**Main point of this project:**

To be able to **analyze** and **simulate** the occupancy of library

-Issue with med sci lib, a lot of open spaces, no way to capture the occupancy because they don’t tap in and out

-If we have the simulation : change the layout, opening hours for different sections of the library(different configurations), how to staff the library, what kind of occupancy may arise?

-Users dispersion + users behaviors in path finding (suggestions on signs / designs furnish / cues)

-Study the issues with seat hoggings etc

**Crowd patterns:**

-Users can only enter through one of the entrances, bi model

-Peaks will be **11-2pm** , **1-2pm** , because a lot of students have classes at fass that end around that time , then stable until 6pm and drop off

-Peak usually in **October** : at least 1,5k at any time (some people dont tap the card they just walk together to pass through the gate), might wanna factor this in for a confidence interval of measurement?

-At univus app, have crowd level, have how many % of space occupancy,

Issue :

* Movement count is measured by students signing into nus wifi. This depends on whether students signed in to nus wifi or not , discrepancy between actual and univus occupancy level
* However, the pattern of distribution is more or less the same during the day, make use of the fact that during the highest peak period is ~ 1.5k at any time (generative function for maybe arrival of students? In modeling)

-weekends, saturdays open but less people more public users(apply for passes 7 days a year, cannot borrow the books)

**LIBRARY TOUR**

**General**

-CLB got two parts, main + chinese lib in 1 building

-Main entrances at level 1, level 4(connected to FASS) & level 6(at the chinese library)

* level 1 most congested, most people use this entrance (2 sets of gantry multiple gantry for each set):
  + First set: access to the rest of the library
  + Second set: access to the reserved books
* level 4:1-3pm busy (2 gantry), line could stretch very long during lunch time
* level 6 exit is quieter (2 gantry)

-Lower levels are usually busier, fewer users on higher floors.

-users come in from one of the entrances and disperse throughout the rest of the building

-level 5 & 6 are quiet spaces, chinese + south east asia regions , a lot of foreigners come and consult

-2 main diagonal staircases connect the floors together.

-As the library is old and has conservation status - structure of library(e.g height of ceiling) cannot be changed

-Size of the lift in the library cannot be increased.

-fire shutters on each floor to isolate the areas to public.(can simulate control or close off of certain sections)

-Not all seats are near power sockets due to the power limit

**Level 6 (chinese library + quiet study area)**

-contains a quiet study area besides the chinese library

-got shelves for chinese collection + semi enclosed sitting areas for the users,model to tackle with chopping?

-usually seats hogging

-40 thousand Chinese items stored

-Entrance at chinese library allows access to all other library areas. (opens at 10am)

-2 gantries , one will open later the gate is not locked , quite quiet because it leads to engineering but YIH is closed now

-Frequency of users enter through here is much smaller as compared to other entrances.

-Usually large group of users will go to other area of lib; only a small portion stays in Chinese lib

-Turn over around this area is not that high

-Sometimes have exhibitions related to Chinese history / southeast Asia are displayed near the entrance

* rate of people going in and out is also quite low during peak periods
* Simulate to see if there is a **difference in queue time** when gates are enabled and not enabled.

**Level 6 (another quiet study area)**

-Nothing except for seats to study

-1 staircase connecting the study area to the rest of the library

-during reading week, another door will be opened to allow students to enter the library from outside.

-This area is not connected to the chinese library, and can only be accessed through the 5th floor.

-toilets of different genders are at different floors, they opened up accessible toilets but not easy to find

-staircase is yellow , should be neon yellow, inspired by Seattle uni, and can lead users from level one to level 6. Its design purpose is similar to the yellow ceilings in NUS. (Can use this to manipulate the public's movements/movements during peak periods).

**Level 5**

-got one spiral staircase to chinese lib.

-If use spiral staircase and go all the way to the top, will enter the chinese lib; if use another staircase then will enter the quiet study area, another 2 set of gantries granting access to the library

-exhibitions of SEA

-2 special collections (SG music collection and Chinese library collection), cannot be borrowed so users have to use space if they wish to reference the books, area is also free for users to come in to use the seating area

* SG music collection has a map area that is donated by US embassy

-another open shelves at the other side

-middle is open space for study

-2 phone booths to make private call

-printing area beside open shelves

-ceiling is low, currently can hold 200k books, used to be at level 3 which can hold 400k books but a lot of collections are electronic so users don’t have to come to library

-pretty quiet ,users only come here when they need the books ,have seats around the parameter

**Level 4**

-outside is open sitting area with gate entry from FASS

-how users experience may change if doesn’t use gate entry that impede the traffic flow

-at noon & evening the queue will be super long as everyone is trying to enter and leave through 2 gate entry

-high traffic when got event, usually come from level 4 entrance and staircase

-quite a problem in terms of managing users experience

-TEL imaginarium

-innovation room(3d printer)

-tech central

-light board room: hosting light board facilities, lecturers writing on board(inverting)

-seminar room ,sound proof usually booked can fit about 100 people

-360imx : can have projectors for immersive experience and visualisation, quite time consuming to convert a normal 360 degree video , worthwhile for exhibitions for weeks

-green room contains AR and VR headsets,hologram,motorbike for VR experience

-multipurpose room :hold events and refreshments

-digital scholarship lab (meeting section)

-digital scholarship lab (working section), those have projects in digital humanities, got workstations to be able to do their work

-recording studio

**Level 3**

-open space for collab use

-design for talking and interactions

-furnitures are movable

-multiple TVs for projects

-During vacation ,closed to hold team building and brainstorming sessions.

-staff office at one end of the floor, usually got a lot of movement for staff and delivery.

-training rooms like library classrooms - holds around 100 people.

-2 meeting rooms that students can book

-turn over rate is higher than upper floors(the design is for people to come and go)

-sound doesn’t travel up

-have buffer space so sound is kept to a certain area

-bar seating areas at the two sides

-users like there cause overlooks the garden at the side

-sometimes users lose their way and they will stand at the walkways outside

**Level 2**

-not open to the public

-closed bookshelves

-artifacts

-closed texts

-temperature control

**Level 1**

-level 1 is usually like a bazaar, co-op and coffee shop:might want to consider the behavior as they go in and out

-service desks

-cafe

-co op

-no access control ,they just come and go including general public

-in between classes , surges during peak hours as people walk through to get to bus stops.

-planning to turn in into a 24/7 but held off for now due to security concerns

-Another set of gantries to the reserved books

-collaborative active learning room: cameras installed there can have hybrid sessions

-during peak hours the lift at level 1 will be crowded ->-if we wanna simulate in terms of traffic, we can think about this

**Outside**

-space outside library is not used as much as before, busiest only during the start of 1st semester(due to year 1s)

-garden outside close to soc and biz

**Questions that client hope to gain insights from**

1)**Distribution of users in the library**, cause they only know how many users in the library but don't know the distribution: maybe look at crowd flow , move to different areas, how users are occupying each space, can measure the occupancy without getting the privacy issues(don't need use the wifi)

2)**Path that users take across the different areas** of the library, important cause the library is very big, so that every area is accessible from any point of the library(make use of design language to infer or intuitively on how to move from one space to another) -> yellow ceiling(common walkway), cues to find their way easily in the building

* The library is very old, conservation status, so they cannot do a lot about the layout, need to work within certain constraints

3)won’t be used on the daily basis, only project basis, because at one glance staffs can tell how crowded it is, but cannot tell **how users dispersion** changes across periods(from morning to evening)

4)**Seat hogging**,**way finding and crowding of entrances** don’t have **actual utilization data** (will be helpful if they can be simulated, especially level 5 +6). Library employs student assistance during peak periods but not much they can do due to liability concerns.

-potential reservation seats

5)**Changes of user behaviors** across time, crowd dispersion for different periods of time.

6)**Reconfiguring the space differently** across during periods of the semester and investigate the users experience

7)**Look at what others has done and adapt those to our current setting**

**Q N A**

**1)Why is reserved books at level 2**

**-**  24/7 aircond +

-no windows + sunlight(preservation reason) +

-floor can take the load +

-ability to put in rails for shelves to move around(compact shelving at another part of the level 2, can pack 2 or 3x the amount of books)

-guidelines on design of shelves, sprinklers and ventilation, fire access panels(no shelves next to the window)

**2)Where are the fire exits?**

-doors directly to walkways

-access panels that SDF can use directly to enter

**3)How can we find the special events happening on certain days?**

-Event calendars available online, can simulate event and non event days

**4)What are the problems the library wishes to tackle for this project?**

-Seat hogging,way finding and crowding of entrances (maybe reconfig library space for different time of the semester)

**5)Tackling seat hogging**

-student assistants during peak periods to police

-encourages for community policing

-removal of items: concerns of liabilities

**6)What are the main responsibilities of the library staff?**

-operations team : look at certain issues like space config and seats hogging , certain ways to partition the space(shutters to control certain space of the building), maximise utilisation + minising cost

-take into account the utility usage : scales linearly with the spaces open(like 1 floor is 1 unit)

-most of the cost is electricity, water usage is not that significant

**7)Configs consideration**

-Fire safety and emergency exits

-power sockets cannot build all over because of power limit, limits the freedom of configurations

**8)Turn over rate**

-looking at traffic, not equal across different area

-individual pods and bar seating(lvl 3) areas are lower

-open space usually higher

-depends on the period during the semester(exam season)

**IDEA**

Current Idea:

* Create a model, able to adjust variables
* Simulate the building, all 6 level
* Allow staff to edit data?

Date, Time, Level: occupancy

TMR: Ask for more data

* Electricity usage – power consumption across different floors/sections
* Wifi usage - to know which space is being used
* More complete data (for a month…?), across the semester
  + W6/7
* Do you need an option to add in more updated data?
* Seat hogging: collect data?

Group 3

Interface for students to scan QR code on tables to counter seat hogging it can also track student displacement in library

Staff Ans:

* Nus came out with a seat hogging program (choke NUS), only selected places affected (currently very new can try to build on that. Things to optimise can be the time a person can book the area and where this system should be implemented).
  + Currently allow time for booking is 1h min 4h max
  + Still in the development phase, librarian staff are supposed to get data on the program but have not received anything yet.
  + Med science library is being tested this current thursday
  + Hong swee library level 1 being tested
  + 6 Nov central library lvl 6 testing
* Maybe can implement a credit score as someone may scan the table but do not use it. Penalise those that do not use the table they booked.
* Deploy assistance during peak period to scan the seats to see which seats are booked but not used.
* Library visitation starts to ramp up from week 8, slowly reaching max usage by week 10. Week 10 would be interesting to observe.
* There is a difference in the number of visitors between Sem 1 & sem 2, usually sem 1 is more busy - could be because of year 1s just come in and trying to accustom to uni live, also can be many people go for internship in sem 2 so as a whole lesser people on campus.
* Visitation during vacations are usually quiet, but near the end of AY will have some activities due to students taking special term and organised staff activities.
* Model don't need to be too high level, as long as can give them a general sense can already.

Group 2

Similar to group 3, also scanning QR code to book seats.

The difference is visitors are only able to book seats when they tap into the library. Scanning the qr code will show them what seats are available so they can book it, the moment they tap out of the library they will no longer hold the seat.

Staff ans:

* Like the idea of booking is only restricted to those physically in the library. However may be difficult to implement as the tap in system is not link to any other system and may be difficult to link.
* Currently rooms can be booked 3 days in advance if change to only can book onsite students may not be ok with it.
* Reservation vs checkin - can only reserve in the library (e.g. can reserve a seat for tmr) or check in in the library (e.g. can only book a seat now which is much stricter)?
* Current data is cleaned - all those that tap in but not tap out or tap out but not tap in are remove (can provide raw data)
* Data collection can be split among the groups - one person come down 1h, total got 32 people. Also may do a collaborated survey with the other groups.
* Rbr (lvl 1) may be more busy during exam week as more people may want to check out the textbooks.

Group 1

Dk what they doing they only ask questions

Staff ans:

* Staff are interested in the movement of visitors as they want to know the user’s experience. (e.g. They want to know if their arrangement of furniture allows users to know where things are. Or if users take too long to reach their destination.)
* Want to know how frequently users move from 1 area to another and what route they use to get to their location.
* Lower levels are designed to be more bustling so their intention is for lesser people to visit the upper floors, they wish to know if it is the same in reality.
* They also want to know how users are using the space
* Difficult to measure how layout will affect space utilisation, they wish to find a way to rearrange furniture to increase maximum usage of furniture (e.g people may not want to sit beside an occupied seat so only 50% of the furniture space is utilised).
* Reason for some levels to have a lot of space is because of fire safety and also load bearing of the floors.
* Facilities also impact how they use the space (e.g seminar room at lvl 4 needs a holding area).
* A lot of usage of printers as lvl 5 maybe people come in not to use the space but just to print. If come in just for printer then can put printer closer to the exit so people don't need to spend too much time in the library.
* Saturday close whole of level 3, vacation close level 3&6, lvl 5 has to be open

Our Group

Staff Ans:

* For rearranging furniture during peak hours, visitors may need to relearn how to get to their destination if furniture is rearranged. May affect the user’s experience. Need to take that into consideration.
* Data able to share:
  + Time in time out data for 1 week
    - The data will contain anonymous student id so we can see how many people clock in but no clock out and how long they spend in the library.
    - When looking at data we need to take in consideration of those that don’t tap out so we can get a more accurate picture of how long people spend in the library( e.g. Some tap in dont tap out then tap in next day, their actual time spend may be 4h but the data will show they are in the library for 24h so we need to take that into consideration.)
  + Electricity consumption
    - Only able to get electricity consumption for the whole building, not different floors.
    - Floors are different sizes so maybe power is proportional to floor area, however, restricted book area (lvl 2) use more power due to 24h usage. Some space share electrical appliances so electrical appliances are on even when 1 of the space is not used.
* They like the idea of updating the dataset every month as it can help make the prediction more accurate. It can also help them see if some of the prediction parameters need to change to better reflect the current trend.
* For seat hogging, they say nus choke is trying a system to penalise those that book the venue but don't use it. However the results are unknown yet as they never get the data.

Meet again in another 2-3 weeks.