Mastermind Crash

A method to reveal the impact of architectural redesign

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Publication date
2021

Document Version
Final published version

Citation (APA)
Pereira Roders, A. (Ed.) (2021). *Mastermind Crash: A method to reveal the impact of architectural redesign*. TU Delft OPEN.

Architecture

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Publication date
2021

Published in
Mastermind Crash

Citation (APA)
Ribeiro Nunes, B. F., & Zijlstra, H. (2021). Architecture. In A. Pereira Roders (Ed.), *Mastermind Crash: A method to reveal the impact of architectural redesign* (pp. 73-112). TU Delft Open.

MASTERMIND CRASH

A method to reveal the impact of architectural redesign

edited by Ana Pereira Roders

AR0108
HERITAGE & VALUES
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Contents

CHAPTER

1

Introduction

by Ana Pereira Roders

Welcome to the course Mastermind: CRASH! As at the classic mastermind game, you will unite as teams and crash the hidden code, to reveal the true impact of architectural redesigns. Thank you for choosing this course as your elective.

My name is Ana Pereira Roders and together with Joana Gonçalves, we are respectively, the coordinator and tutor of this course. I am Professor in Heritage and Values and work with a team of about 20 academics. We are most passionate about the WHY questions, working to better define the values of heritage for society, ever broader and more accurate. Being these values, often, the ticket for conservation, we believe that our work can help monitor and better influence how values change over time and place, towards greater sustainability. Joana Goncalves is a lecturer and PhD candidate, working to better define and reduce the gap between intentions and behaviors of architects, and architecture students of course, when aiming for a sustainable conservation. Even when we want to redesign more sustainably, why do we fail?

Mastermind: CRASH has more experts, most from the section of Heritage and Architecture, that contributed to your lectures, and that in part, will join at the mid-term and final presentations, to provide you feedback, specific to each domain. Those are respectively:

- Gabriel and Wido on Conservation
- Nan and Pirouz on Reuse
- Bruna and Hielkje on Architecture
- Joana and I on Sustainability, and,
- Lidwine and Ivan on Heritage.

This chapter was divided into three parts: 1. Background; 2. Domains vs. Steps; and 3. Game Rules.

Background

The cartoon in the figure makes a caricature of architectural criticism, but gives us enough food for thought! First, architectural criticism can be quite subjective, dependent on the architectural critics and their often-opposing opinions. Second, the nature of the criticism is often aesthetics-oriented, as volumes, forms, materials and styles. We consider it a missed opportunity to really learn from designers and their designs. What worked? What didn't? What was planned? What was unexpected? Not every decision is visible to the naked eye. Without a tailored research and reliable sources, conclusions remain opinions and fail to reveal the true impact of an architectural redesign. Whether you like it or not, should not influence your conclusions.

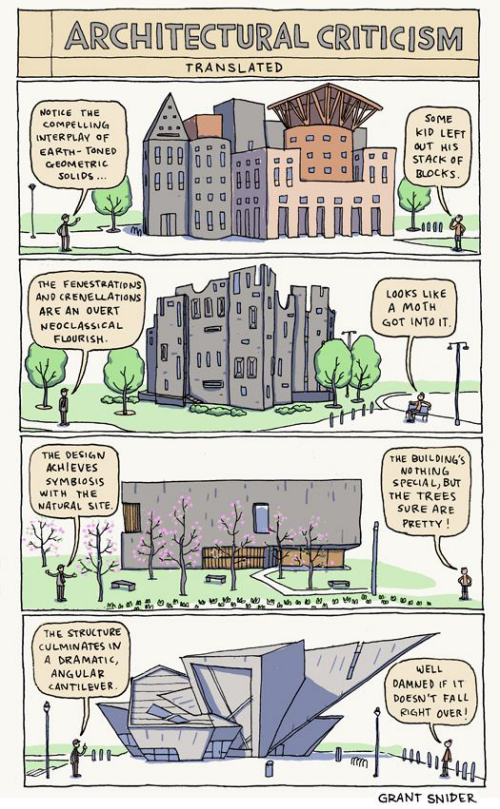


Figure 1.1 : Architecture criticism translated

We strongly believe that, as in other disciplines, the more we learn from architectural redesigns and their lessons, the more we help validate and improve future architectural redesigns. Going beyond opinions in architectural criticism is key. No matter how experienced the architect is, context keeps changing, as does the building technology. What once worked may later fail. When you critique architectural redesigns, you not only help those involved to reflect on their work and outcomes. Also, you develop a sense on how certain flaws weaken designs, and how certain redesign solutions enhance them.

Before we move on, let me give you an example. Have a look at the buildings in the picture.

Figure 1.2 : Historic Centre of Warsaw, Poland

For those that do not recognize these buildings, they are part of the historic centre of Warsaw, in Poland. They may look old from the outside, but they were built in the second part of the twentieth century. Warsaw was deliberately reduced to ruins in 1944 as a repression of the Polish resistance to the Nazi German occupation. The reconstruction project was devised in the years 1945-1951, and implemented until the 60's. Due to such "unique European experience" and contribution "to the verification of conservation doctrines and practices", led by the inhabitants and supported by the whole nation, Warsaw was inscribed in the UNESCO World Heritage List in 1980.

So, how to go beyond opinions and naked eye conclusions? How to develop into a reliable architectural critic? They are not alone and could exchange experiences with others, who also assess the nature and impact of architecture.

Nearly every city, region and country provides design guidelines in planning laws and regulations, as well as, building permit procedures. Depending on the city, these guidelines might tend to focus on the YES, what designers ought to respect, e.g. building heights; or tend to focus on the NO, what designers cannot do, e.g. demolish. These guidelines also help local officers to assess architectural redesigns on their quality, and determine if they can be approved (positive impact) or if instead, needs to be rejected (negative impact).

Unlike architectural criticism which is always done retrospectively, after the redesign has been built, and assessing real impacts, impact assessments can also be done during and before the redesign has been built. Such difference in time does matter and can influence the quality of the redesign greatly, as before built, impacts still can be anticipated, discussed and eventually prevented or mitigated, if they turn out to be adverse (negative).

Moreover, impact assessments also vary in the nature of the impacts, and/or what need to have its impact assessed. Each assessment is normally regulated with national policies, and for the case of European countries, also at the level of the European Commission with the referenced Directives. Respectively:

a. Strategic Environmental Assessment, short named as SEA, is applied to policy, planning and long-term scenarios to determine and mitigate impacts on the environment

b. Environmental Impact Assessment short named as EIA, is applied to development projects also to determine and mitigate impacts on the environment

c. Heritage Impact Assessment, short named as HIA, is applied to development projects to determine and mitigate impacts on heritage-designated resources

Liverpool, in the UK, was in part inscribed on the World Heritage List in 2004, for its unique role in the last three centuries as a major centre generating innovative technologies and methods in dock construction and port management, as well as, representing the early development of global trading and cultural connections throughout the British Empire. However, by 2012, Liverpool was also inscribed in the List of World Heritage in Danger due to the eminent threats, to be caused by the development project Liverpool Waters. A perfect case study to discuss the successes and failures of such impact assessments, which is still unsolved till today.

For the particular case of Liverpool, not one, but three HIA were prepared with three different clients and three different outcomes. Two HIA reports confirmed the negative impacts, but other two overshadow these negative impacts, with the positive impacts of the development project. By coincidence, these last two were the same that developed and approved the project. So, just as with the architectural criticism it is possible to identify the same problems of subjectivity and the tendency to focus on only what supports your intended outcome for the impact assessment, rather than reporting the outcomes with impartiality and credibility.

Just like when honoring awards, decisions cannot be random and transparency is key. Already three decades ago, Sadler (1996) defined 6 key concepts to ensure quality in environmental impact assessments. Accordingly, the concepts are:

1. Systematic approach; as it is important that you share the problems and the defined methodology and suitability to address them;

2. Basis; as people are entitled to see the sources of the data/information, which you use to base your work;

3. Criteria; as you need to clearly explain the attribution of significance in a rational, defensible and problem-relevant way, ranging from negative to positive impacts;

4. Confidence; as the impact prediction and judgement that underlie the attribution of significance may not always be 100% certain, either due to lack of information or unreliable sources; and

5. Impacts; as ecological, social, economic, and cultural. The more you detail your domain and indicators, the better others can understand your work and outcomes.

6. Explanations; as is very important to distinguishing assumptions from facts. Assumptions are like theories you cannot yet proof, but can be mentioned. Though, they reduce the reliability of your conclusions. So, better keep them limited.

You will recognize these concepts in your evaluation grid of this course, as they influence greatly the quality of impact assessments.

Domains vs Steps

In this section we will introduce the five domains and the six steps of the research process that you will follow, during this course, in development of your assignment. Each group is to be formed by 5 students that shall choose one of the five domains. As we told you earlier, the domains are respectively:

a. Conservation

b. Reuse

c. Architecture

d. Sustainability, and,

e. Heritage

The steps are respectively:

1. Define,

2. Collect,

3. Classify,

4. Analyze,

5. Assess, and last,

6. Present

We understand that both these domains and steps can be much broader in definition than we will now explain, but for the purpose of this course, and to enabling you to achieve the learning objectives within the duration of this course, we defined them as such:

1. A student that choses the domain of conservation is most curious to revealing the impact of the architectural redesign, by focusing on the condition of the building, which is to be affected by its materiality, detailing, age, exposure to climate, etc.

2. A student that choses the domain of reuse is most curious to revealing the impact of the architectural redesign, by focusing on the spatial functionality of the building, which mainly concerns the uses people give to such building.

3. A student that choses the domain of architecture is most curious to revealing the impact of the architectural redesign, by focusing on the DNA of the building, which inversely, cannot be changed by people and the uses of the building.

4. A student that choses the domain of sustainability is most curious to revealing the impact of the architectural redesign, by focusing on the sustainable footprint of the building, and therefore, addressing the opportunities and threats for its context, social, environmental and economic.

5. Last but not least, a student that choses the domain of heritage is most curious to revealing the impact of the architectural redesign, by focusing on the cultural significance of the building, and therefore, addressing the strengths highlighted by society, experts and non-experts. These strengths can convey attributes that are relevant to the domains of reuse, architecture and/or sustainability. Though, they are often a selection.

The more you work together as a team and match your domains and attributes, the more you will learn, and consequently, the higher your grades will be. For example, would the building façade be most valuable in its heritage listing, for its unique windows and daylight, the team could team up to research it together. Architecture, would work to defining its DNA, conservation its condition, reuse could use it to validate the relation between the façade and the internal spatial functionality. While sustainability would research the footprint of the windows for the people, planet and profitability, heritage could dig further to understand why such windows became so important, and if both experts and non-experts agree. You may have noticed that, these five domains even if different have much in common.

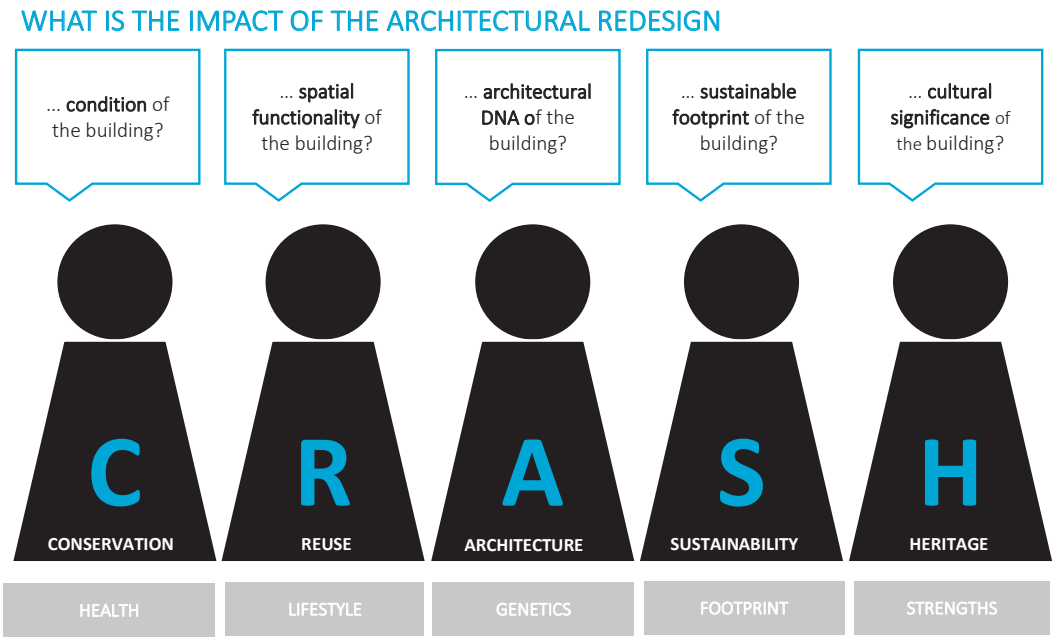


Figure 1.3 : The Mastermind Team

When comparing a building to a person...

a. Conservation would be like health

b. Reuse would be like lifestyle

c. Architecture would be like genetics

d. Sustainability would similarly be like footprint, and,

e. Heritage would be like strengths

Your health is strongly influenced by your lifestyle and genetics. Similarly, your strengths and how others perceive you and what you do, are also influenced by genetics and footprint. That is why we decided to have you teaming up per architectural redesign, so that you can learn from all domains and their relations, and not just the one you chose as your own.

You will follow a process of six steps, which I will illustrate with the indicator materiality, in the domain architecture. When you take these steps on weekly basis, and carefully focus on achieving their milestones, you will finish your assignment on time, and excel on what you can learn from this course. In the first step, to define, I research earlier studies and define my methodology – including the theoretical framework, methods, sources, sampling, tools, etc. - to best research the selected three indicators. In the second step, to collect, you follow the methodology, to collect data on the indicators, about before and after redesign. For the case of materiality, data could be photos, building /redesign documentation as drawings and reports, or the building itself. In the third step, to classify, you organize/process the data and classify according to the theoretical framework. For the case of materiality, the theoretical framework could include material types, textures and colors. In the fourth step, to analyze, you compare the results, obtained for before and after redesign, to reveal change. Like at those games, spot the differences, what has been kept by the architectural redesign will be identified in both classifications. What has been removed will be identified only in pre-design classification. What has been added will be identified only in redesign classification. More detailed analysis can reveal relations between old and new, to contrast, interpret or replicate the existing building. In the fifth step, to assess, you can finally develop/apply an assessment framework to define the impact. The assessment framework is to be developed for your indicators, in the format of a likert scale with bipolar scaling of 5 degrees of impact, ranging from major adverse (negative) to major beneficial (positive). In the sixth step, to present, you define/ apply how to best present/share the results, and reveal the code of your architectural redesign.

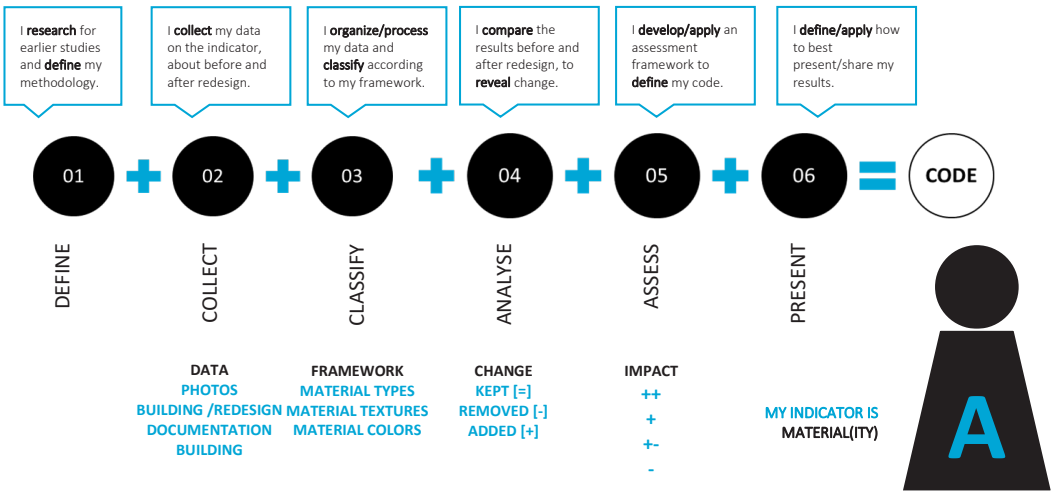


Figure 1.4 : The Mastermind process applied to the indicator materiality

Bringing it all together, these six steps may seem very simple but are not. You need to find balance in your work pace, avoiding both extremes, either by doing it too quickly and subjectively, leading to an unfunded impact assessment, or by doing it too long and systematic that you end up incapable to finishing on time to present your code. As a team, you can help each other. If these themes really interest you, there will surely be more opportunities during your master or even after, in a doctoral research.

Game Rules

For those less familiar with board games, Mastermind is normally played with 2 players, 1 code-maker and 1 code-crasher. Over time, many variations were developed. Nowadays, you can also find it as app online.

Our version of the Mastermind, has also one code-maker, planned to be the architect, but if he/she is not available, you could also select another stakeholder. Examples of stakeholders are the local officer, a project manager, the builder, a user or the owner. The code-maker keeps his/her code secret till the end, as in the original Mastermind. The students, in groups of five, each with a different domain, are the code-crashers. Meaning, that they will together define a code, based on their research, to play against the architect. The tutors and experts, act as code-auditors, making sure the game is played fairly.

Will the architect and stakeholder provide the tutors with the secret code, by the mid-term presentation, we can already hint the match between the code-maker and code-breakers, with the traditional black/white pegs. The colored pegs are used to reflect the estimated impact of the architectural redesign.

To make it more interesting we advise you to already set together an initial code, as a hypothesis. We are sure that there something intriguing you already, either tending for the positive or for the negative side, that made you chose such a redesign as case study.

There is no prior knowledge required for this course. All students are welcome to follow their passions and chose their favorite domain.

There are 5 learning styles we defined for this course, even if lectures are now all online. We will provide you the lectures, which you need to watch and answer the small quests we prepared for you. The tutorials will be organized via zoom, where you will present and discuss your progress with a fellow team, always different every week. For the tutorials, you are asked to prepare a small PPT to share the weekly progress and quests. It should not take longer than the Pechakucha limit 6:40 min. In self-study you are expected to work with your CRASH team, but you are also asked to raise questions and exchange experiences with your domain fellows, from the other teams, via the Brightspace forums we created for the purpose. You are expected to work alone on your domain and the specific tasks you defined with your team. In sum, this course expects a workload of 140 hours, which is by ¼ spent on the lectures, tutorials and presentations. Most of the time, the remaining ¾ is to be spend on self-study, teaming up and developing the assignments.

We strongly recommend you to be proactive and plan your weeks upfront. No need to be exactly as we estimate, as you might have other courses and work part-time. Though, please do plan it. The success of teaming up is to keep communication open, help each other and honor agreements on what each one is expected to do. You can create a Whatsapp group or communicate via Brightspace. What suits you better.

As earlier mentioned, you will analyze the architectural redesigns and determine its impact by comparing the status post and pre- design, but to reveal it, you will need to distinguish what was added (new), from what kept and removed (old). Keep in mind the goal is not to create an historic evolution of a building e.g. creating timelines. You will collect information to reveal the status which the architect found before redesigning, so you can better determine the impact of the solutions. This is different from earlier analysis you might have done in history assignments.

During the tutorials, two teams meet on weekly basis and will provide feedback to each other. The tutor supports the discussions, like a coach, moderating the time and the feedback process, complementing it, when found suitable.

If we succeeded, you can already find this schedule in Brightspace. If that is not the case, please let us know. We will generally meet on weekly basis, so you can share your progress and be provided with feedback, after you watched the lectures. Do note, only the first tutorial is with the entire group. Check Brightspace for the meeting time of your group and join zoom on time. Halfway, we will have a mid-term presentation, and before the final presentation, we will do a trial, when last tips and tops can be exchanged. These presentations are also done in plenary, with all the students.

After the 9 weeks, we are confident that you will master critical thinking in architectural redesign, a form of reflective reasoning that evaluates facts, information and arguments, by applying a range of intellectual skills to form a clear, logical and coherent judgement on the nature and impact of the architectural redesign.

The learning objectives of this course are three-fold.

Concerning Knowledge, you will learn to:

- Assess a selected domain individually, comparing before and after architectural redesign
- Reach consensus on a co-created assessment, making use of a pre-defined framework

Concerning Skills, you will learn to:

- Produce a documentary of a building by means of text, drawings, graphs and figures, reporting the nature and impact of the architectural redesign in the respective domains, as well as, explain their interrelations
- Produce fact sheets, documentaries and argue in discussions with team members and architects, using an appropriate professional scientific language

Concerning Attitude, you will learn to:

- Develop an investigative attitude towards the nature and impact of architectural redesigns, by cross-relating the domains: Conservation, Reuse, Architecture, Sustainability and Heritage.
- Understand the added value of critical thinking, sometimes confirming, others contesting own opinions/general assumptions.
- Experience multi-disciplinary teams and shared decision-making, when comparing and integrating individual results per domain.

The evaluation share is respectively:

a. Lectures quiz (23%)

b. Factsheets (48%)

c. Documentary (17%)

d. Attitude (12%)

A template and examples of the factsheets will be provided in Brightspace. Each student will submit three factsheets per domain: design, pre-design and impact assessment. The Pechakucha (documentary) is done as a team, per project. A template and examples will also be provided in Brightspace. The attitude of each student is assessed by the student, the team and the tutors. A form will also be provided in Brightspace. All submissions will be scanned for plagiarism with the TUDelft software Turnitin. Make sure all work submitted is original and that work used by others is referenced.

In the next chapters, the domain experts will introduce and frame the domains Conservation, Reuse, Architecture, Sustainability, and Heritage, that compose this CRASH course.

CHAPTER

2

Conservation

by Wido Quist & Gabriel P. Redondo

Introduction

As part of the Intervention Impact Assessment done by students in the MSc 2 Course – Mastermind CRASH the Code, Conservation was selected to be one of the domains to assess the impact of the intervention. According to EN 15898:2019, Conservation, is defined as: "measures and actions aimed at safeguarding cultural heritage while respecting its significance, including its accessibility to present and future generations". However, in the context of Impact Assessment of this course,, conservation will be focussed on from the perspective of the historical physical substance. Translated to the HA-triangle it is the focus from the technology perspective towards the design and values perspective (figure 1).

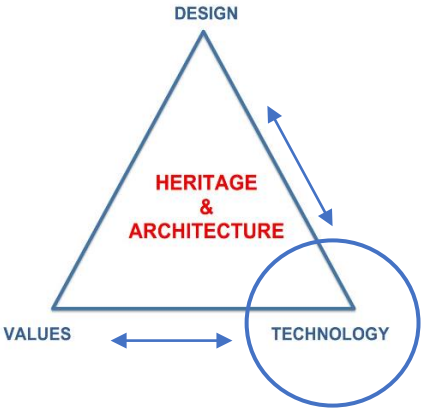


Figure 2.1 : HA-triangle with the focus on Technology for the Impact Assessment on 'conservation'.

The principle of the Impact Assessment on the domain of Conservation is based on a comparison between the current state of conservation and the state of conservation before intervention. It is based on an investigation and inspection (condition assessment) of the situation after intervention (current) compared with the situation before intervention, or in other words: **Condition now - Condition before intervention = Impact**.

The extend of exposure together with the properties of the materials, as well as the characteristics of the construction, set the conditions for degradation. For decades, the basic (western European) principle of **conservation** of built heritage was and still is to do as little as possible and as much as necessary (minimal intervention) to preserve the historic physical substance (see i.e. Venice Charter, Burra Charter, Nara Document on Authenticity). On the other hand, the aim of maintenance or **preventive conservation** is to prolong the service life of buildings, building constructions and building materials. To continue using a built structure, it is normal to keep an eye on its degradation and intervene when the quality drops below a certain level of acceptability. The principle of maintenance should be no different for heritage buildings or non-heritage buildings.

Interventions to building constructions and materials should be based on an assessment of their condition (at T_0). Based on the severity, the extent and the intensity of the defect, interventions should be designed and executed. The impact – to the historical substance - of this intervention can be assessed later by performing another condition assessment (at T_1) and comparing the results of both assessments and relate the difference to the executed intervention(s). The impact can be expressed with the indicators of **reversibility, compatibility, retreatability and durability**.

In the following paragraphs the different elements of the Impact Assessment will be further explained, guided by the research scheme in Figure 2.

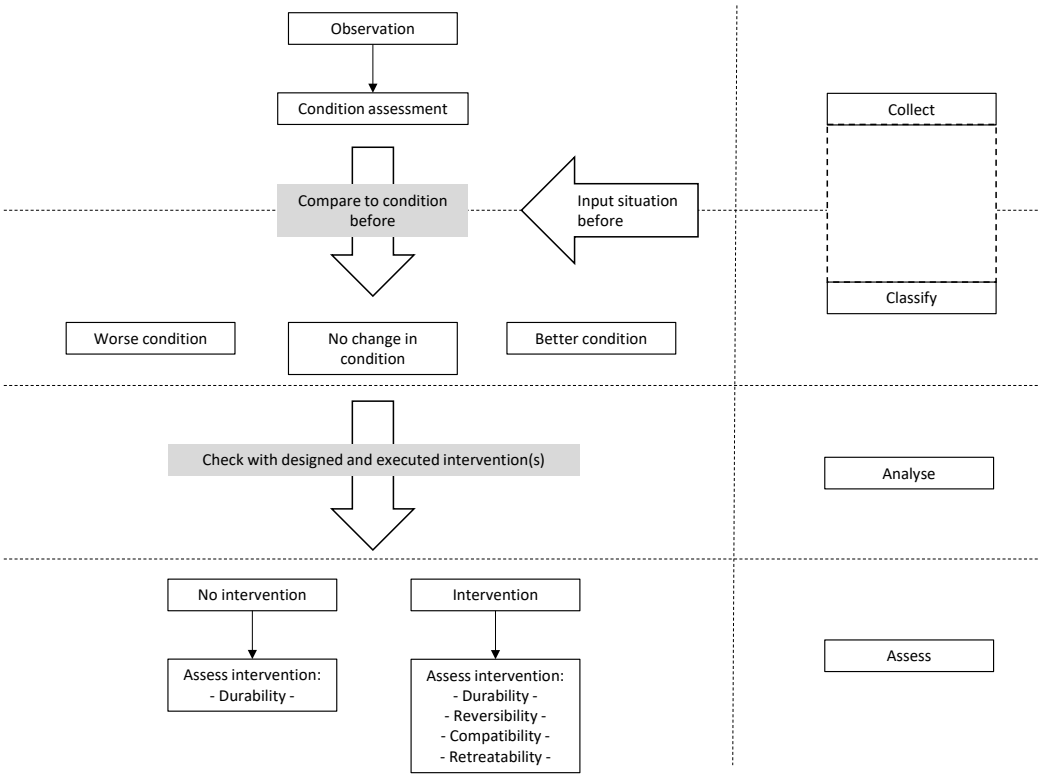


Figure 2.2 : Research scheme Impact Assessment on 'conservation'

Define

The Impact Assessment in the domain of conservation is based on a visual inspection (condition assessment) of the situation after intervention (current) in comparison to a documented situation (condition assessment) before intervention. A condition assessment is defined as determining, interpreting, and quantifying defects of a building, building construction or building material. There are several ways to perform a condition assessment, all -in principle- starts with a visual inspection with the help of additional research.

The current (Dutch) standard in assessing the condition of real estate is set by NEN2767, for historic buildings the most recent standard is set by URL 2005 – Inspecties van monumentale gebouwen[1], build up in line with NEN2767. Next to that, MDCS (Monument Diagnosis and Conservation system)[2] is an especially useful tool as it is an interactive support tool for the inventory and evaluation of damage to monumental buildings. During visual inspections, MCDS helps to clearly identify the types of materials and the types of damage, providing clear communication – helping in the case of an Impact Assessment to compare two condition assessments. The structure of MDCS is based on the consequent elaboration of the following steps:

1. Inspection / hypothesis
2. Diagnosis
3. Design of intervention
4. Intervention
5. Documentation / monitoring

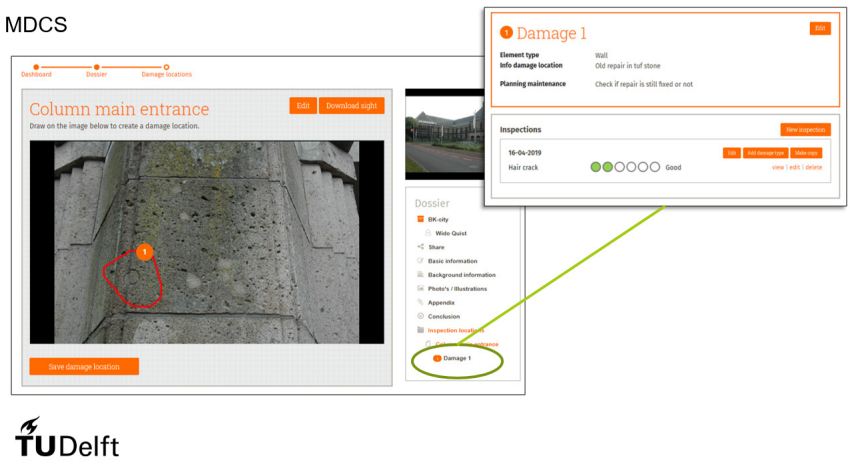


Figure 2.3 : The graphical interface of MDCS.

1 https://www.stichtingerm.nl/kennis-richtlijnen/url2005
2 https://mdcs.monumentenkennis.nl/

The impact of an intervention can be measured using different indicators. In the case of the MSc 2 Course – Mastermind CRASH the Code, the following indicators, with their consequent definition will be used:

- **Reversibility**
  Extent to which the outcome of an intervention can be undone without damage to the object;

- **Compatibility**
  Extent to which an intervention, or a treatment, causes any damage (technical or esthetical) to the historic material;

- **Retreatability**
  Extent to which an intervention can be repeated in the future;

- **Durability**
  Capacity to resist the effects of wear and tear in performance situations

The above mentioned indicators and definitions have been derived and composed from different sources. The concept of reversibility is retrieved from the Charter of Venice and the concepts of compatibility as well as retreatability are retrieved from Teutonico et al. (1997) and NEN-EN 16898:2019. The definition of durability comes from NEN2767. See Quist (2011) for an elaboration on the background of this terminology.

Collect

Input necessary to make an Impact Assessment on the domain of 'conservation' are two condition assessments (T_0 – before intervention and T_1 - current). According to NEN2767 a condition assessment is the determination, interpretation, and quantification of defects. Three defect parameters are identified for this: the severity of a defect, the extent of a defect and the intensity of a defect.

A condition assessment is based on a visual inspection, followed by a hypothesis on the origin of the observed defects, followed by a diagnoses on the cause of the defect, expressed in terms of severity, extent and intensity.

Collecting data means: going on site and documenting the situation (see figure 4 and 5); if possible and/or necessary extended by archival sources and/or oral history to get a better understanding of the situation. Processing the collected data is part of the 'classify-step'.

Figure 2.4 : Documentation of situation on site by means of photography.

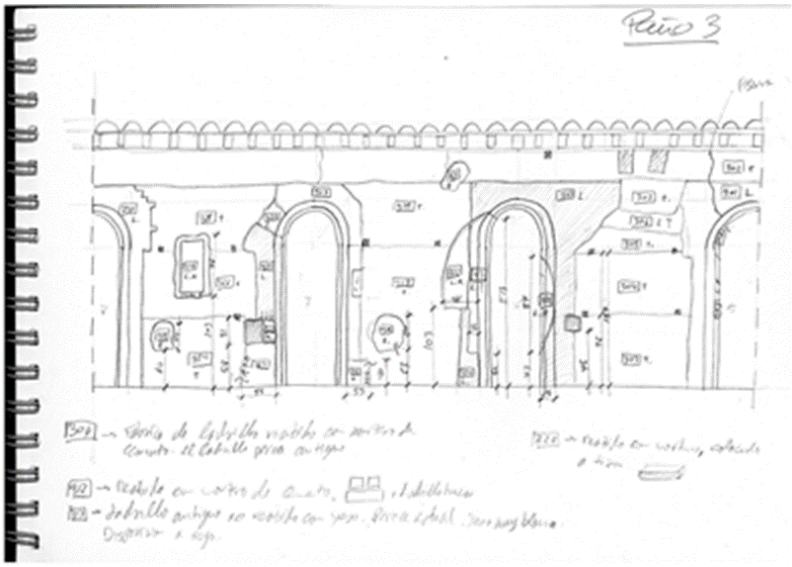


Figure 2.5 : Reduction and first analysis of a situation on site by means of an annotated hand drawing.

To be able to make an assessment of the impact of an intervention, not only the current situation (T_1) is necessary, but also the situation before intervention (T_0). It could be difficult to find out about this situation (as in many cases it is not there anymore due to the intervention). Aim for reports, photographic documentations and oral history to 'reconstruct' the condition before intervention. The project archive of the architect, archive of the Netherlands Cultural Heritage Agency (RCE), local archives, different internet sources, reports by Monumentenwacht, as well as owners or building managers can be of great help to collect this data and should be used. Also the type and intensity of intervention can guide you towards understanding the situation before intervention.

Classify

The aim of the classification-step is to compare the current (T_1) with the situation before intervention (T_0) in order to assess in what way and by how far the current condition differs from the situation before intervention. To be able to make the comparison, both situations need to be documented (collect-step) and need to be diagnosed. This diagnoses is a step in between collecting and classification.

In conservation not all the data about a building is known beforehand, in fact, for most of the buildings just a small portion is known. That implies previous work of investigation on- and off-site to have enough information to assess the building, which turns into diverse types of data (materials, damage types, historic background, geometry, etc.).

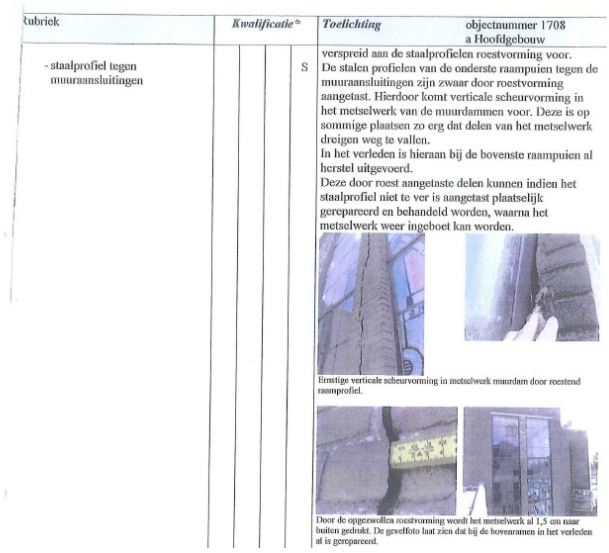
Diagnosing the data does not require a special skill or a deep knowledge of conservation. In fact, even though you are an expert in this field, it is better to switch off that part of the brain when collecting, diagnosing and classifying data to not jump to conclusions too soon. This is similar to a scientific investigation; you may have an idea of what the results are expected, but you should not jump right away to the conclusions without supporting data. The data collected and diagnosed must be relevant to the goal intended (in this case comparison of a situation before and after intervention). When designing an intervention it is necessary to diagnose the type and cause of the damage, but in case of comparison a situation before and after intervention, those are less important: the focus should be on severity, extent and intensity, of course were possible referring to the right damage type.

Figure 6 shows an example of mapping the **characteristics** of the walls of the Romanesque-Gothic church of Teruel's cathedral through visual inspection. There was evident data, like the different materials and construction techniques, but also small elements that looked insignificant at first sight but later they were key to assessing the data. The materials were classified into rubble, solid brick, hollow brick, and plaster. The rubble appeared in between windows, the solid bricks around the windows, the hollow brick in four specific places infilling previous round windows, and the plaster in the area protected by the eaves. The classification of materials and construction techniques provided quantitative and qualitative data to understand past interventions in the building (clue: there were not hollow bricks in the Gothick times).

The same method as applied in figure 6 – mapping materials can be applied to map different types of damages. Based on the percentage of mapping, one could conclude on the extend of the damage and, by using colors or other signs, one can also visually map the severity and intensity.

Instead of visually mapping, it is also possible to make a photo documentation + description + indication of severity/extent/intensity as presented in figure 7.

Figure 2.6 : Mapping of different materials.



Rubriek	Kwalificatie*				Toelichting objectnummer 1708 a Hoofdgebouw
- staalprofiel tegen muuraansluitingen				S	verspreid aan de staalprofielen roestvorming voor. De stalen profielen van de onderste raampuien tegen de muuraansluitingen zijn zwaar door roestvorming aangetast. Hierdoor komt verticale scheurvorming in het metselwerk van de muurdammen voor. Deze is op sommige plaatsen zo erg dat delen van het metselwerk dreigen weg te vallen. In het verleden is hieraan bij de bovenste raampuien al herstel uitgevoerd. Deze door roest aangetaste delen kunnen indien het staalprofiel niet te ver is aangetast plaatselijk gerepareerd en behandeld worden, waarna het metselwerk weer ingeboet kan worden.

Ernstige verticale scheurvorming in metselwerk muurdam door roestend raamprofiel.

Door de opgezwollen roestvorming wordt het metselwerk al 1,5 cm naar buiten gedrukt. De gevelfoto laat zien dat bij de bovenramen in het verleden al is gerepareerd.

Figure 2.7 : Example of a Monumentenwacht-report.

The chief source of information is the existing building, but the historical background is also relevant. The data collected can vary depending on the scope and goal of the project. The data will be classified according to the scope and goal of the project to provide the supporting documents to base your conclusion. Think of the data as the foundations where to build your results.

In case of an Impact Assessment, the classification of the data is only finished when the condition at T_1 is compared with the condition at T_0. Classifying the data is an intermediate step to be able to perform an analysis on the relation between the difference in condition (T_1-T_0) and the executed intervention.

Assess

In the ideal world:
... an intervention must be completely rectifiable (reversibility);
and/or
...an intervention or a treatment shall never cause any damage to the historic material (compatibility);
and/or
... an intervention or a new material must be as durable as possible (durability);
and/or
... an intervention or a treatment must be repeatable after degradation of the intervention (retreatability).

It will be clear that the ideal world in most cases doesn't exist, so an intervention will always have combined effects, resulting in a range of possibilities more or less addressing several factors. For all the indicators (reversibility, compatibility, retreatability, durability), different factors can be defined to assess the impact:

6. Choose an indicator (reversibility, compatibility, retreatability, durability)

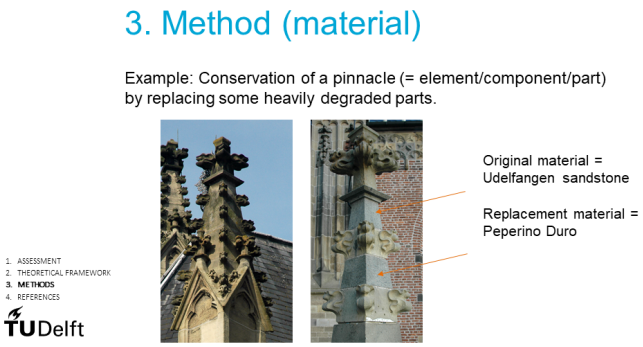
7. Define the factors per indicator (both aesthetical + technical)

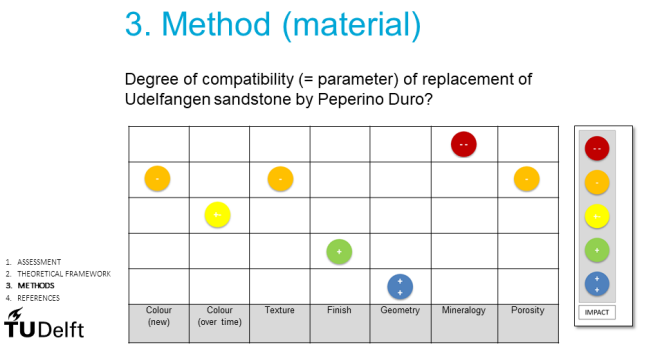
8. Define the weight (importance) per factor

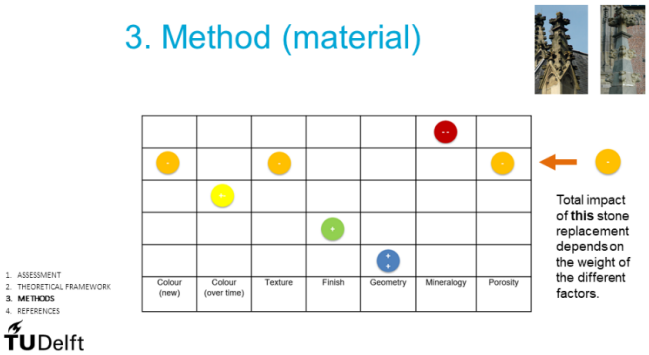
9. Assess the impact (per building part/building construction/building material)

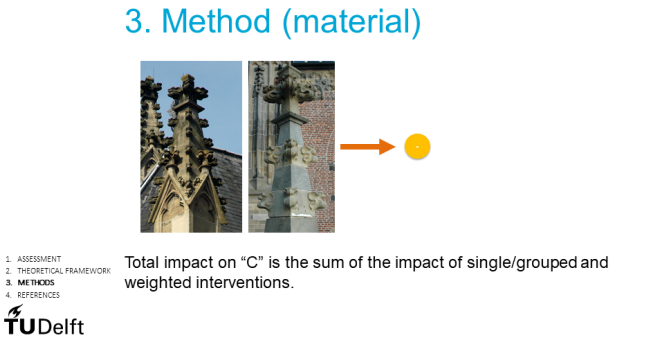
10. Define the weight per building part, building construction or building material

11. Assess the impact of the intervention on "C" (per indicator)









References

Technical Committee CEN/TC 346, NEN-EN 15898 (de; en; fr). Conservering van cultureel erfgoed – Voornaamste algemene termen en definities voor het conserveren van cultuurgoederen / Conservation of cultural heritage - Main general terms and definitions, november 2019

Technical Committee CEN/TC 346, NEN-EN 16096 (en). Conservation of cultural property - Condition survey and report of built cultural heritage, August 2012.

Teutonico JM, Charola AE, de Witte E, Grasegger G, Koestler RJ, Laurenzi Tabasso M, Sasse HR, Snethlage R (1997) Group report how can we ensure the responsible and effective use of treatments (cleaning, consolidation, protection)? In: Baer NS, Snethlage R, (eds) Dahlem workshop on saving our architectural heritage: conservation of historic stone structures, Chichester, pp 293–313

CHAPTER

3

Reuse

by Pirouz Nourian & Nan Bai

3.1 Introduction

Focusing on the quality of reuse of buildings with respect to the efficiency of human movement patterns and the effectiveness of allocation of functional spaces with respect to their needs for social encounter and avoidance reveals the configurative nature and the human impact of architectural design. By comparing such functionality assessments before and after a redesign process for retrofitting, a clearer grasp of the effect of the spatial configuration on the efficiency and the effectiveness of a design can be explicated. In configurational analysis the focal point of attention is the structure of the walkable space in the building, detached and abstracted from the shape of the building. In configurational functionality assessment, the focus is to synthesize multiple analyses, aggregate the results, and derive indicators of quality with respect to either quantitative objectives or qualitative ideals.

Does the structure of the space and the allocation of functional spaces to various locations in the spatial network of a building have an effect on its overall functionality/utility? How can we study these effects? Are the functional spaces placed in their best-fitting locations? Do the design operations like adding an external staircase or tearing down an interior wall make a difference in the accessibility of functional spaces? By digging into this topic, you will gain a methodology with which you can describe and analyse a spatial configuration in a reproducible way.

Learning Objectives

After finishing this course, and having worked on the topic of reuse, you are expected to be able:

- [Knowledge] to describe the functionality of a building using the terminology of network [centrality] analysis.
- [Comprehension] to match their knowledge of network [centrality] analysis to actual situations/examples in indoor spatial configurations, and produce fact sheets on the functionality of a building.
- [Application] to prepare spatial network models for network [centrality] analysis for comparing and judging the change of the configuration of a building before and after a renovation.

Expected Prior Knowledge

All students are welcome to choose the topic of reuse, regardless of their technical knowledge level. However, from a pragmatic point of view, it is recommendable to choose this topic if you have prior affinity with [or enthusiasm for learning] mathematics, programming, and/or computational design. Having some practical knowledge of grasshopper is recommended.

Technical Preparations

Title	Software Installations
Objective	To get all the necessary tools up and running and familiarize yourself with the UIs
Notes	If you need a Windows OS on your Mac; for further info and support on how to do this please go to @hoc: http://adhok.bk.tudelft.nl/site/info/windows-on-mac/
Description	Required Installations for the first Practicum (at home) Needed software packages: Rhino 5, Grasshopper 1 (0.9.0076) **Rhinoceros 5.0**: Can be downloaded from software.tudelft.nl, Go on Installation tab and follow the instructions. **Grasshopper**: from http://www.grasshopper3d.com/ **Gephi**: https://gephi.org/ NOTE: DO NOT TRY TO USE GRASSHOPPER FOR MAC (because it is still a work-in-progress!). Instead, use a Windows OS on your Mac; for further info and support on how to do this please go to @hoc: http://adhok.bk.tudelft.nl/site/info/windows-on-mac/
Platform	Getting started with **Rhino and Grasshopper**: Rhino tutorials: (A-Z-Reference) (must watch & practice, about 5 minutes) (must watch & practice, about 1 hour) (must watch & practice, about 2 hours) Getting started with Gephi: (must watch & practice, about 30 minutes)
Plugins	Centrality Analysis: Rectangle-to-Rectangle graph, using SYNTACTIC and Gephi Accessibility Analysis (optional): CONFIGURBANIST Optional/Extra: The following tools 'might be useful' for your project: SpiderWeb, Mesh+, Weaverbird & Rasterworks.dll: Voxel and Iso-surface Tools: 1, 2, 3, 4, 5

Literature

In this course, we teach the basics of spatial network analysis. These references are for further methodological reading. Technological know-how (related to software) can be strengthened by self-study, practice and active participation in workshops*.

***Methodology:** Mathematical Formalisms, Computational Methods (Algorithms represented as pseudo-code) and Data Models

***Technology:** Programming Languages, Standards, File Types, Software Applications, IDEs, Robotics, Power Tools, etc.

Computational Design Literature:

If you are interested in understanding the fundamental concepts of configurational analysis, then you are advised to remedy your math knowledge by reading extra books e.g. [1] pp.137-181 [2] pp.29-51, [3], [4] pp. 9-26 & pp. 225-236. Most of the topics about computer geometry are covered in [5] pp. 1-5, 7-13, 21-24, 29-33 and [6] pp. 62-63. Highlighted pages are the least you are recommended to read from the following books. For getting started with programming, check [7] (please do the exercises on pages 17, 22, 23, 27, 69, 70, 72), [8], [9], and [10]. For getting started with spatial maths see [11], [12].

[1] R. Fenn, *Geometry*. Springer London, 2001.

[2] C. Tremblay, "Mathematics for game developers," 2004.

[3] M. Batty, *Essential Engineering Mathematics*. 2011.

[4] D. Cherney, T. Denton, R. Thomas, and A. Waldron, *Linear Algebra*. 2013.

[5] M. Botsch, L. Kobbelt, M. Pauly, P. Alliez, and B. Lévy, *Polygon mesh processing*. 2010.

[6] H. Edelsbrunner and J. Harer, *Computational Topology, an Introduction*. 2010.

[7] R. Issa, *Essential Mathematics for computational design*, 4th Editio. Mc Neel, 2019.

[8] A. B. Downey, B. • Cambridge, • Farnham, • Köln, • Sebastopol, and • Tokyo, "Think Complexity."

[9] A. Downey, "Think Python How to Think Like a Computer Scientist 2nd Edition, Version 2.2.23," 2015.

[10] E. Matthes, *Python Cash Course*. 2016.

[11] P. Nourian, "Rudiments of Linear Algebra & Computer Graphics," 2019.

[12] P. Nourian, "Rudiments of Geometry and Topology for Computational Design," in *Fundamentals of Spatial Computing & Generative Design*, Preprint., no. September, Delft, 2020.

Disclaimer

This is not a contract. This document is only made for informative purposes. No rights, complaints, or excuses can be derived from this document. This course is research-oriented and as such it is inherently experimental. We might deviate from the path described here if/when deemed necessary, observing the class dynamics. Please keep in mind that the content of the 'tasks of the week' and lectures might change during the course. For every major update we shall put an announcement on Brightspace. Considering that this document is going to change a few times, please do not print it.

License and Intellectual Property Rights:

3.2 Define

Terminologies

Functionality. According to the Merriam-Webster Learner's dictionary, functionality can be 1. [uncountable] the quality of having a practical use, as the quality of being functional (e.g. a design that is admired both for its beauty and for its functionality); 2. [either countable or uncountable] the particular use or set of uses for which something is designed (e.g. The cameras are comparable in price and functionality. It is equipped with new functionalities).

Spatial Functionality. Concerning to the field of architecture/urban design, we define the term spatial functionality as the "efficiency, effectiveness, diversity, and lucidity of a spatial configuration, respectively in terms of its accessibility, centrality, diversity, and visibility distributions", for the sake of our research purpose, where **Spatial Configuration** can be defined as an indoor/outdoor **walkable** network environment.

It is important to bear in mind that the closeness in the sense of **geodesics** (optimal paths through networks) is different from the distance in Euclidean space since you have to walk on a "walkable network" (see the example below in Figure 1)

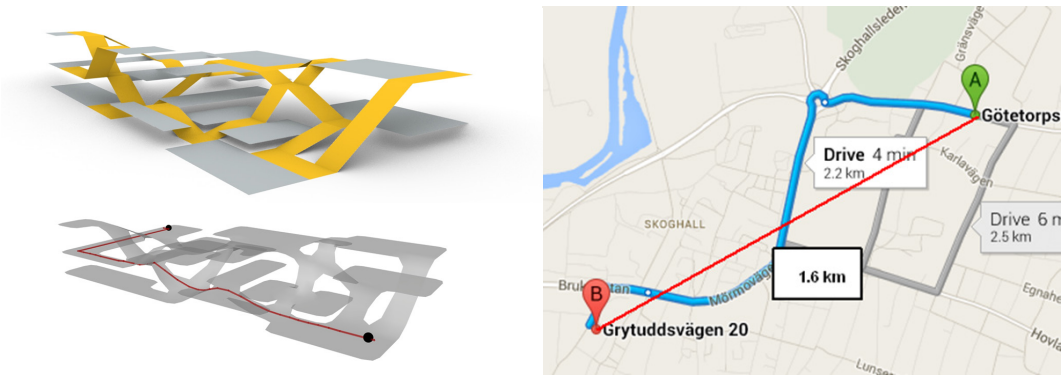


Figure 3.1 : Difference between the geodesic distance and the Euclidean distance. The Euclidean distance for a pedestrian is typically irrelevant in built environments, because the straight path is almost always obstructed and one has to walk through a network to get from A to B; for a bird, however, the distance is typically the length of the straight-line between A & B.

Challenges

Why is research on spatial functionality important? A good design should contribute to both the users in the building and the context where the building fits. From a societal point of view, the following problems can easily occur in an irrational functional design:

- inefficient **accessibility** within large building leads to fatigue and economic loss at work
- ineffective distribution of spatial potentials and spatial needs for **centrality** reduces work efficiency, causes stress, unrest, segregation, fragmentation
- deficient **diversity** makes places socially boring, economically unattractive, and eventually abandoned, thus leaving significant environmental and economical burdens

Through the entire exercise, we would like you to have gained some sense of the following scientific challenges through your readings (self-study):

- How to aggregate accessibility from/to different Point of Interests (POI)?
- How to compute universally comparable indicators of accessibility?
- How to compute universally comparable indicators of centrality?
- How to evaluate centrality levels?
- How to benchmark minimum diversity levels?

Deconstruction

Spatial Configuration is the particular way in which spaces are linked to each other in a building or a built environment. Technically speaking, using the concepts from Graph Theory and Social Network Analysis (which will be covered later in this reader), the way things are related to each other can be modelled as a graph of nodes/vertices and links/edges. Therefore, space can also be seen as a set of labelled objects (nodes/vertices) connected to each other with links/edges. Such an abstraction of space to graph/network is shown below in Figure 2. You may be quite familiar with the form, as it highly resembles bubble diagrams that you may have encountered in your early years in architecture. Interestingly, the nature of bubble diagrams and networks such as metro networks can be described in matrices (watch the full story here).

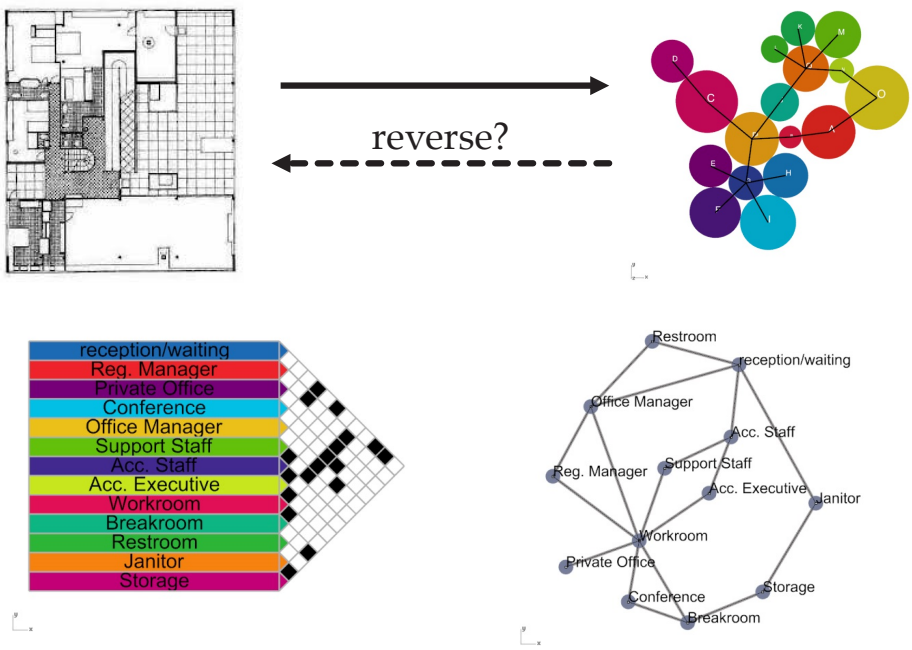


Figure 3.2 : The abstraction of space in architecture plan into a graph/network. Each room is represented with a node (a coloured circle), and two nodes are connected if the rooms are directly connected (e.g. with a door). (Nourian, 2016)

As a supplementary information, Space Syntax methods are also based on Social Network Analysis and/or Graph Theory. You will find certain degree of similarities within the methods if you are familiar with Space Syntax. Feel free to make comparison if you like.

Indicators

Three main indicators will be covered in this topic: efficiency represented as **Accessibility**, effectiveness represented as **Centrality**, and vitality represented as **Diversity**. Here we will give a mathematical definition for each of the indicators, respectively. Don't be afraid of the mathematical formulas at this moment, we will come of their meanings later.

Efficiency w.r.t. Accessibility is the fitness of spatial locations and flows. It can be measured with the temporal efficiency (e.g. logistic efficiency) comparing the spatial distance and the real flowrate within the places:

$$C_i(\rho) = \frac{N}{\sum_{j\in\Omega(i,\rho)} D_{i,j}}, \text{ where } \Omega(i,\rho) = \{j \in V | i \sim j \wedge D_{i,j} < \rho\} \text{ is a neighborhood of } i.$$

Effective w.r.t. Centrality is the match of spatial potential and activities happening in the space, and reflects a spectrum of socio-spatial configurations. The spatial effectiveness can be measured with a set of centrality metrics (e.g. closeness centrality):

$$\text{Diversity} = -\sum_{i=1}^{n} p_i \ln p_i \text{ , where } p_i = \frac{N_i}{\sum_{i=1}^{n} N_i} \text{ , } N_i \text{ denotes the number of POI of } i_{th} \text{function}$$

Vitality w.r.t. Diversity is the degree of mixed-use in a building/residential block/ district. It can be measured with an entropy-based function showing the degree of mix-use:

$$\eta = \sum_i \sum_j T_{i,j} D_{i,j}, \text{ where } T_{i,j}, D_{i,j} := \text{flow rate and distance between } i \text{ and } j.$$

All three indicators will be reached throughout the semester. Possibly more than one methods will be provided to each indicator. It is up to you to decide which method to use for your group project.

Key References

[1] P. Nourian, "Configraphics: Graph Theoretical Methods for Design and Analysis of Spatial Configurations," Doi.Org, vol. 6, no. 14. pp. 1–348, 2016. https://books.bk.tudelft.nl/index.php/press/catalog/book/546

3.3 Collect

Bubble Diagram and Graph

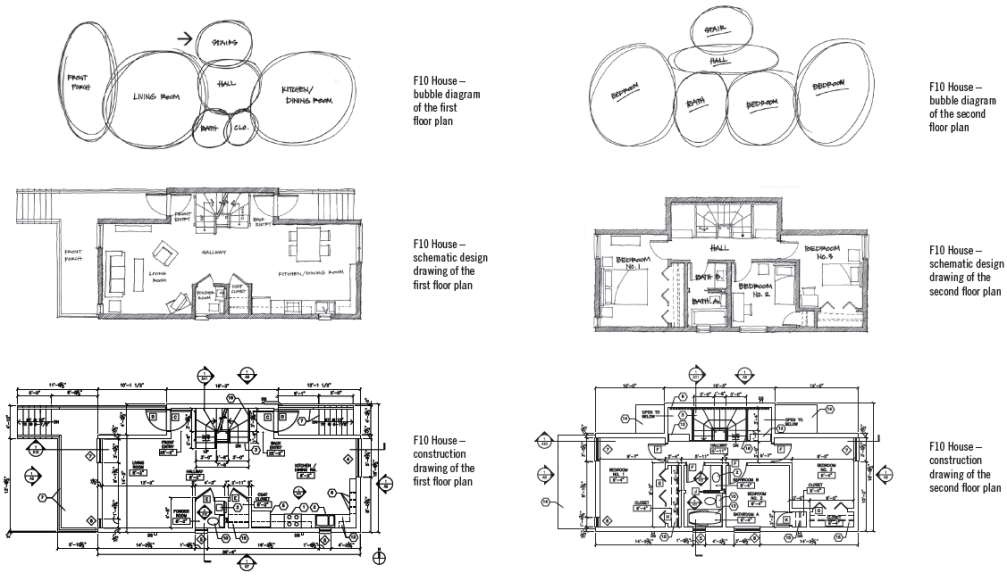


Figure 3.3 : Bubble diagrams for architecture design (Massengarb et al., 2008).

For many architecture students, bubble diagrams (Figure 3) are the beginning step for the architecture design projects in early years. They provide a structural understanding of the functional requirements of a building: an entrance needs to be connected with a corridor before entering the living room, the canteen needs to be close to the kitchen, etc. This was important for us as novice architecture students to know if our design fulfils the basic needs and provided us ideas on how to arrange architectural floor plans rationally (see this video for the full story).

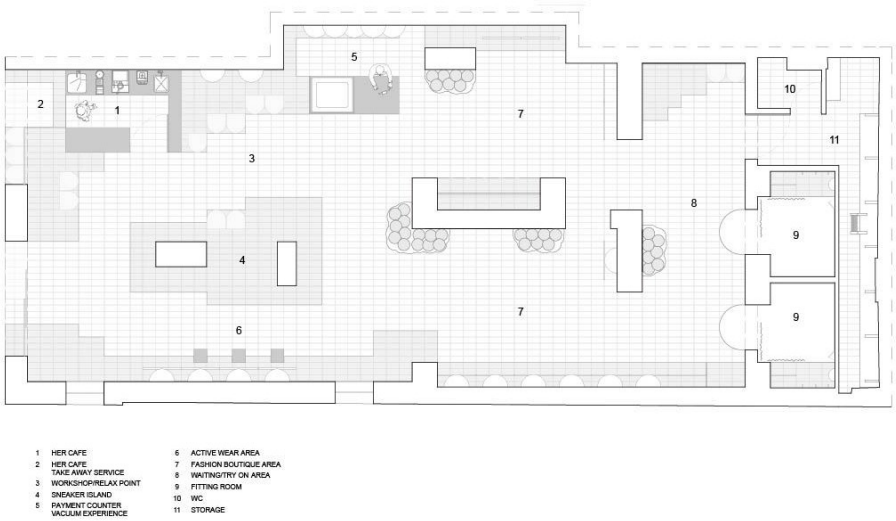


Figure 3.4 : an architecture plan with functional spaces labelled on the graph (https://www.archdaily.com/919104/her-shop-clap-studio/5d01c066284dd152050000e2-her-shop-clap-studio-floor-plan)

As also shown in Figure 2, the bubble diagram is in itself a graph: rooms of different functions are represented as nodes, and the direct connections (for example a door) are represented as links (or edges). All our analyses depend on those graphs. Then the problem is: how to collect the data we need to draw such graph?

The answer is quite simple: we will start from the architecture plan.

As many plans also provide labels of the spatial functions for architects to read and for users to navigate, as is shown in an example in Figure 4 from archdaily.com, the main efforts then go to how do we extract the spatial information systematically as our data.

Walking Spaces, Standing Spaces, and Sitting Spaces

Besides the practical functions, the walkable spaces inside a building can also be annotated with one of the following semantic subdivision:

- Walking spaces are corridors, stairs, ramps, escalators, and all such spaces that should be kept free of obstacles as bridges between pairs of spaces. These spaces mark the routes that are wide enough for people to walk through.

- Standing spaces are platforms on both sides of doors, landings of stairs, or corridor junctions which must be kept horizontal and free of obstacles. These spaces are for humans to stand on for a short while, find their way, and possibly change their paths. Thus, the intersections of walking spaces with other walking spaces or sitting spaces are labelled as standing spaces.

- Sitting spaces are horizontal spaces for stationary objects and moveable furniture. At a medium level of detail, these spaces are rooms to which one can attribute a name/function, at a high level of detail these are the tiles of space where stationary (moveable) objects are placed. Stationary immoveable objects which permanently block pedestrian movement are ignored in this classification because they do not exist in the walkable space network.

The semantic relations between these elements are such that the sitting spaces are connected to each other through walking spaces and standing spaces. The three sorts of spaces can be interpreted as a higher-level meta-function of the walkable space. Such differentiation is not only useful for analysing the space, but also applicable in generative design. An example of using the walking/standing/sitting spaces for such purpose can be found in the following lecture on configurative design:

https://www.researchgate.net/publication/336799509_Configurative_Design_A_Generative_Approach_to_Digitization_Digitalization_and_Digital_Transformation_in_Architectural_and_Urban_Design (video)

This being said, our target data format is going to be a spatial network (or graph) representing the walking space in your building project. The nodes of the graph are going to be the quadrangular tiles (will be introduced next week) separating the rooms; the links of the graph are going to be the direct connections between the tiles (meaning you could literally walk from one tile to the other).

Each node will need to be annotated with two levels of "functions". For a higher level, each tile needs to be labelled as walking, standing, or sitting spaces (**function type**); for a lower level, each sitting space need to be labelled with its practical **function name** (e.g., office, kitchen, storage, shop, etc.).

Data Collection Methods

Generally speaking, the following methods are all helpful to analyse the spatial functionality (i.e., efficiency, effectiveness, and diversity) for different research purposes and complexities. However, for our exercise, we mainly suggest the first- "reading and transforming from building plans" (and second – "experiencing and observing the space occupation", if covid-19 allows us) approach to derive the graph/network data. However, we do encourage you to explore alternative possibilities of collecting both primary and secondary spatial functionality data (a concept that you should encounter from the very first chapters of this booklet) if you really feel confident, interested and motivated by the examples.

- Reading and Transforming the Building Plans

Trained as architects, it is very intuitive to first read the building plans carefully to understand how the space and the functions are organized. Most of the connectivity information for generating the nodes and edges on the spatial graph/network is clearly shown on the plan. And usually it is already obvious where the walking spaces and sitting places are, as the former mostly correspond with commute space and circulation space, and the latter are probably either given a name/label on the plan or filled with furniture to imply the usage.

A simple (probably too simple for our purpose) but powerful pioneer of such approach is the Convex Map in space syntax, where each room is abstracted as a node and the doors become the edges connection the nodes (see Figure 5).

Figure 3.5 : From plan to convex map to show the configuration of the space. (http://otp.spacesyntax.net/applying-space-syntax/building-methods/representations-of-space/)(http://archtech.gr/varoudis/depthmapX/LearningMaterial/depthmap7convex.pdf)

- Experiencing and Observing the Space Occupation

Sometimes the actual usages of certain spaces are not directly reflected on the maps, especially after some self-organization of the users. Sometimes the spaces are not occupied in the same manner that they are designed for. Sometimes the spaces are not even divided in the same way as the original plan. In all those circumstances, it is important to experience the building yourself to observe and record the actual usage of the space. The methodology Public Spaces Public Life (PSPL) proposed by Jan Gehl has been a systematic way to observe, record, and analyse the place (see Figure 6).

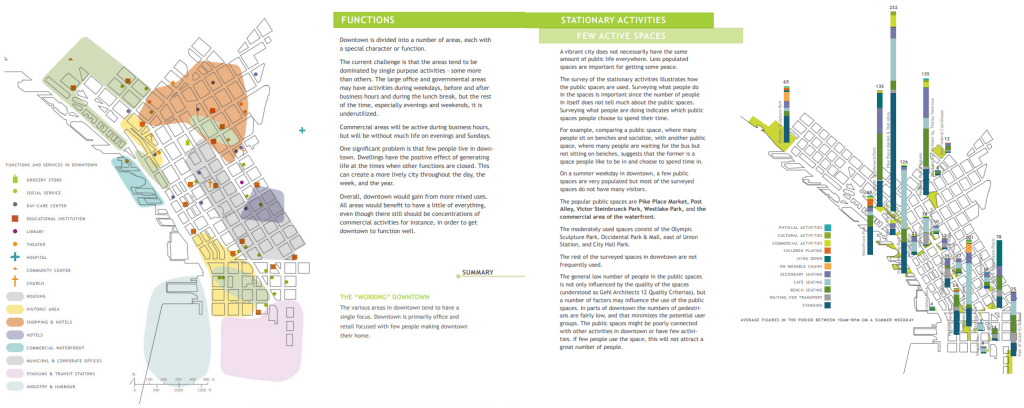


Figure 3.6 : An example of using PSPL to observe and record the usage of public space by people (http://greenfutures.washington.edu/images/publications/Public-Spaces-Public-Life-Downtown-Seattle-Gehl.pdf)

- Monitoring and Recording the Real Behaviour

Though implemented systematically, the human observation may still be biased. We as observers can only be at a spot for a limited time and we have to assume that the samples occurred during the experiment are representative enough. Furthermore, it may be really difficult for human to precisely record the counts, flows, and paths of people. Technological developments in in- and out-door positioning devices and wearable sensors (such as Wi-Fi, GPS, Bluetooth, Ultra-wide Band, etc.) provide us a possibility to monitor and record the exact real-time occupation situation in space (see an example in Figure 7). Privacy, on the other hand, always needs to be a central issue to concern with.

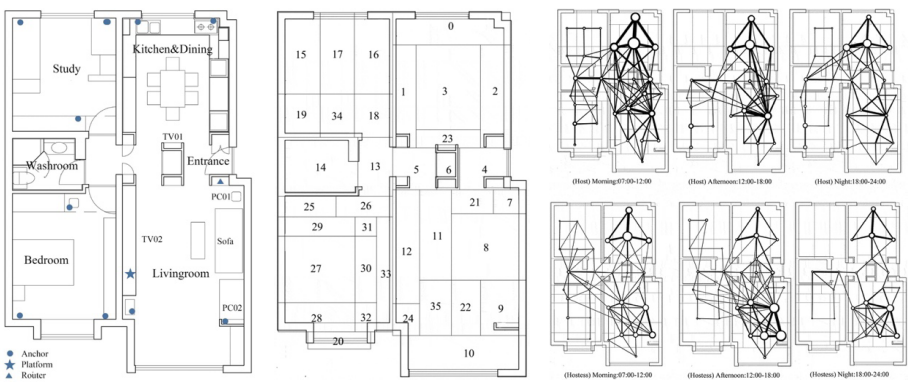
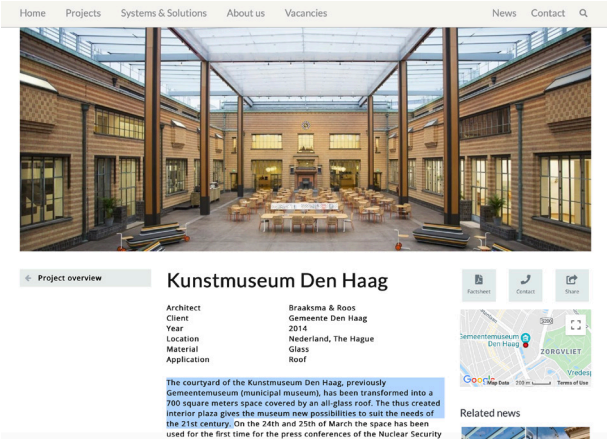


Figure 3.7 : An example of using Indoor positioning devices to track real-time occupation in building (Yang & Huang, 2019).

- Searching and Mining the Archived Documents

For redesign projects, we also care about their status before retrofitting/renovation/redesign. Plans of the pre-redesign phase are still likely to be available, but sometimes the functions were not written on the plan. What could this space be for at that time? How could this space be occupied and used? In such case it would be impossible to directly observe or monitor the usage of space. You may need to be acting like a detective and dive into the archived documents to find the detailed traces indicated in the description (see an example in Figure 8). Be creative at finding source. It is likely that you will find something in the library and the city archive, but don't miss possible information in old postcards, novels, online blogs, and even social media posts!



The courtyard of the Kunstmuseum Den Haag, previously Gemeentemuseum (municipal museum), has been transformed into a 700 square meters space covered by an all-glass roof.

The thus created interior plaza gives the museum new possibilities to suit the needs of the 21st century.

Figure 3.8 : An example of how you can dig into the existing documents to search for useful information about functionality in the Kunstmuseum Den Haag (https://www.octatube.nl/en_GB/project-item/projectitem/142-gemeentemuseum.html).

- Simulating and Analysing the Walking Flow

Finally, sometimes you cannot enter a building for several annoying reasons. Maybe because it's temporally or permanently closed for public (such as an office building). Maybe it is during the restoration phase and not yet open. In such case it is still possible to rationally "guess" (or estimate) how the place will be occupied using simulations. By setting some reasonable rules for the virtual people (we sometimes call them "agents") and let them move in the space, we can also obtain enough theoretical walking flows for research and design purposes (see an example in Figure 9).

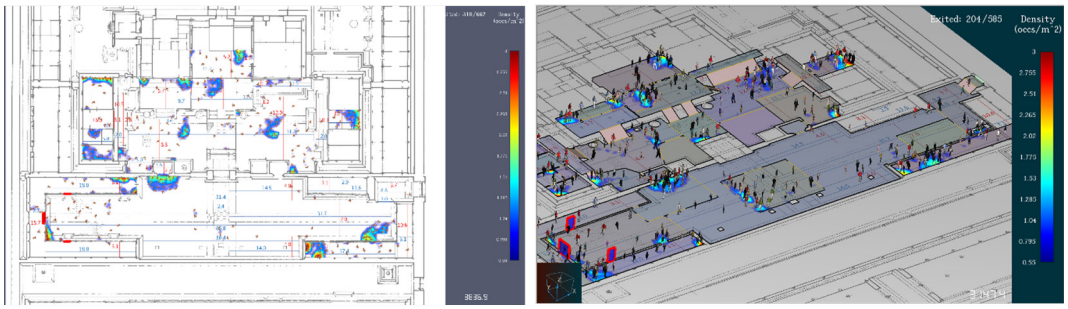


Figure 3.9 : An example of using Agent-based simulation for getting pedestrian's walking flows in Palace Museum, Beijing, China. (Bai et al., 2020)

As a conclusion, there are multiple possible ways to collect the spatial functionality data. Use your creativity and imagination to adapt the fittest method and find the most suitable data for your research interest. As we will mainly deal with the spatial configuration of different function types and practical functions, it is essential to collect plans and information related to function and usage. It is not required for you to collect data of actual/virtual usage (using observation, monitoring, or simulation), but you are welcome to discover those tools.

Exercise Tutorial

Along the topic of reuse, we provide you with an additional excel file to help you record, organize and structure the data that you will collect (and generate). Every week you will need to fill in some columns in the first sheet ("*weekly progress*", as shown in Figure 10) of the table to record your progress. An example from last year is given. Start checking the file and filling the information of first two weeks.

Basic Information (Week1)	
Content	**Answer**
Student Name	
Student ID	
Architect Name	O-office Architects
Case Name	Stone Art Gallery
Case Place	Guangzhou, China
Case Size	1270 m2
Original Construction Date	1960s
Renovation Date	2013
Original Main Function	YJQ Factory
Main Function Now	Art Gallery
Reason for Function Change	
Attitude After Renovation	
Attitude Before Renovation	

Function List (Week 2)		
ID	**Function Type**	**Function Name**
	Walking/Standing/Sitting	**eg. Kitchen, Office, Reading Space**
0	Sitting Space	Exhibition
1	Sitting Space	Head Office
2	Sitting Space	Meeting
3	Sitting Space	Office
4	Sitting Space	Outside Platform
5	Sitting Space	Reception
6	Sitting Space	Relaxation
7	Sitting Space	Storage
8	Sitting Space	Technical
9	Sitting Space	Toilet
10	Standing Space	Buffer Zone
11	Standing Space	Crossing
12	Standing Space	Ending Zone
13	Standing Space	Out
14	Standing Space	Platform

Figure 3.10 : Example of the Sheet "weekly progress" that we provide you for organizing your data

At this stage, you are required to make a list of at least 15 different types of functional spaces that existed and are existing in your case before and after the redesign. Among the functional spaces, at least one should be standing space and one should be walking. You can always add to the list some new functional spaces after you start building your model and labelling the nodes, but it is crucial to have a broader idea of what might come.

We will show you next week how to generate a spatial network from the plans that you have collected, after which you will be filling the second sheet ("*Detailed Node List*", as shown in Figure 11) and annotate each node with its function.

ID	Function Type	Function Name	Area	Depth from the Outside World	Degree Centrality	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
	Assigned by Hand with help of Syntactic		Known with Rhino Model		Computed with Gephi			
0	Standing	Ending Zone	19,897432		6	0.159091	112.916.667	0.372095
1	Sitting	Relaxation	41,42423		6	0.158192	1.333.333	0.4079
2	Sitting	Relaxation	41,731049		6	0.140234	41.983.333	0.198763
3	Sitting	Meeting	4,498588		4	0.124077	0.333333	0.112605
4	Walking	Passway	2,831295		6	0.125749	6.7	0.169207
5	Walking	Passway	2,679318		8	0.14094	81.033.333	0.259511
6	Standing	Buffer Zone	6,915867		6	0.160612	275.95	0.381233
7	Sitting	Exhibition	41,42423		6	0.157598	0.5	0.413745
8	Sitting	Meeting	24,865231		10	0.141892	81.85	0.342082
9	Standing	Buffer Zone	6,877326		4	0.159091	59.866.667	0.321745
10	Sitting	Exhibition	41,42423		6	0.157598	0.5	0.410921
11	Sitting	Meeting	33,899603		10	0.141892	70.9	0.386479
12	Sitting	Outside Platform	117,263369		4	0.125561	0	0.179809
13	Walking	Hall	195,56637		22	0.185841	1328.1	1
14	Sitting	Exhibition	41,42423		6	0.157598	0.5	0.39331
15	Standing	Buffer Zone	13,978969		8	0.16	101.95	0.499506
16	Walking	Passway	10,097707		6	0.140234	4.416.667	0.271262
17	Sitting	Exhibition	18,903782		6	0.138843	0.333333	0.28972
18	Standing	Ending Zone	17,04686		4	0.112	5	0.044234

Figure 3.11 : An example of the Sheet "Detailed Node List" that we provide you to annotate the nodes in your graph

Key References

[1] Masengarb, J., Rehbein, K., & Norris, B. (2008). *The architecture handbook: a student guide to understanding buildings*. Chicago Architecture Foundation. pp. 230-239. https://discoverdesign.org/sites/default/files/2018-08/CAC_Bubble_Diagrams.pdf

[2] Nourian, P. (2019). Configurative Design A Generative Approach to Digitization, Digitalization, and Digital Transformation in Architectural and Urban Design, lecture note. pp. 115-123. https://www.researchgate.net/publication/336799509_Configurative_Design_A_Generative_Approach_to_Digitization_Digitalization_and_Digital_Transformation_in_Architectural_and_Urban_Design

[3] UCL Space Syntax. Representations of Space. http://otp.spacesyntax.net/applying-space-syntax/building-methods/representations-of-space/

[4] Gehl, J. Public Spaces Public Life. https://gehlpeople.com/talks_article/public-space-public-life/

[5] Yang, L. & Huang W. (2019). Multi-scale analysis of residential behaviour based on UWB indoor positioning system-a case study of retired household in Beijing, China, *Journal of Asian Architecture and Building Engineering*, 18:5, 494-506, DOI: 10.1080/13467581.2019.1682000 https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F13467581.2019.1682000

[5] Gehl, J. (2011). *Life between buildings: using public space*. Island press.

[6] Hanson, J. (2003). *Decoding homes and houses*. Cambridge university press.

[7] Bai, N., Nourian, P., Xie, A., Pereira Roders, A. (2020). Towards a finer heritage management: evaluating the tourism carrying capacity using an agent-based model. In *RE: Anthropocene, Design in the Age of Humans - Proceedings of the 25th CAADRIA*. Vol. 1. 2020. p. 305-314. https://www.researchgate.net/publication/343685047_TOWARDS_A_FINER_HERITAGE_MANAGEMENT_Evaluating_the_Tourism_Carrying_Capacity_using_an_Agent-Based_Model

3.4 Classify

Data Format Revisited

As we have already discussed last week, we need a specific data format of data to study the spatial configuration and spatial functionality. It should be a graph/network of spatial configuration with labels of functions annotated on each node. The base of this graph, however, should reflect the shape of the walkable space, as a 2-manifold mesh (further reading).

What is then a 2-manifold mesh? For a comprehensive long story, you could refer to this paper:

https://www.researchgate.net/publication/324921216_Topology_On_Topology_and_Topological_Data_Models_in_Geometric_Modeling_of_Space

For a simpler understanding, a 2-manifold geometry in a continuous setting is a surface that is locally everywhere planar, i.e., topologically similar to a 2D Euclidean plane, but perhaps globally non-planar.

When we model the walkable space as a 2-manifold mesh, we can literally walk from a tile on the mesh to its adjacent tiles directly without any obstacle (see Figure 12).

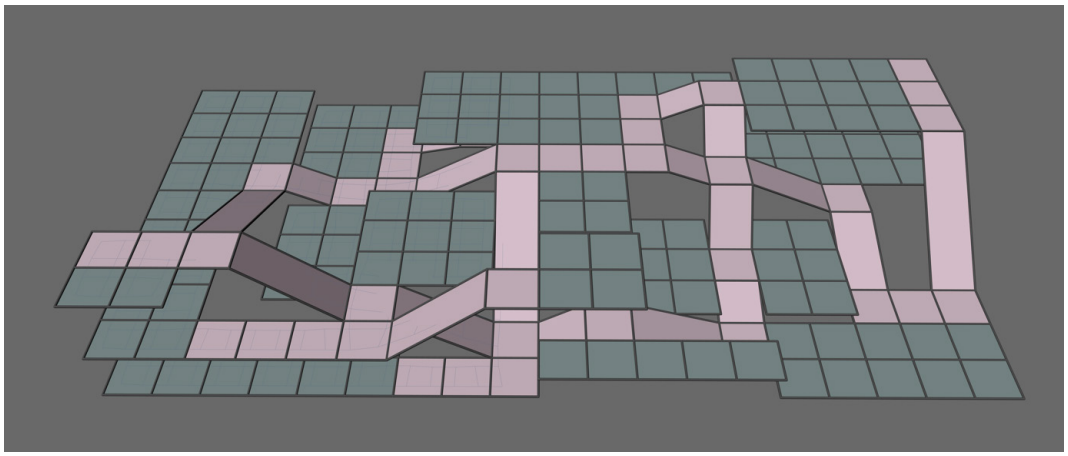


Figure 3.12 : An example of a valid 2-manifold and its "tile geometry" (Algebraic Topology)

Walkable Surface Mesh (revisited) and Why it Matters

The idea of design and analysis of spatial configurations is to model the shape of the walkable space with a correct topology (the connectivity structure) and then extract the topology of the shape of space as a graph/network. We propose a semantic subdivision of walkable spaces into 'walking, standing, and sitting' spaces (check the material of previous week).

It is important to note that we do not model the spaces that are not walkable, e.g. those occupied by immoveable furniture, or those whose ceiling heights are not sufficient, and we model elevators as standing spaces linked with 'hyperlinks'.

If you are interested in the use of these principles in generative design see this

lecture: Topo-Logical Design, pp.115-123. In the context of assessing the functionality of buildings, we model their spatial configurations according to these guidelines and they can be seen as the inverse of the generative design process mentioned in the referenced lecture notes.

What is a Valid Walkable Surface Mesh?

Note: in the process of modelling the walkable surface, the topological validity of the surface is critically important because without a valid topological surface we cannot compute spatial networks. However, geometric deviation and error is not very important (see an example in Figure 13), specially if we are not computing accessibility.

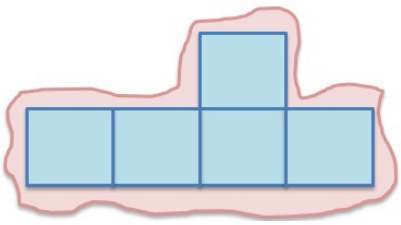


Figure 3.13 : The global precision of the model in terms of its correspondence with the floor plan is not critically important

The basic idea of generating the walkable surface is to put quadrilateral 'tiles' on the floor such that a human can walk from one tile to another. Thus, if a human cannot walk through an edge of a tile to another, e.g. because the other one does not have a sufficient ceiling height, or because there is a wall between the two quad tiles, then DO NOT make the two tiles adjacent. The walkable manifold mesh must be drawn such that it:

- must be a 'valid complex', i.e. the vertices of two adjacent faces must be exactly coincident (share the same positions) along the shared edges (see below in Figure 14 example of valid/invalid tessellation/complex)[1].
- Consists of only quadrangles (not necessarily rectangles)
- It is a 2-manifold mesh (see below in Figure 15 non-manifold mesh examples)

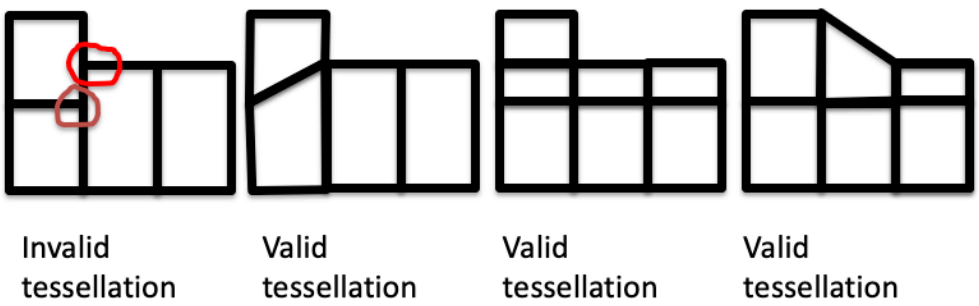


Figure 3.14 : Valid/Invalid Complex and tessellation in the sense of its geometric precision

1 Note: here you actually have two choices, a. drawing *a strictly valid mesh* such as is required in this bullet point, and later using grasshopper to *generate the edges automatically*; b. *not strictly obeying the requirement* here, but add edges *manually*. Both choices work, and they take eventually similar amount of working load. It is up to you to decide how to build your model, as long as we can later have a valid graph. The model tutorial *example_simple_graph.3dm* given is based on the choice b.

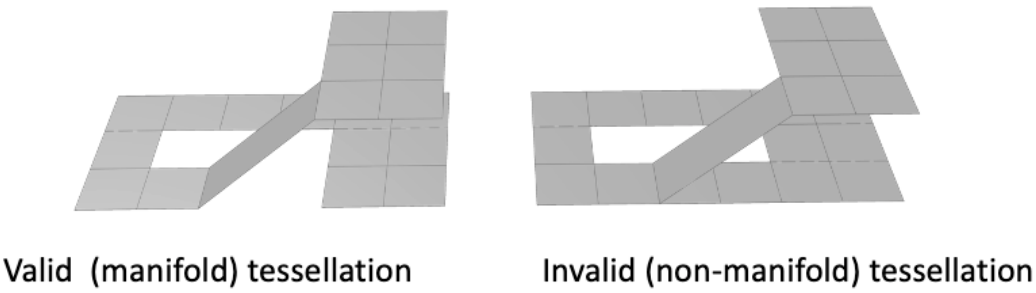


Figure 3.15 : Valid/Invalid manifold tessellation

- A mesh edge can have either two faces incident to it or only one face (if it is on the border of the surface).

- Almost every shape can be approximated by means of quadrangles. See examples below in Figure 16.

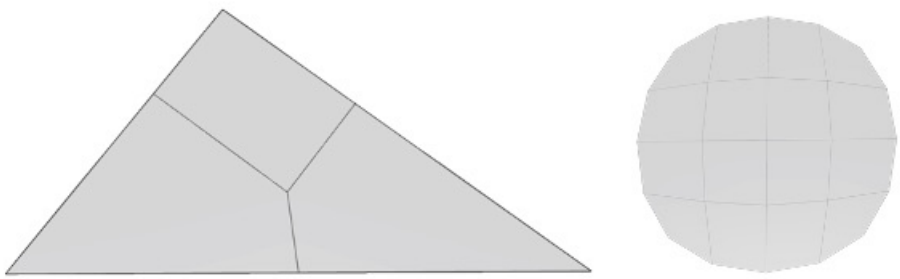


Figure 3.16 : These two examples show how non-quadrangular shapes can either be 'quadrangulated/ quadrilateralized' accurately (as the triangle on the left) or be approximated by quadrangles (as the circle on the right).

In principle, multiple options can lead to the same final results of such a walkable mesh, and thus leading to a spatial configuration graph, which may include:

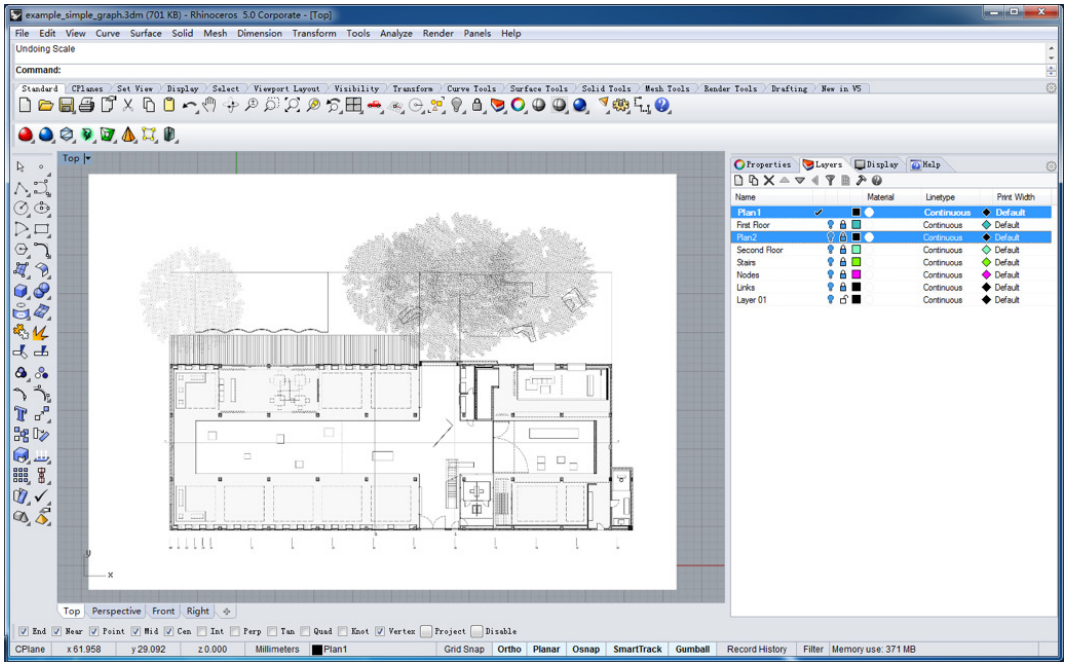
- Topological Skeleton Construction
- Constrained Delaunay Triangulation
- Voxelization
- Arbitrary Tessellation
- Manual Mesh Tessellation

In this exercise, we will guide you how to manually make the mesh tessellation and then derive a spatial network out of the mesh using Grasshopper. However, you are still encouraged to discover the other possibilities.

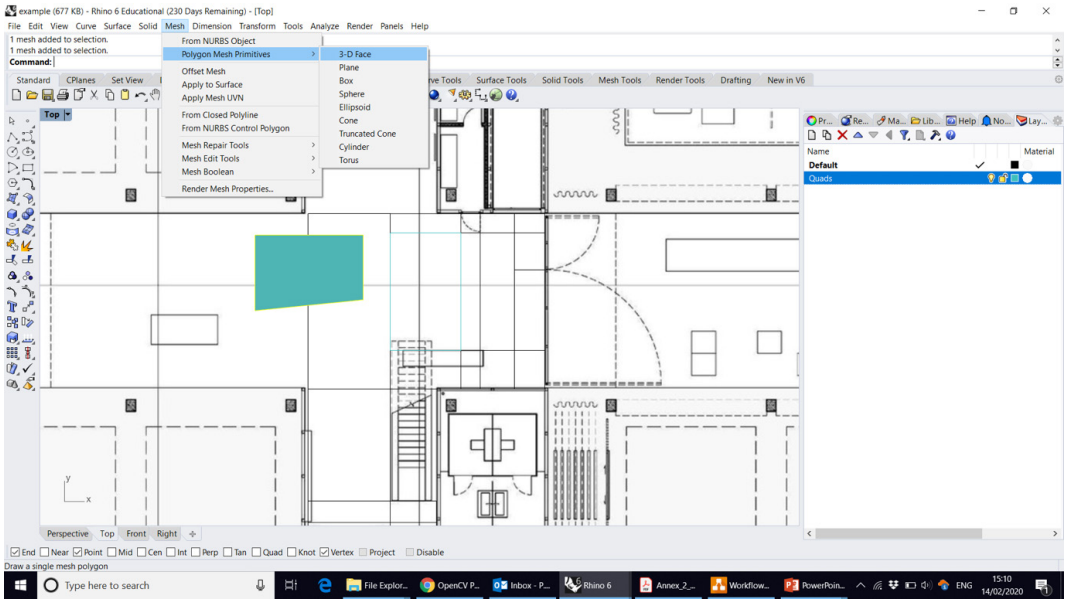
Exercise Tutorial

These are some tips and tricks on how to draw walkable surface meshes in Rhino 5 on Windows. For Mac versions or other versions of Rhino some things might be different.

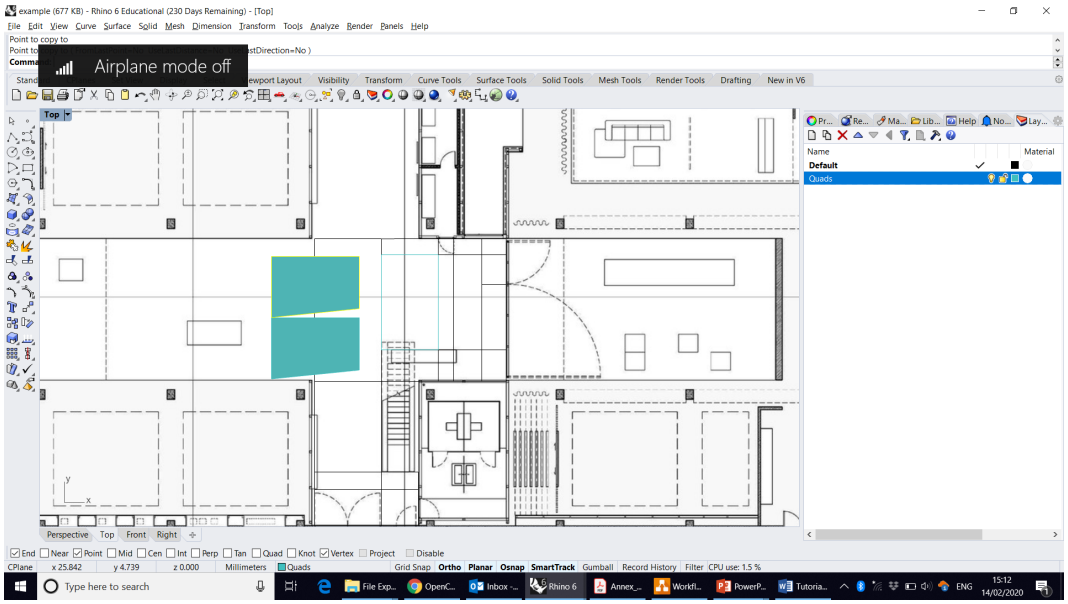
Import your plan into Rhino using command "PictureFrame" and "scale " it to the proper size. Place the floor plans of different height into their correct position. We suggest you to make different layers for each plan:



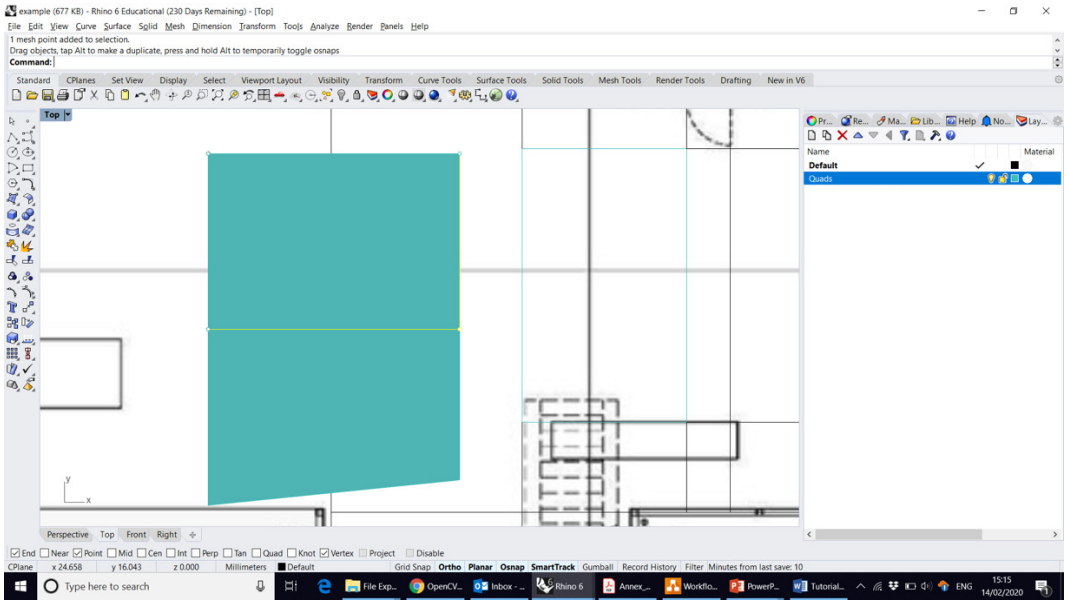
Add a new layer and call it Quad-Meshes (or add different layers for different plan height), then give the layer a distinct color, e.g. Turquoise or something like that. Then start drawing the quad mesh faces using the 3D Mesh face command. It is important to make a abstract quadmesh representing the overall "**outside world**", which later you will need to connect to all the nodes representing the entrance/exit.



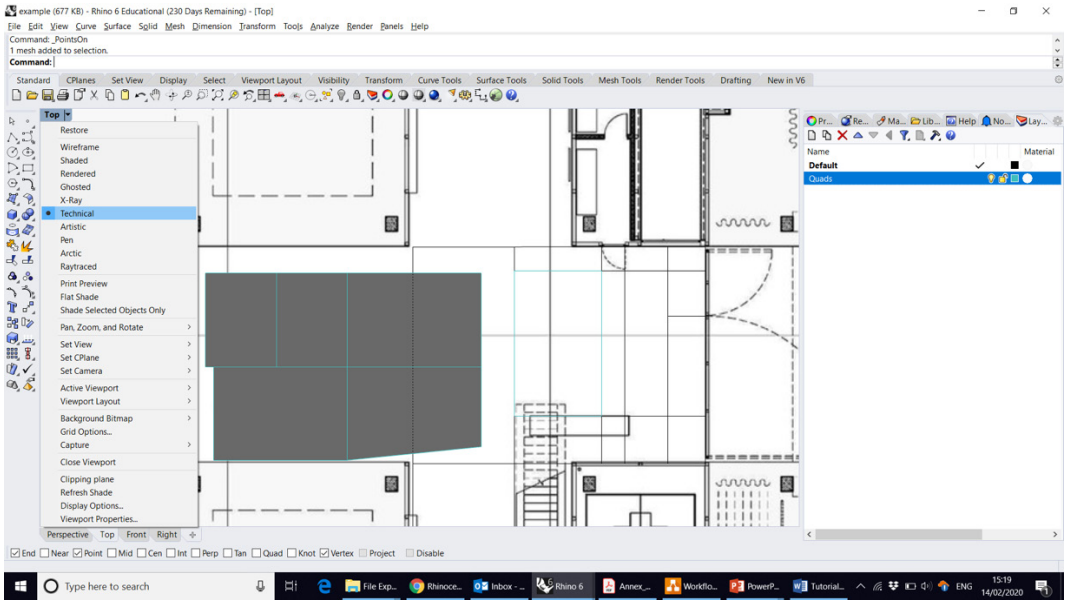
Make sure that the snapping option for mesh vertices is turned on:



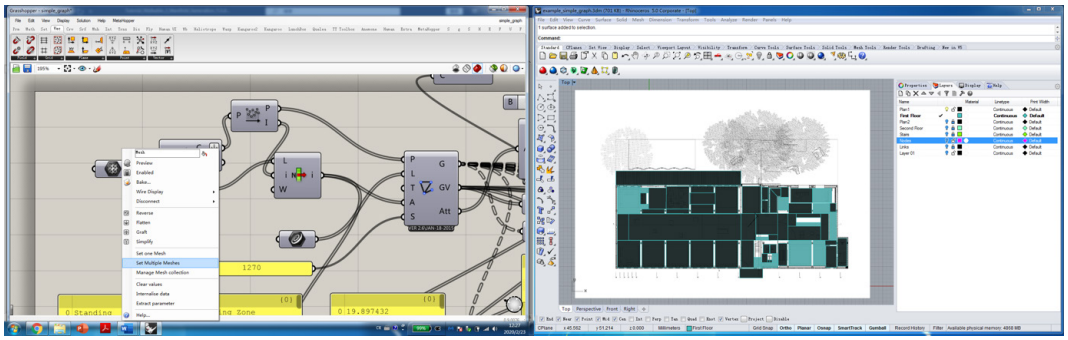
You can press Function+F10 to turn on Mesh Vertices in case you need to edit the mesh quads. Alternatively, you can access this tool via the command line by typing “PointsOn”.



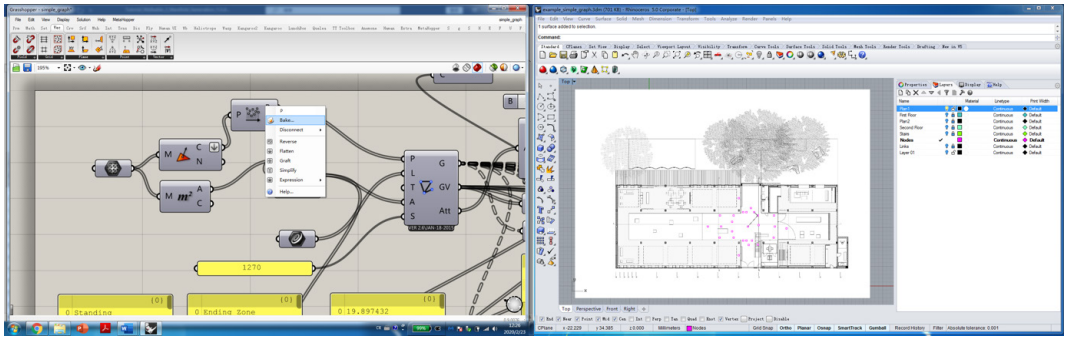
It might be handy to set the view style to technical:



After drawing the meshes, add them into the grasshopper with button “set multiple meshes” and compute the centre points of all of them, sort the points to make the later labelling job easier:

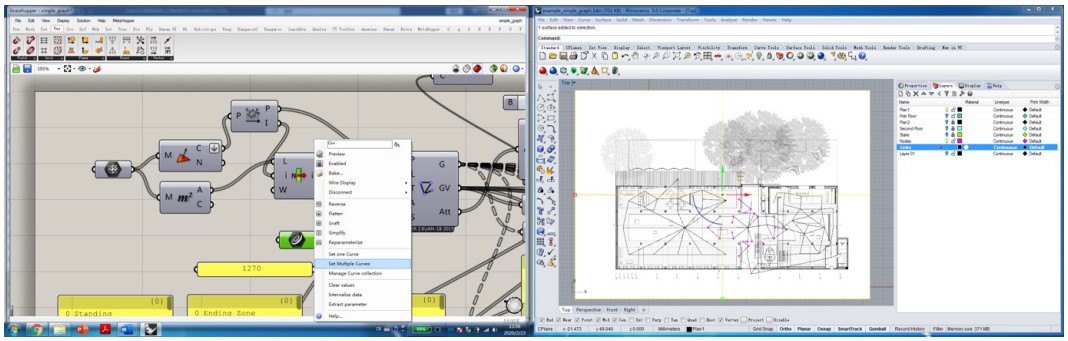


Create a new layer called “Nodes”. Bake the sorted points in grasshopper back to rhino, and put the nodes into the layer “Nodes”:

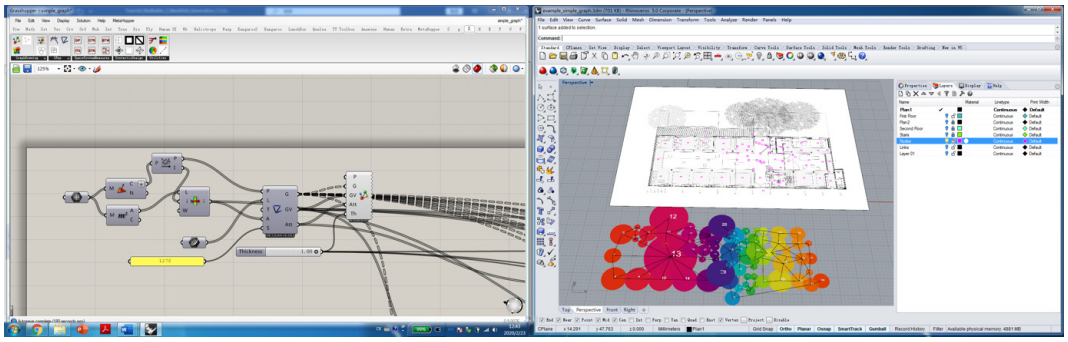


Create a new layer called “Links”. Draw a link between the nodes if there is a direct connection between the spaces, i.e., people can walk across the space. Use “Line” tool/command to draw the links in Rhino. After drawing all the links, select all of them and use “add multiple curves” to add them into grasshopper. This is a very important

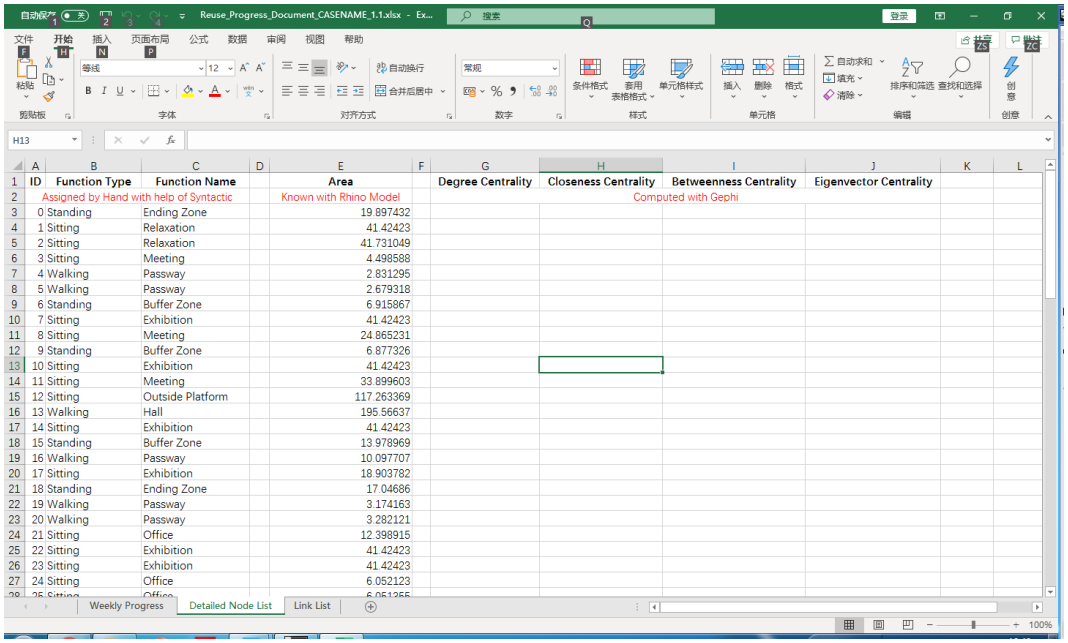
step, as you need to be careful of the topological relations/connections. It is very easy to miss one or two links at the beginning. However, it does not matter that much as you can always add the ones that you have missed in the beginning later. But make sure to re-add all the links to grasshopper when you make any changes. Remember to connect entrance/exits nodes to the outside-world node. It will be used to demonstrate the accessibility of the building.



Input the links and nodes that you have into the tool "GraphFromNodes&Links" and output the default values into the tool "DiskoGraphDrawing" of SYNTACTIC library and you will see a default graph with indices of each node displayed (you need to set a plane in Rhino for the graph to display).



Now that you have the topological nodes and the plan displayed next to each other, you will need to open you excel sheet Reuse_Progress_Document_CASENAME_1.1.xlsx and label each node with their function type (sitting/standing/walking) and their function name from the list you have in the last week.



ID	Function Type	Function Name	Area	Degree Centrality	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
	Assigned by Hand with help of Syntactic		Known with Rhino Model		Computed with Gephi		
0	Standing	Ending Zone	19.897432				
1	Sitting	Relaxation	41.42423				
2	Sitting	Relaxation	41.731049				
3	Sitting	Meeting	4.498588				
4	Walking	Passway	2.831295				
5	Walking	Passway	2.679318				
6	Standing	Buffer Zone	6.915867				
7	Sitting	Exhibition	41.42423				
8	Sitting	Meeting	24.865231				
9	Standing	Buffer Zone	6.877326				
10	Sitting	Exhibition	41.42423				
11	Sitting	Meeting	33.899603				
12	Sitting	Outside Platform	117.263369				
13	Walking	Hall	195.56637				
14	Sitting	Exhibition	41.42423				
15	Standing	Buffer Zone	13.978969				
16	Walking	Passway	10.097707				
17	Sitting	Exhibition	18.903782				
18	Standing	Ending Zone	17.04686				
19	Walking	Passway	3.174163				
20	Walking	Passway	3.282121				
21	Sitting	Office	12.398915				
22	Sitting	Exhibition	41.42423				
23	Sitting	Exhibition	41.42423				
24	Sitting	Office	6.052123				

Later you can copy-paste the labels that you make into grasshopper panels and you can then change your display with a better denotation. You can also copy-paste the data/information from grasshopper into excel to prepare the Area column in the node list and From/To columns in link list, which will later be used in Gephi.

Play with the grasshopper example given to you. In Grasshopper, you can see where a component comes from (which menu/plugin) by pressing Ctrl+Alt+ Clicking LMB (Left Mouse Button). You have full freedom to discover what are the tools doing if interested.

Key References

[1] Masengarb, J., Rehbein, K., & Norris, B. (2008). *The architecture handbook: a student guide to understanding buildings*. Chicago Architecture Foundation. pp. 230-239. https://discoverdesign.org/sites/default/files/2018-08/CAC_Bubble_Diagrams.pdf

[2] Nourian, P. (2019). Configurative Design A Generative Approach to Digitization, Digitalization, and Digital Transformation in Architectural and Urban Design, lecture note. pp. 115-123. https://www.researchgate.net/publication/336799509_Configurative_Design_A_Generative_Approach_to_Digitization_Digitalization_and_Digital_Transformation_in_Architectural_and_Urban_Design

[3] UCL Space Syntax. Representations of Space. http://otp.spacesyntax.net/applying-space-syntax/building-methods/representations-of-space/

[4] Hanson, J. (2003). *Decoding homes and houses*. Cambridge university press.

[5] Nourian, P. (2019). Topology and Topological Data Structures in Geometric Modelling https://www.researchgate.net/publication/324921216_Topology_On_Topology_and_Topological_Data_Models_in_Geometric_Modeling_of_Space

3.5 Analyze

Recall in the section 3.2 we introduced you three indicators, i.e., **Vitality w.r.t. Diversity**, **Efficiency w.r.t. Accessibility** and **Effectiveness w.r.t. Centrality**. All of them were equipped with some mathematical equations. We promised that we will explain the meaning to you later. That is exactly what we will do in this and next weeks.

First let's dig in the topic of **Effectiveness w.r.t. Centrality** and discuss about some basic knowledge of Graph Theory and Social Network Analysis.

Graph Representation

You have already seen an example of how we would normally represent a graph/network in Figure 2 on the bottom left corner. We called it a "relationship chart" of different function nodes, where each black grid means that the two functional nodes are directly linked with each other. However, the official name of the chart is actually an "Adjacency Matrix". The following Figure 17 show you several different representation methods of a Graph $G = (V, E)$, where G means the graph as a whole, V are all the nodes (vertices), and E are all the links (edges). You should be already familiar with those concepts by now. Previously we were referring to the spatial network, where the nodes were places and links were connections. This week we will come back one step to the graph/network in social relationship. Here each node can be a person, and the link can be the relationship/friendship between the two people. Hope you can see the connection between spatial and social network by the end of this week.

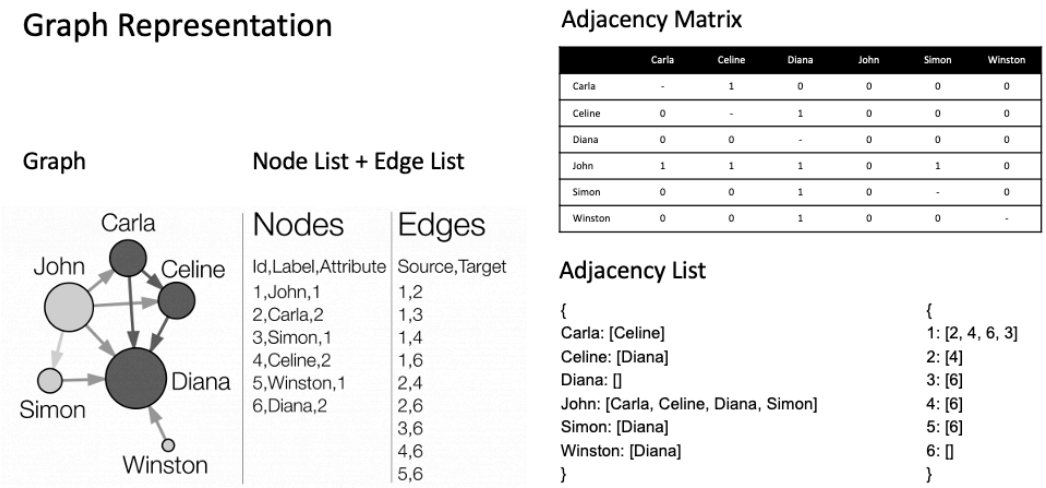


Figure 3.17 : Several ways to represent a graph - diagram, node list, edge list, adjacency matrix, and adjacency list

Though the representations seem different, they are all about the same kind of relationship between the seven people. In the excel file we give you, the sheet 2 and 3 are respectively a node list and an edge list. We choose to use this representation in this course because it is easy to interact both with Grasshopper and Gephi for your exercise.

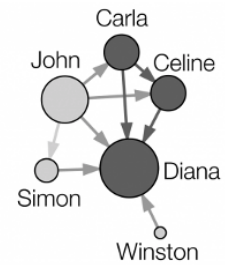
Centrality Measures in Social Network

As you may have noticed in your excel file, we want you to compute four different centrality measures: degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality. There are actually more centrality measures, but these four are the most basic and commonly used. We will introduce them one by one and show you what it particularly means. We will keep using the example above about the friendship in seven people, but instead of treating it as an original directed graph (one-side friendship), we will assume it is an undirected graph to make the calculation easier. For each centrality, we will provide you with its mathematical formula and show you how to do the math. But you are not required to be able to fully understand the equations as long as you understand the story behind. In your exercise, Gephi will do all the math for you!

- Degree Centrality – how many friends do you have

$$C_{\text{deg}}(i) = \frac{\deg(i)}{|N| - 1}$$

The first centrality measure just simply counts the number of neighbours of a node and normalize with the total number of nodes in the graph. In a social network, it shows how many friends you have. It treats the people with the largest number of friends as the most important (or central). In this example, it is Diana who has the most friends.



$$C_{\text{deg}}(\text{Diana}) = \frac{5}{6-1} = 1$$

$$C_{\text{deg}}(\text{John}) = \frac{4}{6-1} = 0.8$$

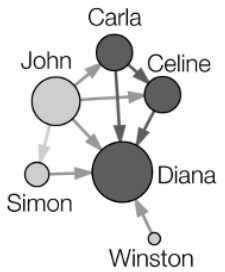
$$C_{\text{deg}}(\text{Winston}) = \frac{1}{6-1} = 0.2$$

Figure 3.18 : Some calculation of degree centralities for the example social network

- Closeness Centrality – how close are you to everyone else in the network

$$C_{close}(i) = \frac{|N-1|}{\sum_{j \in N, j \neq i} D_{i,j}}$$

The second centrality measure counts the reciprocal of the total distance of a node to all the other nodes in the network. In a social network, it shows how close you are to the other people. The less distance you are in friendship chains with all the other people, the more important you are. In this example, it is also Diana who is the closest to all the other people.



$$C_{\text{close}}(\text{Diana}) = \frac{6-1}{1\times5} = 1.0$$

$$C_{\text{close}}(\text{John}) = \frac{6-1}{1\times4+2\times1} = 0.833$$

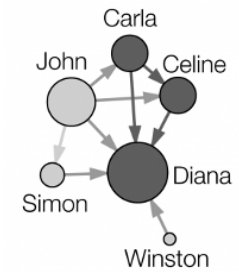
$$C_{\text{close}}(\text{Winston}) = \frac{6-1}{1\times1+2\times4} = 0.556$$

Figure 3.19 : Some calculation of closeness centralities for the example social network

- Betweenness Centrality – how many times you are on a shortest path of friendship chain

$$C_{betw}(i) = \frac{1}{\frac{(n-1)(n-2)}{2}} \sum_{j,k\in N\setminus\{i\},j<k} \frac{\sigma_{jk}(i)}{\sigma_{jk}}$$

The third centrality measure counts the number of times a node happens to be on a shortest path between a pair of nodes in a graph. In a social network, it shows your position between different groups of people. The higher your betweenness centrality, the more likely you are the bridge between several "unconnected" subgroups. In this example, Diana is the only friend of Winston, so she also becomes the bridge of Winston and all the others.



$$C_{\text{betw}}(\text{Diana}) = 0.5$$

$$C_{\text{betw}}(\text{John}) = 0.1$$

$$C_{\text{betw}}(\text{Winston}) = 0.0$$

Figure 3.20 : Some calculation of betweenness centralities for the example social network

- Eigenvector Centrality – how important your friends are in the network

The fourth measure is a bit complex in the sense of mathematics, so we omit the formula (the full story of spatial eigenvector centrality is explained here). But the idea is not difficult to understand: this measure not only captures how you are important, but also how important your friends are in the whole network. In a social network, those "secret" people "behind" the famous people can occur with a low degree centrality but high eigenvector centrality. A related concept of this centrality is the Google's PageRank algorithm, where the portals connecting to other important sites will also be regarded as critical. In this example, we will see that John also has a high eigenvector centrality because both he and his friend Diana are "important".

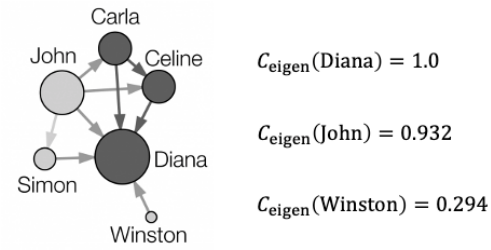


Figure 3.21 : Some calculation of eigenvector centralities for the example social network

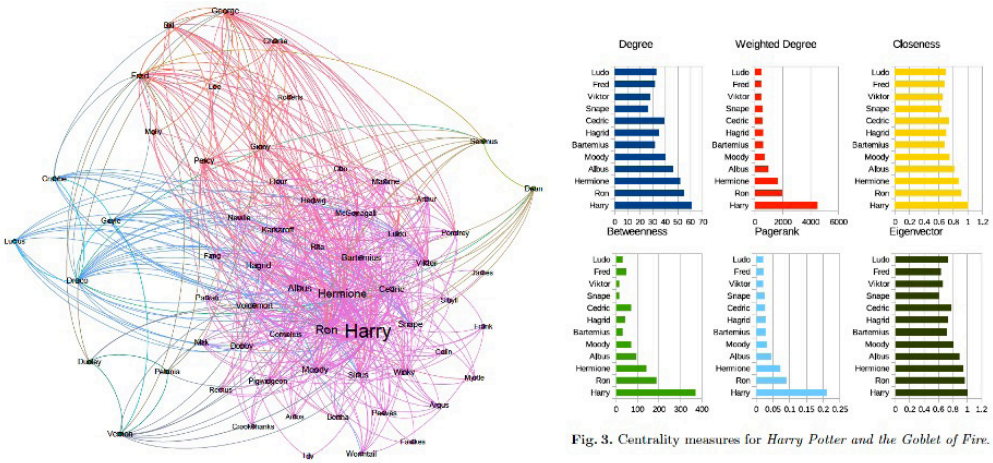


Figure 3.22 : The social network and centrality measures in Harry Potter and The Goblet of Fire

Now that you understand the meaning of the centrality measures in the social network, you are able to check this fun article represented in Figure 22 which measures the social network relationship in *Harry Potter and the Goblet of Fire*. There are also examples for *Twilight*, *The Stand*, *The Lord of the Rings*, and *Marvel* movies. Feel free to choose your best movie/novel/TV series to help you understand the concept better.

Centrality Measures in Spatial Network

Then, what about in space?

Basically, the core idea is still the same as if with a social network. You can check in Figure 23 the best-fit functions in a spatial network inside a building.

- Degree centrality concerns the relative number of immediate connections to other spatial nodes, thus most probably fits the function of spreading information/people. Shops, entrance hall, etc. are some examples which should have a high degree centrality.

- Closeness centrality concerns the relative closeness of a spatial node to all the other nodes, thus fits the function of introduction better. Service areas, ticket counter, toilets, etc. are some typical examples which should have a high closeness centrality.

- Betweenness centrality concerns the extent to which a node happens to be in the best path from one node to another in the network, acting like a bridge. Such nodes thus fit the function of bridges/corridors the best. Bridges, buffer zones, etc. are some examples which should have high betweenness centrality.

- Eigenvector centrality concerns with the connections to other important places, thus reflects the extent of influence. An operation centre is an example which should probably have a high eigenvector centrality (further reading).

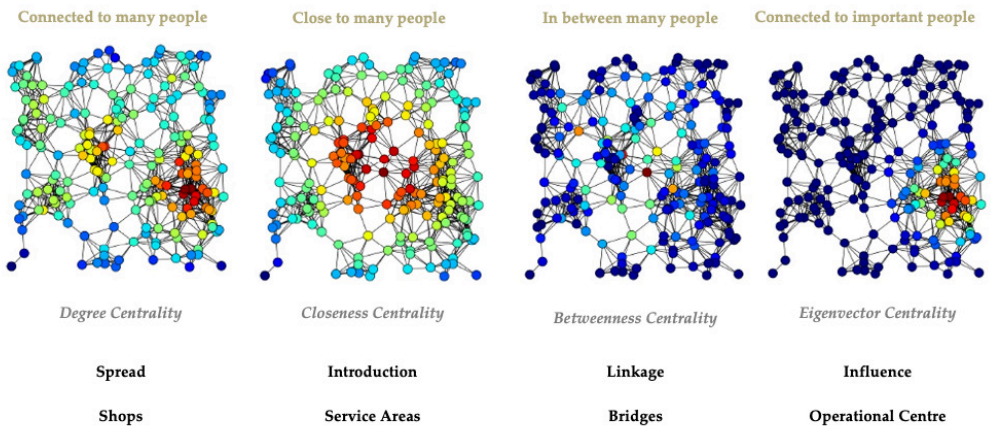


Figure 3.23 : Four archetypical centrality measures in a spatial network in building and their (exemplary) fitting functionalities

The centrality indicators of spatial network may not exactly mean the golden criteria for attributing different functional spaces, nor do they constitute necessary and sufficient conditions for the functionality of a "rational good design". However, they can construe some intrinsic rules as to whether a building is comfortable enough for users in terms of the chances of encounter and avoidance with various 'network voyagers', be it friends, acquaintances, or strangers. The most important take-away from this methodology is that you can use it to evaluate the match of relative spatial potential and activities in the spatial network analysis.

Here is another example of such evaluation. Suppose we would like to evaluate two different spatial configurations of the design for a Regional Government Office: a flat and a hierarchical organization (see Figure 24). Which one is probably more "right" in terms of spatial functional configuration? You may have an intuition for the answer, but it can be hard to explain.

When we draw out the plan and calculate the centrality measures for both scenarios in Figure 25, we may find that in Scenario B, something strange happens: the office manager has a more influential position than the regional manager according to most measures. Is this right? It is then up to you as designer to decide and adjust. Furthermore, the design idea can be easier to explain to the users.

If you also know Space Syntax, you will find that the centrality measures we use here have some close relationship with the concept there such as connectivity, intensity, and choice. You can dig into the topic to compare what is different in space syntax and make your own judgement on which one makes more sense. However, it is out of the scope of this course. If you are interested in using space syntax analytic methods,

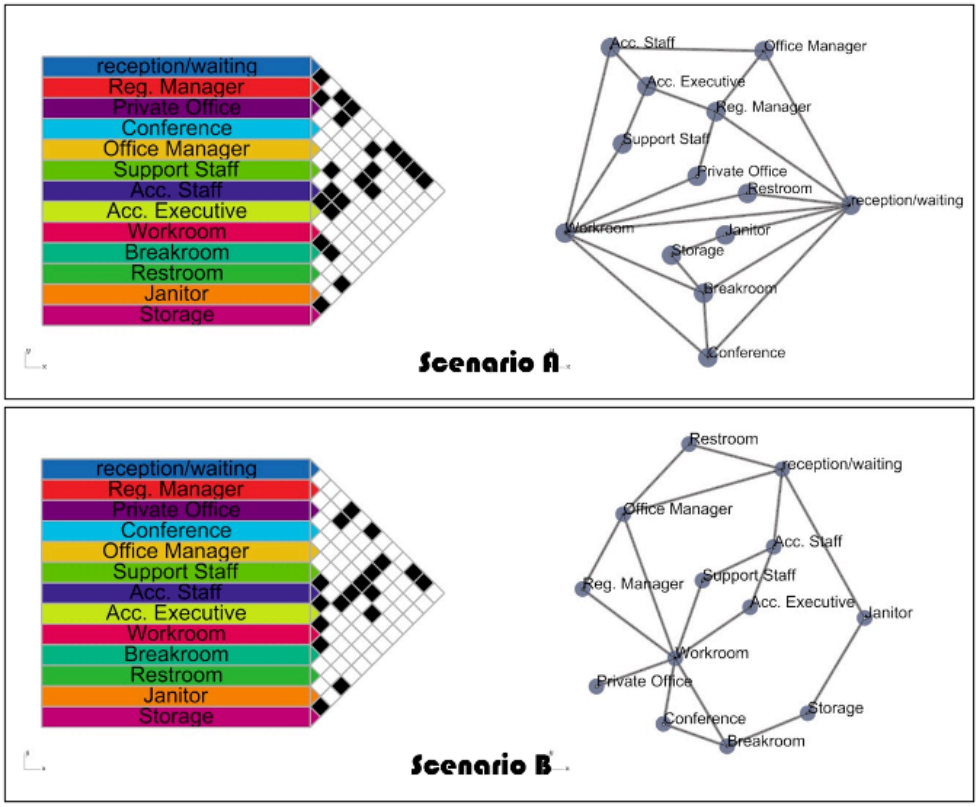


Figure 3.24 : An exemplary design scenarios for a regional office with different spatial configurations

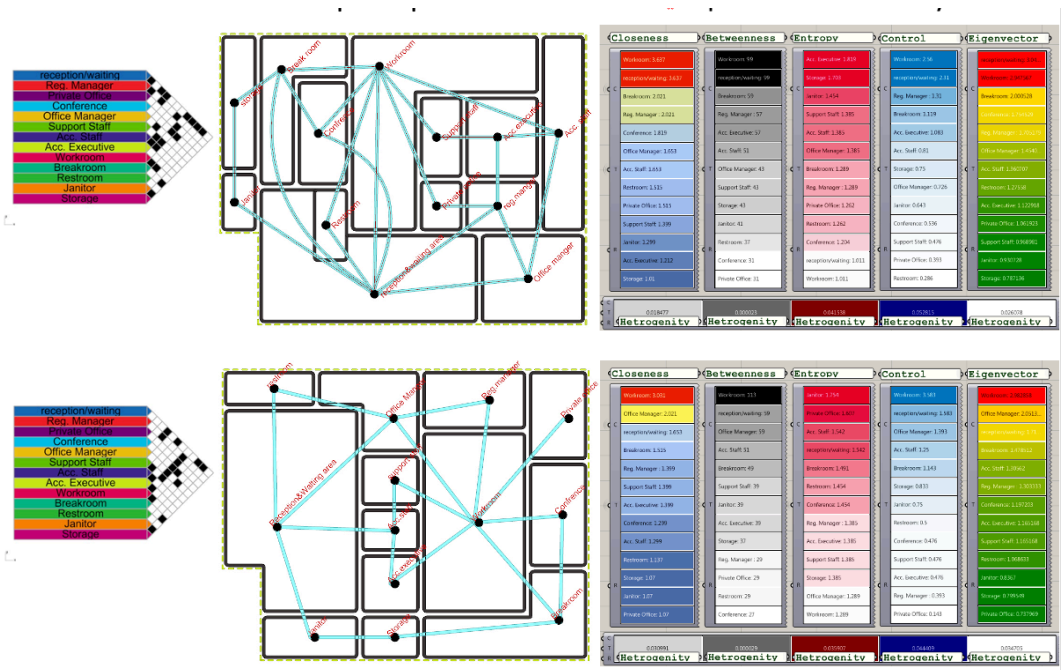


Figure 3.25 : The plans and centrality measures for both scenarios

please note that the centrality measures introduced here have somewhat different names in space syntax and that they are computed in slightly different ways. The comparative study of these indices falls out of scope of this reader but for a simple comparison note that the closeness centrality is almost the same as the 'integration' index in space syntax terminology and the betweenness centrality is almost the same as 'choice' index in space syntax terminology. The differences are mainly due to the

visibility-oriented approach of space syntax methods in large scale spatial analysis and the accessibility-oriented nature of our methods, which is similar to the original architectural space syntax methods proposed for the study of the structure of human settlements in the book Social Logic of Space by Bill Hillier and Julienne Hanson.

Exercise Tutorial

- Basic Tutorial of Gephi

Download and install Gephi from https://gephi.org/. It is a free, easy, and powerful software to analyse networks/graphs.

You can find tutorial at https://gephi.org/users/ and http://www.martingrandjean.ch/gephi-introduction/.

The following manual is based on Gephi 0.9.2 for Mac. For Windows versions or other versions of Gephi some things might be different.

- The Data Format for Gephi

As is discussed in our lecture, there are various ways to represent a network/graph, it is also the case for Gephi. We suggest you to use the Node List + Edge List representation. In order to make your importing correct, make sure to do the following steps in your weekly progress excel sheet before move on to Gephi:

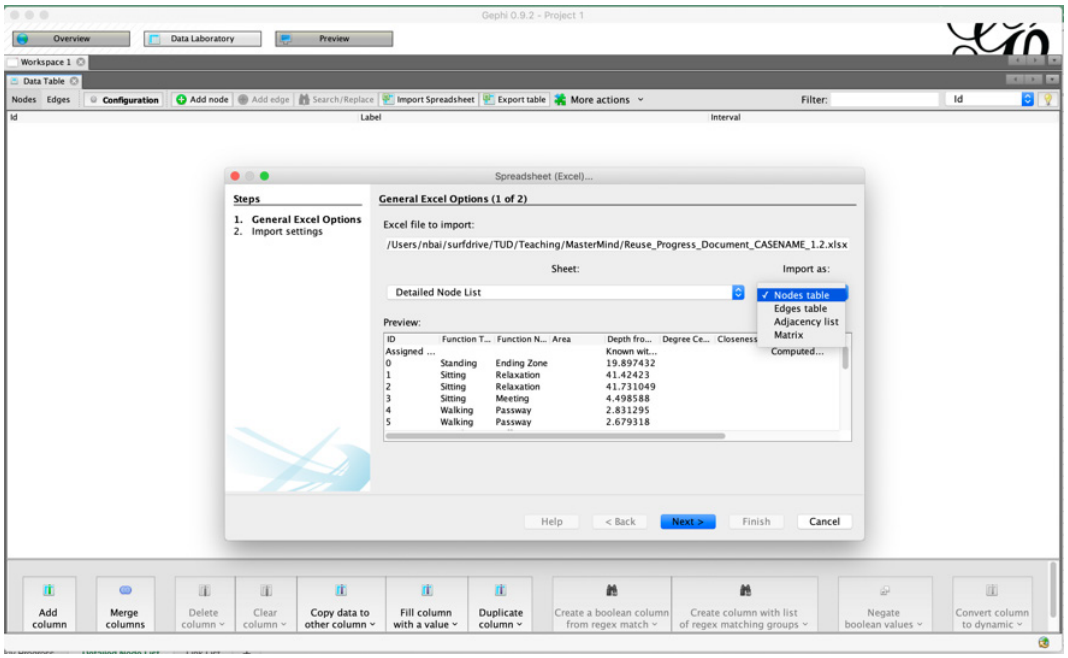
In "Detailed Node List" sheet, make sure the columns ID, Function Type, Function Name are complete. Delete the second-row description written in red.

In "Link List" sheet, change the column names "From" and "To" into "Source" and "Target", as that is required for Gephi.

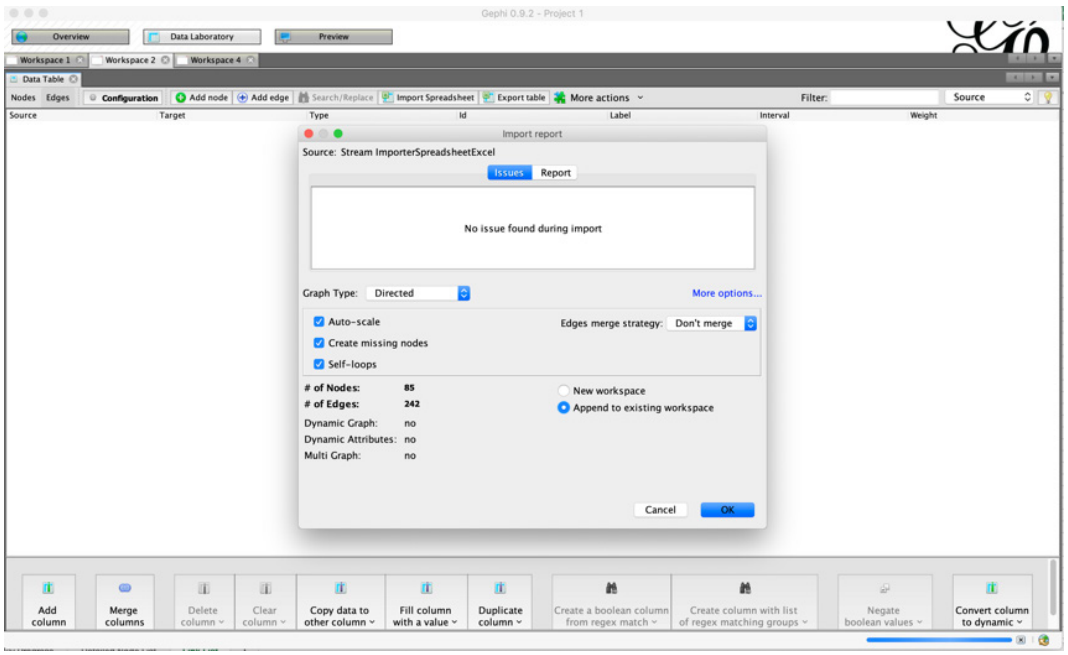
- Network/Graph Analysis in Gephi

Click on "Import Spreadsheet" in Data Laboratory panel and select your weekly progress excel file.

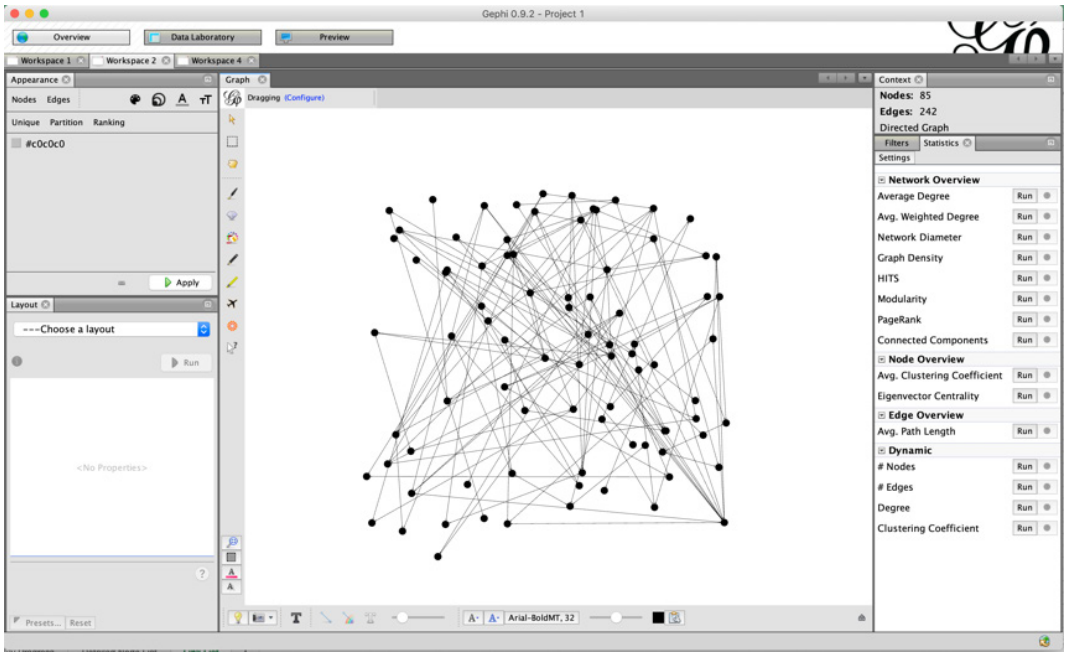
Select “Detailed Node List” sheet and import as “Node table”. Keep everything as default and finish importing the nodes.



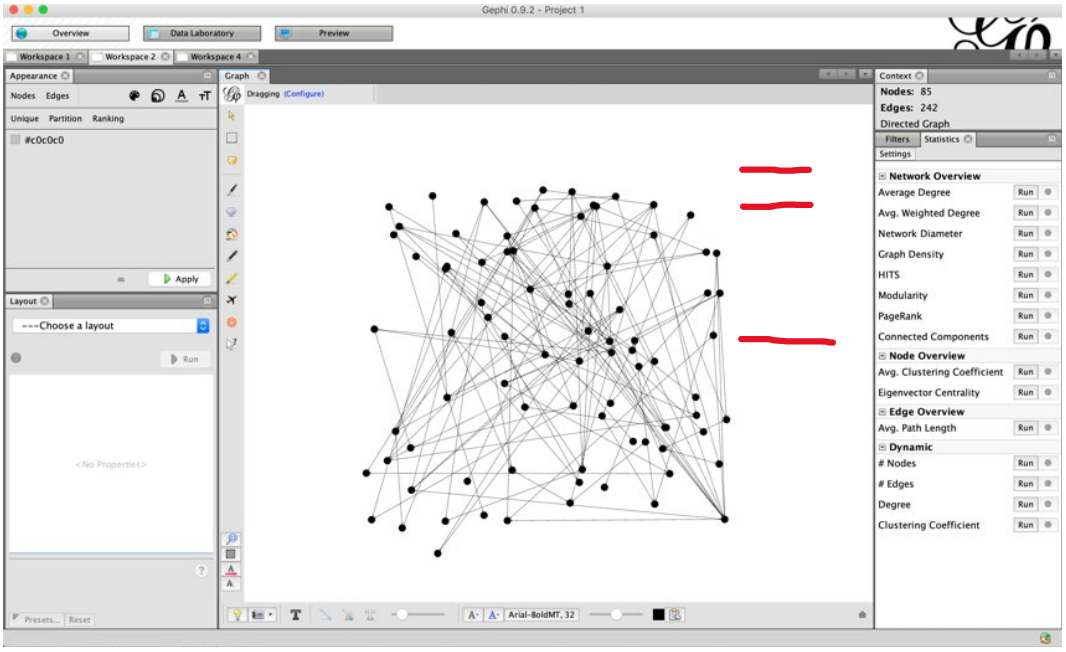
Do the first step again. This time select “Link List” sheet and import as “Edges table”. Keep everything as default except for select “Append to existing workspace” in the last window. Keep the graph type as “Directed” to avoid error, we are able to do analysis as if it is undirected later on.



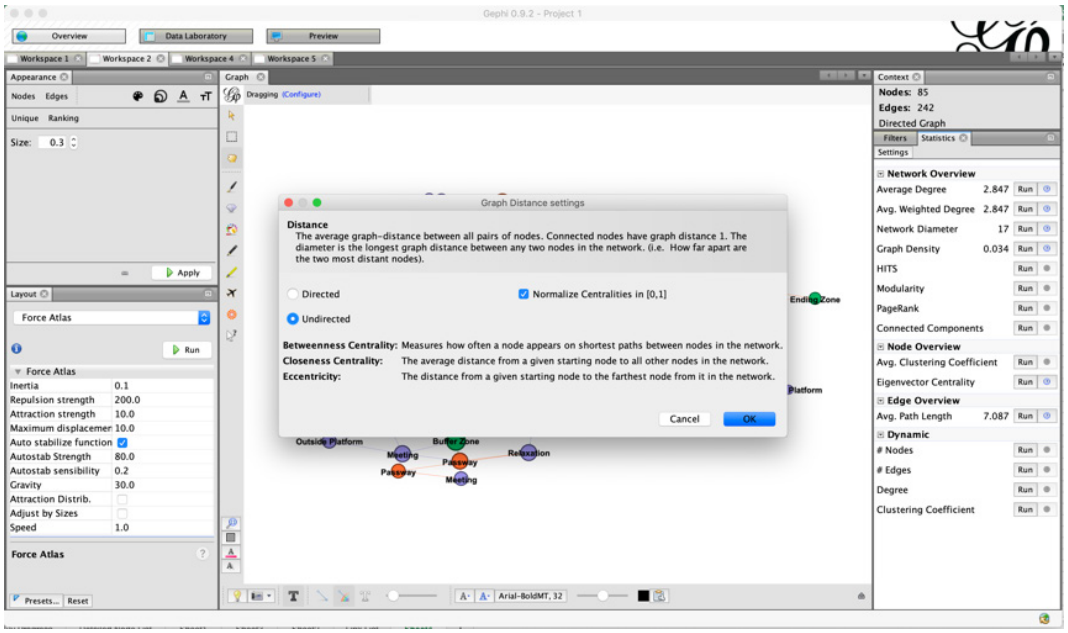
Now in **Overview** panel you will be able to see the initial state of your first graph.



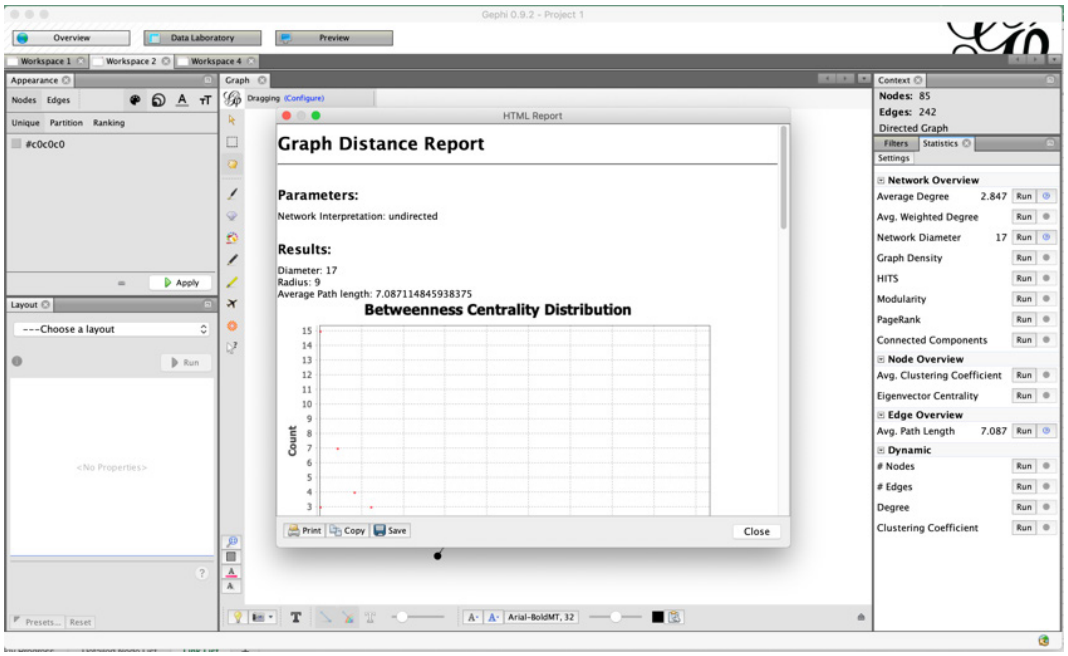
Click the "Run" button for "Average Degree", "Network Diameter", "Eigenvector Centrality" on you right and let Gephi compute all the centrality values for you.



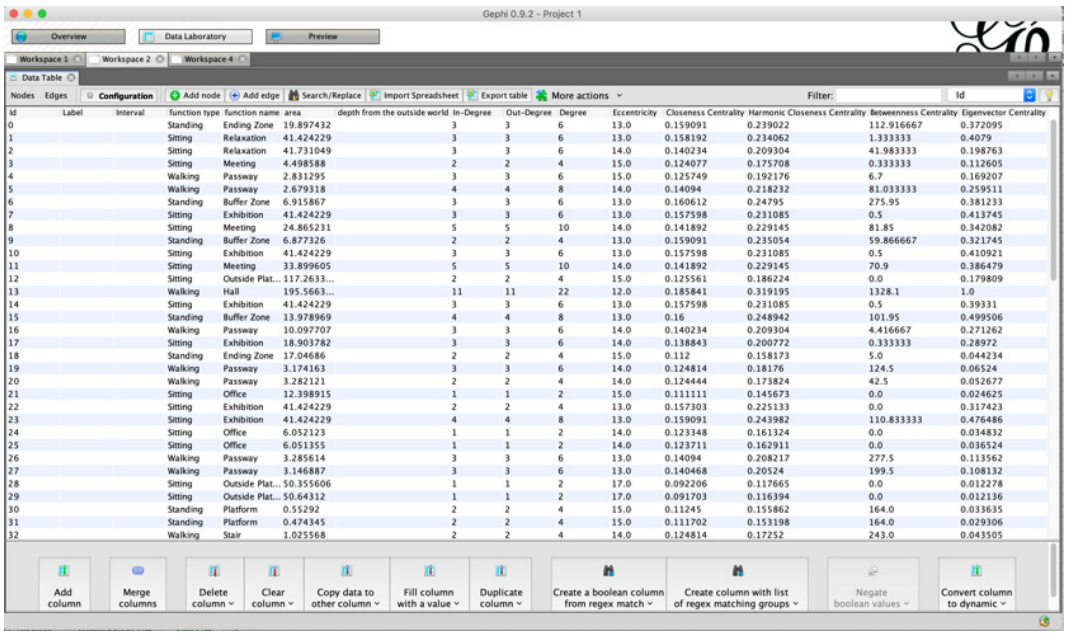
When computing the "Network Diameter", select "Undirected" and "Normalize Centralities in [0,1]". When computing the "Eigenvector Centrality", select "Undirected".



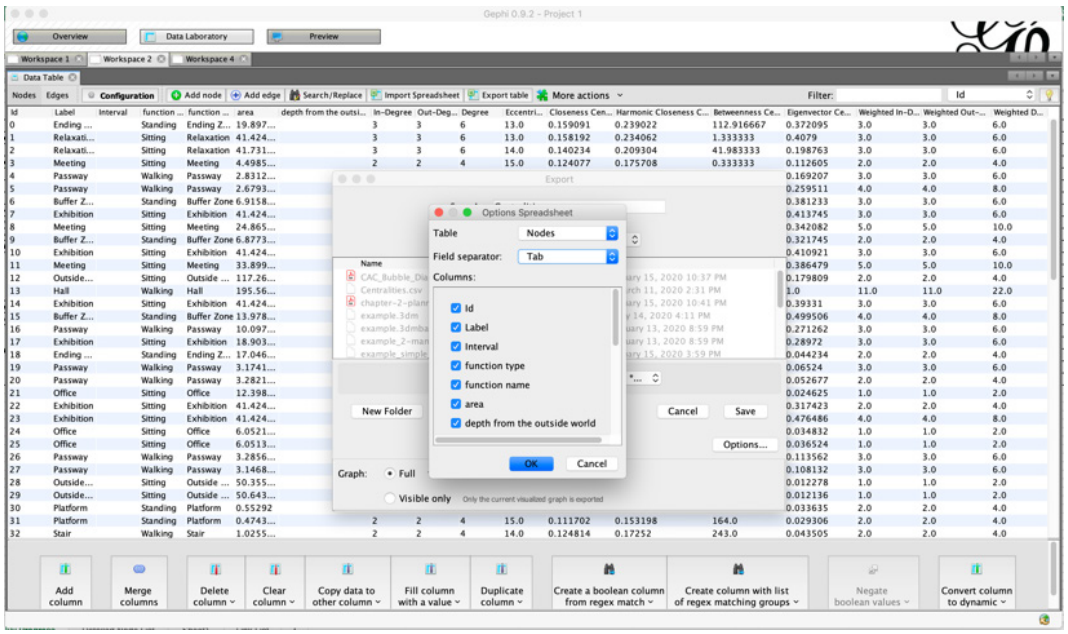
Save some of the pop-up report if you like. You may want to add them into your presentation. Record the "Average Path Length" value if you choose to make your assessment on Accessibility based on that.



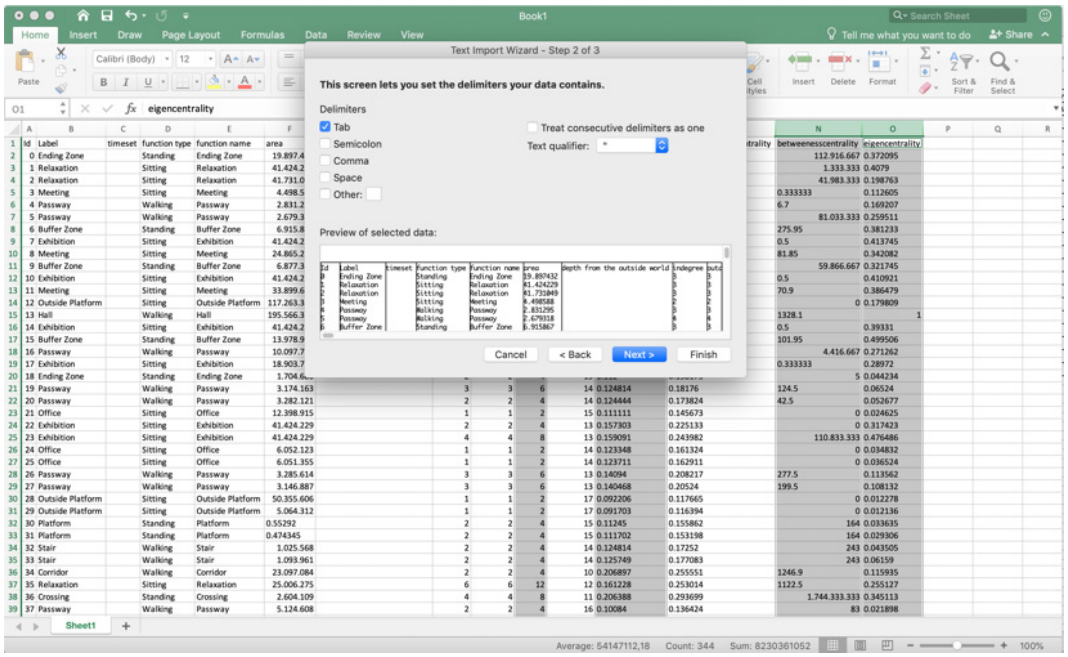
Go back to the **Data Laboratory** panel, and you will see that now you have all the required centrality values (Degree Centrality is here replaced with Degree).



Click on “Export table” and click on “Options...” button. Make sure you choose the Table “Nodes” and Field Separator “Tab”.



You can now import this csv file in excel using "Tab" as Delimiters. Then you can copy-paste the four columns of required centrality values into your weekly progress sheet.

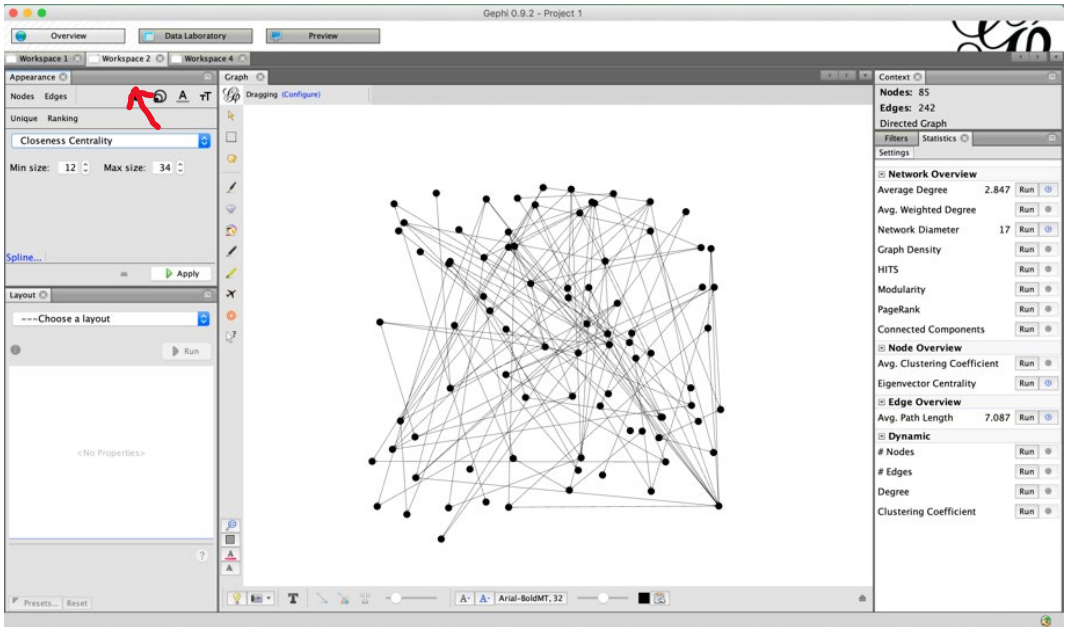


NOTE: Gephi exports the csv file with the standard of decimal points rather than decimal comma (see this link for more information), which means that the numbers may be recognized incorrectly in your excel. Keep this in mind and check what the occasion is for you. You may want to replace all the decimal separator to fit your own computer.

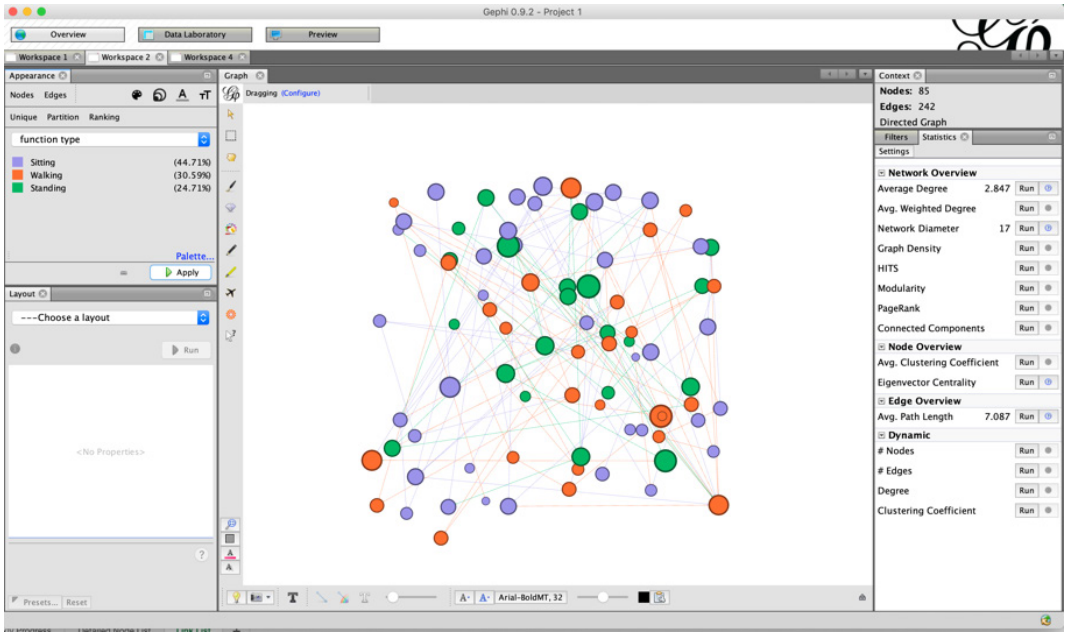
- Network/Graph Visualization in Gephi (optional)

You can also play around with the visualization tools on the left in **Overview** panel. Here are some suggestions what you can do to explore.

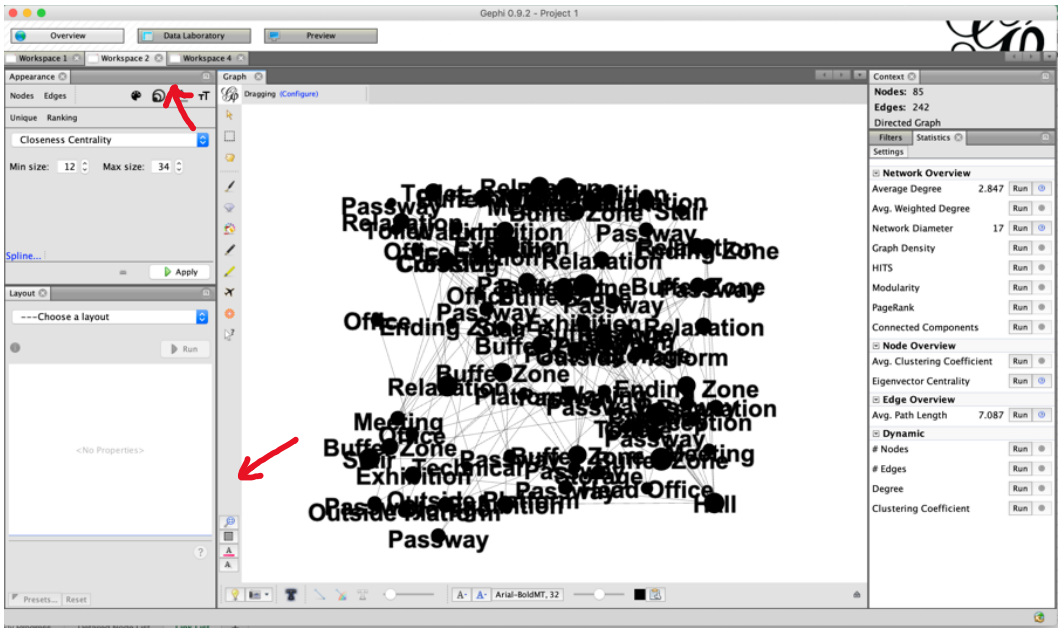
Change the size of nodes by the ranking of any of the centrality values.



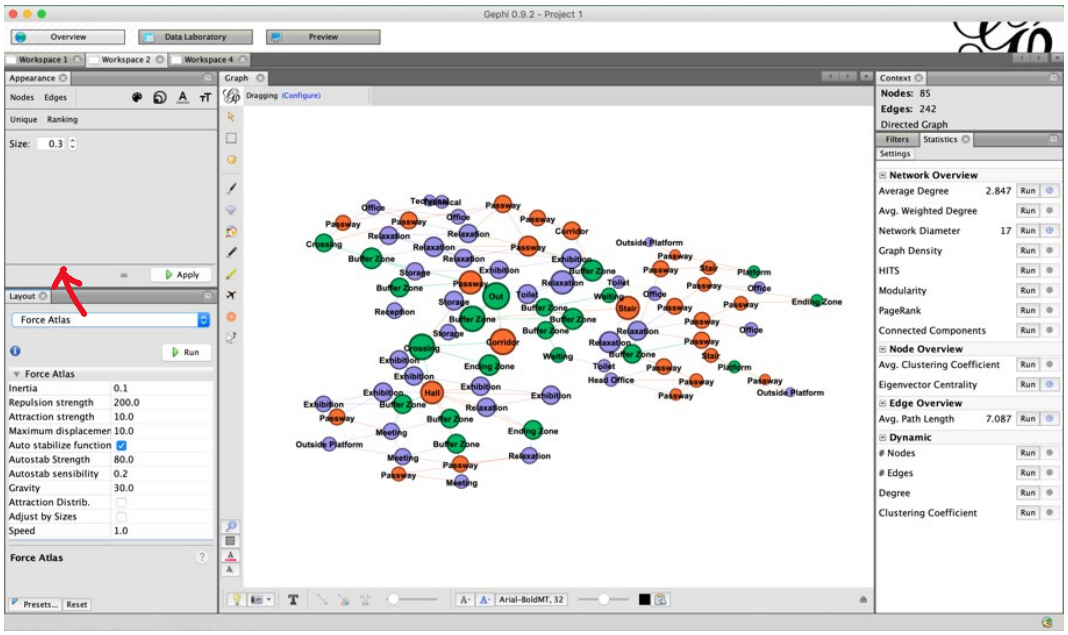
Change the colour of nodes by the partition of different function type or function name.



Copy the function name column into label in the **Data Laboratory** panel and turn on the labels for each node in **Overview** panel and set the label size in a reasonable range.



Try different layout tools to see what happens.



If your labels overlap annoyingly, use “Label Adjust” can be helpful.

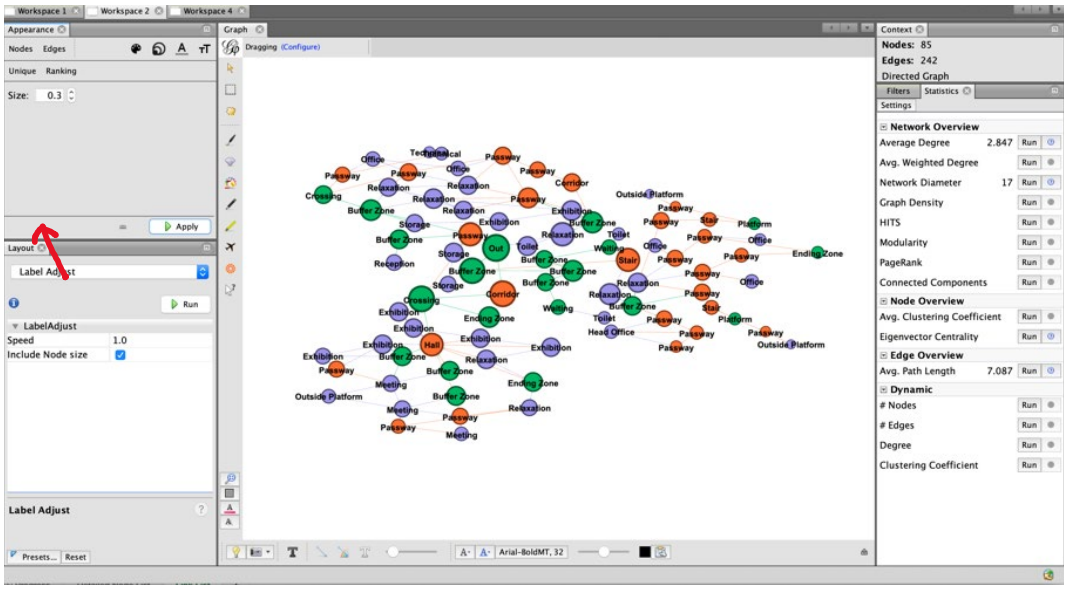


Figure out be yourself what can be a good presentation and visualization for the information that you would like to transfer.

Key References

[1] GEPHI – Introduction to Network Analysis and Visualization http://www.martingrandjean.ch/gephi-introduction/

[2] Easley, D., & Kleinberg, J. (2010). Networks, crowds, and markets (Vol. 8). Cambridge: Cambridge university press. https://www.cs.cornell.edu/home/kleinber/networks-book/

[3] Albert-Laszlo Barabasi. (2016). Network Science. http://networksciencebook.com

[4] Bonato, A., D'Angelo, D. R., Elenberg, E. R., Gleich, D. F., & Hou, Y. (2016, December). Mining and modeling character networks. In International workshop on algorithms and models for the web-graph (pp. 100-114). Springer, Cham. https://arxiv.org/pdf/1608.00646.pdf

[5] UCL Space Syntax. Analysis of Spatial Relations. (tab 1-3) http://otp.spacesyntax.net/overview-2/analysis-of-spatial-relations/

[6] Social Networks in Novels and Films. https://anthonybonato.com/2016/08/03/social-networks-in-novels-and-films/

[7] Nourian P, Rezvani S, Sariyildiz S, van der Hoeven F. (2016). Spectral Modelling for Spatial Network Analysis. *SimAUD 2016.* https://www.researchgate.net/publication/303944600_Spectral_Modelling_for_Spatial_Network_Analysis

[8] Nourian, P, Configurative Design Computational Space Planning, Layout, and Form-Finding in Architecture," doi: 10.13140/RG.2.2.26063.94880/1.

3.6 Assess

In this course we are looking at a special definition of assessment in the sense of the difference made by the design for retrofitting (reuse plan). So far, we have been doing analyses on the first (and probably the most complicated) indicator of effectiveness represented by centralities. In this section, we will first quickly introduce the concept of the other two indicators and how could you possibly measure them.

Vitality with respect to Diversity

Recall that in the beginning of the course, we gave you the further definition of diversity:

$$\text{Diversity} = -\sum_{i=1}^{n} p_i \ln p_i \,,$$

$$\text{where } p_i = \frac{N_i}{\sum_{i=1}^{n} N_i} \,,\ N_i \text{ denotes the number of POI of } i_{th}\text{function}$$

$$\text{Equilability} = \frac{\text{Diversity}}{\ln n}.$$

As shown in the formula above, the concept of diversity is perhaps the easiest to compute, as it gives you a single real number after computing, based on a definition called 'entropy' from Claude Shannon, who is known as the father of the so-called information-science. Entropy, in a manner of speaking, is a measure of how 'varied/messy' is the frequency distribution of the items within a set, assuming that the more so, the more the 'information content.

The concept of Diversity Index was originally used in ecology, and is later adapted in many more fields. Urban planners, for example, also use this concept to judge the degree of land-use mix in the urban environment, which also suggests the vitality of the city. The example below showed in Figure 26 gives you an intuition how is Diversity index applied by urban planner to assess the spatial vitality.

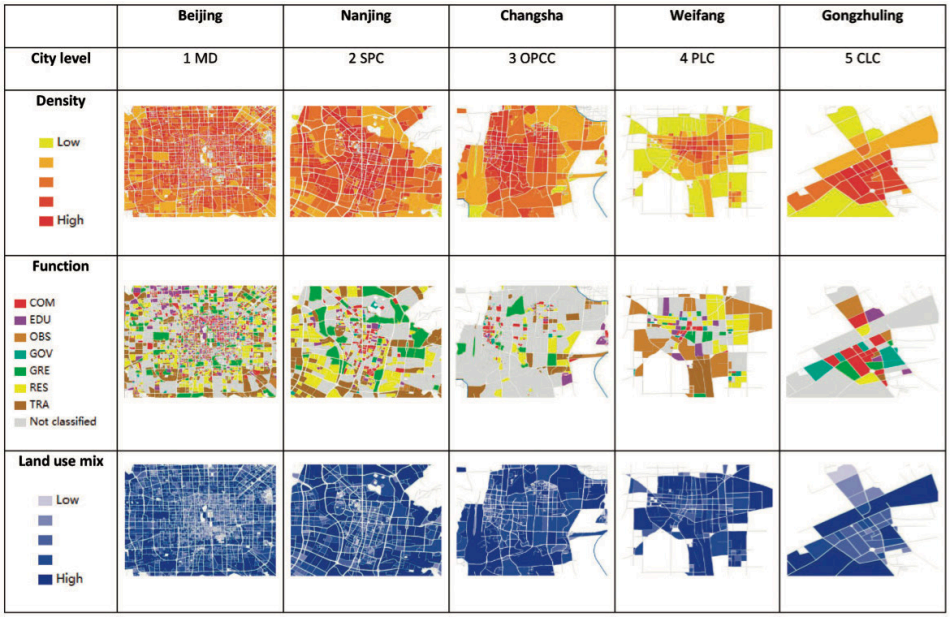


Figure 3.26 : An example of using Diversity Index to evaluate the land-use vitality in Different Chinese cities. (Liu and Long, 2016)

Efficiency with respect to Accessibility

The measure of accessibility, on the other hand, was defined by the given formula:

$$\eta = \sum_i \sum_j T_{i,j} D_{i,j} \text{ ,where } T_{i,j}, D_{i,j} := \text{flow rate and distance between } i \text{ and } j$$

This is the original sense of temporal efficienct, i.e. for the places people go across more often (a higher flow rate), are the distances also short or at least not too long? However, this can only be measured if you have the real-world data of human behaviour. Here is a research done in a home where an old couple live in (check Figure 27). The researcher measured the behaviour pattern of the couple using UWB devices. And in this case, you can really compare the spatial configuration and the human movement together to compute the temporal efficiency.

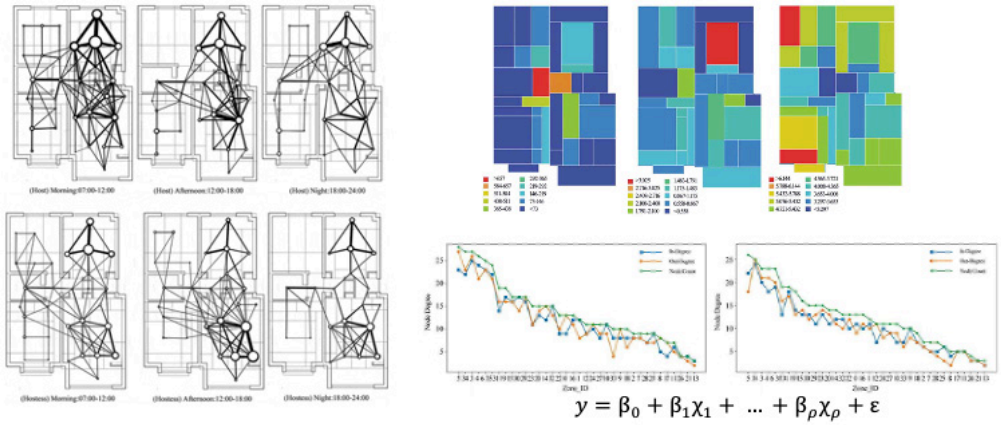


Figure 3.27 : An example of using spatial tracking techniques to capture the real-time flow of people's movement which can be used to compute the temporal efficiency in a building. (Yang and Huang, 2019)

However, in our condition, we are not able to know the real-time behaviour of users in our building case, especially for the before-renovation phase. Here we can use an alternative way to get an idea of how is this place accessible. As we have already generated the spatial configuration graph in the previous step, we can easily get the distance from any given node to all the other nodes (we call this depth). If we pick one critical node (we suggest you to pick the node representing the outside world, unless you are sure why you want to choose some other node), then we can know how far should people walk if they want to move from this place to other places. This also approximates the accessibility in some sense.

An even simpler option to measure the accessibility can be using the average path length of the whole network:

$$l_G = \frac{1}{n(n-1)} \sum_{i \neq j} d(v_i, v_j), \text{ where } d(v_i, v_j) \text{ is the distance between node } v_i \text{ and } v_j$$

Using Gephi or any graph analysis software, we can easily compute the average path length between any pair of nodes in the graph.

Making Comparisons

Now that we have all the three indicators computed, the question is how to compute a single value with respect to the effectiveness of centrality distributions, the efficiency of accessibilities, and the vitality of the diversities in the entire spatial configuration. These three values are, in our case of reuse evaluation, supposed to indicate the difference between the 'before' and 'after' cases.

Well in the case of retrofitting, as the term literally suggests, it could very well be that the before and after situations are incommensurate such as apples and oranges. This is primarily due to the highly likely difference between the functional labels of the spaces in both cases (i.e. a different allocation) or even the addition/removal of nodes and links within the previous spatial configuration.

Increased/Decreased Vitality with respect to Diversity

The definition of diversity provided before is already in a shape to be used for this assessment. It does not even provide a challenge because of the incommensurability of the before and the after situations.

The difference made between the before and the after situations will be simply the diversity of the posterior situation minus the diversity of the prior situation, thus either a positive value indicating increased diversity or a negative value indicating decreased diversity.

Increased/Decreased Efficiency with respect to Accessibility

The definition of the accessibility that we gave before already provides a single aggregate number which can be compared between the before and after situations. However, the case of accessibility is currently out of scope of our project in its original sense, since we are not really collecting the data of the actual flow of people. In this exercise, two other options are given to measure and assess the accessibility: average path length, and the depth difference from the outside.

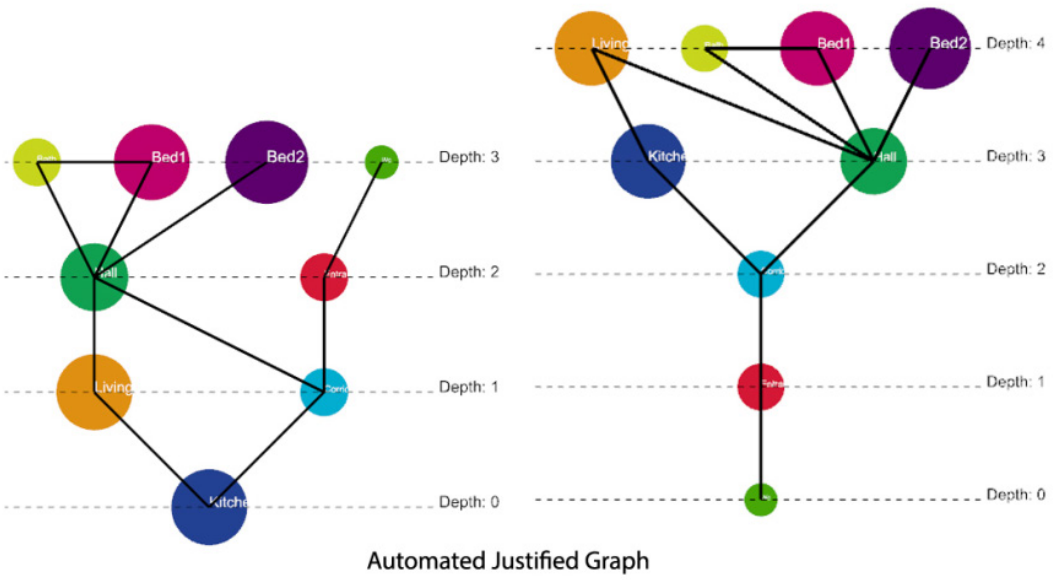


Figure 3.28 : An example of two depth distribution patterns

If you choose to compare the average path length, this is again a single real number value, so you can make assessment by only comparing the two values. The shorter the average path length is, the more accessible this space is theoretically.

However, we do encourage you to compare the pattern of depth distribution from the outside. For example, suppose we have transformed two plans into networks and generated the depth of all the nodes to the "outside world" using Syntactic in grasshopper, yielding two patterns of depth distribution, as shown in Figure 28. For the both patterns, the node at Depth 0 is the outside world, and other spaces have different depths. For the left pattern, two nodes have depth of 1, two have depth of 2, and four have depth of 3; while for the right pattern, one node has depth of 1, one has depth of 2, two have depth of 3, and four have depth of 4. Now we have all the data, how can we make a comparison of the two patterns? Which one is better? You may consider using the mean (average) of the depths to compare the two patterns. Sometimes it can be feasible, but not always.

One important message we want you to remember here is that only comparing the mean (or average) of two groups of values is not always a valid comparison. Here in this case, we have to make a statistical *t*-test, and use the corresponding *p* value to tell us if these two groups of values are different. Only when the *p* value is smaller than 0.05, we can claim that it is valid. But here, when we conduct the *t*-test as shown in Figure 29, we can see though the right "after" pattern has a higher mean than the left "before" one, because of a *p* value larger than 0.05, we can only say that there is no significant change before and after when you make the assessment.

t-Test: Two-Sample Assuming Equal Variances

	Before	*After*
Mean	2	2,777777778
Variance	1,25	2,194444444
Observations	9	9
Pooled Variance	1,722222222	
Hypothesized Mean Difference	0	
df	16	
t Stat	-1,257237114	
P(T<=t) one-tail	0,113355343	
t Critical one-tail	1,745883676	
P(T<=t) two-tail	0,226710686	
t Critical two-tail	2,119905299	

p>0.05, **no** significant difference

Figure 3.29 : The result of t-test comparing the depth values from the two different patterns shown in figure 28

For those of you who are advanced in statistics or interested: *t*-test is a statistical tool to judge whether or not the difference of two samples of values are out of coincidence. A *p*-value smaller than 0.05 shows that the difference is not occurring because of randomness or coincidence, thus a comparison can be valid, as given by the following definition:

$$t = \frac{\overline{X_1} - \overline{X_2}}{s_p\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}, \text{ where } s_p = \sqrt{\frac{(n_1 - 1)s_{X_1}^2 + (n_2 - 1)s_{X_2}^2}{n_1 + n_2 - 2}}$$

Increased/Decreased Effectiveness with respect to (matching) Centralities

For the centralities, however, we need to have a qualitative sense of what is desirable and what is not. Thus, we need to work with a rational/desired ranking of centralities before computing them (by the assessor) and a list of centralities as computed. Then the assessment process is defined in terms of the match between the desired ranking of centralities and the actual ranking of centralities, as to which we will use a rank correlation to figure out the degree of match or mismatch, respectively as a positive or a negative number. In this sense, then the prior and posterior situations are not compared with one another and thus we will not have the incommensurability issue. Instead, the rank correlation coefficients or the posterior situation are subtracted by the rank correlation coefficients of the prior situation.

For simplicity and considering that all these relative differences are dimensionless, then we can average all four such differences to get a comprehensive sense of improvement or deterioration in the use of space. The case of this assessment, however, will always depend heavily on the way the assessor (or the designer) assumes the desired ranking of the centralities to be.

To make this assessment reproducible, the assessor can ask the architect to intuitively provide a desired ranking of the centralities beforehand both before and after renovation, of course, based on a short definition of the centralities[2]. For obvious reasons, the case of degree centrality can be left out of this comparison because it will simply be trivial to guess and see the difference in degree centrality. However, the other three archetypical centralities can be interesting to compare. For each centrality you ask the architect to fill in a questionnaire with such a question: "In your view, how should the ranking of spaces be in terms of this centrality?"

- Closeness Centrality: the extent to which a space is [to be] central in the sense of being close to every other space in the configuration. In other words, how accessible should the space in question be if everyone took a shortest path?

- Betweenness Centrality: the extent to which a space is [to be] central in the sense of being on a path between many other spaces. In other words, how likely should it be to see someone passing through the space in question?

- Spectral Centrality [Eigenvector Centrality]: the extent to which a space is [to be] important in the spectrum of accessibility in the sense of being connected to other important spaces. In other words, how central should the space in question be even if everyone took a random path in the spatial configuration from somewhere to somewhere else?

After you obtained the desired centrality rankings either from the architects or from yourself, you can compare the ranking with the actual computed centrality measures both before and after the renovation using the Spearman's Rank Correlation. It will

2 **Note:** if you find this too difficult, you may also consider doing the estimation yourself as the assessor. However, it would be more convincing to have the architect make the estimation, and later check if this intension was eventually realized with your analysis. It shall be a fun challenge for you to explain the ideas of centralities correctly to the architects.

give you a number *r* called correlation coefficient, ranging from -1 to 1. A *r* value closer to 1 shows that the two groups of variables trend to change in the same direction with each other. A *r* value closer to -1 shows that they trend to change in the opposite direction. And r value close to 0 shows that there seems to be no relationship of the two groups.

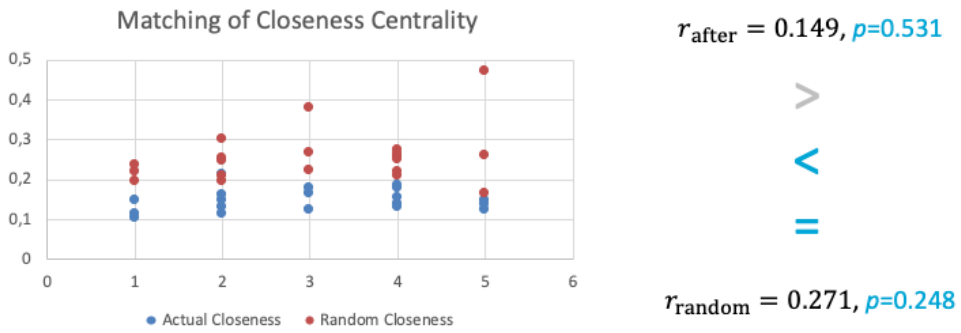


Figure 3.30 : An example of comparing the desired centrality measures with the actual centrality measures both before and after renovation.

As an example, when you have the closeness centralities for all the functional types both before and after the renovation, you can plot them on the y-axis to show their relationship with the expected centralities on the x-axis, as shown in Figure 30. After calculating the correlation coefficients, we can compare the *r* values of before and after, as they are again single real number values. In fact, there is actually also a *p* value for any correlation, if the *p*-value is larger than 0.05, then the correlation is not significant or valid. However, this is out of our scope in this course.

Sometimes you may find out that the correlation coefficient value *r* does not seem right. Why is the correlation coefficient so low? Why is it close to 0 or even negative? Why are things getting worse when the architects do some nice intervention? When all such things against intuition happens, it is the time for you to go and check what is the thing that went wrong.

ID	Function Type	Function Name	Before Renovation		After Renovation		Degree Centrality	Closeness Centrality	Actual Closeness	Actual Degree	Actual Eigenvector	Random Closeness
4	Sitting Space	Outside Platform			3	218,262095		1	0,103156667	2,666666667	0,068074333	0,218761
14	Standing Space	Platform			2	1,027265		1	0,112076	4	0,0314705	0,234693
8	Sitting Space	Technical			2	13,935884		2	0,1124195	3	0,0314645	0,1941415
1	Sitting Space	Head Office			1	24,994483		5	0,122271	6	0,092019	0,165966
3	Sitting Space	Office			5	63,340251		3	0,12381	3,2	0,0873028	0,37838
9	Sitting Space	Toilet			3	24,716381		4	0,130778667	2	0,020472667	0,217979
15	Standing Space	Waiting			2	6,651218		2	0,130841	4	0,024442	0,2078875
18	Walking Space	Passway			20	140,118396		4	0,13586605	6,3	0,18355445	0,2643473
2	Sitting Space	Meeting			3	63,263422		5	0,135953667	8	0,280388667	0,470676
5	Sitting Space	Reception			1	2,745567		4	0,138158	2	0,022632	0,256494
19	Walking Space	Stair			3	14,353502		5	0,146584	4	0,060495667	0,261493
12	Standing Space	Ending Zone			3	71,263411		1	0,147506667	4	0,166833667	0,194716667
7	Sitting Space	Storage			3	23,812347		2	0,149119667	3,333333333	0,090352	0,245783
0	Sitting Space	Exhibition			8	284,164543		4	0,15584575	6,25	0,380537375	0,209614625
6	Sitting Space	Relaxation			9	179,898227		2	0,161611556	8	0,367356667	0,301983778
10	Standing Space	Buffer Zone			11	65,11234		3	0,165799909	6,181818182	0,224553273	0,222217273
11	Standing Space	Crossing			2	34,820004		3	0,179281	7	0,29939	0,266186
16	Walking Space	Corridor			2	35,628254		4	0,179398	4	0,114612	0,2497105
17	Walking Space	Hall			1	195,56637		4	0,185841	22	1	0,275261
13	Standing Space	Out			1	14,376455		2	0,213198	6	0,097472	0,252396

Figure 3.31 : An example of an unreasonable correlation coefficient value before and after renovation

For the example shown in Figure 31, you can see that we gave a high estimation for closeness centrality value for the "head office" and a low estimation for outside. However, it turns out that the head office has a low actual closeness centrality and the outside has a highest one. Now it is up to you to interpret the outcome. Is it because you made an improper estimation? Or is it because the spatial arrangement is bad? This is a chance to make your observation and argument more valid and acceptable.

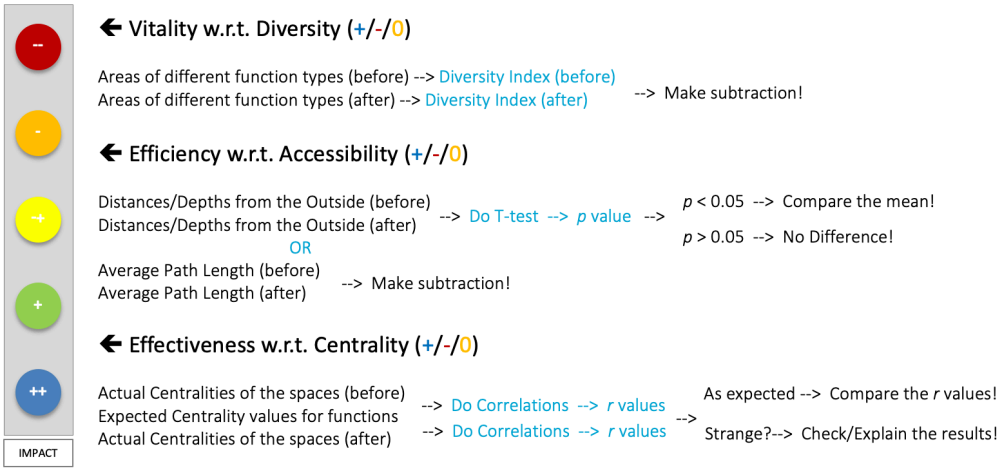


Figure 3.32 : Assessment guideline for all the three indicators

Wrap-up

As a conclusion, for all the three indicators, you can follow this flow chart in Figure 32 to make your assessments.

Most of the concepts and mathematical calculations discussed today are not mandatory for everyone, but you need to know how to interpret your outcome. For the students in our domain, you will have to provide us with the complete *weekly progress excel* with all the data required (shown in the black columns on the left of this slide). We can do the statistics and calculation for you and give you the values (as shown in blue in Figure 32). Then you need to use your understanding to interpret the values properly and give your own assessment for each of the indicators.

We would expect you have a sign-score for each of the indicators, which means that it should be either positive, negative or neutral. Use those signs to get your final code!

However, there are several things to keep in mind when you are doing some statistics like we discuss today. Make the proper interpretation and do not abuse the values you get.

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3.7 Future Research

Design problems in architecture and built environment typically present complexity challenges that are different from pure engineering problems. This is mainly due to the fact that the so-called human-factors (and ergonomics) are necessarily parts of such problems, as to which they have been called 'wicked problems' [13], among other terms [14]. The multi-dimensional and the multi-criteria nature of such problems present spatial and differential complexities demonstrating their physical character while the multi-actor nature and the multi-value nature of them present consensual and rational complexities, demonstrating their human character. In other words, the problems in these fields (design/planning) are such that multiple human actors, possibly with different value-systems must be included in solving them, reaching a consensus [15]. This is why such problems are said to have double-complexity (human/physical) [16].

Complexity and Generative Sciences

Reductionist approaches to such problems have long been criticized, justifiably so, for their over-simplistic attitudes; declaring the necessity for approaches that are rooted in the relatively new umbrella domain called generative sciences for studying complex systems. There is yet much to be done for collecting and consolidating existing knowledge on the human factors affecting spatial qualities; not only to predict human comfort but also to understand it and explain it transparently and unambiguously. Being able to evaluate properly is key to design and planning practices. Even if some day we manage to train machines with Artificial Intelligence to predict comfort by fitting meta-statistical models, we shall still have to be able to understand the basic principles of human/spatial qualities in such a way that we can train ourselves to make more effective quality decisions. After all, the reason why we may want to model a phenomenon is not only to predict its dynamics but also to understand from the model and reach theories that can explain the mechanisms by which those dynamics come into existence in the first place [17]. Thus Explainability and reproducibility of knowledge will be essential to ensure towards developing open-science [18]. Additionally, it would be futile to try to rebuild such theories by ignoring existing theories but of course we need to critically revisit existing theories, embrace the complexity of the phenomena under study and move towards complexity-aware models of human-physical spatial systems, e.g. Agent-Based Models [19]. Two of the domain-specific fields of knowledge pertaining to such qualities and our spatial domain are Environmental Psychology and Ergonomics. When connecting these domains to the spatial subject matters of architecture and built environment, it is easy to see why accessibility and visibility analyses are central to many types of assessments.

Environmental Psychology and Ergonomics

The main issue of our field for going towards scientific design and planning is that we do not yet have a properly categorised understanding of our problems and evaluation frameworks. All computational methods are the means of problem solving. Arguably, then, before discussing which problem-solving methods is better than another one needs to specify the nature of the problem. This is where both the challenges and the interesting intellectual activities intersect: in other words, lots of work is there to be done. We need to work on two major areas in the so-called domain-specific

knowledge areas: problem-formulation, and solution-evaluation. Instead of making both the same, we would suggest to think about evaluation first. Reflecting on existing (and historical) examples and abstracting what makes them comfortable or uncomfortable would be the first major step. Of course it is essential to specify the type of comfort (thermal comfort, psychological comfort, ergonomic comfort, etc.). It is understandable that sometimes the fascination is essentially focused on the methodology or the technology but in the long run the focus on solving real problems helps to boost that fascination as well.

There are at least three scientific journals that publish articles regularly on these subject areas: Journal of Environmental Psychology , Journal of Ergonomics, and Environment and Behaviour.

In Environmental Psychology there are some pioneer figures that deserve more attention: James J. Gibson, Kevin Lynch, Lillian Moller Gilbreth, and of course Jane Jacobs.

A handful of important concepts from the field of environmental psychology that deserve more attention from architecture students are healing environments, defensible space theory, interior design psychology (in particular the idea of defensible space, ibid), and of course the idea of 'eyes on the street'.

Quite a few of these ideas are either about large scale environments or small scale environments where the intensities are such that they afford a scientific investigation; but they certainly apply in fundamental ways to the architectural scale as well. Back to the technical side of the story, the angle to look at such matters from a computational point of view has often been (for good reasons) the concepts of visibility and accessibility at various scales and various types of inter-relations. Of course the whole idea of the so-called Space Syntax theories is also rooted in these lineages of intellectual concerns about use of space and the effect of the shape of an environment on human behaviour. About the latter subject you can find much more through [20]; but there is much more out there especially on the subject of visibility. You can follow the footsteps of late Alasdair Turner for visibility studies in Space Syntax and their relation to comfort.

No reduction in dimensionality

We have explained in this course that walkable spaces are 2D manifolds. Even though many studies have tried to reduce the dimensionality of walkable space into networks consisting of points and lines, we must warn against continuing in that direction because it presents unresolvable scientific challenges in the study of accessibility on networks. A large pedestrian area in a city or a building is not exactly reducible into a bunch of points and lines, it can only be reduced into 2D cells for accessibility studies. Similarly, if the point of attention is visibility, it is clearly a 3D matter that cannot be studied on a floor plan, Visibility can be studied in 3D cells, e.g. on voxels. For learning more about voxelization algorithms and raster based analytic approaches you can check this paper [21], this presentation [22], and this library [23].

Epilogue

Lastly: Technology is the Answer but what was the Question?

The setup of the course is such that it separates solution-evaluation from problem-formulation and problem-solving in design. This is exactly what we need to be able to avoid subjective bias and the traps of logical fallacies. Critical Thinking skills are generally important for all academic endeavours but even more so for the study of human factors, especially due to avoid subjective biases, belief systems, esoteric/mystic approaches, propaganda, commercials, personality-cults and pseudo-science in general towards building scientific approaches to understanding spatial quality in architecture and built environment. There is much more for independent humans to do and achieve collaboratively together in this direction rather than big machines owned by corporations.

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CHAPTER

4

Architecture

by Hielkje Zijlstra & Bruna Nunes

Introduction

Example of analyses of eight department stores in the Netherlands in the HA graduation Studio Vacant Heritage 2020-2021. The elements of the façades extracted. Spatial Building Typology, (Zijlstra, ea 2021)

In the Mastermind Crash course, buildings are analyzed on various aspects, in particular looking at the impact and (measurable) results that the interventions in the building have had. Much of the built heritage is vacant, requires a re-use or the current use requires an update. This causes buildings to change. At Heritage & Architecture we want to make students aware of the impact these changes have on various aspects that play a role in this. This chapter is about architecture. Architecture is a broad concept. That is why we have focused on a limited number of aspects: space, connections and details. So, three scale levels are included in the analysis. A value assessment can be made on the basis of various methods. This is explained and illustrated in this chapter with a lot of examples. This judgment is placed in the framework of the Mastermind Crash course, after which an evaluation and comparison can be made of the change of the building at the moment and with respect to the building in a previous phase of life with the focus on Architecture.

The idea behind the three dimensions of analysis, is that you look at a building not just as an object, but essentially as a living element that relates to the surrounding space, that has its own details proving its uniqueness and that all these three dimensions are influenced by the purpose for the use or the redesign of the building. The building's AR-DNA is an important factor to take into account to try to understand the building itself. The before and after situation always depends on the character of the original building.

The total overview of insights provided by this exercise results in a collection of practical examples that serve as learning material for architects in training. Architecture is an essential part of the assessments addressed by the Mastermind Crash course and, by studying examples and appreciating them, it will contribute to a design vocabulary for the redesign of existing buildings with respect to their heritage values.

Define

Definition

To start off the Mastermind Architecture it is crucial that we find a definition of architecture that corresponds to the specificity of the domain that we are seeking to further analyse.

Architecture is looked at as *"1: the art or science of building specifically : the art or practice of designing and building structures and especially habitable ones"* (Merriam-Webster Dictionary); in other definitions, more poetic, architecture is *"above all, a service. It's a service oriented for well-being. The objective, the first preoccupation, from architecture is to create better conditions, in the city, in housing, in equipments."* (Álvaro Siza Vieira)

However, what we intend to classify as architecture for Mastermind, is everything that, of the building, is inherently related to its DNA, whether it is its original DNA or the new 'AR-DNA' - Architectural DNA (Foqué, 2010) -, achieved through changes that we consider to be contributing to the formation of a new existence of the building.

In this domain, architecture will be taken as *"everything which is inherent on the DNA of the building that, independent from the opinion, will always be there and always be there and is the soul of the building (or 'the being')"* (Pereira Roders & Zijlstra, 2020), meaning the basic nature of the building, its soul or qualities.

Challenges

One of the main challenges in analysing architecture is to learn how to interpret different approaches and design results in built objects regarding interventions in existing buildings over time. We can consider these approaches as either referential contrasts or extreme contrasts (Bloszies, 2012).

Taking two examples to portrait the different approaches, and illustrate these two concepts, we can analyse the Neues Museum in Berlin and the Harbour Office in Antwerp.

As an example of a referential approach, the intervention on the Neues Museum, in Berlin, shows a care bringing back the original appearance of the building, as much as possible, after the visible destruction. It is not an absolute mimicry, given that the difference in material and in the subtlety of details and shapes, smalls differences are revealed in relation to the original model.

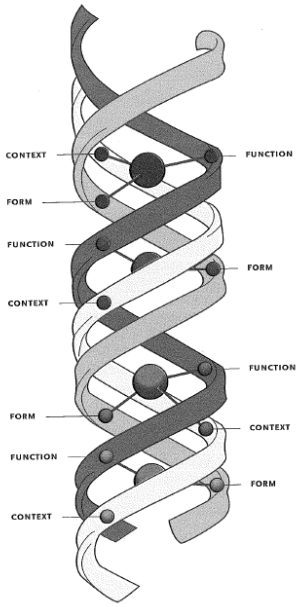
Neues Museum Berlin, 1843-1855 Friedrich August Stüler; 1999 – 2009 David Chipperfield.

In the case of the Harbor Office, in Antwerp, the relationship between new intervention and re-existence is an extreme contrast approach. There is neither the search for an adaptation of material, nor of shape or proportion. The new part is almost overwhelming the old building.

Harbour Office Antwerp, 1922 Emiel van Averbeke; 2007-2016 Zaha Hadid.

Deconstruction

Based on the system theory, Foqué explains that "*a whole, is defined not only by its individual elements but also by their interactions*", therefore we have a system emerging every time single parts [or elements, f.i., building elements] come together to form a structure. (Foqué, 2010) We consider this to be relevant as the architectural inquiry, based on research by design, focuses on both the tensions between objective observable facts/subjective value judgement, and the active intervention where the perceived structure of the design context gets altered or intervened. (Foqué, 2010).



Architectural DNA explained by Foqué.

The objective of the architecture domain is to determine the impact of change at an architectural level, but it is also a fact that there is a lack of frame of reference to compare, evaluate and appreciate buildings, as well as the absence of a solid set of criteria to pursuing this task (Foqué, 2010). To compete with this idea, we have also to think that in a last case scenario, the contents of the reality are the *a priori* (the frame of reference) for what Alberto Perez-Gomez calls a "*truly meaningful architecture*", that lays hidden beneath "*a thick layer of formal explanations*" (Perez-Gomez, 1990).

While discussing the "*Building Genome*", Foqué proposes that "*knowledge pockets*" carrying data about a certain building, are associated with three main domains responsible for defining architectural designing-building problems: the functional domain (related to *utilitas* and *firmitas*); the formal domain (related to *venustas*) and the contextual domain (related to the environment in which the building exists or will exist), forming an analogy with *"the way natural life functions and evolves via its hereditary material"* (Foqué, 2010).

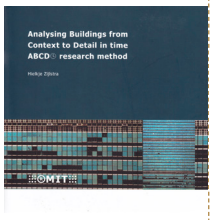
Taking Foqué's three domains as examples of an holistic approach to architecture analysis, we suggest that three dimensions of interpretation are used to obtain an analysis that is transversal to the entire dimension of the building: (1) Connections), (2) Space, (3) Details.

The option to use the nomenclature from the DQI (DQI, 2018) is justified by the simplicity with which information related to this category of analysis can be found. In other words: names similar to those of the DQI are used so that the information is easily located.

At CONNECTIONS, we include the site analysis as well as urban – landscape – entrance – closed/open – views, etc (f.i., for Clark, even structure and access should be interpreted as potential AR-genes (Clark, 2018)); by SPACE, we mean interior – exterior – form – geometry – scale – proportions (etc); on (3) DETAILS, you can include indicators such as construction – connections – materials – texture – smell.

It is rather important that a strategy for linking all three dimensions is found while analysing the building and its qualities, and further in this text, you'll find examples of how to strategically link the three dimensions.

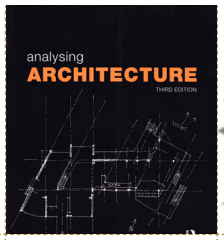
General Methods



Hielkje Zijlstra: Building factors and elements over time

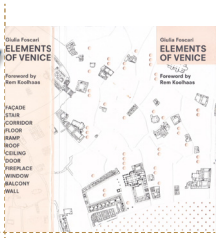
Design Quality Indicator

Design Quality Indicator: Design Approach-based



Unwin: Architectural object

Kano Model: Client/User experience-based



Foscari: Building parts related to urban context

There's a variety of analysis and evaluation methodologies available. While some are more oriented towards user-experience (as is the case of Kano), others will focus on more factors and elements and parts of the buildings. We are interested, however, that through the chosen methodology, the building as a single entity is considered as much as possible.

While in most methods applicable to other domains, we easily see both a qualitative/quantitative approach, the architectural assessment, isolated, tends towards a more descriptive approach and therefore, a qualitative approach. In methodologies that are more oriented to the practice of architecture, we can observe two types of results or data to be analysed. Even though it is a tendentially descriptive approach, and therefore, which develops in a qualitative process, in this descriptive process we can observe the distinction between what would be desirable and what would be most inspiring, and it is still possible to assign levels of classification to the interventions.

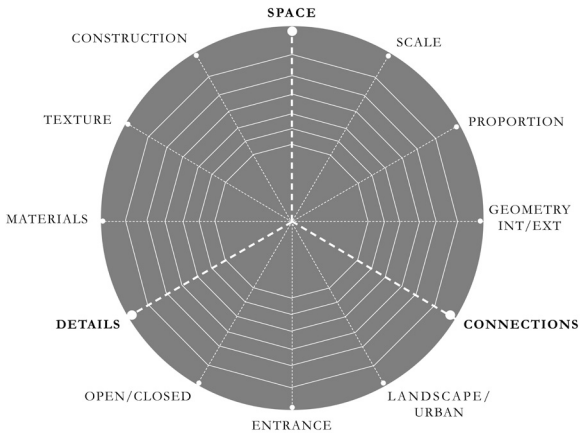
2021 Method(s)

Given the qualities of the methodologies presented, the methods chosen for the 2021 edition of Mastermind are the ABCD method of Hielkje Zijlstra and the DQI (Design Quality Indicator) method.

ABCD method	DQI method
Categories: - **Indicators**: - **Parameters**: not detailed **Context**: Practice oriented. **Target**: new building and existing buildings (refurbished). **Aim**: "evaluating and trying to understand the building's DNA and the evolution over time before they will be redesigned for updated use or re-use" **Approach**: design quality-based. **Process**: qualitative. **Type of Information**: descriptive.	**Categories**: 3 **Indicators**: 10 **Parameters**: not detailed **Context**: Practice oriented. **Target**: new building and existing buildings (refurbished). **Aim**: "evaluating and improving the design and construction of new buildings and the refurbishment of existing buildings" **Approach**: design quality-based. **Process**: qualitative. **Type of Information**: descriptive (desired/inspired); scores (0-6)

Both methods are related to building factors, design quality (design-quality approach) and observe the building as a whole, and architecture as a balanced system. Although in the Design Quality method a holistic analysis character is observed (and, therefore, including categories that include economics, etc), the basis of the two approaches is the physical part of the construction, the tangible part and, therefore, the one that more directly approaches the issue of AR-DNA.

Thus, it is expected that these two methods can be used in a complementary way for a more operative and objective approach, avoiding analysis overlaps with other domains. It is rather relevant in this phase that students keep in mind that, while studying a domain, one is contributing for a more complete overview of a building, so to respect the boundaries between domains is not a restrictive action, but a strategic one.



Adapted DQI/Zijlstra Design Quality Spiderweb (Zijlstra, 2020)

This is an example of what can be a set of indicators to apply, the main indicators being connections, space and details, which can be used as secondary indicators. However, the group of sub-indicators remains open, so that the student can attach to the list sub-indicators he considers most relevant after an introductory analysis of the building.

As an example of this, one of the last year's works, from Diana Ugnat, is very expressive example of an adaptation in the indicators spiderweb (to be consulted in part "5.3. Analysis/Method").

Selected indicators

Using the definitions in the DQI method, connections (urban and social integration) are understood as being "*concerned with the relationship of the building with its surroundings*"; space is perceived as "*about the size (in three dimensions) and interrelationship of the building's rooms or component spaces*" or as "*the functions it may accommodate originally and in the future*"; and **details** (form and materials) "*is concerned with the building's physical composition, scale and configuration within its boundaries*" (DQI, 2018).

To help understand the concept behind these definitions, students can address questions to the indicators themselves, such as: (connections) at what level is this building connected to the surrounding area? Is it visual? Is it physical? Is it social-related?; (space) What evolution can we identify in this space typology? Is it about the dimension? Is it about the relation between areas?; (details) What is the uniqueness of these details? Beyond form and material, how does the detail information contribute for a unique AR-DNA?

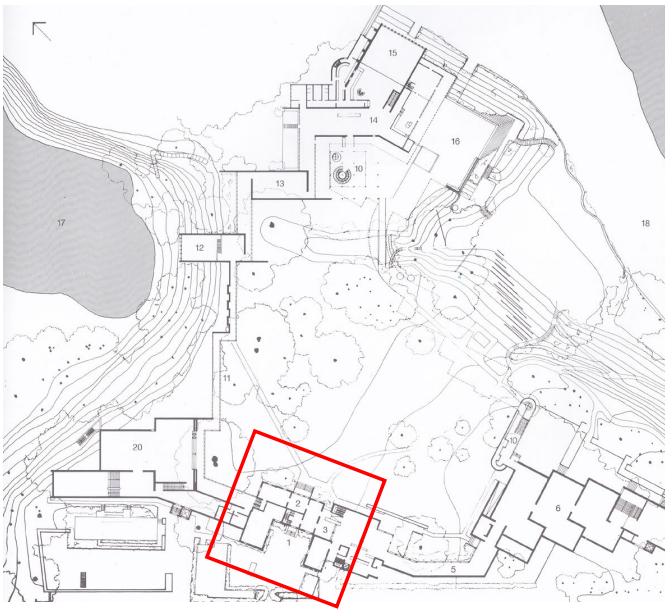
Otherwise, we can define the objective of the architecture domain by the main indicator as:

Connections: not only about accessibility, but rather about how connections to the site make the building belong to the site and internalize the site references; (space) the capacity of space to change completely, not so much in function but mainly in shape and atmosphere; (details) the extent to which a detail in a material can impact the perception of the building and the perception of its purpose.

Examples:

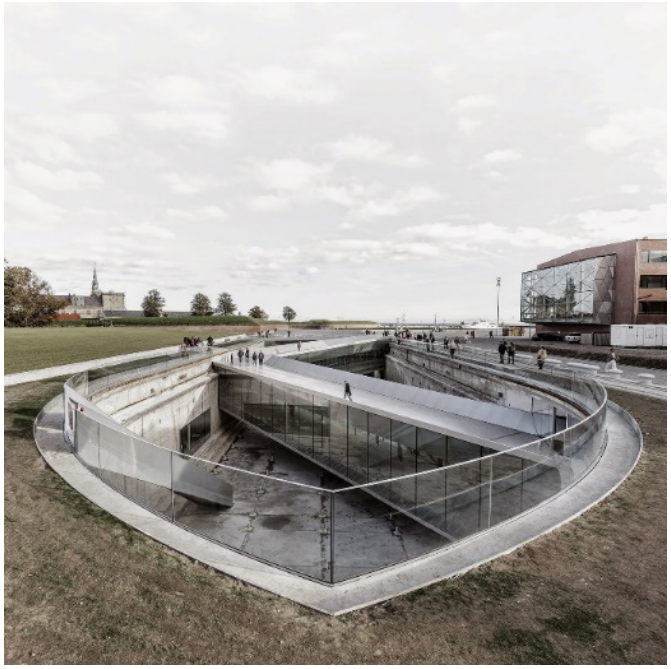
(1) Connections.

Connections: Louisiana Museum Humlebæk extended in 1958 by V. Wohlert and J. Bo.
Views, space and landscape are one composition (Zijlstra 2017)



Louisiana Museum Humlebæk extended in 1958 by V. Wohlert and J. Bo.
Marked red: the Original Villa.
(Bo, J and Wohlert, V. Louisiana M useum Humlebæk, Berlin, Wasmuth 1993)

(2) Space.



Space/exterior: BIG Danish Maritime Museum Helsingør. Museum created in a ship dock. (https://visuall.net/2013/10/18/danish-national-maritime-museum-by-big/)

Space/interior: Church becomes Hotel Restaurant Bizar Bazar, Arnhem (Zijlstra, 2019)

(3) Details.

The Dresden War Museum is a good example of how the transparency of the material is essential to understand the impact of the statement to show the destruction of war.
Details: Dresden War Museum, Daniel Liebeskind 2011 (Zijlstra, 2017)

Collect

Definition

*"The concept of '**context**' is also considered in the method itself, and the structure of the research and investigations. By **analysing the context we can define the area being investigated**. We start by broadening the perspective of the investigation and then develop it in depth. When dealing with an existing building which is to be changed, **the building sets the context.**"* - (Zijlstra, 2009)

It is crucial that students put architecture into context, so a particularly important feature of data collection for assessing architectural impact is that architecture is thought about as the product of its context or/and as the starting point for a new context.

In terms of architectural impact, it is relevant to state that it is not enough to observe the building exclusively and automatically conclude that, if there has been a change, there is a positive or negative impact. The collected data does not automatically originate the assessment. Instead, it is reflected in the collection of relevant information to be able to make the final weighting on the impact of a change on the building.

This collection of information, if done before the intervention, is useful in the sense of understanding what can be changed or what should be highlighted in the final proposal; if done after the intervention, it will be useful to weigh the contribution of this change to the new life, or the new AR-DNA of the building.

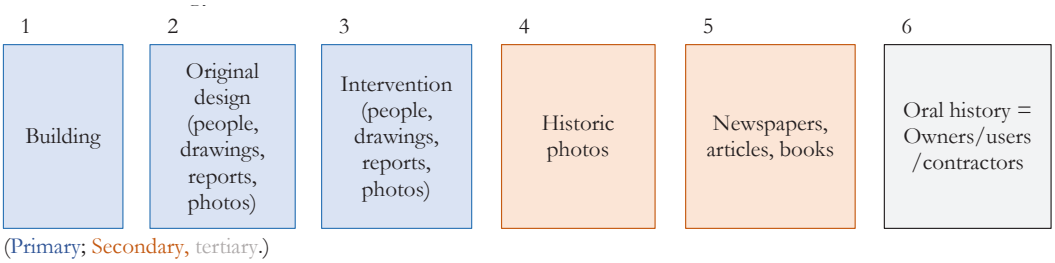
Sources, primary and secondary

The primary sources for assessing the impact on architecture is the building, and the objective is to confront the old self of the building, with the current situation. In other words, to compare the old AR-DNA and the new AR-DNA. From there, after a 1st visit/or evaluation, the consultation of other sources follows, to complement the information that you gathered on site. Especially, if the changes caused by the intervention are recognizable in the final project/final state, it will be interesting to know in detail what was removed or modified that generated a new conception of Connections, Space or Detail.

In this sense, there is a considerable variety of sources that can be consulted, from documentation referring to the original version of the building, architectural archives, photographic archives (primary sources), to literature, historical photographs, newspaper and magazine clippings of the time, interviews, social networks, and even, the collection of testimonies of the inhabitants/users themselves (secondary sources).

Bridging past and present involves some challenges when collecting data. The past is challenging as you can't visit it, so you can only trust in the original drawings and documents to tell the story. At the same time, you must rely more on the user's feedback before redesign or publications that tell the story of the "before". Thus, it is important to visit the building as many times as needed, and that it is looked at from the inside out, and outside in.

A coherent strategy could be:



Nevertheless, in some situations you might encounter some difficulties gaining access to information, so it is always possible to approach the data collection process in a different order, if you keep trace of the information, its origin and, therefore, its value or trustworthiness.

Data

Everything that can be collected has the potential for being converted into useful data. It is rather important that a strategic thought is kept throughout the entire process and that the transition between scales of analysis is kept in mind: zoom out (connections) > object (space) > zoom in (detail).

When possible, students should be able to work with both qualitative information and quantitative information, as it is a more reliable way to assess impact. But it is also true that between this step and the following steps, it is easy to overlap the concepts since in the collect phase, it is intended that they simultaneously observe the data/ information and the description of the available material, and in the classification is carried out simultaneously with the description and identification of the content.

Nonetheless, what will determine the success of the analysis is that you reach to comparable data, that allows you to compare the before and after in every aspect that your analysis is focused on.

Connections	**Space**	**Detail**
Historical layers	Concept	Structure
Stories told	3rd Dimension	*Construction*
Urban & Landscape	*Proportions*	Services
Climate	Typology	Comfort
Structures	*Geometry int/ext*	*Materials*
Scale	Building parts	Joints
Zoning	Functions	Texture
Access	Organisation	Sound
Open & closed	Atmosphere	Smell
Views	Light	Colour
(Zoom out)	(Object)	(Zoom in)

Diagram after Zijlstra lecture: Analyses of Buildings MSc Heritage & Architecture, April 2020.

General Methods

Taking as an example the DQI stages, they focus an entire and more complex process that goes from the stakeholders to the user's feedback. This adds different contributions to reach the final comparable scores. According to the DQI method, to fulfil these stages (Briefing > Design > Design > Ready for Occupation > In Use) 5 steps need to be taken into consideration:

- Interpret the project's original documentation.
- Interpreting the stakeholders' aspirations.
- Experiencing and observing the building.
- Experts' feedback.
- People's feedback.

In other words: always focusing on the before and after the renovation, the work is done by complementing different scales and types of analysis: before/after, documentation/local-field, primary/secondary sources, individual perspectives/groups (varied perspectives that can be triangulated), documents/own observation.

Another interesting method that could complement the DQI and the ABCD methods, is the Haussmann method (Jallon & Napolitano 2017) as it focuses both in the object (space) but also in the location itself. This method also involves using the same approach of analysis for every aspect of the building through (1) reduction drawings, re-drawings and mapping, (2) text blocks to introduce and explain every aspect to be analysed and (3) diagrams.

To have this said, does not exclude that students get to know other methods researching, analysing and evaluating the spatial qualities of buildings. Some other references are Einsenmann (2003, 2008), focused on individual buildings, Radford (2014), focused on understanding the building through a simplification in drawing techniques or Haraguchi (1988) who focuses on the total comparison of aspects of all buildings.

Method

For this year's methods, we have chosen something more specific that incorporates both the features of ABCD and DQI methods, while incorporating the strategies referred in the Haussmann, Radford and Haraguchi methods. The strategy for combining these approaches is through:

1. Reading the building in **relation** with its context:
2. Reading the **contribution** of the building for its context;
3. Interpreting and "understanding the **building as a context in itself**".

While doing this (focusing, ordering, selecting) you must follow the rule of reducing, redesigning and relating information by focusing on your specific question or topic as

well as registering what information you have available for each indicator, keeping trace of the collected information and, especially, using information collected and/or produced by you. It is relevant that you adhere to visual, descriptive and quantifiable information.

At the same time, it is necessary that the information is comparable, so it is important that data related to the same indicator/sub-indicator exists both for the before and after, and that all materials are redrawn in the same way, when possible.

So you need to address four main steps:

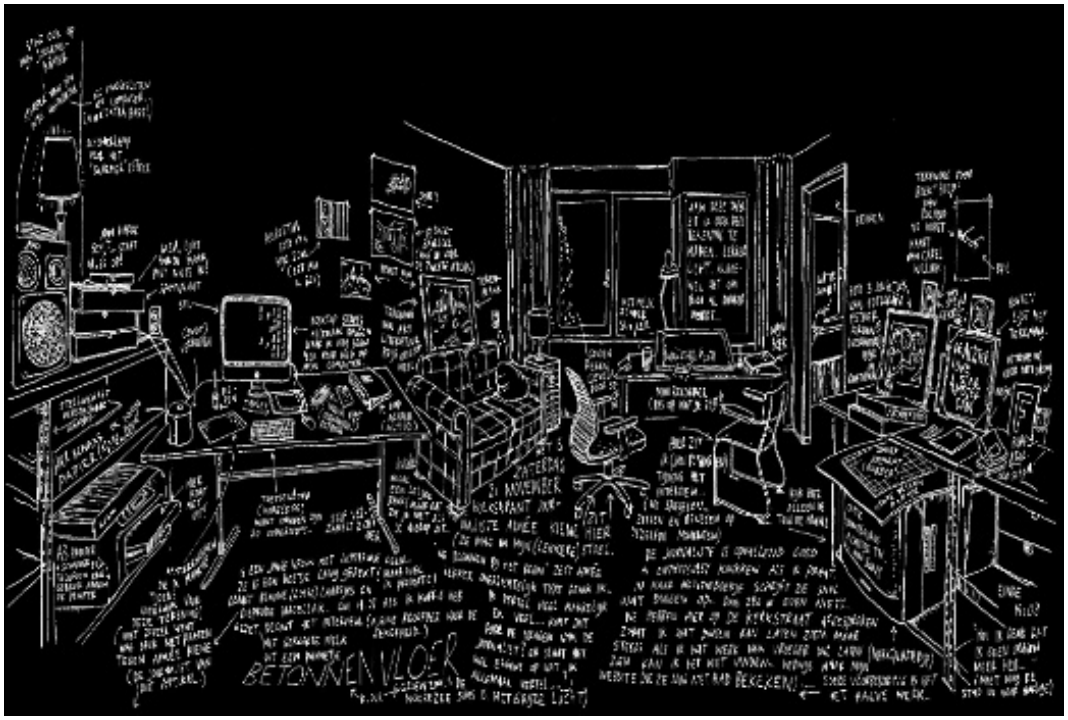
1. the location; 2. the building aspects; 3. Diagrams; 4. Comparable schematic results for comparative assessment.

Historical Develepment of the V&D departement store in Alkmaar Redrawn for the Spatial Building Typology research. (Zijlstra, ea, 2021)

Indicators

Apart from the regular plans, sections and schemes, you have to ask yourself what you need to assess the impact of change in terms of connections, space and details. Taking Emeline Lin's PhD research as an example, it is without too much effort that she goes from the zoom out scale to the detailed scale in the same drawing, many times taking as the starting point a single element and relating it with its context, natural or new context.

(1) Connections (zoom out)



Jan Rothuizen: Zachte atlas van Amsterdam

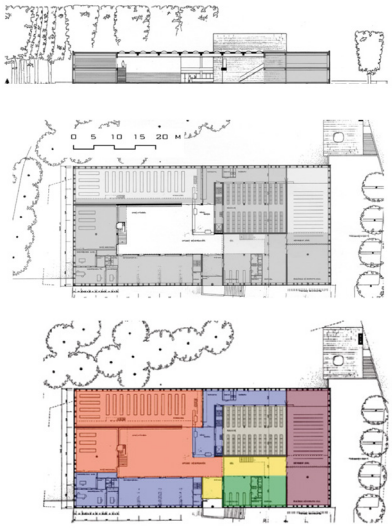
Lin, 2017

Lin, 2020

(2) space (object)

Students must interpret the building and the materials available in such a way that you create some content of your own, by simplifying the data and cleaning the unnecessary information, or by adding information that is not evident enough in the original drawing but is relevant for the analysis being conducted on Mastermind.

On the other hand, it is rather relevant that you think as architects, and not focus on, f.i., a plan just as a flat element or merely functional schemes. Looking at the section and plan of the Provincial Library in Leeuwarden with the heights of the rooms indicated by shades of grey (the lighter the shade, the higher the room) and the same plan with the functional characteristics in 1960.



Jan Provincial Library in Leeuwarden. In colour the different functions located in the floorplan, in grey scale the different floor heights in the floor plan. (Zijlstra, 2009)

(3) details (zoom in)

Zooming in into a detail (either it is a constructive detail, a material, texture, etc) is important, also, that you specifically locate the detail and mark its relation to the entire building and/or external reference (if it exists). As explained before, it is not forceful that you refer to body-related or visual connections but it could be, for instance, that this details participates in a larger narrative, technical wise or social wise.

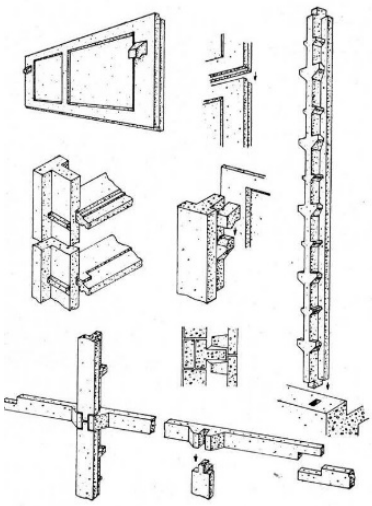


Fig. 11. Détails d'assemblage *des différents éléments de la construction.*

The prefab concrete structure of the housing blocks in Jeruzalem Frankendaal Amsterdam. The structure forms the basis for the floorplan and section. (Zijlstra, 2009)

Classify

Data Analysis

While analyzing data, the classification process is intricately linked to the collection process (collect), since in the organization process you might notice that there are elements missing. Both in architectural analysis and in data classification, you'll be comparing and stripping the building's layers of time, until you find a comparable basis between the after and the before redesign.

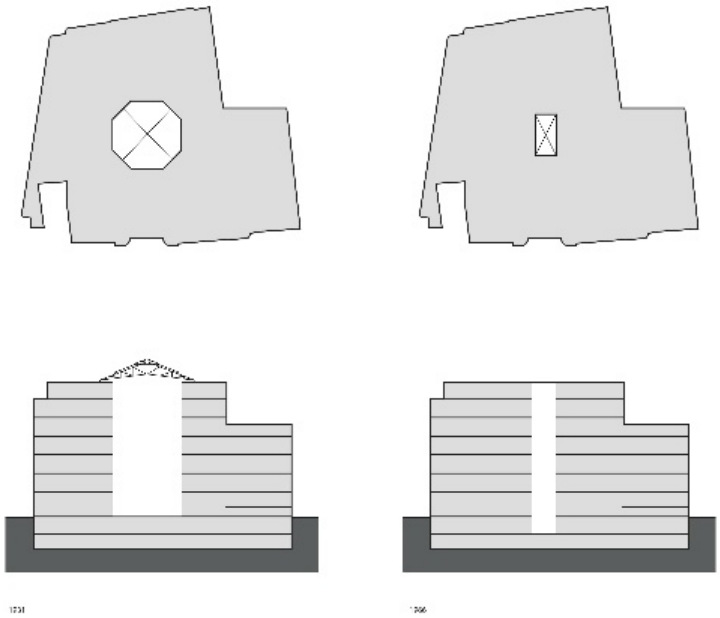
How to classify data, in the architecture domain?

There are bilateral relations between the chosen indicators and the building. There's also a continuous influence between the buildings, the methods for data collection (collect) and the methods for analysis (classify, analyse, assess). Although we have referred to some of the analysis methodologies earlier, they relevant already, once the methods you apply for analysing, imply a certain strategy for collecting the data. This influence or shape each other. It may happen that when visiting the building, or consulting the documentation, another indicator seems more appropriate, or that a chosen indicator may benefit from an innovative perspective taking as a case study a single element or characteristic of the building, performing an analysis that focuses only on one element and uses this element to go through the three proposed dimensions. To achieve this level of clarity, it is, of course, important to ask what data is needed to understand the chosen indicators, and what data is missing to analyze the change.

The collection of material must be strategic. You can collect as much material as you can, but never assume that you will use it all. Students must be prepared to choose what data stays for analysis and what data is put aside. On the other hand, having collected material that does not fit your domain, that material may be useful to a colleague from another domain. Remember that you work as a team and it is wise to help each other to reach a set of information that, being cohesive, will also lead you to a cohesive result in the end. Each of these domains contributes to a result that must reveal the transversal aspects to the different domains.

The combination of sources is essential for a complete and informed study. Thus, for the before and after phases, different sources of information (visual, textual, oral, etc.) can and must be associated. Then, assign function to the elements: create a code that allows you to understand the extent to which a source can be used, or reflects information that is of interest to your analysis.

Remarks on data classification:
- Bilateral influences (indicators-**building**-indicators). - Keep the focus on simplifying information (by redrawing and/or schematize). - **R**educe, **R**edesign, **R**elate information (just as explained in the "3. collect" methods) - Redrawing or doing own schemes, diagrams. - Classifying the data according to the indicators it "talks about".
Classify according to indicator, phase or content.



V&D Haarlem, before and after removing the big courtyard (Zijlstra, ea 2021)

Theoretical Framework

It is important to classify the information by types of characteristics associated with the building, or the type of attribute under study. Whether it is the students' approach to follow materials, finishes, relationships between building and surroundings, etc., then there will be an evaluation of these selected characteristics according to the chosen indicators. Using simple classification methods, we will be asking questions about the essence of the elements that we have collected and later, we will be taking notes that help us include these elements in a narrative and an analysis of our own.

You must relate the research approach, results and findings to what has been done before and add knew knowledge to this. Based on methods and theory mentioned before you are invited to build up the theoretical framework of your research.

First, we will make the classification based on the characteristics of the building and then assess them according to the selected indicators.

For example:

CONNECTIONS	SPACE	DETAILS
"is concerned with the **relationship** of the **building** with its **surroundings**" (DQI, 2018)	"is about the **size** and interrelationship of the building's rooms or **component spaces**"; "the functions it may accommodate originally and in the future" (DQI, 2018)	"is concerned with the building's **physical composition**, scale and configuration within its boundaries" (DQI, 2018)
Visual: inside-outside, Inside-inside, long-distance, skyline analysis. Physical: direct (door), indirect (window), none (no doors or windows). Urban-scale: "how many houses with the same colour type material in the area".	Typology: "number of same type spaces", "number of roofs with the same form". Dimension: areas, internal space heights. Form: external, internal. Adaptation: expanded, moved.	Material: type; texture; **colour**. Detail typology: **door** types, door colours, door shapes, door sizes; **window** types, window frame colours, window frame materials.

And also you also must take into account that both genotype and phenotype are relevant for the analysis, both being distinct parts of the AR-DNA of the building. The phenotype being the DNA part connected to manifestations, stories and cultural significance (Clarke, 2018), and the phenomenon being interpreted as the relation between human daily life and the building/city and how it affects the DNA of the building itself. This means that even the parts of the building that seem to be relate exclusively to physical and technical aspects, could have hidden 'layers' that connects it to broader understandings of architectural impact.

Methods

*"A careful and **creative analysis**, **combination** and **interpretation** of the information will enable us to make **discoveries** which can be used to design and redesign the assignment, and for other projects."* - (Zijlstra, 2009)

While making good use of the methodologies introduced to you in the previous segment, the analysis implies that you permit your creative mind to combine and interpret data in a way that allows you to make new discoveries.

The typification (even within a category) is also a relevant approach. Clarke states that considering the possible different types of intervention that an element has undergone over the years, a particular element can be transformed into a hybrid element, so it must be typified independently (Clarke, 2018), although with some form of reference to the original type that preceded it. One example of that, could be the structure of a building, or a material that has been changed/mixed.

Keeping the comparison between the before and after the redesign, you must make a note of the existing differences, as we said earlier, in order to keep the material comparable. Using the code referred to in the previous segment, the purpose of

classification is to assign a word or phrase, which symbolically attributes to a portion of the data an attribute, a summative, salient quality and reflects the essence of the information or the value of that data.

Here're some examples of possible approaches in assigning a classification to elements according to the indicators under study. In every case, a single attribute/ characteristic was the original focus, but what we want to show you is that the same aspect of a building can provide different readings on a variety of different (sometimes, associated) aspects:

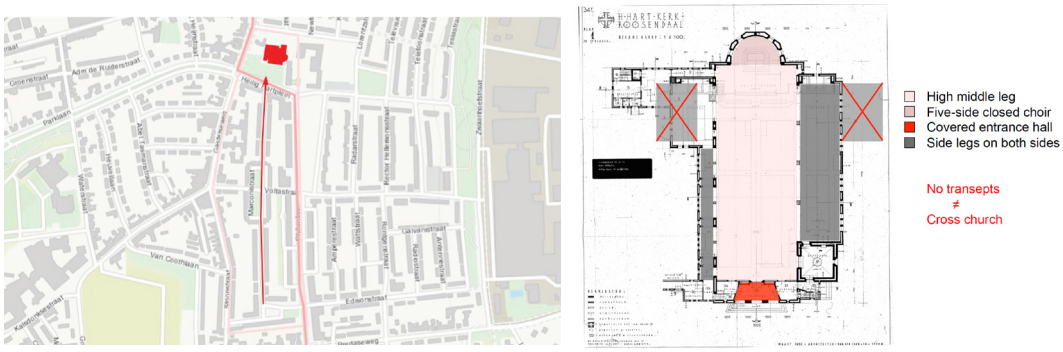
Case study 1: Heilig Hartkerk, Roosendaal, (by Boel, Groen, Muilwijk & Kas, 2017)

Indicator: connections / visual (long distance)

space / form

connections / physical (int-ext)

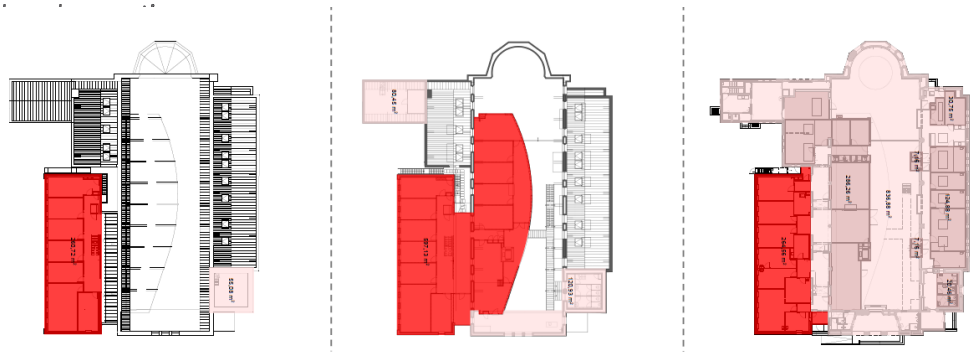
connections / visual (int-ext)



Before

Although the objective of the students was to focus on a physical connection, this type of reference could also be used to refer to visual connections, or context-

After



Case Study 2: St. Anna Church, Breda (by Burgers, Jonge, Mercan, Rutten & Smits, 2017)

Indicator: space/typology

space/dimension-volume

space/elements-stuff

connections/visual int-int

space/dimension-volume

space/volume

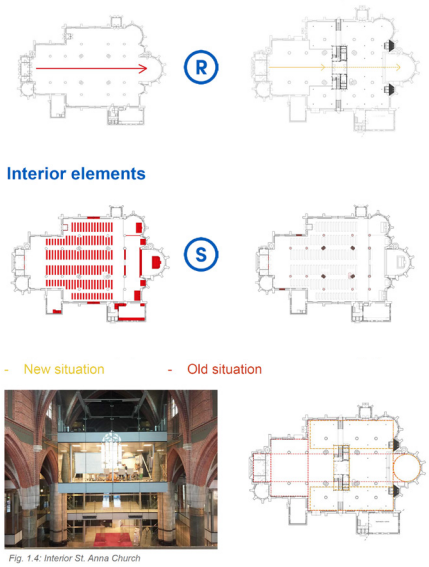
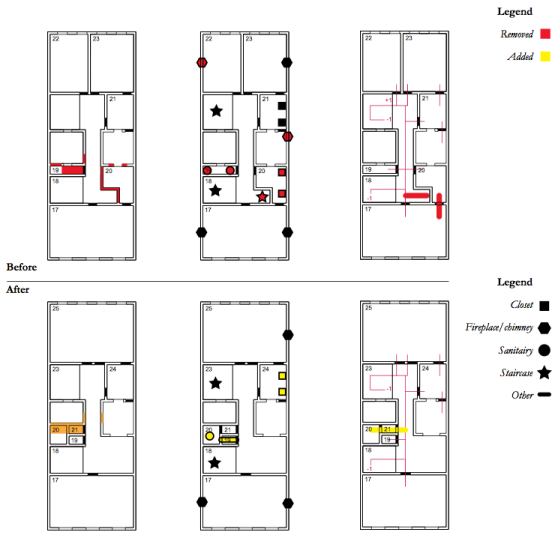


Fig. 1.4: Interior St. Anna Church

Case Study 3: Herengracht 448, Amsterdam (by van den Berg, 2013)

Indicator: Space/Elements



Indicator: Space/Areas

Case Study 4: Edinburgh #1(by Bennink & van Niel, 2013)

Indicator: Space/Object's form

Space/ Object's façades

Details/Window frames

Details/Roof typology

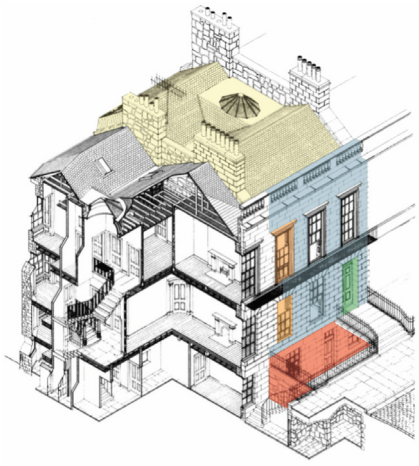
Details/Roof materiality

Details/Material color

discrepancies to windows
discrepancies to entrances
discrepancies to basements
discrepancies to facade
discrepancies to roof

	Windows	Entrance Areas	Facades	Roofs
Typology	Sash and Case, the number of panes depend on the age of the building	Entrance is approached by plats with railings oversailing basements	Palace-fronted block facades in neo-classical style	Pitched, m-pitched in the older buildings
Building material	Wooden frame and astragals. Single glazing from Crown Glass	Wooden doors, stone plats, iron railings and ironmongery	Local sandstone. Attached attributes are made from iron	Local slate
Paint	White painted window frame, astragals and shutters	Doors can be painted in any colour, railings are painted black	Stones should not be painted. Downpipes and balconies are painted black	Not applicable
Appropriate attached objects	Shutters on the inside	Appropriate ironmongery	Downpipes and balconies	Chimneys and parapets. TV antennas and roof windows are accepted

Figure 1.6: Levels of Acceptable Change, based on the Building Attribute Matrix



1. Windows 2. Roofs 3. Entrances 4. Facades Basements

Indicator: Details/Materialcolor

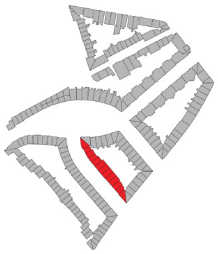
Indicator: Details/Window frames

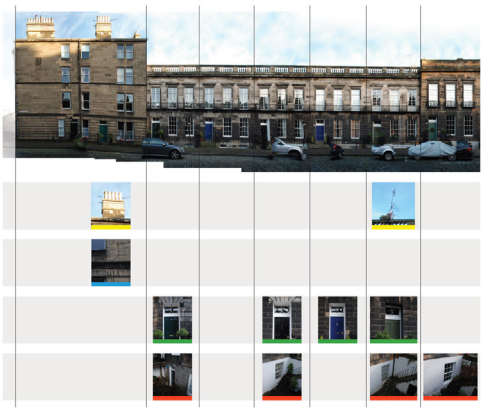
Indicator: Details/Material

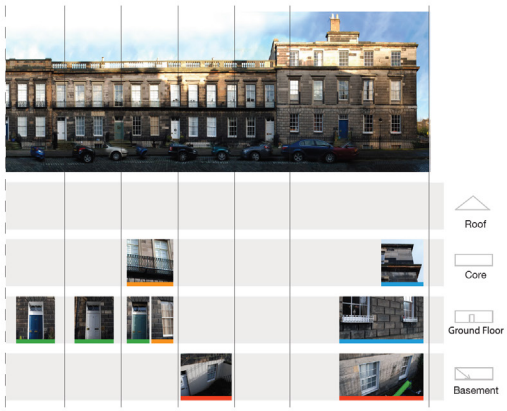
Indicator: Details/Color

Indicator: details/colors

Indicator: connections/urban scale







Map 5.4: Painting of entrance areas in the research area

Map 5.5: Painting of basement areas

Analyze

Data Analysis

Data analysis in architecture is, in a very simplified way, a comparison between the before and after re-design and the consequent revelation of the impact in the difference between these two phases.

We can anchor this analysis on concepts such as scale (building, component, material); or in terms of the type of analysis we are going to apply; in terms of the indicators we intend to study.

At this stage, two questions have to be addressed as a final step before starting the analysis and the impact assessment:

1. What data do I need to analyze change in these specific indicators?

2. What data is missing so I can analyze the impact change?

Theoretical Framework

*"Similarly, one can look at architecture in a series of sliding scales that **interrelate to one another**. (...) within a context: separate tools or analytical enzymes for a **unified analytical whole**. Acting upon the building using the separate acts allows the architect to diagram **one particular aspect**, to understand that aspect and then see how it is **part of a larger holistic vision**. (...) the intention is for the architect to examine the **pieces**, see the **overlaps** and discover the **holistic form**."* - (Jenkins, 2013)

Taking Jenkins' quote as a guideline, the option of selecting three main-indicators to which sub-indicators can be associated (directly related or not), the most interesting and practical option would be that the three indicators could originate a holistic perspective around the whole building and its links to a more remote scale (the scale of the connections, and other domains, as well). As Jenkins says, looking at architecture as scales that inform each other to form an analytical whole, in which a very specific aspect will actually participate in a broader view, examining the pieces, finding the overlaps between the three scales in question and discover the contribution of the specific attribute or element to the building's holistic shape. This extremely specific aspect could be a single detail, if you find a way to interrelate the three dimensions (connections, space, and detail).

After having created a solid amount of data, already classified and simplified, you can start analysing the redesign. One interesting approach is to follow Turner's framework, through which you must find the aspects where, comparing the before and after the redesign, the element/s under study shows the identity of character, similarity or difference.

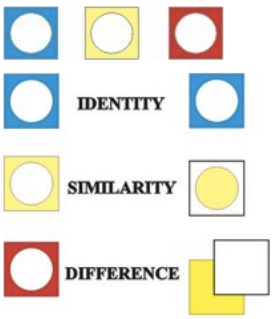


Fig 10.4 Possible contextual relationships between context and development

Possible contextual relationship between contex and development (TURNER, 1998)

You must visualize the change in terms of what has been removed, added or maintained and assuming the possibility, furthermore, of witnessing the transformation of an element, simultaneously, by removing and adding parts while keeping the same character.

Methods

For assessing the impact of change, it is important that the motive for the change is considered, meaning if the change in the architectural level is, f.i., related to a need or its readaptation to a new reality, or if there is, of course, a desire to break with the pre-existing situation. The reason behind the change can act as an aggravating factor or as a mitigation of the impact of change. After this analysis, the change is assessed.

In the analysis of architectural change, it will be understood, then, that both the actions taken at the pre-design level (what has been removed and maintained) and the actions at the design level (what has been maintained and what has been added) reveal the levels of change (or categories of change).

Call for action:
Compare the before and after;
Analyze according to the intention, need or objective;
This change is evaluated according to the indicator.

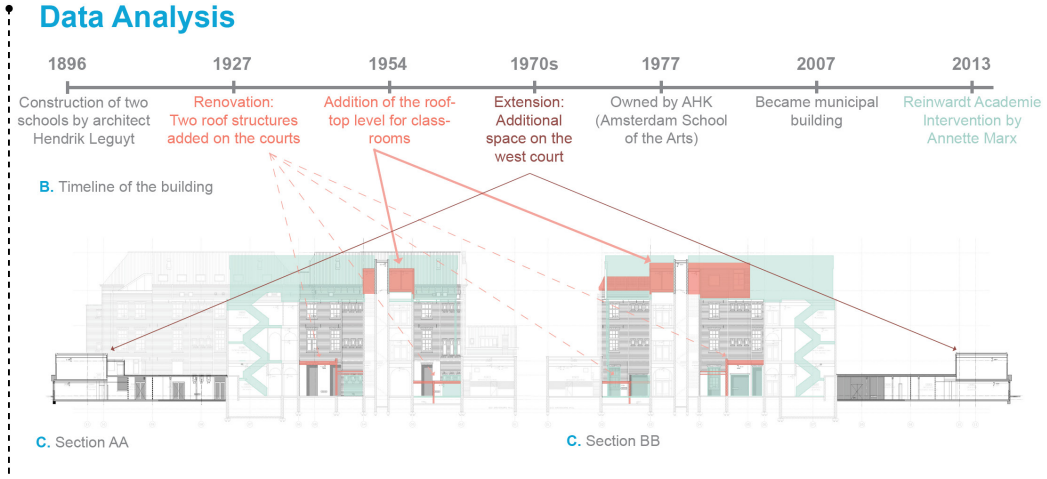
It is also relevant to say, taking back that the collection process needs us to keep our eyes wide open and the analytical brain always ready, the building elements can give us information of the most varied type, so it is important that the analysis of the information be objective and rigorous in understanding what happened, the various meanings that a change may have, but, simultaneously, keeping aside any judgment, or tendency to an immediate pre-assessment that results from the visualization of + and - associated with this change. At the same time, extreme care must be taken with the value we attach to + and -. An addition to something is not always a positive sign. Only if this addition comes against a need imposed by the program or the state of conservation of the element or space, is a positive sign. But if there is no balance between need / justification and action, then we can understand a change, even if it is +, as a minus at the end.

Surprisingly, the last step (oral history) led to the re-interpretation of step 4, the layers of time, which have shown that while applying necessary changes (removing parts/adding new parts) to the window frames, the architects kept one objective in mind: to keep/regain the original atmosphere of the building as much as possible, while using the knowledge of technicians specialized in wooden window frames, and also, while adapting the original design to a more efficient one, that could guarantee a better environment in the building.

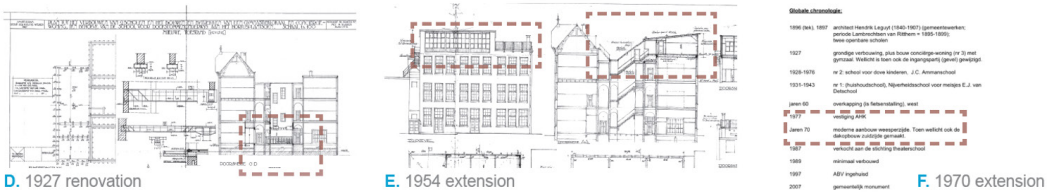
Case Study 1: Reinwardt Academie, Amsterdam (Max Henneman, Marina Brucker, Diana Ugnat, Lars Bouter, Pien Tol, 2020)

As stated previously, in Diana Ugnat's approach, the focus of the impact analysis were the rooftops, courts and openings. As suggested, her analysis included building the chronological mapping of the building, the archival collection and data classification

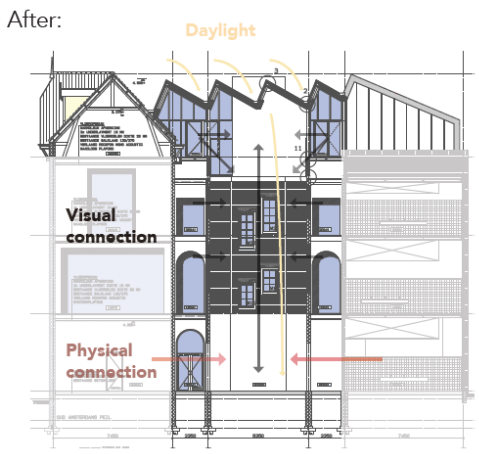
& analysis, the redesign of the necessary drawings ('redesigning for analysing'), the data analysis according to the Turner's framework, and, finally, the assessment (which will be explained in the next segment).



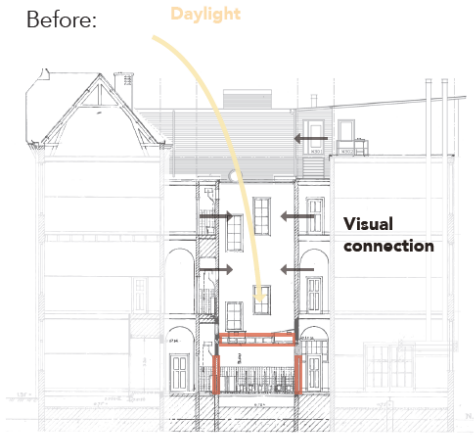
Step 1: Chronological mapping of the building. (This step helped understanding to what extent the layers of time are visible and traceable. In simple terms, the visualization of the layers of time, can become tricky, especially if we use a considerable variety of terms and elements, and also, if we are looking at elements which relevance and impact can be considered somewhat abstract. In this case, there's a clear visual code, for what's happened in the building throughout the years and how those changes make it relevant to chose these 3 elements for her study).



Step 2: Archival collection and focus definition. (This step helped redefine the focus of the work making use of the material available, particularly for better understanding the relevance of the three chosen elements, once their relevance was settled. It is crucial that students notice how different sources of information can be interlinked to create a unified reading of a single element, but it is also important to point out that this is a crucial moment to confirm if all the information/documents needed are available, or, at least, if a satisfiable amount of data is available.)



B. Section central court. Design Annette Marx



B. Section central court. Intervention 1927

Step 3: Redesigning for analysing (The objective of redesigning is to create a new, personal visualization that allows to combine all data collected before. While applying a unified visualization of the relevant information, Diana put aside unnecessary elements and was able to create a new narrative using the original material as the basis for her analysis and rationale. It also can be helpful for mapping or numbering the elements that you'll be focusing on for determining the impact of change, etc).

Kept
Removed
Added

B. ABCD Matrix

	Site	Facade	Entrance	Aesthetics	Courts	Rooftop	Materiality	Usage
Before				same style	closed	yes	same texture	school
After	same	same	same	modern roof	opened	yes	brick / steel / glass	academy

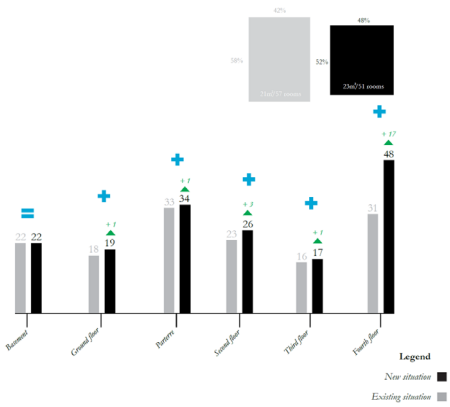
Step 4: Data analysis (rooftops; courts; openings).

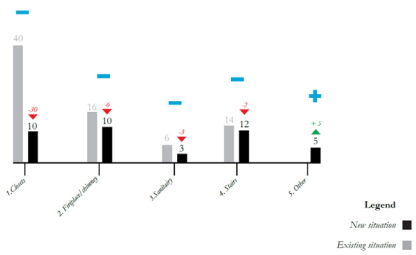
Case Study 2: Herengracht 448, Amsterdam (by van den Berg, 2013)

Indicator: space / areas

Indicator: space / number of spaces

Indicator: space / elements

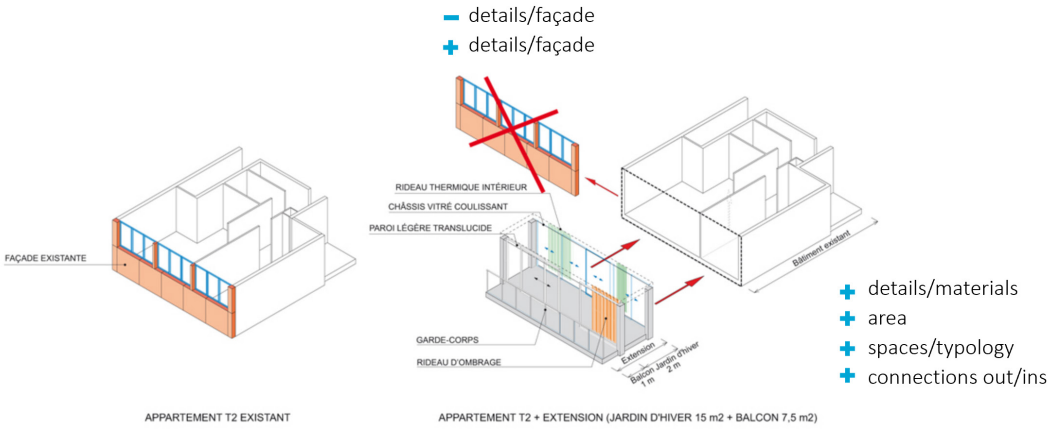




Indicator: space / areas
Indicator: space / number of spaces

Indicator: details / elements
Indicator: space / elements

Case Study 3: Transformation de la Tour Bois le Prêtre, Paris (architects Lacaton & Vassal, 2005-2011)



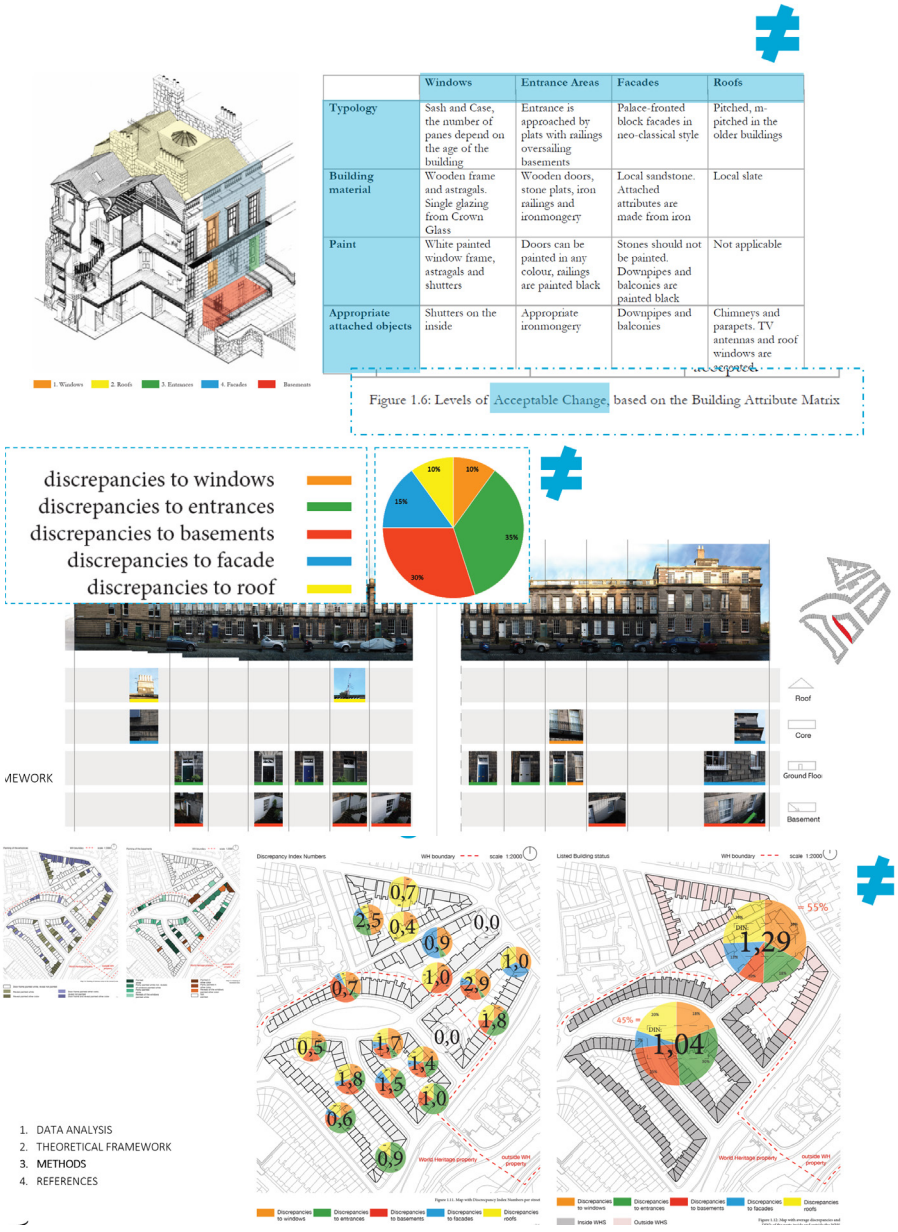
Case Study 4: Trust Housing Stockbridge (sheltered housing complex), Edinburgh #1 (van Niel, 2013)

Indicator: space / areas

		THS (sq.m.)	LHDG (sq.m.)	Proposal (sq.m.)	
	1b1p				
	Gross Internal area	**32,3**	**37,5**	**39,1**	
1	circulation / hall	2,88	1,5	3,7	≠
2	living + dining	10,73	15,2	16,9	
3	kitchen	6,13	6,2	-	
4	bedroom	4,62	8	8,8	≠
5	bathroom	3,4	3,6	4,5	≠
6	storage/utility	3,4	1	0	−
7	outdoor amenity space	0	4	2,6	+
	2b2p				
	Gross Internal area	**46,6**	**50,3**	**54,3**	
1	circulation / hall	4,5	6,5	4,1	−
2	living + dining	14,25	16,6	27,6	+
3	kitchen	6,13	6,8	-	
4	bedroom	13,5	12	14,4	≠
5	bathroom	3,4	4,4	6,3	≠
6	storage/utility	2,88	1,5	1,8	−
7	outdoor amenity space	0	5	4,5	+
	2b3p				
	Gross Internal area	**59,3**	**61**	**65,7**	
1	circulation / hall	6,8	6,5	6,3	−
2	living + dining	14,35	17,6	26,3	+
3	kitchen	7,13	7,5	-	
4	bedroom 1	11,72	12	7,5	−
4	bedroom 2	8,39	8	15,3	+
5	bathroom	3,48	4,4	7	≠
6	storage/utility	5,2	2	1	−
7	outdoor amenity space	0	6	5	+

Indicator: space / areas

Case Study 5: Edinburgh # 2 (Bennink & van Niel, 2013)



Spotting changes does not automatically mean to associate a change with a positive or a negative impact. It means essentially that we're annotating what has changed, either it means that something has decreased, or something has been added. This implies a certain level of acceptable change, which will be extremely relevant when assessing the impact of change.

In this case study, so far we can only tell that discrepancies have occurred in a variety of attributes. If these discrepancies should be considered positive or negative, is something to be supported by a set of criteria that defines the intervals of 'acceptable change' and associates this change with an impact degree/classification.

Assess

Impact Assessment

- When and how do my analysis + and – turn into positive and negative impact assessment indicators?

- What should I consider to be "right" or "wrong" when assessing architecture interventions?

- Should I believe that the criteria that generated positive or negative results in other domains will have the same impact when it comes to architecture and the space itself?

It is hard to make assessment specific and objective when it comes to architecture. If the elements of analysis allow us to do quantitative analysis, our task gets easier, because we can turn all the information into numbers and ratios (i.e., studying areas, number of doors types, number of windows, number of spaces, materials added and subtracted, etc.)

Still, in architecture there's a lot of personal interpretation, in particular when it comes to indicators that have the potential to be more subjective, i.e. aesthetical analysis, body-building "perception" while using the building, etc.

In all the examples of analyses/methods/books/etc there is not an assessment in the sense of a good/bad evaluation *per se* without any relation to other indicators and/or domains.

"Sensitivity to change"

(van den Berg, 2013)

The Twin Towers in New York after they have been destroyed became more important in peoples mind than before (https://www.anderetijden.nl)

Architectural Assessment is a lot about results of analysis. Those are needed to explain why the impact of the intervention is judged more or less positive or negative (by the person doing the judgement).

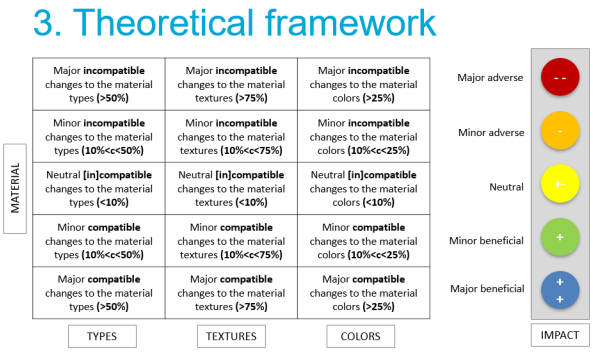
As we told you in the previous lecture, it is a lot about noticing and analysing the change itself, that was implemented in the buildings AR-DNA, so a very pragmatical analysis of what has become different between the before/after situation, but it is also, a lot, about the "Whys" and the motives that lead to that specific change. That's

why "sensitivity to chance" is so important when you're evaluating it, in its relation to the meaning of that change in a specific element/building. For instance, are the Twin towers in New York after 9/11 got more important than before 9/11 even they do not exist anymore?

Also, it is a lot about being conscious that applying very objective and pragmatical parameters/criteria to architecture analysis doesn't always mean that the tool and its criteria is going to lead you to the correct evaluation, at the end, and that by having the same kind of results in assessing different projects by just simply applying the same methodology, tools and criteria provides you with solid and automatically assessments.

Theoretical Framework

You define the theoretical framework concerning each of your indicators, based on literature or assumption. There is no wrong scale, but you do need to explain it. There is no given definition of "high compatibility" or "low compatibility". It is up to you to define the terms of compatibility and also the scale of acceptability of change, because they can (probably) differ depending on the part/aspect of the building you are looking at.



It is needless to say that it is necessary to state the importance of each aspect (related to the other aspects) to be able to come to an overall conclusion. Also the definition of every Judgement (— to ++) needs to be stated to be able to compare to other interventions.

Methods

You might notice that the tendency of most of the studies is to define the intervention only by the amount or percentage of change itself, and classifying the impact as neutral to very large, while by very large they mean very bad because the building has been severely changed, and by neutral they mean that nothing has changed.

At the same time, in a very general way, you might notice change (by just doing a comparison between the before and after) is automatically interpreted as something "damaging" for the building, even when the change means that you are "adding" to the building something that has been important for defining the buildings AR-DNA in the past and has, somewhere in time, disappeared.

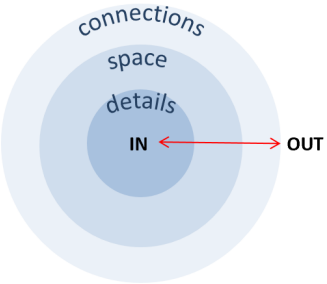
Mixed theoretical framework: Pereira Roders, 2020 / van den Berg, 2013.

Still, we've come across a variety of examples that have shown us that despite the impact of change in the original state of the building might be alarming (if we look only to numbers/indexes), there are other factors that help us determine if that amount of change is actually bad *per se* or if, while it's connected to other factors, that can determined by the project's necessities or the user-experience feedback, and be turned into a "good" change. That "severe" amount of change can represent something positive in the end.

At this point, it would be very important that although some of the examples that we can provide you have the type of evaluation that you see on the legend related to the Mastermind evaluation colour scheme, it is important that you rethink these percentages and how they relate to the type of change you consider to be acceptable or not acceptable. By doing that you will also be able to develop and explain your own sense of impact, both positive or negative.

Again, here some weighting is necessary. It is about frequency and about importance: if this happens a lot and is very important, than the overall assessment is rather clear, but more combinations of frequency and importance are necessary.

Please discuss amongst each other the weighting of both frequency and importance and remember that it is not on the outcome only, but mainly on the reasoning behind the outcome.



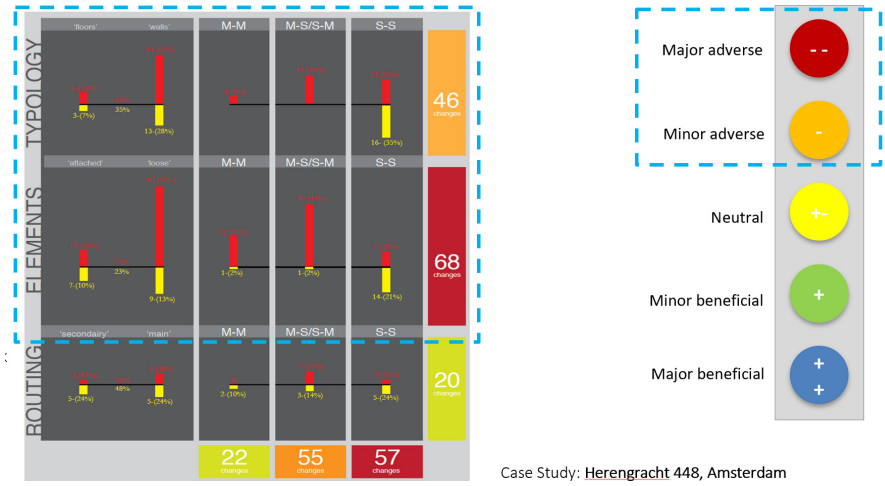
This is very important, in particular because the potentialities that you have identified in your case study (that ultimately lead you to choosing your set of indicators/sub-indicators) and the purpose of that choice might be crucial to better define the specific criteria that leads to your evaluation.

In the end Architecture needs to be assessed in one colour in the mastermind tool. Then it is about the improvements (yes/no) after the redesign interventions, even if it means that, by the end, you need to create your own, adapted, set of values/criteria for what's revealed to be beneficial or adverse in the architecture intervention.

Also, the idea behind these three dimensions of analysis, is that you look at a building not just as an object, but essentially as a living element that relates to the surrounding space, that has its own details proving its uniqueness and that all these three dimensions are influenced by the purpose for the use or the redesign of the building.

So, although you might be analysing each sub-indicator separately, you'll have to come up with a final and single code for the architecture domain, and that means that after analysing the pieces and discovering the overlaps your evaluation is supported by the holistic interpretation of all these elements/indicators and their combination.

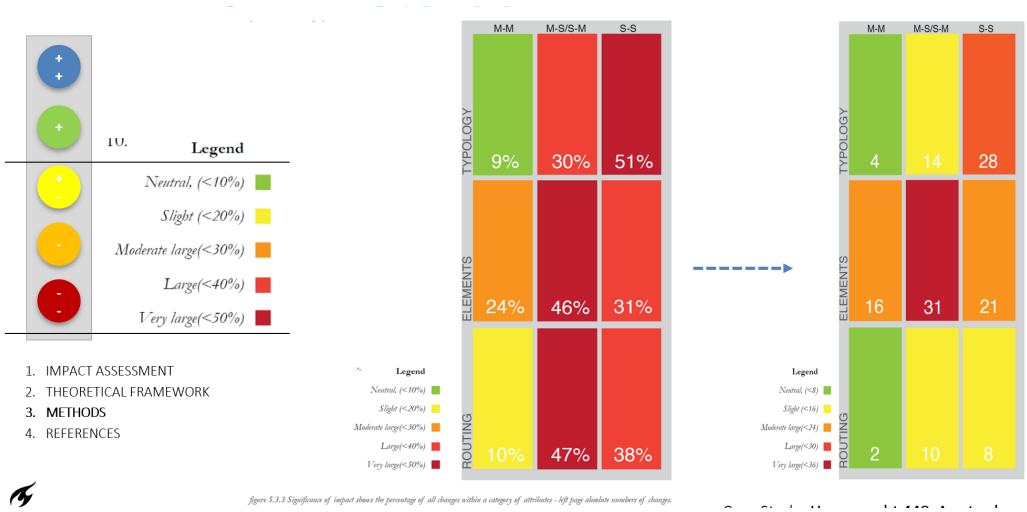
Case Study #1: Amsterdam



Indicator: Space/Areas

The final results have shown that, by comparing the before and after redesign situation, and converting that data into percentages (in typology and on the elements), the changes ration are considered to be, in general, adverse to what's related to the building AR-DNA.

Where does this evaluation come from? And does this mean that this change is, in general, adverse to the building? Probably, yes, AR-DNA has been changed. On the other hand, does this automatically mean that the overall change is negative? No. If you recall that the change in the number of elements was related to the change in the number of spaces and its use, you could conclude that the change on the elements was not so drastic for the overall assessment once all the three indicators would be combined into one final evaluation.



In this case, you could both interpret the results by looking at the percentage of change, or the actual number of changes. But what we want you to focus on is, once again, the criteria defined for the specific case. In this study, every change was interpreted as non-benefitial to the building DNA, so you can't find any positive scores, or, in other words, what you would consider to be positive was the non-existence of change. By saying this, you can conclude that the neutral score is a positive consideration.

Still, this is related to the objective of the assessment and what was defined as acceptable, non-acceptable and positive for the building.

In this case, the focus was the change in the DNA of the building, independently of what's the reason/or motive that lead to the change itself.

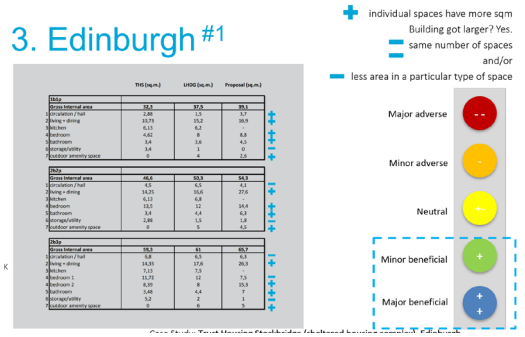
This is not an existing method of assessing impact. Please explore the chosen parameters together with the aspects to be determined in the end. There is no right or wrong definition of a parameter/aspect and there is also no right/wrong definition of the weight per aspect and the weight per element/component/part. You are asked to discuss this amongst each other and find out if you can come to a common ground. If not, not a problem, but explain why.

Examples of applicability:

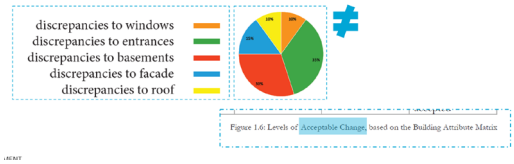
Edinburgh #1 case:

We could look only for the numbers and notice that by decreasing the area in some parts to increase other parts of the building some space typologies were affected negatively by change.

More importantly, we could notice the overall area of the building as also increased, to make room for all these changes concerning the internal areas, so we could add to the analysis/assessment how the visual connections inside-outside got better and also the response of the project to its objective: to create better conditions (areas for mobility, better physical communication interior-interior and better visual communication interior-exterior) for elderly people to live in this building.



So the overall score, after the final combination could be both minor beneficial or major beneficial, depending on the importance of each of these indicators.



For the second Edinburgh case, you must remember that although the study was about "discrepancies", meaning what's been changed in the buildings' façades, there was a margin of acceptancy for those changes.

Also, in some cases, what we call change is something as simples as doing some conservation and returning the building or an element to its original state by adding some more protective layers and repainting it. In a situation like this, it is still change,

but by taking a holistic approach to assessing this change we would consider it to be beneficial, IF, the parameters for acceptable change took into account that kind of intervention as something positive or "acceptable".

Case Study: Edinburgh (Bennink & van Niel, 2013)

75

So in this situation, we can't only pay attention to the objective of the analysis and assessment, we would also have to take into account which parameters were guiding/orienting these decision on what's neutral, beneficial for the overall situation or adverse.

Once we only know that discrepancies were noticed, quantified and studied, we could conclude, on one hand, that only acceptable changes were annotated (which we don't know). If we consider to analyse the information in such a way, we could consider the impact to be minor adverse, neutral or minor beneficial, depending on how profound this changes were.

On the other hand, if both acceptable and non-acceptable changes were studied and quantified, we could conclude these changes to be less beneficial or major adverse because the non-acceptable changes would have a more serious impact.

Case Study: Reinwardt Academie, Amsterdam (Max Henneman, Marina Brucker, Diana Ugnat, Lars Bouter, Pien Tol, 2020)

Space:

The shed roof lets the day-light deep into the building and to the entire new roof floor. (++)

The additional level is more spacious and comfortable for use comparing to the rooftop before. (++)

The new shed roof allows a new interrelation between classrooms and the corridors and changes the DNA of voids that originally were exteriors courts. (++)

However, the new shed roof is made from zinc, and not from the original material - wood. (-)

The new shed roof has a modern look. Contrasting with the original "chalet-style" roof. But corresponds to the creative community of AHK. (+-)

Connection:

The visual connections of the courts were reestablished. As well as the light penetration into the ground floor (++)

The voids became interior "break-out" zones, so often used by the students and staff in comparison to the before situation. (++)

The transformation of an exterior space into the interior shows the relation of a building with the surrounding in the micro-scale. In addition, the voids become an integral part of a ground floor without losing their spaciousness (height aspect) which was not the case before. (++)

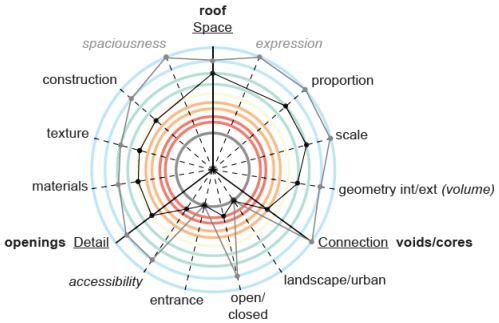
Detail:

The connections within the building were improved by the new openings of the core-voids. The new openings make the court-void accessible from the ground floor. (++)

The new openings support the building's physical composition, by the usage of the identical to the original state materials (white stucco). (++)

Creating openings seems to be the most harmonious way in making the two voids accessible even though the original elements like windows and small bathrooms were removed. (+)

www.tudelft.nl



A. DQI spiderweb

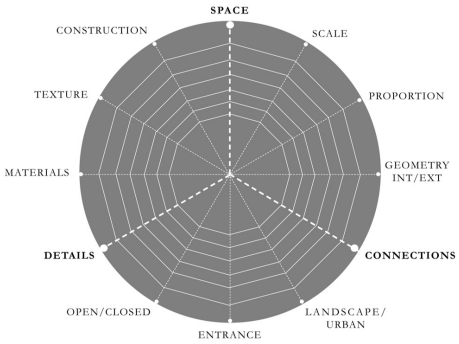
Step 5: Assessing the redesign per category; weighting the parameters.

Step 6: Building the assessment spiderweb.
In Diana's case, it was important to accept not only that changes affect the significance of the 'old self' of the building or spaces, but also, that accordingly to the need or intention for the redesign project, change can also imply a positive contribution for the 'new-self'. Although making good use of the policies available on Heritage Impact Assessment a balance between change/immediate impact and recommended change/needed was a turning factor in the success of her approach. This means, that you must make use of the documents available that guide you through assessing impact, but you must, also, feel comfortable to create your own set of criteria once you are certain that a change (big or small) had a positive impact on the redesign building.

Note that there is a difference between change and impact. The change can be major, but the impact can still be beneficial (if e.g. a lost value in re-introduced). Also the change can be minor, butt the impact drastically adverse (if it is a small but highly important detail that changed). So: distinct in your own project clearly the change from the impact.

As you might recall, in the first chapter we presented the DQI and kano methods. The main indicators were connection/space/detail, but we suggested that you could add more indicators, or make those more specific with sub-indicators.

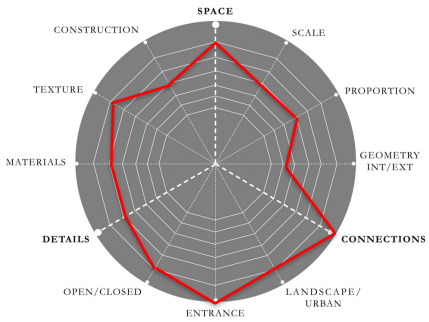
At this point we suggest that you draw the DQI/Zijlstra spiderweb by you with your indicators and sub-indicators.

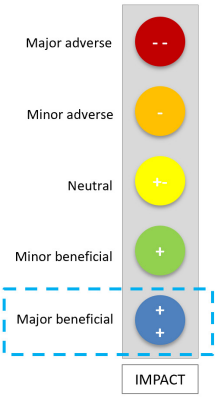


Zijlstra/DQI spiderweb (Zijlstra, 2020)

In the traditional DQI assessment web you can judge on a scale from 1-6 the improvements between before and after. Still, this assessment tool is only allowing us to evaluate a building in a positive way, when we are aware that some of the change may prove to have a negative impact on the overall situation of the building. Saying this, we consider that scoring a negative change with "1" is still classifying it as something positive and, also, it still is not so easily relatable with the mastermind code.

So for the Mastermind, specifically, we suggest that if there are no improvements (pos or neg) then you keep the line in the middle. And also that you change the score scale, which could be, as an example, "-4/-3/-2 /-1 /0 /+1/+2/+3/+4".





Taking by example one building where there's been a significant improvement on connecting inside and outside, by the entrance (+4), we can simulate one possible assessment.

a) scale and proportion it has not been changed (i.e., 0).

b) the use of materials has been changed in a positive way (i.e., +2/+3).

So finally for the impact code in the mastermind overview it could be overall a BLUE peg: Major beneficial in Architecture, because on two (i.e., Connection/Detail) of the three main indicators, the building has been improved. Of course this is subjective / personal, but the analyses can show how on the sub-indicators the improvements can be motivated.

What we could suggest, was that you tried not only to come up with your own score scale and criteria combination, but also that you tried to create something that could be used by all the students in the architecture domain, exploring the importance and significance of change in each case and letting that define the scale for evaluation.

Conclusion (and next steps)

The main objective of the Mastermind Architecture domain is to contribute for the students' awareness of the impact that changes have on various aspects that play a role in architecture redesign. We are looking for opportunities to build up knowledge to improve the course and the collection of best practices in Re-designed buildings with heritage value, while learning from them. An important aspect of this approach is the need to develop the understanding of buildings based on space rather than on functions and understanding the value of reprograming buildings considering space as a non-changeable characteristic, therefore, with a high impact on any redesign solution.

Being aware of the variety of frames of references available to compare, evaluate and appreciate the buildings, the possibility to combine different aspects of each methodology becomes an attractive argument for the pursuit of architectural analysis and assessment. By looking at it in such a way, we believe that we can contribute, together with the students, to define new criteria and to enriching the existing impact assessment criteria and methodologies, by making them more specifically applicable to the architecture aspects alone and by combining the present premises on heritage with the premises that we've learnt from our masters, therefore, continuously connecting past and future.

For future steps, we expect to contribute to the enrichment of the discussions on the impact of change when applied exclusively in the domain of architecture which assessment, when momentarily separated from the other domains, seems too abstract and subjective, even if we look at architecture as a profoundly holistic field. By reducing information through redrawing and combine the main features to compare them the impact of change on space, connections and details can be researched and assessed.

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Design Quality Indicator:
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http://www.dqi.org.uk/
http://www.dqi.org.uk/dqi/Common/DQIOnline.pdf
http://www.dqi.org.uk/perch/resources/dqi-schools-guidance-copy.pdf

Kano Model:
https://www.kanomodel.com

Emeline Lin's design project, Milandia:
https://www.facebook.com/HollandMilandia.

CHAPTER

5

Sustainability

by Joana Gonçalves & Ana Pereira Roders

Define

The first challenge we face when dealing with Sustainability is how to define such a broad concept, and how to establish clear boundaries to make it manageable.

The word "sustainable" refers to a state in which something is maintained and continued for a long period. The origin of the concept, as it is commonly used nowadays, associated with responsible use of resources for balanced development, dates to the 1950s. But it is in 1987 that the Brundtland Report - *Our Common Future* established the most accepted definition of sustainable development: "development that meets the needs of the present without compromising the ability of future generations to meet their own" (WCED, 1987). Development is understood as a process of change that has as a major objective the satisfaction of human needs and aspirations, in three dimensions: economic, social and environmental.

But how is the concept of sustainability understood in the context of built heritage conservation? Depending on the approach, heritage can be understood as either a vector for development (Janssen et al., 2017) or a victim of development (UNESCO, 2015). Too often sustainability and conservation are seen as opposite and even contradictory concepts: heritage as something that needs to be changed, adapted, or even demolished in favour of more sustainable solutions. With this approach the role of heritage for sustainable development is not embraced in its full potentially (Bullen & Love, 2017).

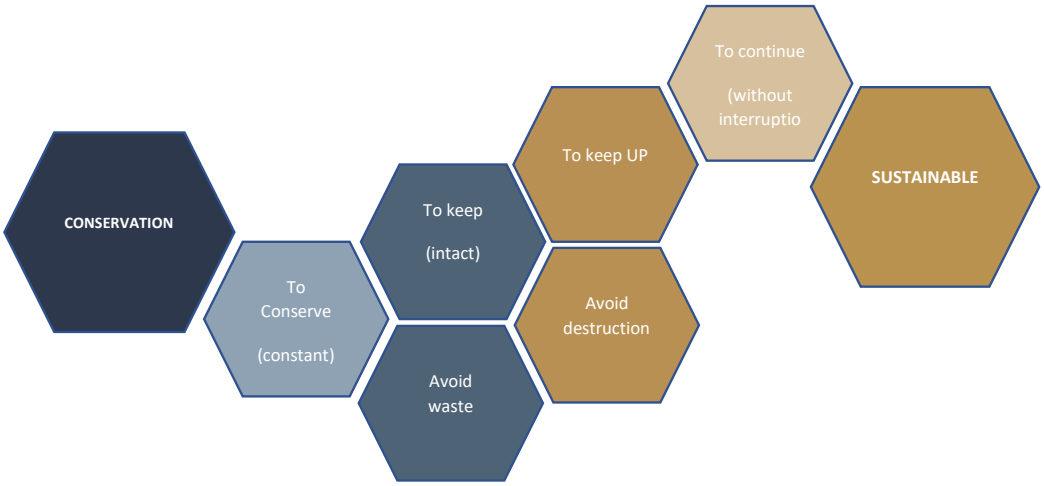

Figure 5.1 : From Conservation to Sustainable according to dictionary definitions (Gonçalves, 2019)

However, if we look back to the concepts of Conservation and Sustainability it becomes clear that these concepts are not incompatible. They are complementary and share a common goal: to avoid destruction and waste of resources, keeping up what is valuable for future generations. This definition allows as to understand heritage not as a fragility that has to be improved, but as a non-renewable resource with opportunities to be explored.

In the last decades several methods, tools, and rating systems were developed to assess sustainability of the built environment, with different indicators, data collection and analysis methods. These tools have in common the main aim to contribute to a consistent path towards achieving balance between nature, people, and the physical environment. But ultimately, this diversity proves that within the field of sustainability, assessment can be used to face different challenges. In the Mastermind course, you are challenged to assess the impact of change of the redesign, comparing a past situation (before the redesign) with the present situation (after the redesign).

Deconstructing the concept of Sustainability, to understand what to include in the assessment, brings us to the Bruntland's Report definition of three pillars for sustainable development: Environmental, Social, and Economic. Each one of these pillars can be further explored in detail with specific methodologies. Lifecycle analysis, for instance, can be used to measure environmental impacts, cost/benefit analysis allow to compare economic impacts of different scenarios, or the sustainable livelihoods method, that is focused in defining priorities for social development. However, Sustainability is a holistic concept: it is a system on which the whole represents more than the mere sum of its parts. Specific approaches focused on each one of the pillars are a valuable contribution for a deeper understanding of each part of the system. But they are partial and do not provide a complete picture of the complex interdependencies between social, environmental, and economic dimensions of sustainability (ISO, 2011). In the Mastermind, following the recommendations of the International Standards for sustainability in building construction (ISO, 2011), we require that the analysis of the impact of the redesign takes into consideration this interdependencies, by taking into account indicators focused on each of the three pillars of sustainable development.

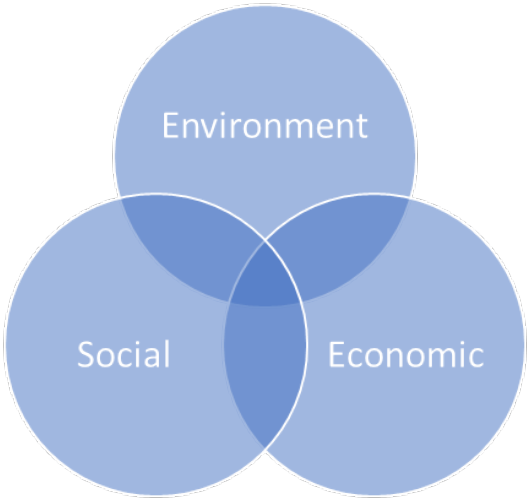

Figure 5.2 : The three dimensions of Sustainability

Considering the premise of a holistic approach to sustainability contributes to clarify the boundaries of the assessment methods within the scope of this course, excluding partial approaches. But even within the tools with a broader understanding of sustainability, differences emerge in the implicit weighting of criteria, considering the predominance of indicators related to one dimension over the others. As an example, the SB-Tool methodology is predominantly oriented towards environmental

concerns: it includes 21 indicators related to the environmental dimension, 15 related with social aspects, and only 3 related with economic aspects. Not always assessment tools clearly classify and organise indicators according to the sustainability dimensions, aiming for deeper integration of the multi-effects of the indicators in the different pillars of sustainability. BREEAM and LEED, for instance, opt for organising indicators in key-areas of performance, or categories. Despite a predominance of environmental concerns, some topics are clearly related with more than one dimension – energy with environment and economic, or awareness with environment and social, are examples of that.

Another important aspect to notice is that despite being applicable to existing buildings, most of the commercial sustainability assessment tools are not developed considering the specific challenges of heritage buildings. This is still a recent topic, and tools for the assessment of sustainability on heritage buildings tend to be more theoretical and experimental than the market-oriented rating systems. As examples of methodologies specifically designed for heritage buildings, we can refer to the set of indicators of Shetabi (2015) for environmental sustainability, the GBC historic building certification system, as a labelling approach, and the Versus methodology for vernacular heritage.

Figure 5.3 : Some Sustainability assessment tools and integration of heritage

But these are only examples of existing tools and many more could be added. Feel free to explore. For feasibility reasons, we chose to explore in the scope of this course only two methodologies: VerSus and LBC. This choice ensures enough range of diversity by covering different approaches: a theoretical method and a market certification tool, one focused on general building and other specific for heritage buildings, including qualitative and quantitative assessment processes, with measured and descriptive indicators. The particularity we would like to highlight in VerSus is its aim to learn from vernacular heritage for a more eco-responsible architecture: an architecture able to integrate in harmony with the surrounding environment. In LBC, we highlight the aim to move beyond sustainability and to achieve regenerative design: not only avoid harmful impacts on the planet but proactively implement positive measures to restore its balance.

These two methods are organised according to different structures. Versus follows the three dimensions of sustainability, while LBC organises indicators according to categories. Despite the different structure and terminology, while exploring the websites and literature, you will find out that the two approaches share common priorities, focusing on core aspects of sustainable development:

- Site: land management according to ecological site features;
- Energy: reduction of consumption and onsite production;
- Water: reduction of use and onsite management;
- Construction: building scale, techniques and solutions;
- Materials: sources, embodied energy, reuse and recycle, waste diversion;
- Indoor environment: avoid pollution sources and ensure a comfortable indoor environment;
- Durability: strategies for maintenance and resilience to extend building lifetime;
- Processes: not directly related to the building, but related to the construction and operation, such as food production or transportation;
- Community: related to community welfare – including physical features of the environment, and with community engagement and inclusion;
- Values: cultural identity, the spirit of the place and connection with nature.

Figure 5.4 : Comparative analysis of VerSus and Living Building Challenge methodologies (Gonçalves, in press)

While you will not have to fully apply these methodologies during this course, we invite you to explore the websites and literature and reflect on how you can combine them, to get the best from both worlds. What lessons can we learn from the existing building that contribute for a regenerative redesign? In your assignment you will select 3 indicators: one related to each dimension of sustainability (social, environmental, economic). You can choose indicators from both methodologies. The main challenge is to be consistent in the selection, ensuring that indicators can be related through a common theoretical framework, establishing relationships among them.

The relationships that can be established among indicators can be illustrated with the example "Light". Measuring daylight and illuminance values allows to measure the buildings performance in relation to health and well-being. The daylight and illuminance are likely related with the choice of an appropriate building orientation, in accordance with the surrounding environment. The building adequate orientation ensuring good levels of natural lighting, will eventually manifest itself in a reduction of costs with energy consumption. But this is just an example.

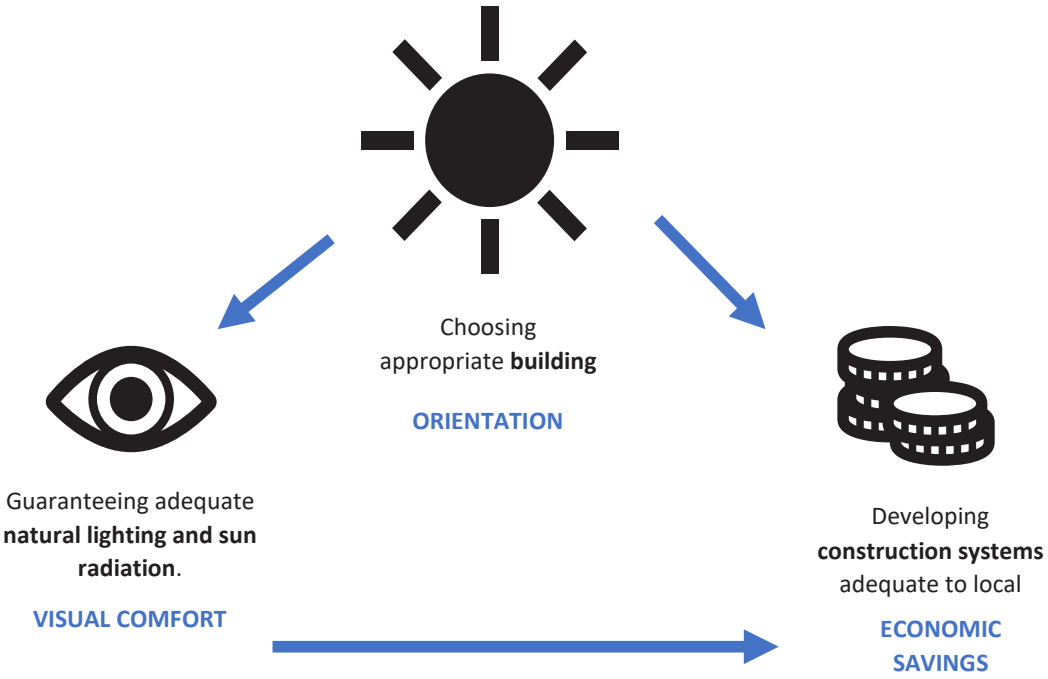

Figure 5.5 : Example of a possible theoretical framework focusing on the relation of the building with light

The **first principle** to consider when choosing indicators for sustainability assessment is **relevance** (UN, 2007): how relevant (and applicable) is the indicator in the scope of the building you are analysing? Is the indicator significant to analyse the impact of the redesign? Is the indicator suitable to establish a relationship between the three sustainability dimensions? Be creative and unveil unexpected connections.

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Collect

When dealing with heritage buildings, availability of information is not a topic to be underestimated, since the analysis of impacts depends on the existence of data from the past situation. In the last we presented a first principle to select indicators for sustainability assessment: relevance. However, the selection of core indicators needs to take into consideration a **second principle**, related with the data collection: **availability**. Availability is, according to the definition on the United Nations guidelines for sustainability assessment, the cost-effective collection of data (UN, 2007). The classes of availability can be defined as follows:

- Available: data is easily available in-situ, through survey or visual inspection
- Potentially available: data can be collected within a reasonable timeframe and with reasonable costs
- Related data available: direct data is missing but related data can be used to estimate and deduce information
- Not available: data is not available or its collection it is not feasible with a reasonable effort

A theoretical framework for sustainability assessment need to take into consideration a matrix relationship between relevance and availability. Look back to the indicators you selected and verify that the analysis is feasible in the scope of Mastermind objectives.

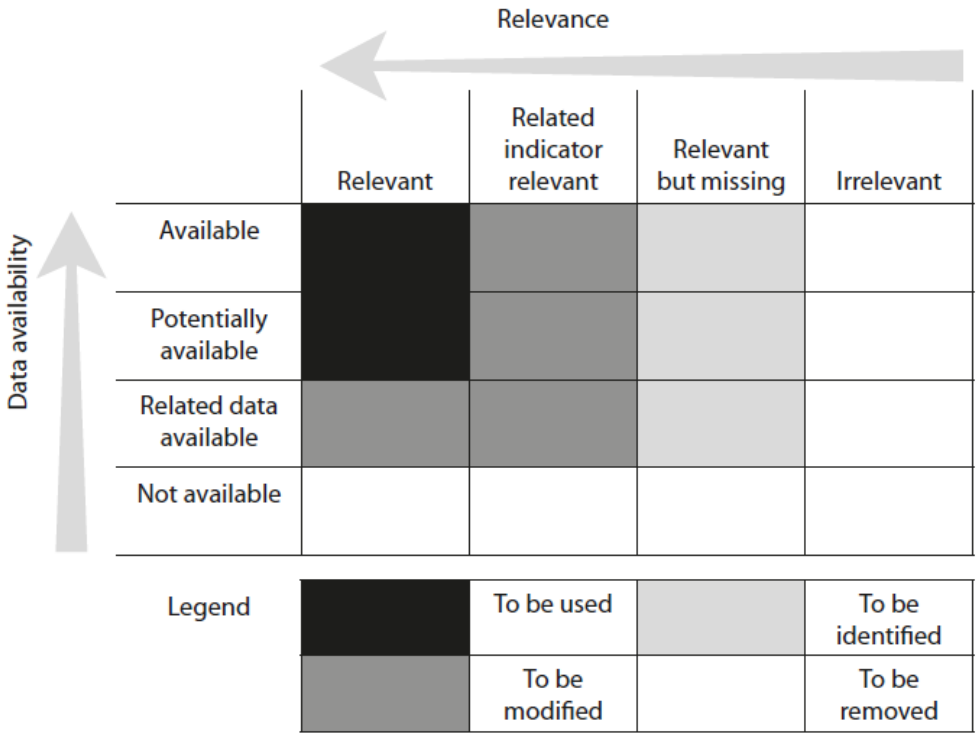

Figure 5.6 : Matrix for selection of core indicators (UN, 2007)

Available and potentially available data can be collected through primary sources. In the domain of Sustainability, the building itself is one of the richest sources of information. Data can be collected in the building through surveys, visual inspections, and measurements of the most diverse types: geometrical, temperature, humidity, air

quality, light conditions, acoustics, etc. Another primary source are the documents associated with the buildings' project. With the intent of measuring the impact of a recent redesign intervention, the architectural drawings (plans, sections, details) are an important source of information, allowing for a better understanding of materiality and techniques. Also, technical reports and processual documents, such as pictures or text, can help trace the decision-making process and understand the previous condition of the building. In ancient buildings documentation of the project may only be available through archival research. However, the redesign teams are most likely to have collected the information related to the state of the building before the redesign process. That is one of the reasons why the community – including all the people somehow related to the lifecycle of the building – is a very relevant primary source of information. Interviews, surveys, and focus groups can be used to collect information from previous and current users, architects, engineers, and construction teams, for instance.

But what happens when primary sources are not enough to obtain all the necessary information for the sustainability assessment? When data is not readily available, the assessment can consider related data to estimate and deduce information. For instance, if it the building is not accessible to the public or if information about the situation before the redesign is not available, we can consider analysing a similar building, with the same typology and characteristics, to estimate its performance. This is done in the Netherlands, for instance, with the temporary energy labelling, that reflects an estimation based on the most common characteristics, and not with specific data of the building. Literature related to the building, architect, and project, is also considered as a secondary source. It can refer to the building before the intervention or even to redesign, when dealing with listed heritage buildings or awarded projects. It is also possible that the building was previously analysed as a case study in scientific research or that there are sustainability assessment reports already published. When it is not possible to directly contact the community, information about public perceptions and experiences might be found in published media, such as local or national news, internet, and social media.

The different sources used to collect information will determine the types of data. Data can be qualitative – for instance when analysing the perceptions of comfort of a user through an interview, or quantitative – if instead the analysis is focused on the results of a survey to several users. Data can be measured in-situ – such as measuring daylight in a room, or calculated – using computer simulations with the adequate parameters. Data can be observed – for example using a building checklist to inventory technical solutions, or in the cases that information is not available, data can be deduced. Different techniques of data collection will results in different types of data, and each one has its advantages and limitations. The most important thing to retain is that awareness and transparency while reporting are essential to ensure the accuracy of the assessment. It is acceptable to use deduced data when direct data is missing; it is not acceptable, however, to use deduced data without reporting the fact and the method used to deduce it.

There are as many methods to collect data as indicators (or likely more). The methods to use in each specific case will depend on the two principles already tackled: which indicators are relevant, and which information is potentially available. As a general rule, consider experience (e.g.: how do you feel in relation to light? Is it cold? Is it too

hot? Do you feel an uncomfortable draft?) and observing the building (e.g.: what is the material of the windows? How many layers of glass? What type of heating system?), read and select project documentation (e.g.: is there a diagnosis report? Was the building previously assessed and certified? What layers of materials compose the walls?), monitor and measure actual performance (e.g: measure distances, size of windows, measure temperature and humidity, etc.), calculate and simulate estimated performance (e.g.: estimate embodied energy or energy consumption), and collect users' experiences.

Which data collection methods to use will also depend on the type of indicator. The VerSus methodology tends to look for qualitative information, while the LBC methodology is more quantitative. While in VerSus the indicator "use of local available resources" can be based on data collected by visual observation and experience of the building and its environment, in the LBC the indicator "20% of materials must come from within 500km" requires that information needs to be calculated.

Let us take as an example the theoretical framework defined in the previous chapter, with the indicators "guaranteeing adequate natural lighting and sun radiation", "Choosing appropriate building orientation", and "Developing construction systems adequate to local conditions". Different methods can be adopted to collect data to verify each indicator. A quantitative approach to verify if the levels of natural light are adequate in the indoor spaces could be measuring illuminance levels in-situ with a luxmeter. Also, quantitative, but relying on calculated data, would be simulating luminance levels through computerised simulation software, as Revit or VELUX daylight visualizer. Another option would be to collect data within the user community, with a visual comfort questionnaire. To analyse if the building has an appropriate orientation it would be important to collect architectural drawings with accurate descriptions of the spaces' functions. This information could then be analysed together with local cartography and the sun path diagram. To verify if the construction systems are adequate to local conditions, in the scope of the theoretical framework defined around the topic "Light", could be assessed through the building's energy consumption. The energy bills can be collected to provide data about the actual consumption, but if this information is not available it would also be possible to estimate the lighting consumption based on survey to users about occupation patterns.

The data collection phase is an opportunity to rethink the theoretical framework according to the two main principles for sustainability assessment: relevance and availability, considering the present and past situations. If information is missing but indicators are relevant, they can be slightly modified with transparency and coherence. Not all available information is relevant: selection is an important part of the assessment.

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Classify

In the previous chapters we discussed how to select indicators for a combined sustainability assessment in the scope of heritage buildings, considering the principles of relevance and availability. This allowed us to define a preliminary theoretical framework to guide the data collection process. The first step of the analysis process is the classification of the raw data collected in a way that allows to contextualize, interpret, and elicit conclusions. For that, we need to go deeper in the theoretical framework, establishing relations between the concepts and identifying requirements and measuring scales.

Using as example the theoretical framework defined in the first chapter, we can understand that the indicator "building orientation" can be used with the aim of assessing how the building benefits from natural and climate resources (Versus, 2014). However, this indicator may be deconstructed in several different requirements: it can refer to the relation of the building with the topography, with the water lines, with the weather conditions such as rain and wind. But in the scope of the preliminary theoretical framework, we are looking to establish a relation between building orientation, natural light, and economic savings. Is this previously established relationship (that depends on the particular choices of each case) that determines requirements for further analysis. In this case, that would be the solar orientation of the building, and, in particular, how it affects the lighting quality in the building. That can be assessed by analysing the dimensions and solar orientation of the openings, the shading devices, or the distribution of living spaces according to natural light. The theoretical framework is the guiding system that informs decisions and provides a clear and transparent justification of all the choices during the process. This is even more important when, for feasibility reasons, the assessment is reduced to a set of core indicators.

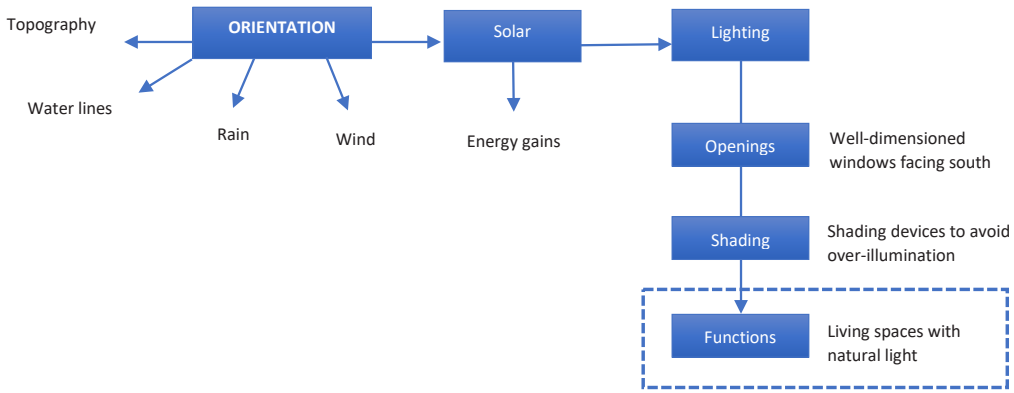


Figure 5.7 : Example of the deconstruction of the indicator "building orientation"

The same process of deconstruction of the indicators into objective requirements can be done for all the indicators in the framework, looking for the requirements that fit the aim of the assessment, the relevance to the case study, and the available data collected. Breaking down the theoretical framework in smaller parts brings a deeper understanding of the involved concepts and allows to detail the requirements of the assessment for further classification of the data. This means that, in the example we are using as case study, the theoretical framework would specify the scale and necessary measurements:

- Choosing appropriate building orientation: living spaces are distributed according to natural light;
- Guarantee adequate natural lighting and sun radiation: quantity of light on the surfaces
- Developing systems adequate to local conditions, providing economic savings: energy costs with artificial lighting.

After defining the specific requirements for the assessments, the data previously collected can be classified according to the indicators. Since the aim of this course is to assess the impact of the redesign intervention, is also important to classify the data according to time period: before and after intervention. Collected data can also be classified as visual data, such as design drawings and cartography; numerical data, such as measurements and cost estimations; and textual data, such as published research or reports. Not all types of data will provide answers for the specific requirements defined in the theoretical framework. For instance, to analyse if living spaces are distributed according to natural light, visual data is necessary, while to analyse costs with artificial lighting, numerical data is essential. The **third principle** for the sustainability assessment Is **coherence** of the chosen analysis methods. The different elements must be integrated through a systematic and logical connection.

Classification of the data also includes the analysis and categorisation according to criteria. This phase is the transition between raw data – the abstract measurements collected – to information – with data contextualised in the scope of the theoretical framework. Classification implies actively engaging with the data in order to make information explicit through visual communication. To analyse the building orientation, for instance, uses and functions must be mapped in the building with a color code, and associated with new openings and building extensions, in overlap with the sun path diagram. The color code can be applied in the building drawings (plans and sections), but information can also be diagrammatically expressed with areas per function in relation to the solar orientation. In another example, the measurements of natural lighting in the building can be expressed with a color scale in applied to the space representation in a grid over the plan. In the case of analysing the economic savings with artificial lighting, types of lamps must be classified (as incandescent, LED, etc.) and categorized according to costs of operation and energy consumption. The definition of categories, scales, and color coding is part of the classification process.

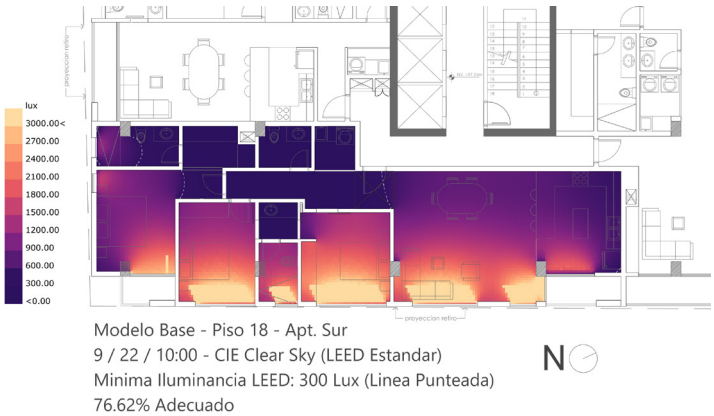


Figure 5.8 : Example of the classification of illuminance in a building (online source: https://discourse.ladybug.tools/t/illuminance-values-too-high-at-noon-only/3011)

Remember: these are just a few examples of the classification process. Last year some students mapped and quantified the use or responsible materials in the building, as you can see in the example; while others described the access to nature according to context, local area, and visual and physical connections. Apply the three principles presented until now (relevance, availability, coherence) to your own redesign case study; define a clear theoretical framework on which to base your analysis decisions; and transform raw data into information.

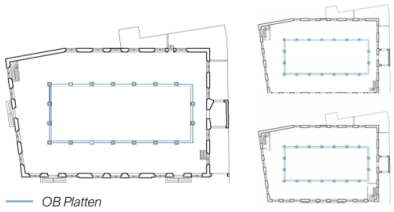
Analysis Classification	Before – OB Platten/Straw Plate	After – OSB Board and Gypsum Board	
Mapping			
SQM	1058,4 SQM	750 SQM	250 SQM
Resources	Agricultural Waste (straw)	Recycled drywall 94% [3]	FSC approved wood
Impurities	60% Grade III : wood waste with considerable contamination and mainly suited for incineration) [1]	< 2% [4]	60% Grade III : wood waste with considerable contamination and mainly suited for incineration)
Recyclable Values	No data on how Straw plate board can be recycled. Assumption : Can not be recycled because there was a large amount of toxic in early production of OB Platten. [2]	Gypsum can be recycled with the same quality through 3 cycles [5]	No data on how OSB board can be recycled. Assumption : Can not be recycled because of high level of impurities → adhesive.

Figure 5.9 : Classification of the indicator "use of responsible materials" in the Trust Theater (Apti, 2020)

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Analyse

We reached the moment on which data was already classified, contextualised, and transformed into information, ready to be analysed. In the analysis phase, information is compared, discussed, and converted into knowledge about the impact of the redesign regarding sustainability. To assess impact and evaluate performance, information must be organised in a way that "enables stakeholders to analyse changes" (Global Report Initiative, 2013). This brings us to the **fourth principle** for the sustainability assessment: **comparability**. The information must be presented in a way that enables comparison between the before and after situation, highlighting changes: additions, subtractions, and transformations.

Once again, the defined theoretical framework determines the possible analysis outcomes. Continuing with the theoretical framework relating solar orientation, visual comfort, and economic savings from the previous chapter, it is possible to elicit a few common rules. Following the principle of comparability, information before and after the redesign must be consistent, using the same scale, and the same type of information. This means comparing the same plan, the same space, with the same scale, instead of trying to extract conclusions by comparing numerical and visual data, for instance. Next, physical elements added or removed must be highlighted, to make change explicit. In the case of analysing the solar orientation of the building, for example, new extensions to the building must be highlighted, indicating total area and dominant orientation. Also, alterations on facades and openings, evidencing and quantifying the increase of floor area and glass area according to orientation. In another example, the analyse of differences in natural lighting must be based in data relating to the same space, with the same scale; physical elements added or removed that might influence the distribution of light must be highlighted; and, finally, the alteration of the amount of light must be quantified, measuring the actual difference between the before and after situation. A similar process of analysis can be repeated for the indicator relating artificial lighting and energy consumption: starting by using the same scale; identifying physical elements added or removed; measure the actual difference in the before and after situation, in this case relating to hours of daily use and the estimated costs.

Summarising, a general approach to the analysis would be:

1. Use comparable information (same type, same scale)
2. Identify changes (physical elements added or removed)
3. Measure difference between before and after (quantifying whenever possible)

Following this 3-step process allows to highlight the differences implemented by the redesign, measure them, and understand how they affect the building's performance. In the case of the theoretical framework in analysis, for instance, it allows to identify more floor area towards North, with less area within a good range of daylight, more hours of use of artificial light, but however, less energy consumption. Bringing all this information together will inform the final assessment of the redesign impact, but it is not yet an evaluation: the purpose of the analysis is to compare, identify and quantify differences and elicit changes.

Depending on the indicators, changes can be analysed in different ways. To measure the change in the openings of De Poldertoren, for instance, Makuté (2020) measured the the area of transparent openings before and after the intervention, relating it with the amount of light in the interior spaces. To measure how the changes on the façade affect energy consumption in the Van Nelle Fabriek, Brajdic (2020), calculated the thermal transmittance of the before and after situations, and estimated the difference on the annual energy consumption. In relation to the indicator "enhancement of public space", Apti (2020) mapped the building spaces used for public functions and was able to estimate the amount of people using the space in a monthly basis. In the indicator "access to nature", after classifying the surroundings of the building, Bouten (2020) characterized and quantified the relation of the building and surrounding environment, before and after.

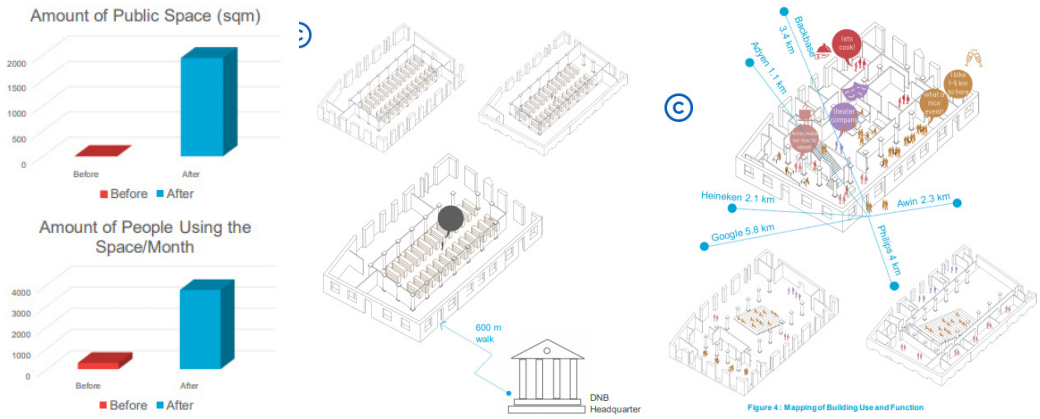

Figure 5.10 : Analysis of the indicator "enhancement of public space" in the Trust Theater (Apti, 2020)

During the analysis process it is important to keep in mind the main goal of the assessment. In the case of the Mastermind, the main goal is to measure the impact of the redesign: the major effect of the new intervention in relation to a previously existing situation. Measuring the environmental impacts of the building in the current situation, while important, does not answer the main goal of the assessment: it only reflects the performance of the building in the current situation, but does not evidence the impact of the redesign – the change – in relation to a previous situation. The goal of the assessment in the scope of the Mastermind is to measure the impact of the changes created by the redesign, and the contribution of those contributions for sustainability. This implies documenting and reporting the situation before the redesign and compare it with the situation created by the redesign.

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Assess

This last chapter is dedicated to the final assessment, integrating the results of the previous analysis, to rate the impact of the intervention. As stated by the International Standard for sustainability indicators in building construction (ISO, 2011), the aggregation of results tends to be a subjective process, since it reflects value choices. There is not one commonly agreed method for aggregation of indicators, and the evaluation will depend on the specific goals and theoretical framework previously defined. As such "clear and transparent documentation should be provided" (ISO, 2011). **Transparency** is the **fifth principle** to consider during the sustainability assessment process. The methodology used should be traceable and repeatable, so that the results are also clear and transparent.

In the Mastermind approach we have been using a theoretical framework composed by three indicators relating the environmental, social, and economic dimensions of sustainability. Aggregation of results means bringing together the separate results of the analysis of each indicator in order to achieve an overall balanced assessment. There are different ways to weight the indicators considered important for the assessment. It can be implicit – when only certain indicators are chosen to be analysed, excluding several others; or it can be explicit - when the value of each indicator for the final result is clearly defined.

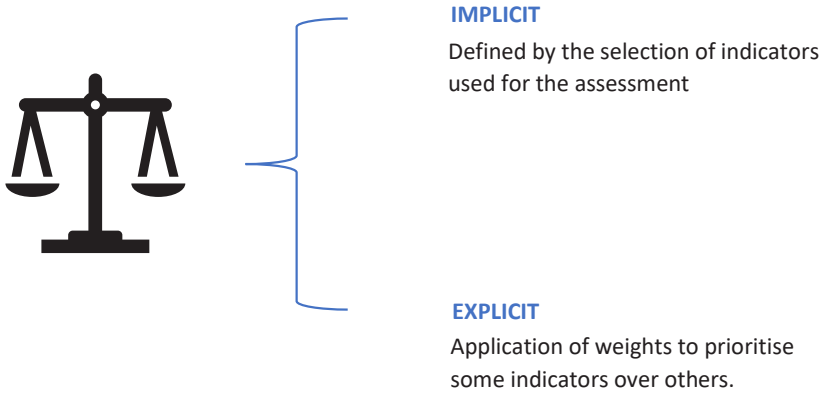

Figure 5.11 : Different types of aggregation of multiple indicators

In the several methods referred in the first lecture, there are examples of these two different approaches. The BREEAM and the LEED systems, for example, use credits or percentages to establish the priority of the categories. After analysing each indicator, the final result is multiplied by a weight factor that is common for all projects. In this way is possible to obtain a final rating that is comparable between different projects using the same system. The final rating indicates with a clear value how sustainable the building is considered to be. the positive and negative aspects that originated the result are not necessarily specified. Instead, they are presented in the reports, contributing for the transparency of the method. Alternatively, the VERSUS and the Living Building Challenge are examples of implicitly weighted methods. In the methodology guides even if requirements are specified, there is no indication on how to aggregate the results with clear weights for each indicator or imperative. In the case studies (both in the guides and online) the results are presented with a list of the principles that can be identified in the project. Instead of rating buildings with a

comparable score, these methods certify that the projects fulfil certain requirements in specific domains. With this approach comparisons between different buildings are not immediate, but the results show with transparency what specific aspects have a more positive impact for sustainable development, and which ones could benefit of improvements.

These different approaches exist because not all sustainability assessments have the same goals. For instance, to label the building performance, explicit weighting is needed. But if the goal is diagnosis and analysis of alternative building solutions descriptive approaches with implicit weighting may be more adequate. Some possible goals of the assessment are:

- Labelling
  Labelling is probably one of the most common approaches, with rating systems as BREEAM, LEED, or energy certifications. It is an *a posteriori* approach, meaning that it reflects the performance of the building as a final result, after the intervention (new construction, renovation, conservation, etc.). It indicates the building performance through a certification or classification system.
- Diagnosis
  Diagnosis is used to identify factors affecting building's performance and verify if requirements are being met. It tends to be an *a priori* approach, used to describe the current situation before interventions and identify aspects that need to be tackled.
- Comparison
  Comparison approaches can be used during the design process, to facilitate decision-making by analysing the differences between alternative building solutions. It is more of an "on-going" approach, with iteration, than labelling and diagnosis.
- Monitoring
  Monitoring are also "on-going" approaches since they are focused on analysing the evolution over time and verify the achievement of objectives. While the comparison is focused on comparing hypothetical scenarios, monitoring is focused on comparing past and present situations.

In the Mastermind course, you are challenged to assess the impact of change of the redesign, comparing a past situation (before the redesign) with the present situation (after the redesign). In this case it is important to apply a mixed method: a theoretical framework was defined, selecting only three indicators considered as priorities for the assessment. This option is consistent with an implicit approach to weight the results. However, describing the differences found between the before and after situation is not enough: the goal is to rate the impact of those changes according to the colour code of Mastermind.

To analyse the impact of change of the redesign, a four-step approach can be used:

1. Define crucial aspects and mandatory pre-requisites
   Are all aspects equally important according to the defined framework?

2. Establish rules of normalization
   How can before and after situations be assessed with the same criteria?

3. Define a final rating scale
   How to define positive and negative for each indicator?

4. Aggregate results in a final label
   Does the redesign have an overall positive or negative impact?

These steps have been addressed gradually in the previous chapters, selecting and defining a core set of indicators, and the criteria for classification of data. It is important that, before determining a final evaluation, these three processes are critically re-evaluated to clear redundancies, focus and verify the **five principles: relevance, availability, coherence, comparability, and transparency**.

When defining a final scale to aggregate results and rate the impact of the redesign, the theoretical framework Is a fundamental tool. By selecting only three indicators to analyse, the final rating will not represent a general assessment of the impact of the redesign for sustainability; the results, however, will evidence the impact of the redesign in a particular aspect of sustainability. It is important to highlight the common denominator between the three indicators to ensure that the analysis contributes to the overall assessment. In the case we used as example in the previous chapters, the common denominator was light. During the analysis important information may emerge, such as general costs of operation of the building, or the impact of solar orientation on the indoor temperature. Despite the importance of these aspects for sustainability, they may not be relevant in the scope of a framework on which the common denominator is light. With the focus on the common denominator, the rules of normalization can be verified and detailed. Often the indicators are expressed in qualitative terms, that can be originate subjective interpretations. For instance "orientation benefiting from climatic context", "comfortable natural light", or "adequate reduction of costs". To determine if changes have a positive or negative impact, concepts used to qualify indicators, such as "benefit", "comfortable", or "adequate", must be characterized in an objective way, referring to standards, regulations or scientific literature, to define the value scales to rate impact - the rules of standardization.

With clear rules of standardization – defining what is positive or negative, the Mastermind color code ranging from red (clearly negative) to blue (clearly positive) can be applied to each indicator. Yellow (+-) means that the redesign does not have any impact in the selected indicator: there is no change. This is valid even if the before situation had already a good performance. Keep in mind that we are measuring the impact of the redesign, not if the present situation is good or bad. Blue (++) means that the redesign changed something to the point of achieving the desired rule of normalization, while green means there was a slight improvement even if not enough to achieve the goal. In the other way, red means that the redesign changed something in a way that the performance is now unacceptable according to the norm, while in Orange the values would still be acceptable, even if worse than before.

With this rating scale it is possible to evaluate the results of the previous analysis, classifying the identified changes into positive, neutral, or negative impacts. In the solar orientation indicator, the analysis showed that more than 50% of the spaces added by the redesign are oriented towards north, which relates to a negative impact according to the defined scale. In the natural light analysis, the analysis concluded

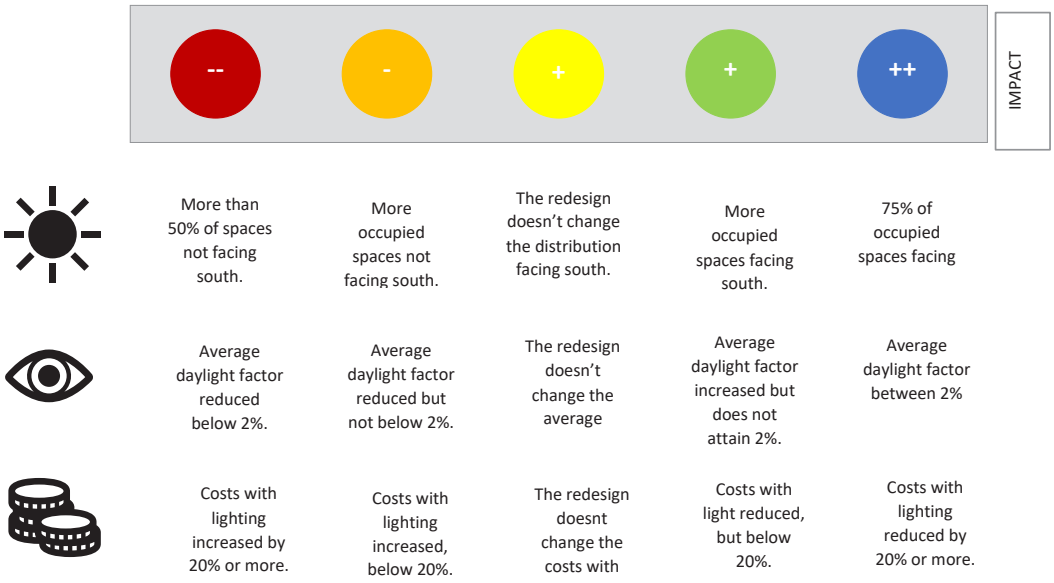

Figure 5.12 : Example of a matrix with the assessment scale

that despite removing some walls, there is less 20% of the area within a minimum of 5% range of daylight factor. In this case the average is still above the accepted 2%DF value defined in the rating scale, so the impact is more negative than positive. Regarding the artificial lighting the analysis showed that despite using more hours of artificial lighting, the replacement of incandescent bulbs by LED, translated in an annual reduction of energy consumption with lighting. The reduction is positive (green) but still below the level defined as excellent in the matrix.

The matrix with a transparent definition of the rating scales allows to establish a measure of the impact of the redesign for each indicator. But there is still one step missing: the aggregation of results, that can be implicit or explicit. The priority system was implicitly defined with the selection of the indicators: in the case study, the assessment is focused on measuring the impact of the redesign in the natural lighting of the building, in a sustainability perspective. It can be considered that all the indicators are equally relevant for the assessment: in the example the redesign would be classified as having a negative impact in the sustainability of the lighting in the building. But even considering the implicit influence the assessment with the selection of indicators, it is also possible to create an explicit rating framework. For instance: assuming that the designer had no influence in the building orientation, because the intervention was very limited by the pre-existing conditions, the influence of this indicator could be weighted and limited to 20%, keeping the remaining indicators with the same weight (40% each). This option would change the final rating of the redesign, from a negative value to a neutral value. The specific weighting system used in the assessment has the potential to affect the final rating. It can be defined in the scope of the theoretical framework, as long as is transparent and justifiable according to the data and method used along the process.

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CHAPTER

6

Heritage

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Introduction

The domain 'Heritage' is the most complex from the fivefold of CRASH. It needs an interdisciplinary research approach, counting with different perspectives of diverse actors (stakeholders). These different perspectives bring the dilemma of objectivity /subjectivity of our perception and analysis. This also urges the application of a combination of quantitative and qualitative research methods.

The complexity of the domain 'Heritage' is conditioned by the different nature of the monuments or buildings considered as heritage. Dealing with heritage of a 17th century house obviously needs another approach then dealing with a Modern Movement monument of the 20th century. In addition, the sort of materials and data available for research could be quite different for these examples.

The heritage paradox is that we try to recognize, decode, define the obvious and hidden qualities of the object to be preserved. We formulate these qualities (attributes and values), anticipating that in the future precisely these will be appreciated by following generations. We learn from the past that the chance that we are unable to recognize some important qualities (attributes and values) is very big, because of our ignorance or simply because of the absence today of ideas that may become crucial in the future. The way to deal with this problem is to apply the already mentioned interdisciplinary research approach and to pay attention to the uniqueness of the features of a building/monument studied, through comparison with others of the same type.

The domain 'Heritage' is also special because of its strong interconnections and overlaps with the other domains of CRASH. Generally, in the first research stages (define, collect and classify) the domain 'Heritage' will have the most important interaction/overlap with the domain 'Architecture'. One of the advantages of the application of the CRASH method is, that in the initial steps you can exclude indicators, attributes and features of the domain 'Architecture', when you work with the 'Heritage' domain. Therefore, communication and discussions with the students of the domain 'Architecture' is crucial on this stage. The main difference between these two domains is that only 'Heritage' focuses on the value of historical layers and concentrates on perception of the different stakeholders. In the final research (analyses and assessment) the domain 'Heritage' needs very close interactions with the other four of the fivefold of CRASH. Such collaboration is crucial in defining the balance of the intervention and evaluation of its impact.

In this chapter we give you logical guidelines to deal with a complexity of the heritage impact assessment.

Define

What is heritage?

The term heritage might make you think of monuments, like churches or castles. Or it evokes images of UNESCO world heritage like the ingenious system of windmills and pump stations at Kinderdijk. It could also remind you of an inherited cupboard or necklace from your grandparents. Also, traditions can be heritage. In the Netherlands, new year's fireworks, Sinterklaas and ice skating are regarded as immaterial heritage. Within de faculty of architecture and the built environment we will focus mostly on built heritage. However, the various types of heritage are interlinked. As you will learn in this course, the identification of heritage depends on the interpretation of people.

For this course we adopt the definition of heritage as described by Peter Howard in his book 'Heritage – Management, Interpretation, Identity', he describes heritage as 'anything that someone wishes to conserve or to collect, and to pass on to future generations' (Howard, 2003, pp. 6-7). It can be 'anything you want', but things inherited do not become heritage until they are recognized as such. Identification is a key aspect. Not everything is heritage, but anything could become heritage. People can collect heritage for their own benefit or for the perceived benefit of others. So, people and their motivations define heritage.

Challenges

Using this broad definition of heritage, there are some aspects that increase the complexity of heritage identification and related actions. First, if heritage can relate to listed and non-listed buildings, to things and activities, to collective and individual values, to the unique and the everyday, to very old and to new things, what does that mean for their protection or for future interventions? As addressed by chairs Pereira Roders and Pottgiesser in their inaugural lectures, we could change our perspective by switching things around and regarding 100% of our built environment as being heritage. This would require exploration of what is valuable and what are the possibilities for change (Roders, 2020). Apart from the identification of what is heritage, the perspective can change in time. If we see heritage as motivated by people, then this motivation can change. A dynamic definition of heritage is a challenge for academics and for institutions in the heritage field. Also, different groups can have different perspectives on heritage significance. Howard defines various stakeholder groups (heritage markets) that all have different interests. People who are prepared to devote time, money and effort to heritage want different things from it, including legitimation, cultural capital, identity and, sometimes, financial reward or just a living (Howard, 2003, p. 102). In decision making about identification of existing values or the impact of future interventions these different positions are a challenge. Lastly, new demands can threaten or strengthen resources of cultural significance. Moreover, also these demands are dynamic and unpredictable. This relates directly to the challenges for architects working on redesign.

Values and attributes

For listed buildings, the narratives highlighting the attributes and values of significance are registered in a statement of significance. A statement of heritage significance seeks to justify what already has been designed. It aims at documenting an objective analysis of significance, describing what matters and why (Historic-England, 2019,

pp. 4,10). This document can serve to justify both listing and conservation as heritage property. For non-listed buildings, although there is no statement available, the same principles apply.

So, heritage significance can be deconstructed in what matters, and why. For the first, we will use the term 'attribute'. Attributes (what) are characteristics or qualities of heritage properties which embody the values that trigger conservation (in any interpretation). In other words, attributes are what we inherit from the past. They are the resources that constituted enough value to past generations to be kept for present ones, either by active protection or otherwise. (Veldpaus, 2015, p. 128). Likewise, they are the resources that we find valuable today, to be kept for future generations. Attributes can be tangible or intangible. A tangible attribute refers to something physical, like a building material, an ornament, a specific architectural form, a spatial layout or an urban structure. An intangible attribute is something immaterial or social. This could be for example a spatial concept, a (collective) memory or a social meaning for citizens. Heritage can be cultural or natural, as is also the main distinction in the UNESCO world heritage list. Cultural heritage includes architectural works, sculpture and painting, archeological structures, groups of buildings or sites. Natural heritage includes natural features consisting of physical and biological formations or geological, physiographical formations which constitute the habitat of threatened species of animals and plants or natural sites (UNESCO, 2017). So, heritage can relate to various scale levels like elements, buildings, landscapes and beyond. Thinking about paintings and sculptures, these heritage items can be both immovable (when applied on e.g., a building or infrastructural work) or movable objects.

'Value' as the second term, refers to the reasons or arguments (why) to justify the significance of the attributes. They are the reason why certain attributes are considered to be heritage and ought to be conserved. Although this sounds all positive, values can also have a negative connotation for example as a reminiscent of war. Or relating to the various stakeholders, it can be positive for one and negative for another. Although heritage assessment traditionally is dominated by experts, nowadays more attention is given to involvement of other non-expert groups. This is addressed e.g. by a European convention that states the need to 'involve everyone in society in the ongoing process of defining and managing cultural heritage' (Council-of-Europe, 2005). As described on the corresponding website, the Faro Convention encourages us to recognize that objects and places are not, in themselves, what is important about cultural heritage. They are important because of the meanings and uses that people attach to them and the values they represent. Seeing values as contingent, meaning that they are socially as well as spatially constructed, is called 'extrinsic'. Another perspective on values as 'intrinsic', meaning inherent in nature in and of itself, not because it serves some human, biological, or ecological need. So, heritage values are seen as fixed and unchanging (Mason, 2002, pp. 8,13,89). Lastly, arguments of quality and quantity play a role. Outstanding Universal Value is a key criterion for UNESCO for world heritage, defining exceptional quality. At the other end, the UNESCO operational guidelines also mention towns, spatial arrangements or structures which are typical of a specific period or culture or stage in history as criteria, in which typical refers to exemplary for larger quantities.

Methods

Various methods are available for the identification of heritage significance. Methods show differences in their approach to values (from traditional to holistic) and in the integration of scale levels (from detail to landscape). Also, they have been developed by different organisations for different goals.

The *Cultural Heritage Agency* of the Netherlands (RCE) has developed an instrument for the assessment of architecture. This includes the following criteria: cultural historical values, architectural and art values, situational and ensemble values, intactness, recognisability and rarity value.

The *Transformation framework* is a tool developed and used by Wessel de Jonge both as an architect in practice and as chair of Heritage & Design. The concept involves designating and mapping out opportunities (for transformation) and challenges (to monumental values). An analysis of challenges, opportunities and obligations aims at establishing a bridge between historic building survey and design (Kuipers, 2017, p. 107). The framework is a visual method based on architectural historical assessment reports, but instead of limitations it aims to indicate possibilities for change.

Heritage & Architecture has developed the *HA Matrix* as an experimental tool to identify the typical features of a built heritage site in its present state in direct relation their ascribed heritage values, presented by means of a matrix. The first axis of this matrix, largely based on Stewart Brand's theory of shearing layers, represents the built artefact [attributes]. The other axis refers to core heritage values derived from Riegl's dialectic value set, augmented by two additions [values] (Kuipers, 2017, p. 86). The tool that combines to sets of categories on attributes (Stewart Brand) and values (Alois Riegl) and is used for educational purposes to communicate about heritage significance.

The *Nara Grid* (Balen, 2008) is based on the Nara Document of Authenticity (ICOMOS, 1994). Similar to the HA Matrix, it is a scheme combining attributes on one axis and values on the other. However, the set of values and attributes is different, rooted in the ICOMOS document on authenticity. It is a qualitative method to assist in disentangling the different layers that define the authenticity of the built heritage.

The *HUL framework*, like the Nara Grid and the HA Matrix, provides a framework of attributes and values. Corresponding to the previous matrices, also this is a tool to classify heritage aspects by differentiation between the attributes (what?) and the values (why). However, the HUL framework is based on a more holistic approach and includes a wider scope of both values and attributes. The set of values is based on the value framework (Tarrafa Silva, 2012) and the taxonomy of attributes (Veldpaus, 2015).

CRASH-Framework

For the MSc2 CRASH course, a combination of two of the abovementioned models is suggested. A matrix of values and attributes is composed of the layers / attributes by Stewart Brand (1995) on the Y-axis, and the values by Pereira-Roders and Tarrafa (2012) by on the X-axis. The elaboration of this CRASH Framework can be found in the chapter 'Classify'.

Students are asked to select 3 indicators. Every indicator is a combination of an attribute (layers) and a value category.

Collect

Data Collection

Collecting data, start with a strategy in mind. Aim at finding what you need, instead of using whatever you can find. However, some explorative searches are necessary to become familiar with the building, context and the narratives. These scoping searches are not as comprehensive as the main search that you will do later to identify the values and attributes, but rather are performed to determine what indicators are suitable for you research. This can be regarded as a 'snapshot' of the volume and type of evidence available (Boland, 2017, p. 45). Once you have a general impression of the building and its context (physical and histories), the availability of sources and the importance of selected indicators to focus on for the research, you start collecting data.

In the data collection, consider the distinction between values and attributes, since these can have different types of sources. Archival drawings for example will tell you about the architectural elements. But only by using additional sources, like the starting points of the architect, the opinion of users or evaluation by heritage professionals, you can find out which of the elements in the drawing are attributes and why they are valuable to a certain stakeholder. Another main distinction in the collection of data is the situation before and after the intervention. These are probably to different sets of documents. In case of the heritage evaluation, also the original situation plays a role. Note that this can be different from the situation before intervention, in case successive interventions have resulted to the present state. Knowing the original situation (or even the not realised starting point or ideology of the architect) is relevant because this sometimes is an inspiration in the redesign.

Sources

Two main types of sources can be distinguished: primary and secondary sources. As defined by various university library guides[1], primary sources provide a first-hand account of an event or time period and are considered to be authoritative. They represent original thinking and can share new information. Among primary sources are for example interviews, oral histories, diaries and documented observations or photographs. Secondary sources offer an analysis, interpretation or a restatement of primary (or other secondary) sources and are meant to be persuasive, often using generalisation, synthesis, interpretation, commentary or evaluation. Examples of secondary sources are (journal) articles, books, reports, documentaries etc. So, the difference is that primary sources present uninterpreted original materials, contrasting with secondary sources that have already be interpreted by others. Being aware of the interpretation by others and having a critical attitude towards their interpretation is important in your objective research for significance.

In the search towards attributes, several sources can be consulted. Starting with tangible resources, an obvious step in heritage research is the archive. Archives provide collections of material, including for example sketches, drawings of several

1 Definition here is retrieved from University of New South Wales in Sydney Library-website on 25.11.2020 from: https://www.library.unsw.edu.au/study/information-resources/primary-and-secondary-sources

stages in the design, detailed plans and photos. Archives sometimes include personal notes, letters etc by the architect or other parties involved, leading to possible intentions and indications for values. Note that the archive is curated/ selected and not all types of sources are included. Observations are another type of (primary) source. Your own observations of tangible resources could include the present situation (by site visit) or historic situations (by photographs/ video etc). Documentation of the observations, both by making pictures but also noting your thoughts, is necessary to use them as sources for the research. Literature is another (secondary) source available, providing information about both tangible and intangible attributes, like for example the design ideology of the architect. Be aware of the author and his/ her position.

As stated in the definitions, people and their motivations define heritage. So, searching for values, sources should reveal the perceptions, evaluations, opinions of the stakeholders involved. This can also be found in literature, for example the intentions of the architect or client. Reports by e.g., architecture-historical research provide the expert evaluation. Other resources, like urban or personal histories, are more likely to hold information about other stakeholders, like users of the building. Looking for historical perceptions, interviews, surveys or post-occupancy evaluations might be available in some cases. The early appreciation of a building can be described in old journals (expert) or newspaper articles (public). For present perceptions, you can collect new material by doing interview. Consider spontaneous street encounters or agreed (online) interviews with involved parties. Alternatively or additionally, you can search for online information holding attributes and values e.g. on social media platforms. Also, your own documentation of user behaviour on site can provide newly collected data. Last but not least, legal documents like statements of significance and monuments descriptions represent the governmental and/ or expert motivations for defining heritage significance. These can be found as municipal documents or registered in national or international monument lists.

Data

Building your own database, that can contain many types of sources, always note the discussed types of sources:

- Type of document: drawing/ book/ article/ photo/ blog article/ interview with.../ legal document
- Source: where did you find it, in case of online source include when retrieved)
- Qualitative/ quantitative
- Primary/ secondary source
- Author (can also be you)
- Year of production

- Possible attributes: note that an element (tangible/ intangible becomes an attribute if valued by someone)
- Type of values: note that one attribute can fit several categories and can be perceived differently by various stakeholders)

Methods

Bear in mind that you try to find what you need (not the other way round). As a general method, verify if you have covered all possible sources in your searches. General things to 'check' are:

- Before & after renovation
- Desk research & Field research
- Values & Attributes
- Tangible & Intangible
- Scale levels
- Primary & Secondary sources
- Different stakeholder perspectives: architects, owners/ users, experts/ academics, governments, visitors, media
- Images & Written documents
- Documents & Your own observation/ interpretation

In case of unavailability of information in one area, find out if alternative sources could compensate. Ultimately the lack of data can be the reason not to select this indicator. Note that the hierarchy in selecting is first importance, and second availability of data. Below you can find a possible checklist for data collection preparing for indicator selection.

	Values & Attributes				
	Statement of Significance	Drawings and photo's	Observation, field research	Expert interpretation	User interpretation
Before	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No
After	Yes/ No	Yes/ No	Yes/ No	Yes/ No	Yes/ No

Checklist for indicator selection on availability of information

Classify

Having collected your data for the selected indicators, what to do with it? The first step is an accurate and thorough analysis of the data. The key question in the analysis of everything collected is: How does the data serve as evidence for heritage significance? As explained in the chapter 'Define' this significance is deconstructed in values and attributes. Note that it is not about your personal opinion about what is valuable and should be conserved. The evidence should show the recognition of heritage significance by people involved. In the words of Howard, people that want to collect heritage for their own benefit or for the perceived benefit of others.

Data analysis

The method proposed for in-depth data analysis is coding. Coding is a process to break down the entire data into meaningful parts, enabling focus and comparison on specific issues (codes) for analysis (Hennink, Hutter, & Bailey, 2020, pp. 218-219). A code in qualitative inquiry is most often a word or short phrase that symbolically assigns a summative, salient, essence-capturing, and/or evocative attribute for a portion of language based or visual data. The data can consist of interview transcripts, participant observation field notes, journals, documents, literature, artifacts, photographs, video, websites, e-mail correspondence, etc. (Saldaña, 2009, p. 14). So, this process of coding can be applied to all types of data you have collected. Two different ways of coding could be used. Deductive coding, means that you use a pre-set classification of codes to study the data. For example, you search for elements in all your information that fit the value categories defined by Pereira-Roders & Tarrafa. This way, coding and classification is integrated. Another way is inductive coding, meaning that you start coding with an 'open mind'. Everything that seems important for you becomes a code. This last method requires an additional step, once you start classification.

A contemporary variant of coding is the use of data from social media, like Flickr, Instagram etc. The tags attached to posts can be regarded as codes, applied by individual contribution. It is a way to study the e.g., the visitor or inhabitant perception of a building or urban place. When using social media as data for your research, the tags can serve as codes. A two-step approach can be used. The first step is automatic and quantitative, showing the most and least used tags for attributes in photos/ textual posts. The second would be expert-based (you as the expert), studying how users refer to the different attributes in the building or landscape and distil values attached to them (Ginzarly, Teller, & Pereira Roders, 2019, p. 4). Other types of data can be analysed quantitatively as well, like how many elements or square meters have been adapted etc. This refers to the analysis phase.

Classifying attributes

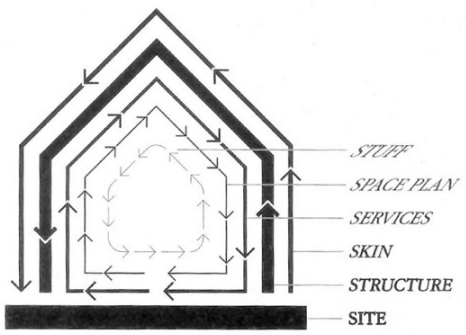
"There isn't such thing as a building. A building properly conceived is several layers of longevity of built components." This statement was made by Frank Duffy, the predecessor of Stewart Brand who he quotes in his book 'How Buildings Learn' (Brand, 1995, pp. 12-13). Brand further developed the concept of 'shearing layers of change', based on the idea that the various components of a building have different rates of change. Where Duffy distinguished four layers, which he calls Shell, Services, Scenery and Set, Brand expands the set of layers. He proposes a set of six S's: Site,

Structure, Skin, Services, Space plan and Stuff (see Figure). Rooted in the idea of continuous change, he also estimates a lifecycle for each of these layers that varies from one day to eternity. In the HA Matrix, developed by the Heritage & Architecture section in Delft, this set is again discussed and additional layers are proposed such as sun, space, substance, shape or soil. In the HA Matrix an adapted version is proposed including: Surroundings, Site, Skin, Structure, Space plan, Surfaces, Services, Stuff, Spirit of Place (Kuipers, 2017, pp. 33,87) (see Figure). This expanding series of layers is also an invitation to you, to critically assess what layer suits your attributes and, if applicable, invent a new shearing layer.

What is relevant for the use of this model in ordering attributes, is the notion that layering also defines how a building relates to people. Organisational levels of responsibility match the pace (life cycle) levels (Brand, 1995, p. 17). The building interacts with different stakeholders on different levels/ layers. Generally, users interact with the levels of stuff and space plan, owners are responsible for services and structure, whereas the wider community relates with the outer skin and the site. However, these interactions can be different for specific buildings, e.g., public interiors or hidden structures. This has an influence on what (attribute) is meaningful for certain individuals or groups and why (value).

Classifying values

Value is a term with many different meanings, from moral standards of behaviour to numbers or monetary value. For this course we suggest using the value framework



BRAND + / RIEGL +	AGE value	HISTORICAL value	INTENTIONAL COMMEMORATIVE value	NON INTENDED COMMEMORATIVE value	USE value	NEW-NESS value	(relative) ART value	RARITY value [+]	OTHER relevant values [+]
SURROUNDINGS / SETTING [+]									
SITE									
SKIN (exterior)									
STRUCTURE									
SPACE PLAN									
SURFACES (interior) [+]									
SERVICES									
STUFF									
SPIRIT of PLACE [+]									

Left: Shearing Layers (Brand, 1995)
Right: HA Matrix (Kuipers et al, 2017) – note that an alternative set of values is used in this matrix

developed by Pereira Roders (2007). This framework was chosen due to its broad scope, related to values in the built environment. Apart from the more traditional heritage values like historical or aesthetical values, the framework addresses a wider range making it applicable to various buildings and contexts, with or without a listed status. The framework includes social, economic, political, historic, aesthetical, scientific, age and ecological values (see Figure). The eight main values have been refined by sub-values and added as an appendix (Tarrafa Silva, 2012) (see appendix). Study the definitions of every sub category carefully to be able to make

a substantiated choice in classification. Often, multiple classifications could match, either for different stakeholders or by slightly different interpretations. Most important is to discuss your arguments and be transparent in your explanations.

Values Framework Pereira Roders (Pereira Roders, 2007)

Data preparation

Both the layers by Brand and the values by Pereira-Roders and Tarrafa are 'just' categories. They are meant to classify the multifaceted and multiform data, in order to structure thinking and communication about heritage significance. The actual value or attribute needs a more specific indication and description (matching one of the classifications). For every selected indicator (value x attribute), note the specific description and their classification.

The coding exercise and the classification should be done for all different types of data (legal document, images, interviews, drawings etc) in a similar way so that they can be combined and compared in the next step, the analysis.

Analysis

Critical reflections on previous stages of the domain's research

Actually, in the previous step (classify) you already started your analysis of the domain 'Heritage'. Now is the time to reflect on classified information and check that you do not miss the important indicators, attributes, elements, which you will need for your evaluation of the intervention. Think about a clear hierarchy of the heritage features of the building. Define furthermore the methodology concerning the assessment, facing the earlier results. Check if you have sufficient information to formulate conclusions. Are the collected data from before and after the implementation of the reuse design comparable? Do they clearly show what has happened with 'the message', significance, identity of the building? If you anticipate that you will be able to find missing information this week - make a planning for this. You are at the point that missing data will limit the results of your research.

Historical Analysis: historical layers from perspectives of different stakeholders.

For a proper analysis of the features of the built heritage you need to understand the genesis of the heritage. You can visualize it with a chronological mapping, which presents the evolution in chronological order, indicating the construction and all alterations to the present state of the building.

VALUE OF HERITAGE ASSET	SCALE & SEVERITY OF CHANGE/IMPACT				
	No Change	Negligible change	Minor change	Moderate change	Major change
For WH properties Very High – attributes which convey OUV	SIGNIFICANCE OF EFFECT OR OVERALL IMPACT (EITHER ADVERSE OR BENEFICIAL)				
	Neutral	Slight	Moderate/ Large	Large/very Large	Very Large

For other heritage assets or attributes	SIGNIFICANCE OF IMPACT (EITHER ADVERSE OR BENEFICIAL)				
Very High	Neutral	Slight	Moderate/ Large	Large/very Large	Very Large
High	Neutral	Slight	Moderate/ Slight	Moderate/ Large	Large/Very Large
Medium	Neutral	Neutral/Slight	Slight	Moderate	Moderate/ Large
Low	Neutral	Neutral/Slight	Neutral/Slight	Slight	Slight/ Moderate
Negligible	Neutral	Neutral	Neutral/Slight	Neutral/Slight	Slight

Table showing levels of Scale & Severity (top) and Significance (bottom) of change (ICOMOS 2010)

It is advisable to also elaborate a chronological heritage map, where you indicate at which stage which building features (attributes) were valued/recognized by different stakeholders as their 'Heritage'.

Assessing the difference between 'before' and 'after' redesign (A – B = impact).

While in the end you only need to compare the situation before and after redesign 'to reveal change', for the 'Heritage' domain you need to start your analysis from the initial stage of the original design. It is important because the redesign architect may refer to the original (maybe even unrealized) design concepts and ideas of the original architect, and could even propose to reconstruct some elements of them. Also, during a redesign process one period of the building existence can be chosen as a reference for the preservation, reconstruction or redesign. To judge such decisions, you must know the whole evolution of the built heritage asset.

Uniqueness of the monument - Tolerance for the change.

To realize how unique the studied building is, you have to compare it with other objects of the same type. You can use all possible documents or other material. The starting point may be the statement of significance in the monument's description. The significance of the monument can help you to define its general tolerance for change. Thus, a mediocre monument has much bigger potential for intervention than a (very sensitive for change) unique object of Outstanding Universal Value (OUV).

Levels of significance

Apply your classification of the heritage features from the previous step (chapter) to create a 'value-mapping', which will help you to differentiate the identified features in different levels of significance.

The position of the architect

For your analysis you need to understand the position of the redesign architect. Try to find what characterized his/her attitude to heritage? Had the redesign architect a reuse 'philosophy', earlier experiences etc.? What is his/her attitude to the CRASH domains? Can you identify a hierarchy or blind spots in the domains? Always be critical and compare the words and deeds of the architect. What were the crucial dilemma for the continuation of the heritage building?

Historical Sensation - Spirit of Heritage

In your analysis you need to keep in mind, that heritage is not only a sum of attributes, values and historic elements. It is more than simply a sum of components, it is an experience, a combination of historic sensations. Of course, they can be very subjective, different for different actors (stakeholders) and difficult to predict or calculate. Yet it is very important to grasp this *Genius Loci* of the building. The analysis of the perception of the building may help you to formulate significant indicators of this phenomena. Also, the analysis of the circulation around and inside the monument can make you realize how historical sensations function and be perceived. To distil this you also study (again) your collected data holding explanations/motivations texts by the architect, interviews with the architect, clients, owners, inhabitants, visitors etc. Compare this information with own observations and present them in visual schemas, drawings etc.

Assessment

HIA - CRASH

In the conservation practice one usually applies the formal (legal) Heritage Impact Assessment (HIA). Heritage Impact Assessment is a process of establishing the impact of a specific design proposal on the significance of a built object and identifying ways of mitigating any adverse impacts. The experts evaluate the impact of the design proposal on attributes and values, indicated in the statement of significance of the monument.

ICOMOS states that 'the assessment process is in essence very simple':

1. What is the heritage at risk [= attributes] and why is it important [= values] – how does it contribute to Outstanding Universal Value (OUV)?

2. How will change or a development proposal impact on OUV? [in our case: What changed that causes the impact? [= change and impact]

3. How can these effects be avoided, reduced, rehabilitated or compensated? [= mitigation]

(ICOMOS, 2010, p. 4-5.)

This approach leads to one-dimensional understanding of the impact. For our CRASH course you can also start with this formal (legal) heritage impact assessment, but we expect more from you. In this course, you should perform in-depth academic evaluation of what happened with the heritage part after the execution of the re-use design. Your research should generate more nuances and be a critical assessment.

To start

You must develop and apply an assessment framework to define the impact. For instance: if a Cultural Historical Reconnaissance Report is present, you start with an quick assessment of what happened with the main components of the (building) complex, that were classified into categories: 'to conserve', 'to sustain by preference, with alterations discussable' and 'replaceable'.

The position of the architect

First of all, define what was the task given to the architect in relation to the heritage part?

What was the position of the architect? Did he/she reduce or engage the heritage (pre)conditions for his/her redesign? With how much respect was he/she dealing with heritage? Did she/he have enough expertise, knowledge, information and time to consider a thoughtful treatment of heritage? How did he/she deal with the visual integrity of the Past? Did he/she value the building/monument as a historic document? Is the 'Heritage' merely preserved, or did the redesign architect facilitate an active use and appreciation of the 'Heritage'? Is a new (potential) heritage generated by the execution of the redesign? In some cases, for example when such star-architects as Peter Zumthor or David Chipperfield realized their redesign proposals, the relation of the new and old could be immediately be recognized as something unique, valuable – becoming new heritage.

Stakeholders - Attributes - Values

A quality-conscious process for reuse is based on interactions of different stakeholders. Try to grasp what attributes have changed, considering the perspectives of different stakeholders. Try to define the limits of acceptable change: a variation that is considered acceptable in a particular component or process – without indicating change in overall character– that may lead to a reduction or loss of attributes for which the site/ building is valued.

Different impacts on the realization of the redesign

A very important aspect for an evaluation is the influence of the execution of the redesign. Very often the realization differs considerably from the design proposal of the architect. What happened with the heritage during the construction is an aspect, which must not be ignored. Try to find what happened, when and why? During the execution of the design some valuable heritage elements can be discovered and a decision about them may be taken during the realization process of rebuilding.

CRASH - balance in the design decision making

In an 'integrated' preservation approach, different CRASH domains interact to make the building/monument vital. Make an assessment of the grades of 'necessary evil' from the perspective of the other four domains: CRAS. Try to develop a systematic way for these judgments/mitigations.

Mitigation

As mentioned before in our assessment, we need to identify ways of mitigating any adverse impacts. Mitigation is an action taken to reduce potential damage to a significant attribute/value of a building/monument. This may include avoiding damage, design solutions, options appraisal or seeking further information, as well as, where damage is unavoidable, recording or documenting elements that are going to be destroyed. Loss of values can be avoided, reduced, rehabilitated or compensated by design. This may be necessary to balance the public benefits of the proposed change against the harm to the building/monument.

One of the possible solutions for mitigation is the reversibility of an architectural intervention. Actually, the reversibility has to become the rule! In an ideal situation *'an intervention must be completely rectifiable (reversibility); and/or ...an intervention or a treatment shall never cause any damage to the historic material (compatibility); and/or ... an intervention or a new material must be as durable as possible (durability); and/or ... an intervention or a treatment must be repeatable after degradation of the intervention (retreatability)'* (A. Pereira Roders, Ppt-presentation Master Mind: CRASH, 2020) . Make a comparison of your case with this ideal situation.

Present impact - anticipated impact

Finally, 'to reveal change', you only have to compare the situation before and after the redesign, but in some cases, you have to include in your assessment the anticipated impacts. We give as an example an interaction of the 'Conservation' and 'Heritage' domains: through creating a glass roof the inside climate has changed, and without a proper ventilation you may in the future anticipate the acceleration of the degradation of the heritage part. This is applicable as well to other domains.

Significance of effect

Identify the scale and severity of a specific change or impact on a specific attribute. The combination defines the significance of the impact: 'significance of effect'.

Conclusions and next steps

Formulate the adequate rating principles for the different evaluations to reach the final assessment: an evaluation of the overall significance of effect – overall impact - of the redesign on individual attributes and the whole building/monument.

Your conclusion has to contain a clear statement of the effects of the redesign on the Heritage values. It could also include beneficial effects of the redesign for 'Heritage', such as a better knowledge and understanding of the building/monument or raising public awareness.

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Appendix

Cultural Values Table (Tarrafa Silva & Pereira Roders, 2012)

		Secondary Values	References
Primary values	Social	Spiritual	beliefs, myths, religions (organized or not), legends, stories, testimonial of past generations;
		Emotional, individual	memory and personal life experiences;
		Emotional, collective	notions related with cultural identity, motivation and pride, sense of "place attachment" and communal value.
		Allegorical	objects/places representative of some social hierarchy/status;
	Economic	Use	the function and utility of the asset, original or attributed;
		Non-use	the asset's expired function, which has it value on the past, and should be remained by its existence (of materials), option (to make some use of it or not) and bequest value (for future generations);
		Entertainment	the role that might be have for contemporaneous market, mainly for tourism industry;
		Allegorical	oriented to publicizing financially property;
	Political	Educational	the education role that heritage assets may play, using it for political targets (e. g. birth-nations myths, glorification of political leaders, etc.);
		Management	made part of strategies and policies (past or present);
		Entertainment	it is part of strategies for dissemination of cultural awareness, explored for political targets;
		Symbolic	emblematic, power, authority and prosperous perceptions stem from the heritage asset;
	Historic	Educational	heritage asset as a potential to gain knowledge about the past in the future through;
		Historic-artistic	quality of an object to be part of a few or unique testimonial of historic stylistic or artistic movements, which are now part of the history;
		Historic-conceptual	quality of an object to be part of a few or unique testimonial that retains conceptual signs (architectural, urban planning, etc.), which are now part of history;
		Symbolic	fact that the object has been part/related with an important event in the past;
		Archaeological	connected with Ancient civilizations;
	Aesthetical	Artistic	original product of creativity and imagination;
		Notable	product of a creator, holding his signature;
		Conceptual	integral materialization of conceptual intentions (imply a conceptual background);
		Evidential	authentic exemplar of a decade, part of the History of Art or Architecture;
	Scientific	Workmanship	original result of human labour, craftsmanship;
		Technological	skillfulness on techniques and materials, representing an outstanding quality of work;
		Conceptual	integral materialization of conceptual intentions (imply a conceptual background);
	Age	Workmanship	craftsmanship value oriented towards the production period;
		Maturity	piece of memory, reflecting the passage/lives of past generations;
		Existential	marks of the time passage (patine) presents on the forms, components and materials;
	Ecological	Spiritual	harmony between the building and its environment (natural and artificial);
		Essential	identification of ecological ideologies on its design and construction;
		Existential	manufactured resources which can either be reused, reprocessed or recycled;

Colophon

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