



# BuildDigiCraft

New Mindset for  
High-quality Baukultur  
in Europe:

*Bridging Craft and Digital*

Annette Bögle, Emiliya Popova (eds.)

## Imprint

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# BuildDigiCraft

## New Mindset for High-quality Baukultur in Europe:

### *Bridging Craft and Digital*

**Annette Bögle, Emiliya Popova (eds.)**

## 2.3 Process

# Intellectual Output 2

## Guidelines for a design process leading to a high-quality Baukultur in the digital age



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# 1.0 Introduction

Shaping the built environment is strongly influenced by the processes related to it and the available tools. The tasks of the build environment are quite complex and they become even more so in our times due to technological, environmental, and social developments and challenges. A highly interdisciplinary and holistic approach is therefore needed to develop solutions that address the qualities of Baukultur.

## List of abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
BIM	Building Information Modeling
CAD	Computer Aided Design
CNC	Computerized Numeric Control
IFC	Industry Foundation Classes
ISP	Intensive Study Program
LCA	Lifecycle Assessment
LCC	Lifecycle Cost
ML	Machine Learning
VR	Virtual Reality

The quality of the overall environmental intervention – the building activity – is one of creation in the initial step, the design process. This step is of course linked to following processes such as planning, construction or maintenance processes. But inherent in the design process is its great freedom for defining and formulating the building task and its values which finally evaluate the overall quality of the intervention. This means a lot of information and data need to be collected and analyzed which is consequently time-consuming and ultimately – at first sight – more expensive. In contrast, a holistic view reveals the financial and qualitative benefit of a careful and thoughtful initial phase for all following processes and the overall result.

All processes connected to building activities undergo major changes and challenges. They are driven, among other things, through digitalization, and the **BuildDigiCraft** project addresses the consequences, the pros and cons in a holistic manner. Focusing on the processes and their tools now leads to a couple of questions.

First of all, in the context of the built environment we need to deal with the dialectic between the generally creative and interactive character of the design process on the one hand and the targeted character of the realization process on the other; a continuous interaction with the physical world is necessary and characterizes the intersection between the visionary world of design and the physical world of project realization.

Transferring this understanding / these circumstances into the world of digital possibilities implies new approaches:

for example, digitalization allows the transfer of an idea or vision into materiality already in the design process. This contains a change of the process: now we can control the design process through physical representations, for example by a printed model of the digital vision. This means on a printed, materialized version a design idea can be evaluated.

Another aspect of the dialectic between the physical and digital world is the digital twin, or more precisely the digital representation of a design as well as a real object. What are the benefits and roles of a digital twin for the physical built environment? A discussion is necessary about the costs and the efficiency of the digital twin, too. However, it is first the design process behind the digital twin that needs to be better understood in order to be able to later answer further questions related to its performance.

Second, any process is characterized by the creator and the connection between the creator and the creation. What seems to be most obvious needs to undergo a new evaluation process under the conditions of the digital time boundary conditions. The most pressing question then is what the connection between the creator and the creation will be in a contemporary process. And what will the role of rapid digital prototyping be? It will prove the idea and it will link the creation closer to the creator. But finally, this project identifies a gap. To fill this gap, the qualities of Craft and Craftsmanship will be introduced into the discourse.

Consequently, and thirdly, a crucial aspect of the design process is that of responsibility. Any design needs a critical review and discourse which is part of the characteristic iteration inherent to the design process. The designer needs to feel responsible for the design and the decisions necessary during the design process. Such an attitude needs to be developed individually by the designer/creator, and is also based on social understanding, which in turn reflects individual and social values.

In the context of digitalization new responsibilities now arise. An array of digital tools influences and shapes the

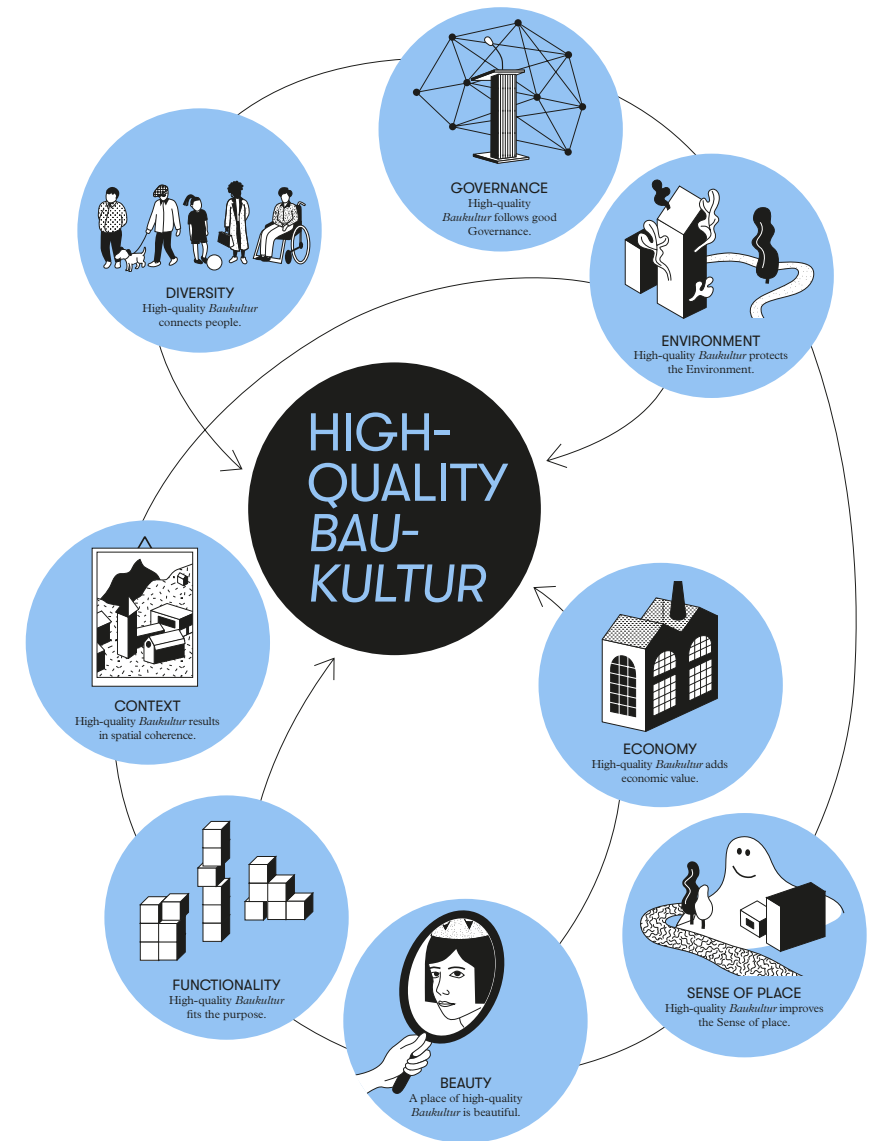
design process. This also reveals an ambivalence toward the new tools and processes. On the one hand, digitalization offers new methods and approaches toward essential questions but on the other, digitalization comes with the fear of standardization, simplification and automatization – to an extent, the designer’s fear of being replaced by a digital process is stirred. But the role and responsibility of the designer is non-negotiable which at the same time needs to be understood by the designer while he/she is drawing his/her own consequences from this fact.

Finally, the role of time is crucial to any design process but this aspect becomes even more essential and influential on the process itself through digitalization in particular. Now processes speed up and new contents are included in the process chain.

As a consequence of these outlined aspects and questions the main challenge in the context of the design process will be to understand the character of the processes, the implications and finally how to handle the process. To generate high-quality Baukultur, there needs to be a holistic attitude which is based on values but at the same time handles the process with respect and caution.

This project uses the approach of Craft and Craftsmanship to lay the basis for the attitude described above. Craftsmanship enables the identification of the designer with the process and the object. Generally, it has a holistic view on the task and is task-oriented. Also, it reconnects the creator with its creation. Consequently, any design approach is highly individual with only a small amount of standardization. The final products and work results are sustainable and of high quality.

A thoughtful and reflective understanding of the design process and its nature leads eventually to accomplishing high-quality Baukultur. Such qualities are in accordance with the Davos Declaration of Baukultur from 2018 and thus with the Davos Baukultur Assessment Framework that was developed. This framework is based on eight criteria to ensure a reflective and thoughtful view towards Baukultur.



Fig[01] Eight criteria for a high-quality Baukultur — the Davos Baukultur Quality System © Swiss Federal Office of Culture / Illustration: Heyday

The **BuildDigiCraft** project uses this framework to create own guidelines that are mainly focused on the design process. These guidelines enable an informed, reflective design process that is value- and not data-driven. The guidelines provide a set of questions to guarantee the flexibility of the criteria within the design process, which also allow the exploration of the full scope of the building task. At the same time the questions of the guidelines make it obvious that such a holistic design process requires time and resources.

## 2.0 Aim and method

The main aim of IO2 “Process” is to increase the understanding of professionals, educators, and researchers about the changing nature of the design process in the context of digital future(s) of the built environment in all its scales: urban, city block/district, building, construction detail. By representing and reflecting upon material from the **BuildDigiCraft** training program research as well as the outcomes of the joint discussion rounds during the ISPs and the input from the relevant invited keynote speakers, a set of recommendations for the future direction of the design process is developed. These recommendations are shaped in the form of guiding questions that help designers and planners to identify/check whether their design process is on the right track leading to a high-quality Baukultur in the digital age (see section 6 “Guidelines: a design process leading to a high-quality Baukultur in the digital age”).

From a methodological perspective, the results of the ISPs are seen as case studies that can demonstrate a state of the art in relation to digital tools involved in the processes leading to design decisions that later manifest in the built environment. The ISP material produced by PhD researchers enrolled at European universities within the field of the “Built environment” works as a pool of information from which the results and conclusions are made. The following is a report from researchers who have been involved both in the planning and the implementation of the ISPs – with a focus here on ISP2 “Digital Futures.” This functions as a backdrop for the Preparatory task of ISP3, which addresses the notion of Craftsmanship. Relationships between design processes and Craftsmanship are mapped this way. The choice was made to follow the structure of the ISP closely in order to communicate the findings as objectively as possible. The results are thus organized reflecting the relevant ISP tasks:

1. State of the art – mapping of digital tools and processes
2. Imaginary digital design processes
3. The role of Craftsmanship in the Process

### 1. State of the art – mapping of digital tools and processes

(ISP2, Digital Futures, Preparatory task 1, Group Work Day 1)

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#### Pre-task 1: Assignment

Reflect on your individual project (PhD project / Master’s thesis or any project of personal interest) in respect to the following three concepts: Baukultur, Craft(smanship) and Digital(ization).

Prepare a presentation with four to six slides, addressing the following issues:

1. Personal profile/introduction – who you are?
2. Baukultur – does the term Baukultur play any role in your work?
3. Craft & Craftsmanship – how do you see these in your work?
4. Digital & Digitalization – what dimensions and representations does the Digital have in your work?
5. Share with the audience your personal statement/choice/interest (Joker slide).
6. Suggest your own five keywords in relation to Baukultur, Digital and Craft, and please add/share (your own) short definition of these words.

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#### Mapping guidelines for the group work during Day 1 (ISP2):

1. Present to each other your Preparatory task 1
  2. Get to know your group better
  3. New joint group work task assignment: Map [y]our digital tools
- ♦ What are the digital tools that you are using in your project/for your work?
  - ♦ Make a collection and cluster them so that you can present them to the rest of the audience in the next session.

Think also of the following issues while clustering:

*Why and what do you use them for?  
What are the challenges in using them?  
What do we gain/lose by applying them: pros and cons.*

- Group presentations and joint discussion in the larger round

A mapping and categorization of digital tools that researchers utilize is studied through the material produced during the ISP2 Digital Futures – either as young researchers’ individual preparative work or as group work. A state-of-the-art situation of digital tools and processes is outlined in this way. Young researchers and PhD researchers have mapped digital tools and reflected on the way they use them in a current design process (leading eventually to manifestations in the built environment).

Within the task “*State of the art – mapping of digital tools and processes*,” young researchers were asked to map the digital tools they knew and worked with in their design and research and reflect on whether it was possible to “cluster” them in categories. The choice was made to use the name the young researchers gave the tools, be they formal identifications such as “LCA-tool” or a commercial name such as “KARAMBA.” A reference list of tool names and what they refer to is one of the results of the mapping.



## 2. Imaginary digital design processes

(ISP2, Digital Futures, Preparatory task, Day 2)

### Pre-task 2: Assignment

Identify a question related to your (PhD) project that you would like to find the answer to/a solution for by applying a conceptual digital workflow or process model. Try to make a preliminary outline of such an imaginary workflow/process. Think digitally and visually, sketch your thoughts. The selected question does not necessarily have to be the main research question of your (PhD) project – it can also be a sub-question related to a specific issue of interest.

This pre-task will be the basis for the group work during the training session.

### Mapping guidelines for the group work during Day 2 (ISP2):

1. Present to each other your Preparatory task 2 on Digital Process Modeling
2. Glossary task: according to step-by-step instructions in the Glossary presentation (see Intellectual Output 1)
3. New joint group work task assignment: Digital Process Modeling  
Find a way to map your imaginary workflows by relating them to the:
  - a) Glossary Matrix
  - b) Digital tools you gathered on Day 1
4. Identify the new and important questions/processes that we need for our future work as professionals responsible for the built environment

The next part of the report is devoted to the analysis of the visualization, i.e., the imaginary future research questions that the participants were to prepare as a pre-task for ISP2. The title of this study is “*Imaginary Future Processes*.” In this task, participants were asked to formulate an imaginary research question that relates to their scientific work, e.g., a doctoral thesis, and to which they would like to find an answer. Then they were asked to create a visual diagram showing the imaginary tools, etc. in a process of finding an answer to the question and in this diagram also include the digital tools that would be involved in the process. “*Imaginary design processes*” is thus a graphic communication

of the process’s diagrams produced by young researchers to depict the design of a digital process that will answer a research question. The diagrams were produced individually as a Preparatory task for ISP2.

Research questions and visual diagrams showing the processes and descriptions were analyzed by the investigating scientific team. Supporting questions were formulated, thanks to which it was possible to better characterize the processes presented and to relate them to the Baukultur idea of a high-quality built environment.



## 3. The role of Craftsmanship in the Process

(ISP3, Craft and Craftsmanship, Preparatory task 1, Reflection “**BuildDigiCraft**” model for scientific reflection)

The ISP3 Preparatory task 1 is reported in the same way as for ISP2. The ISP2 results work as a context describing a backdrop for the Preparatory task the young researchers discussed in ISP3 concerning Craft and Craftsmanship. They were asked to map their ideas of craftsmanship in the context of their research and in the perspective of digital design processes in the built environment. The young researchers discussed and presented their work in a group during ISP3 and the group developed visualizations based on their discussions and finally a synthesis, a conclusion.





with classic stand-alone tools such as Radiance but never with dynamic tools like DIVA.

When asked to describe which digital tools they find the most important, participants focused on open-source tools such as Grasshopper, which can be used to inform almost any process. They rarely mentioned Dynamo Revit Autodesk, which they do not even see as a substitute of the former. It could also be observed that none of the researchers mentioned IFC Standard BIM itself, which might be connected with an urge to go beyond standardized BIM in order to look for more free and explorative approaches to design. Or to design digital tools for a specific project, as is possible with integrated dynamic tools such as Rhino Grasshopper.

Other tools that were listed are visualization tools such as 3dMax, Vray, Lumion, Sketchup or tools from Adobe Suite. Participants naming these mentioned that skills of working with new digital tools replace the old formats. Participants though focusing mostly on the benefits of using those kinds of tools, such as shorter time and higher accuracy early in a design process, also mention constraints which digital tools may pose on free creation, as their functionalities may limit the designer's imagination. Also, immersive technologies, such as AR, VR and 3D scanning, were important for ISP participants as visualization tools, which are easier for non-professionals to read and as such allow for reaching a wider audience.

Those who work mostly on an urban scale focused on urban data analytics, design-planning tools such as ArcGIS or QGIS, but they mentioned them in connection with the new sources of data such as drone or Lidar data. Those type of tools are more and more often combined with AI-based tools using machine-learning algorithms, deep learning neural networks, life structures or fuzzy logic.

In order to use those, there is a need to learn to program in python, C++, Java or R, which are now increasingly starting to be interwoven with parametric modeling and GIS. These tools are used in various types of design tasks from analyzing

geometries and structure optimizing through form-finding up to daylight and wind simulation assessment. The above-mentioned tools are becoming increasingly more available – moreover, one requires only basic programming skills in order to use them. At the same time, some of them are perhaps used in too simplistic a way, as there is a need, not only to feed the algorithms with data there, but to ask the “right” questions and understand whether obtained results are reliable and can support the design process.

Sustainability flows as an undercurrent through the projects. Some participants focused on evaluation tools, namely lifecycle assessment, pre- and post-occupation evaluation and sustainability certifications (in both building and neighborhood scales) and the need to integrate them into the design process from an early phase.

The awareness of the whole building cycle, including end of life and reuse is noticeable among the young researchers, while their predecessors ten years ago focused mostly on the design process itself.

Qualitative indicators were analyzed in a more traditional MCDM framework (e.g., information from pre- and post-occupancy evaluation).

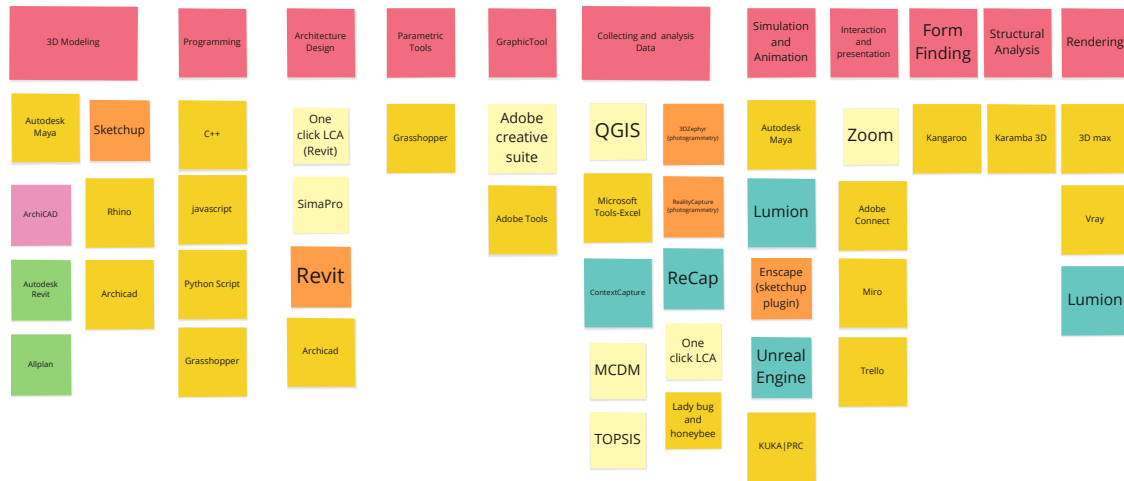
Much attention was also given to the fabrication phase where participants listed: 3D concrete and clay printing, CNC, milling, laser-cutting technologies.

Another important group of tools were project management platforms such as Trello or Base Camp, Internet boards (Mural, Miro, Stormboard, Conceptboard, etc.) but also TeamWork and content management platforms such as Teams, Meets, Zoom, Cloud or Github. This is connected with the way of dealing with the recent pandemic, which in turn has influenced the way design teams work. There are fewer personal interactions, the majority of arrangements are made during scheduled meetings, limiting spontaneous peer-to-peer consultations, however also providing a chance to meet more frequently.



participants have taken account of the pros and cons related to the use of the tools. Cons are that we lose the interaction with the natural world and the joy of working with our hands. A pro is the high professional knowledge that functions well in a multidisciplinary framework.

### Group 3



Fig[6] Results group work “Group work 3.”

This group has created the following categories: 3D modeling, Programming, Architecture/design, Parametric tools, Graphic tools, Collecting and analyzing data, Simulation and animation, Interaction and presentation, Form-finding, Structural analysis, Rendering.

It is interesting to see that parametric tools such as Grasshopper are central again. There is – once more – no reference to a contract/commercial project line framework.

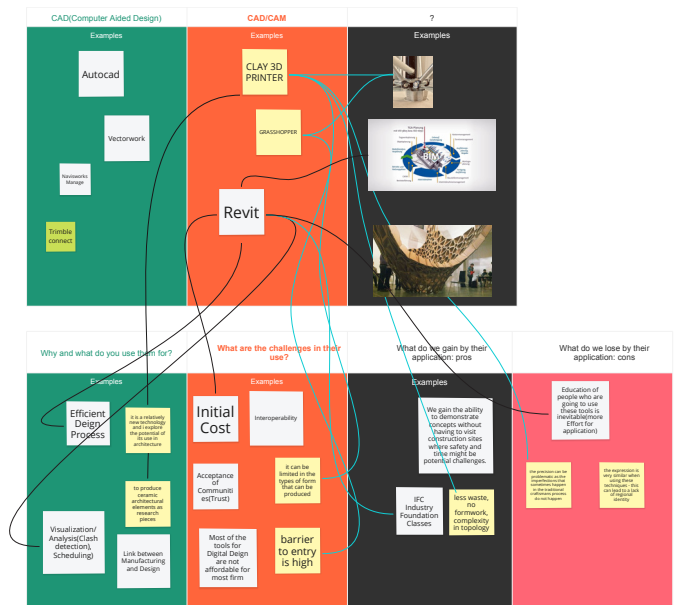
Architecture/design is seen as its own cluster – one should have expected that architecture/design would be the *outcome* of using all the tools – but when architecture is its own category, what is the purpose of all the other tools? Representing information, analyzing information – but for what purpose? Is the hypothesis that good design decisions leading to good architecture?

Do the digital tools create their own right – a kind of artificial self-enforcing demand?

Or is it that architecture/design is what happens when using the Autodesk product Revit, leading to construction drawings and information utilized by construction management to erect a building?

This group has made an addition, whereby they group the tools in two groups – the ones that they know and the ones they have just heard of, as shown in Fig[6]. It indicates an ongoing exploration of acquiring still new tools/skills and combining them for different questions.

### Group 4



Fig[7] Results group work “Group work 4” (interactive white board).

This group’s classification demonstrates that parametric tools have isolated older-generation digital tools like “Autocad.” The black lines have Revit as a focal point and show how rapid digital prototyping (e.g., 3D clay printing) is integrated in a parametric design process. The group outlines the cons: that it involves high initial costs. Grasshopper represents a parallel parametric design tool realm, where the green lines connect to some of the same aspects. The researchers do not subscribe to an Autodesk monopoly – they place Rhino Grasshopper and Revit as equals and seldom mention BIM, at least it is not central, though it is represented here via a diagram (a reference

to the “BIM world” of IFC classes, etc.). However, the Autodesk products that create an efficient lineup in terms of commercial project lines are not given a more significant role to play than Grasshopper and 3D clay printing tools: the researchers know BIM is there, but it is just an option alongside other digital tools. Still, one should keep in mind that BIM itself is not a tool, it is a work methodology used on the basis of 3D digital tools /software.

### 3.1.2 Partial conclusions

The conducted analyses allowed a mapping of main features and the evolution of design process in the digital era. We are moving beyond commercial design project pipelines and IFC standardized BIM design stages: the PhD researchers do not see themselves as working solely within IFC standardized BIM notions. Digital models are just a prerequisite for any design processes and later representation. They freely design digital design processes for different contexts.

Integrated dynamic tools such as Rhino Grasshopper are mainstream.

A lot of importance is given to visualization tools; however, the PhD researchers also focus on the artistic constraints that these tools pose. Immersive technologies – AR, VR and 3D scanning – were important for ISP participants as visualization tools, which are easier for non-professionals to read and as such allow reaching a wider audience.

Within the framework of the ISPs, young researchers defined boundary conditions as efficient use of digital tools. They are directly linked with the quality of the data available. Digital tools can help to define and frame the city, they may influence the way we evaluate and design buildings and structures. With the massive amount of data generated by people, devices and networks, we can conduct data-driven analyses of the spatial and functional patterns of the city nearly in real time. Urban data helps us understand where interchange points of the urban life lie and which type of activities occur there. Therefore, to inform design process, the study and understanding of the

condition of life in the city is necessary, which is manifest also in the design processes outlined in the ISP.

At the same time participants point out not only the benefits of using digital tools, but also the dangers such as digital exclusion, problem of data security or insufficient regulation of the use of AI-based tools. Very few digital tools address social sustainability, as the majority focus on technical or economic problems. There is an expanding range of quickly developing health and environmental sustainability assessment tools.

Diving directly into the design process, new software, no matter how advanced, cloud-based, AI-assisted and form-giving, can be seen as a constraint for a free creative process, limiting the possibility to freely visualize. Before, we could design using only basic tools like pencils or pens, but now we need specific tools which may not be accessible to some people due to lack of their availability or their high price. At the ISP we could observe a strong focus on open-source tools, which is one of the main reasons why tools such as Grasshopper are so popular.

The Covid-19 pandemic has accelerated the digitalization of design work. It has caused more importance to be given to project and teamwork management tools, which not only serve as a platform for project management, but also allow the introduction of waterfall design processes based on more agile principles. However, most participants pointed to the benefits being in the frequency and visualization potential of online meeting tools.

While working on categorization of the digital tools, researchers to a much lesser extent stick to commercial project pipeline in design processes, which for current designers is the usual way to group tools. It may be due to the limited industry practice that the young researchers possess, but one can find such a statement oversimplifying, as similar non-linearity/freedom can be observed in most innovative design companies. Evidence of this is that tools traditionally connected with the final phases of design,

for example a lifecycle assessment, start to be used in the pre-design phase. We move from linear design processes to something a lot more holistic. The tools, for this shift, are already there but these processes are not mainstreamed yet. We are in a transitory phase where one can observe that each design studio has its own culture of using digital tools, just as the young PhD researchers do.

The end of life of buildings as an impact from construction and operating buildings is integrated in design processes pointing to an emphasis on circularity.

Generally, researchers stressed the benefits of the implementation of digital tools and technologies, in that they improved the quality and performance, e.g., the material use and structural efficiency or adaptability of design. They also emphasized that digital tools support interdisciplinarity, e.g., BIM technologies facilitating collaboration between different professions. The promised “seamless” connectivity between information realms is still in a natal stage. At the same time, they were also aware of various limitations of these tools, such as their lack of flexibility, which is why integrated dynamic tools like Rhino Grasshopper were the tools of choice as they provided the most freedom.

## 3.2 Imaginary digital design processes

(ISP2, Digital Futures, Preparatory task, Day 2)

In the Preparatory task 2, Day 2, ISP2 researchers were asked to visualize an imaginary future digital design process that could answer a question related to their research.

The purpose of analyzing these examples in the context of this report was to identify future trends and characterize design processes to see whether they related to the Baukultur idea. In other words: was it possible to look at the Baukultur processes through the prism of the current research topics undertaken by young people in the **BuildDigiCraft** project? Such an approach will allow reflection on the characteristics and complexity of contemporary design processes and their role in shaping the high-quality built environment.

Examples prepared by the participants are presented below – formulated research questions with illustrations of processes. Then the examples were analyzed by answering a set of supporting questions, developed by the ISP organizers for a better evaluation of the complexity of the suggested imaginary design processes. Answers to individual questions are presented below in the order corresponding to the numbering of the presented projects (submitted Preparatory tasks 2, Day 2, ISP2).

### Overview of the supporting questions for complexity evaluation of the suggested imaginary design process:

1. *What are the individual research questions and what are their process illustrations?*
2. *What are the needs and problems the research question is answering to or solving?*
3. *What are the aims of the processes leading to answering the research question?*
4. *What is the character of the process (linear, circular, repetitive, iterative ...)?*
5. *What is the scale, range and scope of the presented processes?*
6. *Who are the design processes for?*
7. *Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?*

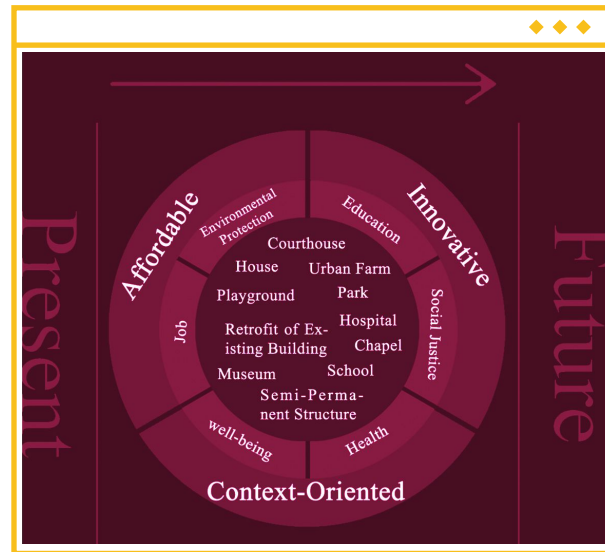


**Project 1 by Asad Fallah,**  
HafenCity University

How can digital design and fabrication bring solutions to vulnerable communities?

1. What are the individual research questions and what are their process illustrations?

Fig[8]



2. What are the needs and problems the research question is answering to or solving?

Problem: contemporary living environments are often not affordable for their residents and not sufficiently aimed at improving environmental conditions. Need: human- and eco-friendly communities for a good quality of living (Baukultur), which are affordable, innovative and context-oriented.

3. What are the aims of the processes leading to answering the research question?

Providing health, well-being, jobs, education, social justice and environmental protection to make the communities affordable and innovative, yet immersed in the local context and identity.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear in time, circular in management of the process (identification of problems and needs, vision, design and project phase, implementation, maintenance and management, identification of new problems and needs ...).

5. What is the scale, range, and scope of the presented processes?

Neighborhoods and communities scale – influence on the local groups. This process does not have a very wide territorial impact, but is very complex in terms of the individual elements subject to the processes: design (architectural) layer, social layer, environmental layer, economic layer, technical/technological layer, etc. The processes within each of the layers will require separate tools. And all of these smaller processes are part of the master process of shaping the living environment and the high-quality Baukultur within the neighborhoods.

6. Who are the design processes for?

This process is aimed at groups of residents forming the local communities – the receivers are the inhabitants.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

The whole spectrum of the Davos Baukultur criteria: good governance, economical accessibility, eco-friendliness, sense of place and immersion in the local context, beauty of the residential areas (quality of architecture), functionality of living spaces (physical accessibility), diversity – openness for diversified societies and different human needs.

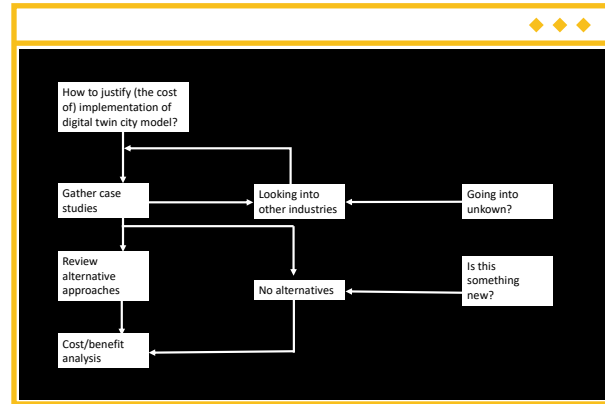


**Project 2 by Egils Markus,  
Riga Technical University**

1. What are the individual research questions and what are their process illustrations?

Fig[9]

How do we justify (the cost of) implementation of the digital twin city model?



2. What are the needs and problems the research question is answering to or solving?

Problem: do we need and how do we balance the cost of implementing the digital twin city model? Do we need to put our efforts (and costs) in the creation of the digital twin city model instead of using the same efforts and money in solving the problems in reality? There is a need to check whether we can afford to create the digital twins of city models.

3. What are the aims of the processes leading to answering the research question?

To (check whether we need to) create the digital twin city model.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear in the phase of creating the model, circular and iterative when the updated and upgraded versions are needed.

5. What is the scale, range, and scope of the presented processes?

The process of creating the digital twin city model is fully virtual, but based on the urban processes and case studies from real cities. Technologically specific, involving the AI, AR and VR technologies.

6. Who are the design processes for?

The process is aimed at different receivers in different phases: (1) AI and VR professionals; (2) engineers and designer who create urban spaces and design urban structures and infrastructure; (3) finally – inhabitants being able to see how the city can develop in the future (if the costs of creating the digital twin city model are justified).

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

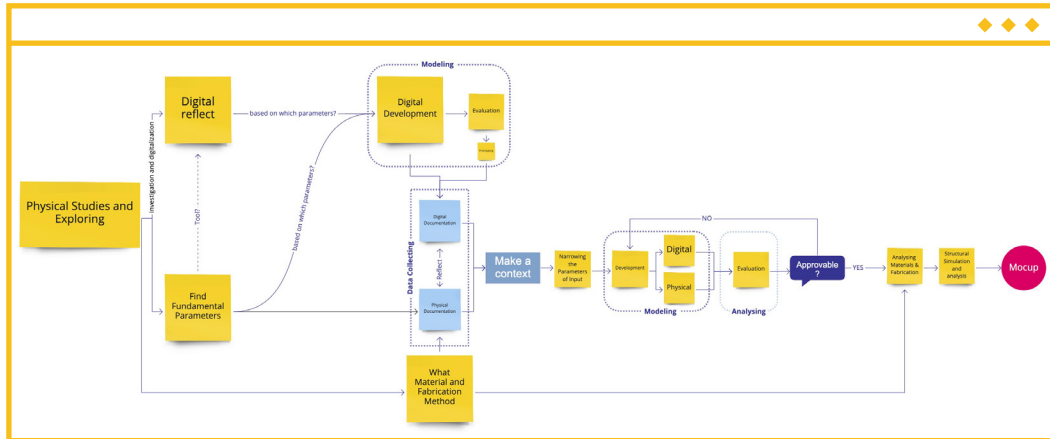
Economy (virtual simulations lead to saving money in real world), environment (simulations of the environmental impact of the city), functionality (testing of the solutions on the digital twin model), beauty, and context (by testing architectural solutions in terms of aesthetic and social values).

## Project 3 by Faezeh Sadeghi, Aalto University

1. What are the individual research questions and what are their process illustrations?

How can the physical studies be transferred to the digital environment in an accurate way?

Fig[10]



2. What are the needs and problems the research question is answering to or solving?

Problem: does the digital environment allow for the same accuracy as physical studies? What values can be added to the design processes by the parallel physical and digital studies on the materials and prefabrication methods? Need: creation of a pre-production mock-up with the use of the digital tools (to obtain the best quality of a product/design/architecture/construction).

3. What are the aims of the processes leading to answering the research question?

To create a pre-production mock-up by using digital tools and physical studies on the material and fabrication methods and to check in what way and to what extent the digital and physical approach complement each other or can replace each other.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear, leading to the obtaining of the final product of a mock-up (to produce real objects).

5. What is the scale, range, and scope of the presented processes?

The process is focused on the search for a digital equivalent of physical studies, so it concerns designers who understand the essence of the design matter, supported by specialists in digital tools. The scale of the impact of the process is therefore narrow and concerns the production line for the production of specific items, or rather their prototypes.

6. Who are the design processes for?

The process is aimed at designers searching for the most optimal and accurate tools allowing for studies on materiality and form of objects that lead to the creation of pre-production mock-ups.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

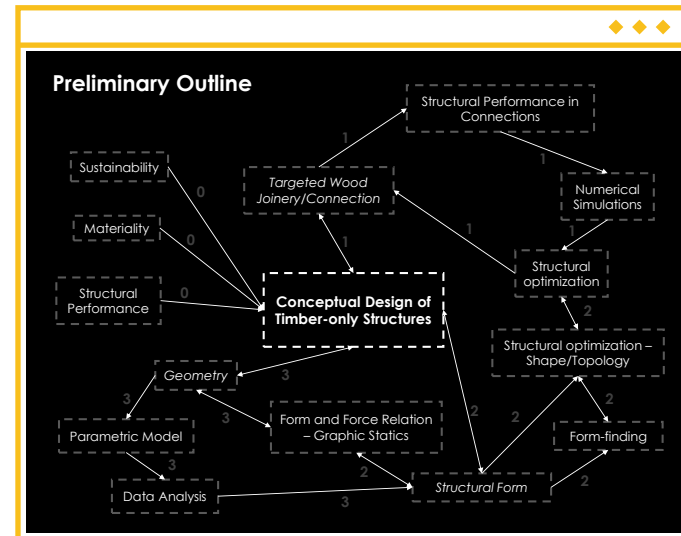
**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

Economy (searching for cheaper and better solutions in design), environment (can digital studies replace physical studies to reduce the impact on the environment?), beauty and functionality (the potential of the digital tools to support the physical studies to enhance quality, functionality and beauty of materials, forms, architecture ...)

## Project 4 by Gengmu Ruan, Aalto University

1. What are the individual research questions and what are their process illustrations?

Fig[11]



How can the process of conceptual design of timber-only structures be developed?

2. What are the needs and problems the research question is answering to or solving?

Problem: how to develop and enhance the process of conceptual design of timber-only structures using the physical material (timber to be re-used) and digital tools of design. Need: to re-use timber material in a sustainable way in order to design timber-only structures (without use of any other material) with the support of digital tools allowing for material analyses, parametrization and optimization of the form-finding process.

3. What are the aims of the processes leading to answering the research question?

To re-use timber material to create new forms of timber-only structures with the support of the digital tools.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear in the process of obtaining the new structure design (old material – re-use – finding new forms and parameters of structures and their forms – conceptual design), but circular in the whole process if we do not want to end up with conceptual design but with building (new timber-only structures can be re-used again in time).

5. What is the scale, range, and scope of the presented processes?

Architects and structure engineers can be involved in the process in the conceptual phase, but also craftsmen like carpenters who can “understand” the timber material well. The process is half-physical, half-digital. The process is technologically specific, but at the end the results can be implemented as real structures, which can enhance Baukultur with values of digitally aided sustainability and craftsmanship.

6. Who are the design processes for?

The design process is aimed at structure engineers, architects, carpenters who can use their craft, their technical and digital skills to look for new forms of timber-only structures based on the re-used material.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

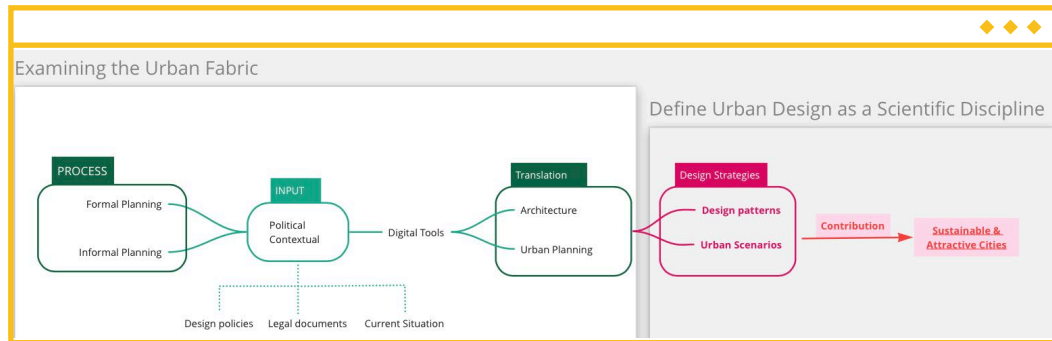
**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

Economy (re-use of the exploited timber material), environment (no need to harvest wood by cutting forests), sense of place and context (timber structures can support the locality of architecture), beauty (beauty of natural materials), functionality (searching for optimization).

## Project 5 by Ilirjana Haxhij, Gdańsk University of Technology

1. What are the individual research questions and what are their process illustrations?

Fig[12]



How can we strive to create sustainable and attractive cities?

2. What are the needs and problems the research question is answering to or solving?

Need: we want to live in sustainable and attractive cities.  
Problem: how can this be reached by integrating complicated processes of urban planning systems, architectural design, urban scenarios and using urban patterns, local contexts, digital tools (design, use of big data ...)

3. What are the aims of the processes leading to answering the research question?

To create sustainable and attractive cities immersed in local contexts and based on the local patterns with the support of digital tools of design and planning.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Circular and iterative, because the process of creating urban spaces never reaches its final shape, as the needs of inhabitants and urban factors are always changing – meaning that the process demands constant verification and recognition of new problems to solve them again and again.

5. What is the scale, range, and scope of the presented processes?

The process is multi-tooled, multi-ranged, and multi-scaled. Physically, digitally, and virtually. The whole community should be involved: inhabitants (participation processes), urban designers and architects should be a bridge between inhabitants and other stakeholders, like businesses and authorities. The processes range is very wide territorially, socially, and professionally.

6. Who are the design processes for?

The design and planning process is ultimately aimed at the local communities and inhabitants of urban spaces.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

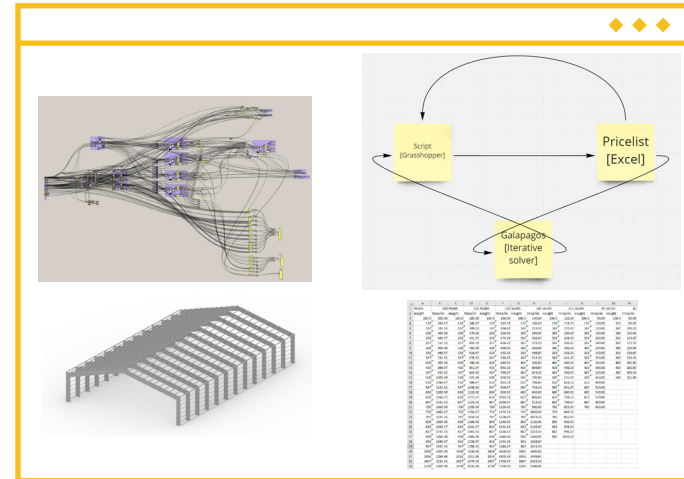
Eight criteria: Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

The whole spectrum of Davos Baukultur criteria: good governance leads to well-managed urban areas striving for economical accessibility and eco-friendliness, need of sense of place and immersion in the local context, beauty of the city with high-quality architecture and urban design, functionality of urban spaces (physical accessibility), diversity – openness for diversified societies and different human needs.

**Project 6 by Julian Sorensen,  
Denmark Technical University**

1. What are the individual research questions and what are their process illustrations?

Fig[13]



What is the relation/workflow between reinforcement strategies, design and printing process?

2. What are the needs and problems the research question is answering to or solving?

Problem: how to balance the elements of the process of the designed and printed reinforced structures: design process, reinforcement process and printing process? Need: to obtain high-quality reinforced, sustainable structures.

3. What are the aims of the processes leading to answering the research question?

To optimize the process of design and printing the reinforced structures with the support of digital tools (Grasshopper, Galapagos ...).

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear + circular – linear as a way to reach the aim, but iterative in the constant enhancement of the processes.

5. What is the scale, range, and scope of the presented processes?

The process is technically specific, with the involvement of specialists only (structure engineers) using the digital tools

of design, calculation and printing. Can be imagined as fully digital with the physical product at the end of the process.

6. Who are the design processes for?

The process is aimed at structure engineers searching for the optimization of the design, calculation, reinforcement and printing of structures.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

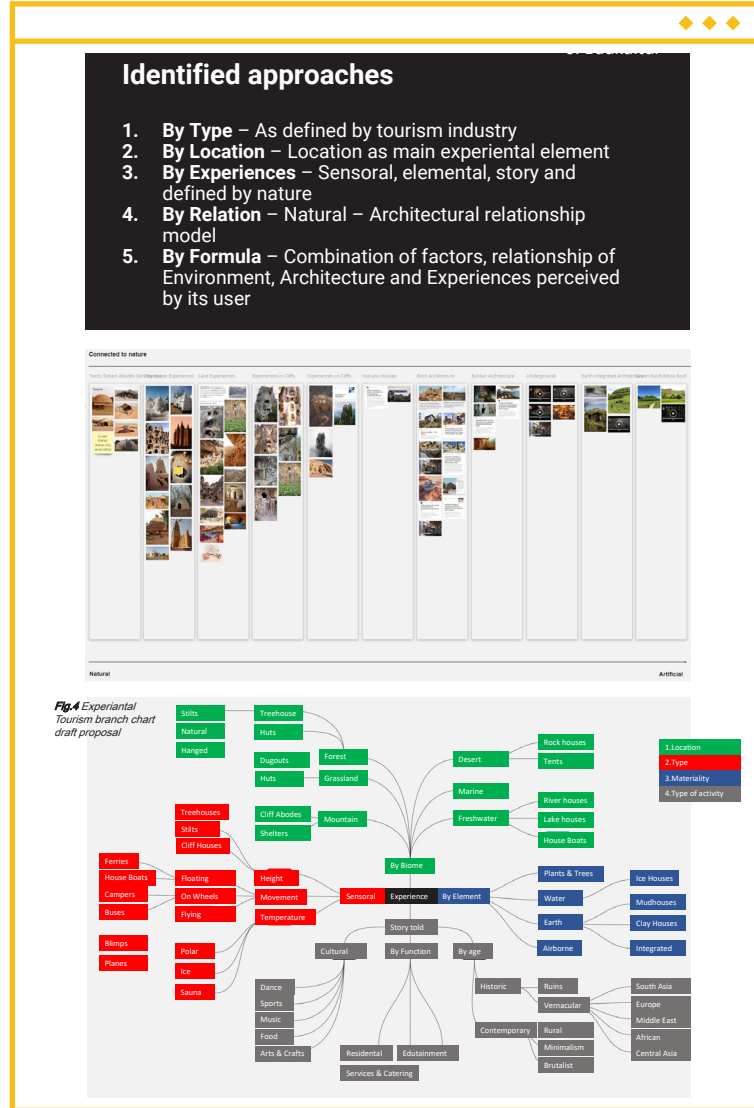
Economy (optimization of the design and production process of the reinforced structures, reducing the material use), environment (balancing the elements of the process should lead to reducing the environmental impact), beauty, and functionality (care for the quality of design and effectiveness of structures).

**Project 7 by Matijs Babris,**  
Riga Technical University

1. What are the individual research questions and what are their process illustrations?

What is experiential architecture organizational typology for nature tourism applications?

Fig[14]



2. What are the needs and problems the research question is answering to or solving?

Problem: what is experiential architecture organizational typology for nature tourism applications?  
Need: identification of the organizational typology of experiential nature architecture for tourism purposes.

3. What are the aims of the processes leading to answering the research question?

To identify the organizational typology of experiential architecture for nature tourism purposes.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear – the identification process leads to creation of typology, which can be finished or developed in time.

5. What is the scale, range, and scope of the presented processes?

The process is specific to architecture, nature and history specialists, needs physical studies and digital processing for organizational and classification processes.

6. Who are the design processes for?

In the identification process, they are aimed at the researchers, but the results may be targeted at the tourism organizations.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

Governance and economy (proper tourism management in terms of experiential nature architecture for the care of its values and potential), environment (treating experiential nature architecture as a part of nature that should be protected), sense of place and context (typology may help in understanding the local identity and connections of the nature architecture with the local architectural traditions – e.g., vernacular architecture).

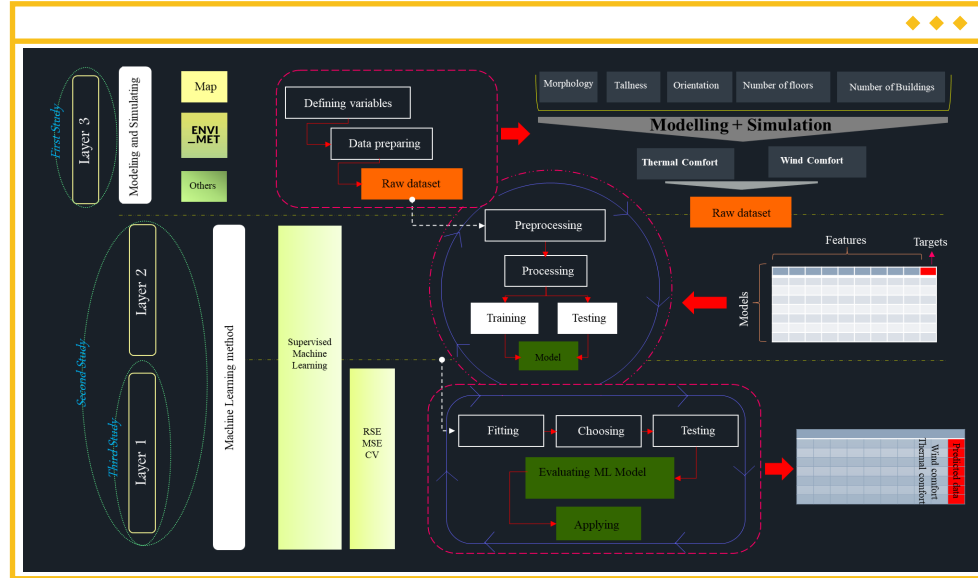


**Project 8 by Nasim Eslamirad,**  
Tallinn University of Technology

1. What are the individual research questions and what are their process illustrations?

How do we apply machine-learning (ML) to optimize the architectural design?

Fig[015]



2. What are the needs and problems the research question is answering to or solving?

Problem: how do we support human-computer interaction with the use of machine-learning in data analysis and forecasting in architectural engineering and urban design?  
Need: we need better energy efficiency of buildings and need to develop guidelines in the field of optimization.

3. What are the aims of the processes leading to answering the research question?

To identify the design strategy for the sustainable values of the build environment. To optimize the process of design (case study of design solution for the energy efficiency of buildings and outdoor thermal comfort), in particular to use ML for data analysis and forecasting in architectural engineering and urban design.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear + circular (iterative) – linear as a way to reach the aim, but circular/iterative in the constant enhancement of the processes within the layers. The complex character of the process consists of overlapping layers and studies.

5. What is the scale, range, and scope of the presented processes?

The process is focused on searching for the most optimal design using ML for data analysis and forecasting in architectural engineering and urban design.

6. Who are the design processes for?

The process is aimed at architects and urban planners to support human-computer interaction, with great potential to deal with the complexity of the defined problem in architectural and urban environment.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

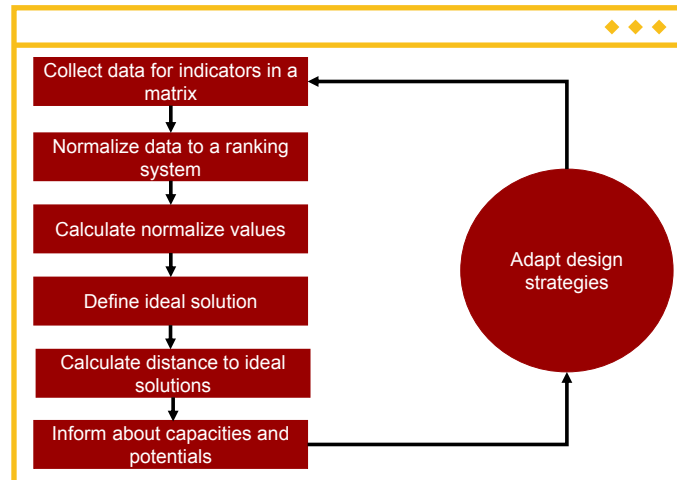
Economy (searching for optimal solutions in design, using ML for data analysis and forecasting in architectural engineering and urban design), environment (collecting more accurate data than the input data of the building energy profile and urban optimization to reduce the impact on the environment), beauty and functionality (the potential of digital tools to support the physical studies to enhance quality, functionality and beauty of materials, forms, architecture, landscape ...).

**Project 9 by Rune Andersen,**  
Denmark Technical University

1. What are the individual research questions and what are their process illustrations?

Fig[16]

How can the capacity of buildings be used to select transformation strategies that give most sustainable value?



2. What are the needs and problems the research question is answering to or solving?

Problem: how can the capacity of buildings be used to select transformation strategies that provide the most sustainable value? Need: implementation of design strategies in relation to consolidated indicators and data in a digital model in order to obtain the most optimal solution strategy to finally visualize and inform about the effects of the strategy / obtain the most sustainable environment.

3. What are the aims of the processes leading to answering the research question?

The improvement of the design and digital fabrication process of the design.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear – the process that consolidates indicators and data in a digital model (from collecting data for indicators in a matrix to the information about capacities and potentials) in order to adopt design strategy. The process can be repeated in the cycle phases.

5. What is the scale, range, and scope of the presented processes?

The process is focused on searching for the most sustainable design strategy. Touching economic, social and environmental aspects on many scales addresses architects and urban planners but also a broader audience (policy-makers and local actors) who will be informed about the design strategies' potential).

6. Who are the design processes for?

The process is aimed at architects and urban planners searching for the optimization of the design process and strategies, however by visualizing and informing about the effects of strategies ultimately also aimed at the policy-makers and local communities.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

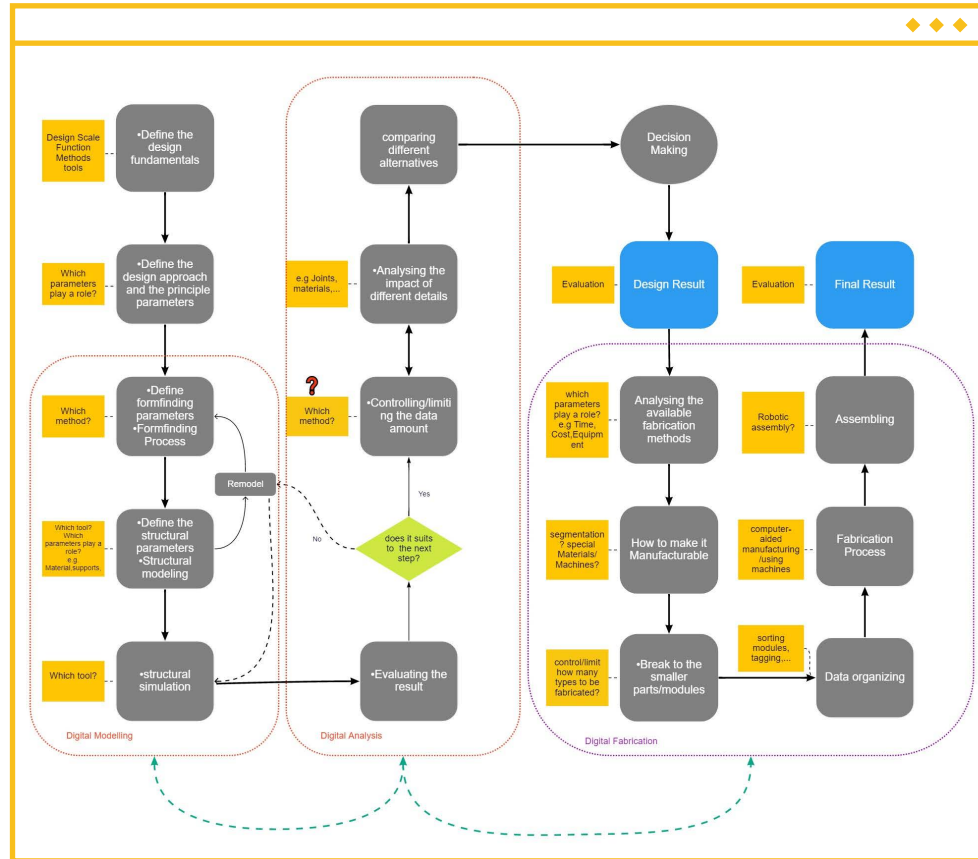
The whole spectrum of Davos Baukultur criteria: good governance, economical accessibility, eco-friendliness, sense of place and immersion in the local context, beauty of the residential areas (quality of architecture), functionality of living spaces (physical accessibility), diversity – openness for diversified societies and different human needs (since the process investigates sustainable values).

**Project 10 by Sepideh Barati,**  
HafenCity University

How do we make complex stress-line-inspired designs manufactural?

1. What are the individual research questions and what are their process illustrations?

Fig[17]



2. What are the needs and problems the research question is answering to or solving?

Problem: how do we make complex stress-line-inspired designs manufactural? Need: to improve the design and digital fabrication process of the design.

3. What are the aims of the processes leading to answering the research question?

The improvement of the use of digital tools by questioning background operations following a perceptual approach.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear – through three phases, leading from digital modeling, through digital analyses (repeatable in the modeling and analysis phase) to digital fabrication to obtaining the final product of the fabrication and evaluation of it (to both product digital and real objects).

5. What is the scale, range, and scope of the presented processes?

The process of creating the final result of digital fabrication is fully virtual, based on the design fundamentals. It concerns the design phase of the narrow area of the complex stress-line-inspired design. Technically specific, involving (most probably) the AI, AR and VR technologies. Can be imagined as fully digital with the physical product at the end of the process.

6. Who are the design processes for?

The process is aimed at designers searching for the optimal and most appropriate tools and methods allowing for digital fabrication of the complex stress-line-inspired design.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

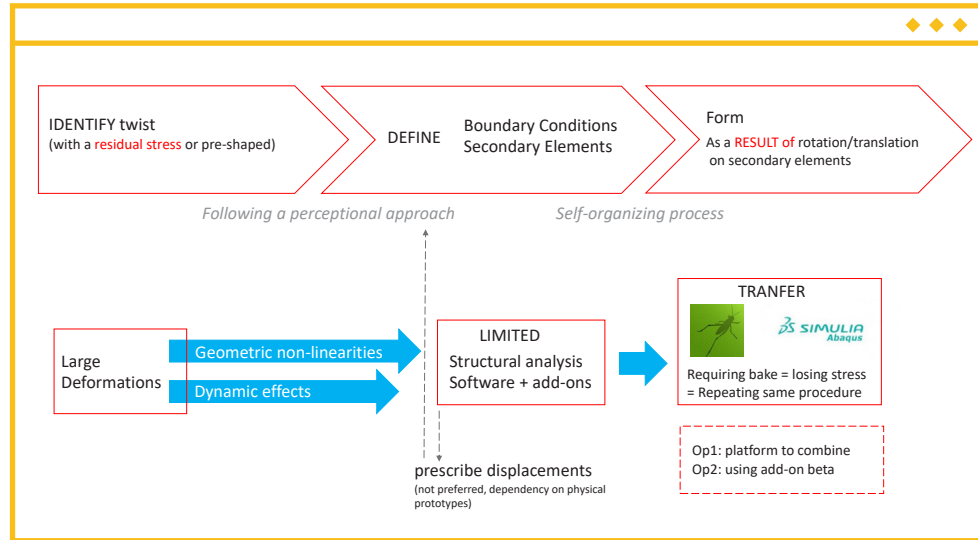
Economy (optimization of the design and production process of the complex stress-line-inspired designs), environment (balancing the elements of the process should lead to reducing the environmental impact), beauty and functionality (care for the quality of design and effectiveness of structures).

**Project II by Serenay Elmas,**  
Aalto University

1. What are the individual research questions and what are their process illustrations?

How can I represent active torsion by following a perceptual approach in a digital environment?

Fig[18]



2. What are the needs and problems the research question is answering to or solving?

Problem: how do we represent active torsion by following a perceptual approach in a digital environment? Need: to improve the use of digital tools by questioning background operations following a perceptual approach.

3. What are the aims of the processes leading to answering the research question?

The improvement of the use of digital tools by creating the taxonomy of tool paths based on different knitting stitches that can be parametrized.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear – leading to obtaining the final form as a *result* of rotation/translation of secondary elements (three phases process: identification of the twist, definition of the boundaries conditions, creation of final form).

5. What is the scale, range, and scope of the presented processes?

The process is technically specific with the involvement of specialists only (structure engineers) using the digital tools of design and calculation but following a perceptual approach. Can be imagined as fully digital with the physical product at the end of the process.

6. Who are the design processes for?

The process is aimed at designers searching for the optimal and most appropriate digital tools and methods allowing for representation of active torsion.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

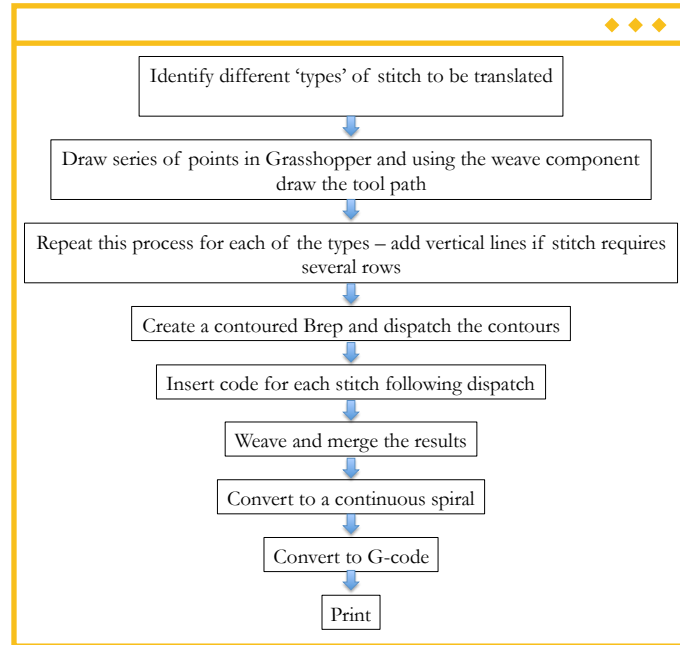
Economy (optimization of the design and production process of the structures, reducing the material use), environment (balancing the elements of the process should lead to reducing the environmental impact), beauty and functionality (care for the quality of design and effectiveness of structures).

**Project 12 by Suzi Pain,  
Royal Danish Academy**

1. What are the individual research questions and what are their process illustrations?

How can I translate a Japanese knit pattern into a digital tool path? How can I create the taxonomy of tool paths based on different knitting stitches that can be parametrized and used for the 3D printing in clay?

Fig[19]



2. What are the needs and problems the research question is answering to or solving?

Problem: how do we create the taxonomy of tool paths based on different knitting stitches that can be parametrized and used for the 3D printing in clay? Need: translation of a Japanese knit pattern into a digital tool path.

3. What are the aims of the processes leading to answering the research question?

To create an algorithm/digital path for converting the different types/patterns of knitting stitches into a Grasshopper (parametric design) series of steps for 3D printing in clay.

4. What is the character of the process (linear, circular, repetitive, iterative ...)?

Linear + circular – linear as a way to reach the aim (parametricized knit pattern and used for 3D printing), but circular/iterative as the constant enhancement of the processes.

5. What is the scale, range, and scope of the presented processes?

The process is focused on the improvement of the digital tools (mainly Grasshopper) by drawing inspiration from tradition and culture and searching for a digital equivalent of physical studies, so it concerns designers who understand the essence of the design matter, supported by specialists in digital tools. The scale of the impact of the process is therefore narrow and concerns the production line for the manufacturing of specific items or rather their prototypes.

6. Who are the design processes for?

The process is aimed at designers searching for the optimal and most appropriate tools allowing for studies on materiality and form of objects leading to creation of pre-production mock-ups.

7. Which of the eight criteria for assessing high-quality Baukultur do the processes refer to?

**Eight criteria:** Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity.

Economy (searching for optimal and better solutions in design), environment (can digital studies replace the physical studies to reduce the impact on the environment?), beauty and functionality (the potential of the digital tools to support physical studies to enhance quality, functionality and beauty of materials, forms and architecture, drawing inspiration from tradition and culture).

### 3.2.1 Partial conclusions

The analysis of examples of research questions and processes geared toward answering these questions shows that young researchers take up issues that are firmly rooted in the values inherent in the Baukultur ideas. They are looking for solutions that lead to a better quality of life, greater material efficiency, more economical production, to reducing the impact of processes on the environment, while they are still embedded in the local culture, context and values. Tools that are essential in these processes are digital data analysis tools, computational methods, design aids, simulations and many others, described and analyzed in other chapters of this report.

The role of digital tools in contemporary design processes is to support humans most effectively, allowing for the reduction of errors and the most accurate analyses and results. However, what can be seen from the illustration of these processes is that digital tools and new technologies do not dominate the processes, nor are they an end in themselves. The ultimate goal of the undertaken research issues is to strive to build better and better quality and search for new solutions and opportunities in the physical world, the true framework of human life.

One can also see the reflection and the questions posed, whether such advanced use of digital tools is always economically justified, whether digital tools are not starting to lead a “parallel life” that has no impact on contributing to the improvement of the quality of reality in which people live.

Creating a design process to answer a specific contextual challenge is a skill that all the participants excelled in. Digital tools at hand were used creatively and contextually – even though the tools themselves might have been developed for a specific design stage, they can be used in new ways.

## 3.3 The role of Craftsmanship in the process

(ISP3, Craft and Craftsmanship, Preparatory task 1, Reflection “BuildDigiCraft” model for scientific reflection)

### 3.3.1 Introduction

ISP3 addressed the topic of Craftsmanship. This is closely related to the design process in the sense that an act of working with material is the essence of a (building) process leading to manifestations in the built environment. Furthermore, the mapping of tools and processes of ISP2 demonstrated that there is a tendency to think holistically (including e.g., 3D printing and end-of-life perspectives in the design process). The ISP2 works as a backdrop to the ISP3 Preparatory task concerning Craft and Craftsmanship. Essential questions in ISP3 were:

What is craft and craftsmanship to you in your research ?

What is the relation between a design process and Craftsmanship in a digital age?

Craftsmanship involves skills in using tools, and in general, the young researchers’ did not make a distinction between physical tools and digital tools.

Answers for these questions were given through a series of exercises (pre-tasks and group work) based on the young researchers own projects and experiences.

### 3.3.2 Results

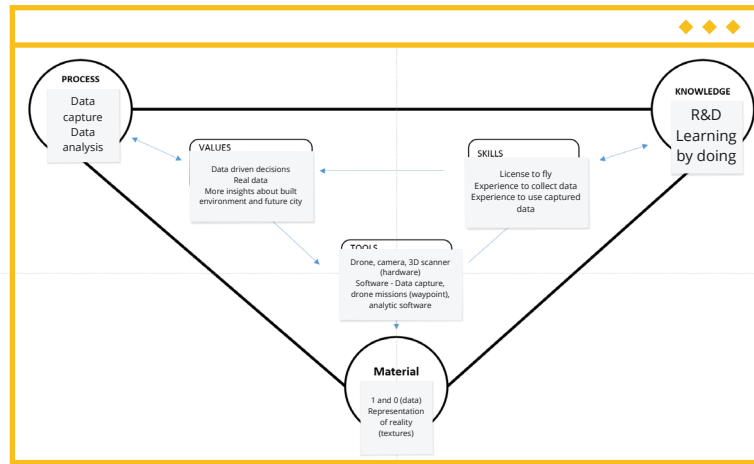
#### Group 1

It became evident in one of the exercises that the material processed through Craftsmanship is not considered to be “wood” or “metal” as was traditionally the case.

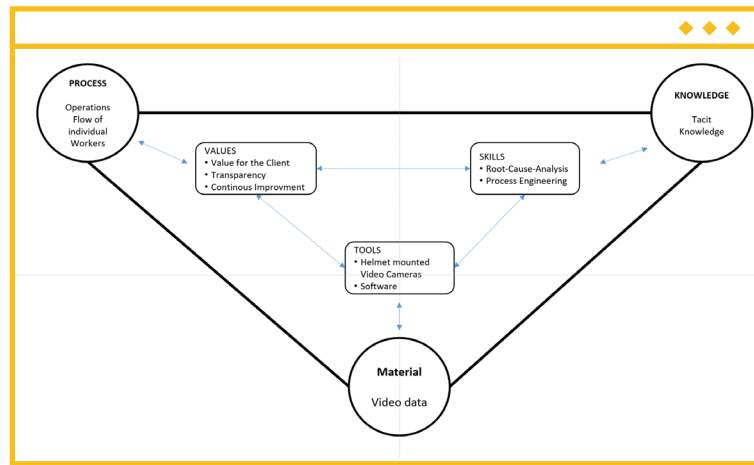
Instead, the material might be the data and the tools drone, the camera, 3D scanners, etc. (Fig[20] and Fig[21]).



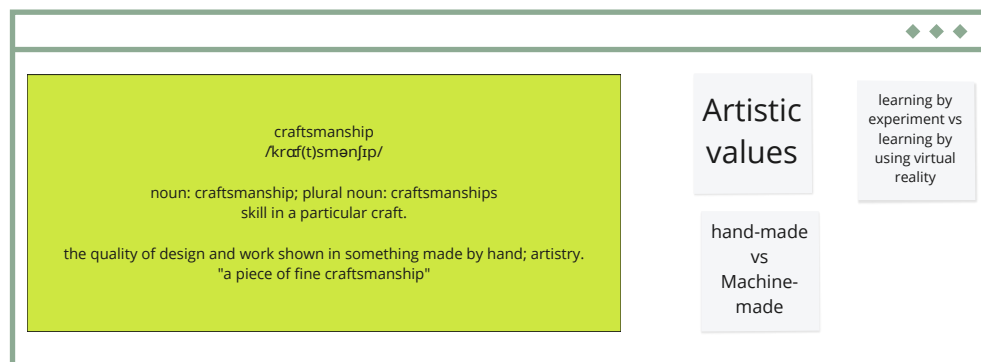
Fig[20]



Fig[21]

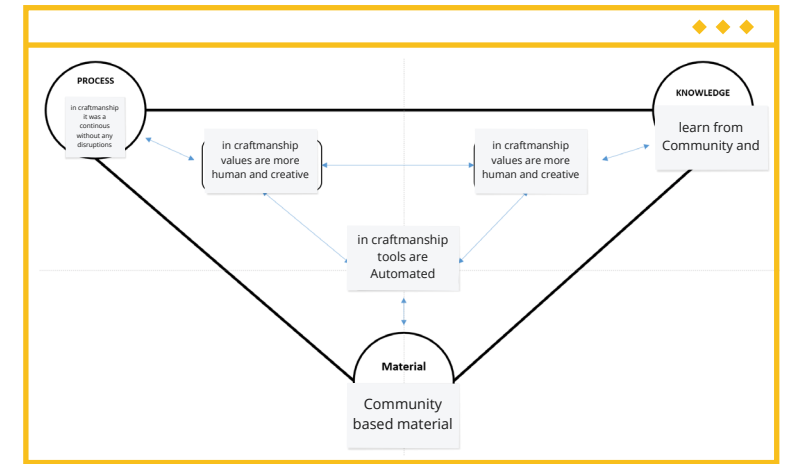


Fig[22]



However, "Craftsmanship" is discussed by this group as having a certain connotation of something that involves the human hand and as such is expected to represent humanistic values, experimentation, and artistic values. (Fig[22]).

Fig[23]



The group created a synergy graphic of their conclusion.

In Fig[23] the "Craftsmanship" is visualized as a synthesis that can involve automation, if the process is continuous and without disruptions, and as having to represent human and creative values, involve knowledge from a community and work with material – both digitally and physically – rooted in a community.

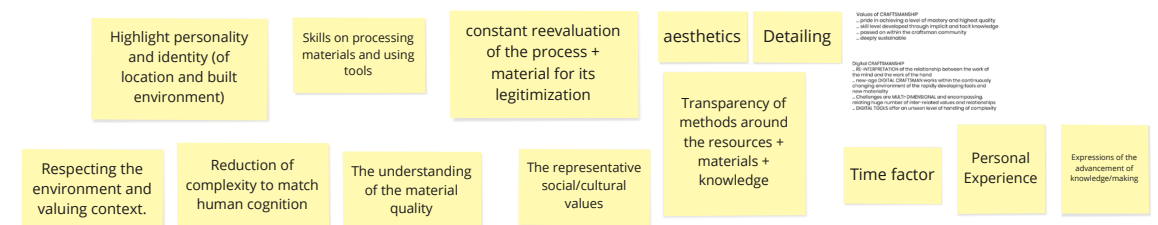
### Group 2

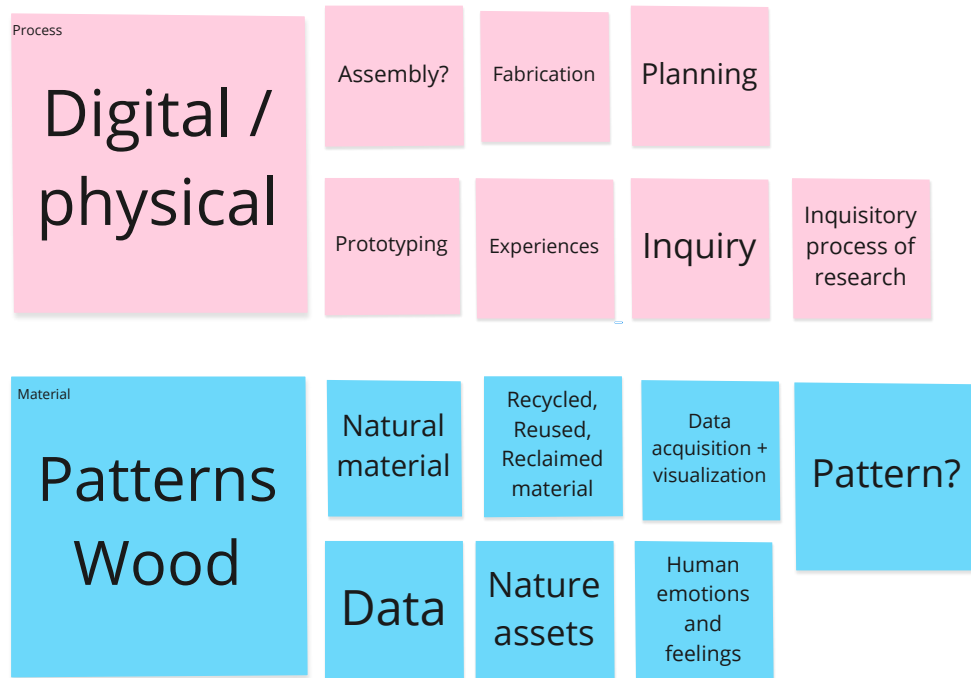
An outline of the notions of Craftsmanship is provided through a juxtaposition of **Process**: digital/physical – and **Material**: patterns/wood (Fig[24]):

Process: assembly, fabrication, planning, prototyping, experiments, inquiry, planning.

Material: natural material, recycled, reclaimed material, data, human emotions and feelings.

Fig[24]





Fig[25]

Based on this initial discussion, further traits of what can be understood as Craftsmanship today were described (Fig[25]):

Craft and Craftsmanship:

- Highlight personality and identity (of location and built environment)
- The representation of social/cultural values
- Constant re-evaluation of the process + material for its legitimization
- Reduction of complexity to match human cognition
- The understanding of the material quality
- Transparency of methods around the resources
- Time factor and personal experience

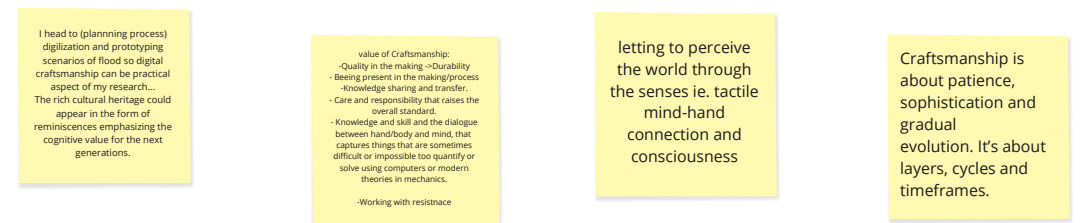
**Group 3**

The young researchers outlined the meaning of “Materials,” “Process,” and “Knowledge” in the particular context of their own research projects – and with this also implicitly skills and tools.



Fig[26]

Based on this discussion the group outlined the following traits of Craftsmanship today:



Fig[27]

Craft and Craftsmanship:

*“Digitalization and prototyping scenarios of flooding – can be practical aspects of my research. The rich cultural heritage could appear in the form of reminiscences emphasizing the cognitive value for the next generations.”*

*“Value of Craftsmanship: quality in the making – durability. Being present in the making/process. Knowledge sharing and knowledge transfer. Care and responsibility that raises the overall standard. Knowledge and skills and the dialog between hand/body and mind that captures things that are sometimes difficult or impossible to quantify or solve using computers and modern theories in mechanics – working with resistance.”*

*“Allowing the world to be perceived through the senses, i.e., tactile mind–hand connection and consciousness.”*

*“Craftsmanship is about patience, sophistication and gradual evolution. It’s about layers, cycles, and time frames.”*

### 3.3.3 Partial conclusions

The notion of Craftsmanship was explored within the framework of Process in a digital age as a backdrop. It can also be the skills to work with data and digital tools, machining prototypes. However, the Craftsmanship aspect has to do with the way it is achieved, the consciousness behind it; patient, undisrupted evolution, caring and responsibility, a connectedness (between mind and hand), a sense of belonging (to a community).

In spite of working with digital production technologies in their research, the young researchers chose to define Craftsmanship as adhering to humanistic values. These can be present also when working with 3D print, etc.

It is a general trait that the Craftsmanship aspect is understood to incorporate a specific set of values behind the way it is performed, a consciousness behind the act.

## 4.0 Conclusion on the evaluated ISP tasks

Generally, researchers stressed the benefits of implementing digital tools and technologies to improve the work quality and performance, e.g., through material use and structural efficiency or adaptability of design. Implicitly, they generally referred to the sustainability challenges. They stressed that digital tools support interdisciplinary, e.g., BIM technologies facilitating collaboration between different professions. At the same time, they were also aware of various limitations of those tools such as lack of flexibility. They pledged that “seamless” connectivity of BIM is still evolving. It could also be observed that standardized IFC-BIM and a linear process management

is being bypassed by the more open development of their “own” digital tools and the use of cloud-based tools, which can provide solutions.

The PhD researchers are preoccupied by the risk of losing humanistic values – that the digital tools will lead to just iteration without artistic energy.

While working on the categorization of the digital tools, some researchers to a much lesser extent stick to a project line, which for current designers is the default way of grouping tools. It may be due to the limited design practice they possess, but one can find such a statement oversimplifying as similar non-linearity/freedom can be observed in most innovative design companies – tools traditionally connected with the final phases of design, for example a lifecycle assessment, are beginning to be used in the pre-design phase for optimization purposes. We move from linear design process to something a lot more holistic. The tools for this shift are already there, but these processes are not mainstreamed yet. We are in a transitory phase where one can observe that each design studio has its own culture of using digital tools.

While discussing the role of digital tools, ISP participants focused on analyzing, evaluating and optimizing the design through form-finding simulations. Optimization is no longer seen as the primary engineering task. Instead, this task is defined as an interaction with the digital tool for form-finding and strictly integrated in a design process.

Efficient use of digital tools is directly linked with the quality of the data available. Digital tools can help to define and frame the city, they may influence the way we evaluate and design buildings and structures. With the massive amount of data generated by people, devices and networks, we can conduct data-driven analyses of the spatial and functional patterns of the city nearly in real time. Generating indicators, obtaining data on which designers’ decisions can be based is an integrated part of the designers’ design process – be it qualitative (e.g., post-occupancy evaluation) or quantitative data (such as the number of sun hours on façades).

At the same time, participants point out not only the benefits of the use of digital tools, but also the dangers, for example digital exclusion. It is costly to buy the tools, compared to pen and papers. The exclusion also happens from the skills needed to operate the digital tools, such as basic python programming. The educational background needed to operate these high levels of informed design is in itself excluding parts of the world that do not have access to building up these skills. The problem of data security or insufficient regulation for the use of AI-based tools also need to be taken into account. Very few digital tools address social sustainability, as the majority focus on technical or economic problems. There is also an expanding palette of ever-growing range of quickly fast-developing health and environmental sustainability assessment tools.

Diving directly into the design process, new software, no matter how advanced, can be seen as a constraint for a free creative process, limiting the possibility to freely visualize. Before, we could design using only basic tools like pencils or pens but now we need specific tools which may exclude people from using them due to a lack of their availability or their high price. During the ISP we observed major appreciation for open-source tools, which is one of the main reasons why tools like Grasshopper were so popular among the participants.

The Covid-19 pandemic has accelerated digitalization of design work which in turn has meant that more importance is given to project and teamwork management tools. These don't only serve as a platform for project management, but have also allowed an introduction to waterfall design processes based on more agile principles.

Craftsmanship is seen as humanistic, and artistic values behind the work as “material.” Material is understood as both traditional building materials like “wood,” but also data, emotions and information from a community. Craftsmanship is thus transformed into the digital realm as representing, for instance, uninterrupted experiments, a special time quality as well as artistic quality.

## 5.0 Discussion: relation of the young researchers' design processes to the processes within the Baukultur idea and eight criteria for high-quality Baukultur assessment framework

### 5.1 The scope of identified processes, their range and multidisciplinary

The presented illustrations of processes show a very wide spectrum of research undertaken by young scientists. They also show diversity in terms of scales, specialties and fields of study. It can be said that they reflect the complexity of the processes involved in shaping the built environment. Importantly, regardless of whether a given process concerns a selected issue in structural engineering, architectural design or shaping a complex urban environment, each of these processes involves many digital tools, each project is inter- or multidisciplinary, involving specialists from various industries. This reflects the reality in which science is moving away from narrow specialization in favor of a more holistic approach, which is especially important in shaping the built environment.

The Davos Declaration and the eight criteria for assessing the high-quality Baukultur also reflect a holistic approach to shaping the human environment – in deference of nature and culture, respecting resources, limiting consumption, and in the social sphere – with an emphasis on equalizing economic opportunities and inequalities – striving to access various resources. The Davos Declaration clearly shows that engineering, architecture and urban planning do not serve to meet only aesthetic needs and that the concept of quality means much more than just the quality of materials and a good neighborhood. Research issues developed by the participants are an expression of similar sensitivity and awareness across disciplines and research projects.

## 5.2 Needs and problems identified, and aims of the processes relating to reaching high-quality Baukultur

In their research, the participants strive to solve a number of important problems that result from very specific needs formulated by the participants of the project processes. Most of the identified needs result from real problems faced by engineers, designers, but also policy makers, ordinary residents and everyday users of urban spaces. The goals that young researchers want to achieve are overwhelmingly consistent with the goals of the Baukultur movement – building a high-quality built environment at all scales and affordable for all people along with a sustainable approach to the environment as well as resources and cultural heritage.

## 5.3 The character of the processes and its relation to the character of the processes within Baukultur

As for the character of the processes, in most cases they are identified as complex, often divided into phases and overlapping stages in the constant enhancement of the processes, combining linear with circular and iterative characters. A major observation is that digital design processes in the framework of the ISPs are contextual, and thus emphasize the “sense of place” as a primary quality. The solutions are contextual, but the digital processes are also contextual in the sense that they are “tailored” to a specific challenge or question. This is worth noting, because digitalization in the built environment opens up for cost reduction and efficiency by simple “copy and paste” maneuvers in all design phases from pre-design to completion. The advanced documentation demand, e.g., concerning sustainability, could in a negative sense push for “building the same building” again and again in a sort of platform-thinking known from industry. However, the

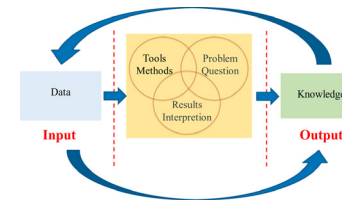


Fig 28] “Data vs. Knowledge” (source: Group 4, ISP2 Workshop, Task 1).

young researchers are united in insisting on the contextual potential of digitally informed design processes.

Using digital tools and transferring some processes to the virtual world allow you to perform a series of iterations in order to achieve the best possible results. Relating these processes to the character of processes within the Baukultur idea, it can be stated that currently most processes are looped, iterative, because striving for high quality requires many corrections and consistently reacting to new, constantly emerging problems. In shaping the built environment, in principle, none of the processes are closed, because the environment is subject to constant changes, and these in turn require an ongoing adaptation of tools and methods along with an evolving of knowledge and frequent reformulation of development and strategic goals.

Processes are no longer only linear but complex and interconnected; mostly circular and iterative. The factor of time and effort in the process has changed through digital technologies. Since new tools and technologies have been introduced to all stages of the processes from design to implementation, it allowed for optimization and increased efficiency of the output.

## 5.4 The scale and range of the processes and their relation to the scale and range of the processes within Baukultur

In terms of the scale and scope of the processes presented by the participants, they can be easily related to the variety of scales and scope of the processes within Baukultur. It is worth noting that it is not only about the scale understood as the scale of projects, e.g., architectural or urban projects, but also about the impact of the process – how many participants are involved in it, who will be affected by these processes and who will be the beneficiaries of the processes. Since the main goal of Baukultur is to create a high-quality living environment, the range of processes within



Baukultur refers primarily to the scale of local communities, neighborhoods, districts, but also entire cities or – on the other side of the scale – small groups organized around an idea (university, local community, groups of people who want to change something in their environment). Many of the processes presented by the participants correspond to these types of processes, where the goal is to create sustainable communities and become immersed in local culture and values.

Of course, due to the scientific nature of the presented processes, some of them concern the solution of very specific problems, such as in the field of structural engineering, where the result is the development of, for example, a new form or method of production of structural elements. It can be said at first glance that this is too small a range of impact to talk about embedding this type of project in the Baukultur idea, but the introduction of new, ecological construction elements may have an impact on the creation of, among others, more accessible, low-emission, cost-effective structures, of which new housing estates will be built. Thus, even the smallest scale or scope of the process can fit in with the ideas of Baukultur, as long as the goal is to care for a better quality of human life in connection with technology, nature and culture.

## 5.5 The receivers of the processes and the relation to the processes within Baukultur

Considering the issue of who is the recipient of the project processes, it can be concluded that the recipients of the processes illustrated by the participants are very diverse groups – social, professional and specialist. The size of the recipient groups is also varied. From quite narrow groups of designers, specialists in the field of engineering and design who will, for example, use new solutions or technologies, to entire communities – from local neighborhoods to residents of entire cities, which consist of socially, economically, professionally, and ethnically diverse groups.

The Baukultur movement is aimed at all members of the community. From this premise, the recipients of high-quality built environment – based on aesthetic, social, cultural and environmental values – should be as wide a group of users as possible. This assumption is in line with the idea of inclusiveness, too, which is also an element of Baukultur. In today's world it is very easy to exclude others, therefore it is necessary to emphasize the importance of those processes where the aim is to integrate, include or deliver high-quality products or services available to the widest possible audience.

It is very valuable that young scientists who want to reach out with their solutions or to a wide audience think about the recipients of processes in a similar way as the Baukultur idea promotes. And even if not broadly, these solutions are to bring improvement to certain groups of stakeholders. Often, however, one small change entails another, so many of the processes presented can also be seen as processes initiating a whole chain of subsequent processes, which, in effect, will lead to the achievement of Baukultur's goals. Such an approach also confirms the above-mentioned feature of processes that they are iterative, interrelated and intertwined.

## 5.6 Multidisciplinarity, simultaneity, overlapping, distinction of processes – relation to the eight criteria of Baukultur

Contemporary processes of shaping architectural and urban spaces are complex. This results from the nature of the projects they concern. The construction of buildings, structures, design and construction of housing estates require many stages of work, from strategy development, through design, implementation, to use and maintenance, and later renovation, modernization, and revitalization, then recycling and/or upcycling of the used materials and structures. Each of the major processes is made up of many



smaller sub-processes. This complex nature is also evident in the examples of young scientists. Each of them tried to illustrate one, their own process aimed at answering a research question, but it is clear that each of these issues is or may and should even be a part or sub-process of other processes. Sometimes the opposite is true – for complex issues such as striving to create attractive and sustainable urban environments, participants recognize that this cannot be achieved in a single process, that it is a complex task combining multiple disciplines, multiple professionals and projects.

The idea of Baukultur and the created criteria for assessing the high quality of the human living environment also reflect the complexity of the processes. Eight evaluation criteria indicate that each project or implementation should be assessed in light of many aspects. In order to achieve the desired goals according to eight criteria, it is necessary to undertake at least as many processes, and one overarching one, which will coordinate the sub-processes. Of course, this is a simplification, but it illustrates the complexity of contemporary design processes well.

Baukultur's eight quality assessment criteria clearly show the characteristics of inter- and multidisciplinary design of built environment and the complex knowledge and competent specialists it requires. The aspect of engineering, i.e., the competences of constructors, architects, and urban designers, is only a part of these processes. In order to create high-quality space, the competences of management, economy, sociology, energy, environmental protection, transport, culture, and many other disciplines are needed. Within each of them, we can additionally talk about the necessary digital competences – about the need to use various digital tools and new technologies, thanks to which processes can become faster, more effective and less prone to error. However, it is also a trait of digitalization that the many aspects can be weighed against each other and integrated in a design decision.

## 5.7 Responsibility for the process(es)

Considering the contemporary conditions of life in general, in particular the multidisciplinary and the interweaving of individual processes related to the built environment, the answer to the question about responsibility is as complex as the character of the processes themselves.

Any process or action within processes demands one person's responsibility. Transdisciplinarity is an obvious circumstance, and the parallel occurrence of individual processes and their overlapping is inevitable. Hence, responsibility is present in the implementation of individual research projects, projects that ultimately form part of a larger whole anyway.

Apart from that, the responsibility for the processes is divided into individual stages of the processes taking place, from planning through implementation and maintenance of a sustainable environment. In each of the phases of given tasks, we must ensure their reliable implementation. It is inevitable to manage these processes to make them visible and effective.

This corresponds very well with the eight Baukultur criteria. It is important to take responsibility within each one of them. For these criteria (Governance, Economy, Environment, Sense of Place, Beauty, Functionality, Context, Diversity), the first priority is management and economic issues as key to the realization and successful implementation of a sustainable environment.

Today, we live in a reality of constant changes, challenges and threats. Desirable features facilitating adaptation to such conditions are flexibility, adaptability to changing needs, readiness to take risk, but also the ability to minimize it. It becomes possible, among other things thanks to new technologies and artificial intelligence, which enable the creation of simulations, digital twins and observation under the influence of changing factors.

Young scientists are aware of this, which is why at this stage of their research they also use a variety of tools and, one could

say, consciously complicate the processes they undertake in order to put their research projects to many possible tests.

One of the most important aspects of the idea of Baukultur is the issue of the identity of the place, values flowing from and within the local context and culture. Such an approach is necessary, if we want to preserve the regional and cultural uniqueness and distinctiveness of architecture and elements of the built environment. Architecture, as a carrier of culture, should connect people with the place where they live and from where they come, it should also emphasize the uniqueness of culture, nature, landscape and urban context. This is to prevent the creation of repetitive objects taken out of context, which, thanks to the use of digital tools and technologies, are very easy to multiply and spread across the world regardless of culture.

Therefore, emphasis should be placed on the conscious use of digital tools, which need to be at the service of culture and local identity, not instead of them. As mentioned above, the digital processes are not standardized or adhering to a project line. In that sense they are “tailored” to a specific context.

It should also be remembered that we design for people and through people. Living in a very digitized world today, there is a fear that we will lose control over digital tools and processes, that architecture and the newly shaped living environment will lose the human factor. We are currently fascinated by the achievements of technology and use them extensively, but we must always relate the results of our work to the culture of history and heritage that constitutes our identity. We must ensure that all processes are aimed at and relate in effect to the users of space who are diverse and unique at the same time. Examples of such design processes are shown in the ISPs' work.

Craftsmanship as a notion is translated by the young researchers to be values behind the acts of using digital tools.

Baukultur and the evaluation criteria give hope that these values will be considered and taken care of in contemporary design processes, using all the latest methods and tools, both digitally and traditionally, to create beautiful and sustainable spaces and living environments.

## 6.0 Guidelines: a design process leading to a high-quality Baukultur in the digital age

The idea is that the design process is often overlooked as something invisible, not tangible. However, it is the series of decisions made in a design process that will eventually lead to poor- or high-quality Baukultur. We now have a situation where designers involved in design processes of Baukultur have access to new digitalized, visualized information that was not accessible just a few years ago. We have thus the potential for **creating design processes** that will lead to higher levels of sustainability and cultural appreciation. Digitalization also pose considerable risk, because design processes used to be regulated by industry standards and tradition. They are now much more free, and the guidelines are there to help designers reflect on the quality and values behind the design processes they perform.

Two main points to think about:

### Commercial mainstream processes and artistic process – what is the balance?

- *Is there a conflict between a mainstream automatized, standardized digital process as compared to the artistic/values in the process?*

### Criteria-driven or value-driven process – what is the balance?

- *Is there a conflict between a **criteria-driven** process and **value-driven** process (based on architectural tradition, etc.)? If so, how do I address this conflict in my design process?*

## 6.1 Guiding questions to (digital) design processes

### Background for the guideline question:

#### *How is the design process created?*

- Informed processes (support decision-making and potentially provide access to better choices). Leading to high-quality Baukultur. Nearly none of the ISP participants works in REVIT, BIM is rarely mentioned, young researchers work more freely and exploratively. While working on the categorization of the digital tools, researchers and designers to a much lesser extent stick to a linear, standardized project process.
  - This may be due to the limited design practice of young designers and researchers of this project. On the other hand, such non-linearity/freedom of using digital tools can be observed in most innovative design companies. Moving from a linear design process to a more holistic process is a general trend.
  - An example is that there is an expanding range of fast-developing urban comfort and environmental sustainability assessment tools as well as tools traditionally connected with the final phases of design, e.g., LCA, that are starting to be used in the early design phase.
  - We are in a transitional phase where each design studio has its own culture of using the digital tools. Designers should thus be aware that they are actually creating a design process and that the way they choose to inform design decisions matter.
- Q Which design process could I design to fit this specific context, place, and task? What are the questions I would like the process to answer?**

### Background for the guideline question:

#### *Who has access to the new levels of information behind design processes?*

- There is a risk that the overwhelming access to information will give a lot of power to parts of society that can afford a prolonged pre-design phase and can pay for the software, tools, and IT expertise. But what about those who can't?
  - Before, only basic tools like pencils or pens were used, but now we need specific tools which may exclude some people due to a lack of availability or because of their price.
- Q Is there an open-source version of the digital tool you want to include in your design process?**  
(A strong focus on open-source tools (such as Grasshopper).

### Background for the guideline question:

#### *Who can misuse information involved in this design process?*

- Benefits of the use of digital tools, but also the dangers, such as digital exclusion, the problem of data security, or insufficient regulations for using AI-based tools.
- Q Will my use of this data compromise privacy and dignity of anybody?**

### Background for the guideline question:

#### *Are humanistic values and social sustainability included?*

- The Covid-19 pandemic has accelerated the digitalization of design work which has caused more importance to be placed in project and teamwork management tools.
- They do not serve only as a platform for project management, but also allow to change the waterfall design processes to agile and more participative ones.
- Visualization in digital tools allows for inclusion.
- There is a risk that what doesn't have a number – i.e., what is not “captured” by the digital process – is not emphasized in the design. This could be the craft of the

human hand, humanistic values, not easily captured aspects of biodiversity, human well-being, social inclusion, beauty, sense of place, artistic expressions and ideas.

- Q **How can I plan online meetings to avoid long-distance flights and use online collaboration platforms to better involve stakeholders?**
- Q **How can I ensure accessibility to design collaborative platforms for all stakeholders? What about also addressing citizens?**
- Q **Are the visualizations adequately designed to communicate to stakeholders and create transparency and inclusion?**
- Q **Have I included information about social sustainability in the design process?**

**Background for the guideline questions:**

*What about living nature? Qualitative and non-measurable criteria?*

- Very few digital tools address biodiversity and sense of place as majority focus on technical or economic problems.
  - As mentioned, there is a risk that what doesn't have a number – meaning, what is not “captured” by the digital process – is not emphasized in the design. This is important concerning living nature, which as such doesn't have a voice – and as an extension of living nature, also the sense of a specific place on this planet.
- Q **Have I included in the design process information concerning:**
    - **sense of place (genius loci)**
    - **biodiversity**
    - **beauty?**
  - Q **Have I included considerations of environmental impact?**

**Background for the guideline question:**

*Are art and work of the human hand included?*

- If there is little scope for original ideas involved in the design process and/or the design processes do not show enough artistic or creative elements, this will have a negative impact.
  - Immersing directly into the design process, new software, no matter how advanced, can both inform and constrain a creative process.
  - Optimization is no longer seen as the primary engineering task.
  - The digital tool is for form-finding and is strictly integrated in a design process.
- Q **Have I reflected on whether the digital tools in this project have improved or indeed at times restricted artistic freedom and working with values?**
  - Q **Have I checked whether the automated iterations are running wild? Who or what controls the “design” of the design process?**
  - Q **Have I left space for “the mark by the work of the hand”?**
  - Q **Have I included more lifecycles and considerations about end of life and reuse?**

**Background for the guideline question:**

*Is there transparency in weighing qualitative and quantitative information?*

- Having a well-informed digital design process could be a quantum leap toward creating truly regenerative architecture that not only avoids negative impact but regenerates lost balances in nature and cities. With the information now available and visualized by designers, it is possible to holistically include “everything” – many parameters, criteria, and indicators – to make the right

design decisions for all phases of the built environment:  
its use, end of life, reuse ...

- Q Q: Do I have a multi-criteria framework where I have an overview and can weigh qualitative and quantitative information and criteria?**
- Q Q: Have I established transparency in how to weigh different criteria and indicators? Have I included both qualitative and quantitative information in my design process?**

**Background for the guideline question:**

*Is your process on the DAVOS Baukultur track?*

- If one of the keys to high-quality Baukultur is the design process, what characteristics of the PROCESS / kind of PROCESSES do we need now and in future? How do we assess the processes that lead to high-quality Baukultur?
- Q How does the process relate to the eight criteria: Governance, Functionality, Environment, Economy, Diversity, Context, Sense of Place, Beauty? What question(s) am I trying to answer with this simulation at this point in the process?**

## 6.2 Strategic recommendations:

- Criteria needs to be flexible at the beginning of the design process.
- The process should be based on values (art, culture, sense of place, nature, humanity ...) not data-/criteria-driven.
- Use more time and resources on design process – make sure it is artistic, driven by humanistic values (digitalization can harm the quality of the design processes behind the built environment because it is tempting to “copy and paste” financial reasons, instead of creating a sense-of-place-driven original design process for it).