datemats

Knowledge & Technology Transfer of Emerging Materials & Technologies through a Design-Driven Approach

2.5 Transnational Workshop

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EXECUTIVE SUMMARY

This document reports the Project task 2.5 Interdisciplinary Knowledge sharing, consisting of setting up specific activities, such as co-design creative sessions for the knowledge sharing of the results related to company surveys, reports, best practices, methods, etc. The task took place on M9, led by Polimi, and involving all the partners.

The task is part of Work Package 2, aiming to share and build a transnational knowledge methodology. The objective of this phase was to detect all the information about the different EM&Ts approaches and methods used by each High Education Institutions as well as the European SMEs' needs in terms of issues and gaps related to EM&Ts knowledge transfers. This work package supported the exchange of good practices, mutual learning, and the development of joint results amongst stakeholders in the partner countries.

According to the Project description, this deliverable [2.5] consists of the execution of a Transnational Workshop aiming to share the knowledge generated in the other tasks of WP 2, i.e. literature review in current methods about EM&Ts [2.2], a survey to HEIs to identify the gaps regarding EM&Ts between Academia and Industry [2.3], the identification of gaps, limits, and constraints related to EM&Ts technology transfer gaps [2.4]. Through participatory sessions, the members of the consortium discussed the primary research findings. This was a crucial phase of the entire project because it set the ground for the definition of the contents of the new Knowledge Transfer Method in WP3.

This document introduces the context of participatory workshops as a research method. Then, it describes the methodology applied for the setting up and execution of the activities, the development of the toolkit based on canvases and frameworks, and for the collection and analysis of data. Finally, the document presents the resulting Logical Framework as a universal and concise systematization of the items retrieved from the triangulation of the previous tasks, the use of the tools, and the participants' discussion in the workshop. In conclusion, limitations, implications, and further development of the Logical Framework and the related Transnational Workshop are discussed.

ABSTRACT

English. The document reports the setting up and execution of Transnational Workshop involving the Datemats project partners, aiming to share the knowledge generated in the previous tasks of the project. The objective of this phase was to detect all the information about the different approaches and methods for Emerging Materials and Technologies (EM&Ts) knowledge transfer used by each High Education Institutions as well as the European SMEs' needs in terms of issues and gaps related to EM&Ts knowledge transfers. Through participatory and co-design sessions, the members of the consortium discussed the primary research findings, shared good practices and outlined a Framework. This was a crucial phase of the entire project because it set the ground for the definition of the contents of the new Knowledge Transfer Method.

Spanish. El documento informa sobre la planificación y ejecución del workshop transnacional en el que participaron todos los socios del proyecto Datemats, con el objetivo de compartir el conocimiento generado en las tareas anteriores del proyecto. El objetivo de esta fase fue el de detectar toda la información existente sobre las diferentes estrategias y métodos para la transferencia de conocimiento de los materiales y tecnologías emergentes (EM&T) que se usan en las instituciones de educación superior (universidades), así como las necesidades de las pequeñas y medianas empresas (PYMES) en relación a los problemas o necesidades relacionados con los EM&T. A través de sesiones participativas y de co-diseño, los miembros del consorcio debatieron sobre las principales conclusiones, compartieron buenas prácticas y establecieron un marco de trabajo. Ésta fue una fase crítica para el proyecto porque establece el punto de partida para la definición de los contenidos del nuevo Método para la Transferencia de Conocimiento.

Portuguese. O documento reporta o desenvolvimento e execução do Workshop Transnacional realizado pelos parceiros do projeto Datemats, com o objetivo de partilhar o conhecimento gerado pelas atividades realizadas no projeto. O objetivo desta fase foi o de detetar todas as informações sobre as diferentes abordagens e métodos de transferência de conhecimento sobre Materiais e Tecnologias Emergentes (EM&Ts) usados por cada uma das Instituição de Ensino Superior, assim como as necessidades das PME europeias relativamente às questões e lacunas relacionadas à transferência de conhecimento em EM&Ts. Através das sessões participativas de *co-design*, os membros do consórcio discutiram as principais conclusões da pesquisa, partilharam boas práticas e estruturaram uma estrutura provisória. Esta foi uma fase crucial de todo o projeto, pois preparou o terreno para a definição do conteúdo do novo método de transferência de conhecimento no projeto.

Italiano. Il documento descrive l'organizzazione e esecuzione di un workshop transnazionale che ha coinvolto tutti i partner del progetto Datemats, con l'obiettivo di condividere le conoscenze generate nelle precedenti attività del progetto. L'obiettivo di questa fase è stato quello di condividere tutte le informazioni sui diversi approcci e metodi per il trasferimento di conoscenza dei materiali e delle tecnologie emergenti (EM&Ts) utilizzati da ogni istituto di istruzione superiore, nonché le esigenze delle piccole medie imprese europee in termini di questioni e lacune relative al trasferimento di conoscenza di EM&Ts. Attraverso sessioni partecipative e di co-design, i membri del consorzio hanno discusso i principali risultati della ricerca, hanno condiviso le buone pratiche e hanno elaborato un quadro di riferimento. Questa è stata una fase cruciale dell'intero progetto perché ha posto le basi per la definizione dei contenuti del nuovo metodo di trasferimento di conoscenza che verrà utilizzato nelle attività del progetto Datemats.

Danish. Dokumentet rapporterer planlægningen og afholdelse af de transnationale workshops med de forskellige Datemats partnere og har til formål at dele den viden, der indtil videre er blevet genereret i projektet. Målet med denne fase af projektet var at kortlægge de forskellige tilgange og metoder til at overføre viden om 'Emerging Materials and Technology (EM&Ts)', som på nuværende tidspunkt bruges i undervisningen på de forskellige videregående uddannelser. Ligeledes har denne

fase haft fokus på at undersøge Europæiske små og mellemstore virksomheders behov og udfordringer i forhold til overførsel af viden om EM&T. Gennem 'co-design' arbejdsmøder har medlemmerne i konsortiet diskuteret de vigtigste resultater og fund, delt hvad der kan ses som god praksis og udformet rammerne for projektet. Det har været en vigtig fase for hele projektet, da det har etableret grundelementerne i en ny metode til overførsel af viden.

Finnish. Tässä dokumentissa raportoidaan Datemats -hankekumppaneiden yhteisen Transnational Workshop -työpajan suunnittelu ja toteutus. Työpajan tarkoituksena oli jakaa hankkeen aiemmissa tehtävissä tuotettua tietoa. Tämän vaiheen tavoitteena oli kartoittaa miten yliopistot siirtävät uusiin materiaaleihin ja teknologioihin (EM&Ts) liittyvää osaamista ja tietoa yrityksille, sekä hahmottaa eurooppalaisten pk-yritysten tarpeita kyseisiin aihealueisiin niihin liittyen. Yhteissuunnittelun periaatteita seuraten konsortion jäsenet keskustelivat yhdessä tärkeimmistä tutkimustuloksista, jakoivat hyviä käytänteitä ja hahmottelivat puitteet yhteiselle viitekehykselle (Framework). Koko hankkeen kannalta tämä oli olennainen vaihe, jonka avulla pohjustettiin uusia tapoja osaamisen siirtämiseen (Knowledge Transfer Method).

Swedish. Dokumentet rapporterar upplägget och genomförandet av den tvärnationella workshop som involverat partnerna i Datemats-projektet och syftar till att dela kunskapen som genererats i projektets tidigare uppgifter. Målet med denna fas var att kartlägga information om olika tillvägagångssätt och metoder för kunskapsöverföring kring kommande material och teknologier (Emerging Materials and Technologies, EM&Ts) som används av högskoleinstitutioner, såväl som behov hos europeiska små- och medelstora företag vad gäller frågor och luckor kring kunskapsöverföring relaterat till EM&Ts. Konsortiets medlemmar diskuterade de primära forskningsresultaten genom samverkande designsessioner, delade god praxis och tog fram ett ramverk. Detta var en avgörande fas i hela projektet eftersom det lade grunden för definitionen av innehållet i den nya kunskapsöverföringsmetoden.

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1 INTRODUCTION: PARTICIPATORY WORKSHOPS IN RESEARCH

This document reports an Interdisciplinary Knowledge Sharing activity [Task 2.5] carried out with the organization and execution of a Transnational Workshop involving all the partners and led by Polimi that took place during the Transnational meeting in Copenhagen [Task 1.3]. The workshop consists of setting up of specific activities, such as co-design creative sessions for knowledge sharing of the results related to company surveys, reports, best practices, methods, from the previous tasks. The main findings of the activity have been formalized in a Logical Framework for an original teaching method that will work as a blueprint for the following tasks of the project.

Participatory methods have been used from years in the context of Academic research (Creswell, 2012; MacDonald & Headlam, 2016), Educational Research (Creswell, 2009; Cohen, Manion, & Morrison, 2017), and specifically in Design Research and Practice (Sanders & Stappers, 2012).

In the landscape of Design Research (Sanders, 2006), a participatory mindset characterize design researchers that are not only working and collaborating with people (i.e. users of a product or service), but involving them in all stages of the design development process, by co-creation practices, to help ensure that the designed product or service meets their needs (Sanders and Simons, 2009). A participatory approach to design research is characterized by the use of physical artefacts and tools, i.e. rationally designed devices that produce both tangible commodities and productive systems for intangible commodities (e.g. education, knowledge, or decisions) (Illich, 1973-75, via Sanders & Stappers, 2012). An example of the use of tools for participatory design applied in the educational context is the guidebook 'Design Thinking for Educators' (IDEO, 2012). In a participatory framework, tools and methods are used to stimulate creativity, and problem-definition and -solving capabilities, as a scaffold for collective creativity (Sanders & Stappers, 2012). Collective creativity is crucial to solve wicked problems (Buchanan, 1992), i.e. the ones that are "difficult or impossible to solve because of incomplete, contradictory, complex interdependencies" (Rittel & Webber, 1973).

In the setting of participatory research, the format of the workshop arises as a method for qualitative research (Ahmed & Asraf, 2018; Ørngreen & Levinsen, 2017). Workshops provide an opportunity for researchers to identify and explore relevant factors in a domain, which are not evident to participants or researchers before the workshop process. Workshops are characterized by being events of a limited duration targeted to a group of participants, aiming to an outcome both for the organizers and the participants. Workshops are specifically designed to fulfil a pre-defined, though not predictable, purpose. Workshops encourage engagement through collaborative discussions and feedback between the facilitator and the participants (Ahmed & Asraf, 2018). Strategies and guidelines to organize and carry on a workshop properly are suggested by the literature (Chambers, 2002; MacDonald & Headlam, 2016).

Generally, workshops involve as participants a small group of people selected accordingly by a common domain, expertise, or interest, e.g. experts in the research field, users of products, or students. In particular, a workshop involving colleagues and project partners has the threefold aim of fulfilling participants' expectations to achieve something related to their interests, fulfil a research purpose (Ørngreen & Levinsen), and knowledge sharing and alignment between the partners. In this particular type of workshop, the participation is characterized by a collaborative and collegiate modality. The researcher plays the complementary roles of the 'clinician', who focuses on participant needs, and the 'ethnographer', who focuses on the research (Ørngreen & Levinsen). In the analysis of the results, the Design researcher works as a translator that translates insights, ideas, thoughts into a framework that inspires new design directions.

2 METHODOLOGY

The aim of the transnational workshop was to fruitfully discuss and elaborate on the Logical Framework resulting from the methods, gaps, and issues identified from the Literature Review about EM&Ts methods and knowledge transfers [D2.2] – aimed to analyze the current methods used for EM&Ts – and the Surveys to companies about issues connected to EM&Ts [D2.3] – containing specific interests and needs related to EM&Ts and the internal company's methods to manage knowledge on that innovation area, supported by statistic data, to identify the gap between Academia and Industry.

Expected results from the participants' discussion are data and information to integrate and complete the Logical Framework and to validate, clarify, and update the existing information. Another aim of the task was the search for a consensus among the participants since the Logical Framework is a pillar outcome of the project on which following tasks and related deliverables are based on, e.g. Training contents of the specific teaching method for each EM&T [D3.1], EM&T Transfer Toolkits [D3.4].

2.1 SETTING UP THE ACTIVITIES AND TOOLS

To achieve these results, Polimi organized a workshop, structuring a set of activities and designing their supporting tools. The workshop took place during the 2-day Transnational Meeting [T1.3] at Copenhagen, hosted by partner KEA, and was structured in two separate moments characterized by dedicated activities and tools.

2.1.1 DAY 1

On day 1 (at the end of the first day of the meeting), partners were invited to reflect and elaborate on the results presented by the partners, in particular the Gaps, Issues, and Methods identified by the EM&T-specific Literature Review [T2.2] and the results of the Survey to Companies on EM&Ts [T2.3]. The aim of the activity was to summarize all the relevant issues to start discussing specifically the common aspects that the four EM&Ts share, to prepare the participants for the following day's activity, and to start collecting relevant data to update and adapt the tools for the following day's activity.

A 30-minutes collective discussion was carried out on the topic. The activity was supported by a poster named 'Shared Ground' [Annex 7.1] describing and organizing in a graphical and concise way the common issues and aspects of the four EM&Ts, resulting from [T2.2] and [2.3]. The poster was designed by Polimi and printed out (A1 format) before the meeting. A tangible copy of it was both provided during the discussion and projected. The poster was structured on one page divided into different sections: one introductory section about the EM&Ts naming; one section about the highlights from the Survey to Companies for each EM&T; one section about the results from the Literature Review: common Gaps & Issues, and Methodological approaches, shared among the EM&Ts (Fig. 1). The tool and activity were introduced and facilitated by Venere Ferraro and Stefano Parisi, from Polimi. Data collection was carried out by taking notes directly on the poster. A whiteboard was used by one of the facilitators to keep records and organize the most relevant points of the discussion systematically.

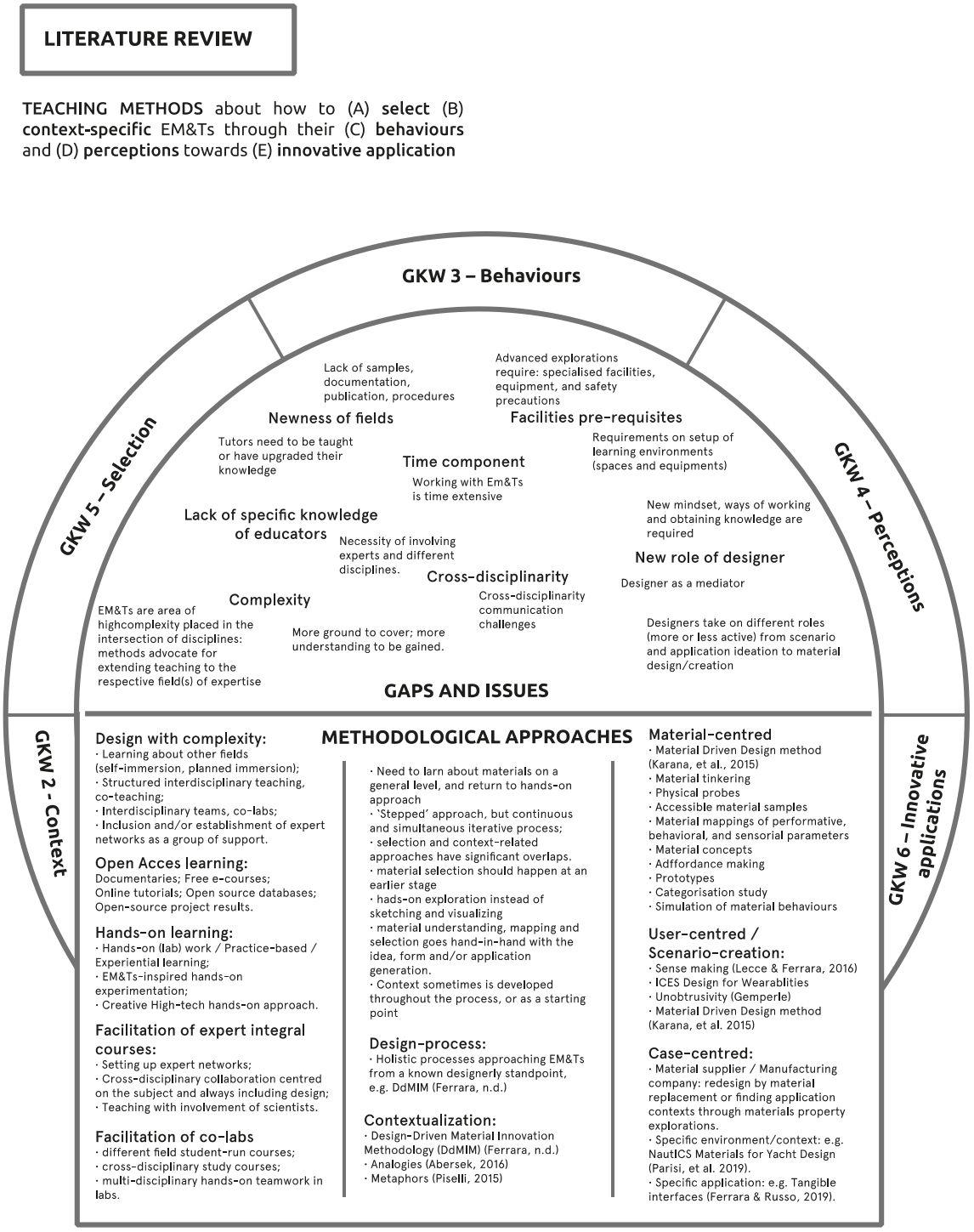


Fig. 1. A graphical representation of common gaps and issues contained in the 'shared ground' poster.

2.1.2 DAY 2

On Day 2 (the whole morning of the second day of the meeting), partners were invited to take part in the core activity of the workshop, after the introduction of the previous day. The aim of the activity was to discuss and elaborate on different topics related to each EM&T in order to complete and update the Logical Framework.

A set of tools had been designed by Polimi and printed out (A3 format) before the activity. The main topics of discussion had been classified and translated into a set of canvases named 'Towards a Logical Framework' [Annex 7.3] to fill out by the partners. Each canvas was provided with graphical elements, schemes, charts, and blank boxes to complete, supported by instructions and suggestions for each section. Rather than modules to complete in each section, the canvases work as a flexible tool to facilitate thinking and debating; participants could decide to focus more on one canvas they found more significant than other, or to move from one canvas to another with no specific logical sequence. Also, participants were welcome to use any techniques to work on the canvases, e.g. writing notes, keywords, sentences, drawings, sketches, mapping. For each EM&T, 4 canvases were produced having an identical structure and distribution of the contents:

1. 'Sum up'. The aim of this canvas was to provide a list of EM&T-specific gaps & issues from the literature review [D2.2] and the survey to companies [D2.3]. Also, it describes the role of the designer dealing with the EM&T area, as described in the literature review. Therefore, this canvas was not meant to be filled out, but any type of intervention was welcomed.

2. 'The EM&T.' The aim of this section was to identify the most relevant dimensions to describe the EM&T and position it on such aspects. This helps in characterizing the specific EM&T under a variety of lenses and perspectives, from the most technical and objective (e.g. price, performances, availability) to the most qualitative (e.g. self-communication, aesthetic values, authenticity). Also, it allows identifying criteria to compare and relate the different EM&Ts. In the canvas, participants were asked to identify some dimensions to position the EM&T, using a set of scales (1-axes parallel charts): they were welcomed to propose values, polarities and optional intermediate positions on the scale, place the EM&T; but also visualize on the scale the current position, and the future or expected one. Some example scales with given values and polarities were provided, e.g. the granularity of the EM&T (from nano to macro), the required technology (from low-tech to advanced), the availability (from low to high), the price (from cheap to expensive), technological readiness (from low to high). A blank box was also provided with the request to identify pillars that characterize the specific EM&Ts. Pillars may include approaches, mindset, methods, as well as tangible elements. The suggestion was identifying them starting from the gaps and issues in Canvas 1. 'Sum up'.

3. 'The role of the designer.' The aim of the section was to define the role of designers working in the specific EM&T and the kind of design process they apply. This activity will play a crucial role in determining the contents and formats of the Datemats unique teaching method. This can be achieved by identifying the most relevant dimensions to describe the role of the designer for the specific EM&T and position it on such aspects. Indeed, from the Literature Review [D2.2] a variety of roles and design tasks emerged in different EM&T (e.g. materials exploration, concept ideator). This helps to characterize the designer activity and role under a variety of lenses and perspectives and to identify criteria to compare and relate the designers working in the different EM&Ts. A set of scales (1-axis charts) and cross-maps (double-axes charts) were provided in order for participants to propose the most relevant dimensions to position the role of the designer working in this specific EM&Ts. Some example scales were presented, with given values and polarities, e.g. the focus (from the material to the application), the approach (from abstract to pragmatic). These example scales were intersected in an example cross-map, i.e. the value abstract/pragmatic approach crossing with the value application-/material-focuses identifying four areas in the quadrants: material selection, materials making, concept ideation, product prototyping. In addition, a blank box was provided with the request to visualize an outline of the design process to apply in this specific EM&T, focusing on the starting point, the main steps, the required tools, and methods. Another blank box was added with the request to elaborate a definition of the role and aim of the designer in this specific EM&T.

4. ‘Cross-disciplinarity.’ The aim of this canvas was to identify and name the intersecting disciplines framing the cross-disciplinarity for this specific EM&Ts. This activity will have a crucial role in determining contents, modules, teaching staff profiles, and other requisites in the formulation of the Datemats teaching method. The canvas provides a graphical scheme with intersecting bubbles representing the crossing disciplines working in the area, vaguely inspired by the Krebs Cycle of Creativity (Oxman, 2016). Participants were asked to identify the subjects and related practices and contents by filling the scheme. Then, they were asked to answer the following questions: how this cross-disciplinarity will affect the EM&T methodology setting up, materials, and pre-requisites? What are the requirements to enable the cross-disciplinarity? Where to find resources and expertise? Other comments.

In addition to the 4 ‘Towards a Logical Framework’ canvases, an updated version of the ‘Shared Ground’ poster was produced and printed out in leaflet format (A4) [Annex 7.2], with the following structure: one page about the EM&Ts naming and the results from the survey; a second page about the methodological approaches. This leaflet was provided to each participant as a sum up of the previous activity.

The tool and activity were introduced by Venere Ferraro and Stefano Parisi, from Polimi (Fig. 2). Participants were divided into small teams (four participants per group), to encourage interaction and discussion. Groups had a heterogeneous composition of the members, i.e. from different organization and countries, combining Academic partners with non-academic partners, as follow:

1. Group 1: Pirjo Kääriäinen, Aalto; Maria Isabel Rodriguez, Tecnun; Christian Bergman, IDC; Désirée Scalia, CIAPE
2. Group 2: Stefano Parisi, Polimi; Robert Thompson, Materfad; Anke Pasold, KEA; Petter Reuterholt, IDC.
3. Group 3: Mette Bak-Andersen, KEA; Ona Bombì, Materfad; Catarina Miranda, ISQ; Alba Obiols, BCD
4. Group 4: Aitor Cazon, Tecnun; Sara Lucia Rueda Mejia, Alto; Tânia Avelino, ISQ; Daniela Amandolese, MCI.

The room was organized, exhibiting a set of samples of materials from each EM&T provided by the partners on four different tables. Therefore, each table was assigned to a specific EM&T. Four copies (1 per group) of all the four canvases regarding each EM&T ere displayed on the related table. In rotation, groups had to move from one table to another, discuss and fill empty canvases on 25 minutes turn, and then leave the filled canvases on the table and move to the next one (Fig 3). At the end of the activity, participants were asked to verbalize their insights and opinions by presenting the results for each EM&Ts, 6 minutes for each EM&Ts (Fig. 4). A 15 minutes collective discussion followed (Fig.5). As for the previous day activity, a whiteboard was used by a facilitator to keep records and organize the most relevant points of the debate systematically. The second-day activity took around 2 hours and a half, in total. One facilitator, Venere Ferraro, from Polimi, introduced the activity and moved around the working tables to support the groups. In addition, the facilitator had the role of checking the time and guarantee that the scheduling of the activity was respected.

Figs. 2-5. Pictures portraying the workshop phases, from the explanation of the activities and tools, the use of the toolkit in small groups with the support of physical samples, the presentation of the results, followed by the collective discussion and the organization of the findings on a whiteboard.

2.2 DATA COLLECTION AND ANALYSIS

Data collection was done by Polimi by keeping all the filled canvases as a record, a tool for data collection and analysis. They were filled with notes, sketches, schemes containing opinions, and data generated by the group discussions on each EM&T. Also, audio-recording was used to collect data and opinions during the collective discussion and presentation for the results. The whiteboard used to record and organize the main relevant points of the debate was photographed and used for data collection. In addition, the facilitator took notes during the activity.

Collected data from all these sources were analysed by Polimi, producing transcripts of the audio tracks, and clustering relevant data on a digital wall. The obtained information was organized in a graphical representation of the Logical Framework, considered as a blueprint for the development and implementation of the Datemats teaching methods in the following phases of the project.

3 RESULTS: DATEMATS LOGICAL FRAMEWORK

The outcome of the Transnational Workshop is a representation of the Logical Framework for the four EM&Ts, on a portable digital file. The Logical Framework serves as an outline of the grounding for the unique teaching method to be applied in the distinctive EM&Ts areas, mainly based on Literature Review about EM&Ts methods and knowledge transfers [D2.2] and the Transnational Workshop [T 2.5]. A draft version was provided to partners for having feedback that was integrated into an updated version. The Logical Framework is divided into five sections, each corresponding to one page of the pdf, as follows:

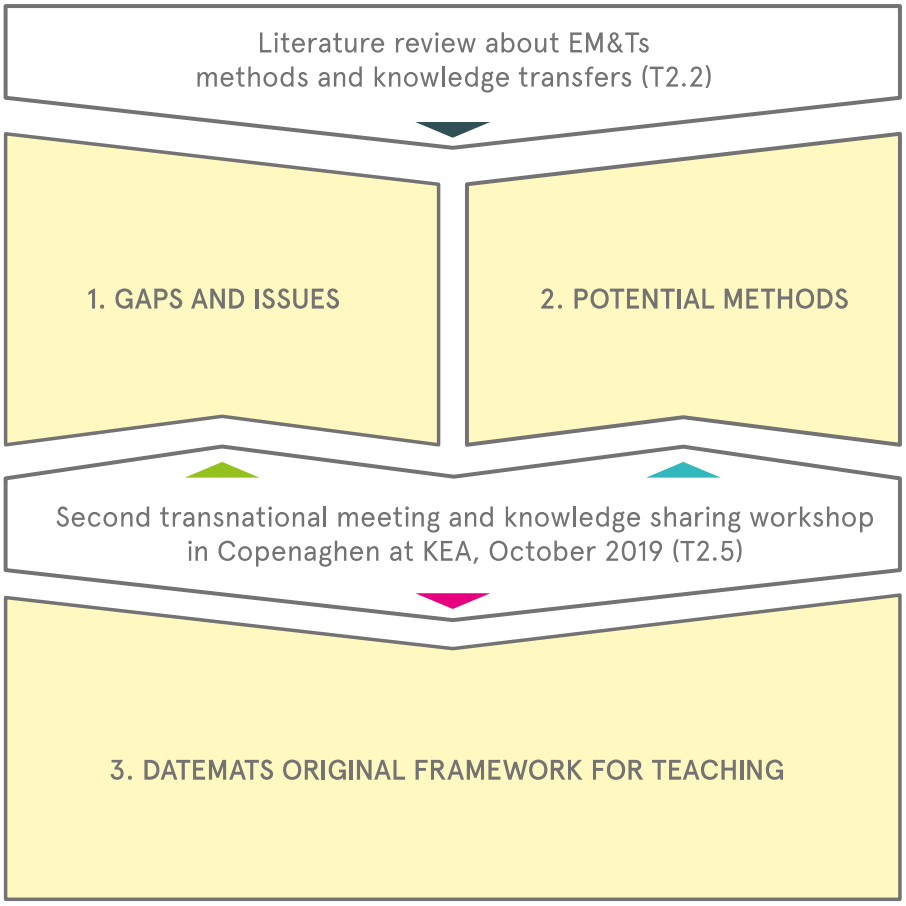
1. Index, methodology, and navigation tool
2. Common and Specific Gaps and Issues
3. Potential methods: State of the Art
4. Potential methods: Cross-disciplinarity
5. Datemats original framework for teaching.

In this section of the document, the main highlights from the Logical Framework are summarized. For an extended version of the Logical Framework, the complete and original file is attached [Annex 7.4]. It is also recommended to read the Literature Review about EM&Ts methods and knowledge transfers [D2.2], where issues, gaps, as well as methods are extensively described and supported by references to academic publications and other sources.

3.1 INDEX, METHODOLOGY, AND NAVIGATION TOOL

The first section of the Logical Framework serves both as an explanation of the methodology applied and an index of the contents as a graphical navigator to the document. It represents a graphical interpretation and re-elaboration of a flowchart describing the contents of each section, how they relate to each other, and how they are achieved. Each of the resulting blocks is numbered and entitled to the sections and parts the Logical Framework is divided. Each of the process blocks is numbered and entitled to the project tasks that contributed to the generation and information of the results. The description is supported by arrows.

The chart shows that ‘Common and specific gaps an issues’ and ‘Potential methods: State of the Art and Cross-disciplinarity’ are obtained by the Literature Review about EM&Ts methods and knowledge transfers [D2.2] and informed by the Transnational Workshop [T2.5]. The results and discussion from the Transnational Workshop [T2.5] brought to identify the ‘Datemats original framework for teaching.’ A schematic and reduced representation of the chart is replicated on each page of the Logical Framework file as a navigation tool.



3.2 COMMON AND SPECIFIC GAPS AND ISSUES

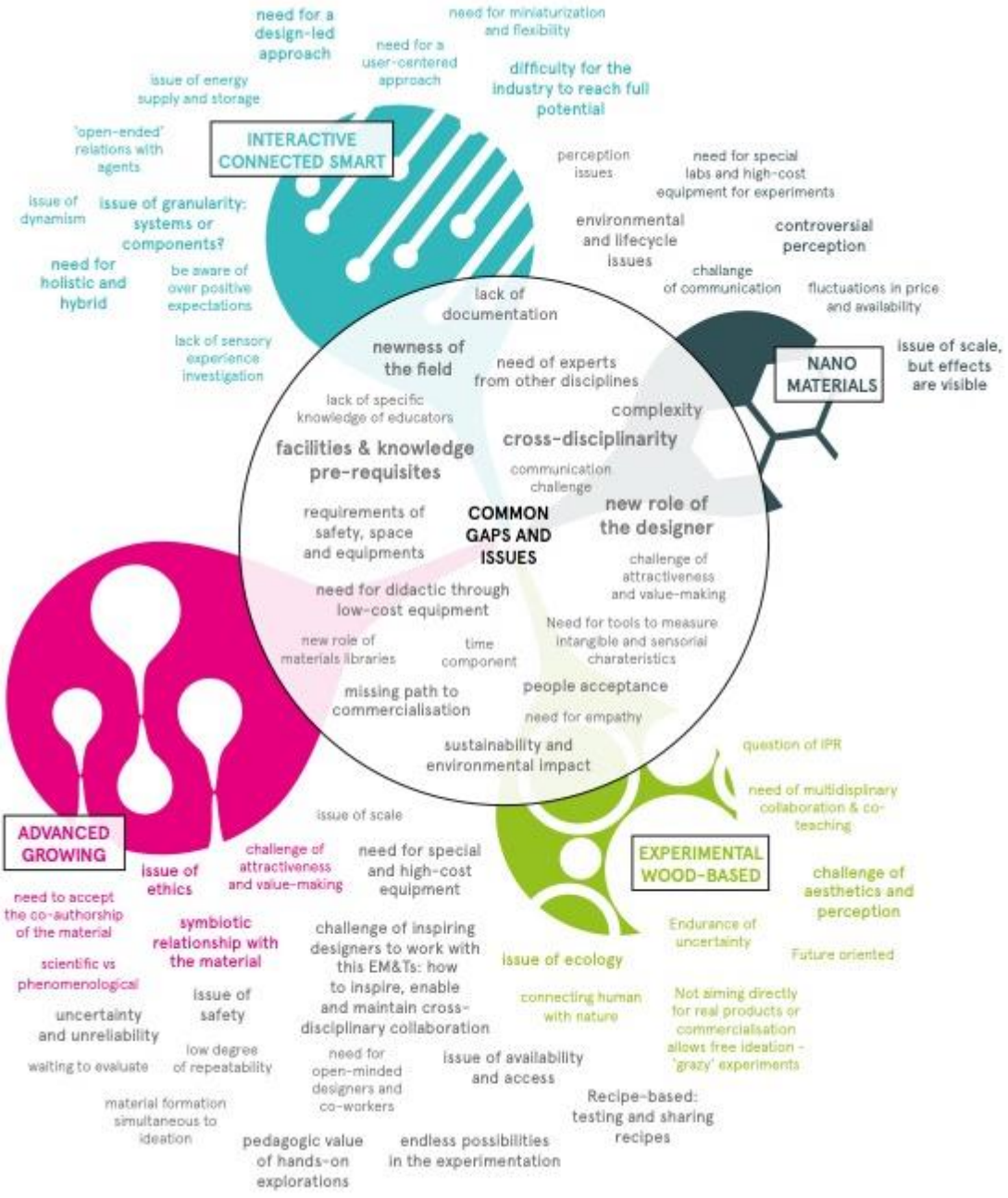
In this section, the Logical Framework presents the common gaps and issues as well as the ones for the distinctive EM&Ts. In particular, it is worthy of mentioning the issues and gaps that might have a direct implication into the formulation of didactic contents and definition of the course structure in the following Work packages: the complexity and cross-disciplinarity of the field that leads to the need of experts from other disciplines and opening up a challenge about communication and languages to use; the newness of the field causing a lack of documentation and specific knowledge of educators; the need to identify and provide facilities and knowledge pre-requisites, and in particular guarantee safety and use low-cost equipment for didactic; the need of integrating tools and contents about the experience, intangible and sensorial qualities of material, sustainability and environmental impact, commercialization and entrepreneurship.

Specifically, the ICS Materials EM&Ts area is characterized by the need for a holistic and hybrid approach considering material qualities & interactive behaviours, the physical & the digital, the system & the individual components, the technicalities & the experience. The Nanomaterials EM&Ts area is characterized by the need for specialized labs and high-cost equipment for experimenting, and the issue of scale and evidence of the technology. Both the areas share problematic lifecycle and environmental matters, controversial perception, and fluctuation in price and availability of the materials and techniques.

The Experimental Wood-based EM&Ts area is characterized by not aiming directly for real products or commercialization, which allows free ideation and ‘grazy’ experiments. The Advanced-growing EM&Ts area is characterized by a symbiotic relationship between the designer and the living material and the issue of ethics. Both the areas share the issue of time needed for the material to grow and

dry, which brings to detachment between the moment of intervention of the designer and the moment of observation of the result. They share a recipe-based and hands-on approach that leads to endless possibilities in the experimentation with a low degree of repeatability and high-rate uncertainty and unreliability. Both are involved in the interplay between a scientific approach versus a phenomenological approach.

Another result of this section is the definitive naming agreement for EM&Ts. Indeed, before the workshop, some of the names were still too broad. In the workshop an effort by the partner was made to reconsider the EM&Ts naming and outline more limited borders for their definition, i.e. Self-healing & Growing Materials was renamed as Advanced Growing Materials, Nanotech & Carbon-based Materials became nanomaterials, ICS Materials & Wearables was reduced to ICS Materials, and finally, Bio-materials & Wood-based was renamed as Experimental Wood-based materials.



3.3 POTENTIAL METHODS: THE STATE OF THE ART

In this section of the Logical Framework, a survey on potential methods to inspire or integrate into Datemats unique teaching method is presented. The potential methods ere classified in: case-centred (e.g. for specific material suppliers/manufacturing company, specific environment/context, specific application); contextualization (e.g. the use of analogies, metaphors, biomimicry); user-centred/scenario-creation (e.g. sense-making, unobtrusivity, and wearability); material-centred (e.g. material-driven design, material tinkering, experimental pedagogy, material mappings, material meanings, physical probes and material samples, material concepts, prototypes, simulation of material behaviours, affordance making); Design process.

The result is a holistic and 'stepped' but continuous and simultaneous iterative Design Process based on learning materials on a general-level and returning to a hands-on approach. The process may place material selection at an earlier stage, and context definition as a starting point or developed throughout the process. The process would prioritize hands-on exploration over sketching and

visualizing. Material understanding, mapping, and selection would go hand-in-hand with the idea, form and application generation.

3.4 POTENTIAL METHODS: CROSS-DISCIPLINARITY

The section is focused on cross-disciplinarity and co-teaching. Design with the complexity means: learning about other fields by self-immersion or planned immersion; structure interdisciplinary teaching and co-teaching; building interdisciplinary teams and co-labs; including or establishing expert networks as a group of support. Cross-disciplinary teaching is characterized by Open Access learning (e.g. open-source project results, open-source databases, documentaries, free e-courses, online tutorials), Hands-on learning (e.g. lab work, practice-based, experiential learning), Facilitation of expert integral courses (setting up expert networks, cross-disciplinary collaboration, teaching with the involvement of scientists), and Facilitation of co-labs (e.g. diverse field students-run courses, cross-disciplinary study courses, multi-disciplinary hands-on teamwork in labs).

Each EM&T stands at the intersection of three primary disciplines. Besides some minor distinctions and specifications, design and materials & manufacturing are common areas for each EM&Ts, while the third discipline is specific for each area.

ICS Materials EM&Ts area is situated in the intersection of design (e.g. human-centred design, design for disassembly, interaction design, visual design), materials & manufacturing (e.g. textiles), and computer ccience (e.g. digital technologies). By the triangulation of these disciplines, the design practice about this EM&Ts is unfolded as ‘Embedding & programming.’ Other relevant disciplines and knowledge fields involved in the area are ergonomics, psychology & perception, and sustainability & circular Economy. The definition of the Application sector emerges as fundamental, e.g. health, sports, military, but not limited to wearables, e.g. automotive, architecture, furniture.

Nanomaterials EM&Ts area is situated in the intersection of design (e.g. creativity and Design Thinking for innovative application), manufacturing processes, and ‘hardcore’ science (e.g. material science, chemistry, physics). By the interplay of these disciplines, the design practice in relation to this EM&T is unfolded as ‘Super-empowering & Biomimicry’. Other relevant disciplines and knowledge fields involved in the area are sustainability, economics & marketing, psychology & perception.

Experimental Wood-based EM&Ts area is situated in the intersection of design (e.g. material exploration, user-centred design), manufacturing (e.g. crafting, making, fabrication, and producing), and chemistry (e.g. chemical engineering, material sciences). By the triangulation of these disciplines, the design practice concerning this EM&T is unfolded as ‘experimental cooking.’ Other relevant disciplines and knowledge fields involved in the area are biology, engineering, arts, psychology & perception, and sustainability & ecology. The interaction with the Service sector emerges as fundamental, e.g. new businesses for recycling and reuse for composting.

Advanced Growing EM&Ts area is situated in the intersection of design (e.g. material exploration), manufacturing (e.g. crafting, making, producing), and biology (e.g. biotechnological Science). By the triangulation of these disciplines, the design practice in relation to EM&Ts is unfolded as ‘growing.’ Other relevant disciplines and knowledge fields involved in the area are chemistry, ethics, communication, psychology & perception, and Sustainability (e.g. engineering for production processes and lifecycles).

DESIGN WITH THE COMPLEXITY

- Learning about other fields (self-immersion, planned immersion);
- Structured interdisciplinary teaching, co-teaching;
- Interdisciplinary teams, co-labs;
- Inclusion and/or establishment of expert networks as a group of support.

Open Acces learning

- Open-source project results.
- Open source databases;
- Documentaries;
- Free e-courses;
- Online tutorials;

Hands-on learning

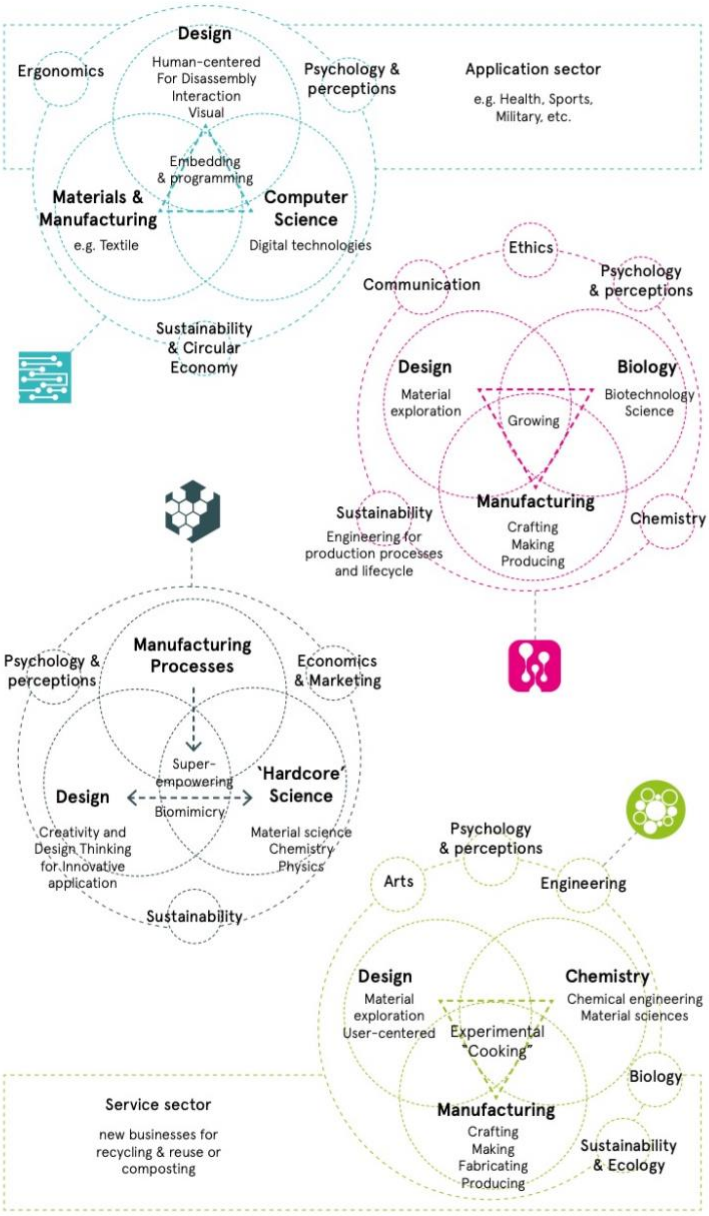
- Hands-on (lab) work / Practice-based / Experiential learning;
- EM&Ts-inspired hands-on experimentation;
- Creative High-tech hands-on approach.

Facilitation of expert integral courses

- Setting up expert networks
- Cross-disciplinary collaboration centred on the subject and always including design
- Teaching with involvement of scientists

Facilitation of co-labs

- diverse field students-run courses
- cross-disciplinary study courses
- multi-disciplinary hands-on teamwork in labs

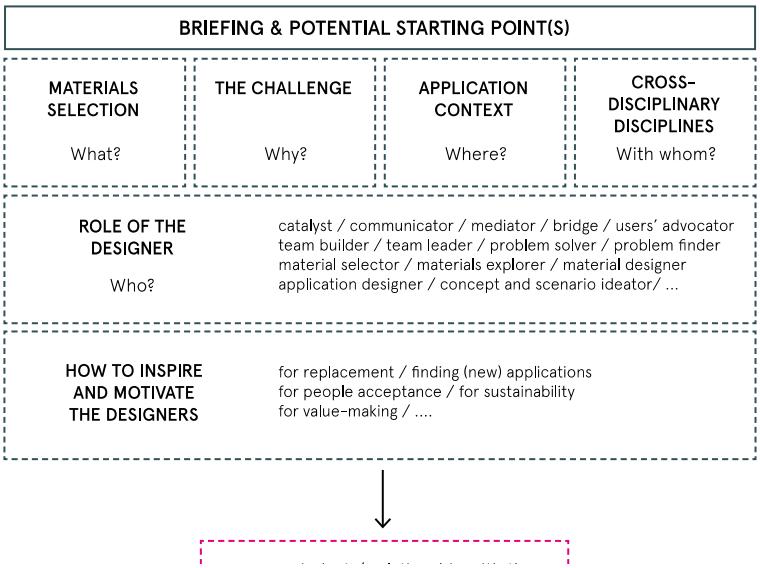


3.5 DATEMATS ORIGINAL FRAMEWORK FOR TEACHING

The last section of the Logical Framework outlines an original framework for teaching.

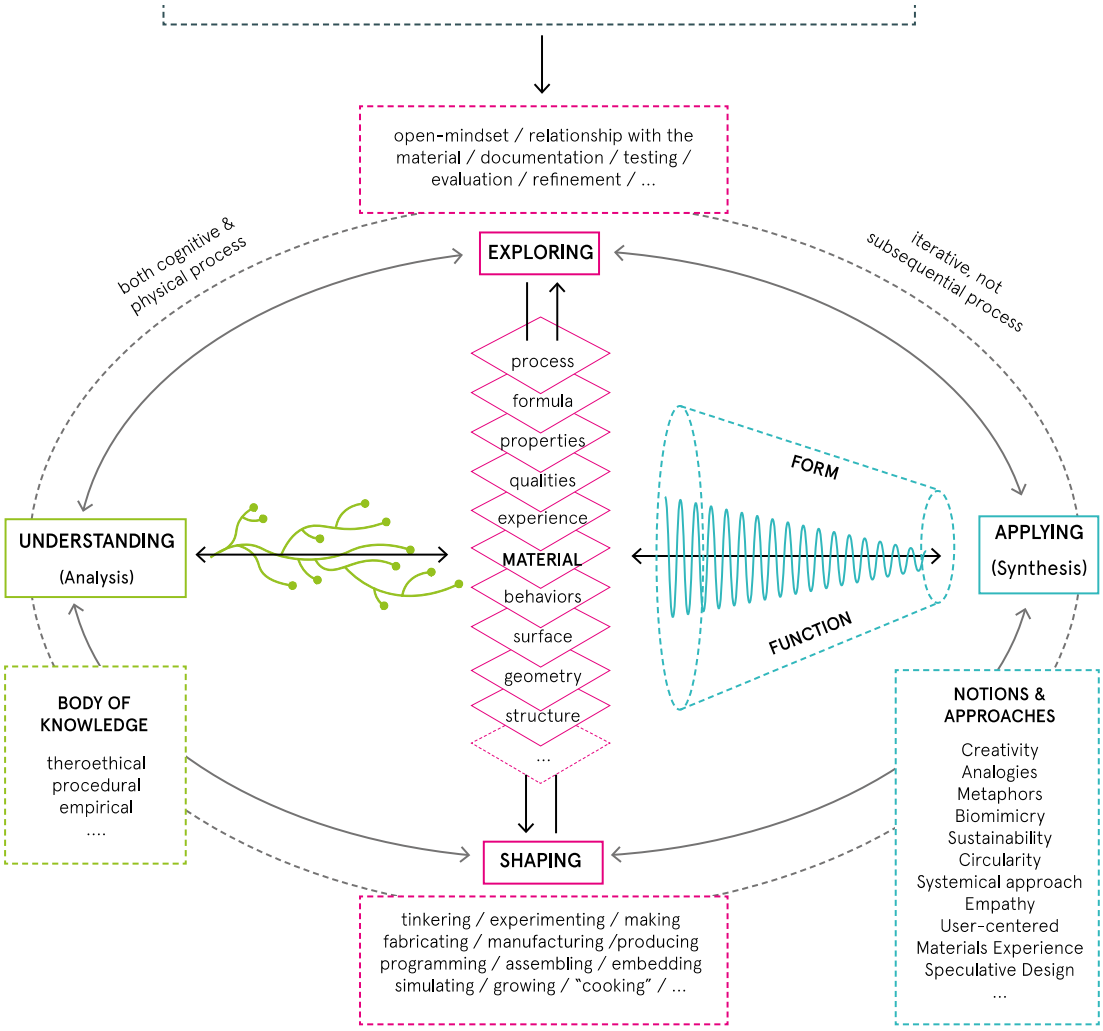
The application context definition and materials identification could be the starting point of the process. Indeed, the briefing and potential starting point(s) for the design didactics on EM&Ts are presented using the 5 Ws (i.e. What, Why, Where, With whom, and Who) and one How questions:

- Selection of the material (i.e. What?)
- A Design challenge (i.e. Why?)
- Application Context (i.e. Where?)
- Cross-disciplinary disciplines (i.e. With whom?)
- The role of the designer as: catalyst, communicator, mediator, bridge, users' advocator, team builder, team leader, problem solver, problem finder, material selector, material explorer, material designer, application designer, concept and scenario ideator, etc. (i.e. Who?)
- And finally, how to inspire and motivate designers for: replacement, finding (new) applications, for people acceptance, for sustainability, for value-making, etc. (i.e. How?)



The teaching and learning process is both cognitive and physical and is based on the identification of three main didactic blocks: Understanding, Shaping/Experimenting, and Applying. Although the description of the process establishes a chronological succession of the three blocks, they are profoundly intertwined, iterating, and often simultaneous and overlapping in their definition.

1. 'Understanding' is a module where the fundamental knowledge is given to students. It is based on a varied body of knowledge (e.g. explicit, tacit, theoretical, procedural, empirical) and the sources for acquiring knowledge can be a mix of material-produced (e.g. interaction with material samples), interpreter-produced (e.g. discussion with instructors, experts, and peers), and representation-produced (e.g. studying on texts and videos).



2. 'Shaping/Exploring' is the connecting block between 'Understanding' and 'Applying.' This is the block where tacit knowledge is mainly acquired. Exploring and Shaping represent two sides of the same block. While Exploring put emphasis on the designer getting knowledge on the materials and processes by iterating, documenting and evaluating, Shaping is focused on the material being manipulated in many ways, e.g. tinkering, making, fabricating, manufacturing, producing, programming, assembling, embedding, simulating, growing, cooking. The initial stages of this block move ahead from the Understanding phase by exploring all the different opportunities that the material can exploit, with trials and errors, obtaining successes and failures. Multiple directions or 'branches' are identified, outlining a divergent 'branch-like' process. In this block, the material is experimented and shaped on its multiple dimensions, namely the process, the formula, the properties, the qualities, the experience, the behaviours, the surface, the geometry, the structure, etc. Approaching the 'Applying' block, only one direction – or 'branch' – for material development is selected, and a converging and iterative process is applied, targeting the definition of form and function.

3. 'Applying' block represents the synthesis of the process when the material is embedded and encoded into a project. In this block, the main strategies and approaches that are applied are: creativity, analogies, metaphors, biomimicry, sustainability, circularity, systemic approach, empathy, user-centred design, materials experience, speculative design, etc.

4 DISCUSSION AND CONCLUSIONS

The Transnational Workshop has reached the aim of sharing knowledge and creating a consensus and clarification among the partners on the results and outcomes of the first tasks of the projects. Moreover, the Transnational Workshop supported the implementation at a Transnational level of all the key information collected via desk research and already implemented at each National level; according to the specific needs, the partners have brought a more in-depth national view. The Logical Framework for the four EM&Ts and the original Teaching Method is the principal result of the task. Pictures of the workshop are attached to the report [Annex 7.5].

The framework is based on literature review and collective discussion on a participatory activity in order to obtain the highest agreement between partners and a proper degree of scientific referencing to academic sources.

The framework has an inclusive nature, which tends to accommodate every definition and elements. However, it is evident that each area and institution have its own specific needs and characteristics. In order to create a universal and common framework for all areas and institutions, it may happen that some aspects are banalized in the process of universalization. Efforts have been made to avoid banalization, e.g. avoid creating the neat distinction between explicit knowledge delegated to learning theory in a traditional classroom and tacit knowledge destined only to practical activities in workshops, which separation is outdated and characteristic of a surpassed way of teaching design.

Another challenge was faced when some concepts that are typical of an area have been extended to other areas, with the risk to become irrelevant. Efforts have been made to highlight when elements are distinctive of one EM&T area, when elements are belonging to two or more EM&Ts, and when shared by all, creating distinctions.

Attention was dedicated to preserving and reporting definitions and categories already identified in previous deliverables, enriching and updating them with new information, instead of altering them.

Concluding, the Logical Framework arises as one pillar of the research project's core. It will have direct implications in the definition of contents and formats in task and deliverables in the following Work packages, e.g. Training contents of the specific teaching method for each EM&T [D3.1], Pre-mobility [D3.2], EM&Ts Transfer Toolkit [D3.4] in Work Package 3; potentially, in the definition of training contents and exercises addressed to companies [D4.2] and in the Knowledge Transfer Lab [D4.3] in Work Package 4; ultimately, in the Interdisciplinary EMT&s challenges [D5.3] and in the final version of the EM&Ts Transfer Toolkit [D5.4]. Therefore, the Logical Framework is fundamental for determining how the project would approach tasks related to HEI education in the EM&Ts field, Industry, and the design of an innovative material toolbox. By project description, the Logical Framework will be contained by the e-book [D2.4].

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6 CREDITS

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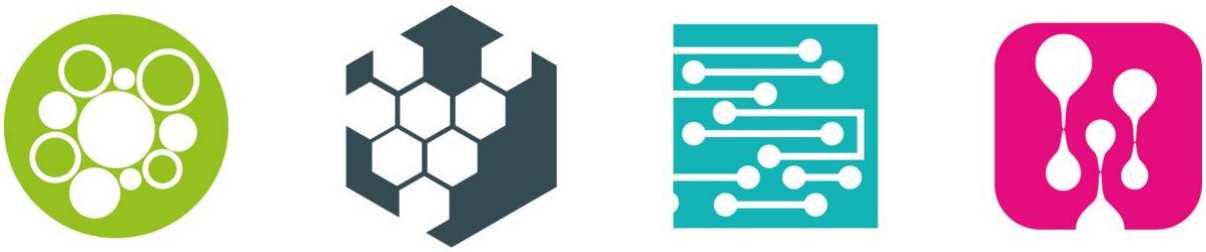
7 ANNEXES

7.1 'Shared Ground' poster, by Polimi

7.2 'Shared Ground' updated leaflet, by Polimi

7.3 'Towards a Logical Framework' canvases, by Polimi

7.4 The Logical Framework file, by Polimi with the contribution of all the partners



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