base patient track in use and the activity details. These tables included:

- Patient name
- Patient number (which is stored on the patient in a label, “PatientTypeNumber”)
- Patient type (adult or pediatric)
- Number of patients with this surgery type that arrived over the course of a year
- Number of family members that accompanied each patient
- Number of possible waiting room areas, prep room areas, and procedure room areas, as well as the actual area names in the model
- Stage of recovery each patient required: first stage recovery and/or second stage recovery
- Percent of patients that recover in each specified area: first stage recovery, second stage recovery, observation beds, and/or ICU
- Process times for Initial Wait Activity, Patient Prep Activity, Patient Procedure Activity, First Stage Recovery Activity, and Second Stage Recovery Activity
- Current number of this specific patient type in the model

An example of this table can be seen in Figure 5. The patient track to be used is determined by which table the data came from and whether the patient is a child or an adult. From there, the patient’s process

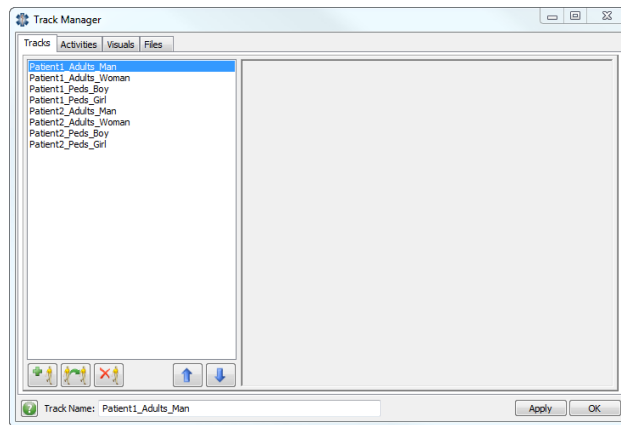


Figure 4: List of all patient tracks.

Row	Patient Name	Patient Number	Track Type	Future Volume Annual 2021	Wait Location	Number of family members	Wait Time to go into Pre-Op Minutes	Number Prep Locations	Prep Location 1	Prep Location 2	Prep Time Minutes
1	IVDrugInfusion+OFT_IVDrugInfusion_DFT_Adult_OP	1.000000	2.000000	72.000000	_4_Adult_PedArea	2.000000	20.000000	1.000000	_4_Adult_PerOpBaysArea		120.000000
	CardioversionWHITE_Adult_IPInHouse_	2.000000	2.000000	97.000000	_4_Adult_PedArea	0.000000	0.000000	1.000000	_4_Adult_PerOpBaysArea		180.000000
	CardioversionWHITE_Adult_OP	3.000000	2.000000	251.000000	_4_Adult_PedArea	2.000000	20.000000	1.000000	_4_Adult_PerOpBaysArea		180.000000
	CardioversionWHITE_Peds_OP	4.000000	1.000000	5.000000	_4_Peds_PerOpArea	3.000000	20.000000	2.000000	_4_Peds_PerOpBaysArea_W	_4_Peds_PerOpBaysArea_E	105.000000
	CardioversionWHITE_Adult_IPInHouse_	5.000000	2.000000	52.000000	_4_Adult_PedArea	2.000000	0.000000	1.000000	_4_Adult_PerOpBaysArea		105.000000
	CardioversionWHITE_Adult_OP	6.000000	2.000000	135.000000	_4_Adult_PedArea	2.000000	20.000000	1.000000	_4_Adult_PerOpBaysArea		135.000000

Figure 5: Example of a patient table.

locations and process times were taken from the appropriate table using the “PatientTypeNumber” label on the patient and global macros for the specific column that contain the needed information. The activities used the following code to treat the table cells as code and executed them as such for the process times and process locations:

```

executefsnode (gettablecell ("tablename",
    getlabelnum (patient, "PatientTypeNumber")
    , Column_Global_Macro), NULL, NULL, NULL,
    1);

```

2.2 Arrival Pattern

Once the Patient Tracks were built, an arrival pattern for the patients was implemented. For each patient type, we were given the number of patients of that given type that were expected to arrive in a year. These arrivals were to be evenly distributed throughout the year. It was not possible to accomplish this with the available arrival patterns using the latest version available (at the time of the study in 2012) of FlexSim HC; therefore, we created a custom arrival pattern using multiple messages. When the model was reset, it sends the initial message to the arrival object to kick off the custom arrival method. This initial message created a single message for each patient; these messages created the patient with the proper patient information and track, as well as the next arrival for this specific patient type. In this way, every patient type had only one arrival message queued up for each patient type.

3 DATA COLLECTION

The client requested a graph that showed how many people were in a given area during each individual hour of the day. There is currently (2012) no such graph built into FlexSim HC that provides the level of detail that the client is interested in, so we created a custom output file that tracked every single activity that a patient experiences, as well as the family members that were in the model with the patient. This output file included fields for the patient’s name, the patient’s type number, the patient’s PCI, the activity number, the start time of that activity, the end time for the activity, the amount of time the patient waited to start that activity, and the area that activity is in. For every family member of a given patient, the above information was also recorded in the output file. This information was recorded using the “Activity Started” trigger. An example of this .csv file can be seen in Figure 6.

P	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1		PATIENT_NAME	PATIENT_TYPE_NUMBER	PCI	ACT	ACTST	ET	EXT	WT	AREA													
2	1	PediatricCardiacSurgery_Peds_IPSameDay_2	2	2	30	0.001	1.133277	198.382625	0	4_Peds_WaitingArea													
3	2	COMP_100_PediatricCardiacSurgery_Peds_IPSameDay_2	2	2	30	0.001	1.133277	198.382625	0	4_Peds_WaitingArea													
4	3	COMP_200_PediatricCardiacSurgery_Peds_IPSameDay_2	2	2	30	0.001	1.133277	198.382625	0	4_Peds_WaitingArea													
5	4	COMP_300_PediatricCardiacSurgery_Peds_IPSameDay_2	2	2	30	0.001	1.133277	198.382625	0	4_Peds_WaitingArea													
6	5	AdultNeurosurgery_AdultOPHome_27	27	1	30	0.001	1.146288	460	0	2_WaitingArea													
7	6	COMP_100_AdultNeurosurgery_AdultOPHome_27	27	1	30	0.001	1.146288	460	0	2_WaitingArea													
8	7	COMP_200_AdultNeurosurgery_AdultOPHome_27	27	1	30	0.001	1.146288	460	0	2_WaitingArea													
9	8	COMP_300_AdultNeurosurgery_AdultOPHome_27	27	1	30	0.001	1.146288	460	0	2_WaitingArea													
10	9	AdultNeurosurgery_AdultOPNIBS_28	28	1	30	0.001	1.157952	460.167751	0	2_WaitingArea													
11	10	COMP_100_AdultNeurosurgery_AdultOPNIBS_28	28	1	30	0.001	1.157952	460.167751	0	2_WaitingArea													
12	11	COMP_200_AdultNeurosurgery_AdultOPNIBS_28	28	1	30	0.001	1.157952	460.167751	0	2_WaitingArea													
13	12	COMP_300_AdultNeurosurgery_AdultOPNIBS_28	28	1	30	0.001	1.157952	460.167751	0	2_WaitingArea													
14	13	AdultCardiacSurgery_Adult_OP_5	5	1	30	0.001	1.172465	31.172465	0	5_WaitingArea													
15	14	COMP_100_AdultCardiacSurgery_Adult_OP_5	5	1	30	0.001	1.172465	31.172465	0	5_WaitingArea													
16	15	COMP_200_AdultCardiacSurgery_Adult_OP_5	5	1	30	0.001	1.172465	31.172465	0	5_WaitingArea													
17	16	COMP_300_AdultCardiacSurgery_Adult_OP_5	5	1	30	0.001	1.172465	31.172465	0	5_WaitingArea													
18	17	GeneralPeds_Peds_IPSameDay_15	15	2	30	0.001	1.185606	460.290251	0	4_Peds_WaitingArea													
19	18	COMP_100_GeneralPeds_Peds_IPSameDay_15	15	2	30	0.001	1.185606	460.290251	0	4_Peds_WaitingArea													
20	19	COMP_200_GeneralPeds_Peds_IPSameDay_15	15	2	30	0.001	1.185606	460.290251	0	4_Peds_WaitingArea													
21	20	COMP_300_GeneralPeds_Peds_IPSameDay_15	15	2	30	0.001	1.185606	460.290251	0	4_Peds_WaitingArea													
22	21	GeneralPeds_PedoPHome_16	16	2	30	0.001	1.206009	460.478789	0	4_Peds_WaitingArea													
23	22	COMP_100_GeneralPeds_PedoPHome_16	16	2	30	0.001	1.206009	460.478789	0	4_Peds_WaitingArea													
24	23	COMP_200_GeneralPeds_PedoPHome_16	16	2	30	0.001	1.206009	460.478789	0	4_Peds_WaitingArea													
25	24	COMP_300_GeneralPeds_PedoPHome_16	16	2	30	0.001	1.206009	460.478789	0	4_Peds_WaitingArea													
26	25	AdultCardiacSurgery_Adult_IPSameDay_4	4	1	30	0.001	1.207483	31.207483	0	5_WaitingArea													
27	26	COMP_100_AdultCardiacSurgery_Adult_IPSameDay_4	4	1	30	0.001	1.207483	31.207483	0	5_WaitingArea													
28	27	COMP_200_AdultCardiacSurgery_Adult_IPSameDay_4	4	1	30	0.001	1.207483	31.207483	0	5_WaitingArea													
29	28	COMP_300_AdultCardiacSurgery_Adult_IPSameDay_4	4	1	30	0.001	1.207483	31.207483	0	5_WaitingArea													
30	29	GeneralAdult_Adult_IPSameDay_11	11	1	30	0.001	1.218575	31.218575	0	5_WaitingArea													
31	30	COMP_100_GeneralAdult_Adult_IPSameDay_11	11	1	30	0.001	1.218575	31.218575	0	5_WaitingArea													
32	31	COMP_200_GeneralAdult_Adult_IPSameDay_11	11	1	30	0.001	1.218575	31.218575	0	5_WaitingArea													
33	32	COMP_300_GeneralAdult_Adult_IPSameDay_11	11	1	30	0.001	1.218575	31.218575	0	5_WaitingArea													
34	33	GeneralPeds_Peds_OPNIBS_17	17	2	30	0.001	1.226944	460.515396	0	4_Peds_WaitingArea													
35	34	COMP_100_GeneralPeds_Peds_OPNIBS_17	17	2	30	0.001	1.226944	460.515396	0	4_Peds_WaitingArea													
36	35	COMP_200_GeneralPeds_Peds_OPNIBS_17	17	2	30	0.001	1.226944	460.515396	0	4_Peds_WaitingArea													
37	36	COMP_300_GeneralPeds_Peds_OPNIBS_17	17	2	30	0.001	1.226944	460.515396	0	4_Peds_WaitingArea													
38	37	GeneralAdult_Adult_OP_home_12	12	1	30	0.001	1.238596	31.238596	0	5_WaitingArea													
39	38	COMP_100_GeneralAdult_Adult_OP_home_12	12	1	30	0.001	1.238596	31.238596	0	5_WaitingArea													
40	39	COMP_200_GeneralAdult_Adult_OP_home_12	12	1	30	0.001	1.238596	31.238596	0	5_WaitingArea													
41	40	COMP_300_GeneralAdult_Adult_OP_home_12	12	1	30	0.001	1.238596	31.238596	0	5_WaitingArea													
42	41	GeneralAdult_Adult_OP_home_8	8	1	30	0.001	1.242798	273.746424	0	4_Adult_WaitingArea													
43	42	COMP_100_GeneralAdult_Adult_OP_home_8	8	1	30	0.001	1.242798	273.746424	0	4_Adult_WaitingArea													
44	43	COMP_200_GeneralAdult_Adult_OP_home_8	8	1	30	0.001	1.242798	273.746424	0	4_Adult_WaitingArea													
45	44	COMP_300_GeneralAdult_Adult_OP_home_8	8	1	30	0.001	1.242798	273.746424	0	4_Adult_WaitingArea													
46	45	AdultNeurosurgery_Adult_IPSameDay_26	26	1	30	0.001	1.246768	460.219498	0	2_WaitingArea													
47	46	COMP_100_AdultNeurosurgery_Adult_IPSameDay_26	26	1	30	0.001	1.246768	460.219498	0	2_WaitingArea													
48	47	COMP_200_AdultNeurosurgery_Adult_IPSameDay_26	26	1	30	0.001	1.246768	460.219498	0	2_WaitingArea													

Figure 6: Example .CSV output data file.

Once a full year of data was collected, the output file was considered complete. The file is then put into a query that sorts through the data to determine how many people are in each area for every hour of every day in the year. This file outputs another file that was then analyzed to determine if there was enough room in the periop bays and waiting room chairs. This file can be seen in Figure 7.

4 RESULTS

From the analysis we were able to learn that the maximum capacities were reached on a few of the floors in the waiting rooms, especially the fourth and fifth floors, for a few hours each day. This problem can be alleviated by assigning families to wait on different assigned floors or by adding 10-15 additional chairs to the fourth and fifth floors. All other floors did not reach the maximum capacity.

We also learned that the fifth floor “maxed” out its capacity on a daily basis for the periop bays planned for in the new construction, while the adjoining existing periop bays were underutilized. This delta can be operationally managed throughout the day. The periop bays designated for adults on the fourth floor reached maximum capacity for several hours each day. All other periop bays had sufficient space for the patients that were assigned to them.

We learned that the procedure rooms had sufficient capacity to accommodate the planned number and types of patients. Some patients were slightly delayed due to volume during different times of the week;

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	B				
1	date		1-Jan																								2-Jan																																
2	hour	Number of Locations	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23									
3	_2_HybridArea	1	0	0	0	0	0	0	1	1	1	1	2	1	1	1	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
4	_2_MRIArea	1	0	0	0	0	0	0	1	2	2	2	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
5	_2_ORArea	7	0	0	0	0	0	0	3	7	7	7	7	4	2	3	3	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
6	_2_PerioPBaysArea_E	5	5	5	5	5	5	5	6	5	5	4	5	2	1	0	2	2	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
7	_2_PerioPBaysArea_W	12	12	12	12	12	12	12	17	5	7	7	3	2	1	2	3	2	1	2	2	2	2	2	2	4	4	4	4	5	7	2	3	2	1	3	4	2	1	2	2	2	2	2	4	4	4	4	5	6									
8	_2_WaitingArea	57	40	23	23	27	27	27	38	37	40	33	23	31	25	22	21	18	15	19	15	12	12	13	13	9	9	9	13	13	11	11	15	22	19	17	30	21	25	14	20	17	17	13	7	9	8	6	2	2	6	4							
9	_3_NIBSBaysArea	39	0	0	0	0	0	0	2	3	11	19	23	26	34	38	37	38	37	37	38	37	37	38	37	37	38	38	38	30	26	24	17	13	15	27	27	32	33	35	33	34	37	34	32	32	31	28	28	26	24	1							
10	_4_Adult_PerioPBaysArea	12	12	12	12	14	13	14	12	6	10	9	12	7	13	13	12	10	8	9	7	6	7	9	10	11	11	13	13	12	12	12	15	8	11	12	11	9	8	5	7	7	5	4	6	7	6	5	6	5	6	7							
11	_4_Adult_WaitingArea	28	46	37	37	37	33	29	30	30	44	40	42	31	42	29	30	25	21	21	10	11	14	12	5	5	9	20	9	3	7	24	21	33	36	37	29	20	21	26	24	22	18	21	16	10	7	3	0	0	4								
12	_4_EPLabArea	4	0	0	0	0	0	0	4	4	5	4	4	5	4	5	4	4	3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
13	_4_ORArea	3	0	0	0	0	0	0	3	3	5	3	3	2	1	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
14	_4_Peds_PerioPBaysArea_E	5	5	5	5	6	5	5	7	6	8	7	5	6	6	4	3	2	4	5	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
15	_4_Peds_PerioPBaysArea_W	10	10	10	10	10	10	10	15	9	9	10	9	5	5	5	2	0	2	1	2	2	3	4	6	6	6	8	8	9	5	3	3	2	1	0	1	1	1	2	1	0	1	1	2	3	4	5	7	8	8	1							
16	_4_Peds_WaitingArea	49	39	35	35	31	35	35	60	49	48	51	50	44	44	34	21	19	16	15	9	6	10	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
17	_4_PedsORArea	3	0	0	0	0	0	0	1	3	3	2	2	1	0	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
18	_4_ProcedureRoomArea	2	0	0	0	0	0	0	2	3	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19	_4_TEEArea	2	0	0	0	0	0	0	2	2	2	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
20	_5_CathLabArea	5	0	0	0	0	0	0	5	5	6	5	7	5	6	3	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
21	_5_ORArea	5	0	0	0	0	0	0	5	5	6	5	6	5	3	3	2	2	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	_5_PerioPBaysArea_E	14	13	13	14	14	14	14	19	6	7	11	11	10	9	7	8	5	3	5	4	2	4	3	3	5	6	8	9	14	14	17	4	7	8	6	4	5	2	1	2	5	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
23	_5_PerioPBaysArea_W	13	13	13	13	13	13	13	15	10	13	9	8	5	4	5	3	2	6	9	10	11	13	13	13	13	13	13	13	13	13	13	13	13	13	14	8	8	3	8	7	4	4	3	4	4	5	9	9	11	11	13	13	13	13	1			
24	_5_VasoORArea	2	0	0	0	0	0	0	2	2	3	2	2	2	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
25	_5_WaitingArea	86	79	14	14	16	18	18	22	66	58	83	85	87	76	79	62	40	26	50	29	24	26	7	13	10	6	16	15	14	4	8	59	52	86	98	93	58	55	41	39	32	34	25	21	23	8	6	12	14	12	0	6	2					
26	_6_EndoArea	2	0	0	0	0	0	0	2	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
27	_6_ORArea	12	0	0	0	0	0	0	0	12	12	16	13	13	10	6	4	4	5	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
28	_6_PerioPBaysArea_N	27	0	0	0	0	0	0	0	6	11	14	14	12	9	5	2	3	3	4	4	4	3	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	_6_PerioPBaysArea_S	6	1	1	1	1	2	2	2	3	3	1	1	1	0	0	1	1	1	0	0	1	1	1	0	1	1	1	1	2	2	2	2	3	2	1	1	0	0	1	1	1	0	0	1	1	1	0	0	1	1	1	1	2	2	2	2	0	
30																																																											
31																																																											

Figure 7: Output showing area occupancy by hour.

however, they were still able to be processed within the same year. These areas included the Cath Lab, Endoscopy areas and the ORs designated for adults on the second, fourth, and fifth floors. There may be a need for an additional MRI machine eventually as the model showed that there were patients delayed waiting for the MRI machine.