BuildDigiCraft

New Mindset for High-quality Baukultur in Europe:

Bridging Craft and Digital

Annette Bögle, Emiliya Popova (eds.)

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2.2 Glossary
Intellectual Output 1

Glossary as a method for reflection on complex research questions

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Contents

1.0 Introduction

Globalization and digitization are strongly influencing the process of shaping the built environment. The latter is causing the new design tools to emerge faster than ever before in history, while the former is speeding up not only the development, but also the broad roll-out of more agile and interdisciplinary methodologies and work approaches. The design process is also becoming more and more inter- and trans-disciplinary. This is leading to the formation of design teams, in which team members bring together not only very different backgrounds and experiences but also different sets of vocabulary, which is one of the causes impeding flawless cooperation and a lack of common understanding within the team.

These trends call for a shared platform of understanding and clarification of professional terms and concepts in order to make the design process not only efficient, but also fully relatable and well-founded. In today's highly specialized world, professionals and specialists immerse themselves deeply into their fields, using a highly specialized, often hermetic vocabulary that is becoming less accessible and comprehensible to the wider public. Fragmentation in specializations, technological progress and greater and greater confinement to thematic professional bubbles are conducive to increasing isolation and exclusion of various groups from the possibility of mutual understanding about certain topics. The number of specialized terms is constantly growing, and professional language is becoming more and more complicated.

On the other hand, despite the increasing complexity of terms and the ever greater fragmentation of disciplines and professional paths, the importance of interdisciplinary and transdisciplinarity is continuously growing.

Shaping the built environment by implementing the goals and principles of Baukultur and striving to build high-quality spaces in the process is also based on the interdisciplinary approach which in turn requires reflected cooperation between the many different disciplines and fields involved in the process.

One of the main goals of the **BuildDigiCraft** project is to discuss, create and introduce new tools that enable an innovative way of thinking toward building a bridge between the digital world, the craftsmanship and material-based approach to work. As participants of the project, we believe that despite the constant progress in applying digital tools to design and manufacture products, the techniques, values and skills of manual work and traditional craftsmanship are becoming even more important for the process of shaping a high-quality built environment in the digital age. Creating a material environment with objects and buildings filling the space requires a certain understanding of and sensitivity toward properties of material such as texture, color and performance related to outdoor and indoor factors, resulting from the characteristics of the material from which the objects are made. Therefore, the questions we pose in the project relate, among other things, to whether virtual reality and artificial intelligence are able to fully reproduce the properties and performance of real objects in physical space.

Just as effort is required to build a bridge between the physical and digital world, it is also difficult to build a common platform for understanding – a shared language – that enables mutual appreciation between participants of interdisciplinary design and fabrication processes.

Therefore, the aim of this intellectual output is to create a foundation for a shared understanding of the main concepts explored within the **BuildDigiCraft** project. We worked on the premise that this could be achieved by developing a multidimensional glossary database, a core source of shared knowledge, which would be used as a base component in the development of each of the other intellectual outputs of the project.

The **BuildDigiCraft** project explores what concepts and notions researchers and participants use who are involved in design processes aimed at a high-quality built environment. The question we face is whether engineers, architects, planners, builders, designers, craftsmen, artists,

environmental engineers and other experts, regardless of whether they deal with digitally-driven or traditionally-based methods and tools, are actually able to understand each other today using a mutually comprehensible linguistic corpus.

2.0 Description of the Glossary Matrix method

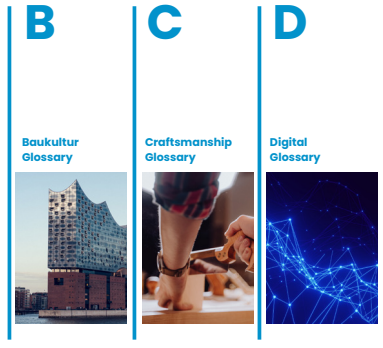
2.1 The concept of the Glossary

[1] Glossary definition, https://en.wikipedia.org/wiki/Glossary [accessed: 12.05.2022]

As defined by Wikipedia [1], a glossary usually provides an alphabetical list of terms in a particular domain of knowledge. During the course of the **BuildDigiCraft** project, we attempted to identify, collect, and create a set of terms that were to be included in the "Glossary." One of the roles of "our" Glossary was to enable joint work on the text of the Manifesto as an expression of the commitment to a high-quality built environment. Another aim was to observe whether the concepts and phrases used by participants in their research projects and during the workshops could be understood by everyone and used in similar contexts. We also considered to what extent the specialized vocabulary, in the case of the **BuildDigiCraft** project relating to the architectural, urban, artistic, technical and engineering aspects of the built environment, might be incomprehensible to a wider group of non-specialists and whether it can be used in public debate on shaping the quality of the built environment, i.e., striving for high-quality Baukultur. The project thereby provides the chance of specifying the essential words and notions associated with the digital aspects of designing the built environment. It sets them in relation to those introduced in the **BuildDigiCraft** project triangulation of Process [Chapter 2.3 | IO2], Knowledge [Chapter 2.4 | IO3], and Material [Chapter 2.5 | IO4].

Methodologically, the Glossary has been developed in an analog way, based on face-to-face discussions at project meetings and during the four intensive study programs (ISPs). The discussions included both group and individual reflections on pre-selected notions and concepts as well as the identification of new ones. Within this phase a specially developed "Glossary Matrix" is used as a framework tool for knowledge organization and documentation.

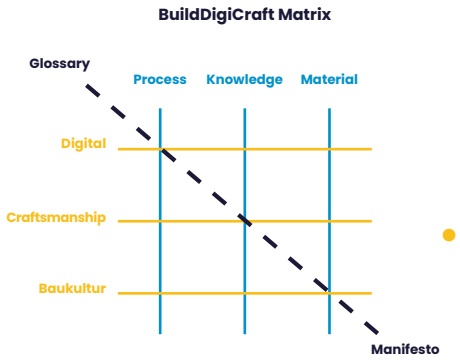
The **main aim and motive** of the Glossary is to help describe, explain and thereby provide a shared, contextual definition of all the concepts and notions that the project participants came across during the joint investigation of the main project question: **how do we shape the future built environment in a world of growing digitalization and professional specialization?** There is a strong need for a tool that enables inter- and trans-disciplinary design teams to build a common platform to share ideas. This platform allows different team members to set their concepts and notions in a common **BuildDigiCraft** framework. First, the Glossary method can help team members identify the most essential and vital ideas in their design and research work. Secondly, they can start exploring these ideas through the framework of the **BuildDigiCraft** and the Glossary Matrix. Thirdly, this may lead to a shared understanding of the individual ideas and respectively to the consideration of the specific context in which they are embedded.



Fig[●1] **BuildDigiCraft** Introductory Presentation "Glossary" (ISP1, ISP2). Photos by: Jonas Tebbe (left), Bailey Alexander (middle), and Conny Schneider (right) on Unsplashed.

The main focus of the Glossary was on the intersection between **Baukultur, Craftsmanship and Digitalization.** The concept and structure of the Glossary were created at the beginning of the project and were applied and tested during the first two ISPs. In the next project stages, it continued to be used already as an established concept and tool allowing for regular updates. It proved to be useful in establishing a common ground (vocabulary) for members of all professions and disciplines involved in the project training program: structural and architectural engineering, architectural and urban design as well as urban planning. So finally, in an attempt to define the Glossary, we can say that it is a resource tool that allows you to organize, group and collate word concepts in the context of the **BuildDigiCraft** project. It should also be added that one of its most important roles is to build the conceptual base needed to develop the last of the intellectual outputs, which is the Manifesto.

2.2 The context of the Glossary



Fig[● 2] **BuildDigiCraft** matrix.

The Glossary builds on the concept of the **BuildDigiCraft** project matrix and specifically on one of its two main axes, containing the three components of Process [Chapter 2.3 | IO2], Knowledge [Chapter 2.4 | IO3] and Material [Chapter 2.5 | IO4]. It was within the exploration of the Process–Knowledge–Material interrelation that the foundation for the further development of the Glossary was built.

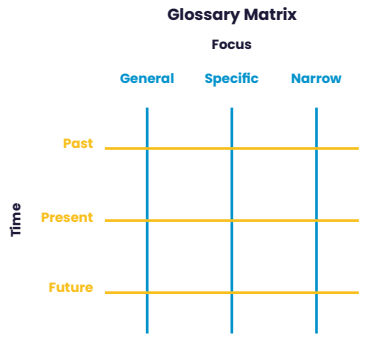
The **BuildDigiCraft** matrix is built on the following fundamentals and concepts (Fig[● 2]):

- on the vertical axis we find: (1) **Digital(ization)**, which influences the current and future process of shaping the built environment, (2) **Craftsmanship**, which addresses the gap between the actual situation of Digitalization and its potential, and finally, (3) **Baukultur**, which lays the values and principles we follow in the process of shaping the built environment and at the same time joins the above concepts. We believe that there is a strong connection between these three components as they all refer directly to the quality of space created by the design team as well as to the acceptance of the proposed design by civic society, including all the actors involved both directly and indirectly in the process.

- the horizontal axis consists of the following components: (1) **Process**, which includes the whole cycle of design, planning, construction, maintenance, and end of use, (2) **Knowledge** defined as tacit and implicit knowledge that influences these processes and (3) **Material**, which relates to the physical representation of design in the built environment and also responds to the need of understanding materiality in the digital context.

The outcomes of the Glossary are expected to enrich the three main components of the project: “Process,” “Knowledge,” and “Material” by providing common ground for further discussion. At the same time, the Glossary, as a reflection of the concepts and notions used within the digital context of the built environment that interweave with the principles of craftsmanship, provides the foundation for the **BuildDigiCraft Manifesto** [3.0 Manifesto (IO5)].

2.3 Glossary Matrix



Fig[● 3] Glossary Matrix.

The idea of the Glossary was further operationalized to create the Glossary Matrix (Fig[● 3]), which serves as a framework tool for establishing the dimensions within which the posed concepts and notions can be explored. The Glossary Matrix helps to identify and structure the content of the Glossary.

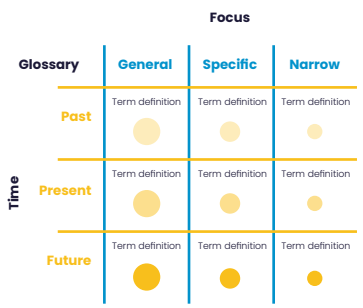
The two axes of the Glossary Matrix are: **focus** and **time**.

The **“x” axis** of the matrix – **Focus** – enables the identification and use of notions and ideas according to the scale of their focus, which is connected with the availability and use of different terms derived from a broad spectrum: **general**, which is available to a wide range of non-specialists, through to a more **specific** one, which is used by specialists in the context of their profession, up to a **narrow** one – used strictly in relation to the problems of specific research projects such as PhD or Master’s theses of the ISPs’ participants.

Time factor, pictured on the **“y” axis**, is used to describe the meaning and appearance of notions and ideas throughout time. This section is divided into: the **Past**, meaning both the distant and more recent past , the **Present**, which includes both the present time and the very near future, and finally, the **Future**, both near and distant, including the future that is very difficult to predict.

2.4 Step-by-step Glossary

In order to use the Glossary Matrix, a specific work formula has been created. The formula is thought to be open and is easily used for various topics of research. Depending on the topic, the form of description of individual entries differ. The first step of the formula is the definition of **keywords** in the context of time and focus. The graph on the next page illustrates the matrix table with its main definition axes **focus** and **time** (Fig[● 4]).

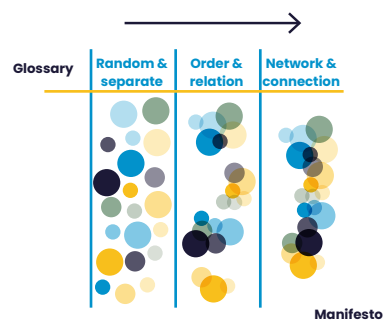


Fig[● 4] Glossary Martrix: keyword definition.

The following steps make up the work formula for the matrix:

- The preliminary step to start working with the matrix is to define the most relevant and representative group of keywords related to the selected topic of study.
- The next step is to assign these keywords to the appropriate matrix cells. They should be described following the axes of time and focus. The form of description depends on the preferences of the user of the matrix. The matrix itself allows for different forms of representation: written description, only one word, one sentence, very detailed observation and description, pictures, photo, graphics, etc. Users of the matrix should match the keyword set to the table according to their individual level of knowledge, perception and research approach.
- Filling in all of the cells of the matrix is not necessary. Some of the fields may be left blank. This will be the case if the term did not exist in the past or the user of the matrix does not see the need to describe the keyword in the specific context of focus or time line.
- The users of the matrix decide for themselves when to finish working on the table. This offers the possibility of continuous fine-tuning depending on the knowledge acquired and the development of the research field. The description and understanding of the selected term are constructed in such a way that the matrix table gives a full picture and definition of this term in the context of the specific research field. By studying individual terms and keywords, the user can conduct an in-depth analysis of a research topic, which in turn can lead to new research links.
- In the final stage, the matrix leads to a better understanding of the evolution of terms and their changeability over time in regard to the differentiated focus and to the identification of the Glossary content. The content of the Glossary builds on the basis of the completed matrices. This will not only allow researchers and practitioners from different disciplines to define research inquiry better and thus build a common platform and framework for trans-disciplinary research, but could also identify and help prepare new directions for future research.

2.5 Glossary collider



Fig[● 5] Glossary collider.

The next stage of using the Glossary Matrix tool is the application of the **glossary collider**. This stage of the vocabulary analysis corresponds to the search for connections and collisions of individual definitions from and within various domains, which again provides a broader context for understanding individual meanings.

- After adding the terms to the matrix, the set of **individual definitions** is obtained (see the description of the matrix formula above). The keywords are separately and independently defined at this stage. In order to identify connections and relations, the contents of the matrices (keyword definitions) need to be structured accordingly.
- In this case, an **arrangement of contents** (grouping, sorting, positioning, classification according to the desirable categories) is required. What is important is that the individual terms need to be arranged by identifying the mutual relations and interactions between them.
- The final and complex Glossary combining different research disciplines and approaches can be built upon the understanding of interactions between terms, their arrangement and meanings in different contexts.
- In this way, a network of connections is built between a network of terms. Identified groups of terms (individual, separate words belonging to a group – a discipline or a process, e.g., a group of words related to architecture) are able to create/form a network of terms (a network of organized words – broader, complex terms, formed from the grouped words, which are equally understandable to everyone representing a given discipline or profession), so as to build a platform for shared understanding.

The individual phases of searching for relationships and connections between particular words and their definitions are shown in the Fig[● 5].

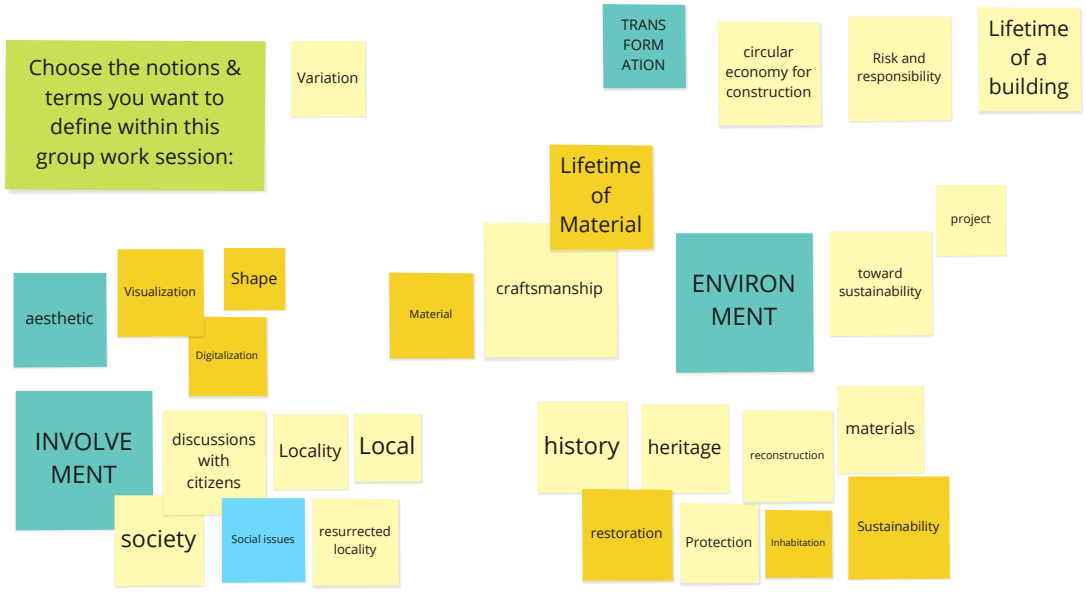
2.5.1 Glossary Matrix examples from the ISP1

The pictures presented further below show possible and different approaches to the Glossary Matrix tool by the participants of the first Intensive Study Program (ISP1). The participants were asked to bring their individual keywords relating to their own scientific research. During the group work the participants listed and then selected terms that they considered important – which related on the one hand to their own research work, on the other hand to the **BuildDigiCraft** contexts discussed at the ISP1, such as Baukultur, Craft & Craftsmanship, and the digital (built) environment. The following days of the training were devoted to these specific aspects. The below illustrations show the interpretation and outcome analysis of the research topics created during the ISP1 using the Glossary Matrix tool.

Baukultur context

The first of the presented pictures shows the group of words selected from the range of scientific topics of various PhD researches in the context of Baukultur. The members of the working group 1 first identified and created several groups of words using stickers on an interactive white board, thereby outlining the fields of possible interpretations.

Fig[● 6] ISP 1, Day 2, Group 1.



Next, the agreed and selected terms were matched with the appropriate matrices. The below examples show two of the matrices that the group looked into. Particular words like *"heritage"* and *"material"* (as seen in the graphs) and others were placed in the matrices, a new possible interpretation of the words being generated in the process.

Fig[● 7] ISP 1, Day 2, Group 1.

Heritage	General	Specific	Related to (PhD) thesis
Past	Piece of architecture	Church of St. Nicolaus in Gdańsk Function: church	**Testing the material**
Present	Heritage	**Church of St. Nicolaus in Gdańsk Function: church**	
Future	**Heritage**	**Church of St. Nicolaus in Gdańsk Function: church/museum/ object of adaptation**	

Fig[● 8] ISP 1, Day 2, Group 1.

Material	General	Specific	Related to (PhD) thesis
Past	Material of natural origin	Trees	Study of the properties of materials
Present	Buildings	Wooden constructions	Composite materials
Future	**Reuse**	Recycling of waste wood	Artistic strategies for the reuse of material components

The second group chose the word *"Materiality"* as relevant to the term Baukultur. It can be observed that the *"Material"* and *"Materiality"* terms, in the context of shaping the built environment, are in both cases related to recycling, reusing resources, reducing consumption, and a sustainable approach to design and build processes.

Fig[● 9] ISP 1, Day 2, Group 3.

MATERIALITY	General	Specific	Related to (PhD) thesis
Past	Stability	Understanding material strength Design over the wall, materiality is defined during the structural design process	Material properties in the last stages of design
Present	Durability	Understanding material quality Collaborative design, materiality is defined during the design process	Product behavior Material properties input
Future	Sustainability	Replicability of existing materials with sustainable ones Collaborative design, materiality is one of the main inputs for the design process	Recycle/reuse of the materials Material-driven design

The other group, as is seen in the illustration below, placed the term *"Baukultur"* itself in the matrix to try to define it and discuss its meaning in relation to focus and time. The graph illustrates how the matrix construction allows for organizing one's thinking and defining the term under the inclusion of various aspects.

Fig[● 10] ISP 1, Day 2, Group 2.

Baukultur	General	Specific	Related to (PhD) thesis
Past	Relation of culture and built environment	Sustains social cohesion, well-being and resilience	Existing construction – cultural heritage assets and contemporary creation were separate
Present	Construction is both a cultural act and creates space for culture	Embraces every human activity that changes the built environment	Existing construction and contemporary creation must be considered as a single entity
Future	Need to implement a new, adaptive approach to shaping our built environment	**Baukultur calls for contemporary creation and the existing buildings**	**Baukultur does not only refer to the built environment, it also relates to the process of creation**

Craft & craftsmanship context

The four matrices presented below show the individual approaches toward the term *"craftsmanship."* It is a good illustration of how the matrix supported by pictures can relate to the elaborated term and how different the interpretation of the word can be in the context of history, the future role, the meaning and form of craftsmanship. This opens the field for discussion as to how the traditional understanding of the word could vary in the present and future, or whether craftsmanship will in future be replaced with a different meaning, or whether and in what form it will even exist.

Fig[● 11] ISP 1, Day 3, Group 1.

Craftsmanship Egils	General	Specific	Related to (PhD) thesis
Past	Everything is handmade	Scale models, architectural details, construction work	Manually doing things, data gathering, a lot of labor needed
Present	High-quality work involves manual labor in combination with technologies	Scale models, architectural details, prefab, digital data, CNC, laser cutters	Looking into solution on how to work smarter and more efficiently while not losing quality
Future	Technologies take over manual labor, fully automatized solutions with some human supervision	Robotized solutions, higher educated people needed with know-how	Working smart, data-based solution not professional guessing

Fig[● 12] ISP 1, Day 3, Group 1.

Asad Craftsmanship	General	Specific	Related to (PhD) thesis
Past	It was a collective act within society	Craftsmen working habitually, internalized skill, open source	**Evolution of skills and construction**
Present	There is an artisan's perspective of the issue	Closed system, lack of narrative	Possibility of integration of skills and construction as one entity
Future	**Bringing back the quality to objectification**	**Work is the extension of identity in society**	Skilled confidence + skilled cooperation + quality

Fig[●13] ISP 1, Day 3, Group 1.

Craftsmanship **Matijs**	**General**	**Specific**	
Past	Necessity	Part of trade. One of main providers of income	Technique
Present	Relic?	**Conservation** of existing buildings mostly?	**3D scanning**
Future	Luxury	**Informational bandwidth extension** – digitalization drawing, hand–eye coordination	**Virtual planning?**

Fig[●14] ISP 1, Day 3, Group 1.

Craftsmanship ***Rzemiosło*** **(Polish)**	**General**	**Specific**	**Related to (PhD) thesis**
Past	Small-scale manufacturing including making and repairing utility items by hand or with simple tools	Carpentry works (show of skills and abilities)	Object with its **orginal function** (in this particular church)
Present	With reference to the fields of art: mastery of technique, creative workshop (in retreat)	Object of preservation (a great carrier of skills and abilities from past)	**Object** of interest as a great **specimen** of knowledge
Future	Automatization, Digitalization of crafts (algorithms, computer-aided crafts: 3D prints)	Hopefully still existing object (still as a great carrier of skills and abilities from past)	**Digital reconstruction** of piece of architecture (with possibility to share the knowledge and show former ways of constructing buildings)

Other groups selected the terms related to craft and craftsmanship and these were, for example, *"making + tool,"* but also *"Material"* – the word already discussed in the Baukultur context. It shows how the same term can be defined and discussed differently, depending on the context in which it is used.

The presented matrices show the possible transformation of understanding *"Material"* and *"Materiality,"* and also what *"making + tool"* could mean. Both analyses present the evolution of the terms' meaning, showing the transition from the physical and material world to the digital and programmable one. The need to care for nature and implement a circular economy when focusing on materiality is also stated very clearly.

Fig[●15] ISP 1, Day 3, Group 4.

MAKING + TOOLS	**General**	**Specific**	**Related to (PhD) thesis**
Past	Handmade Customized High level of detail	Slow but high-quality process Unique detailing High level of tacit knowledge	Mastery of the process of making
Present	Industrialized and human-driven Standardized Low level of detail	Fast and mass production. Low level of freedom	Embracing the digitalization in the building sector
Future	Automated and machine-assisted Customized High level of detail	Fast and mass-customized process and tools. High level of freedom and environmentally friendly	Use of AI, big data and digital fabrication as mainstream

Fig[●16] ISP 1, Day 3, Group 4.

MATERIAL	**General**	**Specific**	**Related to (PhD) thesis**
Past	Good quality and "natural"	Materials were taken from nature. The human interaction was made by hand-driven tools.	Accept the material as found in nature
Present	Redesigned materials and "industrialized"	Industrialized and standardized products. More precision and control. Standardized production process by machinery	Creation of new materials but not accepted in the mainstream industry. Analyze where to use materials in a more efficient way
Future	Redefined materials as performance	Flexible and circular	Development and creation of new smart, programmable materials. Use of data to enhance performance
Future	Design with waste		

Digital (built) environment context

As with the previous topics, the two different approaches to terms related to digitization are very clear. One of the groups initially inserted the word *"Digital"* into the matrix, trying to define it in the context of their research interests, while other groups defined relevant concepts in the context of digital design and built environment.

The below illustrations show the sample matrices elaboration around the words connected with digital: *"Digital"* itself, *"Control in digitalization"* and *"Digital fabrication."*

The analysis of the term *"Control in digitalization,"* according to the presented matrix, shows the growing role of digitalization, which has a powerful influence on people at present. Yet the future will see a strong connection between the digital and physical world, leading to the development of customization, and better relations between humans, the digital world and nature.

Fig[●17] ISP 1, Day 4, Group 4.

Digital	General	Specific	Related to (PhD) thesis
Past	Database	CAD	Information, data
Present	Data operation, visualization, parametric design	BIM, 3D, big data, analyzing tools (Grasshopper, Dynamo)	Pre-knowledge, software development
Future	Interoperability Co-production Merging of physical and digital	AR & VR, scanners, 3D printing, sensors. Machine learning and neural networks-assisted design	Neurolink, AI, brain-computer interfaces

Similarly, observing the *"Digital fabrication"* term with the matrix lens, where the mix of technologies and the human factor is significant, leads us to the conclusion that prefabrication, hybrid and smart design can act in symbiosis with nature.

Fig[●18] ISP 1, Day 4, Group 2.

Control in digitalization	General	Specific	Related to (PhD) thesis
Past	Digitalization is supplementary	2D and 3D modeling; printing out drawing; physical models	**Learning from physical models, developing modeling tools and merging into virtual world**
Present	Dependence on digitalization. Also confidence in digitalization as a problem solver	Only 3D modeling. Requirements for simulation of indoor climate and energy use which often differs from the physical world	Focus more on sustainability
Future	Digitalization provides customization. People are again in control	3D models and VR. Strong connection between the digital world and the physical world. Digital prototyping	Better understanding for the possibilities but also limitations of digitalization, enhancing the control of human-based to understand nature better

Fig[●19] ISP 1, Day 4, Group 2.

Digital fabrication	General	Specific	Related to (PhD) thesis
Past	Massive, industrialized production Simple, repetitive	Small prefabricated unit in construction	Learning experience from how carpenters use and process natural materials
Present	Beginning to use 3D printing and CNC cutting	**Whole construction in small-scale project or prefabrication of main components and assembly on site**	**Combining the knowledge and fabrication process**
Future	**Combination of digital fabrication and other technologies. The mark of human hands**	**Highly prefabricated, hybrid and smart design/construction**	"Collaborate" with nature

In addition to the concepts directly related to *"Digital"* that included this term, some groups defined other concepts that they believed related to digital processes of designing or shaping the environment. In this way, a variety of concepts have been embedded in both the closer and looser contexts of the entire **BuildDigiCraft** project.

Examples of such terms related to digital are *"design process"* or *"quality and evaluation,"* which were analyzed through the matrices. The presented examples show that the reflection on these issues in the framework of the matrices leads to rather optimistic conclusions. Digitization and new technologies will be able to support various processes of shaping the built environment to an ever greater extent, contributing more and more to overcoming the negative phenomena that our world already faces, and which will increase in the future. So digital tools are seen rather as an ally in the fight for a better tomorrow of Baukultur.

The last matrix dealing with the topic of digitization is interesting in that it touches on the integration of the physical and digital world, which should be considered as the direction in which technologies related to architecture, structures, construction, and environmental shaping at all scales are heading. Artificial intelligence and virtual reality are treated as fully controlled tools in the hands of designers, which brings to mind the previously presented matrix on control in digitization. It can be said that the conclusions drawn from the analysis of both matrices are similar.

Fig[● 20] ISP 1, Day 4, Group 3.

Design process	General	Specific	Related to (PhD) thesis
Past	Standardization (Mass production)	Design process deals with standard products and measures. Mass production affects the design and the building process. Process "over-the-wall," whereby the architect finishes the design, sends it to an engineer, then sends it to builders and so on. The design as a product	**Use of industrial process to mass-produce better solutions**
Present	Automation (Customization)	Design process deals with a level of customization. The possibility of digital fabrication allows specific solutions. Collaborative design process between architects and engineers. The design as a system	**Use of digital fabrication and generative systems to build up systems that provide solutions for a class of problems**
Future	AI(zation) (Mass customization)	High freedom of design, with mass-customized solutions. It is uncertain how AI will take part in the CREATIVE design process. The design as a system of systems	**Use of AI and big data to find better solutions for very specific problems. Design of products and unique solutions**

Fig[● 21] ISP 1, Day 4, Group 3.

Quality and evaluation	General	Specific	Related to (PhD) thesis
Past	Client satisfaction	Manually/visually checked	The construction industry slow to adopt changes, backwards, client dissatisfied with the result, behind schedule, budget. Change does not happen – change movement
Present	Client satisfaction, economic value, aligned toward sustainability, energy efficiency, etc.	According to regulations, computer-aided check	Diffusion of innovations: "hard" and "soft" parts, acceptance
Future	Global challenges: population growth, shortage of resources	Entrusted to AI	Radical change through digitalization. The overlooked negative consequences, learning from failure and the supportive structures (e.g., education)

Fig[● 22] ISP 1, Day 4, Group 4.

Integration of digital and physical	General	Specific	Related to (PhD) thesis
Past	Co-existence of physical and digital with architect and builder as a bridge	Two-dimensional attribution, CAD drawings, scale models. Mediation through print or hand drawings	**Digitalization of drawing, Information input bandwidth extension. Increasing dimensionality**
Present	Combining digital and physical approach through interactive mediums	**Real time integration of Extended realities, BIM and parametric modeling**	**Enabling assisted creation. Augmented reality in construction. Spatial design in VR**
Future	Robotics and automatized creation. Selection as a process of design	Merging of digital and physical through 5G-enabled distanced real-time creation	**Artificial intelligence-assisted buildings, bio-architecture. Brain–computer interfaces**

The sense and logic of these types of tasks was to span the analysis of specific terms between past and future to understand the possible forms of continuation of positive humanistic aspects of craftsmanship and digitalization. As Baukultur postulates development through quality, presented matrices and their outcomes open the broad spectrum of links between past and future, between human-made environment and nature, technology and art, etc.

The tool of the matrix has shown that it can be used in a variety of ways and in a variety of contexts. Using the tool can help in building discussions, defining concepts, finding contexts and relationships. It's up to the users how deeply they delve into defining the terms – it may depend on their specific needs. Working with the matrix showed how important it was for building mutual understanding and relationships in the working group. Each of the group members was, on the one hand, embedded in the context of their own research work, but on the other hand, the group had to build a platform for mutual understanding by defining term concepts relevant to everyone. The matrices were able to help with this.

3.0 The Glossary Matrix
as a reflection of the individual scientific work embedded in the concepts of the BuildDigiCraft project

3.1 The relation of the Glossary to the Manifesto

Many important documents relating to the shaping of space and related aspects that arose in the past and are still being created took the form of open manifestos, presenting the most important assumptions and guidelines. Such a task was set for the **BuildDigiCraft** project – to create a Manifesto proclaiming how to still draw in the modern and future digitalized world from the value of manual work and craftsmanship, how to build a bridge between the world of artificial intelligence and computer capabilities and the values of the physical, material world that still remains and surrounds us. It's the physical creations that create our surroundings – the built environment. The quality of our life depends on the character of the physical products of engineering, architecture, art, and town planning.

The Manifesto should be understandable to everyone and written in clear language with an unambiguous message. It should not be addressed only to a narrow group of specialists, but to all users and recipients of design processes who are simply users of the space and the built environment.

The Glossary was created as a tool that can help define the most important concepts and reflect on whether these concepts are understood similarly in different professional environments and society in general. Processing words in the Glossary allows for reflection on to what extent the functioning words are hermetic concepts, understandable only to a narrow group of specialists and to what extent they are widely understood. Another question that the Glossary can help to answer is whether a given concept means more or less the same at all and whether it is understood in a similar way by both specialists and society at large. It may turn out that the same concepts are understood in completely different ways and mean something entirely different for different groups. This in turn can lead to a lack of mutual understanding or to a false reading of the Manifesto.

Therefore, one of the aims of the Glossary was to create a database of keywords proposed by ISP participants, which, on the one hand, were closely related to the research or projects they were working on, on the other hand, were relevant to the pursuit of high-quality Baukultur and finally, were to be linked to the world of digital tools used in design or to craftsmanship, materials, and other physical aspects of design.

On the basis of the group of keywords and their processing in matrices, it is possible to check the different meanings and contexts of various concepts directly related to the processes of designing and shaping the built environment.

3.2 Glossary as a reflection of the individual scientific work

In addition to creating a database of concepts used to write the Manifesto, the matrices can also be used individually to reflect on the conducted research in the context of the key vocabulary used. The processing of keywords in matrices can become a reflection of scientific work through the prism of the terms used. Matrices can be helpful in defining the most important key concepts with which one can describe one's own research work, but also disseminate and distribute it to a wider audience, clear in the knowledge that the concepts used will be understood in the right way.

Therefore, as part of the ISP, participants had to look at their own work and research projects through the prism of the Glossary Matrix to find a conceptual and verbal reflection of their work.

This method of working with the matrix as a reflection of the individual scientific work was used during **ISP2 "Digital Futures"**: word processing by matrices can reflect the individual scientific work through the lenses of the **BuildDigiCraft** project's values and pillars, thus contributing to building the platform of common understanding within different groups of specialists aiming at building a Baukultur of high quality.

3.3 The use of matrix during the ISP2 – description of the method

The leading topic of **ISP2 "Digital Futures"** was set, of course, in the context of the **BuildDigiCraft** project, and therefore primarily in the context of Baukultur. The aim of the second ISP was to reflect on the direction digital tools involved in design and construction processes were taking in shaping a high-quality built environment. What is their role now and what will it be in future, to what extent will further digitization of design processes take place? How do individual ISP2 participants position themselves with their research projects in this context? The most important concept from which the work on matrices and the discussion began was the term *"Digital,"* for which various contexts, extensions, and associations were then built in relation to individual research projects and in relation to the idea of Baukultur as a whole.

The method of working with the matrix used during the second training shows how widely and in which multi-faceted ways it can serve. The way the matrix is built allows for its multi-layered and multi-directional use – wherever it is necessary to reflect on definitions, meanings, concepts and how they are embedded in various contexts and dimensions.

The **"x" axis** of the matrix organizes the concepts in relation to how widely they are used and how they are understood – in general terms, i.e., how they are understood by the general public without division into individual professions, then how the concept is understood in a narrower context, e.g., within the professional group for which it is a concept used on a daily basis in project or research work. The last and narrowest approach is to define the word excluded in the context of individually conducted project or scientific work.

In turn, the **"y" axis** of the matrix shows the views of a given concept in the context of time. It is looking at a concept through the prism of the past, present and future. This approach allows us to observe whether a given concept existed in the past, and if so how it was understood, how its definition or application may have changed today and how it may change in the future.

Each of the concepts can therefore be defined, associated and observed from nine perspectives represented by the fields of the matrix relating to the scope of meaning and time.

3.4 Steps of the process

Word processing in the matrix has been divided into consecutive stages.

Step 1 Getting acquainted with the initial set of keywords introduced by the participants of the Intensive Study Program

The preliminary task for the participants was to propose five keywords relating to their scientific work. The group prepared the words during the group work session on their first day of the ISP.

Step 2 Selecting keywords from a set prepared by the participants as a preliminary task, relating to or associated with the term "*Digital*"

The objective of steps 1 and 2 was to select a set of keywords relating to the concept of "*Digital*." From a collection of all the terms and concepts proposed by the participants, each group then chose the words, which to their mind most closely related to the concept of "*Digital*." In this way, a set of words was created, which was then processed in the matrices throughout the entire training program.

Fig[● 23] Collected keywords in Pre-task 1, ISP1.

- 3D-SCANNING
- ADAPTABILITY
- AESTHETIC
- AGILE
- ALGORITHMIC
- DESIGN
- ALIVE
- ARCHITECTURE
- BAUKULTUR
- BUILDING NDUSTRY
- BUILT and UNBUILT
- BUILT ENVIRONMENT
- CARE
- CHANGE
- CIRCULAR
- CIRCULAR ECONOMY
- COLLABORATION
- COMMUNICATION TOOLS
- CONNECTION
- CRAFT
- CRAFT TECHNOLOGY
- CRAFTSMANSHIP
- DATA-AVAILABILITY
- DATA-INTEGRATION
- DETAIL
- DEVELOPMENT
- DIGITAL
- DIGITAL FABRICATION
- DIGITAL TOOLS
- DIGITALISATION
- EMOTIONAL
- ENVIRONMENT
- FUTURE-ORIENTED
- GENERATIVE DESIGN
- HERITAGE
- IDENTITY
- INFORMED PROCESS
- INTEGRATION
- INTEGRITY
- INTERACTIVE DESIGN
- INVOLVEMENT
- LEARN
- LIFE-CYCLE
- LIFESTYLE
- MACHINE LEARNING
- MANAGEMENT/ ECONOMIC SYSTEMS
- MATERIAL
- MATERIAL COMPUTATION
- MATERIAL REUSE/ RECYCLE/UPCYCLING
- MATERIALITY
- MATERIALITY & DIGITAL
- MEGASCANS
- OPEN BUILDINGS
- OPTIMISATION
- OWNERSHIP
- PARTICIPATORY
- PEOPLE
- PHOTOGRAMMETRY
- POLICIES
- PRESERVE
- PROJECT
- REFLECTION
- RESILIENCE
- RESISTANCE
- RESPONSIBILITY
- REUSE
- REVITALISATION
- SAVE
- SCALE
- SHAPE
- SOCIAL
- SOCIAL ISSUES
- SOCIAL PARTICIPATION
- STRUCTURAL ART
- STRUCTURES and ARCHITECTURE
- SUSTAINABILITY
- SYSTEM
- TACIT KNOWLEDGE
- TACTILE
- THINK OUTSIDE THE BOX
- TIMBER-ONLY STRUCTURES
- TIME
- TRANSFORM
- UNIQUE
- UNREAL ENGINE
- URBAN PLANNING
- VR HDM MODELING
- WELL-BEING

Step 3 Processing the word "*Digital*" the matrix

In the next step participants added the word "*Digital*" to the matrix and tried to describe it by using the words selected in the second step. They aimed to define the term "*Digital*" in the context of focus and time by using the keywords to observe whether they relate to the past, presence and future and to what extent they are used and/or understood in general, specific (professional) or very narrow (individual) contexts.

Fig[● 24] Matrix example for "Digital."

Time \ Focus	Digital	General	Specific	Narrow
Past			CAD	
Present		AI	Parametric design AI	CAD Rhino
Future		AI	Parametric design AI	Rhino

Fig[● 25] Matrix example for associations with "Digital."

Time \ Focus	Digital	General	Specific	Narrow
Past		Calculating machine, calculator, Turing machine	Digit, binary system	Machines solving the problems
Present		Informarion era, smartphone, internet	Parametric design	
Future				

Example: the word "*Digital*" could have been described by the possible selected words – "parametric design," "artificial intelligence (AI)," "computer-aided design (CAD)," "computer program Rhinoceros 3D (Rhino)."

The following illustration is an example that shows a possible approach to this task. This illustration was given to the participants as an example from which they could build their matrices in the group work.

The matrix helps to observe in which context related to focus and time the terms are placed in the matrix. This may lead to understanding how the terms related to design processes are captured by different interest groups in relation to time, i.e., how they were captured in the past and how they will be understood in future.

Fig[● 26] ISP 2, Day 2, Group 2.

Digital	General (used and accepted by the society)	Specific (used and accepted by the academic field)	Related to (PhD) thesis Narrow (used and accepted by the expert)
Past	Parameter Data shuffling	Computer-aided design	Optimization Data collection Data analysis
Present	Digital Interfaces 3D scanning DIGITALIZATION	DIGITAL TOOLS Algorithmic MACHINE LEARNING 3D SCANNING Generative design Material computation Computer-aided manufacturing INTERACTIVE DESIGN	DIGITAL TOOLS MACHINE-LEARNING 3D SCANNING Digital fabrication Optimization Craft technology MATERIAL COMPUTATION
Future	Circular economy AI INTERACTIVE DESIGN	GENERATIVE DESIGN MACHINE LEARNING INTERACTIVE DESIGN MATERIAL COMPUTATION	MACHINE LEARNING Optimization Complex structures INTERACTIVE DESIGN MATERIAL COMPUTATION

The above illustration is the response of the participants as a result of this stage of group work. It is clear how significantly the range of available digital tools changes when comparing the past with the present, and interesting that this number does not increase in relation to the future, but is similar, or even decreases.

The word "*Digital*" was included in the matrix again and this time described with the relevant associations, definitions or pictures. General and specific associations with "*digitality*" were identified as part of a group effort. All of the participants were also asked to identify their own definitions of digitality related to their respective individual scientific work (the narrow individual context).

This helped to observe the term of "digital" in the broader context – from the general view through the lens of society to the very narrow definitions and associations related to the individual research topics.

Fig[● 27] ISP 2, Day 2, Group 1.

Digital process	General	Specific	Related to (PhD) thesis
Past	Digits, particularly binary digits	How to create a bridge between digital tools and current situation	Aid of CAM/CAD for vulnerable communities settlement
Present	Digital presentation of data	Using digital tools as a medium for 2D and 3D presentation	Vast majority of people do not benefit from digital design and fabrication
Future	Data-driven presentation of data	Using the virtual models for analysis and further steps ... 4D, 5D ...	Using digital tools for affordable process and implementation

Step 4 **Processing of the terms selected in step 2 (terms related to "*Digital*") in relation to the three pillars of the BuildDigiCraft project: Process, Material, and Knowledge.**

The aim of processing the terms was to observe and define them in the context of the individual scientific research through the lens of the Process, Knowledge, and Material.

As a group, the participants sought to divide the given set of the "Digital" words into the subgroups related to "Digital/Process," "Digital/Material," and "Digital/Knowledge."
Each of the groups then selected the keywords from each subgroup to categorize them by matrix.
Example: as a term associated with the "Digital/Process," the "parametric design" could have been selected and placed with the matrix. The associations/definitions/pictures relating to the "Digital/Process/parametric design" terms could have appeared in the matrix.

This step produced a set of concepts and terms that could act as a bridge between the general concept of Digital and its role in design processes with the values and pillars of the **BuildDigiCraft** project, which aims to find tools to create built environment of high quality. The collection of the obtained concepts and their descriptions on the one hand shows a very wide range of the concept of digitality, on the other hand, shows their approach in the context of Processes, Knowledge, and Materiality, and thus embeds them in a set of concepts directly related to the concept of Baukultur. It also shows very individual, highly specialized research paths in which the commonly understood concepts related to the digital world acquire completely new meanings and represent different values.

The concepts, descriptions, definitions, and associations presented in the matrices build a base of concepts that should be included in the discussion on the digital future of design processes aimed at building a physical, real environment. This set of concepts should also be reflected in the Manifesto ending the project.

3.5 Glossary Matrix examples from the ISP2

The following examples illustrate the path taken by each of the working groups in developing the words in the matrices following the step-by-step diagram described above. These examples also prove that the matrix is a flexible tool and that it can be used depending on the needs, e.g., whether the result of the study is to be purely about definitions, about searching for associations and synonyms, or searching for given contexts.

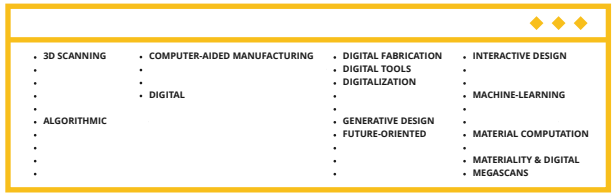
The examples presented next make reference to the conducted training program entitled "Digital Futures." They show how the participants' research topics could be analyzed and described in matrix formats.

Step 1+2 **getting acquainted with the list of terms prepared by the participants and selecting a few keywords relating to the term "*Digital*"**

Summary of the list of terms that had been categorized as ***"Can be digital"***:

- 3D-SCANNING
- ABUNDANCE
- ADAPTABILITY
- AESTHETIC
- AGILE
- ALGORITHMIC
- ALIVE
- ARCHITECTURE
- BUILDING INDUSTRY
- BUILT ENVIRONMENT
- CHANGE
- CIRCULAR
- CIRCULAR ECONOMY
- COLLABORATION
- COMMUNICATION TOOLS
- COMPUTER-AIDED MANUFACTURING
- DATA ANALYSIS
- DATA AVAILABILITY
- DATA INTEGRATION
- DESIGN
- DEVELOPMENT
- DIGITAL
- DIGITAL FABRICATION
- DIGITAL TOOLS
- DIGITALIZATION
- DIVERSITY
- FUTURE-ORIENTED
- GENERATIVE DESIGN
- HUMAN-ORIENTED
- IDENTITY
- INFORMED PROCESS
- INTEGRATION
- INTERACTIVE DESIGN
- INTEROPERABILITY
- LIFECYCLE
- MACHINE-LEARNING
- MANAGEMENT/ECONOMIC SYSTEMS
- MASS CUSTOMIZATION
- MATERIAL COMPUTATION
- MATERIAL REUSE/ RECYCLE/UPCYCLING
- MATERIALITY & DIGITAL
- MEGASCANS
- REVITALIZATION
- SCALE
- SHAPE
- STRUCTURAL ART
- STRUCTURES & ARCHITECTURE
- SUSTAINABILITY
- SYSTEM
- TACIT KNOWLEDGE
- THINK OUTSIDE THE BOX
- TIME
- TRANSFORM
- OPPORTUNITIES
- OPTIMIZATION
- OWNERSHIP
- PARAMETER
- PHOTOGRAMMETRY
- PRESERVE
- PROCESS-ORIENTED
- PROJECT
- REFLECTION
- RESPONSIVE
- SAFETY
- SCALE
- SHAPE
- STRUCTURAL ART
- STRUCTURES & ARCHITECTURE
- SUSTAINABILITY
- SYSTEM

The narrower set was selected, which was entitled as ***"exclusively/mainly digital"***:



Step 3 the working groups add the term "*Digital*" itself to the matrix

The below examples show the matrices elaborated by different working groups. It is interesting how differently and at the same time similarly the groups approached the matrix tool while working on the term "Digital."

Fig[● 28] ISP 2, Day 2, Group 2.

Digital	General (used and accepted by the society)	Specific (used and accepted by the academic field)	Related to (PhD) thesis Narrow (used and accepted by the expert)
Past	Parameter Data shuffling	Computer-aided design	Optimization Data collection Data analysis
Present	Digital Interfaces 3D scanning DIGITALIZATION	DIGITAL TOOLS Algorithmic MACHINE LEARNING 3D SCANNING Generative design Material computation Computer-aided manufacturing INTERACTIVE DESIGN	DIGITAL TOOLS MACHINE-LEARNING 3D SCANNING Digital fabrication Optimization Craft technology MATERIAL COMPUTATION
Future	Circular economy AI INTERACTIVE DESIGN	GENERATIVE DESIGN MACHINE LEARNING INTERACTIVE DESIGN MATERIAL COMPUTATION	MACHINE LEARNING Optimization Complex structures INTERACTIVE DESIGN MATERIAL COMPUTATION

Fig[● 29] ISP 2, Day 2, Group 1.

Digital	General	General tools	Specific	Specific tools	Related to Phd. Ms.	Related to (PhD) thesis
Past	Supporting tool (not within the process) Limitation of software Availability of data Efficiency Modeling objects	2D design software	**Visualization Representation level**	Autocad, CAD	**Learning from historical buildings/ constructions**	Hand drawing – graphic statics, Geogebra
Present	Efficiency/effectiveness Powerful computational power, automatically formed shapes based on parameters, digital fabrication (Grasshopper, FEM) modeling performance of objects	3D, 4D design software	**Cost estimation Time management Data-driven design**	Grasshopper Rhinoceros, BIM, GIS	**Cost effective/Innovative design solutions, Data capturing based on available data**	Specific Grasshopper plugins: Karamba, kangaroo and so on; FEM (Ansys, Abaqus) for structural analysis ReCap, ContextCapture
Future	With machine-learning and AI, future-oriented design, more environmental consideration Automation vs. social Modeling systems performance & interaction?	AI, 5+D design softwares	**Automated design and process Prediction Performance/interaction-driven**	**?**	City modeling/analyzing tools for new forms of data?	CityEngine

Design for reuse and reassembly

Efficient structural design; material, form and cost

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

CAM/CAD for vulnerable communities

How the digital design process can be better socially integrated with real-life performance in the future built environment?

Fig[● 30] ISP 2, Day 2, Group 4.

Digital	General	Specific	Related to (PhD) thesis
Past	PARAMETER Data shuffling	Computer-aided design	Data collection Data analysis Optimization Visualization
Present	DIGITALIZATION PARAMETER Algorithmic MASS CUSTOMIZATION	MATERIAL COMPUTATION Machine-learning Computer-aided manufacturing	DIGITAL TOOLS Integration COMPLEX STRUCTURES DATA ANALYSIS Optimization Craft technology
Future	Artificial Intelligence	Bio-digitalization Brain–machine interfaces Limited/prohibited application for AI regulations	COMPLEX STRUCTURES Neuralink? Deep learning Estimating the resulting experience and ratings (Airbnb type) before building the object

Step 4 processing the terms related to the **BuildDigiCraft** project pillars discussed during the consecutive days of the ISP2 (Process, Material, Knowledge)

During the changes the participants developed the selected terms and concepts in the matrices that on the one hand were placed in the context of the topic of individual days (Digital/Process, Digital/Material, Digital/Knowledge) and on the other hand related directly to the individual research work carried out by the participants.

As can be seen, the groups first wanted to find out what would happen to the concept of "*Digital/Process*" once it was placed in the matrix, and only then developed related but individual concepts. The same applied to the term "*Digital/Material*."

Digital/Process

Fig[● 31] ISP 2, Day 2, Group 1.

Digital process	General	Specific	Related to (PhD) thesis
Past	Digits, particularly binary digits	How to create a bridge between digital tools and current situation	Aid of CAM/CAD for vulnerable communities settlement
Present	Digital presentation of data	Using digital tools as a medium for 2D and 3D presentation	Vast majority of people do not benefit from digital design and fabrication
Future	Data-driven presentation of data	Using the virtual models for analysis and further steps ... 4D, 5D ...	Using digital tools for affordable process and implementation

Fig[● 32] ISP 2, Day 2, Group 1.

Digital Process (timber structures)	General	Specific	Related to (PhD) thesis
Past	Low computational power, manual manipulation, hand-made carpentry (hand drawing, AutoCAD)	Material modeling is too complex to achieve, structural system is more based on experience, limitation of computation	Learning from traditional timber constructions (data collection from history)
Present	Powerful computational power, automatically formed shapes based on parameters, digital fabrication (Grasshopper, FEM)	Possible to simulate material properties, fast generation of optimal shape with targeted optimization	High potential in high-rise timber constructions, material-efficient mass timber, form-finding of timber structures
Future	With machine learning and AI, future-oriented design, more environmental consideration	4D, 5D modeling ... optimized solution with consideration of structures, environments, reuse ...	Highly automatically fabrication with high structural performance, highly precise timber connections/joinery fabrication

Fig[● 33] ISP 2, Day 2, Group 4.

Bio-digitalization	General	Specific	Related to (PhD) thesis
Past	Literal examples in nature	Digital cultural generative design	1988 DNA analysis, cell computation 2012, establishing the field
Present	Inspiration from nature	Swarm Robotics. Mathematical biomimicry. Digital Microtechnology	Prof. Ludwig Ferdinand – construction botany – faster/ modular way of plant assembly. Hybrid living nature and technology. Assembled and merged into shape
Future	Merging of natural and digital LIFECYCLE EIA (Environmental Impact Assessment) LIFESTYLE ENVIRONMENT FUTURE-ORIENTED	Molecular nanotechnology and self-assembly. Swarm robotics	Protohome – generative design for additive manufacturing

Digital/Material

Fig[● 34] ISP 1, Day 1, Group 1

Digital/ material/ availability	General	Specific	Related to (PhD) thesis
Past	Local materials	Denmark used bricks from clay, concrete from lime, etc. Norway and Sweden used timber due to high resources of timber (large forests)	
Present	Available materials between nations Digital tools optimizing structures or forms through machine-learning	Every nation has access to a worldwide "shop of materials," e.g., China buying a lot of steel Even fragile materials can be very strong, and handle a lot of loads if the structural system is correct	Optimization Testing
Future	Synthetic biological materials Fungus Spiderweb (gene-modified goats)	Growing materials in labs or farms through biological processes Composites of new material can maybe lead to new statical systems (free-form) using AI	New material properties Machine-learning Biodegradable

Fig[● 35] ISP 2, Day 2, Group 4.

Intangible/tangible immaterial/material HERITAGE	General	Specific	Related to (PhD) thesis
Past	Heritage was mostly "material" with the possibility of a tangible approach towards the object	Gothical church in Binarowa  Photogrammetry did not yet exist	Authenticity
Present	Today we are witnessing the digitalization of most of the existing material heritage. Photogrammetry, 3D scans, 3D inventories of the objects	 	Authenticity/digital representation of authenticity
Future	In future the object can be destroyed, damaged, dismantled due to many reasons. But with the use of digital tools we can preserve the object and memory, etc. even though it no longer exists	Authentic object no longer exists 	Digital remains

Fig[● 36] ISP 2, Day 2, Group 3.

Materials and their feelings, and applications	General	Specific	Related to (PhD) thesis
Past	Finding materials in nature and investigating their aesthetic aspects, availability, diversity, abundance and emotional feeling Symbolism	Doing crafts with circular materials like wood	Research on the technical aspects of material especially mechanical and chemical aspects
Present	A wide range of materials for different applications Artificial material and 3D printing	Chosen materials for defined applications for ALGORITHMIC, BUILDING PHYSICS SYNERGY OPTIMIZATION COMPUTER-AIDED MANUFACTURING ENERGY OPTIMIZATION	Digital fabrication facilitates the building of complex structures and artificial materials
Future	Flexible selection of materials that should be converged for general to specific applications	Machine-learning to predict the best material for the desired application	ALIVE materials can be integrated in buildings

Digital/Knowledge

On the day devoted to the concept of Knowledge in digital reality, participants no longer defined the terms "*Digital/Knowledge*" – only one group did so. Other groups either juxtaposed it with the notion of "*Data*," or immediately moved on to the terms related to Knowledge, but that were already embedded in their individual research work. The term "*Data*" was actually the most frequently researched and developed word in the context of knowledge.

Fig[● 37] ISP 2, Day 4, Group 2.

Knowledge & Digital	General	Specific	Related to (PhD) thesis
Past	Limited information and digital tools Single disciplinary Defining Creation of knowledge	Transferred through skills and books	from physical to digital (transfer)
Present	Unlimited information / automated information systems Fragmented data Organization of multi-disciplinary connections Re-defining Dissemination of knowledge	Filters. Automated knowledge retrieval. Distanced learning? Self-learning? Control by algorithm. Data generated from the physical world. Machine learning any formats	from physical to digital and back to physical (transfer)
Future	Easier accessibility Learning from experiments Mixed physical/digital-complex systems/AI realities Fully multidisciplinary Connections between academia and industry, where knowledge access is flexible, relevant for the environmental/social/economic aspects Learner-oriented Public vs. individual – privileged groups benefits	Brain–machine interfaces. Artificial intelligence	parallel to digital and to physical (transfer) Neuralink

Fig[● 38] ISP 2, Day 4, Group 4.

Data vs. knowledge	General	Specific	Related to (PhD) thesis
Past	Data: problem Knowledge: application of data	Data: information Knowledge: transition of the information	Data: hypothesis, question Knowledge: interpretation of results
Present	Data: wicked issues Knowledge: addressing wicked issues	Small data Mega data Big dataset	Data: statistical models and solution Applying machines (artificial intelligence, machine-learning, deep learning) Knowledge: high-rate results, reliable results
Future	Data: multi-criteria Issues Knowledge: interdisciplinary science	Data: mega data, big dataset knowledge: digital language	Data: applying machines (artificial intelligence, machine-learning, deep learning) Knowledge: wisdom

Fig[● 39] ISP 2, Day 4, Group 2.

Digital data & analysis	General	Specific	Related to (PhD) thesis
Past	Produced and collected data Few specialized tools for handling data with low availability	Auto CAD visualization, excel for text data, printing 2D	Computer statistics, relational and non-relational databases. Data warehouses
Present	Aggregated different types of generated data multiple interactions Many specialized tools with easier availability	Wide range of data sources and representation, 3D printing, virtual reality, AI, Grasshopper, Ladybug – passive software	Business intelligence, data mining. Big data, cloud data, analytics in the cloud
Future	Automatically generated data diversity of networks beyond our original geographical places or disciplines Risk, loss Reconstruction Open vs. private data/ownership	AI-enabled analysis. Aware/Active software. Not only visual, but also other senses included in data, like sound digits, etc. Nudging towards sustainability	Predictive, cognitive and augmented analysis (natural language and world/environment processing). Virtualization

Fig[● 40] ISP 2, Day 4, Group 3.

Data analysis in timber engineering	General	Specific	Related to (PhD) thesis
Past	Less data samples available, slow process	The record of timber properties and timber structures is limited, diversity based on geological areas	Data collection and review of previous timber buildings
Present	Quick testing record with technology, more complex material models	Bigger data than before, simplified model, conservative	Statistic analysis and comparison between data from different sources
Future	A huge dataset including data from the past	Data distinguishing, more complex data analysis model	Identification of good data for certain purpose, optimized design output based on optimized data, the combination of human subjective ways of thinking

Digital technologies and tools must be data-fed to do their jobs. This data is processed, interpreted and becomes the source and object of building knowledge about the surrounding reality, too. The linguistic work with matrices has revealed how common and in how many contexts the word "*Data*" is used, which seems to be the basic and universal term wherever digital technologies have entered the equation. Working with words based on the example

of matrices allows us to reflect on meanings. From the examples above, you can see that the participants needed to revise their understanding of the definition of "*Knowledge*" and "*Data*" in the context of the wealth of information that we are surrounded by on a daily basis.

Social context

On the last day of the training participants discussed the social context of digital technologies and looked at relationships between the human world, the world of technology (digital reality) and the physical world. As the goal of the Baukultur movement, also enshrined in the Davos Declaration (Davos Declaration 2018), is to care for the quality of the built environment and to demand its continuous improvement while minimizing the impact on the natural environment and limiting the use of natural resources, the need to reflect on ethical issues and values that creators, engineers, and designers should follow has become all too apparent.

The matrix tool was used again to discuss ethics and values in relation to the built environment and to examine the relationships between them. Participants considered the concepts of ethics and values, but also other terms, such as those relating to culture or sustainability.

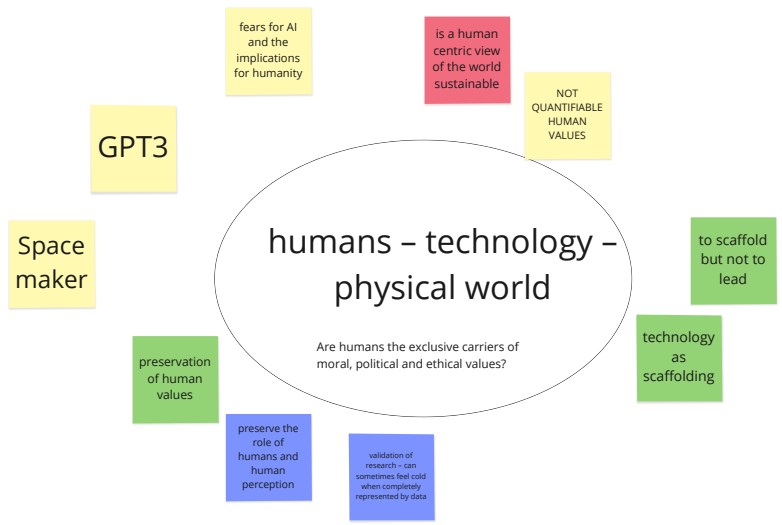
In addition to filling in the matrices, the participants also created diagrams and drawings to analyze and understand the discussed relationships. In this case, therefore, the matrix has become a linguistic resource, while diagrams allow an understanding of the relationship, hierarchy and interdependencies between the concepts. In this example you can see that both methods support each other, providing a more complete picture.

The above examples show two levels of analyzing vocabulary. First, the general level shows the relation to the potential field of interest of the research with the context of the Baukultur quality assessment. The second level looks at the closer relation between the first level and the individual research of the participants.

The words, terms, sentences, and related statements can explain, provoke ideas, generate possible uses and pave the way to think about the future aims. They also allow an interpretation of contemporary facts, relationships between past, present, and future, relationships between craft and crafted, creator and creation. The matrices show the way how the possible relationships in the different fields of research can relate to each other and find common language and vocabulary platforms of possible interactions, but also allow the formulation of hypotheses concerning what the digital environment could look like in future.

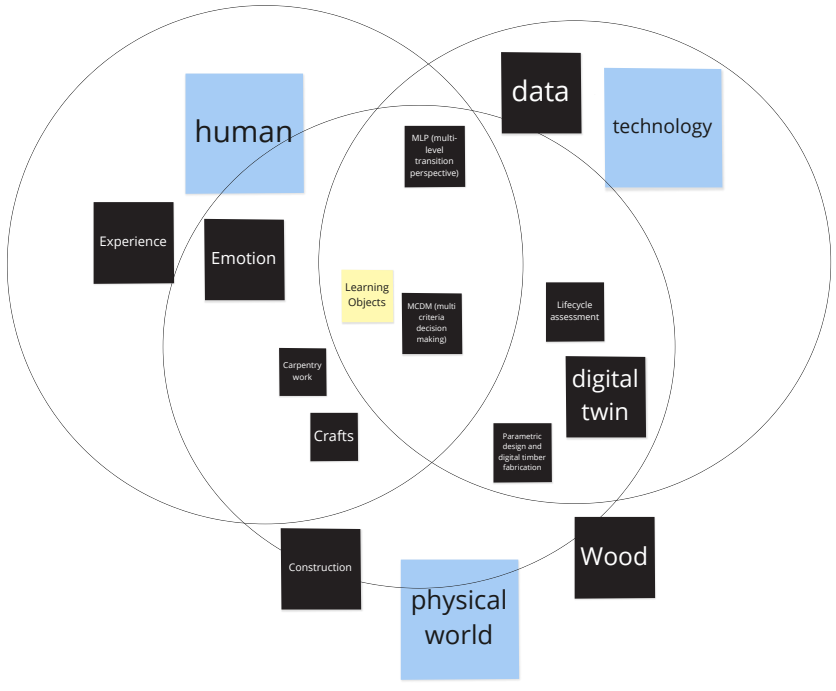
Fig[● 41] ISP 2, Day 5, Group 2.

Values and ethics	General	Specific	Related to (PhD) thesis
Past	Religion and culture about continuing the human race, like having children	in the past it was mainly about preservation of human life. Inability to deal with global aspects and challenges	Working with indigenous materials with tacit knowledge
Present	About continuing the life on our planet, like sustainability UN goals, etc.	Examples of how we are interested in larger aspects, like resources, sustainability, food for all, education for all	New materials and structures defined through digital tools and a combination of tacit and explicit knowledge/technique
Future	Need to develop a critical framework across different disciplines to treat each other humanely, fear of technology used in inhumane way	As a society we must not lose control, we must preserve human rights and privacy, make sure that technology is a scaffolding and support and not to be misused	Using technology to its best but preserving human and humanistic values and approaches



Fig[● 42] ISP 2, Day 5, Group 3.

Timber constructions (sustainability, culture)	General	Specific	Related to (PhD) thesis
Past	Handmade constructions, craftsmanship	Wood carpentry in timber temple construction	Materials follow functions; representative meaning of religion
Present	Digital fabrication with robots	Parametric design of wood joinery, digital fabrication ... (slogans)	Waste of materials; only an environmental issue (more or less limited in the general public)
Future	Optimized digital fabrication with robots, taking sustainability, material properties, aesthetics into account	Machine-learning, based on various sets of motivations	Minimizing waste of materials; future representative meanings



4.0 Discussion and conclusions

The aim of this intellectual output was to create a common foundation for a shared understanding of the main concepts explored within the **BuildDigiCraft** project.

During the course of the project an attempt was made to identify, collect, and create a set of terms that was then referred to as the "Glossary." At the beginning of the project, when the idea of the "Glossary" and the matrices, with which the terms and concepts were to be processed, were developed, it was not really known how working with the matrices would look like and what its effect would be. The idea of working with matrices assumed quite a lot of freedom and openness to ideas, associations and interpretations of the users. In the first Intensive Study Program (ISP1) each of the groups working with matrices approached the topic differently. It became clear that the method of working with matrices would not lead so much to the creation of a specific resource of defined concepts, but instead be an attempt to build the foundations for a specialized linguistic corpus related to the design and shaping of space, with particular emphasis on the context of knowledge, design processes, and materials.

The participants' task was, on the one hand, to propose and define the most important concepts related to the subject of undertaken research and projects, i.e., to create a defining Glossary, but on the other hand, work with matrices allowed for the acquisition of textual resources, similar to the work on linguistic corpora.

However, the linguistic corpus is not a dictionary, which is worth mentioning in the context of the **BuildDigiCraft** project. The corpus is a collection of texts used for linguistic research, e.g., determining the occurrence frequency of word forms, the syntactic structures and contexts in which given words appear (Corpus linguistics definition). Importantly, linguistic corpora should be saved in electronic form (Bennett 2010, Wynne 2004), thereby being able to be used for text analysis and processing by computers. The corpus is a set of texts containing typical constructions and uses of words along with information about their meaning and function.

Corpora are created in order to represent a given language area, e.g., for a specific field. Depending on the application of a given corpus, the following types can be distinguished: general, specialized, and parallel corpora (Bennett 2010). Specialist corpora contain texts on specific specialist topics, e.g., engineering, architecture, medicine, economics. Therefore, in the case of the **BuildDigiCraft** project, we can talk about an attempt to create a specialized database of concepts and texts in relation to urban design, architecture, structural engineering and construction, craftsmanship, all of which allow the pursuit of high-quality Baukultur.

Text corpora are authentic linguistic materials, thanks to which one can take a closer look at the forms in which the written word functions. This allows the isolation of typical uses of words and constructions, the possibility of studying their meanings and functions and the opportunity to observing the evolution of the language. Corpora are necessary for linguistic research, creating and updating dictionaries and preparing foreign language textbooks. They are a valuable source of knowledge not only for linguists, but also computer scientists, e.g., to create computer translators or other programs supporting work with language. Language corpora are also used as teaching and test datasets in machine-learning methods used in natural language processing (op. cit.).

The linguistic corpus is therefore not a glossary, but a valuable source of knowledge about the use of a language in specific contexts. Real linguistic corpora contain millions of words as they are based on many different texts from different sources. Of course, the resource of concepts and texts that were created as part of the work on matrices and the Glossary within the **BuildDigiCraft** project is significantly more limited and cannot be treated as a real corpus, but this collection allows for the first observations of the terms used by project participants when talking about research and disciplines within the framework of which they work and create. Therefore, it can be concluded that the work on the Glossary under the **BuildDigiCraft** project bore the hallmarks of working on a specialized linguistic corpus, although of course to a limited extent. However, even such a modest resource of concepts that were "acquired" in the project allows for the first observation of what vocabulary is used to talk about design processes in the digitized world in relation to shaping the built environment.

When talking about the Glossary and linguistic corpus in the context of the **BuildDigiCraft** project, it is necessary to pay attention to the fact that none of the project participants were native English language speakers, but have learned English as a second language. For this reason, the English vocabulary built in the project is probably somewhat narrower than it would be if the participants were to speak about the same topics in their native tongues. At the same time, thanks to this narrowing down, the accumulated resource might be more concise and accurate.

The basis of the Glossary was also to create a database of keywords relevant to the subject of the project, at the same time showing the wide range of research that is undertaken in the pursuit of high-quality Baukultur. It is worth paying attention to the relationship between the linguistic corpus and keywords. Creating lists of keywords in context is one of the main tasks of concordance programs needed to handle the language corpus. In such programs, the keyword takes a central position, with the context written to the right and to the left. Thanks to this procedure, it is possible to adapt the use of a given word to the specific needs of the project. The most important function of each linguistic corpus is searching for individual words – quickly and efficiently, without browsing through the next pages of a paper dictionary. After selecting a specific word, you instantly receive a series of concordance lines that allow you to find the appropriate context for a given text.

One of the roles of the Glossary was to create a shared platform for understanding that would enable joint work on the text of the Manifesto as an expression of the commitment to a high-quality built environment. Experience with working on this Glossary within the project shows that even a limited simulation of building a linguistic

corpus can yield interesting results, uncovering the tapestry of research topics and concepts important to participants in a variety of contexts and references as well as over time.

In order to create a real linguistic corpus, the texts that are to be included in the corpus must be selected according to specific criteria. Common criteria for creating a corpus include:

- **Type of text** – whether the language is derived from speech, writing, or electronic means
- **Category of text** – whether, e.g., in the case of written text, it is a book, magazine, letter, etc.
- **Text domain** – whether it is, for example, popular or scientific text
- **Corpus language** (or languages) and its/their variants
- **Text placement** – e.g., British English, American English, Australian English
- **Text dating** (Sinclair 2004)

Project members had to embed the matrix-processed word concepts in terms of both time and focus, but also related them to the main contexts of the entire **BuildDigiCraft** project, i.e., Process, Knowledge, and Material in relation to Digitality and Craftsmanship. Thus, it can be concluded that the criteria for creating the real corpus were partially applied, although, of course, in a selective and limited form. Nevertheless, the imposed discipline and the way concepts were worked on through matrices helped to organize the verbal material and ensured the participants focused on precise terms. This led to the creation of a database of terms and concepts, which were then described through a variety of contexts, reflecting how the corpus was created. As the matrices and the obtained sets of contextual concepts and texts were created mostly as part of group work, it can be assumed that the participants, when selecting the final formulations, agreed on them among themselves and used terms that were understandable to everyone.

Interesting feedback on matrices was formulated by the ISP participants, relating to the proposed time categories: past, present, and future. Participants noted that the boundaries between these categories, e.g., between the past and the present, are difficult to establish. Many processes and phenomena started in the past and continue uninterruptedly until today. Therefore, it is often impossible to decide where the boundary between the categories of time is. This is a valuable insight, which confirms that the Glossary Matrix as a tool can be used quite freely and adapted to various needs and assumptions. The matrix initiators recognized that this clear division into time categories was initially needed to organize the linguistic material. However, now in the later stages of working with the matrix, users can decide how they can adapt it to their needs – e.g., by blurring the boundaries between categories or abandoning such divisions. The matrix is thus an open tool.

It can therefore be noted that the matrices obtained as a result of group work, but also other results of group work, such as conducted and saved discussions in the form of diagrams, sets of notes, multimedia presentations, could be a scaffolding for building a linguistic corpus, which is referred to as the Glossary in the **BuildDigiCraft** project. It can also be stated with a high degree of certainty that the concepts, matrices, and obtained text and verbal effects worked out during Intensive Study Programs may become a linguistic basis for the development of other intellectual outputs of the project.

Undoubtedly, the interaction of all participants and partners of the **BuildDigiCraft** project allowed for deepened reflection on the variety and depth of the professional language of the designers of built environment in digital era. There is a clear need to increase the awareness about the concepts and notions already generally used within the context of digitization in order to also be able to better interweave them within the context of Craftsmanship and the context of the built environment.

5.0 References

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