Campus Configuration and Building Approach Design on Patient Arrival and Spatial Navigation at Large Hospitals | Explorative Study, Methods, and Validation

Group Presentations: Practitioner/Researcher Collaborations at EDRA 54 Mexico City | June 21, 2023

PRESENTERS

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ACKNOWLEDGEMENT

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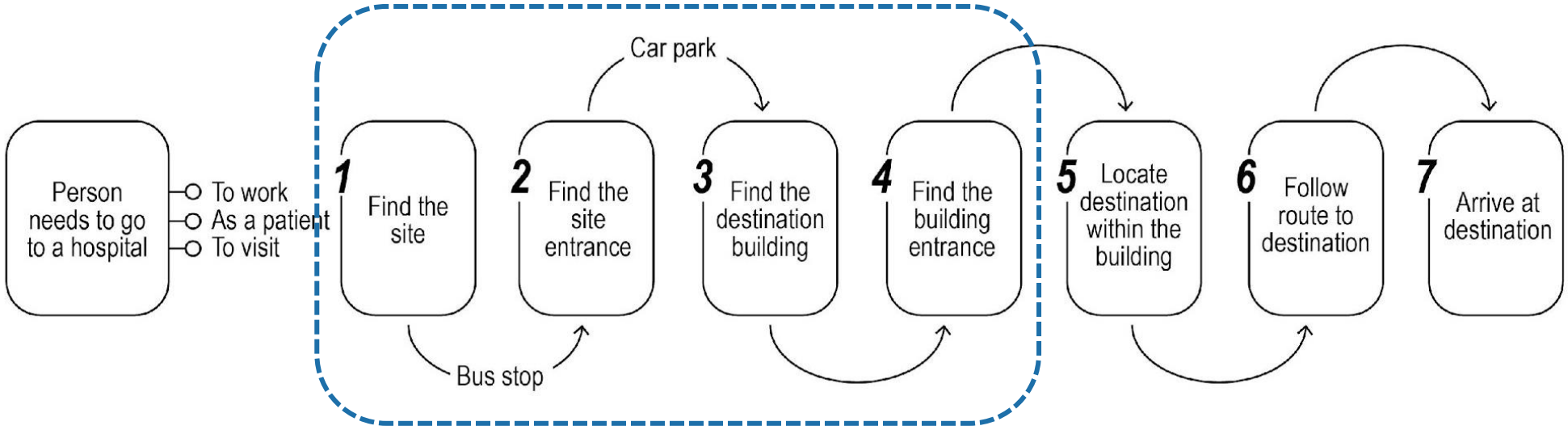
1. Part 1: Exploring the Impacts of Spatial Configuration and Signage System on Medical Campus Wayfinding using Space Syntax
2. Part 2: Behavior Mapping Methods for Building Arrival and Transitional Spaces
3. Part 3: Case Study and Method Validation at UC Medical Center Campus
4. Discussion, Q&A

AGENDA

Research has shown that wayfinding difficulties are often pervasive, beginning outside the building with the search for the correct parking areas a continuing through to the search for the correct room (Shumaker & Reizenstein, 1982).

PATIENT ARRIVAL JOURNEY

Typical wayfinding process at healthcare facilities
adapted from Miller & Lewis (2000, p.130)



STUDY PURPOSES

For both vehicle and pedestrian traffics:

- Filling a research gap by examining campus configurations regarding hospital wayfinding using space syntax techniques;
- Establish a protocol to use observational and behavior mapping methods in the building arrival zone, including the outside-inside transitional spaces;
- Using behavior data to validate the space syntax techniques for vehicle and pedestrian traffic analysis regarding campus level wayfinding and spatial navigation at large hospitals.

PART 1.

Exploring the Impacts of Spatial Configuration and Signage System on Medical Campus Wayfinding using Space Syntax

PROBLEM STATEMENT

- Challenge in wayfinding for **large healthcare campuses** having complex environment with several buildings
- **Medical centers within educational campuses** pose further complexity due to mixture of buildings, larger scale of the campus and the scattered availability of various resources
- Various types of **users**
- Study on **outdoor hospital campus** is limited

RESEARCH OBJECTIVES

- To evaluate the effectiveness of the wayfinding system in the outdoors for academic medical campuses.
- The study compares four academic medical campuses in respect to their wayfinding contents.
- The wayfinding is evaluated based on:
    1) spatial configurations of campus street network
    2) signage system

CONCEPTS

Spatial Configuration

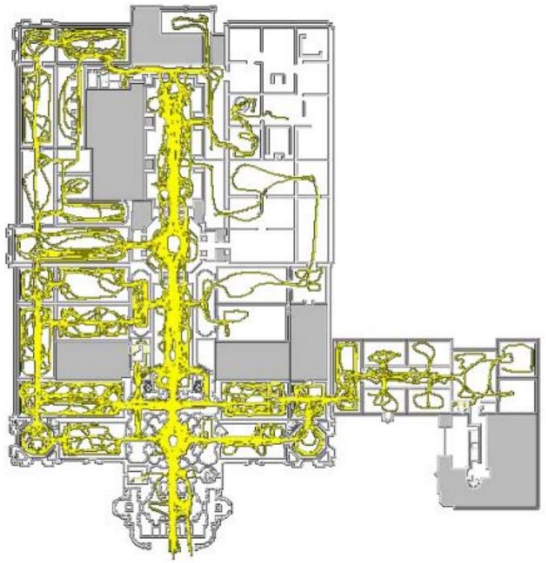
- Intelligibility
- Integration
- Connectivity
- Step Depth

Signage System

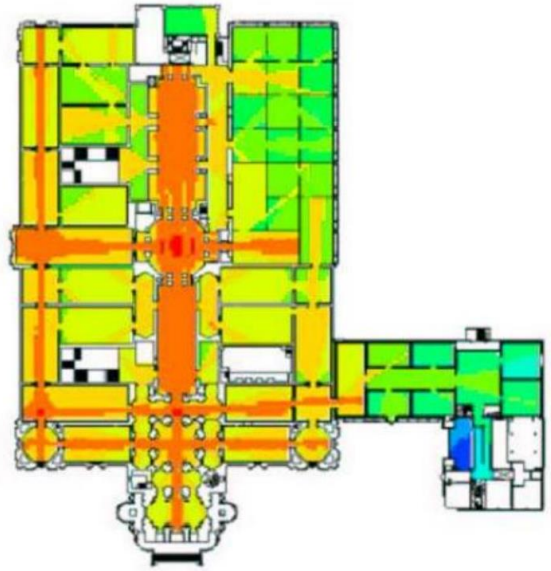
- Arrival points
- Decision points
- Confirmation points

SPACE SYNTAX

- Space syntax analyzes spaces as networks of choices; it also forecasts the likely effects of spatial configuration on user behaviors
- Highly visible and integrated spaces are livelier and frequented by more people; segregated spaces have lesser frequentation



Movement traces of visitors in first 10 minutes of the visit at Tate Britain (Hillier et al., 1996)



Visibility analysis of Tate Britain using Space Syntax techniques (Source: Space Syntax Ltd)

Space syntax provides a set of theories and techniques that explain the different hierarchies of physical spaces (Bafna, 2003).

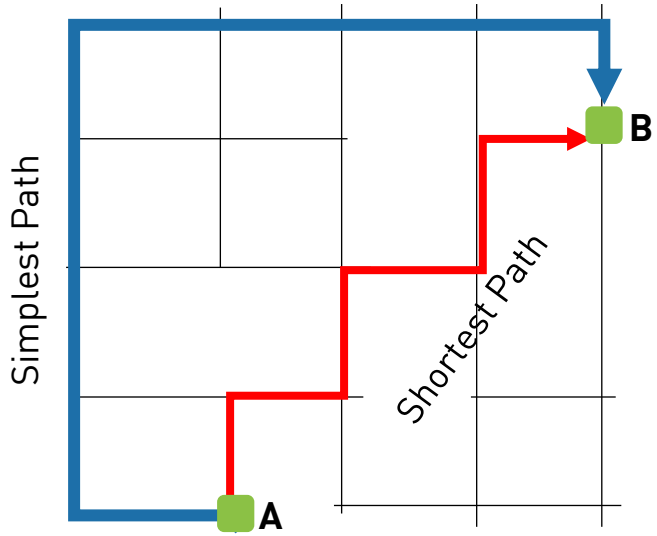
- ***Integration.*** Counts the number of steps for going from one line to another thus categorize street networks based on accessibility and connectivity.
- ***Connectivity.*** Measures the number of points that are directly connected to a specific point (Geng et al., 2020) and is used as a local measure.
- ***Step Depth.*** Counting the number of intervening spaces between two spaces. The more the depth, the more the hierarchy. In a street network, the number of turns is considered step depth.
- ***Intelligibility.*** Correlation between Integration (global) and connectivity

Space syntax has been effectively used in evaluating spatial configurations in many hospitals, educational campuses, and historic and modern cities (Geng et al., 2020; Hajrasouliha, 2017; Navastara et al., 2018; Zhang et al., 2020).

SPACE SYNTAX CONCEPTS

Spatial Configuration

- **Spatial configuration** is defined as the way the relationship between any two spaces is altered by their connection to a third space (Hillier, 1996)
- Measures accessibility of all points from all other points
- Measures accessibility from simplest path point of view
- Considers minimum turns



Shortest vs. Simplest path, adapted from Berhie & Haq (2017)

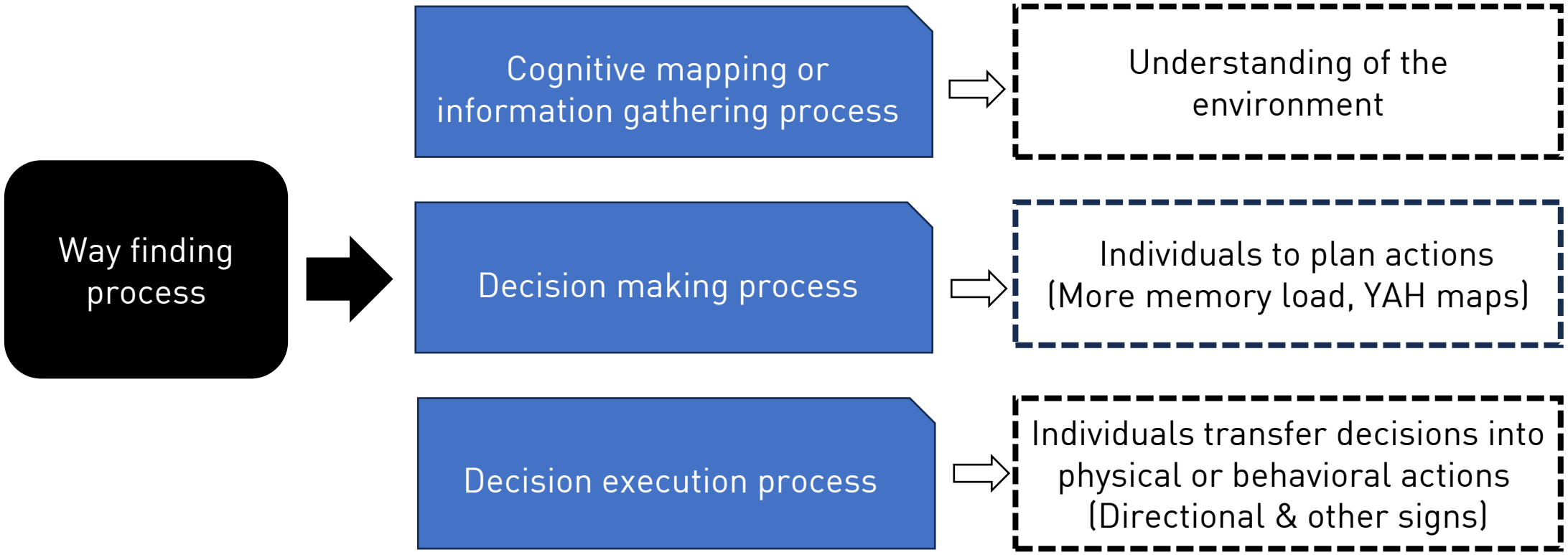
Signage System

- Effectiveness of wayfinding system includes **stop**, **search**, **decide**, and **legibility** as behavioral qualities with stop quality most commonly used.
- Stop behaviors linked with **availability of appropriate signages & landmarks** at decision points or complexity of the spatial configurations (Haq & Zimring, 2003).

Signage System

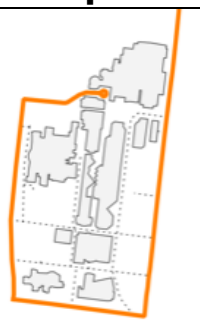
- Fundamental aspects of a building's configuration such as **decision points, directional changes** and distances as relevant predictors of wayfinding effectiveness in complex buildings (Best,1970).
- **Parking lots** are to be well equipped with enough wayfinding elements because those are the first point of contact for a visitor (Ulrich & Quan, n.d.).
- **Outdoor route strategy** focusses on which route to take based on instructions on directions, the **outdoor survey strategy** influences the navigator's orientation in the environment (Lawton, 1996;Weisman 1979).
- Few studies explained survey strategy to be more effective for its **cognitive influence**.
- Few other studies highlighted that outdoor survey strategy with easily perceived structures are **effective in guiding** but falls short in route information processing.

Signage System



(Chen, 1999)

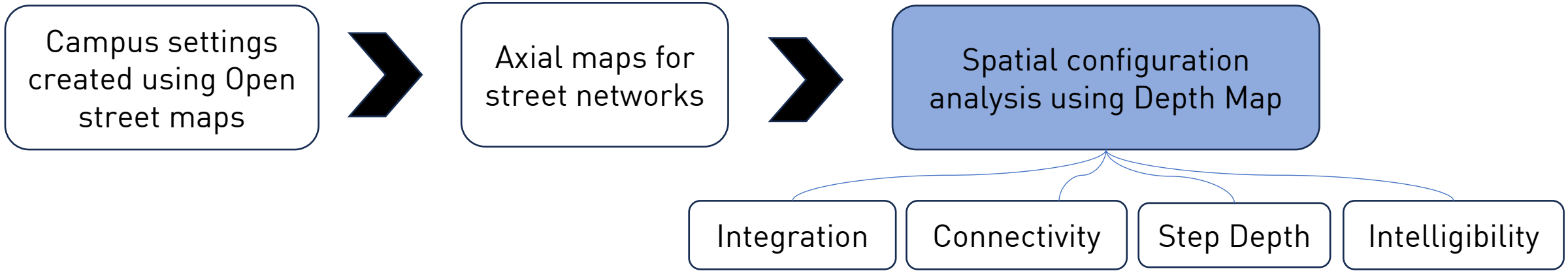
DESCRIPTION OF THE SETTINGS

SM1	SM2	SM3	SM4
Dispersed	**Building focus**	**Axis focus**	**Dispersed**
			
No clear organization but smaller patch of buildings	Single focal building	Important buildings are arranged along a single axis	No clear organization, but the larger patch of buildings
Number of streets are more due to smaller and dispersed buildings	Streets surround the focal building from all sides,multiple entry points	Single axis connected to major buildings, limited entry points	Intermediate streets are minimized due to larger footprint of buildings

Name of Setting	Size of Campus	Number of Beds	Number of Buildings	Specialties	Type of Hospital
SM1	38 Acres	414	10	Hospital Neuroscience Cancer hospital Outpatient pavilions	Urban
SM2	68 Acres	1154	13	Hospital Public health School of medicine Cancer hospital Eye hospital Outpatient Surgical pavilion	Urban
SM3	46.5 Acres	645	09	Hospital Medical research Bio medical engineering Cancer hospital Medical center Eye hospital	Urban
SM4	71 Acres	1000	12	Medical center Clinic Children hospital Rehabilitation hospital Psychiatric hospital	Urban

METHODOLOGY

Spatial Configuration



METHODOLOGY

Signage System

Classification of signage system

Identification and mapping of signages based on classification system

Signage system quantification

- Arrival points
- Decisions points
- Confirmation points

Tool

RESULTS

Spatial Configuration

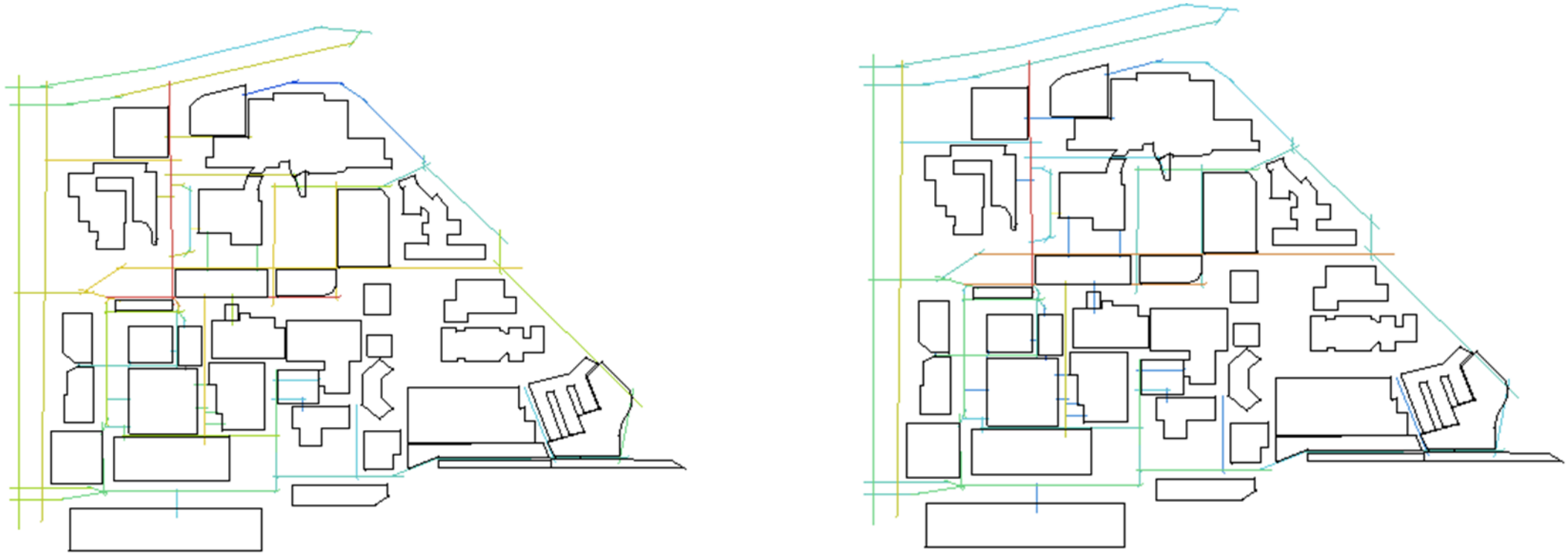


Figure 1. a. Integration (Rn) b. Connectivity (Cn) for SM1

Spatial Configuration

Figure 2. a. Integration (Rn) b. Connectivity (Cn) for SM2

Spatial Configuration

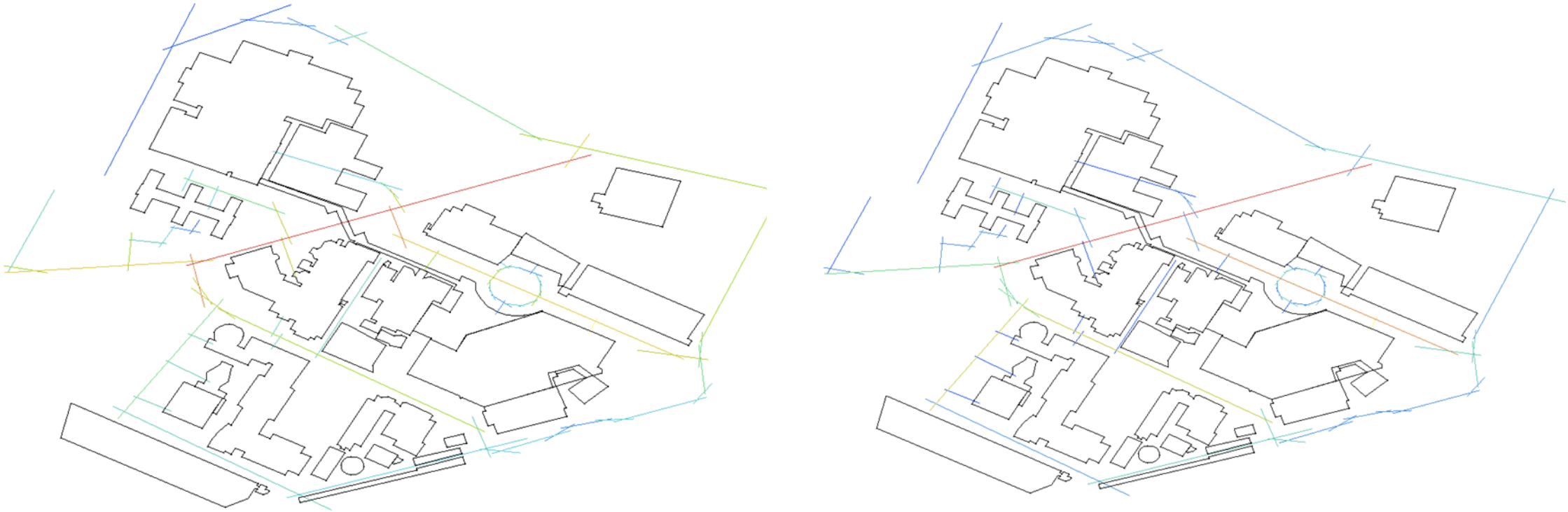


Figure 3. a. Integration (Rn) b. Connectivity (Cn) for SM3

Spatial Configuration

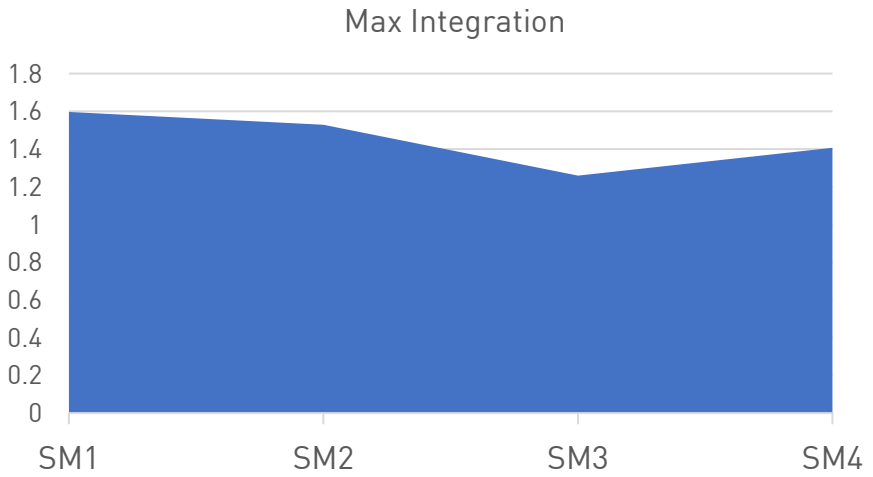
Figure 4. a. Integration (Rn) b. Connectivity (Cn) for SM4

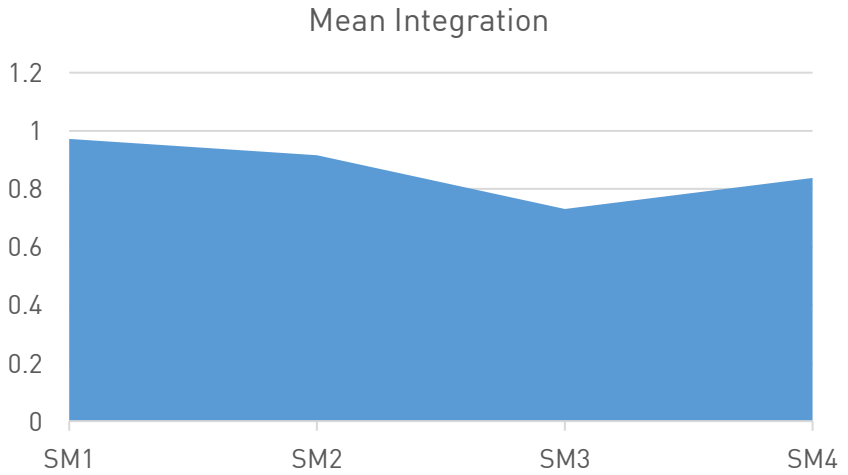
Environmental variables	**SM1**	**SM2**	**SM3**	**SM4**
Intelligibility (r)	0.575	0.638	0.556	0.452
Maximum integration	1.596	1.528	1.259	1.407
Mean integration	0.972	0.916	0.731	0.838
Maximum connectivity	10	14	7	10
Mean connectivity	2.697	3.008	2.228	2.571
Step depth for emergency entrance (max)	12	13	11	11
Step depth for emergency entrance (mean)	7.105	6.97	5.3	4.857
Step depth for hospital main entrance (max)	9	13	15	11
Step depth for hospital main entrance (mean)	5	6.97	8.528	4.857

DISCUSSIONS

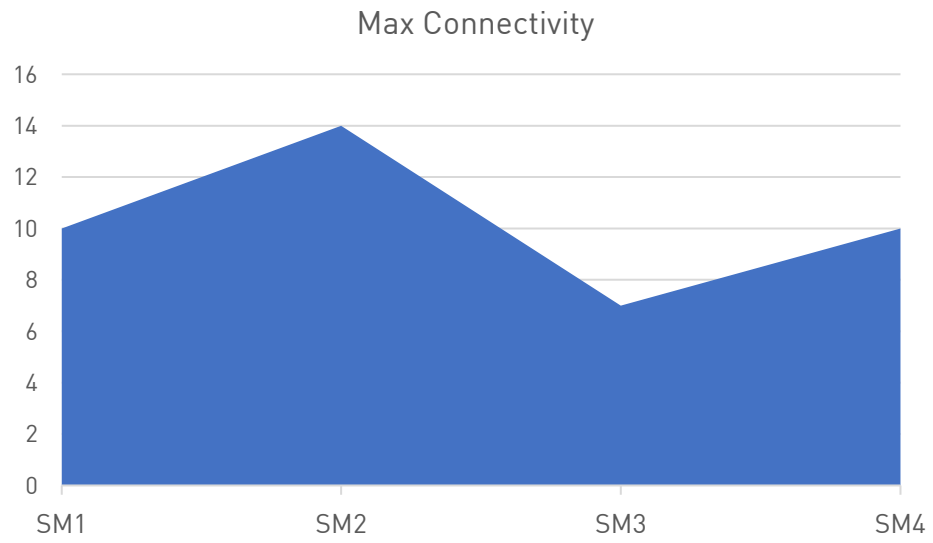
Spatial Configuration

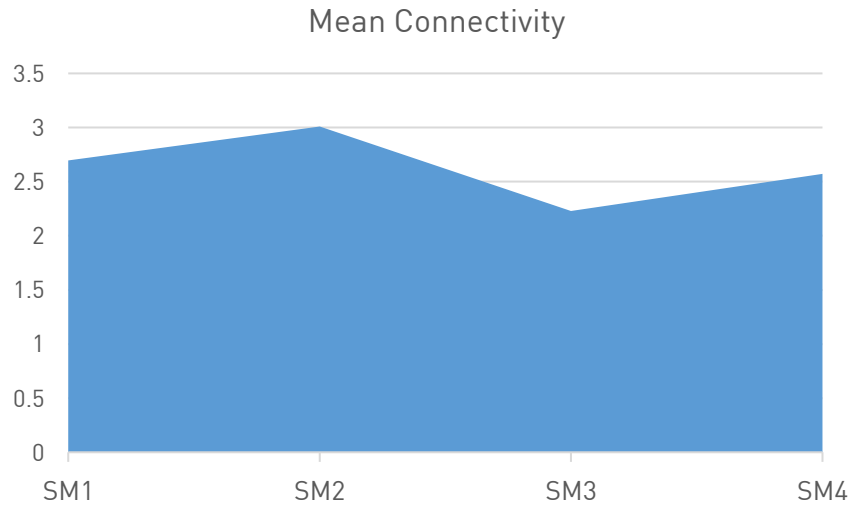
- SM1 and SM4 have dispersed campus. Longer footprints make SM4 less accessible (Mean Integration 0.972 vs. 0.838)
- SM1 has the highest max and mean integration indicating each segment is well integrated to the whole system.
- SM3 has axis focus configuration, important buildings are accessed through the main spine, but limited entry points give rise to low integration value (Rn=0.731)



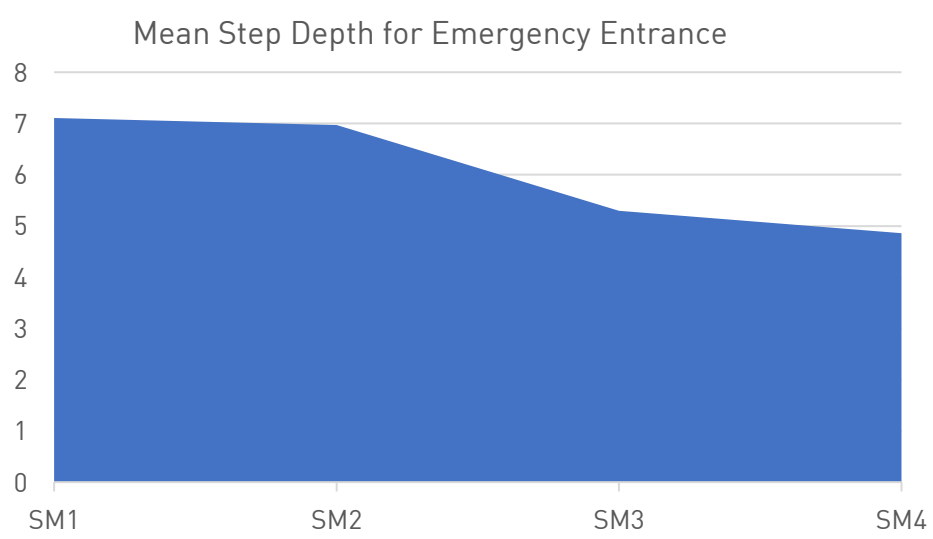


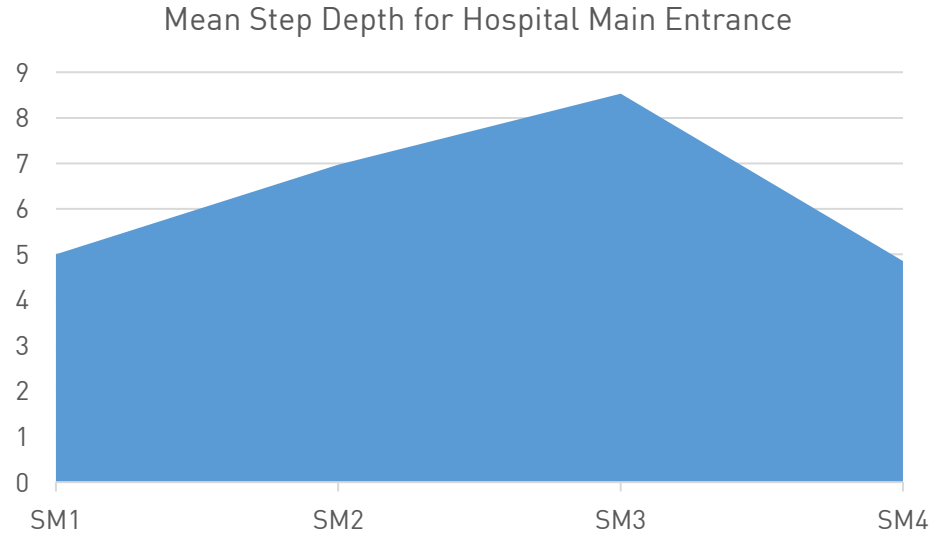
- Connectivity indicates direct connections of each street with other streets in the vicinity and counts the number of connections each street has to the adjacent streets. (Van Nes & Yamu, 2021)
- Connectivity value is highest for SM2 followed by SM1 and SM4.



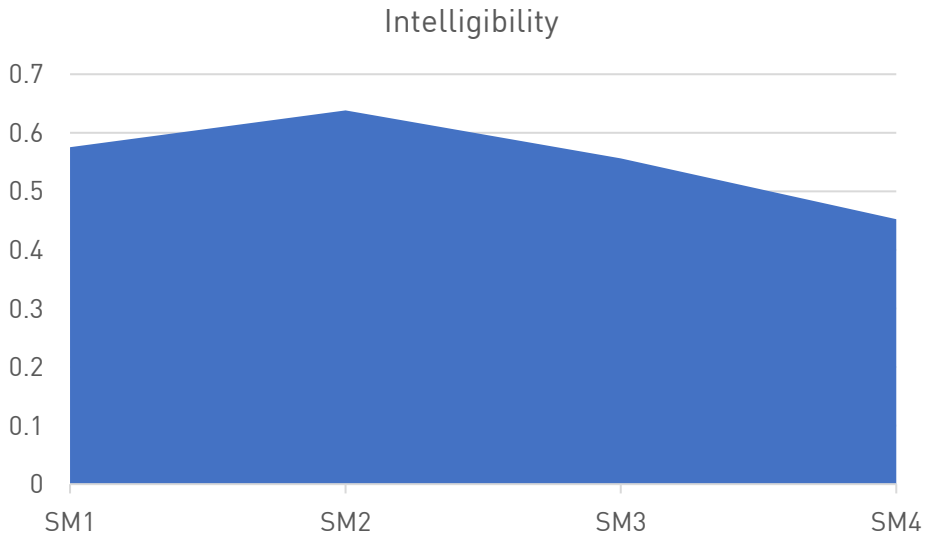


- Step depth (mean) for SM1 is the highest (7.105) which means more steps required to reach the emergency entrance.
- Step depth for hospital main entrance is comparatively lower (5).
- Step depth (mean) for SM4 is the lowest (4.857) for both emergency and hospital main entrance.





- Intelligibility for SM2 is the highest (0.638) which shows that its parts are well correlated with the whole system
- Well accessed from different parts of the campus because of more axial lines (113)
- SM4 has the lowest intelligibility because of the longer footprints of buildings (70 axial lines)



CONCLUSION

Spatial Configuration

- Overall, building focus configuration showed good integration and connectivity
- Axis focus configuration decreased the mean integration

SIGNAGE CLASSIFICATION SYSTEM

- **Category 1.** Navigation systems which supports final confirmation (e.g. destination signages)
- **Category 2.** Navigation systems which supports orientation at intermediate points to some extent and confirmation (e.g. building identification signage)
- **Category 3.** Navigation systems which supports orientation at choice points only but of lesser importance (e.g. street names)

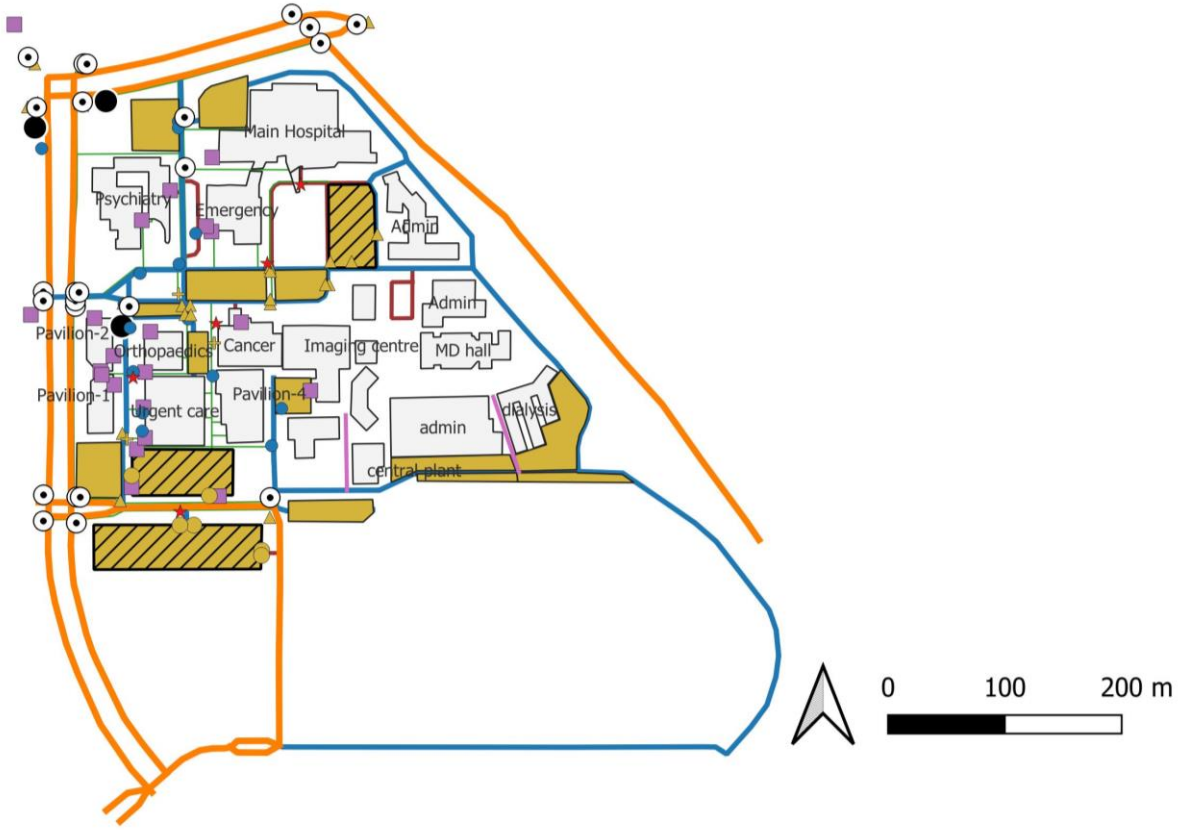
SIGNAGE CLASSIFICATION SYSTEM

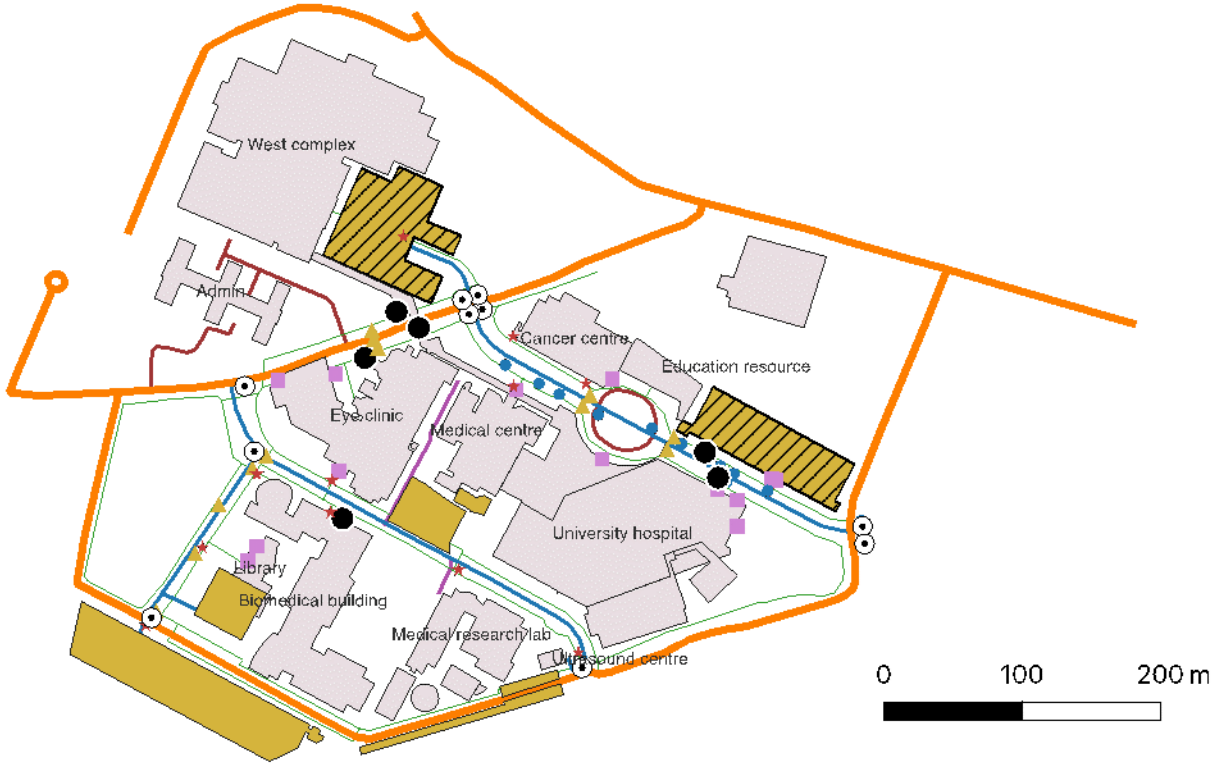
- **Category 4.** Navigational systems for orientation and individual's current location but less guided and more self exploratory (e.g. YAH maps)

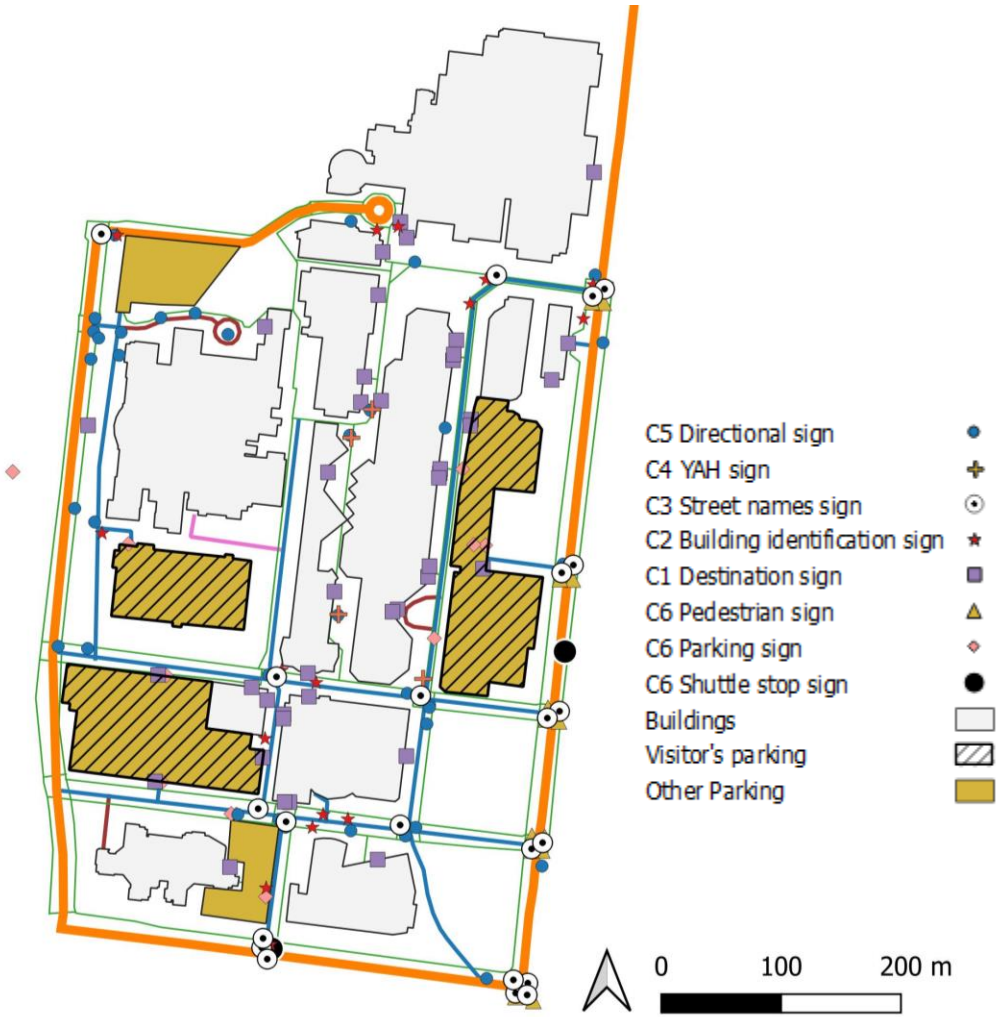
- **Category 5.** Guided navigational systems for orientation and individual's current location (e.g. Directional signages)

- **Category 6.** Ancillary navigation systems which are important but does not contribute to wayfinding (e.g. Information signages)

SIGNAGE SYSTEM ANALYSIS




West complex
Admin
Cancer centre
Education resource
Eye clinic
Medical centre
University hospital
Library
Biomedical building
Medical research lab
Ultrasound centre
0
100
200 m

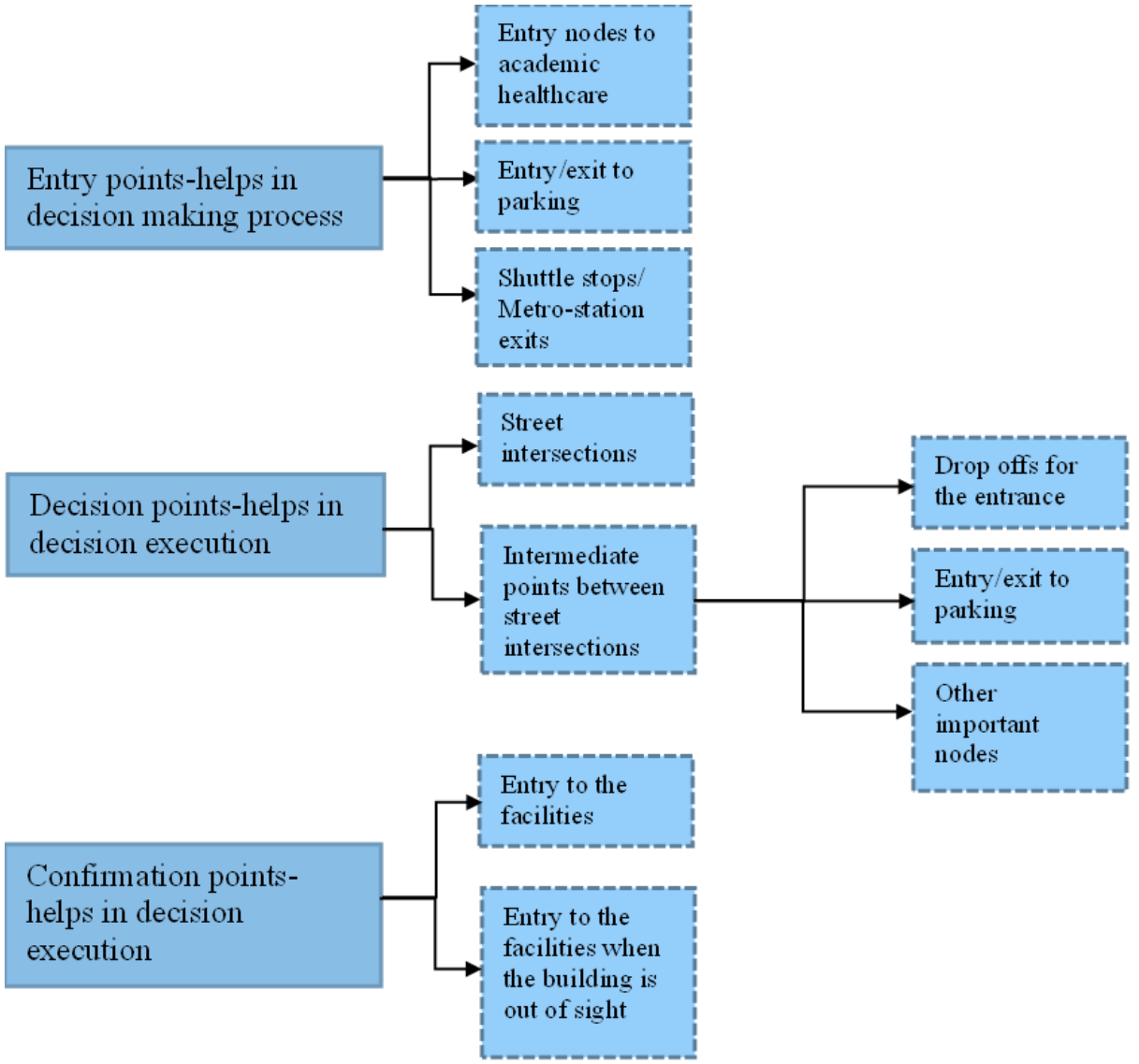

C5 Directional sign
C4 YAH sign
C3 Street names sign
C2 Building identification sign
C1 Destination sign
C6 Pedestrian sign
C6 Parking sign
C6 Shuttle stop sign
Buildings
Visitor's parking
Other Parking
0
100
200 m

FRAMEWORK

Signage System

Wayfinding effectiveness is assessed from three main aspects:

- effectiveness of decision-making process at arrival points,
- effectiveness of decision execution process at all decision points
- effectiveness of decision execution process at all confirmation points.



RESULTS

Signage System

Campus settings	Total number of entry points to the campus	Number of Parking entry/exit	Number of Shuttle stops/metro station exits	Group average for C4 signages	F-value for C4 signage	P-value for C4 signage
SM1	05	03	02	0.36	0.627	0.600
SM2	09	02	08	0.1		
SM3	05	02	03	0		
SM4	10	03	02	0.25		

Campus settings	Total number of intersections	Total number of C5 signages	Group average of C5 signages at intersections	Group average of C5 signages at intermediate points	P-value for C5 signages at intersections	P-value for C5 signages at intermediate points
SM1	22	17	0.590	0.666	**0.065***	0.204
SM2	14	28	0.857	2.666		
SM3	06	16	0.833	2.2		
SM4	16	41	1.562	1.142		

CONCLUSION

Signage System

- The settings have limited number of C4 category maps which explains that decision making process at arrival points was given least priority in healthcare campuses.
- SM1 in spite of having a dispersed configuration and having the highest number of intersections has the lowest group average for signages at both intersections and intermediate points.
- Setting SM4 seem to have maximum number of guided navigation aids or directional signages followed by SM2.
- Longer buildings such as SM4 limits the number of street intersections in comparison to SM1 which has smaller footprints; but require more C1 and C2 signages for better identification of the entry points to the buildings.

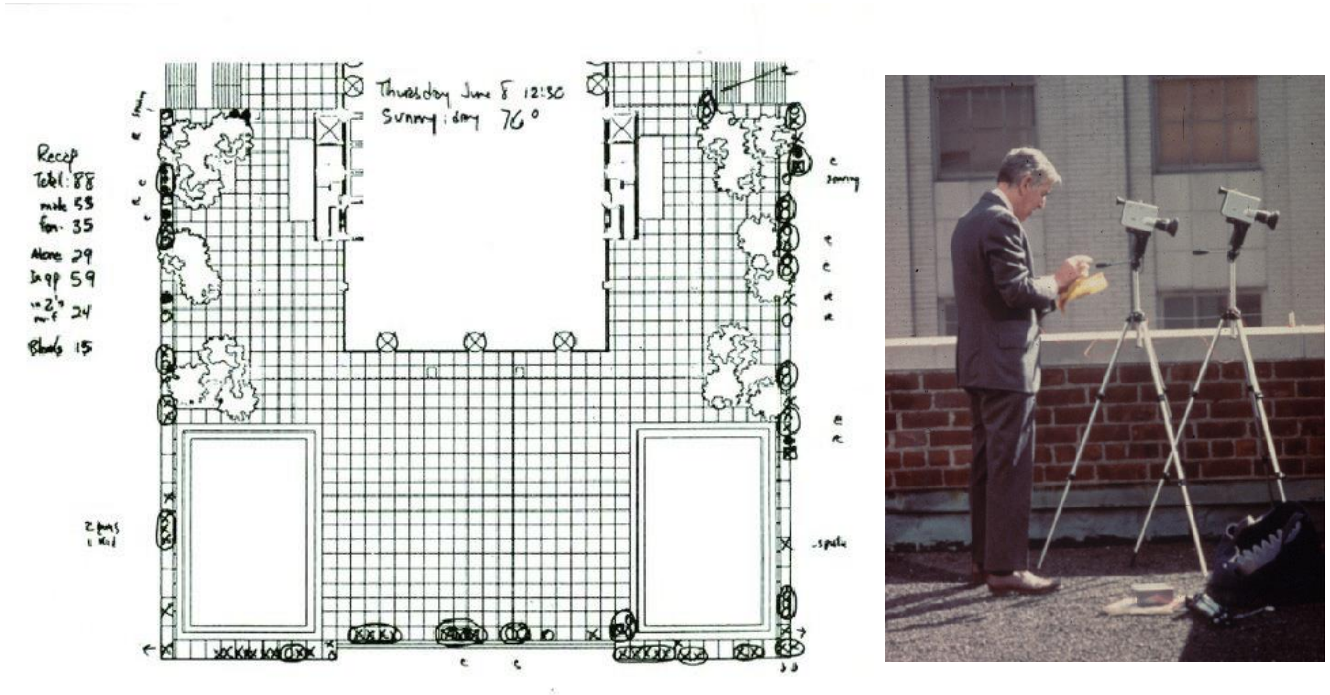
PART 2.

Behavior Mapping Methods for Building Arrival and Transitional Spaces

- How to conduct observation and behavior mapping studies at building arrival zone that involve complicated variables, both vehicles and people, inside and outside, and in transitional spaces?
- What data collection techniques are appropriate and efficient for chaotic but privacy-sensitive settings such as large hospitals?

BEHAVIOR MAPPING

- Systematically observe and record behavior patterns in a particular environment or setting
- Aims to gain insights into how people behave in different situations, and to identify factors that influence their behavior
- Involves observing and recording a variety of behaviors, such as verbal and nonverbal communication, movement, interactions with others, and environmental factors that may influence behavior

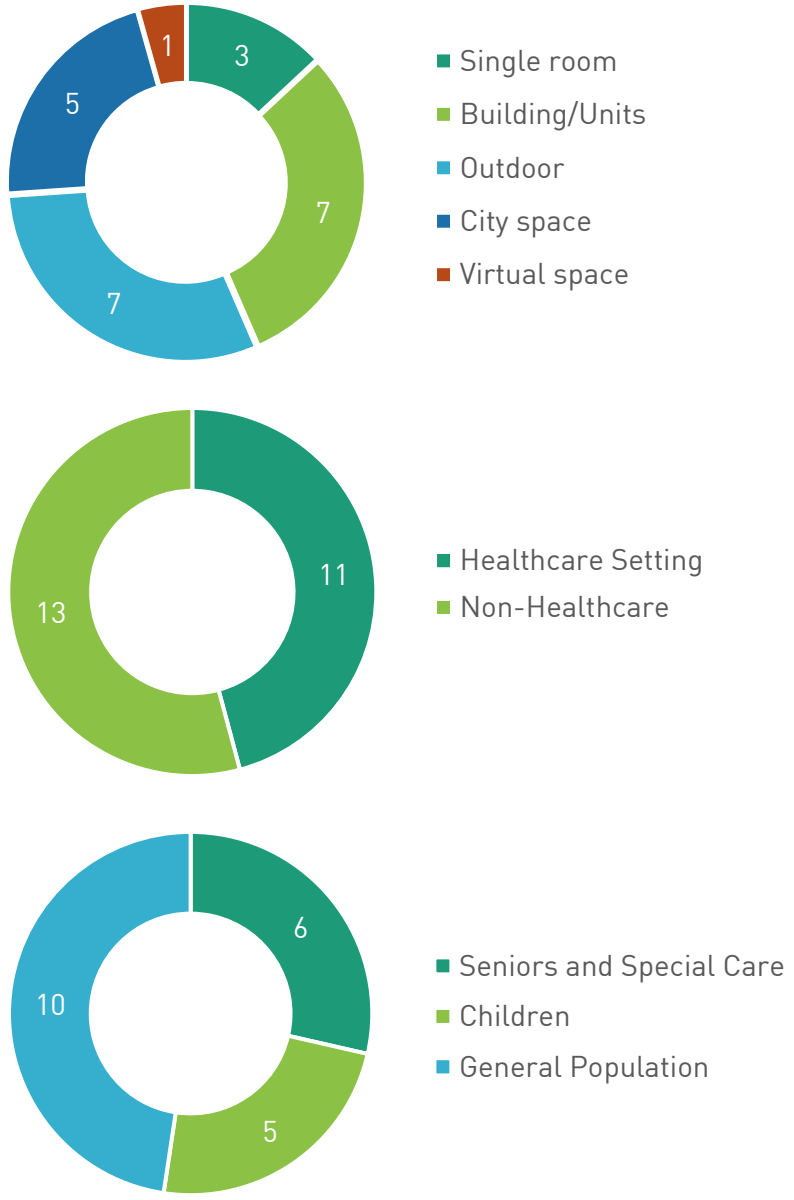


William H. Whyte's investigation of the public plazas in Manhattan using time lapse cameras, head counts, and behavior mapping (Whyte 1961).

INSTRUMENT REVIEW

Quick Facts

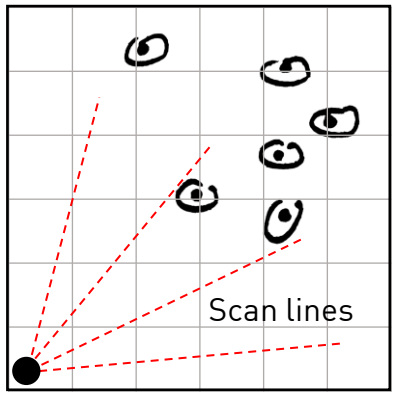
- A total of **24** peer-reviewed articles using various types of behavior mapping methods
- **5** scopes of spaces: single room, building/units, outdoor space near the building, city space/parks, and virtual space
- **11** empirical studies about healthcare studies and **13** on other topics
- **6** studies about the seniors or occupants who need special care, **5** studies about young children, and **11** about the general population
- **1** methodology paper, 1 literature review about general behavior mapping studies, and 1 literature review about behavior mapping in healthcare studies



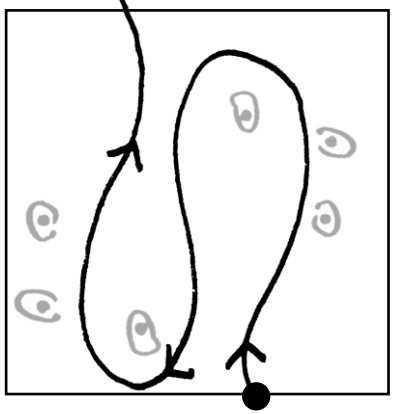
Data Collection Strategies

Zone 1	Zone 2	...
		Zone N

Dividing a Large Site to Multiple Observation Zones

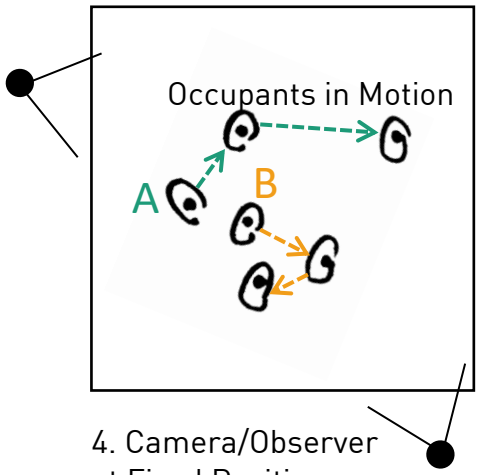


1. Observer at Fixed Position
Scanning/Snapshot

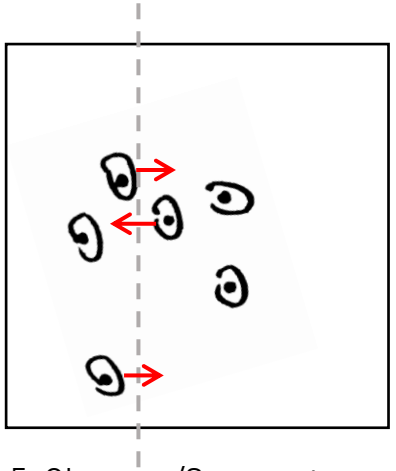


2. Observer in Motion
Scanning/Snapshot

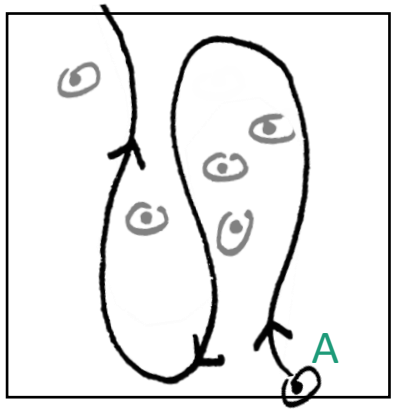
3. Observer in Motion
No Occupant Involved
Tracing



4. Camera/Observer at Fixed Positions
Shadowing



5. Observer/Sensor at Virtual Boundary
Head Count



6. Occupant tracking their own routes | **Self-Reported or Keeping a Diary**

Variables

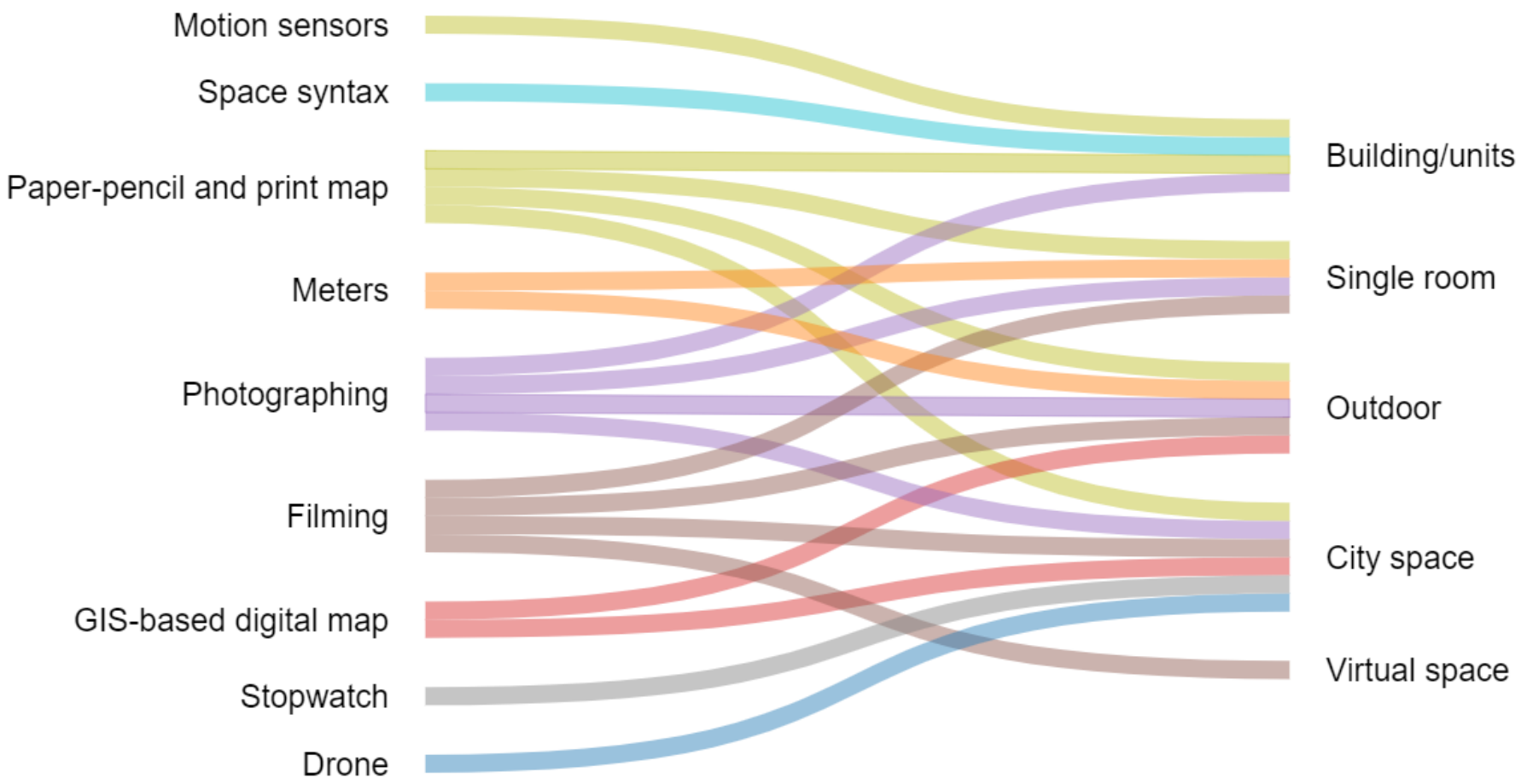
- Head count
- Occupant's profile and demographic info
- People conditions (patient situation)
- Behaviors/activities and intensity

- Location
- Interaction with environmental features
- Interaction with other people/socialization
- Time/duration in the space
- Movement and flow
  - Walking distance
  - Speed
  - Directions

- Weather condition
  - Sun/shade
  - Outdoor temperature
- Measurements of built environment factors
  - Acoustics
  - Lighting/illumination level
  - Temperature and humidity

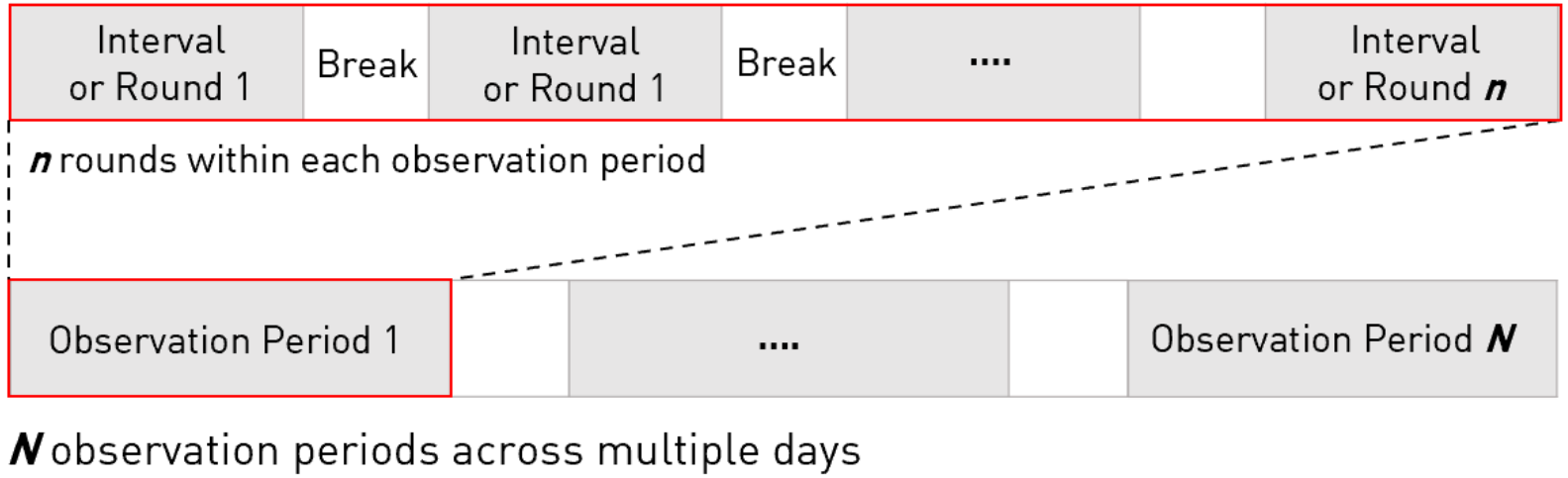
People-Centered | People-Environment Interactions | Space-Centered

Technique and Device



Data Collection, Timeframe, and Sample Size

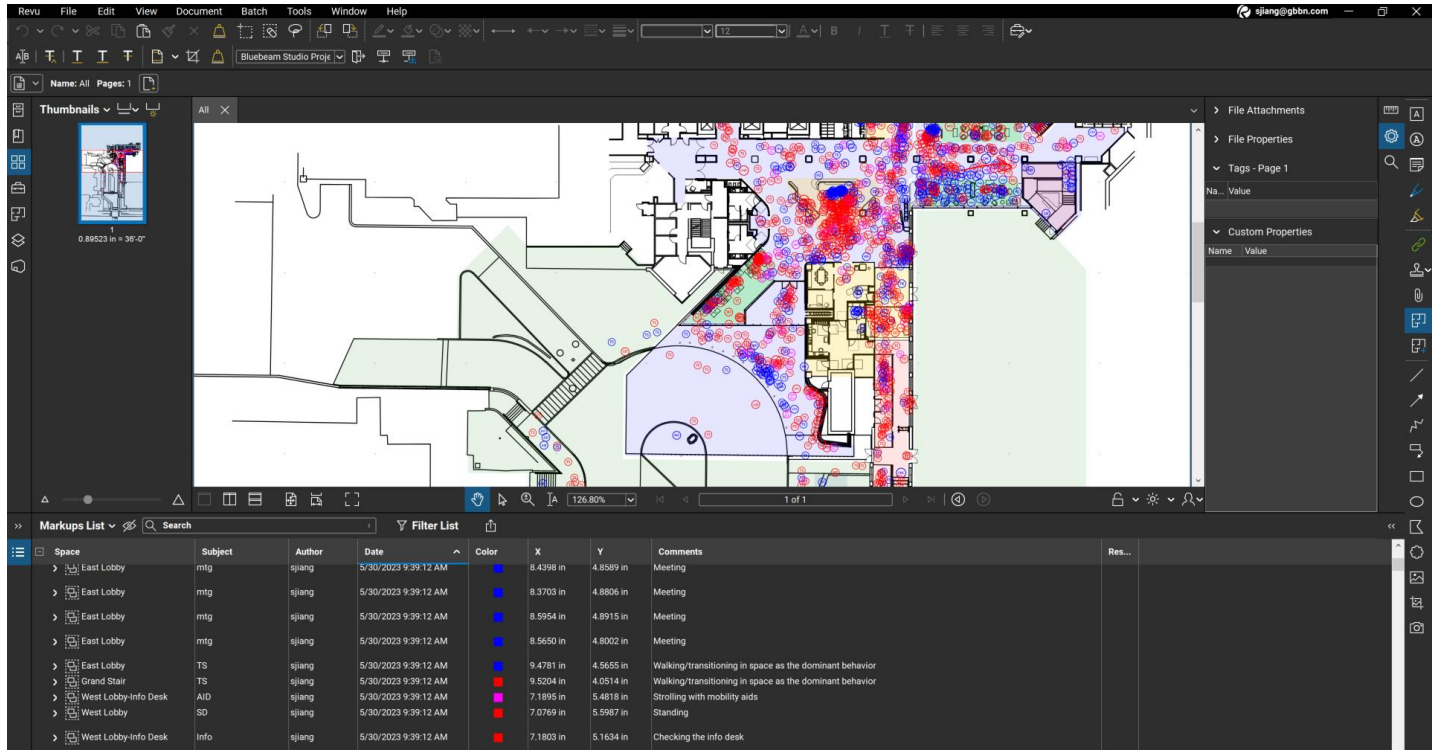
- ***n*** observation rounds in each observation period, typically 15-30 minutes per interval for scanning/snapshot; ***N*** observation periods per day
- Shadowing per occupant ranges from 10 seconds to 1 minute
- Data collection timeframe ranges from 2 days to multiple days across 10 weeks
- Sample size ranges from 16 (shadowing) to over 1000 observations



BEHAVIOR MAPPING PROTOCOL

For Building Arrival and Transitional Spaces

- **Two strategies:**
  - Snapshot/scan **pedestrians** on the ground level – headcounts, behaviors, distribution in space, etc.
  - Shadow **vehicles** from a vantage point – destination, route selection, behavior/activities
- **Tools**
  - Pedestrians: Paper-pencil or Digital
  - Vehicles: GIS Cloud



Bluebeam

BEHAVIOR MAPPING PROTOCOL

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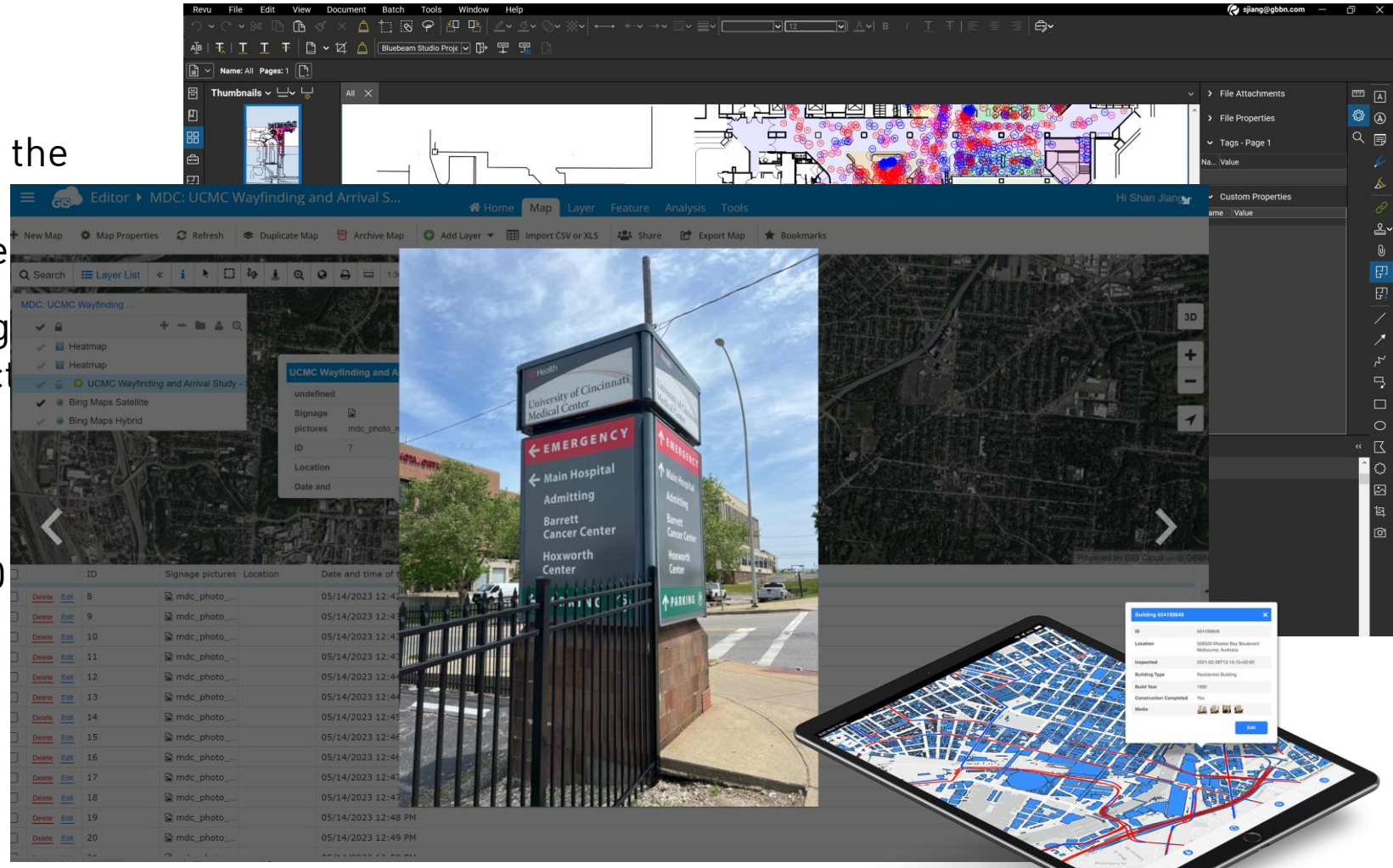
  - Pedestrians: Paper-pencil or D
  - Vehicles: GIS Cloud



GIS Cloud

PART 3.

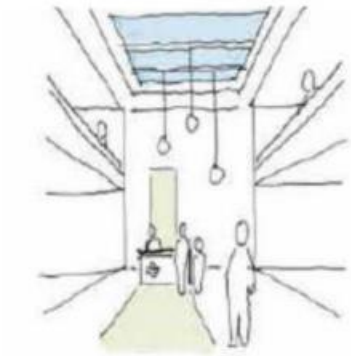
Case Study and Method Validation at UC Medical Center Campus

THE SITE

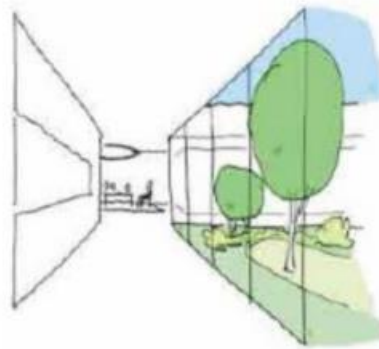
- **University of Cincinnati Medical Center (UCMC),** Cincinnati, OH 45219, USA
- UCMC offers a wide range of medical and surgical services, including emergency care, cancer care, heart and vascular services, neurology and neurosurgery, orthopedics, transplant services, and more.
- Level I trauma center and a regional referral center

FOUNDATIONAL PRINCIPLES

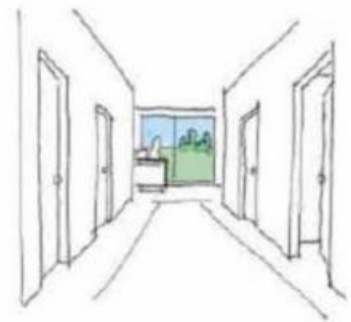
ARRIVAL



ORIENTATION



TRANSITION



DESTINATION

ARRIVAL PROJECT GOALS

1 Clarify sequence of arrival, orientation, and transition for visitors at multiple scales.

2 Create a cohesive, understandable, and useful central space that enhances the patient and visitor experience.

3 Create a mantle for the UCH brand that expresses the pride, aspirations, and quality of care of the institution.

DESIGN PRINCIPLES

Visual Hierarchy

Intentional Placemaking

Simplify and Declutter

Program Performance / Experience

Ease of Experience

Memorable Sense of Place

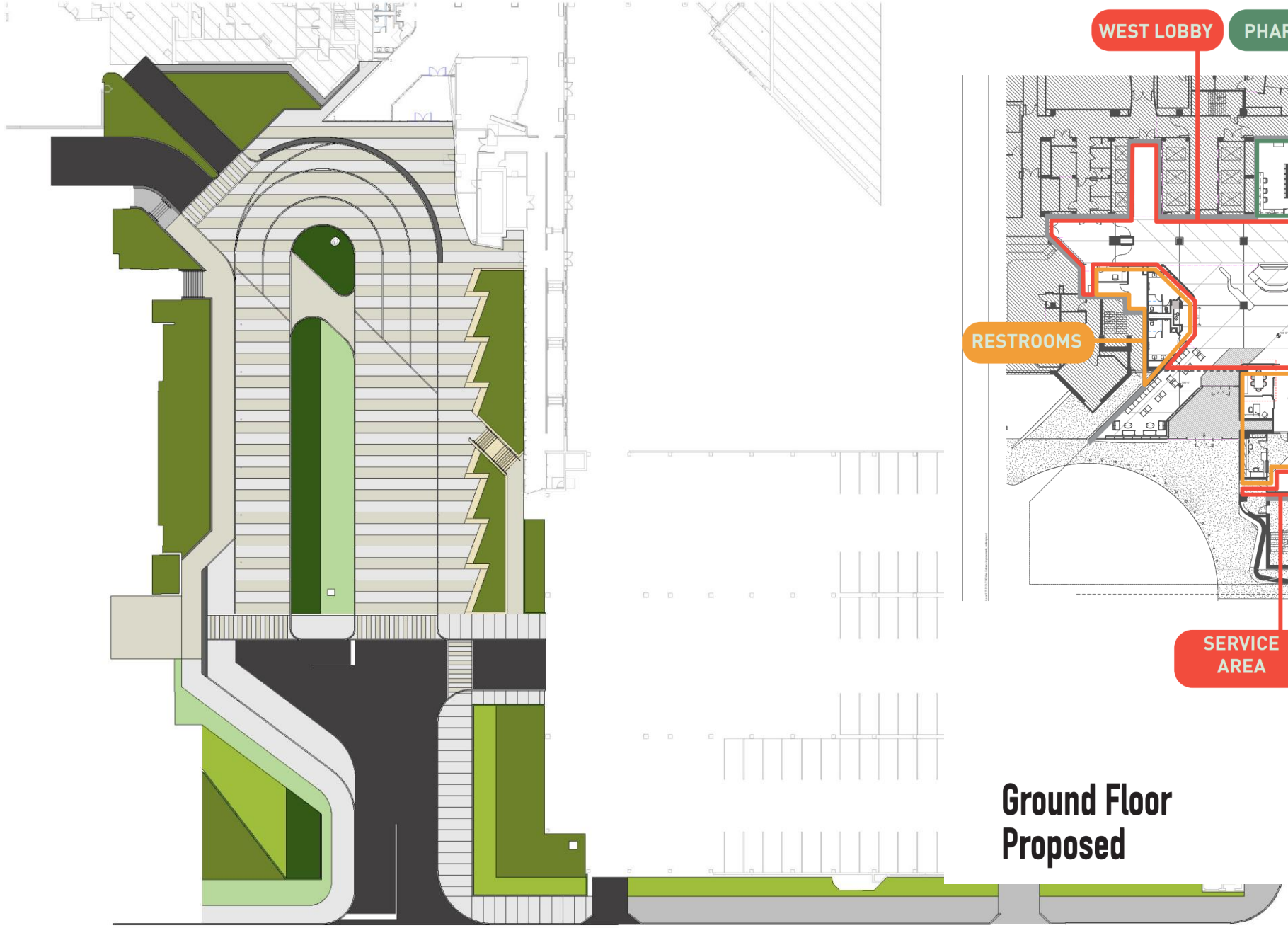
Health Giving Spaces

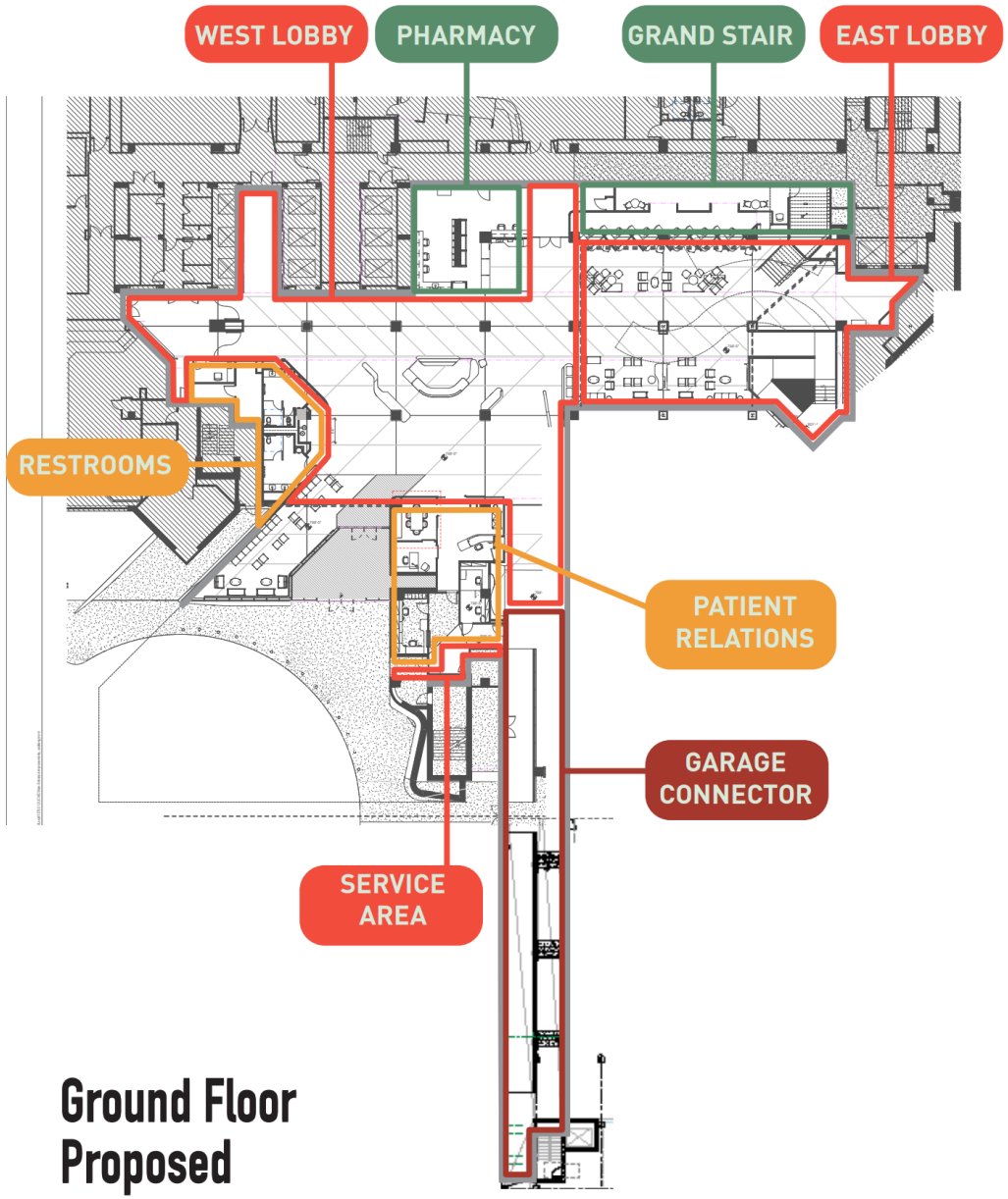
Convey Our Bold Story of Hope

Quality Space


Health
VALET
VALET
MARIE BROWN


UC Health
UC Health
UC MEDICAL CENTER
P
OPEN
BELLEVUE
GARAGE
3144
Bellevue Ave





Ground Floor Proposed


EXIT
Bellevue Garage
USPS Drop Box
Parking Validation
Cashier


INFORMATION


UC MEDICAL CENTER


UCHealth


Health
BEFORE

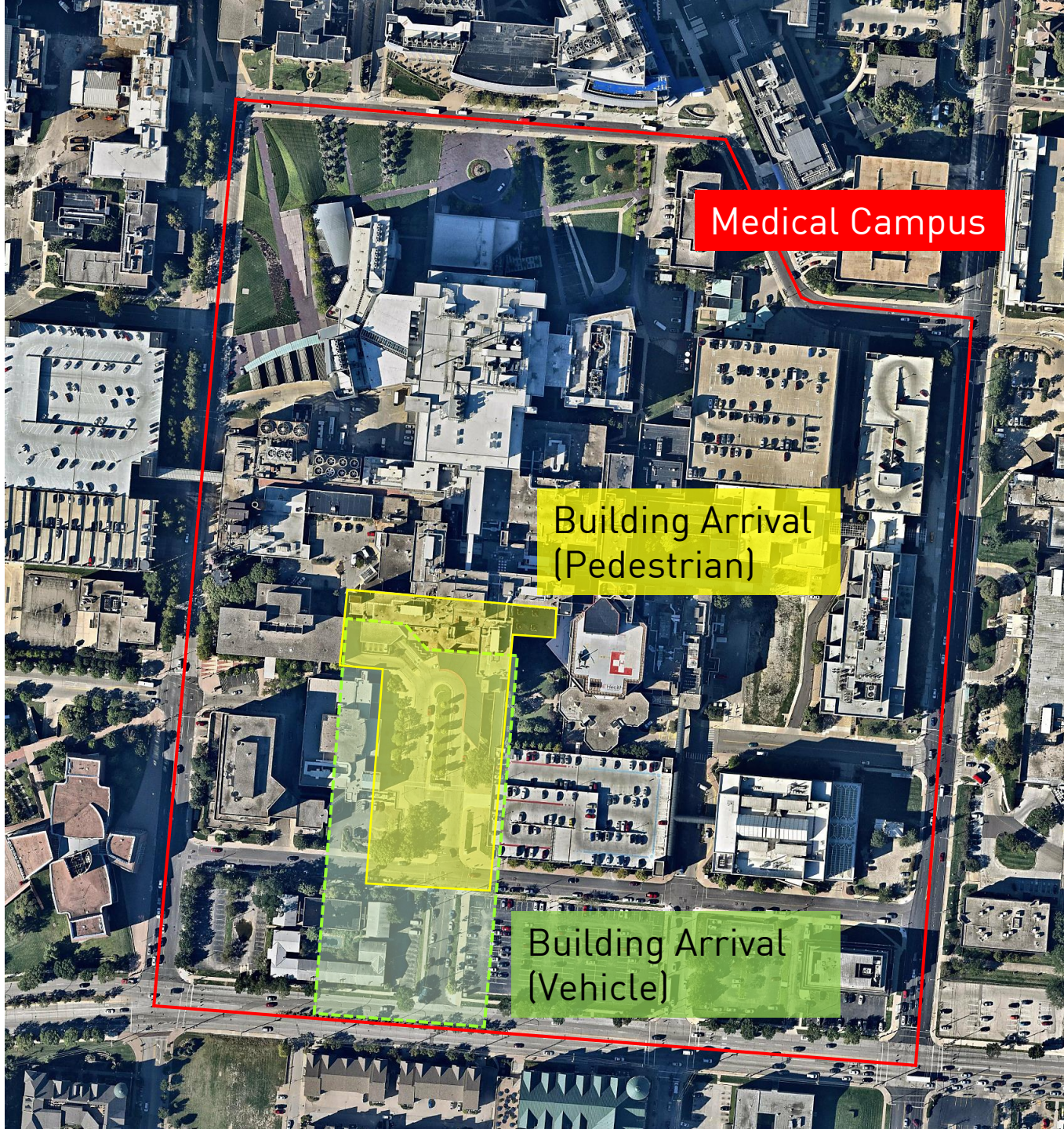
RESEARCH AOI

Space Syntax Analysis:

- Medical Campus, Building Arrival Zone (pedestrian and vehicle)

Behavior Mapping Analysis:

- **Snapshot/scan:** Building Arrival Zone –Pedestrian
- **Shadow:** Building Arrival Zone - Vehicle



FIELD DATA COLLECTION

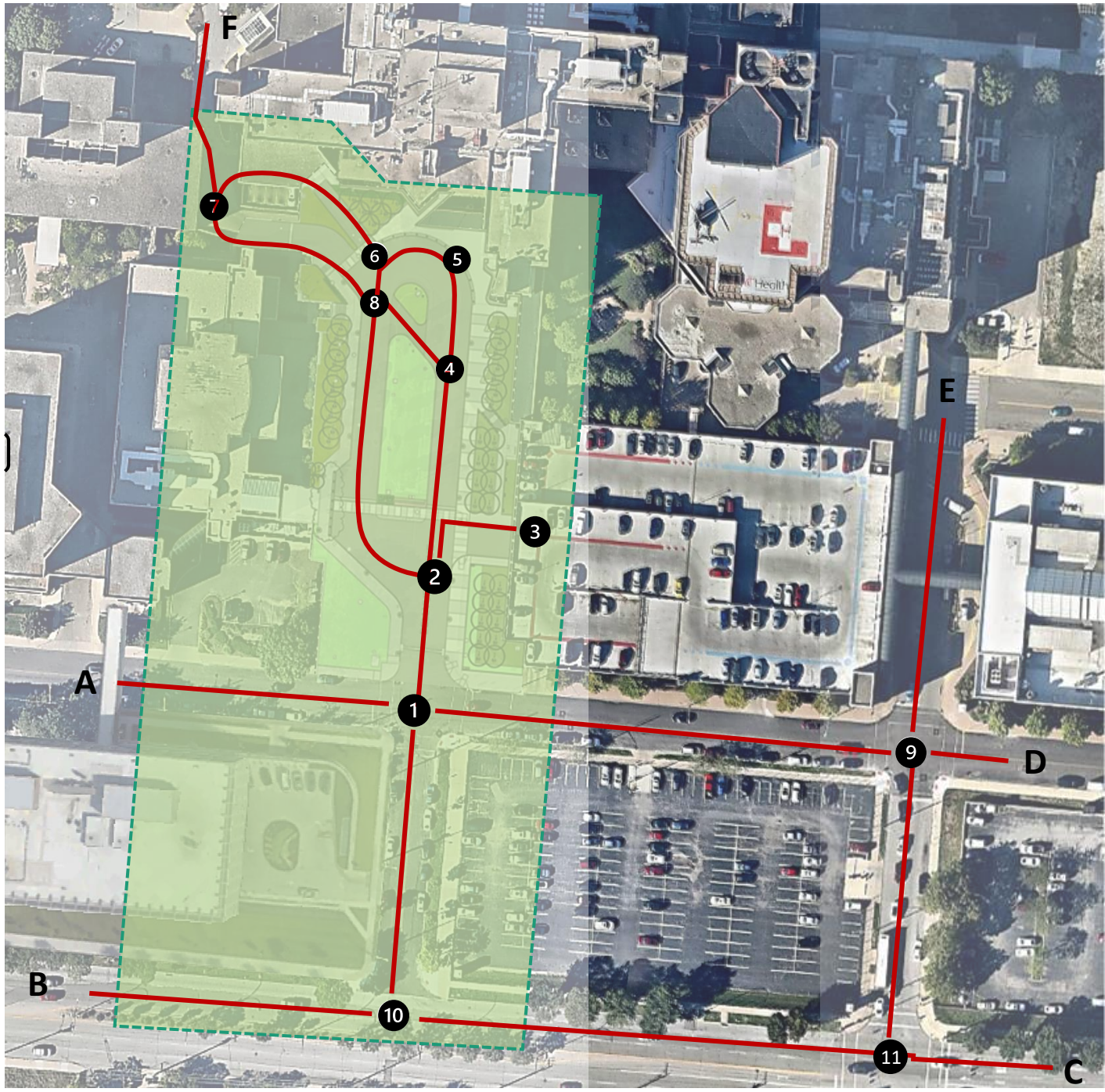
	Day 1 05/14/2023 (Sun.)	**Day 2** 05/15/2023 (Mon.)	**Day 3** 05/17/2023 (Weds.)	**Day 4** 05/18/2023 (Thurs.)	**Day 5** 05/19/2023 (Fri.)	**Total**
Vehicle Shadowing*						
Timeframe	n/a	1:00PM-5:00PM	3:00PM-5:00PM	n/a	9:00AM-1:00PM	10 hrs
# of Periods		4	2		4	10
Periods		1:00PM-1:45PM 2:00PM-2:45PM 3:00PM-3:45PM 4:00PM-4:45PM	3:00PM-3:45PM 4:00PM-4:45PM		9:00AM-9:45AM 10:00AM-10:45AM 11:00AM-11:45AM Noon-12:45AM	
Vehicle Data		71	55		93	219
Pedestrian Snapshot						
Timeframe	2:30PM-3:00PM	9:00AM-11:00AM 1:00PM-3:00PM	n/a	3:00PM-5:00PM	9:00AM-11:00AM 11:00AM-1:00PM	20 hrs
# of Periods	1	2		1	2	5
# of Rounds	1 round	15 rounds		7 rounds	15 rounds	38
Behavior Data	58	844		400	884	2128

*To ensure consistency for systematic data collection, every 3rd vehicle entered in the virtual site boundary; each vehicle was shadowed for 5 min max.

DATA | VARIABLES

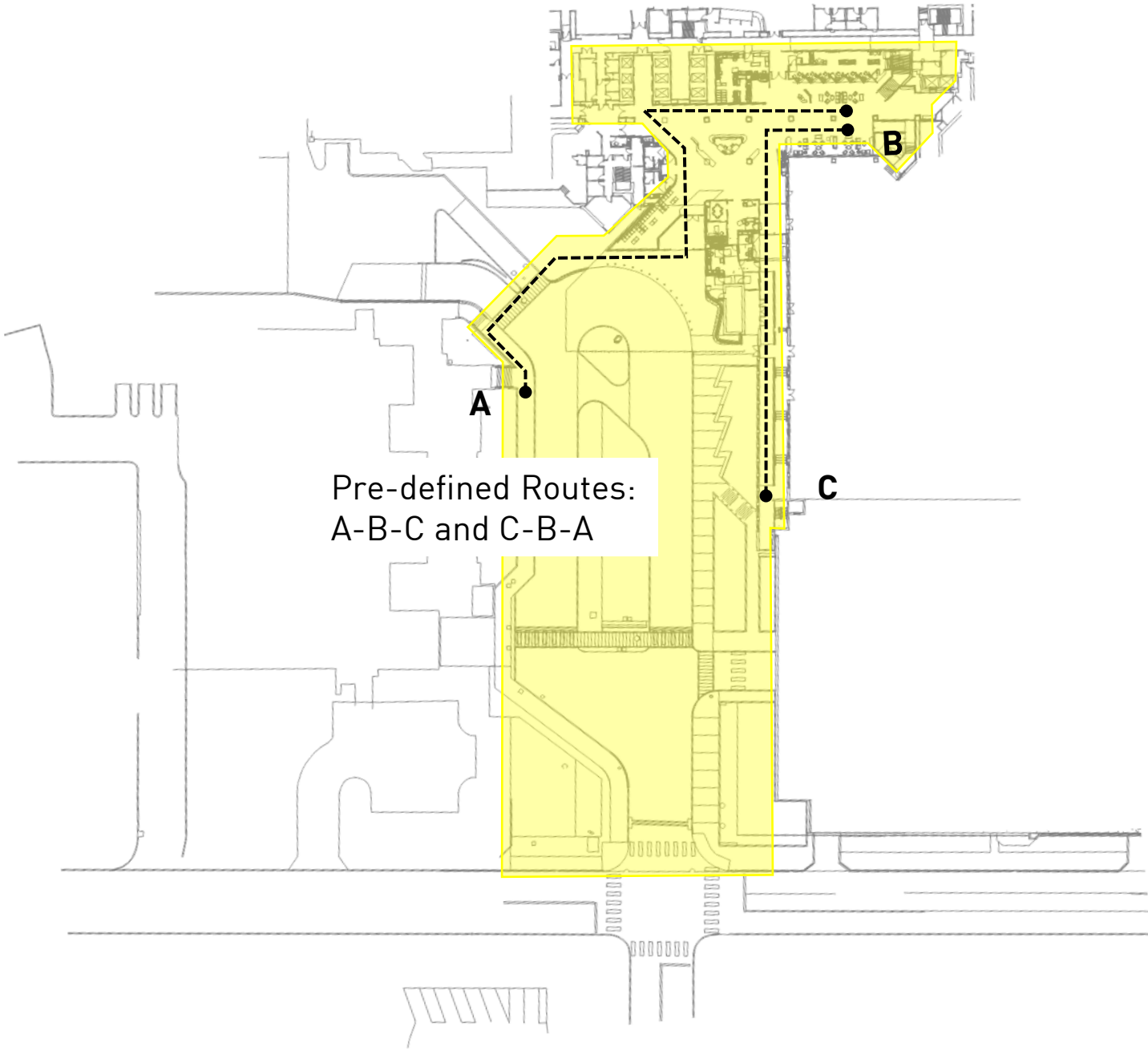
Vehicle Shadowing

- Variables/constructs:
  - Route segment (between two nodes)
  - Node
  - Stop (major stop and parking destination)
  - Vehicle Behavior/Activity
- Technique: GIS Cloud via portable device, photographing



Pedestrian Snapshot / Scanning

- Building Arrival Zone: system scanning for the snapshot of occupancy situation at any given observation time
- Predetermined route for the building arrival and transitional spaces, following the A-B-C and C-B-A sequence alternatively
- Variables/constructs:
    - Occupancy profile
    - Occupancy count
    - Space and location
    - Behavior/activity
- Technique: Bluebeam on iPad



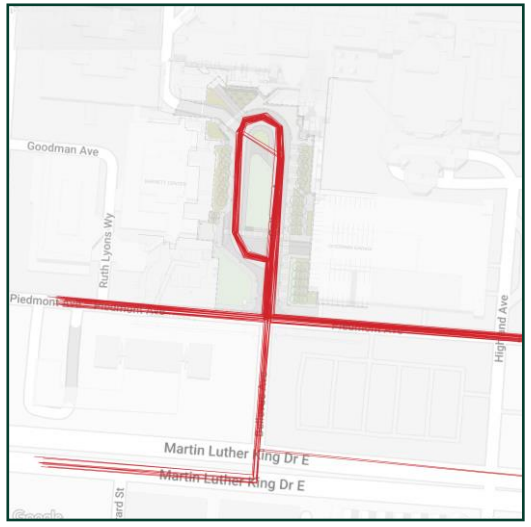
DATA ANALYSIS

Traffic Volume

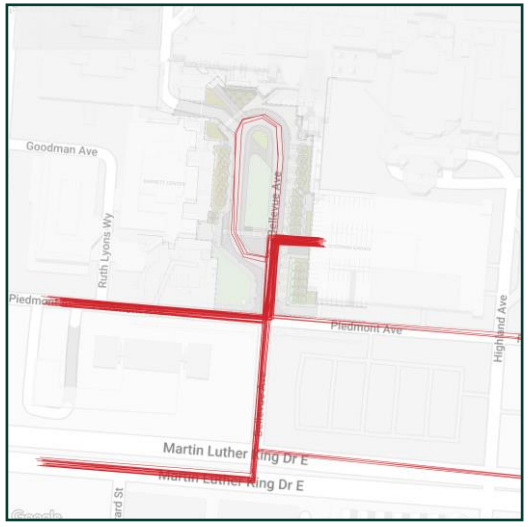
Ambulance (6.9%)

Public Transportation (15.8%)

All Personal Vehicles (PV) (74.3%)



Passthrough PV (34.6%)



Garage PV (17.7%)

Inpatient Discharge PV (6.3%)

Vehicle Profile

Blue – Ambulance
Green – Public transportation
Red – Personal vehicle

Route Selection

- A total of 87 unique routes
- Top ranked route selection as highlighted

Route 17 (14.2%)

Route 26 (4.1%)

Route 23 (3.7%)

Route 35 (3.7%)

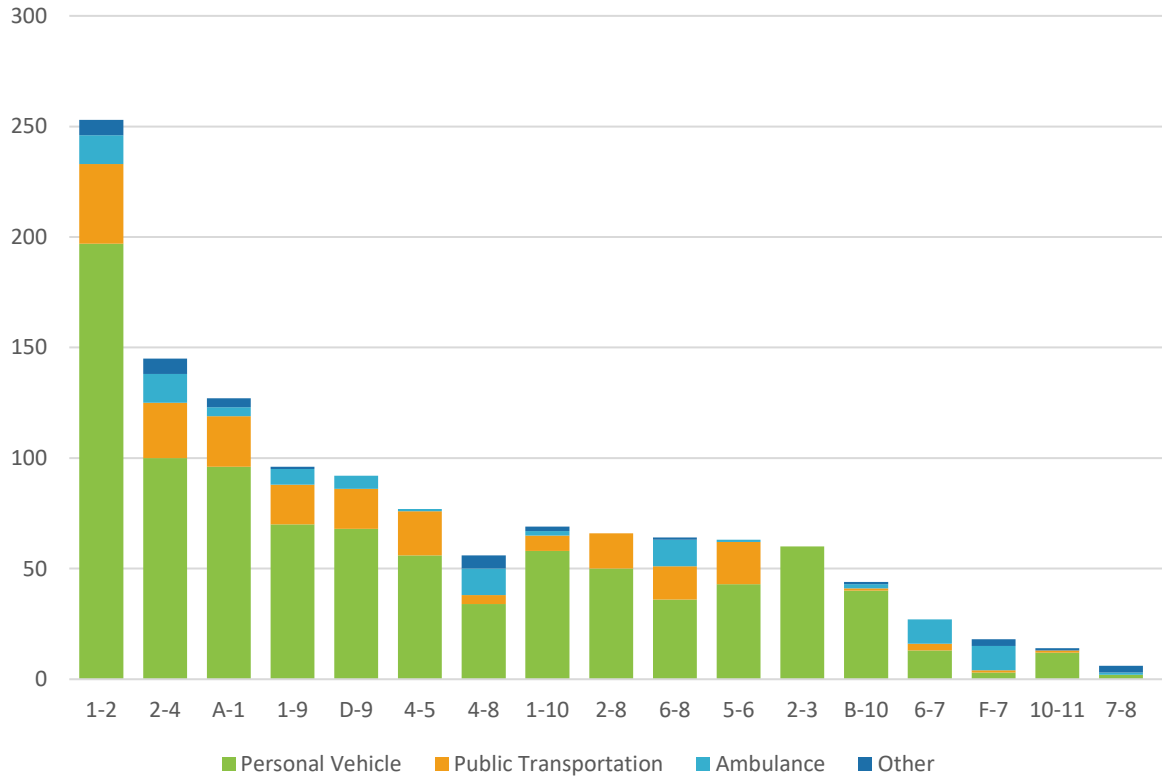
Route 22 (3.2%)

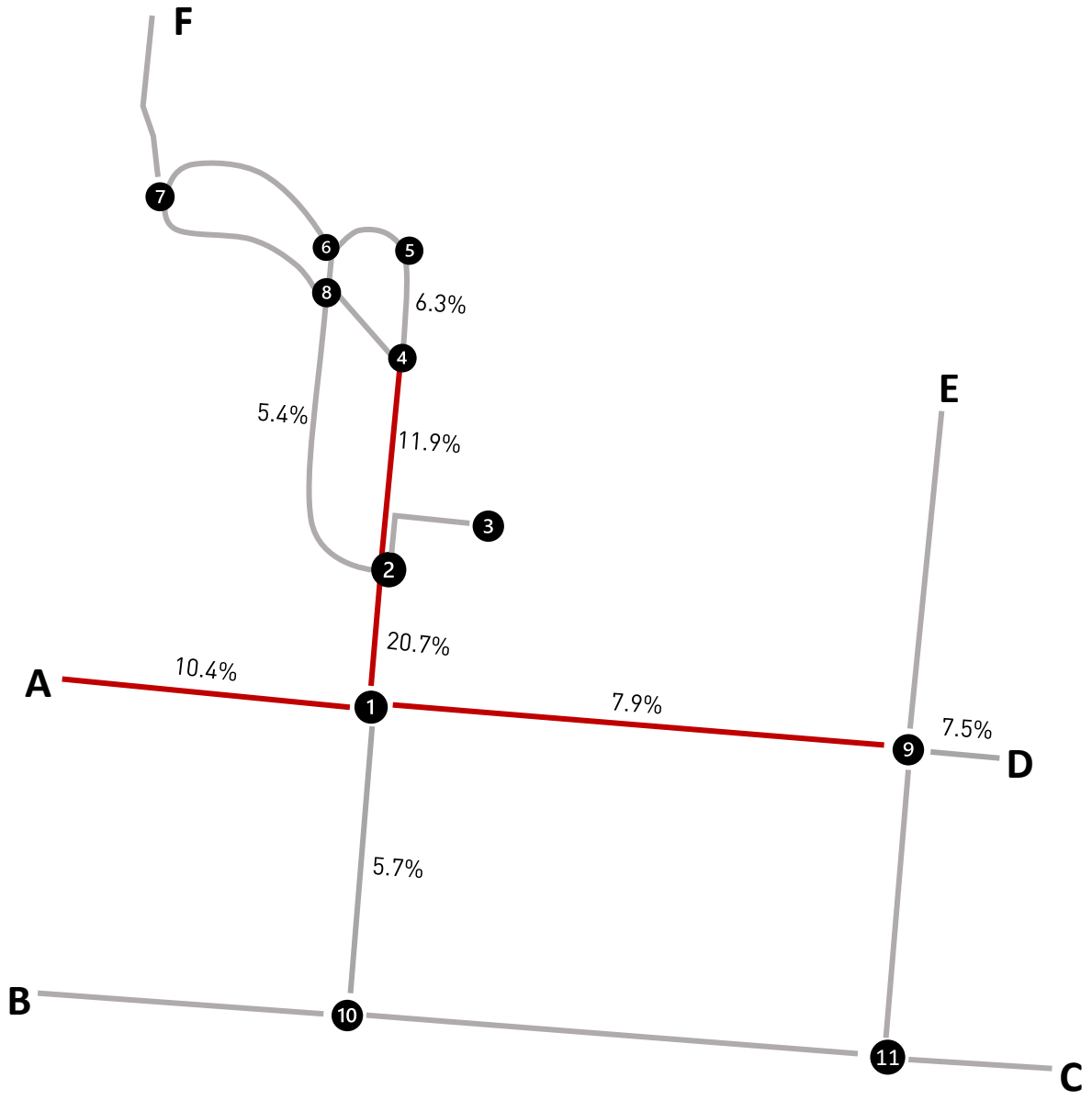
Route 48 (2.7%)

Route 52 (2.7%)

Traffic Volume by Route Segment

Vehicle Profile	Count	Route Segment Sum	Mean
Ambulance	13	96	7.38
Other	7	37	5.29
Personal Vehicle	171	955	5.58
Public Transportation	28	210	7.50
Grand Total		**1298**	**5.93**

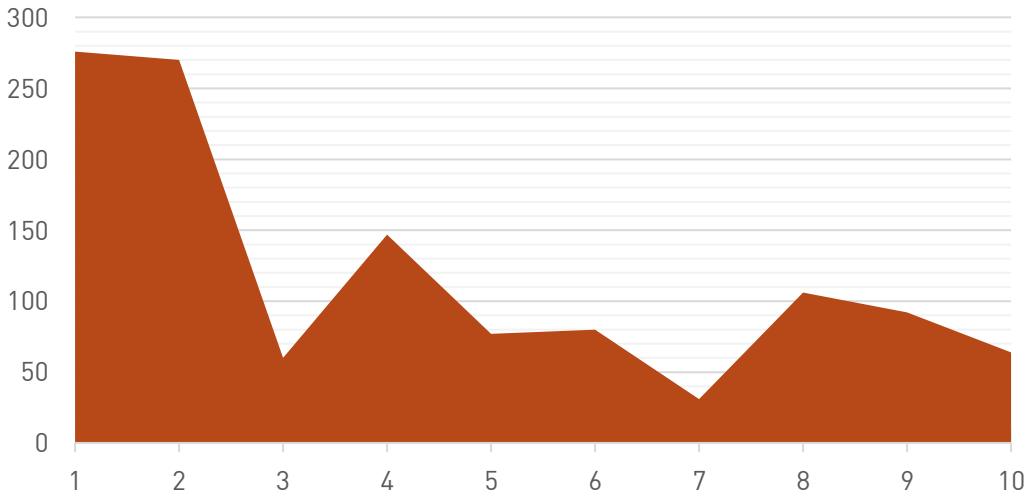


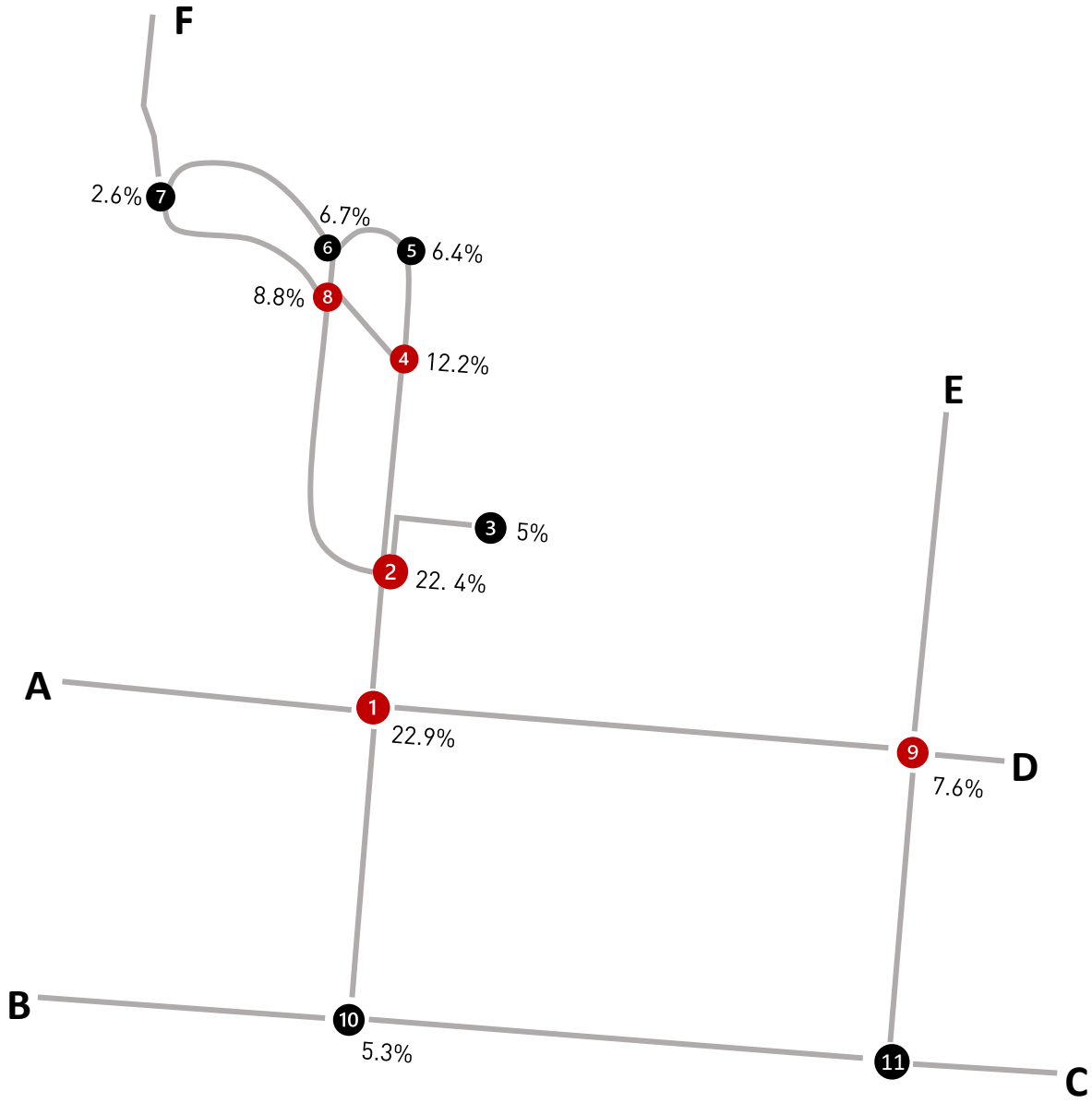


*Route segment traffic above 25% highlighted in red

Traffic Volume by Node

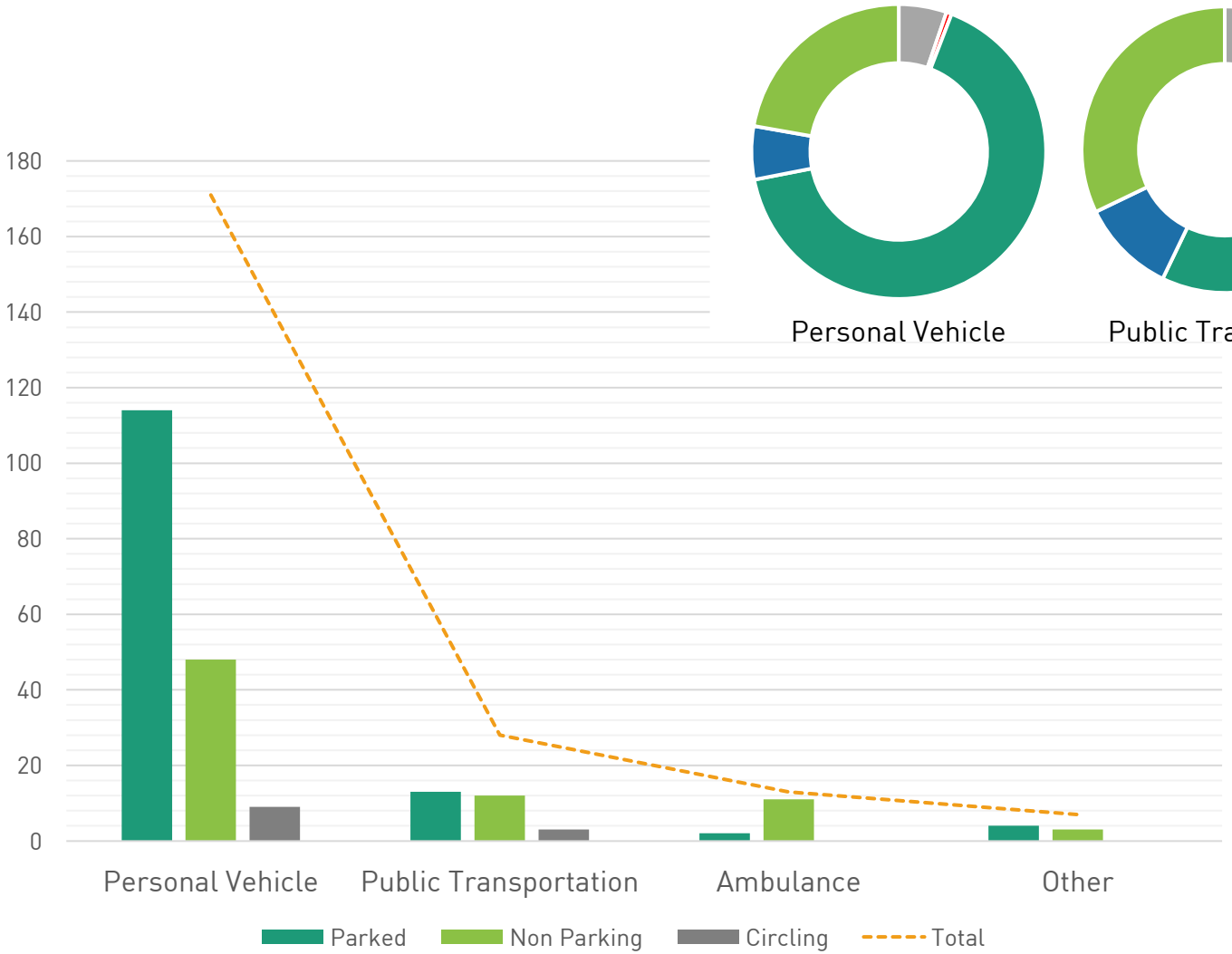
Vehicle Profile	Count	Node Sum	Mean
Ambulance	13	84	6.46
Other	7	36	5.14
Personal Vehicle	171	905	5.29
Public Transportation	28	193	6.89
Grand Total		**1218**	**5.56**

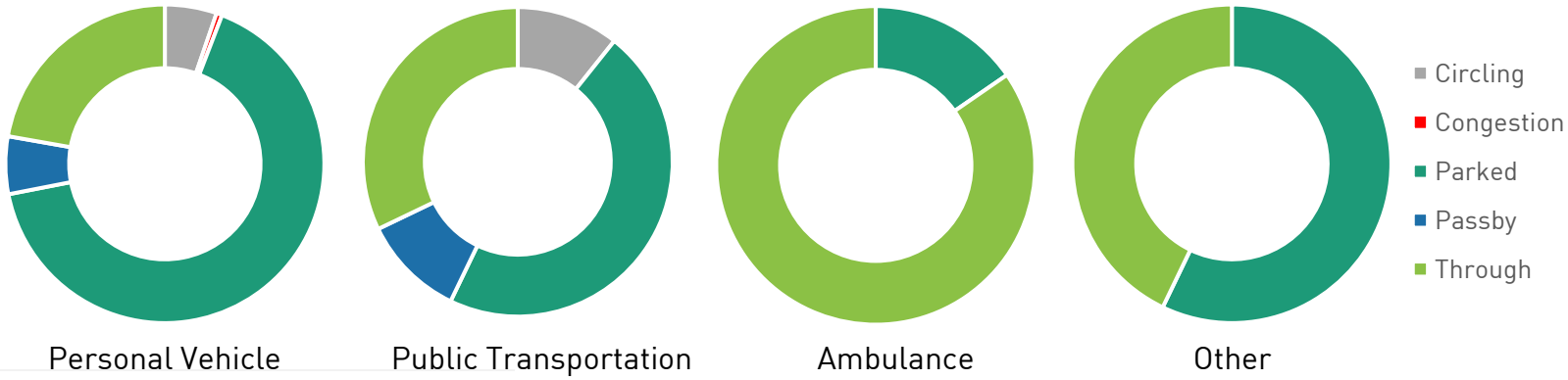




*Node traffic above 50% highlighted in red

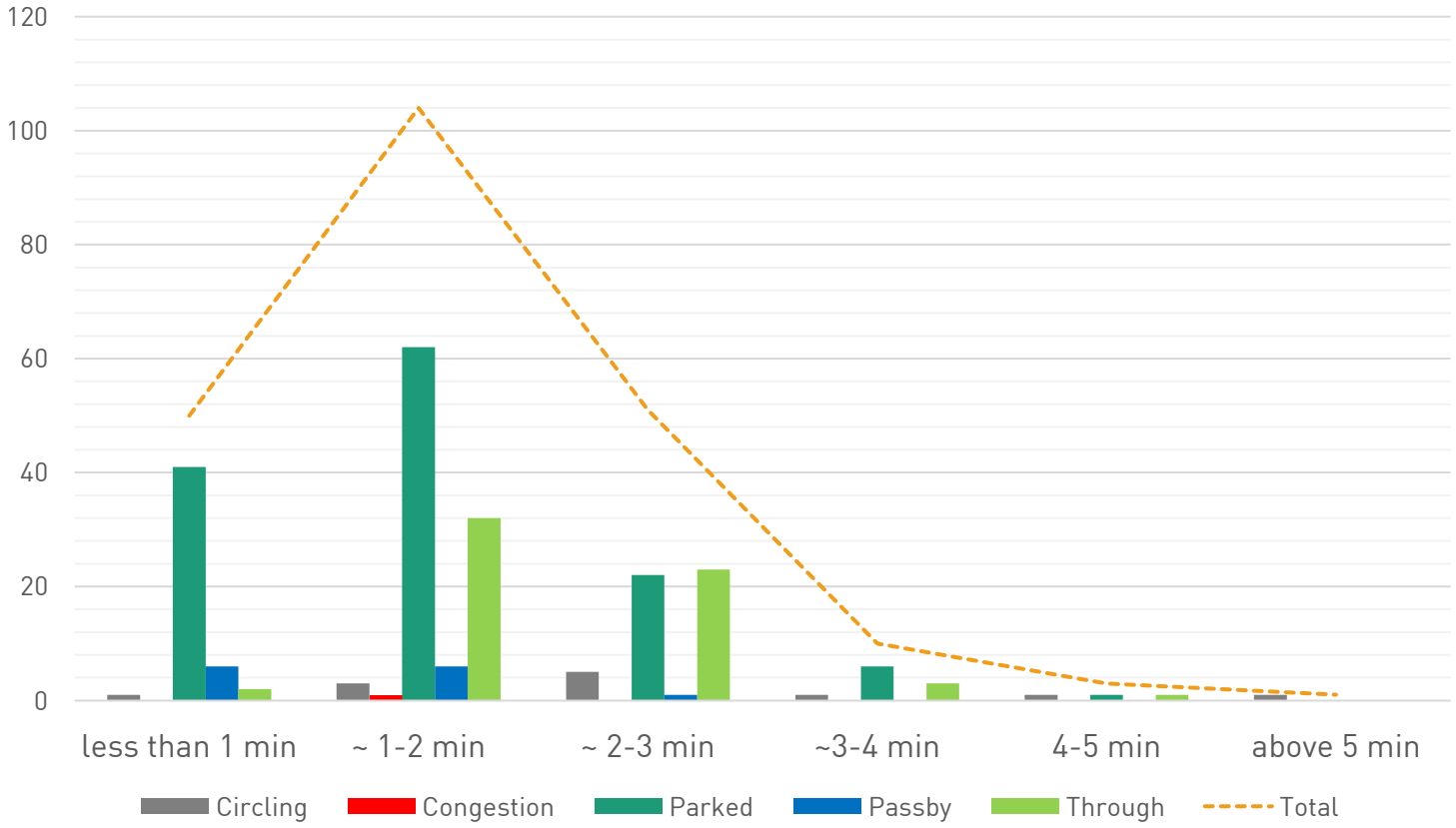
Vehicle Behaviors





- 60.3% (132) vehicles eventually parked
- 27.9% (61) stopped briefly and drove through the arrival zone
- 5.9% (13) passed by the site without stopping
- 5.5% (12) obvious wayfinding behavior (circling) within the arrival zone
- 0.5% (1) congestion event happened
- Valet staff members serve as traffic directors to guide the traffic other than parking the cars

Vehicle Behaviors and Time Factors



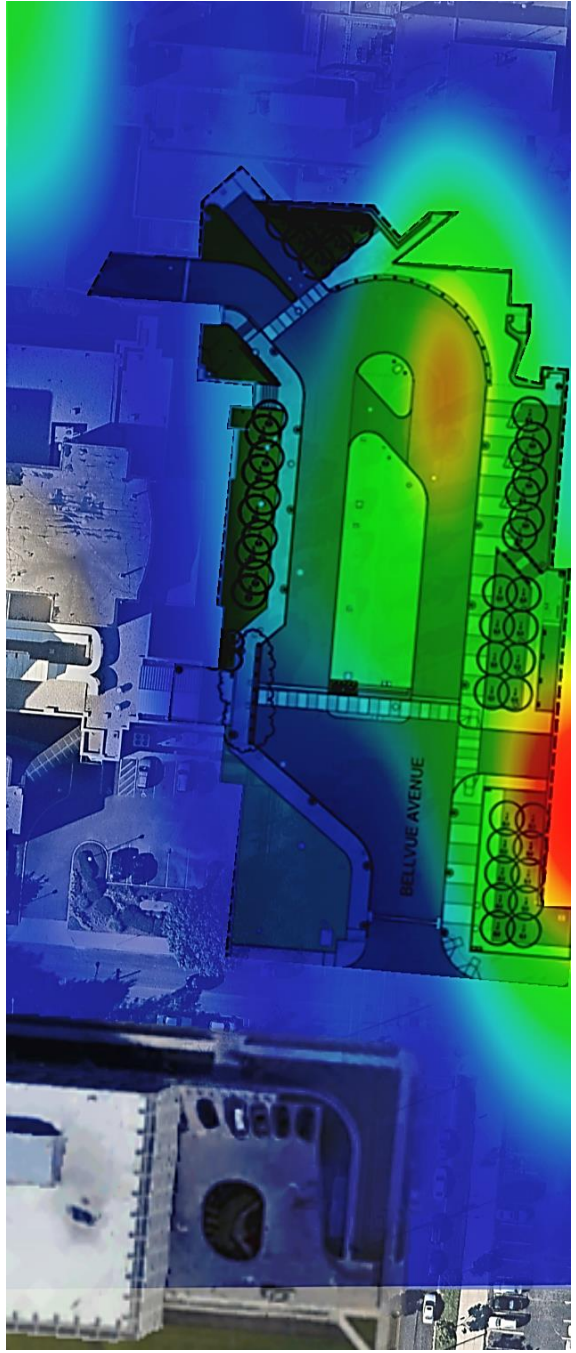
- **70.3%** of vehicles spend less than 2 minutes to either park or go through the arrival zone.
- 50 (22.8%) vehicles spend less than 1 min, 104 (47.5%) spend between 1-2 min, 51 (23.3%) spend about 2-3 min at the arrival zone.

Major Stops

- Significant amount of stops at the parking garage entrance
- More vehicle stops occur along the right side of the paths near the building main entrance

High Low

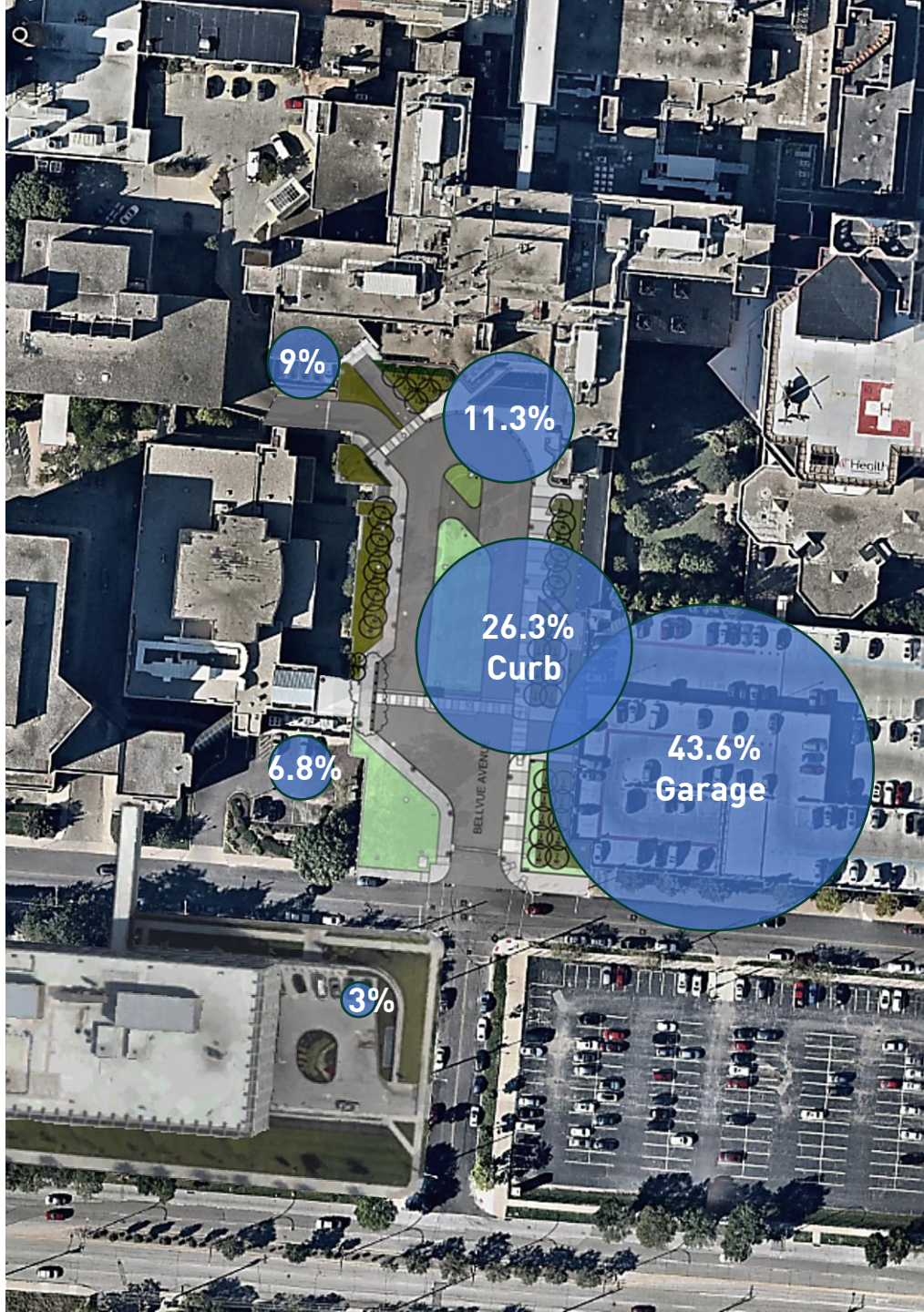
Major stop location in the arrival experience



*Heatmap and dot map generated by GIS Cloud

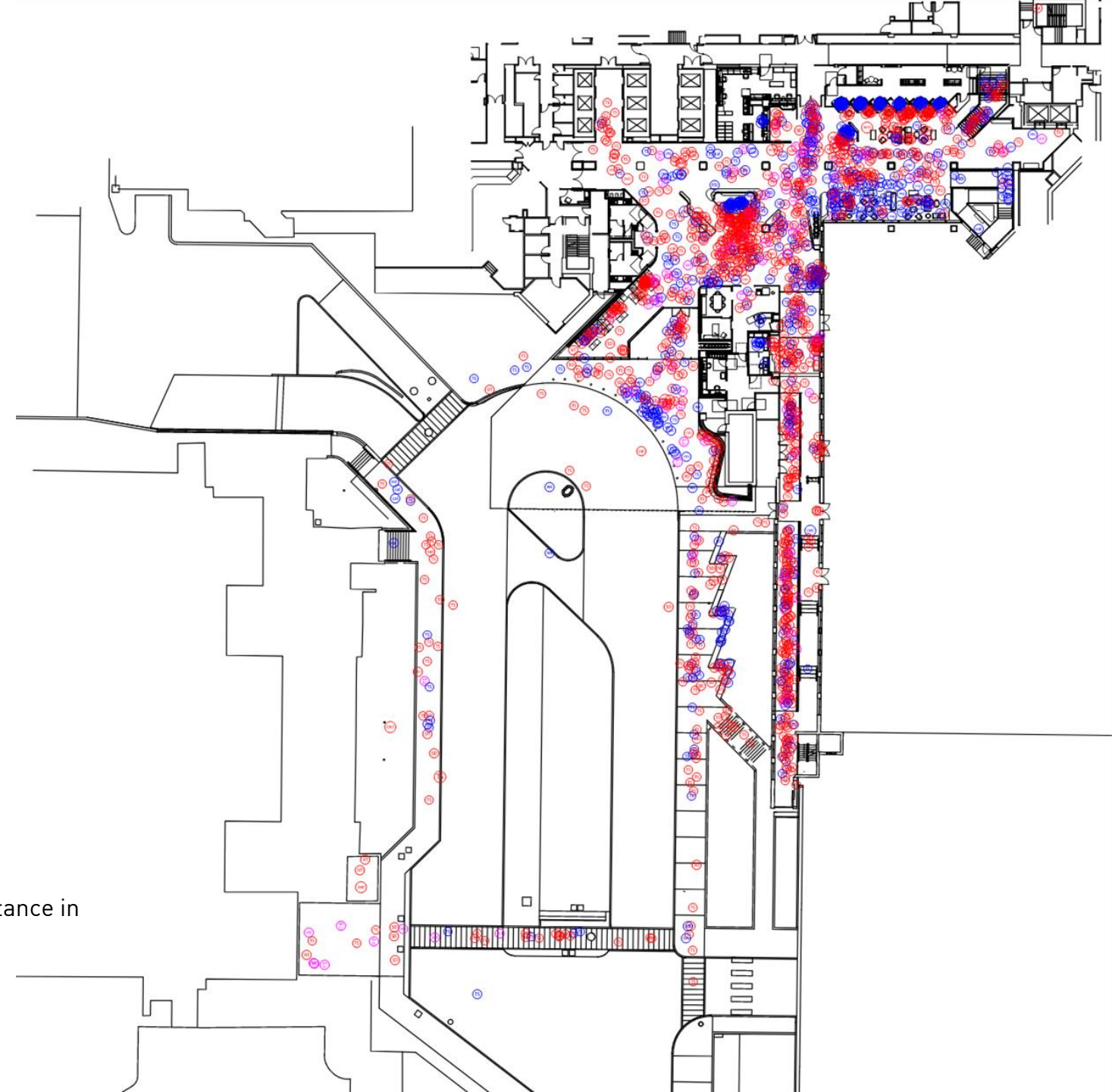
Parking Destination

Vehicle Profile	Garage	Curb	Main Entrance	Inpatient Discharge	Cancer Center	Neuro-science	Total
Personal Vehicle	58	27	13	10	6	0	114
Public Transportation	0	4	2	1	2	4	13
Ambulance	0	0	0	1	1	0	2
Other	0	4	0	0	0	0	4
Total	**58**	**35**	**15**	**12**	**9**	**4**	**133**
Percentage	**43.6%**	**26.3%**	**11.3%**	**9%**	**6.8%**	**3%**	**100%**



DATA ANALYSIS

Pedestrian Snapshot



All Occupants (N = 2096)
Red – Ambulatory patient/visitor (N = 1257)
Pink – The disabled or patient in critical condition (N = 106)
Blue – Hospital staff (N = 733)

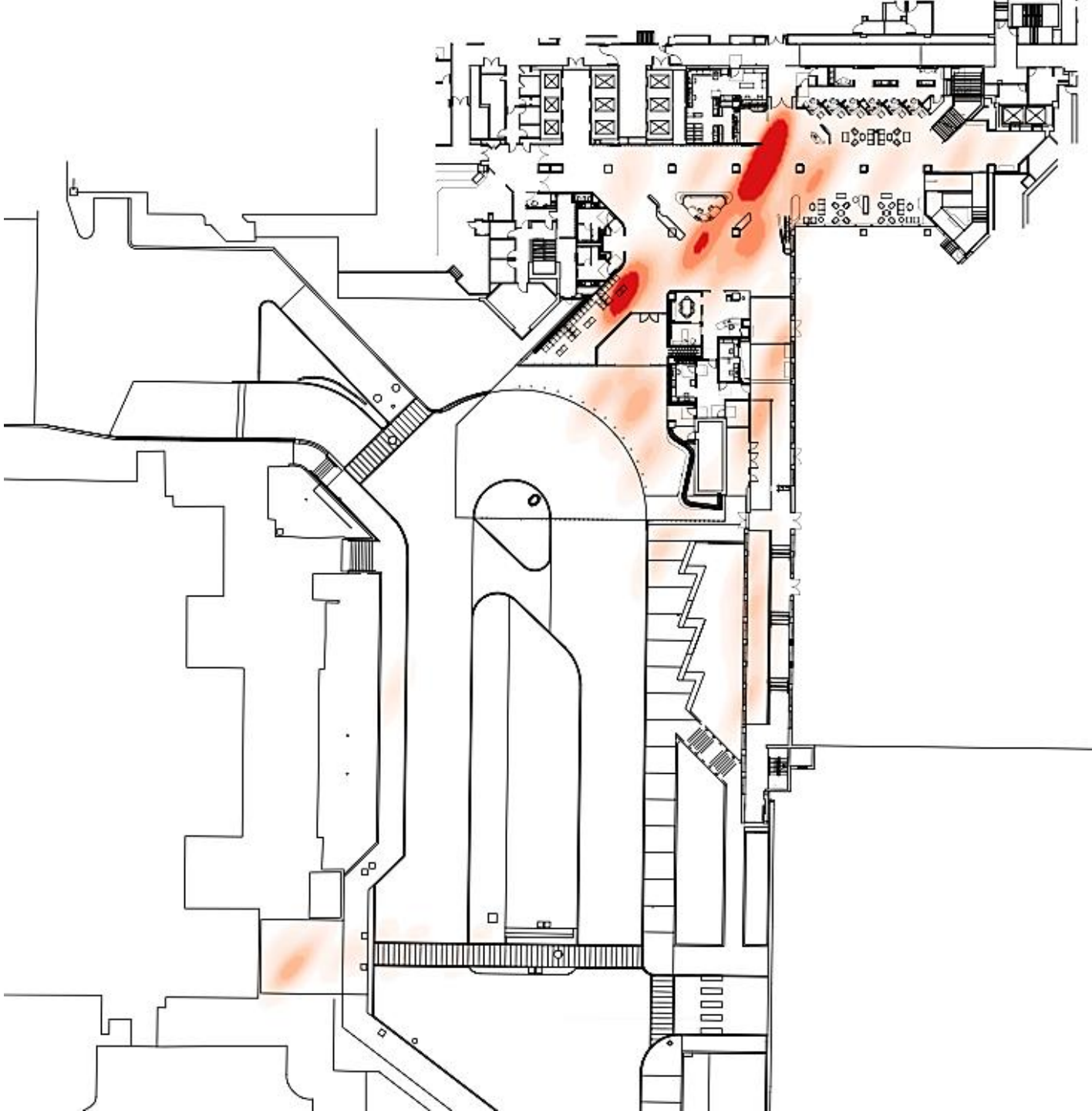
*Each bubble is 3ft in diameter, representing the minimum social distance in public spaces

Ambulatory Patient/Visitor Occupancy Heatmap

Ambulatory Patient/Visitor (N = 1257)

Occupancy High — Low

The Disabled/Critical Condition Occupancy Heatmap



Disabled/Critical Condition (N = 106)

Occupancy High — Low

Staff Occupancy Heatmap

Hospital Staff (N = 733)

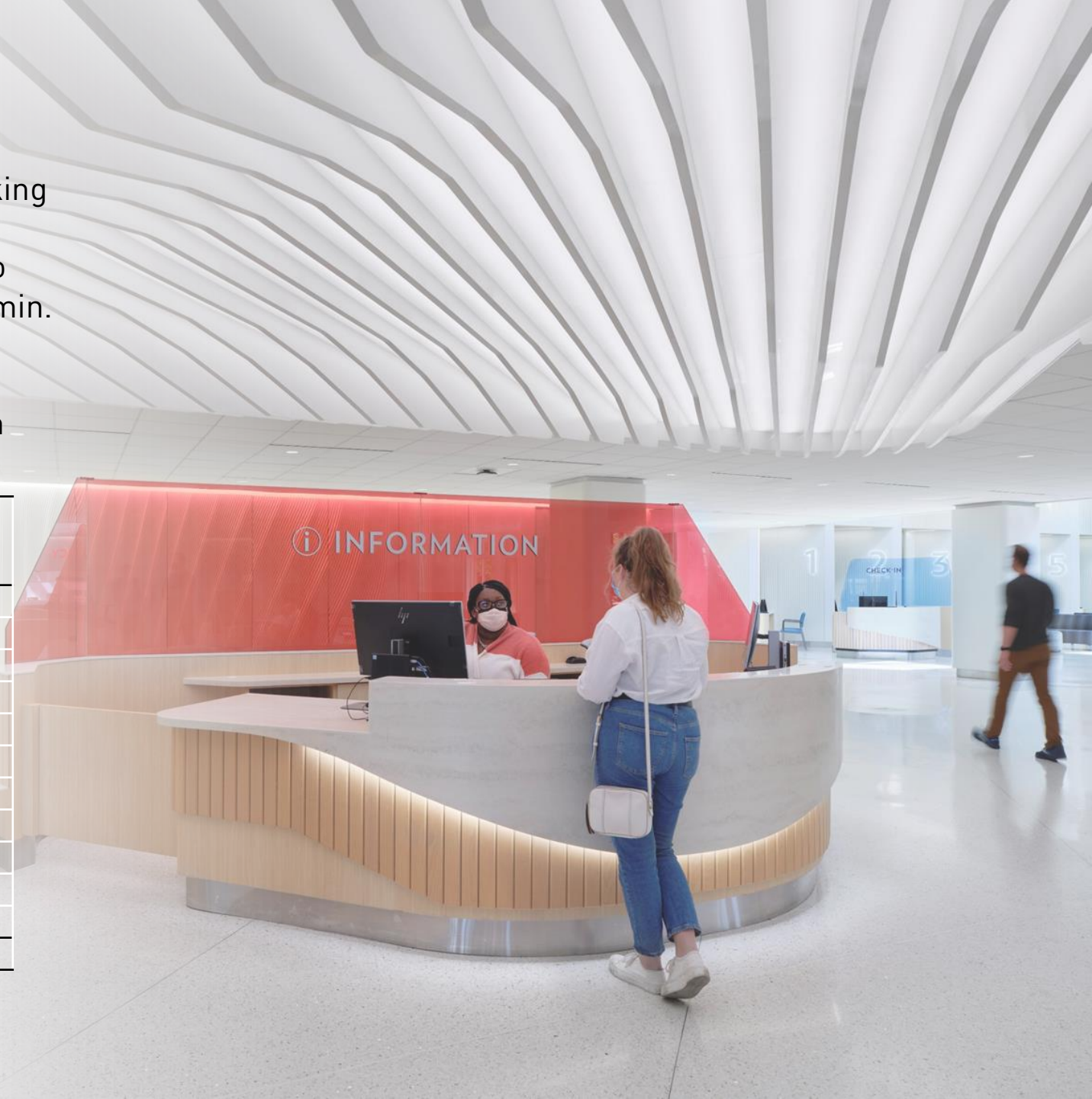
Occupancy High — Low

Wayfinding Behaviors

- Identified 0.95% active wayfinding behaviors (asking staff members to give verbal direction).
- Observed a total of 214 people at the Central Info Desk Zone within 11 observational intervals (10 min. each interval, random sampling in a typical workday); **30.4%** (N=65) were given verbal wayfinding guide by staff. The average resolution time is ~ **0.5 min.**

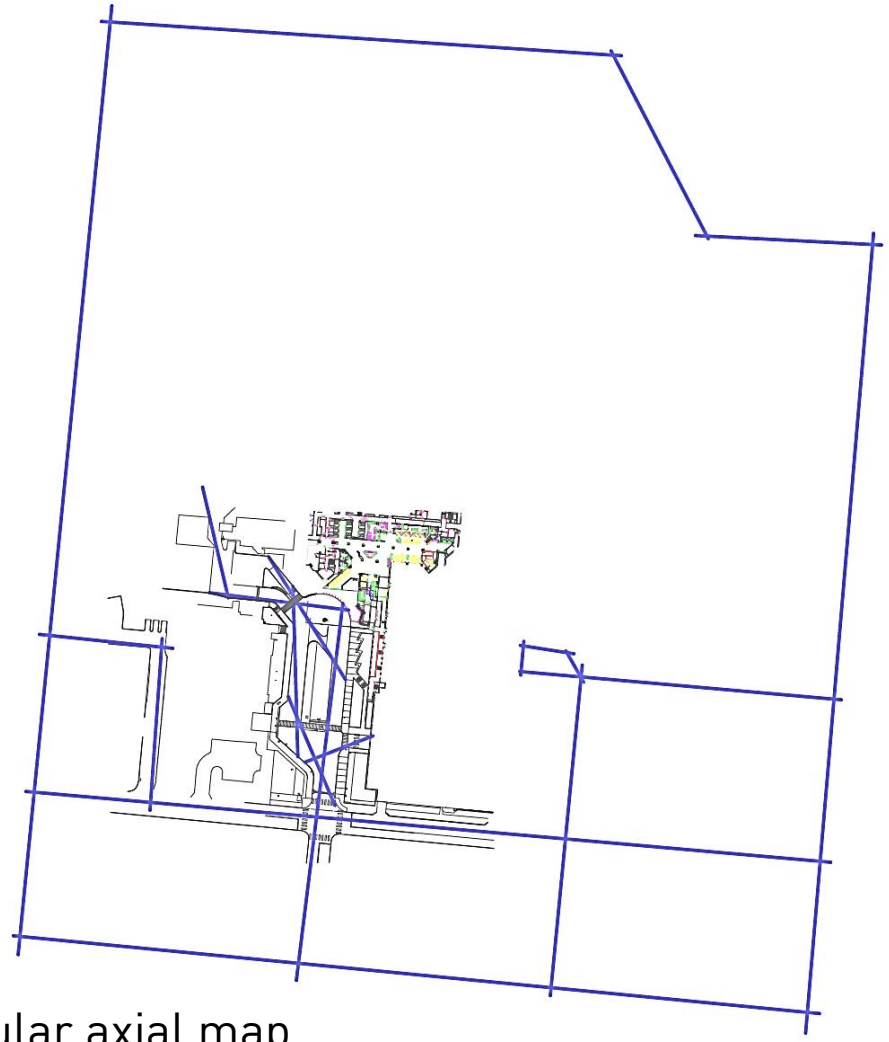
Observation Interval	# of People Observed	Average Resolution Time*	Verbal Wayfinding Guide	% of Wayfinding Guide
9:26-9:36AM	13	0.77	1	7.7%
9:52-10:02AM	18	0.56	4	22.2%
10:30-10:40AM	17	0.59	6	35.3%
11:14-11:24AM	22	0.45	5	22.7%
11:28-11:38AM	22	0.45	7	31.8%
12:10-12:20AM	22	0.45	7	31.8%
1:16-1:26PM	25	0.40	8	32.0%
1:36-1:46PM	20	0.50	8	40.0%
1:48-1:58PM	15	0.67	6	40.0%
2:10-2:20PM	18	0.56	6	33.3%
3:40-3:50PM	22	0.45	7	31.8%
Total	**214**	**0.51**	**65**	**30.4%**

*Average resolution time = 10 minutes / total # of people processed at the central info desk; unit in minute



METHOD VALIDATION

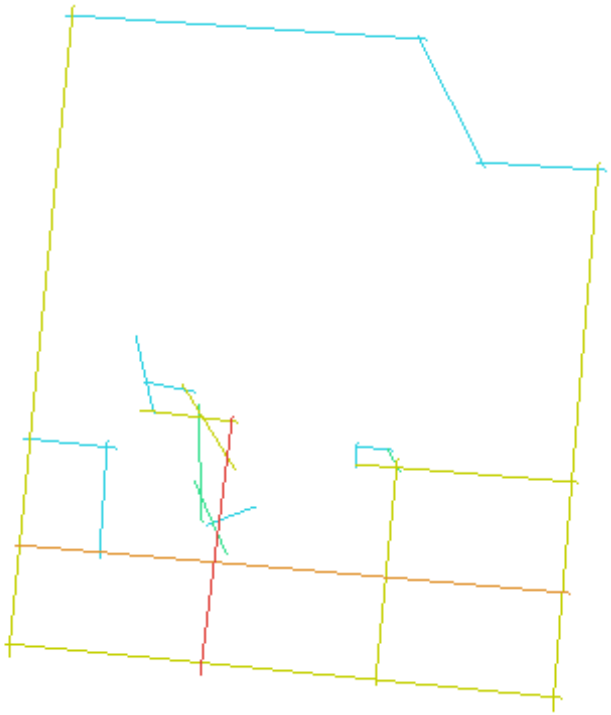
Space Syntax Analysis



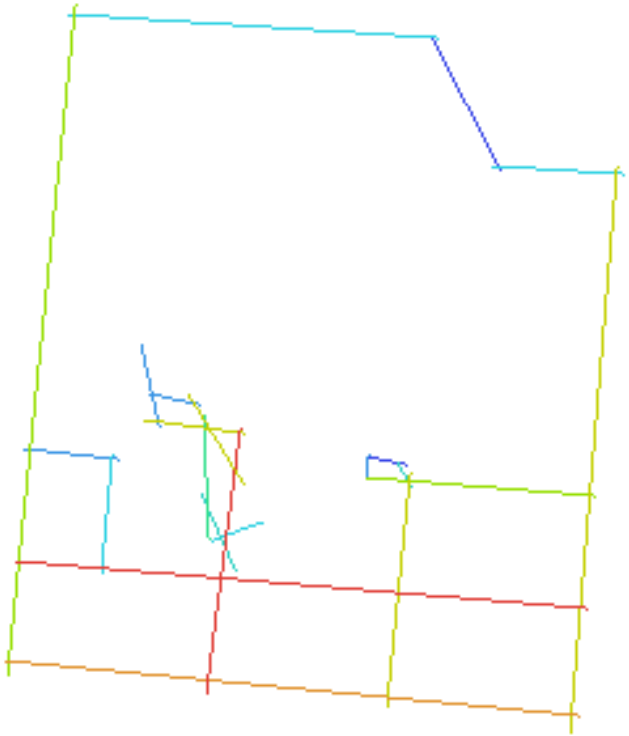
Vehicular axial map

Ped axial map

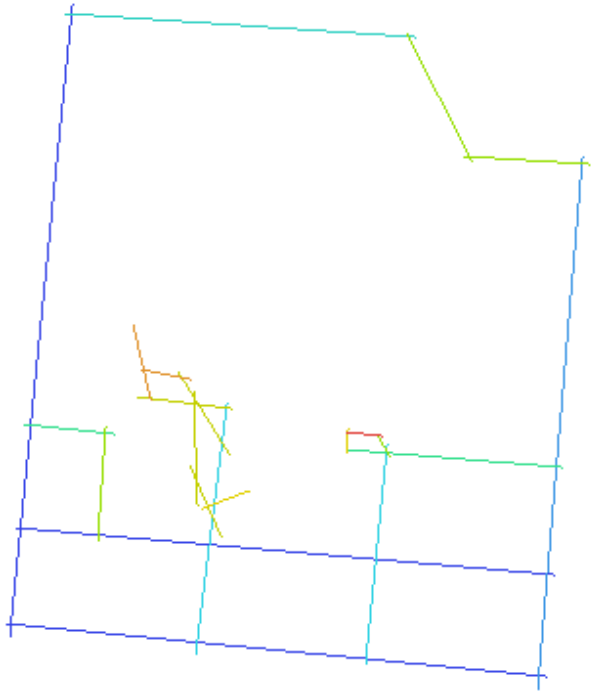
Vehicular Connectivity



Vehicular integration

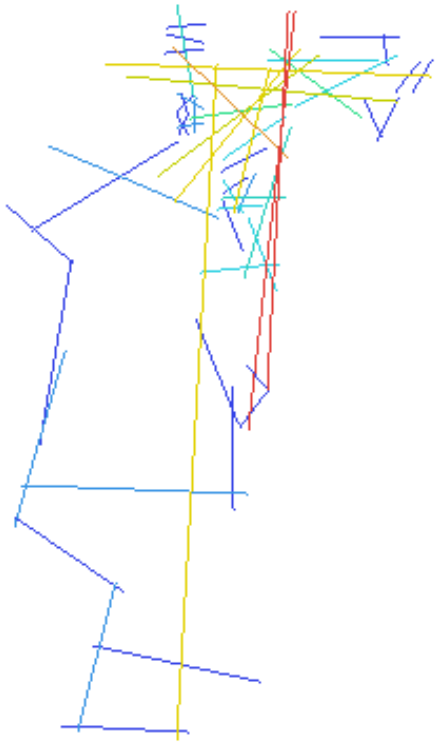


Vehicular Mean Depth with Line Length Weighted

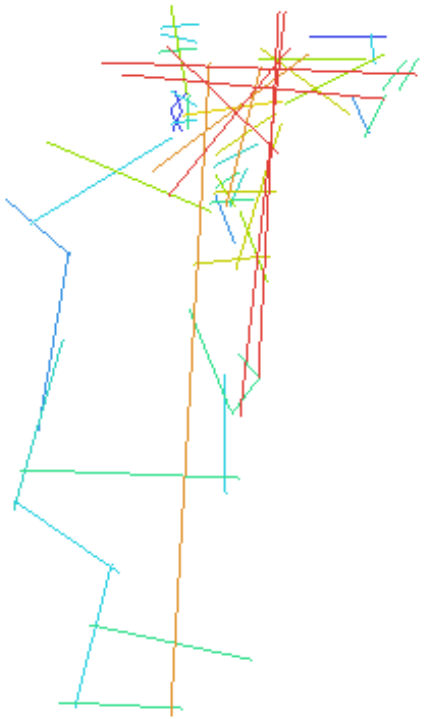


Vehicular	Minimum	Average	Maximum
Connectivity	1	3.09	6
Integration	0.86	1.36	2.08
Mean Depth	1.89	2.15	2.47
Mean depth with line length weighted	1.45	2.07	2.71

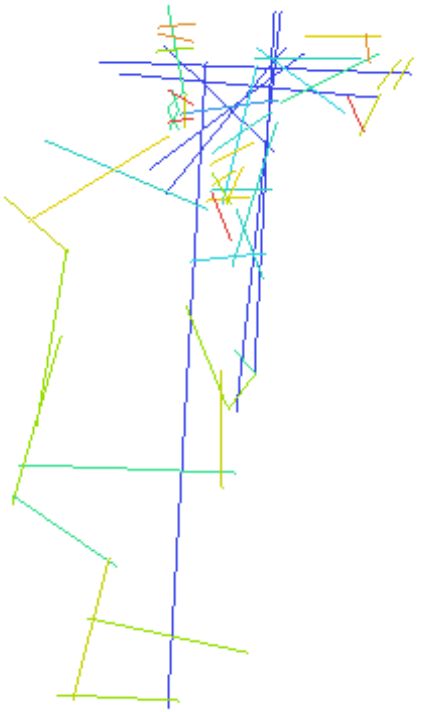
Ped Connectivity



Ped Integration

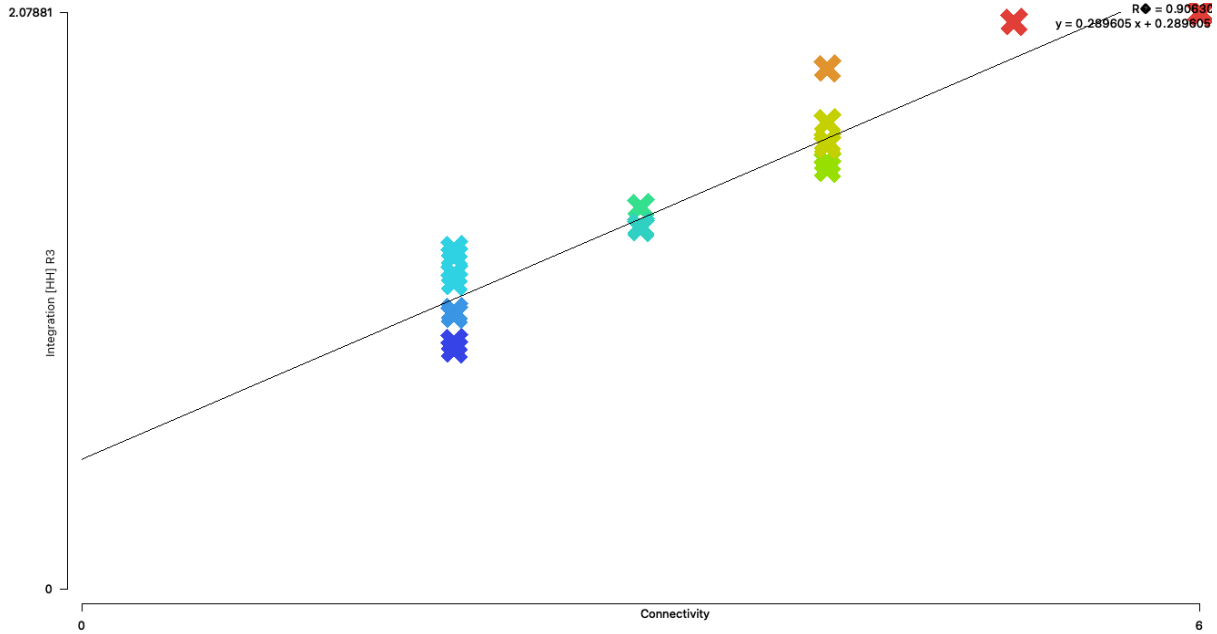


Ped Mean Depth with Line Length Weighted

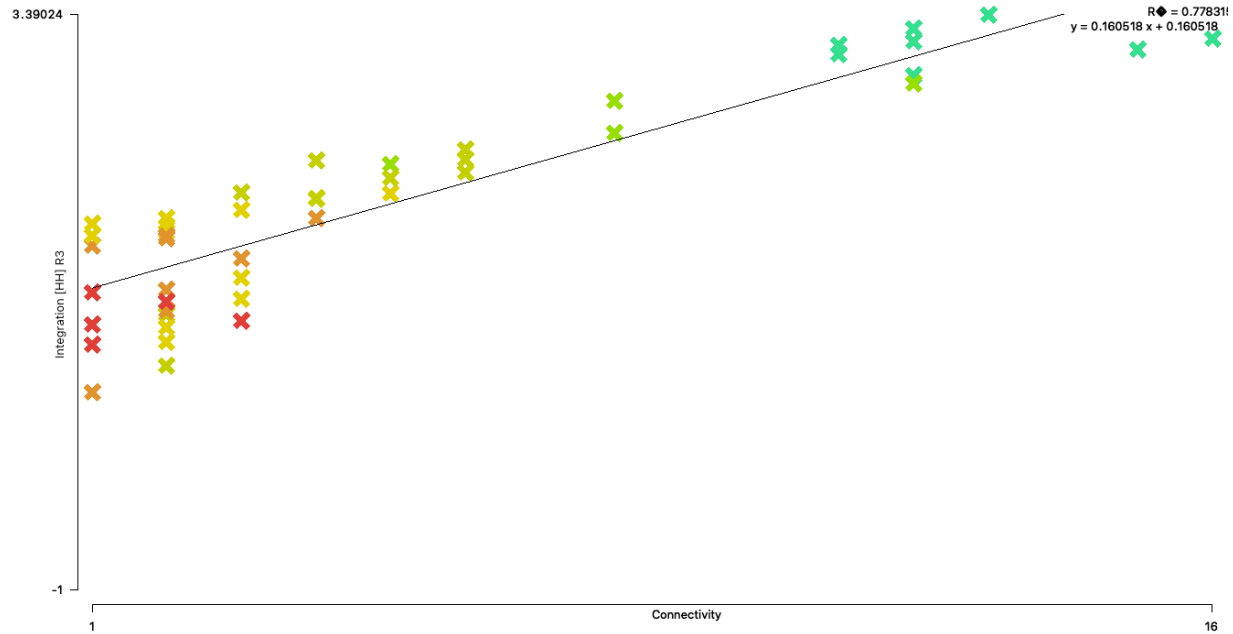


Pedestrian	Minimum	Average	Maximum
Connectivity	1	4.47	16
Integration	0.5	1.82	3.33
Mean depth	1.93	2.33	2.75
Mean depth with line length weighted	1.56	2.20	2.86

Wayfinding Intelligibility

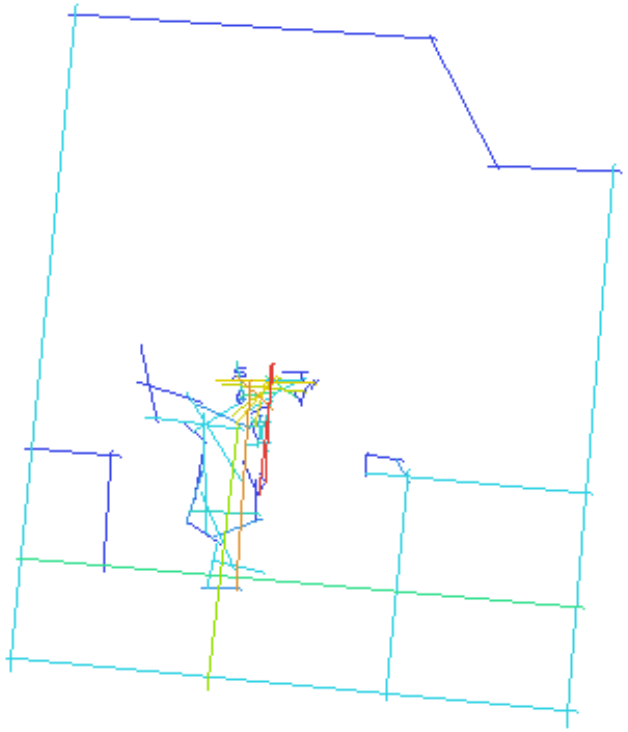


Vehicular intelligibility
R=0.91

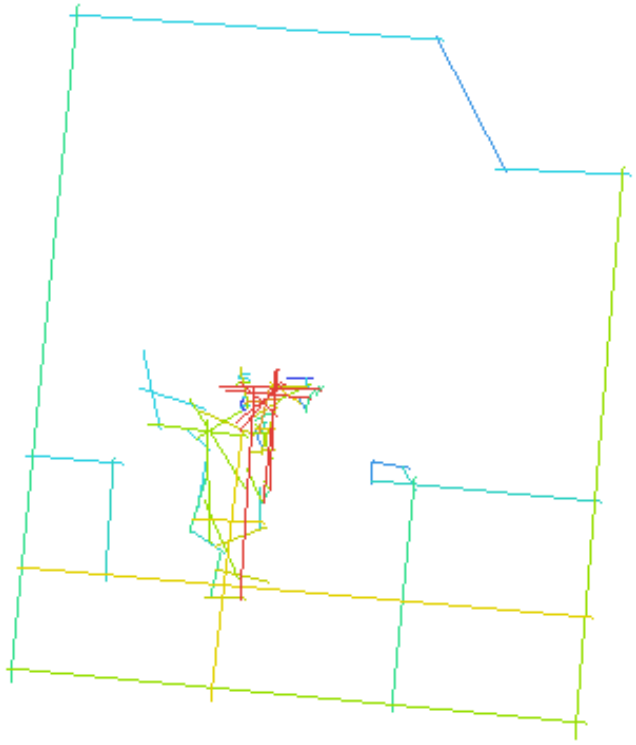


Pedestrian intelligibility
R=0.78

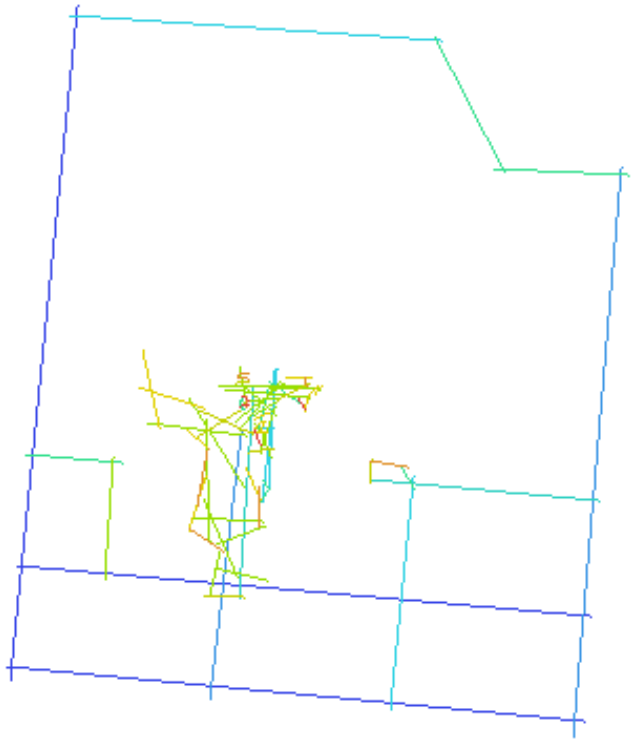
Ped+Vehicular Connectivity



Ped+Vehicular integration



Ped+Vehicular Mean Depth with Line Length Weighted



Pedestrian + Vehicular	Minimum	Average	Maximum
Connectivity	1	4.40	16
Integration	0.50	1.79	3.12
Mean depth	2	2.36	2.75
Mean depth with line length weighted	1.64	2.33	2.85

Space Syntax Analysis Findings

The results show that the vehicle circulation wayfinding is very efficient with high intelligibility value on the UCMC campus. The wayfinding system for pedestrians has lower intelligibility than the vehicle circulation.

Identified pedestrian routes with have high integration values:

- The interior pathways from parking to entrance
- The exterior pathway towards the entrance
- The hallway that connects the west and east lobby
- The circulations around the information desk

Correlational Analysis

Connectivity is significantly correlated with Personal vehicles, public vehicles, other vehicles, and total traffic.

Vehicle Traffic and Street Spatial Configuration Space Syntax Analysis Correlations			
		Connectivity	**Integration Score**
Personal Vehicles	Pearson Correlation	**.697***	0.577
	Sig. (2-tailed)	**0.025**	0.081
Public Vehicles	Pearson Correlation	**.724***	0.570
	Sig. (2-tailed)	**0.018**	0.085
Ambulance	Pearson Correlation	0.497	0.291
	Sig. (2-tailed)	0.144	0.415
Other Vehicles	Pearson Correlation	**.714***	0.558
	Sig. (2-tailed)	**0.020**	0.094
Total Traffic	Pearson Correlation	**.709***	0.575
	Sig. (2-tailed)	**0.022**	0.082

Correlational Analysis

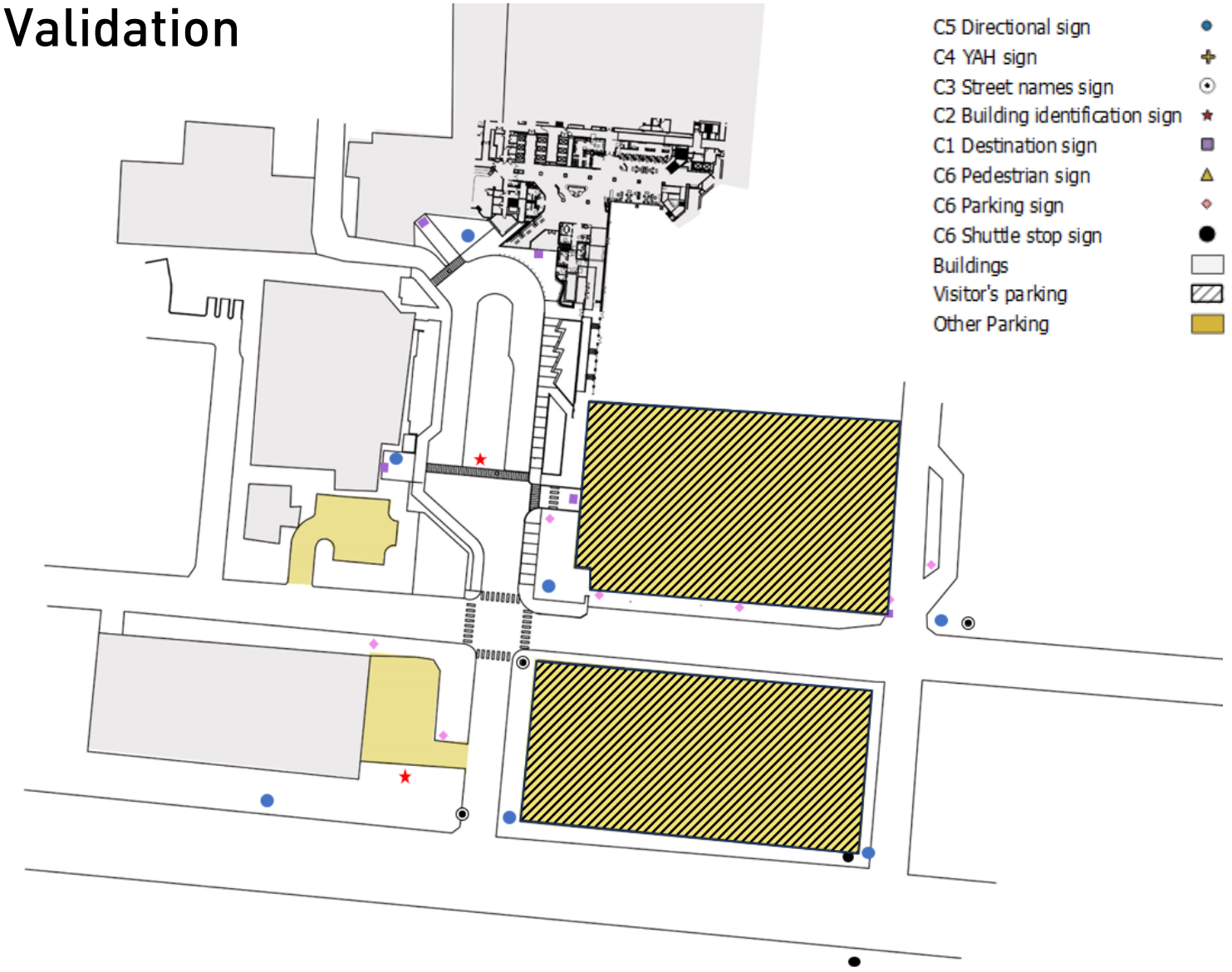
Connectivity and integration scores are significantly correlated with all pedestrian movement volume, including ambulatory, disabled, staff, and the total pedestrian traffic.

Pedestrian Traffic and Spatial Configuration Space Syntax Analysis Correlations

		Connectivity	Integration Score
Ambulatory Visitor/Patient	Pearson Correlation	**.773****	**.623****
	Sig. (2-tailed)	**0.000**	**0.002**
Disabled/Critical Condition	Pearson Correlation	**.794****	**.662****
	Sig. (2-tailed)	**0.000**	**0.001**
Staff	Pearson Correlation	**.679****	**.542****
	Sig. (2-tailed)	**0.000**	**0.008**
Total	Pearson Correlation	**.765****	**.616****
	Sig. (2-tailed)	**0.000**	**0.002**

WHAT'S NEXT?

Signage System Analysis and Validation



Q&A

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