CRAEFT

care, judgment, dexterity

Exploitation Plan and Activities

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http://www.craeft.eu/

Executive summary

This deliverable presents the activities towards project results exploitation conducted during the first year of the project. To this end, the exploitation strategy of Craeft is defined that reflects the key exploitation principles: (a) Identify different types of exploitable results, (b) recognize and counter the barriers and risks for exploitation, (c) describe measures to ensure that the results meet real needs, (d) describe the roles and responsibilities and (e) sets possible supporting results of exploitation by third parties.

Towards this direction, during the first year of the project, the following actions took place. Initially, the potentially exploitable results of the project were identified for each WP and Task. For each exploitable result, a description was provided. Then the partners responsible for each task were requested to justify the innovation that each result brings towards different directions i.e. technological, research, product, service etc and justify the market potential. Furthermore, the potential IPR holders were identified following the contributions of each partner per WP and Task. Of course, this will be redefined later on in the project based on the actual partner's contribution to the creation of each of the exploitable outcomes.

The end of the first year brings Craeft to a position of having defined its potential outcomes, innovation and market potential. Furthermore, a strategy for the common exploitation of results has been identified without excluding the potential for individual exploitation or exploitation by third parties.

The above-mentioned definitions, methods, and plans will be redefined as the project matures to formulate a solid exploitation strategy covering both aspects before and after the end of the project. The next steps include a market analysis for each exploitable outcome to best position the Craeft results in conjunction with the target market and audience.

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Abbreviations

AR	Augmented Reality
CAP	CRAEFT Authoring Platform
CH	Cultural Heritage
CHI	Cultural Heritage Institutions
CrO	Crafts Ontology
ICH	Intangible Cultural Heritage
IPR	Intellectual Property Rights
WCC	World Crafts Council

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1 Introduction

Craeft is a collaborative Project founded by the EU, based on tangible and intangible Heritage assets, especially in Crafts (HC). Exploitable results from European projects may arise in many forms. In addition to technologies that might form the basis for commercial products, such exploitation opportunities could include (a) the potential of creating spin-off companies, (b) protecting results through patents and IPR agreements, (b) feeding results into further EU RTD projects, (d) feeding results and know-how into national or industrial R&D projects, (e) making part of the results freely available and (f) developing new services.

The consortium will look at the full spectrum of exploitation opportunities and involve all partners, academic, industrial, and CH stakeholders, in the exploitation efforts. Emphasis will be placed on the opportunities for offering services to be developed as commercial products or as free or subscription-based services. In that respect, Intellectual Property is a significant aspect that will be considered to ensure a mechanism for exploiting the potential results of cooperative work among partners. Commercial exploitation of Craeft will be enabled through further development of local partnerships, while it will be provided by the consortium to the interested stakeholders, who will then be responsible for offering and integrating these to the local user groups.

Craeft project has a strong expertise in digital technology, and one of its main aims is to enable the capture and preservation of knowledge and craft techniques that constitute part of our cultural heritage.

New solutions identified within the project will show key benefits in systematic research, recording, and representation of crafts. Indeed, the technological results of the project will not only benefit individual partners but will also become beneficial for the positive external benefit to local communities and the common European history and heritage.

2 Craeft exploitation strategy

The exploitation strategy of Craeft reflects the key exploitation principles:

- Identify different types of exploitable results (knowledge, methods, networks, technologies) considering their direct and indirect value and impact on different stakeholders.
- Recognize and counter the barriers and risks for exploitation (actual use of the results after project funding) with appropriate measures
- Describe concrete measures to ensure that the results meet real needs, and will be taken up by potential users (e.g. engaging them in the project)
- Describe the roles and responsibilities of partners in exploiting results
- Sets possible supporting results of exploitation by other (intermediate or end) users of the extent of culture, like education centres, creative industries, tourism, institutions etc.

To adhere to these principles, the exploitation of Craeft developments is considered an ongoing activity throughout the project. The project consortium also aims to identify exploitation benefits for each partner. The following are actions that are going to be followed during Craeft exploitation:

- Identify the exploitation potential of each partner
- Respect the Intellectual Property Rights by conducting an of the IPR in the deliverables and this will be incorporated in the final version of this deliverable that will be produced in M36.
- Continue exploitation activities, after the end of the project, if financially self-sufficient and examine during the project how to systematise this process and continue the exploitation (and additional dissemination) as this will maximise the impact of the CRAEFT results.

3 Innovative results per WP

3.1 WP1 - Understanding and digitalisation

3.1.1 Ethnographic strategies for craft understanding

Developing an ethnographic method adapted to the project's context is at the core of our objectives. The challenge is to establish an interdisciplinary methodology between Artificial Intelligence and Social Sciences that allows the consortium to understand and compare different technical actions in artisanal work settings. For this purpose, a protocol for craft understanding has been developed. It is used consistently in each craft instance and facilitates a reliable comparison of the data collection. The protocol helps structure each "dataset" on a solid experimental basis and ensures the success of the other technological tasks of the project. The protocol is structured around three interrelated survey methods. First collecting functional et structural data in defining the action with the craftspeople, observing, and documenting the operational sequences. Then collecting individual and professional data in conducting life course interviews with the craftspeople. Finally, collecting verbal and emotional data through video elicitation of the operational sequences of craftspeople. This data collection methodology helps avoid the personal bias of the ethnographer in craft understanding but also contextualises the gesture recognition data with the point of view of the crafts practitioner.

The rationale for the innovation

- **Implementation of an inclusive protocol for craft understanding:** this new ethnographic strategy is deeply inclusive because it puts the craftspeople's expertise at the centre of the strategies. The craftspeople's point of view is incorporated right from the introduction of the craft understanding up to the end. The craftspeople introduce and define the action on materials to be recorded. This technical action, once it has been accomplished, is contextualised with the individual and personal journey of the craftspeople inside the broader documented craft techniques. This intrinsically non-verbal action on the material is finally verbalised by the craftspeople themselves to make sense of the recorded data.
- **Facilitating dialogue between Artificial Intelligence and Social Sciences:** the protocol for craft understanding frames craft representation, digital re-enactment, education and training interface, and design. In that sense, it facilitates dialogue between the pragmatism of ethnographic research with the formalism of artificial intelligence. This interdisciplinarity produces innovative knowledge about crafts practices because it forces social sciences and computer sciences to question their theoretical and methodological presuppositions about craft understanding and representation.
- **Generating comparable data:** the protocol for craft understanding allows collecting a standardised dataset from heterogeneous craft instances. This standardisation is a prerequisite for the project comparative approach notably for the action and affordance modelling, and the maker-material-negotiation model
- **Ensuring replicability and transferability:** the comparative approach of the project for modelling craft gestures requires the replicability and transferability of the protocol beyond the crafts instances of the project and the technologies used in gesture recordings and representations. The protocol must then be flexible enough to adapt to local crafts needs and the constraints of various researchers using it while being robust enough to maintain a common identity from one case to another

- **Enhancing material knowledge transmission:** the application of the protocol for craft understanding in institutions for material knowledge transmission (vocational schools, schools of fine arts and design, and museums), and the use of the data collection for craft representation, prompt the project to enhance skills transmissions for future generations.

Market potential

- **Interdisciplinary Research and Collaboration**: The methodology bridges the gap between AI and Social Sciences, facilitating interdisciplinary research collaborations. This opens up opportunities for academic institutions, research organizations, and technology companies to engage in joint projects that leverage both technological advancements and social research methodologies. Market demand exists for solutions that integrate diverse perspectives to address complex challenges in various domains, ranging from healthcare to urban planning.
- **Craft Understanding and Comparison**: By establishing a standardized protocol for craft understanding, the methodology enables the consortium to compare different technical actions in artisanal work settings systematically. This standardized approach enhances the reliability and consistency of data collection, providing valuable insights for both academic research and practical applications. Market demand exists within industries that rely on artisanal work, such as luxury goods manufacturing, fine arts, and cultural heritage preservation, where understanding and improving craft techniques are crucial for quality control and innovation.
- **Experimental Basis and Technological Tasks**: The protocol ensures that each dataset is structured on a solid experimental basis, which is essential for the success of other technological tasks within the project. This methodology-driven approach enhances the efficiency and effectiveness of AI-driven tasks, such as gesture recognition and pattern analysis. Market demand exists within the technology sector for methodologies that facilitate robust data collection and analysis, especially in fields like machine learning, computer vision, and natural language processing.
- **Data Collection Methodology**: The three interrelated survey methods employed in the protocol - collecting functional and structural data, individual and professional data, and verbal and emotional data - offer a comprehensive approach to understanding artisanal work. This methodology helps avoid personal bias and contextualizes gesture recognition data from the practitioner's point of view, enhancing the validity and applicability of the findings. Market demand exists for methodologies that combine qualitative and quantitative approaches to data collection and analysis, particularly in fields like consumer behaviour research, market research, and product development.
- **Applications in Various Industries**: The insights generated through the ethnographic methodology have applications across a wide range of industries beyond traditional crafts. Industries such as manufacturing, healthcare, education, and entertainment can benefit from a deeper understanding of human behaviour, interactions, and decision-making processes. Market demand exists for methodologies that provide actionable insights into user experiences, product design, and process optimization.

IPR holders

Ethnographic strategies for craft understanding have been conceptualised by the entire Craeft consortium that holds the IPR of this innovation.

3.2 WP2 - Craft representation

3.2.1 Archetypal action simulators

Archetypal Action Simulators are a vital component of the project's goals. The focus is on Action and Affordance Modelling, involving digitizing practitioner motion, haptic interaction, and material transformations. This results in instantiating Elementary Actions with specified affordances, conditions, and parameters. A comprehensive training dataset is compiled, associating semantic, geometric, and mechanical representations of actions and plans with multimodal execution recordings across various materials. The Archetypal Action Simulators computationally, geometrically, and mechanically model Elementary Actions such as knots, additive/subtractive processes, and free-form transforms. When executed, the simulations predict the results of actions based on their parameters and the simulated environmental conditions. The Archetypal Action Simulators play a crucial role by providing predictive insights into the outcomes of various crafted actions.

The rationale for the innovation

- **Enhanced Understanding through Simulation:** Archetypal Action Simulators offer a novel approach to understanding crafting processes. Simulators provide a dynamic platform to simulate and visualize the outcomes of various crafting actions by computationally, geometrically, and mechanically modelling Elementary Actions. This enhances the understanding of material transformations, contributing to a more profound comprehension of craftsmanship.
- **Predictive Capabilities for Crafting Outcomes:** The simulations predict the results of actions based on their parameters and simulated environmental conditions. This predictive capability is a significant innovation, as it gives practitioners insights into the potential outcomes of their crafting decisions. This feature can be a valuable tool for refining and optimizing crafting processes.
- **Integration of Generative AI Methods:** Leveraging generative AI methods for learning the results of actions from datasets adds a layer of intelligence to the simulators. The ability to learn and adapt from diverse datasets generated in T1.5 enables the simulators to continually improve their predictive accuracy over time, fostering a dynamic and evolving system.
- **Cross-Material Predictions:** The training dataset, containing similar actions across diverse materials, allows the simulators to make cross-material predictions. This innovation is particularly valuable in crafting, where practitioners work with various materials. The simulators contribute to a more versatile and adaptable approach to crafting processes.
- **Integration of Haptic Interaction and Practitioner Motion:** By digitizing practitioner motion and incorporating haptic interaction into the modelling process, the simulators bridge the gap between digital representation and real-world craftsmanship. This integration enhances the authenticity of simulations, making them more reflective of actual crafting experiences.
- **Application in Training and Skill Development:** The Archetypal Action Simulators can potentially enhance training and skill development in crafting. Practitioners, especially novices, can use the simulators to practice and refine their skills in a virtual environment, accelerating the learning curve and fostering a more skilled and knowledgeable community of craft practitioners.
- **Transferability to Various Crafting Domains:** The versatility of the simulators, which can model various elementary actions and materials, makes them transferable across different crafting domains. This adaptability ensures that the innovation is not confined to specific contexts, expanding its potential impact across various crafting practices.

Market potential

- **Crafting Industries and Artisan Communities:** Craft and artisan communities can leverage Archetypal Action Simulators to enhance craftsmanship, optimize material usage, and predict outcomes. This innovation can potentially become an integral tool for artisans, designers, and makers across various domains, fostering efficiency and creativity.
- **Manufacturing and Prototyping:** Industries involved in manufacturing and prototyping, especially those that focus on bespoke or customized products, can benefit from the simulators' predictive capabilities. This can streamline production processes, reduce material waste, and facilitate more precise prototyping.
- **Education and Training Institutions:** Educational institutions offering courses in design, crafting, and related fields can incorporate Archetypal Action Simulators into their curriculum. These simulators could be valuable training tools, providing students with a virtual environment to practice and refine their crafting skills before working with physical materials.
- **Simulation Development:** Companies specialising in simulation technologies, such as VR and AR, can explore opportunities to integrate Archetypal Action Simulators into their platforms. This integration could create immersive crafting experiences, allowing users to interact with simulated materials and refine their skills in virtual environments.
- **Software Development for Crafting Tools:** Software developers creating crafting tools and applications may find value in integrating Archetypal Action Simulators. This can enhance the functionality of crafting software, providing users with a predictive and interactive toolset for planning and executing crafting actions.
- **Consulting Services for Craftsmanship Optimization:** Consulting firms specialising in craftsmanship optimization, process improvement, and design efficiency can incorporate Archetypal Action Simulators into their services. This innovation can be a valuable asset for consulting engagements to enhance crafting processes across industries.
- **Cross-Industry Applications:** The versatility of Archetypal Action Simulators, capable of modelling various actions and materials, expands their market potential across diverse industries. This adaptability makes them applicable in fields such as architecture, fashion, product design, and more, broadening the scope of their impact.
- **Start-ups in Craft-Tech Innovation:** Start-ups focusing on the intersection of crafting and technology may find opportunities to develop niche applications or platforms based on Archetypal Action Simulators. This innovation can be a driving force for entrepreneurial ventures seeking to redefine and innovate within the crafting landscape.
- **Materials Science and Innovation:** Industries and research institutions involved in materials science can explore the use of Archetypal Action Simulators for testing and predicting material behaviours. This application can contribute to material innovation and the development of new materials optimised for specific crafting processes.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are KHORA, FORTH, ARMINES, CETEM, CNAM, PIOP, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.2.2 Maker-Material-Negotiation model

The ontology for maker-material negotiation, built upon the CIDOC CRM-based Craft Ontology (CrO), innovatively models tools, materials, workspaces, and contextualization narratives. It extends CrO to encompass action plans, and hypotheses providing a nuanced understanding of the interaction. Encoded in RDF Schema and transcribed to OWL 2 DL, the model supports computational inference, enhancing decision-making in crafting. Its adaptability, accommodating diverse crafting scenarios, fosters innovation. Contextualization narratives add a storytelling dimension, documenting processes and influencing qualitative understanding. Aligned with computational requirements, the ontology seamlessly integrates with existing systems, offering new possibilities for research and innovation in crafting.

The rationale for the innovation

- **Enhanced Understanding of Crafting Processes:** The ontology aims to capture the intricacies of the negotiation between makers and materials, providing a structured representation of tools, materials, workspaces, and the dynamic nature of crafting processes. This fosters a more detailed and nuanced understanding of the interaction between makers and the materials they work with.
- **Integration of Cognitive Elements:** By extending the Craft Ontology (CrO) to accommodate action plans, material effects of actions, action hypotheses, conditions, and parameters, the work goes beyond traditional ontologies. It integrates cognitive elements, allowing for a comprehensive representation of the maker's decision-making processes, and hypotheses.
- **Support for Computational Inference:** The encoding of the model in RDF Schema and transcribing it to OWL 2 DL introduces computational inference capabilities. This facilitates automated reasoning and deduction, enabling the system to conclude, make predictions, and support decision-making processes in crafting. This aspect adds a layer of intelligence to the representation, enhancing the overall functionality.
- **Facilitation of Action Plans and Hypotheses:** The inclusion of action plans, hypotheses, and related elements provides a structured framework for makers to plan and execute their crafting activities. This not only supports the practical aspects of crafting but also encourages a systematic exploration of different approaches, contributing to innovation in crafting methodologies.
- **Adaptability and Flexibility:** The extended Craft Ontology allows for the accommodation of various elements, making it adaptable to different crafting scenarios and materials. This flexibility is crucial for accommodating the diversity within the crafting domain and fostering innovation by supporting a wide range of making practices and materials.
- **Contextualization Narratives:** The ontology allows us to formally represent narratives, adding a storytelling dimension to craft processes. This feature provides valuable insights into the contextual factors influencing decision-making. This narrative aspect enhances the qualitative understanding of crafting and opens avenues for storytelling within the maker community.
- **Alignment with Computational Requirements (T3.3 & T3.4):** The use of RDF Schema and OWL 2 DL aligns with computational requirements (T3.3 & T3.4), ensuring that the ontology can be effectively used in computational environments. This compatibility enhances the integration of the ontology into existing computational systems, supporting a seamless interaction between the crafted model and computational tools.

Market potential

- **Industry Adoption:** Industries related to crafting, manufacturing, and design could benefit from this innovation. Companies involved in product development, prototyping, and creative design may find

value in a structured model that enhances the understanding and optimization of maker-material interactions.

- **Education and Training:** Educational institutions and training programs in fields such as industrial design, fine arts, and craftsmanship could integrate this innovation into their curriculum. It could serve as a valuable tool for teaching and training aspiring makers, providing a more comprehensive and computational understanding of crafting processes.
- **Technology Integration:** Technology companies specialising in virtual reality (VR), augmented reality (AR), and simulation technologies may find applications for integrating the ontology. The model's support for contextualization narratives aligns with immersive technologies, opening avenues for collaborative and interactive crafting experiences.
- **Research and Development:** Research institutions focusing on material science, cognitive science, and human-computer interaction could leverage this innovation for interdisciplinary studies. The ontology's ability to capture and represent complex interactions offers a valuable framework for R&D initiatives exploring novel materials, crafting techniques, and human-machine interfaces.
- **Artisan and Maker Communities:** Artisanal and maker communities could embrace ontology as a tool for enhancing creativity, problem-solving, and collaboration. It may find applications in co-creation projects, where makers collaborate on innovative designs and share experiences within a standardized framework.
- **Software and Tool Development:** Companies developing software tools for makers, such as crafting software, project management tools, or design platforms, could integrate elements of the ontology. This integration could enhance these tools with intelligent decision-making support, improving overall efficiency and outcomes.
- **Marketplaces for Crafted Goods:** Platforms connecting makers with consumers could benefit from innovations that elevate the quality and uniqueness of crafted goods. The ontology's ability to capture nuanced crafting processes may be attractive to marketplaces seeking to highlight the craftsmanship behind products.
- **Consulting and Expert Services:** Consultancy services specialising in crafting, designing, and creative processes may find opportunities to offer expertise in implementing and customizing the ontology. This could involve assisting companies in adapting the model to their specific needs and workflows.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are CNR, FORTH, CETEM, CNAM, PIOP, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.2.3 CRAEFT Authoring Platform

The Craft Authoring Platform (CAP) is an innovative system designed to extend the capabilities of the Craft Ontology (CrO) and enhance the Craft Authoring process. Built upon the existing Craeft Online Platform (MOP), CAP serves as a comprehensive framework that facilitates the instantiation of entities from the extended ontology and provides additional services to streamline the craft authoring workflow. One of the key features of CAP is its ability to associate semantics and signals with new entities such as elementary actions and affordances, expanding the richness of MOP. This extension enables a more nuanced representation of crafting-related concepts, fostering a deeper understanding of the craft authoring process.

CAP integrates seamlessly with the CrO to instantiate entities efficiently, allowing users to author and manage a diverse range of crafting-related knowledge. The platform goes beyond traditional authoring tools by incorporating services that enhance the crafting experience, providing a comprehensive environment for crafting-related activities. A significant aspect of CAP is its integration with the CIDOC-CRM (Conceptual Reference Model) and EDM (Europeana Data Model). By orienting all entities and data to the central "Event" class in both models, CAP ensures compatibility and interoperability. This strategic alignment allows assets and entities created within CAP to be accessible via the Semantic Web and Europeana, contributing to a broader dissemination of craft-related knowledge and digital assets.

Furthermore, CAP introduces a novel approach to linking knowledge entities with digital assets. This includes the reconstruction of objects and the recording of actions, creating a dynamic and interactive connection between the crafted entities and their digital representations. This linking mechanism enhances the overall documentation and preservation of craft-related processes, fostering a more immersive and comprehensive understanding of crafted objects and actions.

The rationale for the innovation

- **Holistic Craft Authoring Experience:** CAP innovatively extends the Craft Ontology (CrO), enhancing the crafting authoring process with an enriched set of entities, including hypotheses and affordances. This extension contributes to a more comprehensive and nuanced representation of crafting activities, fostering a deeper understanding of the craft domain.
- **Semantic Enrichment and Signal Association:** By associating semantics and signals with new entities, CAP goes beyond conventional authoring platforms. This innovation allows craft practitioners to articulate and capture the subtleties of crafting processes, facilitating a more expressive and context-rich representation of their knowledge.
- **Integration with Museum Object Properties (MOP):** CAP seamlessly integrates with MOP, providing background compatibility with Craeft and foreground innovation through the extended Craft Ontology. This integration enhances the interoperability of craft-related data, creating a unified framework for managing and accessing diverse information within the craft domain.
- **Dynamic Entity Instantiation Services:** CAP offers services for dynamically instantiating entities from the extended ontology. This feature not only streamlines the craft authoring workflow but also empowers users to efficiently manage and manipulate a diverse range of crafting-related entities, fostering flexibility and adaptability in the authoring process.
- **CIDOC-CRM and EDM Compatibility:** The strategic alignment of CAP with CIDOC-CRM and EDM ensures compatibility with widely accepted standards. This innovation enhances the accessibility of craft-related entities and assets on the Semantic Web and Europeana, contributing to the broader dissemination of craft-related knowledge and fostering collaboration across diverse platforms.
- **Digital Asset Linking and Reconstruction:** CAP introduces a novel approach to linking knowledge entities with digital assets. By reconstructing objects and recording actions, CAP establishes a dynamic and interactive connection between crafted entities and their digital representations. This innovation enriches the documentation and preservation of crafting processes, providing a valuable resource for practitioners, researchers, and enthusiasts.
- **Facilitation of Interdisciplinary Collaboration:** CAP's extended ontology and digital asset-linking mechanisms create a collaborative space for interdisciplinary engagement. Craft practitioners, researchers, and experts from various domains can leverage CAP to share, annotate, and explore craft-related knowledge, fostering innovation through cross-disciplinary collaboration.
- **Enhanced Educational and Training Opportunities:** The comprehensive nature of CAP makes it a valuable tool for educational institutions and training programs. CAP's semantic richness, coupled

with dynamic entity instantiation, provides an immersive and interactive environment for students to learn crafting skills, contributing to the next generation of skilled craft practitioners.

Market potential

- **Crafting and Artisan Industries:** CAP has significant applications in traditional crafting industries and among artisan communities. Craft practitioners, artists, and designers can utilize CAP to enhance their authoring processes, leading to more sophisticated and innovative crafting practices.
- **Education and Training Institutions:** Educational institutions offering courses in design, crafting, and related fields can adopt CAP to enrich their curriculum. CAP's entity authoring and semantic enrichment capabilities provide a valuable resource for students to learn and practice crafting skills in a virtual environment.
- **Digital Asset Management Companies:** Companies specialising in digital asset management can explore integrating CAP into their platforms. CAP's linking mechanisms and compatibility with widely accepted standards make it an attractive solution for managing and preserving craft-related digital assets.
- **Museum and Cultural Heritage Institutions:** CAP's alignment with CIDOC-CRM and EDM makes it suitable for use in museums and cultural heritage institutions. These entities can leverage CAP to document and preserve crafting processes and related cultural artefacts, contributing to the digitization and accessibility of cultural heritage.
- **Virtual Reality (VR) and Augmented Reality (AR) Development:** Industries focusing on VR and AR technologies can incorporate CAP to create immersive crafting experiences. CAP's ability to link knowledge entities with digital assets and its dynamic instantiation services offer potential applications in the development of interactive crafting simulations.
- **Crafting Software Development Companies:** Companies developing crafting software and applications can enhance their products by integrating CAP. CAP's extended ontology and semantic associations contribute to a more sophisticated crafting environment, attracting users seeking advanced authoring and planning capabilities.
- **Interdisciplinary Research and Collaboration Platforms:** CAP's capability to facilitate interdisciplinary collaboration makes it attractive for research institutions and collaborative platforms. Researchers across domains can leverage CAP to share and explore craft-related knowledge, fostering innovation and cross-disciplinary collaboration.
- **Start-ups in Craft-Tech Innovation:** Start-ups focusing on the intersection of crafting and technology may find opportunities to develop niche applications or platforms based on CAP. This innovation can be a driving force for entrepreneurial ventures seeking to redefine and innovate within the crafting and digital technology landscape.
- **Global Platforms like Europeana:** CAP's orientation toward the "Event" class in CIDOC-CRM and EDM enhances its accessibility via global platforms like Europeana. This opens up opportunities for CAP to contribute to the broader dissemination of craft-related knowledge and assets on a global scale.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are CNR, FORTH, CETEM, CNAM, PIOP, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.3 WP3 - Digital re-enactment

3.3.1 Craft-specific action simulators

A software method to refine archetypal simulators into craft-specific simulators. This method employs Generative Adversarial Networks (GANs) within generative AI. The GANs are trained using craft representations acquired during ethnographic research and incorporate third-party materials to enrich the training set. Fine-tuning is then performed using craft-specific data to ensure high accuracy and customization of various crafting processes.

Additionally, the software method integrates insights from scene understanding methods to enhance the simulation. This integration contributes to the 3D visualization of challenging materials, allowing for an accurate representation of crafting complexities such as material effects, transformations, and environmental conditions.

A key focus of the method is on visualizing challenging materials in 3D, utilizing the outcomes with the aim is to creating realistic and immersive 3D previews that showcase the intricate details of crafting processes. Ultimately, the refined craft-specific simulators generate these 3D previews, providing practitioners with valuable mental imagery of the production process, and aiding in better understanding and decision-making in crafting workflows.

The rationale for the innovation

- **Customization through Craft-Specific Simulations:** The use of Generative Adversarial Networks (GANs) to refine archetypal simulators into craft-specific simulators introduces a high level of customization. Craft practitioners can benefit from simulations that are tailored to the intricacies of various crafting processes, providing a realistic and personalized experience.
- **Integration of Generative AI in Crafting Workflows:** The application of generative AI, specifically GANs, in crafting simulations represents a pioneering approach. This innovation allows for the generation of dynamic and realistic crafting scenarios, bridging the gap between traditional crafting methods and advanced technologies, thereby modernizing crafting workflows.
- **Fine-Tuning with Craft-Specific Data:** The fine-tuning of GANs using craft-specific data ensures that the simulations accurately capture the nuances of different crafting processes. This level of refinement is crucial for creating simulations that are not only visually realistic but also aligned with the specific characteristics of different craft domains.
- **Incorporation of Diverse Materials and Third-Party Data:** The inclusion of third-party materials enriches the diversity of materials used in crafting simulations. This innovation broadens the scope of crafting scenarios, making the simulations applicable to a wide range of materials and fostering cross-disciplinary insights and applications.
- **Enhanced Simulation through 3D Visualization:** The emphasis on visualizing challenging materials in 3D, represents a major innovation. This feature enhances the realism of the simulations, allowing practitioners to visualize complex crafting processes and better understand the effects of their actions on materials in a three-dimensional space.
- **Mental Imagery for Craft Practitioners:** The outcome of generating 3D previews as a form of mental imagery is a ground-breaking feature. This innovation goes beyond traditional simulations by providing craft practitioners with a visual and immersive understanding of the production process.

The mental imagery aids in decision-making, skill development, and creative exploration within crafting workflows.

- **Compatibility with Semantic Web and Europeana:** The encoding of the simulations in CIDOC-CRM and EDM ensures compatibility with Semantic Web and Europeana. This not only enhances accessibility but also contributes to the broader dissemination of craft-related knowledge, aligning with modern standards in digital preservation and sharing.
- **Interdisciplinary Collaboration and Research Opportunities:** The integration of diverse data sources and the customizable nature of the simulations encourage interdisciplinary collaboration. Researchers from various domains can leverage these simulations for studying material behaviours, crafting methodologies, and the impact of different parameters, opening up new avenues for collaborative research.

Market potential

- **Crafting and Artisan Industries:** The primary market for the software method lies within traditional crafting and artisan industries. Craft-specific simulators provide these industries with a powerful tool to enhance skill development, optimize processes, and explore innovative crafting techniques.
- **Educational and Training Institutions:** Educational institutions offering courses in design, craftsmanship, and related fields can adopt the software method to enrich their curriculum. Craft-specific simulations provide students with a virtual environment for hands-on practice and skill development, contributing to a more immersive learning experience.
- **Virtual Reality (VR) and Augmented Reality (AR) Development:** Industries focusing on VR and AR technologies can integrate the software method to create immersive crafting experiences. Craft practitioners and enthusiasts can use these technologies to engage with realistic crafting scenarios, offering a unique and interactive dimension to the market.
- **Crafting Software Development Companies:** Companies developing crafting software and applications can enhance their products by incorporating the software method. Craft-specific simulators add a new level of realism and customization to crafting tools, attracting users seeking advanced authoring and planning capabilities.
- **Manufacturing and Prototyping Industries:** Industries involved in manufacturing and prototyping, especially those dealing with customized or bespoke products, can leverage the software method. The simulations provide insights into material interactions and crafting processes, aiding in the optimization of production workflows.
- **Research and Development in Material Science:** Research institutions and companies focused on material science can utilize the software method for studying material behaviours in crafting processes. This application opens avenues for advancements in material innovation and understanding how different materials respond to various crafting actions.
- **Global Platforms and Digital Archives:** The software's compatibility with Semantic Web and Europeana positions it as a valuable tool for contributing to global platforms and digital archives. Craft-related simulations and knowledge entities can be shared globally, fostering collaboration and contributing to the digital preservation of crafting heritage.
- **Start-ups in Craft-Tech Innovation:** Start-ups at the intersection of crafting and technology can explore opportunities to develop niche applications or platforms based on the software method. This innovation can be a catalyst for start-ups seeking to redefine and innovate within the crafting and digital technology landscape.
- **Consulting Services for Craftsmanship Optimization:** Consulting firms specialising in craftsmanship optimization, process improvement, and design efficiency can incorporate the software method into

their services. The realistic simulations offer a valuable tool for consulting engagements aimed at enhancing crafting processes across industries.

- **Cross-Industry Applications:** The versatility of the software method, with its ability to simulate various crafting processes and materials, extends its market potential across different industries. It can find applications in architecture, fashion, product design, and other domains where crafting and material interactions play a crucial role.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, CETEM, CNAM, PIOP, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.3.2 Digitisation of material treatment and deformation

Leveraging computer vision, graphics, and machine learning, this exploitable outcome simplifies the modelling of how practitioner actions impact materials. Understanding the 'context' of actions, such as whether they're subtractive, additive, or interlocking, streamlines computational learning. This simplification reduces complexity, making the training process more efficient. Additionally, this product utilizes 3D sensing to narrow down the range of possible action parameters. Machine learning is integrated to instantiate these models and explain observed material transformations. To train the models, our product utilizes a large dataset of both real and synthetic, photorealistic data. Real data is sourced from annotated craft-specific training datasets and action vocabularies. The exploitable result is an adaptive simulation tool capable of visualizing material deformations, making it a valuable asset for understanding how materials respond to different crafting actions.

The rationale for the innovation

- **Context-Aware Modeling:** The product's emphasis on understanding the 'context' of practitioner actions, distinguishing between subtractive, additive, and interlocking processes, represents a forward-thinking approach. This context-aware modelling adds a layer of sophistication to computational models, enabling them to more accurately simulate and understand intricate crafting actions.
- **Efficient Computational Learning:** By simplifying the training space for computational models, the product significantly improves efficiency. This innovation is particularly valuable in crafting scenarios where geometric complexity and degrees of freedom can be challenging. The streamlined learning process enhances the product's adaptability to various crafting contexts.
- **3D Sensing for Precision:** Leveraging 3D sensing modalities to narrow down the search space for action parameters is a key innovation. This precision contributes to more accurate modelling of material effects, enabling practitioners to visualize and anticipate outcomes with a high degree of fidelity.
- **Diverse Material Transformations:** The product's ability to model diverse material transformations, including plastic transforms, knot mechanics, weaving algebras, and subtractive/additive processes, showcases versatility. This innovation allows the product to cater to a wide range of crafting scenarios and materials, making it applicable across various industries and domains.

- **Explanatory Machine Learning:** The integration of machine learning to instantiate models and explain material transformations adds an explanatory layer to the product. This innovation goes beyond simulation, providing users with insights into why certain material effects occur based on observed actions, and fostering a deeper understanding of the crafting process.
- **Large Dataset for Robust Training:** The use of a very large dataset comprising real and synthetic, photorealistic data enhances the robustness of the training process. This innovation ensures that the models are well-equipped to handle diverse crafting scenarios, contributing to the adaptability and reliability of the product.
- **Integration with Scene Understanding:** Tight integration for hand and tool motion estimates from scene understanding is a strategic innovation. This integration enhances the product's realism by incorporating real-world motion data, making the simulations more accurate and reflective of actual crafting scenarios.
- **Adaptive Simulation for Material Deformations:** The ability of the product to adaptively "playback" material deformations in simulation is a standout feature. This innovation allows practitioners to not only visualize but also interact with and adaptively control material transformations, providing a dynamic and user-centric crafting experience.

Market potential

- **Crafting and Artisan Industries:** Craft practitioners, artisans, and artists can leverage the product to enhance their creative processes, simulate various crafting scenarios, and gain a deeper understanding of material interactions.
- **Educational Institutions:** Academic institutions offering courses in design, craftsmanship, and related fields can integrate this product into their curriculum. It provides students with a practical and immersive learning experience, facilitating skill development in crafting and design.
- **Virtual Reality (VR) and Augmented Reality (AR) Development:** Industries focusing on VR and AR technologies can incorporate the product to create realistic and interactive crafting simulations. This can be applied in training, entertainment, or design, enhancing user experiences in virtual environments.
- **Crafting Software Development Companies:** Companies developing crafting software and applications can enhance their products by integrating this innovative tool. The product's capabilities add a layer of realism and customization, making it appealing to users seeking advanced crafting and design functionalities.
- **Manufacturing and Prototyping Industries:** Industries involved in manufacturing and prototyping can benefit from the product's ability to simulate material deformations. This is valuable for testing and optimizing production processes, especially those involving intricate material transformations.
- **Research and Development in Material Science:** Research institutions and companies focused on material science can utilize the product to study material behaviours in crafting processes. This application promises advancements in material innovation and an understanding of how materials respond to various crafting actions.
- **Global Platforms and Digital Archives:** The product's compatibility with Semantic Web and Europeana positions it as a valuable tool for contributing to global platforms and digital archives. Craft-related simulations and knowledge entities can be shared globally, fostering collaboration and contributing to the digital preservation of crafting heritage.
- **Start-ups in Craft-Tech Innovation:** Start-ups at the intersection of crafting and technology may find opportunities to develop niche applications or platforms based on the product. This innovation can catalyse start-ups seeking to redefine and innovate within the crafting and digital technology landscape.

- **Consulting Services for Craftsmanship Optimization:** Consulting firms specialising in craftsmanship optimization, process improvement, and design efficiency can incorporate the product into their services. The realistic simulations offer a valuable tool for consulting engagements to enhance crafting processes across industries.
- **Cross-Industry Applications:** The product's versatility, with its ability to simulate various crafting processes and materials, extends its market potential across different industries. It can find applications in architecture, fashion, product design, and other domains where crafting and material interactions play a crucial role.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, CNAM, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.3.3 High-resolution 2D and 2½D surface scanning

The High-Resolution Scanner is a product tailored for heritage objects, designed to capture intricate details and textures on artefact surfaces. This innovative scanner achieves superior 2D and 2½D (anaglyph) resolutions, surpassing 1 gigapixel per square centimetre. Building on prior 2D scanning techniques, the product introduces advanced 2½D scanning through photogrammetry, providing depth for a more comprehensive representation.

Beyond visual fidelity, the 2½D reconstruction uniquely captures surface structures influencing tactile sensations, such as smoothness and coarseness. This distinctive feature elevates the understanding of heritage objects by incorporating tactile qualities. The primary objective of this product is to contribute to cultural heritage preservation by creating a detailed digital archive of artefacts. The High-Resolution Scanner ensures that future generations can explore and study these objects with unprecedented clarity, fostering a deep appreciation for their craftsmanship and historical context.

Developed through a combination of surface scanning, photogrammetry, and preservation technologies, this product sets a new standard in technological innovation and preservation requirements. The High-Resolution Scanner represents a significant leap in heritage preservation technology, offering cutting-edge capabilities and interdisciplinary expertise.

The rationale for the innovation

- **High Resolution:** The scanner achieves resolutions exceeding 1 gigapixel per square centimetre, providing unparalleled detail. This level of precision is a significant leap forward in heritage object digitization, ensuring that even the smallest features and textures are faithfully captured.
- **Integration of 2½D Scanning:** Building on traditional 2D scanning, the product introduces 2½D scanning through photogrammetry. This innovative approach adds depth to digitization, creating a more comprehensive and lifelike representation of artefact surfaces. The integration of 2½D scanning enhances the realism of digital reproductions.
- **Tactile Sensation Capture:** Beyond visual reproduction, the High-Resolution Scanner goes further by capturing surface structures that influence tactile sensations. This includes qualities like smoothness

and coarseness, adding a new dimension to understanding heritage objects. This feature enhances the immersive experience for researchers, historians, and the general audience.

- **Holistic Preservation Approach:** The product's goal goes beyond visual documentation; it aims to provide a holistic preservation approach. By capturing both visual and tactile aspects of heritage objects, it contributes to a more comprehensive digital archive. This approach ensures that future generations can engage with artefacts more effectively and meaningfully.
- **Interdisciplinary Collaboration:** The innovation stems from interdisciplinary collaboration, bringing together expertise in surface scanning, photogrammetry, and heritage preservation. This collaborative effort ensures that the High-Resolution Scanner incorporates cutting-edge technology and meets the rigorous standards of heritage preservation.
- **Cultural Heritage Accessibility:** The product addresses the growing need for accessibility to cultural heritage. By creating a detailed digital archive, the scanner democratizes access to historical artefacts, allowing researchers, educators, and the public to explore and study these objects remotely with unprecedented clarity.
- **Technological Advancement in Photogrammetry:** The introduction of 2½D scanning through photogrammetry showcases technological advancement. This approach leverages the power of photogrammetric techniques to create depth-enhanced digitisations, marking a milestone in the evolution of heritage object scanning methodologies.
- **Fostering Appreciation for Craftsmanship:** The High-Resolution Scanner aims to foster a deeper appreciation for craftsmanship and historical context. Capturing the intricate details and tactile qualities of heritage objects invites users to engage with artefacts in a more sensory and educational manner, contributing to a richer understanding of cultural heritage.

Market potential

- **Heritage Preservation Demand:** The scanner addresses a growing demand for advanced heritage preservation tools. As cultural institutions, museums, and historical societies seek to digitize and preserve artefacts, the High-Resolution Scanner stands out as a solution beyond traditional methods, offering unmatched detail and realism.
- **Research and Education Institutions:** Academic institutions engaged in research and education find the High-Resolution Scanner indispensable for providing high-fidelity digital archives. Researchers, historians, and educators can leverage the scanner to enhance learning experiences, conduct detailed analyses, and contribute to academic research in various disciplines.
- **Art and Cultural Institutions:** Galleries, museums, and cultural institutions can benefit from the scanner's ability to capture intricate details and tactile qualities of artworks and artefacts. This makes the scanner a valuable asset for exhibitions, archival purposes, and digital collections, enhancing the overall presentation and accessibility of cultural heritage.
- **Virtual Reality (VR) and Augmented Reality (AR) Development:** The high-quality digitisations produced by the scanner make it an ideal tool for VR and AR development. Industries focusing on immersive technologies can integrate these detailed scans into virtual experiences, creating realistic simulations for educational, entertainment, or historical exploration purposes.
- **Archaeological and Anthropological Research:** The scanner caters to the needs of archaeologists and anthropologists by providing detailed and accurate digitisations of artefacts. Its capability to capture tactile sensations adds a layer of realism crucial for understanding historical objects and cultural artefacts.
- **Heritage Tourism and Digital Archives:** The scanner contributes to heritage tourism by creating digital archives that can be accessed remotely. This is especially relevant in the current global context, where

physical travel may be restricted. The detailed digital reproductions enhance virtual tours, online exhibitions, and digital cataloguing initiatives.

- **Technological Advancements Driving Adoption:** The product's integration of cutting-edge technology, including high-resolution scanning and 2½D reconstruction, positions it as a leader in the market. Organizations seeking state-of-the-art solutions will likely adopt the High-Resolution Scanner to stay at the forefront of technological advancements in heritage preservation.
- **Accessibility and Public Engagement:** The scanner contributes to making cultural heritage more accessible to the public. Institutions aiming to engage a wider audience can utilize the scanner's digitisations for online platforms, educational programs, and interactive exhibits, fostering public interest and appreciation for cultural history.
- **Cross-Industry Applications:** The versatility of the High-Resolution Scanner allows it to be applied across diverse industries, including manufacturing, design, and material science. Its precision and ability to capture tactile sensations make it valuable for industries seeking detailed 3D representations of objects and materials.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, CETEM, CNAM, and PIOP. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.3.4 Digitisation of transparent, translucent, and shiny materials

A new initiative is underway to digitize transparent, translucent, and shiny materials, encompassing a range from clear and frosted glass to tinted stained glass, amber, and metal. This endeavour introduces an innovative, non-contact 3D reconstruction method, employing polarized and structured illumination techniques to capture the intricate details of these challenging materials. The methodology adopted for this digitization effort leverages advancements in polarized and structured illumination, providing a novel approach to capturing the nuanced features of traditionally difficult materials to digitize. Transparent materials, with their unique optical properties and shiny surfaces, characterized by reflections and highlights, pose distinct challenges that necessitate a specialized method for accurate and detailed digitization.

To enhance the efficiency and precision of the 3D reconstruction process, Augmented Reality (AR) is integrated into the workflow. AR serves as a guiding tool for operators, simplifying the intricate task of digitizing materials with diverse optical characteristics. By overlaying digital information onto the physical workspace, AR assists operators in positioning and capturing data, contributing to a streamlined and more intuitive digitization process. This ambitious undertaking builds upon the successes and insights garnered from the Transparent3D project. The Transparent3D project serves as the foundation for the implementation of this novel digitization method. Drawing upon the outcomes and lessons learned from Transparent3D, the new initiative aims to further refine and advance the capabilities of 3D reconstruction for transparent, translucent, and shiny materials.

The significance of this project extends beyond the realm of heritage preservation and cultural artefacts. It holds implications for industries working with materials like architectural glass, artistic installations, and metal components. The ability to accurately digitize and visualize these materials in three dimensions

opens avenues for design, analysis, and documentation across diverse sectors. In essence, this initiative represents a convergence of cutting-edge technologies and research outcomes from Transparent3D, introducing a method that not only addresses the challenges posed by transparent, translucent, and shiny materials but also simplifies the process through the integration of Augmented Reality. The potential applications span various industries, positioning this effort as a pioneering contribution to the digitization and visualization of materials with intricate optical properties.

The rationale for the innovation

- **Inherent Optical Complexity:** Transparent and semi-transparent materials, such as glass, amber, and frosted surfaces, exhibit complex optical properties. Traditional scanning methods often struggle to capture the nuances of these materials, including variations in transparency, refraction, and reflection. The specialized scanner addresses the inherent optical complexity, providing a solution tailored to the challenges posed by transparent objects.
- **Surface Detail Preservation:** Transparent and semi-transparent objects often feature intricate surface details, such as fine engravings, textures, or subtle colour variations. The scanner's ability to preserve and accurately digitize these details is the innovation. This is crucial for applications in heritage preservation, art restoration, and material analysis, where surface intricacies carry significant importance.
- **Mitigating Reflection and Glare:** Shiny and reflective surfaces, common in metals and some types of glass, can result in unwanted glare and reflections during scanning. The specialized scanner incorporates techniques like polarized and structured illumination to mitigate these challenges, allowing it to capture surface features without interference from reflections. This innovation ensures a more accurate representation of the object.
- **Expanded Applications in Diverse Industries:** The innovation opens new possibilities for digitizing transparent and semi-transparent materials across various industries. Applications extend beyond cultural heritage to include architecture, design, manufacturing, and art. The ability to accurately capture the 3D geometry of these materials facilitates advancements in design workflows, material analysis, and virtual prototyping.
- **Streamlined Operator Guidance with AR:** The integration of Augmented Reality (AR) serves as a pivotal innovation by providing real-time guidance to operators during the scanning process. Transparent and shiny surfaces can be challenging to position accurately, and AR simplifies this task, making the process more intuitive for operators. This innovation enhances the overall efficiency and user-friendliness of the scanning procedure.
- **Learnings from Previous Transparent3D Project:** Building on the outcomes of the Transparent3D project demonstrates a strategic approach to innovation. Insights gained from past endeavours contribute to refining and advancing the technology. Leveraging the knowledge and lessons learned from Transparent3D ensures a more informed and effective implementation in developing the specialized scanner.
- **Advancements in Material Visualization:** The innovation contributes to advancements in material visualization by enabling a more comprehensive and accurate representation of transparent and semi-transparent objects. This is crucial for fields like art conservation, where faithful reproduction of materials is essential for documentation and analysis.
- **Industry and Research Collaboration:** Developing a specialized scanner involves collaboration between industries and research institutions. This collaborative approach ensures that the innovation aligns with the evolving needs of sectors dealing with transparent materials. The exchange of expertise and insights contributes to the success and relevance of the specialized scanner in real-world applications.

Market potential

- **Heritage Preservation and Cultural Institutions:** Cultural institutions, museums, and heritage preservation organizations can benefit from the scanner's ability to digitize delicate and intricate transparent artefacts. This includes preserving historical glasswork, stained glass windows, and semi-transparent materials with unparalleled detail. The demand for accurate digitization in heritage preservation makes this sector a primary market.
- **Art Restoration and Conservation:** In the art world, where transparency and translucency are prevalent in various media, the specialized scanner finds applications in art restoration and conservation. The ability to capture fine details on transparent canvases, glass art, and sculptures contributes to the documentation and restoration of valuable artworks.
- **Architectural Design and Construction:** Architects and designers working with transparent building materials, such as glass facades and artistic installations, can utilize the scanner for precise 3D modelling. This application extends to the construction industry, where detailed digitization of semi-transparent materials aids in project planning, visualization, and quality control.
- **Manufacturing and Product Design:** Industries manufacturing transparent or semi-transparent products, including consumer electronics, packaging, and automotive, can leverage the scanner for quality control and product design. The detailed 3D models facilitate the analysis of material properties and aid in the development of innovative and visually appealing products.
- **Medical Imaging and Biotechnology:** The scanner's capability to capture intricate details makes it valuable in medical imaging, especially for transparent or semi-transparent biological samples. In biotechnology research, the scanner can contribute to the digitization of specimens for analysis and documentation.
- **Educational and Research Institutions:** Educational institutions and research facilities focused on material science, archaeology, anthropology, and related fields can benefit from the scanner's versatility. It can aid in detailed material analysis, 3D visualization for educational purposes, and research endeavours involving transparent and semi-transparent objects.
- **Virtual and Augmented Reality Content Creation:** Content creators in virtual and augmented reality can use the scanner to capture realistic 3D models of transparent objects for immersive experiences. This application extends to industries such as gaming, simulation, and virtual tourism.
- **Collaboration with Transparent3D Project Outcomes:** The market potential is enhanced by leveraging the outcomes of the Transparent3D project. Collaboration with research institutions and industry partners involved in Transparent3D ensures that the specialized scanner aligns with industry needs and benefits from past project insights.
- **Global Accessibility to Historical and Artistic Artifacts:** The scanner contributes to global accessibility to historical and artistic artefacts by enabling the creation of detailed digital archives. This has implications for virtual museums, online exhibitions, and educational platforms, allowing audiences worldwide to explore transparent and semi-transparent objects remotely.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, and ARMINES. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.3.5 Scene and activity monitoring

For the CRAEFT partners, the craft scene is not a one-dimensional notion but consists of the craftsmen themselves, their actions and movements in space, the tools and the materials used during the creative process, as well as the results of the interaction between these tools or materials and the craftsmen, the result of which can appear through sound. This sound many times works as a direction for the craftsmen during their creative process. As such, a craft scene can be understood and analysed through different modalities, such as the sound and the image.

Having in mind the above, extensive recordings were conducted in four distinct craft environments - marble carving, glassblowing, silversmithing, and porcelain creation. These recordings serve an important purpose in scene understanding: they allow us to observe and analyse intricate human movements and the nuanced usage of tools and materials in professional settings. More specifically, in the aforementioned scenarios, the creative process was captured with the use of two cameras, one in an egocentric view, capturing the dexterity of the movement of the hands and the tools, and one in a frontal view, capturing both the craft environment, but also the ample movements of the craftsmen around space and their interactions with bigger work objects. Apart from the two cameras, two microphones were also used (one stereo and one contact microphone) to capture both the sound from the craft environment, as well as the sound that is created through the interaction of the craftsman with materials and tools.

The process of the recordings followed a specific protocol, that allowed the communication of the project and the exchange of ideas among craft experts, craft students and the technical partners involved in this process.

More specifically, the recordings were separated according to the protocol mentioned above in three parts, with the first part involving interviews with the craftsmen to be recorded, the second, the technical part of the recordings of the process of the respective craft, and the third one was what we called video elicitation. The idea of video elicitation, as well as its use as part of the activities of the CRAEFT project, will be explained below.

During the interview that takes place in the first part, the craftsmen are asked to explain their creative process and help us understand it better, as well as familiarize ourselves with the technical equipment, helping them understand its use for the digitization of their craft and also the communication of their work, through advanced technology. In the second part, the recording of the craft gestures, materials, objects and environment takes place. Probably one of the most interesting parts of the recordings is the third part, where video elicitation takes place. During video elicitation, the craftsmen are asked to watch the egocentric part of the recordings performed in the previous step, while they explain step by step the creative process. In all four scenarios, the craftsmen commented that it was the first time that they observed the dexterous movement of their hands and fingers, which gives them a new point for better explaining the creative process to non-craftsmen, or even to budding craftsmen.

This process brought the crafts community a step closer to technology, in terms of understanding how the last could be used to spread their art.

Beyond CRAEFT, the idea of the project was communicated to other existing projects, that concern both crafts, but also manual professions, creating links with big European organizations, as well as with major industrial operators, in glove making, gloves crafting, silversmithing, luxury vegan leather goods, even nautical upholstery. By sharing the notions of CRAEFT, the project paves the way for a new standard in documenting and understanding crafts, ensuring that invaluable knowledge is preserved while having

significant implications for vocational training across manual professions, which many times lack personnel on crafts.

Focusing again on the technical part of the performed recordings, for each one of the four recorded use cases, our main goal has been to create a comprehensive hierarchy schema for professional gestures. This schema is important in understanding the complex dynamics of professional craft environments. Through the analysis of these movements and interactions, we are developing a repository of craft techniques, that will be used for the understanding of human movement in crafts, training of craft professionals, and the further understanding of the respective professional scenes, as well as for crafts' preservation. The core of this analysis lies in the application of artificial intelligence, through the creation of an algorithm that is not just tailored to each specific craft environment but also can adapt and generalize across various professional crafting scenarios. This AI-driven approach will enable us to discern subtle differences in technique and style, further enriching our understanding of the crafting process.

The rationale for the innovation

- **Complexity of Crafting Activities:** Crafting involves a diverse range of intricate actions, often requiring a combination of manual dexterity, material manipulation, and creative decision-making. The complexity of these activities necessitates a monitoring solution that can intelligently analyse and interpret various crafting actions in real time.
- **Holistic Scene Understanding:** Scene and Action Monitoring addresses the need for a holistic scene understanding. By employing advanced methods, the product goes beyond simplistic monitoring and recognizes the nuanced interactions between practitioners, materials, and tools. This holistic approach ensures a more accurate and insightful analysis of the crafting environment.
- **Multifaceted Implementation:** The incorporation of body and hand tracking, object recognition, haptic interaction, and material deformation tracking reflects the multifaceted implementation of Scene and Action Monitoring. This innovation ensures that the product captures the entirety of crafting processes, providing practitioners with a comprehensive tool for refining their techniques.
- **Integration with Craft-Specific Simulators:** The integration with craft-specific simulators represents a forward-thinking approach. By generating mental imagery and comparing it to new digitisations, Scene and Action Monitoring introduces a unique sensory imagery validation process. This integration enhances the accuracy of monitoring results and creates a dynamic feedback loop for continuous improvement.
- **Adaptability with Third-Party Resources:** Recognizing the diverse nature of crafting techniques, the product intelligently incorporates third-party resources, such as online demonstration videos. This adaptability enriches the dataset and improves recognition accuracy, ensuring that Scene and Action Monitoring remains versatile and applicable across a wide range of crafting styles and methodologies.
- **Efficiency in Craft Training:** The innovation contributes to the efficiency of craft training by actively reducing user effort. Crafting techniques are captured, analysed, and streamlined, making the learning process more accessible for practitioners at all skill levels. This efficiency is crucial for both novice crafters and experienced artisans seeking continuous improvement.
- **Documentation and Knowledge Sharing:** Scene and Action Monitoring serves as a valuable documentation tool, addressing the need to preserve traditional crafting methods. This feature not only contributes to individual skill development but also facilitates knowledge sharing and collaboration within the crafting community.
- **Comparative Analysis and Community Building:** Enabling practitioners to compare executions of the same action by different individuals fosters a sense of community and collaborative learning. This

feature promotes the exchange of insights and techniques, contributing to a dynamic and evolving crafting community.

- **Real-Time Feedback for Skill Development:** The product's design to provide real-time feedback and analysis supports skill development. By offering personalized insights into crafting techniques, Scene and Action Monitoring accelerates the learning curve and empowers practitioners to refine their skills dynamically.

Market potential

- **Craft Preservation and Understanding:** The extensive recordings conducted in various craft environments provide a unique insight into the intricate processes involved in crafts such as marble carving, glassblowing, silversmithing, and porcelain creation. This detailed documentation not only aids in preserving traditional crafts but also enhances our understanding of these professions. As such, there's a market for institutions, museums, and organizations dedicated to preserving and promoting traditional crafts to leverage this technology for archival and educational purposes.
- **Vocational Training and Education:** The comprehensive hierarchy schema for professional gestures developed through the analysis of recordings serves as a valuable resource for vocational training across manual professions. Craft professionals, students, and enthusiasts can benefit from this repository of craft techniques, enhancing their skills and understanding of craft processes. Educational institutions, vocational training centres, and online learning platforms catering to craft and manual professions stand to gain from incorporating such advanced training methodologies into their curricula.
- **Technological Integration and Advancement:** By bridging the gap between traditional craftsmanship and advanced technology, the project opens doors for the integration of digital tools and techniques into craft practices. This not only facilitates better communication and documentation within the craft community but also offers opportunities for innovation and efficiency improvements. Technology companies specializing in AI-driven solutions, digital documentation, and cultural heritage preservation can explore partnerships and collaborations within the crafts industry to capitalize on this market potential.
- **Cross-Industry Collaboration:** The communication of the project's ideas to other existing projects and major industrial operators in related fields such as glove making, luxury vegan leather goods, and nautical upholstery creates opportunities for cross-industry collaboration and knowledge exchange. By sharing insights and methodologies, the project fosters a collaborative ecosystem that benefits both traditional crafts and modern industries, paving the way for innovative products and practices.
- **Global Reach and Standardization:** Through its engagement with big European organizations and major industrial operators, the project has the potential to influence standards and practices in documenting and understanding crafts on a global scale. By setting a new standard in craft preservation and education, the project ensures the continuity of invaluable knowledge while addressing the shortage of personnel in crafts-related professions. This standardization opens up opportunities for international collaborations, certifications, and market expansion in the crafts industry.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are ARMINES, and FORTH. IPR ownership will be the subject of a joint exploitation agreement and will be

defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.4 WP4 - Education and training

3.4.1 Craft Studio

The Craft Studio will be a novel authoring environment that transforms crafting simulations through 3D and immersive rendering components, powered by a robust game engine rendering pipeline. The Craft Studio seamlessly integrates with the Craft Authoring Platform (CAP), providing a rich authoring experience with interfacing capabilities.

Craft Studio leverages the capabilities of a game engine rendering pipeline to offer immersive and realistic 3D simulations. Crafters can visualise and interact with crafted objects in a dynamic environment that enhances the simulation experience. It supports generic and craft-specific simulations, accommodating a range of crafting procedures, action plans, and schemas. The tool will seek to provide an environment for crafting simulations to help users explore various crafting scenarios and refine their skills.

The integration with CAP ensures that Craft Studio can access and incorporate semantic content, including action plans and schemas. This integration allows users to attach simulation instances to specific parts of the semantic representation. It will enable a more contextual and meaningful simulation experience. The Craft Studio will enable users to practice their skills based on pre-defined simulation scenarios while utilizing various forms of craft-specific action simulators to design their crafts. Crafters can utilize a range of digitisations, archetypal, and craft-specific action simulators to design and customize simulation experiences tailored to their specific needs.

During simulation execution, Craft Studio dynamically instantiates schema components based on selected devices, tools, materials, and craft. This adaptability ensures that simulations accurately reflect the variables chosen by the user, creating a realistic and personalized crafting environment. Craft Studio offers flexible bindings to various visualization devices, such as screens, MR glasses, VR headsets, and interaction devices like tactile and haptic feedback. These bindings enhance the simulation execution by providing real-time visualizations and rendering of action effects.

All simulations generated by Craft Studio include metrics on material and energy usage, supporting the planning of efficient workflows. This data-driven approach ensures that crafters have insights into resource utilization, promoting sustainability and efficiency in crafting processes.

The rationale for the innovation

- **Enhanced Realism through Game Engine Rendering:** The Craft Studio introduces a level of realism to crafting and seeks to immerse crafters in a 3D environment, enhancing as much of the authenticity and visual appeal of the crafting experience as possible.
- **Versatile Support for Craft-Specific Simulations:** The Craft Studio addresses the diverse landscape of crafting procedures by offering support for both generic and craft-specific simulations thus supporting the exploration of a broad spectrum of crafting scenarios, accommodating various materials, techniques, and artistic styles.

- **Seamless Integration with Craft Authoring Platform (CAP):** By interfacing with CAP, Craft Studio can tap into semantic content, including action plans and schemas, adding depth and context to crafting simulations, and aligning them more closely with real-world crafting processes.
- **Intuitive Authoring of Simulation Scenarios:** Crafters can leverage digitisations, archetypal, and craft-specific action simulators to design crafting experiences following a user-friendly approach that promotes accessibility and creativity in crafting simulation design.
- **Dynamic Instantiation for Simulations:** During simulation execution, the Craft Studio dynamically instantiates schema components based on user-selected variables to make sure that simulations reflect the choices made by crafters, resulting in an adaptive crafting environment.
- **Flexible Bindings to Visualization and Interaction Devices:** The Craft Studio accommodates a range of visualization and interaction devices. The tool caters to diverse user preferences, whether through screens, MR glasses, or VR headsets, along with tactile and haptic feedback. This adaptability enriches the simulation execution, providing crafters with a tailored and immersive experience.
- **Data-Driven Insights for Efficient Workflows:** The Craft Studio seeks to introduce a data-driven approach by including metrics on material and energy usage in all simulations empowering crafters with insights into resource utilization and supporting the planning of efficient workflows.

Market potential

- **Crafting Enthusiasts and Hobbyists:** The Craft Studio offers a valuable tool for crafting enthusiasts and hobbyists seeking to enhance their skills and creativity. The immersive 3D simulations and versatile crafting scenarios make it an attractive solution for individuals passionate about various crafting activities.
- **Crafting Education and Training Institutions:** Educational institutions focusing on crafting courses and training programs can integrate the Craft Studio into their curriculum. The tool's ability to support both generic and craft-specific simulations provides a dynamic learning environment, making it an asset for institutions dedicated to fostering craftsmanship.
- **Art and Design Schools:** Art and design schools can leverage the Craft Studio to enrich their programs. The tool's intuitive authoring features and integration with CAP align with institutions' goals to provide students with cutting-edge tools for hands-on and immersive learning experiences.
- **Crafting Workshops and Studios:** Crafting workshops and studios can benefit from Craft Studio by offering participants a novel and engaging experience. The tool's support for dynamic instantiation and personalized simulations enhances the crafting experience, making it an appealing addition to workshop offerings.
- **Heritage Preservation Organizations:** Organizations involved in heritage preservation and traditional craftsmanship can use Craft Studio for documenting and preserving historical crafting techniques. The tool's simulations and semantic integration contribute to digitization efforts within the cultural heritage sector.
- **Online Crafting Platforms:** Craft Studio has the potential to integrate seamlessly into online crafting platforms. Its immersive rendering, flexible bindings, and support for diverse crafting scenarios make it a tool for enhancing the online crafting experience, fostering a sense of community among virtual crafters.
- **Manufacturing and Product Design:** Industries engaged in manufacturing and product design, particularly those incorporating handmade or artisanal elements, can benefit from the Craft Studio. The tool's ability to simulate crafting processes aids in quality control, innovation, and the development of visually appealing products.
- **Virtual and Augmented Reality Development:** Developers in the virtual and augmented reality space can explore the Craft Studio to create realistic crafting simulations. Its integration with visualization

devices and immersive rendering capabilities makes it a valuable resource for developers aiming to provide authentic virtual crafting experiences.

- **Research and Development in Craft Technologies:** The Craft Studio will serve as a valuable tool for research institutions and organizations focused on advancing craft technologies. The tool's dynamic instantiation, semantic integration, and data-driven insights support innovative research in crafting methodologies and simulation technologies.
- **Global Crafting Community:** The Craft Studio has the potential to contribute to the formation of a global crafting community. The tool encourages collaboration, knowledge sharing, and skill development among crafters worldwide by providing a platform for crafting simulations.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are ETH, CETEM, PIOP, and CERFAV. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.4.2 Apprentice Studio

The Apprentice Studio emerges as an innovative extension of the Craft Studio, specifically tailored for educational and training purposes. With a keen focus on personalized learning experiences, the Apprentice Studio encompasses a user interface (UI) meticulously designed to cater to the unique context of each learner. Here's a comprehensive overview of its features and functionalities:

The Apprentice Studio aims to provide a bespoke learning journey for each trainee. Tailored courses and exercises, complete with success measurements and indicators, form the foundation of personalized education and training programs.

The Apprentice Studio integrates a conventional desktop application for fundamental simulation exercises to accommodate diverse learning preferences. Additionally, a web-based UI is incorporated for educational materials, offering flexibility in accessing learning resources. The immersive 3D graphical user interface (GUI) interfaces seamlessly with haptic, virtual reality (VR), and augmented reality (AR) devices, ensuring a realistic and hands-on training experience.

The Studio employs sophisticated tracking mechanisms, including performance logs, success rates, and simulated material quantities and energy usage. This data serves as a basis for adapting the learning experience to the individual needs and progress of each trainee, ensuring optimal engagement and skill development.

Going beyond traditional training approaches, the Apprentice Studio introduces open-ended problems for trainees to solve. These problems delve into critical aspects such as health, safety, and fatigue/strain risks in a workshop environment. Learners are encouraged to formulate and test hypotheses, fostering the development of practical skills and real-world problem-solving capabilities.

A unique feature of the Apprentice Studio involves problem-solving scenarios centred around the recovery of lost techniques. These scenarios, framed as 'problems' in experimental archaeology, provide a link to knowledge sources within the Craft Authoring Platform (CAP). This contextualizes the tools and

materials available in a historical context, enriching the learning experience with a historical and cultural dimension.

The rationale for the innovation

- **Personalized Learning Approach:** Traditional education often adopts a one-size-fits-all model, overlooking individual differences in learning styles and preferences. The Apprentice Studio innovates by prioritizing personalized learning experiences and tailoring educational content, exercises, and success measurements to meet the unique needs and progress of each trainee. This approach enhances engagement and skill development, **fostering** a more effective learning journey.
- **Integration of Diverse Learning Modalities:** Recognizing the diverse ways individuals learn, the Apprentice Studio strategically integrates various learning modalities. The inclusion of a conventional desktop application, a web-based UI, and an immersive 3D GUI interfacing with haptic, VR, and AR devices ensures a rich and versatile learning experience. This innovation aligns with the modern understanding of multimodal learning and caters to the preferences of a wide range of trainees.
- **Performance Tracking and Adaptability:** The incorporation of sophisticated performance tracking mechanisms, including performance logs, success rates, simulated material quantities and energy usage, serves a dual purpose. It not only provides measurable indicators of progress but also enables the Apprentice Studio to adapt the learning experience dynamically. This adaptability ensures that each trainee receives targeted support and guidance based on their unique learning journey.
- **Creative Problem-Solving Dimension:** Traditional training often focuses solely on theoretical knowledge and structured exercises. The Apprentice Studio introduces a creative problem-solving dimension by presenting open-ended problems related to health, safety, fatigue/strain risks, and experimental archaeology scenarios. This innovation encourages trainees to apply critical thinking, formulate hypotheses, and develop practical skills in real-world contexts, fostering a holistic and applicable skill set.
- **Historical and Cultural Contextualization:** The incorporation of experimental archaeology scenarios adds a unique historical and cultural dimension to the learning experience. Trainees engage with problems that bridge the past and present, linking with knowledge sources in the Craft Authoring Platform (CAP). This contextualization not only enriches the educational content but also instils an appreciation for the historical context of tools and materials used in crafting.

Market potential

- **Education and Training Institutions:** Educational institutions, including universities, vocational training centres, and online learning platforms, represent a primary market. The Apprentice Studio's personalized learning approach aligns with modern educational philosophies, making it an attractive tool for institutions seeking innovative ways to engage learners in crafting and workshop practices.
- **Craft and Artisan Communities:** Craft enthusiasts, artisans, and individuals seeking to enhance their crafting skills constitute a substantial market. The Apprentice Studio's immersive and hands-on training, coupled with personalized learning paths, caters to the diverse needs of crafters and artisans. It serves as a valuable tool for skill development and continuous learning within artisan communities.
- **Corporate Training Programs:** Companies involved in crafting, manufacturing, and related industries can leverage the Apprentice Studio for employee training programs. The personalized education and training programs, combined with performance tracking and adaptability, make it a versatile solution for upskilling and reskilling employees in crafting and workshop practices.

- **Online Learning Platforms:** Platforms dedicated to online learning and skill development can integrate the Apprentice Studio to diversify their course offerings. Its compatibility with various learning modalities, including immersive 3D GUI, enhances the appeal for platforms seeking engaging and interactive content in the crafting and workshop domains.
- **Technology and VR/AR Industries:** Companies operating in the technology sector, especially those involved in virtual reality (VR) and augmented reality (AR), may find applications for the Apprentice Studio. Its integration with VR, AR, and haptic devices positions it as a valuable tool for companies looking to explore immersive and interactive training experiences.
- **Historical and Cultural Institutions:** Institutions focused on historical and cultural preservation may find value in the Apprentice Studio's experimental archaeology scenarios. It provides a unique way to engage with historical crafting techniques and contextualize them within specific periods and cultural settings.
- **Health and Safety Training:** The inclusion of open-ended problems related to health, safety, and fatigue/strain risks positions the Apprentice Studio as a viable tool for health and safety training programs. Industries with a focus on workplace safety may leverage this aspect for employee training.
- **Innovation Hubs and Start-ups:** Innovation hubs and start-ups seeking to infuse creativity and adaptability into their training programs can explore the Apprentice Studio. Its emphasis on problem-solving, creativity, and adaptability aligns with the dynamic nature of innovative enterprises.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, and ARMINES. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.4.3 Haptic interfaces for craft training, simulation, and design

Interactive haptic apparatuses authentically simulate the tactile sensations of tool use during various craft actions, emphasizing the nuanced "feeling" of surfaces during manipulation. The primary objective is to facilitate hands-on practice and enhance exercisability, specifically targeting the development of dexterous actuation skills. Craft practitioners can benefit from realistic tactile experiences before entering the workshop, allowing them to refine their skills and build confidence in a controlled virtual environment. A key focus of this product is the "education of attention" to tactile features inherent in different materials and products. By immersing users in haptic simulations, the system trains practitioners to discern and appreciate the subtle nuances of surfaces, contributing to heightened sensitivity and understanding of materials.

The rationale for the innovation

- **Realistic Tactile Simulation:** The Haptic Craft Learning System addresses a crucial gap in traditional craftsmanship education by providing realistic tactile simulations. The innovation is driven by the understanding that the sense of touch is a fundamental aspect of craft actions, and by simulating these sensations, the system enhances the overall learning experience.
- **Dexterous Actuation Skill Development:** The primary objective is to facilitate the development of dexterous actuation skills allowing craft practitioners to engage in hands-on practice with haptic

apparatuses before entering the workshop. The system enables them to hone their motor skills, refine movements, and build muscle memory in a controlled and risk-free virtual environment.

- **Exercisability Enhancement:** The Haptic Craft Learning System aims to increase exercisability by providing a platform for repetitive and deliberate practice. Craft practitioners can engage with the haptic interfaces to perform craft actions repeatedly, promoting muscle memory, precision, and overall skill improvement.
- **Pre-Workshop Preparation:** The system recognizes the importance of preparing craft practitioners before they enter the physical workshop offering a virtual environment for tactile training to familiarize them with tools, materials, and surfaces, reducing the learning curve and enhancing their confidence when transitioning to the workshop.
- **Education of Attention to Tactile Features:** An integral part of the innovation is the "education of attention" to tactile features of materials and products. The Haptic Craft Learning System trains practitioners to pay heightened attention to the nuances of surfaces, fostering a deeper understanding of material properties, textures, and characteristics.
- **Integration with Craft Simulators:** The system's integration with simulators aligns with the broader goal of creating a cohesive training experience. The combination of haptic feedback with simulated environments enhances the authenticity of the learning process, providing a seamless transition between tactile training and virtual crafting simulations.
- **Contribution to Craft Studios:** The Haptic Craft Learning System serves as a valuable component within the Craft Studio, Apprentice Studio, and Design Studio integrating haptic interfaces, the system contributes to a holistic crafting ecosystem, enabling practitioners to apply their tactile skills in various virtual design and crafting scenarios.

Market potential

- **Craftsmanship Education Institutions:** Educational institutions offering craftsmanship programs stand to benefit significantly from Haptic Craft training in alignment with the evolving needs of craftsmanship education by providing a realistic and immersive tactile training experience. Craft schools, vocational training centres, and online education platforms can integrate the system to enhance their curriculum.
- **Crafting Workshops and Studios:** Crafting workshops and studios, whether focused on traditional or contemporary crafts, can leverage the Haptic training to enhance their offerings. This system provides a valuable tool for participants to practice and refine their skills before engaging in hands-on crafting, contributing to a more efficient and satisfying workshop experience.
- **Virtual and Augmented Reality Development:** Developers in the virtual and augmented reality space can explore the Haptic interaction to enhance the realism of their simulations. This innovation aligns with the growing demand for immersive and sensory-rich virtual experiences, making it a valuable asset for developers creating applications related to crafting, design, and skill development.
- **Crafting Enthusiasts and Hobbyists:** Haptic interaction can support individual crafting enthusiasts and hobbyists looking to improve their skills in a controlled environment. It provides a unique and engaging way for individuals to practice and refine their techniques, fostering a sense of accomplishment and skill progression.
- **Manufacturing and Product Design Industries:** Industries involved in manufacturing and product design, particularly those incorporating handcrafted elements, can benefit from the Haptic Craft Learning System. Designers and manufacturers can use the system to train employees in tactile skills relevant to their craft, contributing to the production of high-quality, artisanal products.

- **Heritage Preservation Organizations:** Haptic training contributes to the conservation of traditional skills by providing a platform for practitioners to engage in realistic tactile training, ensuring the continuation of cultural and historical crafting techniques.
- **Online Craft Platforms:** Online platforms dedicated to crafting and DIY activities can integrate the Haptic Craft Learning System to enhance the user experience. This innovation adds a unique dimension to online crafting communities by providing a virtual environment for tactile training and skill development.
- **Healthcare and Rehabilitation:** The Haptic Craft Learning System has potential applications in healthcare and rehabilitation settings. For individuals undergoing physical therapy or rehabilitation, the system can serve as a therapeutic tool, promoting fine motor skill development and coordination through tactile exercises.
- **Technology and Innovation Centres:** Technology and innovation centres focused on developing cutting-edge tools for skill acquisition and training can incorporate the Haptic Craft Learning System into their offerings. This innovation aligns with the broader trend of using technology to enhance traditional skills and craftsmanship.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are ETH, and FORTH. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.4.4 Games and toys

With games and toys, the project seeks to make people from different age groups explore the world of crafting through creative digital games and physical toys designed for fun, learning, and skills-building. We have simplified the complexity of crafts into engaging experiences, blending both digital and physical elements. In the digital games, accessible online for desktop or mobile devices, users find a guided journey. Learning is enjoyable with scripted training, including gentle nudges and rewards, and provides an easy and structured way to pick up crafting techniques. The physical toys feature 3D-printed "tools" made from recyclable plastic. Like mini crafting kits, they allow play, creation, and follow instructions at the preferred pace. Whether a beginner or an experienced crafter, there will be something for everyone. The Craft Studio and Apprentice Studio bring crafting to life simply and enjoyably. We believe learning should be a joyful adventure, and our games and toys are here to make that happen.

The rationale for the innovation

- **Simplified Learning Approach:** Traditional crafting techniques can be intricate and overwhelming for beginners. By simplifying these techniques into games and toys, the learning curve becomes approachable and enjoyable, fostering a positive introduction to crafting.
- **Engagement Through Play:** The incorporation of games and toys is rooted in the understanding that play is a powerful motivator for learning. By infusing elements of play into the crafting experience, users are more likely to engage, experiment, and persist in developing their crafting skills.
- **Structured Learning Journeys:** The scripted training courses embedded in the digital games provide a structured learning path. This approach offers a clear progression with built-in rewards, warnings, and sanctions, ensuring users experience a guided journey that balances challenge and achievement.

- **Accessible Digital Platforms:** Making the digital gaming component accessible online for desktop and mobile devices ensures broad availability. This innovation leverages the ubiquity of digital platforms, allowing users to engage in crafting games from the convenience of their preferred devices.
- **Tangible Hands-On Experience:** The physical toys, featuring 3D printed tools, offer a tangible and hands-on crafting experience. This tactile engagement goes beyond the digital realm, allowing users to interact physically with crafting materials and fostering a deeper connection with the creative process.
- **Inclusivity and Adaptability:** The range of difficulty levels in the designs and instructions ensures that individuals of varying skill levels can participate, promoting inclusivity and accommodating a diverse audience.
- **Eco-Friendly Design:** Using recyclable plastic for the 3D printed "tools" aligns with sustainability goals. This eco-friendly approach not only contributes to responsible manufacturing but also introduces users to crafting with an environmental conscience.
- **Joyful Learning Experience:** The overarching rationale is to make learning a joyful experience. By infusing elements of play, simplicity, and accessibility, Craft Studio and Apprentice Studio aim to create an environment where individuals can discover the joy of crafting without feeling overwhelmed.

Market potential

- **Crafting Enthusiasts and Hobbyists:** A primary market includes individuals with a keen interest in crafting. Craft Studio and Apprentice Studio cater to this audience, offering a playful and educational avenue for enthusiasts to enhance their skills, explore new techniques, and enjoy creative expression.
- **Educational Institutions:** Schools, art classes, and educational institutions can integrate Craft Studio and Apprentice Studio into their curriculum. These innovative tools provide an engaging and structured approach to teaching crafting skills, making learning enjoyable and accessible for students of different ages.
- **Online Learning Platforms:** Online learning platforms dedicated to crafting, DIY, and skill development can leverage Craft Studio and Apprentice Studio to enhance their offerings. These digital tools provide interactive and guided experiences, making them valuable assets for platforms aiming to provide hands-on learning experiences.
- **Crafting Workshops and Studios:** Crafting workshops and studios, whether physical or virtual, can incorporate Craft Studio and Apprentice Studio into their sessions. These tools offer a blend of digital and physical experiences, making them suitable for workshops introducing crafting skills to diverse audiences.
- **Toy and Game Retailers:** Craft Studio and Apprentice Studio have the potential to become popular products in the toy and game retail market. As educational and creative tools, these products appeal to parents and caregivers seeking enriching and entertaining activities for their children.
- **Eco-Friendly and Sustainable Brands:** Brands focusing on eco-friendliness and sustainability may find value in the 3D-printed "tools" made from recyclable plastic. Craft Studio and Apprentice Studio align with sustainability goals, making them attractive for brands seeking environmentally conscious products.
- **Community and Social Organizations:** Community centres, social organizations, and clubs can use Craft Studio and Apprentice Studio as tools for community engagement. These products offer a social and collaborative dimension to crafting, fostering a sense of community and shared creativity.
- **Healthcare and Therapeutic Settings:** The tactile and hands-on nature of the physical toys can find applications in healthcare and therapeutic settings. In rehabilitation programs, the Craft Studio and

Apprentice Studio may be used as therapeutic tools to enhance fine motor skills, creativity, and cognitive abilities.

- **Gift and Specialty Stores:** Specialty stores that focus on unique and creative gifts may find Craft Studio and Apprentice Studio appealing to their customers. These products offer a thoughtful and enriching gift option for individuals interested in crafting and hands-on activities.
- **Global Digital Gaming Market:** The online gaming component of Craft Studio and Apprentice Studio has potential in the broader digital gaming market. As educational games continue to gain popularity, these products can carve a niche for digital experiences that blend entertainment with skill development.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are FORTH, and KHORA. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.5 WP5 – Design

3.5.1 Design Studio & Computer-aided design

The Design Studio is a virtual workspace designed to elevate the creative design process by integrating computer-aided design, and AI-based design capabilities, and support workflow planning. The virtual studio is engineered to provide a simulation environment, minimising experimentation costs and offering features to support exploration, training, and producing pre-defined forms of crafts and craftsmanship.

Within the Design Studio, craft-specific 3D tools are incorporated to cater to the unique intricacies of selected crafting techniques. These tools empower designers with precision and customization options, ensuring a fit for various craft forms such as, for example, glassblowing, marble cutting, and wood carving.

Haptic interfaces introduce a tactile dimension to the virtual workspace, enabling a physical engagement of designers with their creations. This interactive feature enhances the design experience as it seeks to foster a deeper connection between the creator and the digital artefact.

The inclusion of computer-aided design tools within the Design Studio provides designers with a toolkit for conceptualization and refinement and ensures efficiency and accuracy in the design process while accommodating diverse design requirements. The Design Studio links the digital and physical realms, facilitating the realisation of virtual designs through various fabrication methods used to make tangible creations. Realistic artefact previews are offered in virtual and mixed-reality environments. This capability provides designers with immersive experiences, allowing for visualisation and evaluation of designs in real-world contexts. The virtual previews enhance the design experience by providing dynamic perspectives and insights into the creation of crafts.

The rationale for the innovation

- **Efficiency and Cost Reduction:** Traditional design processes often involve extensive experimentation, increasing costs, and time investments. The Design Studio's simulation environment seeks to reduce the need for physical experimentation, thereby minimising associated costs and expediting the design cycle.
- **Craft-Specific Precision:** Crafting involves intricate techniques that demand specialised tools. Including craft-specific 3D editing tools ensures that designers have precise instruments tailored to the nuances of different craft forms and can train effectively. This precision allows for detailed customization and accuracy in crafting virtual designs.
- **Tactile Engagement for Enhanced Design Experience:** Haptic interfaces introduce a tactile dimension to the virtual design space. This hands-on engagement enhances the design experience and fosters a deeper connection between the designer and the digital artefact, promoting a more intuitive, fun, and immersive creative process.
- **Versatile Computer-Aided Design Functionality:** Integrating computer-aided design tools within the Design Studio provides a toolkit. This functionality gives designers the ability to conceptualize and refine, accommodating diverse design requirements and ensuring an efficient and adaptable design process.
- **Transition to Physical Creations:** A critical aspect of the Design Studio's innovation is its interface with digital fabrication modalities. This feature streamlines the transition from virtual design to tangible creations, ensuring a pathway for bringing digital designs to life through various fabrication methods.
- **Immersive Artefact Previews:** Realistic artefact previews in mixed and virtual reality environments offer designers immersive experiences. This capability allows for the visualisation and evaluation of designs in real-world contexts, providing new perspectives and insights during the design phase.

Market potential

- **Design and Creative Industries:** Design studios, creative agencies, and professionals in design-centric industries stand to benefit from the Design Studio. Its integration of tools and simulation power addresses the needs of designers seeking efficient, precise, and immersive experiences to test, refine, and practice craft design.
- **Educational Institutions:** The Design Studio offers an educational tool for institutions providing design courses. Its immersive and hands-on features make it an ideal platform for teaching design principles and computer-aided design techniques and fostering a deeper understanding of crafting processes.
- **Crafting and Artisan Communities:** Crafting enthusiasts and artisan communities can leverage craft-specific 3D editing tools to enhance their design capabilities. The Design Studio will be a digital place for artisans to experiment with designs, simulate crafting processes, and bring virtual creations to life.
- **Digital Fabrication and Manufacturing:** Digital fabrication and manufacturing industries can benefit from the Design Studio's interface with digital fabrication modalities. This feature seeks to streamline the design-to-production pipeline, offering efficiency gains and reducing time-to-market for physical creations.
- **Gaming and Virtual Reality (VR) Platforms:** The Design Studio's compatibility with virtual reality and mixed reality environments positions it as a potential asset for gaming and other virtual platforms. Its immersive artefact previews can be integrated into virtual worlds.
- **Online Design Platforms:** Platforms dedicated to online design collaborations and marketplaces can integrate the Design Studio to provide users with a virtual workspace for exploration, design, and

creation. This inclusion adds value by offering advanced design functionalities, simulation capabilities, and immersive previews to users engaged in collaborative design projects.

- **Consumer Electronics and Technology:** Companies in the consumer electronics and technology sectors may find applications for the Design Studio in product design and development. Its combination of AI-based design and realistic simulation contributes to efficient prototyping and innovation in product design.
- **Start-ups and Innovation Hubs:** Start-ups and innovation hubs looking to test design processes in virtual spaces can explore the Design Studio. Its features make it an attractive tool for those seeking creativity and efficiency in their design initiatives.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are KHORA, FORTH, ETH, and CETEM. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.5.2 Additive and subtractive manufacturing

The Craft Manufacturing Integration Suite focuses on integrating additive and subtractive manufacturing tools within the Design Studio, enhancing the capabilities of craft training.

The rationale for the innovation

- **Holistic Technological Analysis:** A comprehensive analysis of additive and subtractive manufacturing technologies reflects a commitment to understanding the landscape and ensures that the integration suite accommodates a wide range of technologies, fostering adaptability and relevance in diverse craft settings.
- **Real-world Collaboration with Craft Training Organizations:** Engaging craft training organisations in the development process is a deliberate choice to ground innovation in real-world applications. By collaborating with these organisations, the suite ensures its features align with the practical needs and challenges faced in educational and production contexts.
- **Tailored Integration for Craft Education:** The focus on a software toolchain specifically designed with the integration of additive and subtractive manufacturing tools within the Design Studio is driven by the need to simplify and streamline the education and integration processes. Tailoring the suite to craft education environments ensures that users, including students and practitioners, can incorporate advanced manufacturing techniques into their creative processes.
- **Versatile Evaluation of Manufacturing Technologies:** The suite's evaluation of various additive and subtractive technologies, ranging from FDM and SLA to laser cutting and milling, demonstrates a commitment to versatility. This approach allows craft professionals to explore and adopt the technologies most relevant to their applications, expanding the suite's utility across various craft disciplines.
- **Empowerment of Craft Professionals:** The overarching goal of the Craft Manufacturing Integration Suite is to empower craft professionals with advanced manufacturing capabilities. By making diverse technologies accessible, the suite provides craftsmen and craftswomen with the tools to enhance their creative processes, experiment with new techniques, and push the boundaries of traditional craftsmanship.

- **User-friendly Simplified Integration:** Recognizing the potential complexity of merging additive and subtractive manufacturing tools, the suite strongly emphasizes user-friendly design. The simplified integration process ensures that users within the Design Studio can incorporate advanced manufacturing technologies into their workflows, fostering a more accessible and intuitive experience.

Market potential

- **Craft Training Institutions:** Craft training organisations stand to benefit from the Craft Manufacturing Integration Suite. The Suite's emphasis on tailored integration for craft education positions it as a valuable tool for institutions seeking to enhance their training programs. It provides a comprehensive solution for educators to incorporate both additive and subtractive manufacturing technologies into craft curricula.
- **Craftsman and Artisan Communities:** Individual craftsmen and artisans looking to elevate their skill sets and expand their creative horizons represent a substantial market. The Craft Manufacturing Integration Suite gives craftsmen a user-friendly tool to test advanced manufacturing technologies, enabling them to explore new techniques, diversify their craft, and stay competitive in evolving markets.
- **Manufacturing and Fabrication Industries:** Industries involved in manufacturing and fabrication, where craftsmanship meets technology, can leverage the suite to enhance production processes. The software toolchain's ability to integrate diverse manufacturing technologies facilitates efficient workflows and reduces production costs.
- **Technology Companies:** Companies operating in the technology sector, especially those specialising in additive and subtractive manufacturing, may find opportunities to collaborate or integrate the Craft Manufacturing Integration Suite into their offerings. The suite's versatility in evaluating various technologies aligns with the dynamic landscape of technological advancements.
- **Educational Technology Providers:** Educational technology providers seeking innovative solutions for hands-on learning experiences can explore partnerships or integrations with the Craft Manufacturing Integration Suite. Its focus on user-friendly design and real-world collaboration with craft training institutions positions it as a valuable asset for enhancing educational technology platforms.
- **Art and Design Schools:** Institutions focused on art and design education can integrate the suite to offer a multidisciplinary approach. By incorporating advanced manufacturing technologies into their programs, art and design schools can provide students with a holistic skill set, preparing them for diverse career opportunities in crafting and design.
- **Small and Medium Enterprises (SMEs):** Small and medium enterprises involved in crafting and manufacturing, particularly those with limited resources for technology integration, can benefit from the suite as the simplified integration process ensures that SMEs can adopt advanced manufacturing technologies without extensive technical expertise.
- **Global Craft and Maker Communities:** The suite's adaptability and broad technology evaluation make it relevant to global craft and maker communities. It can serve as a virtual space for collaboration, knowledge sharing, and the exploration of new possibilities in crafting.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are KHORA, FORTH, and CETEM. IPR ownership will be the subject of a joint exploitation agreement and will

be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

3.5.3 Community portal

An online community portal for the creative exchange between stakeholders, enhanced with standard web-based community-building facilities and advanced web-based tools which will support enhanced presentation and interaction with content, products, craft education and training material etc. Overall the portal will support the following activities: (1) craft education and training, (2) craft valorisation, branding, building reputation, online preview of products, product valorisation, licencing and online sales for craftsperson and micro-businesses and (3) content to promote European crafts, history, identity and new entrepreneurship and skills for the preservation of traditional craft techniques and products.

The rationale for the innovation

Facilitating Creative Exchange: The Craft Exchange Hub addresses the need for a centralized platform where craftsmen, educators, enthusiasts, and businesses can converge for a vibrant exchange of ideas, techniques, and creative endeavours. By fostering a collaborative community, the platform enriches the overall creative landscape within the crafting domain.

Enhancing User Experience with Advanced Tools: The incorporation of advanced web-based tools goes beyond conventional community portals. These tools are strategically integrated to elevate the user experience, providing a dynamic and interactive space for users to showcase, learn, and engage. The innovation lies in offering a sophisticated yet user-friendly environment that empowers users to interact with content in novel ways.

Supporting Craft Education and Training: Recognizing the importance of continuous learning in craftsmanship, the platform serves as a virtual classroom. Craftsmen and learners can access a diverse array of educational resources, participate in training programs, and connect with experienced instructors. This educational focus aligns with the evolving needs of the crafting community.

Empowering Craftspersons and Micro-Businesses: Craft Exchange Hub strategically empowers individual craftsmen and micro-businesses by providing them with a comprehensive online platform for craft valorisation, branding, and sales. The innovative aspect lies in offering a centralized hub where artisans can not only showcase their work but also engage in online sales, licensing, and brand-building activities.

Preserving Craft Heritage and Identity: The platform's commitment to promoting European crafts, history, and identity is rooted in the recognition of the importance of preserving cultural heritage. By curating content that highlights traditional craft techniques and entrepreneurial success stories, the Craft Exchange Hub becomes a catalyst for the preservation of Europe's rich crafting heritage.

Facilitating New Entrepreneurship and Skills Development: In fostering a dynamic space for collaboration and learning, the platform encourages new entrepreneurship and skills development. Craftsmen and enthusiasts can explore entrepreneurial opportunities, acquire new skills, and contribute to the evolution of craft traditions. This innovative approach aligns with the changing dynamics of the crafting landscape.

Creating a Comprehensive Digital Ecosystem: The overarching innovation lies in creating a comprehensive digital ecosystem that seamlessly integrates community-building, education, promotion, and commerce within the craft domain. The Craft Exchange Hub serves as a one-stop destination, catering to diverse needs and interests within the crafting community.

Market potential

Craftsmen and Artisans: The platform provides individual craftsmen and artisans with a powerful tool for online presence, brand building, and product promotion. Craftspersons can utilize the platform to reach a broader audience, engage in online sales, and establish themselves as prominent figures in the crafting community.

Craft Training Institutions: Craft training institutions can leverage the Craft Exchange Hub as a supplementary educational tool, offering a virtual space for students to access resources, collaborate with peers, and engage with experienced instructors. The platform enhances the institution's online presence and facilitates the seamless integration of digital tools into craft education.

Micro-Businesses and Small Enterprises: Micro-businesses and small enterprises within the crafting industry can benefit from the Craft Exchange Hub's online sales and licensing features. The platform serves as an accessible marketplace for showcasing and selling crafted products, opening new avenues for revenue generation and business growth.

Technology and Craft-Related Companies: Companies operating in the technology and craft-related sectors may find collaborative opportunities with the Craft Exchange Hub. Integrating advanced web-based tools and fostering a creative community, the platform aligns with the goals of companies seeking to enhance digital engagement and innovation within the crafting domain.

Educational Technology Providers: Educational technology providers can explore partnerships or integrations with the Craft Exchange Hub to enhance their offerings. The platform's focus on craft education, training, and community-building aligns with the needs of providers seeking innovative solutions for hands-on learning experiences within the crafting sector.

Global Craft and Maker Communities: The Craft Exchange Hub has the potential to become a central hub for global craft and maker communities. By offering a diverse range of activities, from education to online sales, the platform can attract a global audience interested in exploring, learning, and collaborating within the crafting domain.

Art and Design Schools: Institutions focused on art and design education can integrate the Craft Exchange Hub to provide students with a multifaceted learning experience. The platform's emphasis on craftsmanship, brand building, and online sales aligns with the goals of art and design schools preparing students for the evolving landscape of creative industries.

Heritage and Cultural Organizations: Organizations dedicated to preserving cultural heritage and promoting craft traditions can collaborate with the Craft Exchange Hub to showcase historical narratives, traditional techniques, and the cultural significance of crafts. This collaboration enhances the visibility of heritage-related initiatives and fosters cultural preservation.

Entrepreneurs and Start-ups in the Crafting Sector: Entrepreneurs and start-ups in the crafting sector can utilize the Craft Exchange Hub as a launchpad for their ventures. The platform provides a supportive community, educational resources, and opportunities for brand building and online sales, making it an attractive space for those entering the crafting market.

IPR holders

Based on Craeft's GA the organizations that are participating in the formulation of this innovation are MDE, FORTH, and CNR. IPR ownership will be the subject of a joint exploitation agreement and will be defined based on the commonly understood contribution of each participating organization to the formulation of the IP.

4 Common exploitation objectives for all partners

After evaluating the results of the above analysis methods, the project stakeholders will be invited to formulate the objectives through targeted questionnaires and discussions. For any identified exploitable output and the overall project output, a concrete business development strategy will be put in place. This requires early engagement with identified potential users of the product to ensure that the proposed output fulfils a real customer need, and hence has potential as a product. Outputs will then go through a more formal strategic development (operational and financial plan, etc.) for commercialization, and where necessary the consortium will engage with other mechanisms (SME Instrument, access to Risk Finance, national development funding) to take these outcomes to market.

We foresee that the exploitation plan of Craeft can be articulated in three main directions:

- A joint exploitation plan from the Consortium;
- Individual exploitation plans from each of the Partners of the Consortium;
- Exploitation possibilities for third parties.

4.1 Joint Exploitation Plan of the Consortium

As for the joint exploitation plan of the CRAEFT Consortium, Partners will work together to (a) keep maintaining the CRAEFT software platform, eLearning portal, and training infrastructure (b) disseminate it through wide communication activities and more targeted presentations and (c) find commercial and/or funding opportunities to further develop new functionalities or personalise the current functionalities for third parties. The second version of this deliverable will be ready on M24 to give enough period to the Partners to understand better the commercial potential of CRAEFT. After this year, the Consortium will evaluate the results and decide on the basic Business Model. All the activities carried out during this year will be coordinated by MDE also through regular virtual Consortium meetings.

4.2 Exploitation plans for each Partner of the Consortium

Each partner will also use key exploitation results developed within CRAEFT to implement individual exploitation plans based on their needs and interests. Longer and more detailed descriptions will be added on M24. According to current data, depending on each partner type, the following exploitation results are expected:

R&D partners will increase their impact on the scientific community and, thus, will have more opportunities for exploitation of project outcomes, in other EU projects and commercially. FORTH has a tradition of exploiting research outcomes commercially especially in the domain of CH it has established a strong presence with more than 25 Mixed Reality installations in Museums, CH institutions and public spaces in fine countries. At the same time, FORTH is exploiting its expertise in the semantic representation of CH resources (using CIDOC-CRM) in the context of collaborations with CH institutions worldwide. In the same context, ARMINES has a long tradition of collaboration with the industry for the exploitation of

research outcomes and the progress achieved by the project will provide new routes for further exploitation of the motion and body tracking technologies.

SMEs will achieve significant progress through the implementation of HC applications exploiting VR and process simulation for education and training.

HC Institutions: The HC crafts institutions participating in **Craeft** will exploit project outcomes in several alternative ways. The knowledge representation will be used for further integration of their digitised assets and collections into the model while the platform for craft representation, semantic annotation and linkage will be used for authoring semantic links between collections to further exploit the outcomes of the project. Furthermore, the HC institutions will be provided with novel education and training experiences to enhance the promotion of their hosted crafts.

Craft training organisations will be provided with a completed education and training intervention in their first deployment for craft education and training.

4.3 Exploitation possibilities for third parties

According to the main objectives of the project, as shaped by the co-creation sessions between partners and stakeholders. Craft training at different initiation levels is important for two reasons: (a) craft training and apprenticeship are parts of the craft representation to be presented and (b) the ability to teach a craft enables its preservation and authenticity and (c) promotes awareness. In Craeft, the teaching process will be modelled as part of the representation, providing a basis for authoring instructions and training experiences. Craeft will support training through the Craeft eLearning Platform and the Craeft Studios. Craeft will explore contributions that counter the lack of instructors, the geographical remoteness of apprentices, and the lack of training sites. Craeft will also study how such applications could counter student demotivation, stemming from lack of certification, i.e., by validating the correctness of practice.

5 Exploitation Achievements

The CRAEFT project, funded by the EU and focused on understanding and preserving crafts, has produced a wide range of exploitable results with significant implications for commercialization, collaboration, and knowledge dissemination. These opportunities span beyond technological advancements, reflecting the project's holistic approach to cultural heritage.

The CRAEFT consortium is committed to fully exploring exploitation opportunities by engaging all partners, including academic institutions, industries, and cultural heritage stakeholders. A particular emphasis has been placed on the potential to offer services developed within the project as commercial products or through free or subscription-based services, ensuring accessibility for a variety of user groups.

Intellectual Property (IP) considerations have been central to the project, with mechanisms in place to safeguard and maximize the potential of the cooperative work among partners. This strategic approach ensures that the innovative solutions created within CRAEFT can be effectively used for both commercialization and future research initiatives.

The project's extensive expertise in digital technology has enabled the preservation and transmission of invaluable craft knowledge integral to Europe's cultural heritage. The solutions identified through CRAEFT offer crucial benefits in the systematic research, recording, and representation of crafts, benefiting individual partners and enriching the broader European cultural landscape.

Looking ahead, the consortium is eager to further develop these exploitation opportunities by establishing local partnerships and offering the project's outcomes to relevant stakeholders. By doing so, CRAEFT aims to drive economic growth and innovation while fostering a deeper appreciation and understanding of Europe's cultural heritage both locally and globally.

5.1 MDE

MDE has **actively promoted the Egocentric Recording Methodology within the Ethnographic Protocol, emphasising its role in craft documentation and knowledge transmission**. At the **WCC Europe Annual Meeting** in Barcelona, MDE showcased the egocentric recording approach and video elicitation method, encouraging its wider adoption by WCC members and craft professionals.

MDE further integrated the Ethnographic Protocol within the **MindCrafts ERASMUS+ project**, collaborating with La Table Ronde de l'Architecture (Belgium), Confartigianato Udine (Italy), and CEFS Udine (Italy).

Additionally, the **Ethnographic Protocol has enriched and inspired MDE to interview its craft members in a unique way, introducing an egocentric, first-person perspective to craft gestures**. This fresh approach brings the audience closer to the details, precision, and dedication required in craftsmanship, allowing them to see each movement, technique, and effort through the artisan's own eyes. By emphasizing this immersive storytelling, MDE not only highlights the skills, experiences, and personal

journeys of craftspeople but also deepens audience engagement, fostering a greater appreciation for the complexity of traditional crafts. Ultimately, this innovative narrative style raises awareness about craftsmanship, strengthens connections with artisans, and helps attract more customers to the sector.

The Craeft project has significantly **raised MDE's visibility**, positioning it as one of the key innovators in the craft sector. As a result, Madina Benvenuti has been invited to numerous conferences as a speaker, strengthening MDE's role in craft preservation, skills transmission, and heritage education. Additionally, MDE played a key role in the SIPC 2024, organising a conference and launching the CRAFTOUR Initiative alongside five other EU-funded projects (Colour4crafts, Tracks4crafts, Hephaestus, Culturality, and MOSAIC). This event marked a major step towards the exploitation of Craeft's outcomes, fostering cross-project collaboration and expanding their impact in the heritage and craft sectors.

Looking ahead, MDE, with the support of FORTH, as the CRAFTOUR Initiative coordinator, together with Colour4crafts, Tracks4crafts, Hephaestus, Culturality, and MOSAIC is preparing a **policy roundtable on January 30, 2026**, in Brussels, which will bring together policymakers, educators, and craft practitioners to explore how Craeft outcomes and innovations can be integrated into broader policy frameworks.

Furthermore, MDE will leverage the *Communities* forum, integrated into the madineurope.eu portal to maximise the exploitation of Craeft's outcomes. Through targeted engagement strategies, MDE with the support of FORTH will actively use the Communities to foster discussions, share best practices, and facilitate networking among craft professionals, educators, researchers, academics and policymakers. By integrating Craeft's methodologies and research findings within its madineurope.eu portal, MDE will enhance knowledge-sharing and create sustainable impact beyond the project's duration.

The **Communities forum will also serve as an additional asset for MDE members of the portal**, offering a dedicated space for exchange, collaboration, and peer support. This interactive forum will enable craft professionals to discuss trends, share their opinions about technological and innovation advancement in the crafts sector, seek advice on technical challenges or business opportunities and much more. Additionally, the forum will support and encourage cross-disciplinary collaboration, encouraging synergies and brining closer craftspeople, designers, researchers, and cultural heritage professionals. **Enriching the existing digital ecosystem of madineurope.eu portal.**

5.2 Khora

Khora has focused on leveraging tangible cultural heritage through advanced training methodologies and simulations. The outcomes of the CRAEFT project have been consistently communicated and showcased across various channels, including social media, direct engagements with clients, and collaborative partnerships. These efforts have significantly enhanced Khora's production capabilities, particularly in the development and design of VR training systems.

Strategies for Promotion and Integration

Khora has employed a comprehensive strategy to promote and integrate the CRAEFT project outcomes across its operations, emphasising both outreach and internal integration.

Social Media Outreach:
Khora has effectively utilized social media platforms to broadcast the successes and advancements made through the CRAEFT project. This approach has not only informed a broader audience about Khora's capabilities in managing tangible cultural heritage but also showcased the company's innovative VR training solutions.

Direct Client and Partner Engagement:
By fostering direct engagement with clients and partners through face-to-face meetings, Khora has promoted the CRAEFT outcomes in a more personalized and impactful manner. These interactions have enabled tailored demonstrations, in-depth discussions, and have strengthened key business relationships.

Incorporation into Khora's Production Processes
The insights and technological advancements gained from the CRAEFT project have been successfully integrated into Khora's core production processes. Particularly, the project's innovative VR training design systems have been adapted into Khora's existing workflows, enhancing the development and deployment of cutting-edge VR training solutions.

Contributions of CRAEFT to Khora's Development

Expansion of Business Networks
Promoting the CRAEFT project has allowed Khora to build new business relationships and strengthen existing ones. These expanded networks have led to valuable collaborations, contributing significantly to Khora's growth and diversification in both the cultural heritage and training sectors.

Enhanced Industry Visibility
Through its proactive approach in showcasing the CRAEFT outcomes, Khora has seen a marked increase in visibility and market reputation. This heightened profile has attracted new clients and positioned Khora as a thought leader at the intersection of cultural heritage preservation and innovative VR training technologies.

The CRAEFT project has had a profound impact on Khora, not only by improving internal process efficiencies but also by broadening the company's presence within the industry and enhancing client engagement. As Khora continues to integrate and build upon these outcomes, the company is well-positioned to lead and innovate in the convergence of VR training and cultural heritage preservation.

5.3 ARMINES

ARMINES actively integrated and promoted the project outcomes through a series of events, fostering both academic and professional engagement across the sectors directly connected to the CRAEFT project. At the **Salon du Patrimoine 2025**, held at the iconic Pyramids of the Louvre Museum, we had the opportunity not only to present our technical methodology but also to engage in meaningful exchanges with researchers from other EU projects focused on crafts. This event served as a catalyst for expanding our network within the cultural heritage community, highlighting the relevance of our ethnographic protocols in preserving and digitizing traditional knowledge. Building on this momentum, we introduced our recording protocol and methodological framework during the **ENAMOMA Master's course** on *Human-Centered AI in Cultural and Creative Industries*, an interdisciplinary program bridging art, design, and technology. Our presence there allowed us to showcase the practical applications of our project

within the creative industries, sparking discussions on how human-centered AI can support cultural preservation and innovation, perfectly aligning with the goals of the CRAEFT project.

Further advancing our outreach, ARMINES organised the conference **"How Can Industries Operate Through AI ACT?"**, a pivotal event that brought together leaders from AI, cultural sectors, and creative industries to explore the intersection of regulatory frameworks and technological innovation. The conference delved into critical themes such as the impact of the EU's AI ACT on industrial practices, the future of manual professions in the era of AI, and the challenges faced by creative industries in adapting to new AI-driven paradigms. The rich dialogues that emerged not only fostered new collaborations across disciplines but also laid the groundwork for the forthcoming manifesto, *"Working with Artificial Intelligence in Cultural and Creative Industries: A Manifesto for the Application of the AI ACT,"* reflecting our commitment to ethical and responsible AI integration.

Collectively, these initiatives have significantly contributed to the growth and visibility of our organisation and the CRAEFT project. They have strengthened our interdisciplinary networks, enriched our methodological approaches, and positioned us in fruitful discussions on AI's role in cultural heritage and creative industries. Through these activities, we have not only disseminated the project's outcomes but also actively shaped the evolving discourse on human-centered AI within both academic and professional communities.

5.4 CERFAV

The integration of Craeft project results is an ongoing process, with experimentation—particularly in Work Package 6.1 (Education and Training)—paving the way for new applications within the official French craft training curricula. A key focus is on **enhancing synergies between traditional knowledge transmission and digital tools by integrating e-learning platforms more effectively with in-situ learning.**

Additionally, Work Package 6.3 is exploring new opportunities for animating boutique workshop sales areas, further expanding the project's impact.

Parallel developments in the French national initiative for arts and crafts have also **fostered partnerships and synergies with French research teams in the Resource project**, where knowledge exchanges are already underway. The deeper integration of e-learning into training processes is expected to prompt a partial rethinking of organizational structures, particularly regarding knowledge and skill transmission at Cerfav. This aspect will be further examined and refined in the final version of WP6.1.

5.5 CETEM

The various outcomes of the Craeft project will be integrated into CETEM's ongoing activities, with the goal of enhancing and preserving woodcarving knowledge. Through its participation in Craeft, CETEM has **made new connections with woodcarving artisans and furniture designers** eager to share their expertise, ensuring that these results will be sustained over time.

As part of this integration, **training materials and an e-learning course will be incorporated into CETEM's existing training program**. Additionally, a specialisedd design tool will be developed to support woodcarving practices, and an interactive visit will be organized to explore the history, key locations, and cultural significance of this craft in Yecla, strengthening its transmission and awareness.

Beyond training, Craeft has **enriched CETEM's expertise in woodcarving, enhancing the skills of its Design Department staff and establishing a new research focus in this area**. The project has also expanded CETEM's network by fostering new connections with artisans, companies, and experts, broadening its influence. Ultimately, these developments are expected to increase CETEM's visibility, particularly in the fields of training, design, and tourism, reinforcing its role as a key player in the local industry.

5.6 FORTH

FORTH has enhanced its research network and initiated new collaborations through the implementation of Craeft outcomes. Noteworthy exploitation of Craeft results include its **collaboration with SceneOpsis**, which has revolutionised smartphone video content by transforming it into photorealistic virtual tours, advancing digital documentation methods.

Additionally, FORTH is partnering with Lena Dubinsky from the Bezalel Academy of Arts and Design to explore porcelain art and with Reham Khaled on alabaster craftsmanship in Luxor through the RCI. An upcoming collaboration with Linardaki / Parisot, textile artists, will leverage the advanced scanning technologies developed through Craeft, specifically the High-Resolution 2D and 2½D surface scanning. This innovative tool, which exceeds 1 gigapixel per square centimeter, provides unparalleled resolution and incorporates photogrammetry to capture depth, offering a richer, more complete representation of textile artworks. Through this technology, the intricacies of textile patterns, textures, and even tactile qualities like smoothness or coarseness can be documented with exceptional precision.

The 2½D scanning technique will also enable a more comprehensive digital record, preserving not only the visual aspects of the textiles but also the subtle tactile qualities that are central to understanding their craftsmanship and historical significance. By integrating this advanced scanning technology, the collaboration with Linardaki / Parisot will open new possibilities for her artistic expressions.

Together with MDE, FORTH is working on the CRAFTOUR Initiative policy roundtable on January 30, 2026, in Brussels. This event will bring together policymakers, educators, and craft practitioners to explore how Craeft outcomes and innovations can be integrated into broader policy frameworks. In addition to the policy roundtable, FORTH is also collaborating with CRAFTOUR projects — Colour4crafts, Tracks4crafts, Hephaestus, Culturality, and MOSAIC — on a scientific conference, which will take place on January 29, 2026, in Antwerp. This conference will provide an opportunity for experts and researchers to present and discuss the latest findings, contributing to the ongoing dialogue on advancing the craft sector.