CRAFT 4.0 INTELLECTUAL OUTPUT 1 OVERVIEW

THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR.

CRAFT IN THE DIGITAL AGE.

AN INTRODUCTION TO CRAFT 4.0

"Digital tools, computers, software, imaging, and modelling are stretching the boundaries of making both in the process of creating form and in the development of the design itself. On the face of it there may appear to be a conflict between the machine/computer and hand-made where historically the machine has represented a threat to craft. However, these technologies also represent a significant opportunity to support the production of hand-crafted objects and to enhance the development of the craft sector. The emergence of affordable digital manufacturing and fabrication tools are acknowledged as having the potential to radically reshape contemporary craft practice, production and consumption.

Current trends in the craft sector show how important it is for craftspeople to embrace opportunities brought by the digital revolution. Craft 4.0 aims to create training tools and a peer network for craftspeople in the areas of digital modelling and digital/additive manufacturing. Furthermore, the project aims to improve digital competences in the craft sector and in doing so enhance the craft making process. Providing an opportunity for the craftsperson to cultivate product design and development skills, increase sectoral networking locally and internationally while also increasing customer engagement, with the purpose of improving and developing individual craft businesses."

Craft 4.0 is divided into intellectual outputs; this interim report will focus on the activities that were undertaken in order to produce Intellectual Output One (IO1). This first phase develops the project concept through focused and in-depth investigatory primary research. IO1 establishes the methodological cornerstones for the development of all design phases through a univocal approach, In particular IO1 consists of:

QUESTIONNAIRES.

A report of the results received from a *questionnaire* aimed at craft professionals. This questionnaire provides direct insights from craft professionals into the specific requirements for the development of a focused training strategy in 3D printing and digital modelling. This report underpins the potentiality of adaptation of digital technologies by craftspeople using traditional methods in the sector, providing initial parameters that will be explored further throughout Craft 4.0.

CASE STUDIES.

A collection of *case studies* sourced from all participating partners at local, national and European level; serve as examples to craft professionals of how digital modelling, 3D printing and other digital tools can improve their business model. Furthermore, this compilation of case studies provides insights from adapters into paths of learning and their experiences in adapting digital technologies into their practice, providing Craft 4.0 evidential context to ensure transferability and clarity within the proposed training tools in digital modelling and digital/additive manufacturing.
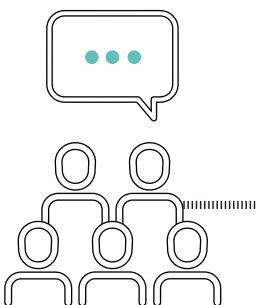
FOCUS GROUPS.

A collection of *focus groups* chaired by all particpating partners further extrapolated the primary findings from the previously undertaken questionnaire and case studies in order to further inform the design of the proposed training content. The focus groups were conducted through expert presentations and demonstrations of digital making technologies, informing participants of relevant applications within various craft sectors.

THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR:
QUESTIONNAIRES.

"This survey was outlined as a structured questionnaire, questions were chosen to construct clear profiles of the how participants worked as craftspeople and to establish how they perceived digital technologies as a tool to be utilised within craft as a discipline. Secondly, the questions chosen aimed to establish whether participants potentially wanted to engage with digital technologies within their own practice, as craftspeople.
Lastly this survey aimed to establish any potential issues that respondents perceived in utilising the digital."

QUESTIONNAIRE PARAMETERS:

Objective: To gain insights into the specific requirements from craft professionals, on the development of a focused training strategy in 3D printing and Digital Modelling.

Design: An online survey composed of 17 questions pertaining to the craftsperson and their experience / lack of experience in the functionality of digital technologies within their practice.

Setting: This questionnaire was provided upon an open access website platform, inviting participants that defined themselves as craftspeople.

SUMMARY REPORT LAYOUT:

For the purpose of this summary report the analysis of the results will be divided under the following headings: Craft Professional Profile, Working Environment, Digital Making Technologies and the Craftsperson, Employment, Digital Making Technologies and the Craftsperson, Barriers to using Digital Technologies in Craft, Online Course Skill Development and finally, Online Course Skills Recognition. The results and analysis will be delivered simultaneously through infographics and written text. This summary report will conclude with an overall summary of the findings of the report.

online
survey

Type of data collection
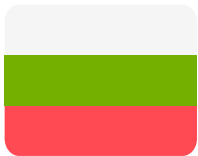
17

Questions

10

Nationalities

160

Respondents

28.09.2019
18.10.2019

Time span

Bulgaria
25 people — 15.6%

Ireland
25 people — 15.6%

Italy
21 people — 13.1%

Sweden
32 people — 20%

Spain
28 people — 17.5%

Brazil
1 person — 0.6%

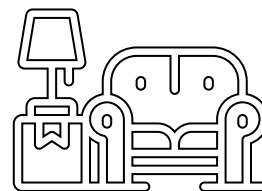**Germany**
1 person — 0.6%

Romania
25 person — 15.6%
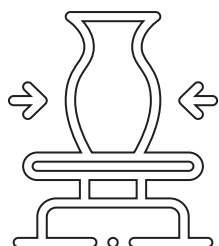
UK
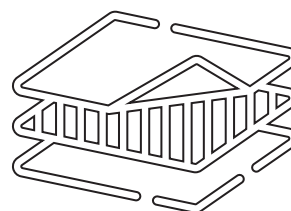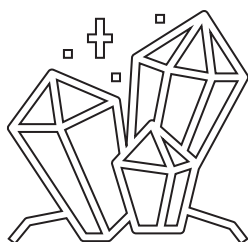1 person — 0.6%

USA
1 person — 0.6%

Furniture
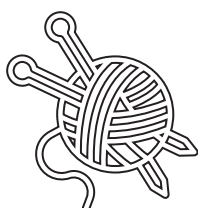26 people — 16.2%

Ceramics
18 people — 11.3%

Paper
20 people — 12,5%

Glass
11 people — 6,9%

Textiles
16 people — 10%

Wood

38 people — 23.8%

CRAFT PROFESSIONAL PROFILE:

From the ten participating nationalities: 15.6% were Bulgarian, 15.6% were Irish, 13.1% were Italian, 0.6% were German, 0.6% were American, 15.6% were Romanian, 17.5% were Spanish and 20% were Swedish. Despite some outliers the number of participants was negligible between each contributing partner. The 160 responses received were from participants across the craft sector; these participants had distinct areas of focus such as wood, glass, furniture, paper, jewellery, textiles; with an additional 46 respondents defining their work outside the above-named categories but still within the craft sector.

An analysis of the vast and varying backgrounds of the questionnaire participants and their chosen material outputs, highlights that working within the craft sector covers an inclusive and expansive field. Diverse materials and techniques are already being utilised by craftspeople within their practice to produce craft objects.
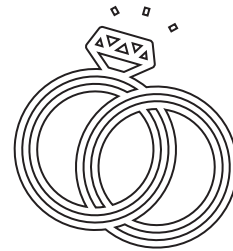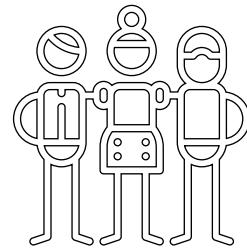
Jewellery

18 people — 11.3%
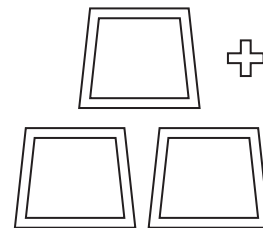
Other

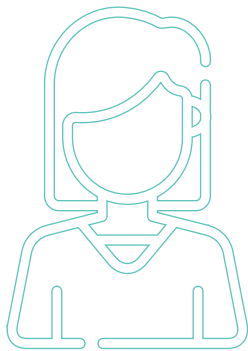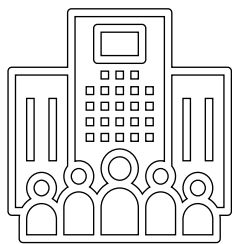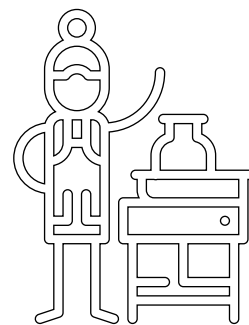46 people — 28.8%

Shared Workspace
27 people — 16.9%

Self Employed
94 people — 58.8%

Work from Home
53 people — 33.1%

For a Company
36 people — 22.5%

Dedicated Workspace
80 people — 50%
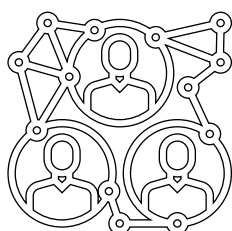
Part of a Collective
30 people — 18.8%
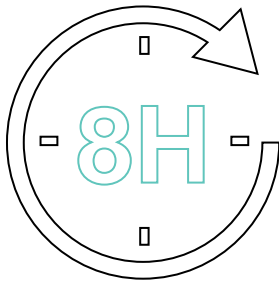
Full-time
58 people — 36.3%

WORKING ENVIRONMENT:

The questionnaire results showed that 36.3% of participants are in full time gainful employment within the craft sector with an additional 27.5% in part-time employment. The remaining 33.8% of respondents stated they are currently not gainfully employed within the craft sector. The majority of questionnaire participants (58.8%) stated they were self-employed. 22.5% of responses received stated they were employed by a company with 18.8% of responses stating they were part of a collective.

From the questionnaire responses received 50% stated they work outside of the home within a dedicated workspace with an additional 16.9% of respondents stating they worked within a shared workspace. The questionnaire results illustrated that the majority of modern craftspeople work outside of the home environment (66.9%), dedicating a specific space to their craft, in the minority are the remaining 33.1% of craftspeople surveyed who stated they worked from home.
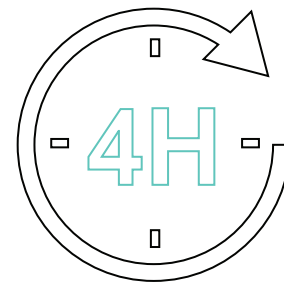
Part-time
44 people — 27.5%
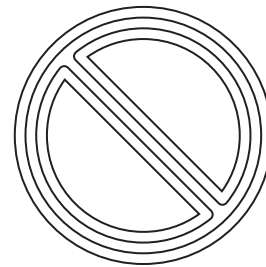
Not employed
54 people — 33.8%
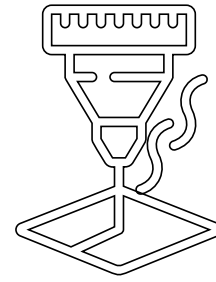
Laser cutting
69% of people
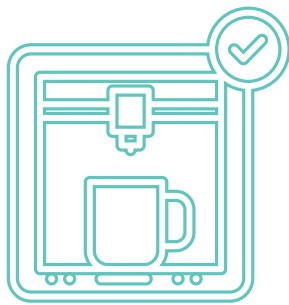
3D Printing
59% of people
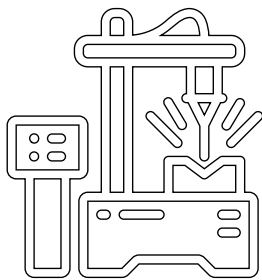
CNC Milling
63% of people
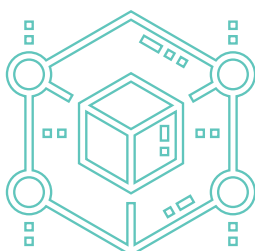
Digital Modelling
71% of people

DIGITAL MAKING TECHNOLOGIES AND THE CRAFTSPERSON:

Of the 160 questionnaire participants that were polled, 59% had some prior experience in 3D printing, 68% of participants have used laser-cutting within their practice and 63% of participants have had some experience with CNC milling. The majority of surveyed craftspeople at 71% stated they had existing experience with digital modelling. These results at a preliminary stage demonstrate that within the craft-sector, there has already been successful adoption of digital technologies into existing practice.

Surveyed craftspeople showed an overwhelming positive interest in further developing competences in digital technologies and participating in a training strategy for 3D printing and digital modelling with 93% of responses received stating they would be interested in developing these skills. Additionally, the results of the questionnaire placed the development of these skills and competences in digital technologies within the craft sector in a high importance category, with 77% of polled craftspeople aligning the development of digital competencies with the development of the craft sector itself.

Training Access
51.9% of people

BARRIERS TO USING DIGITAL TECHNOLOGIES IN CRAFT:

Concerns raised by participants in developing digital competencies were captured during the questionnaire process. Access to tools was the biggest barrier perceived by respondents in adopting digital making technologies in their own practice with 73.8% of respondent raising it as a concern, with access to training being another concern from 51.9% of survey participants. Other concerns raised by survey participants accounted for 15% of the results these included: lack of ability to adopt and learn digital competencies and cost barriers to utilising the technologies.
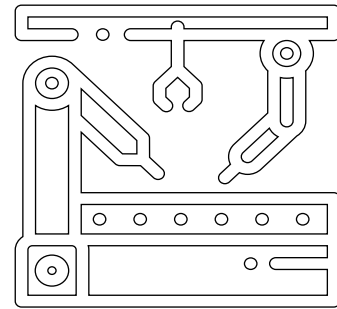
Tool Access
73.8% of people

93%

of people interested in developing skills.
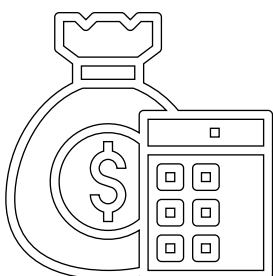
Cost & Other
15% of people

3D Printing
91% of people
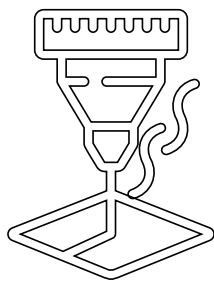
Laser cutting
91% of people
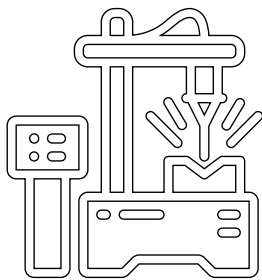
CNC Milling
75% of people
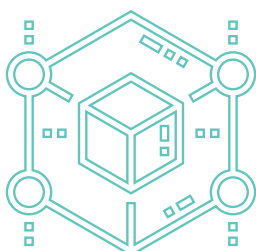
Digital Modelling
88% of people

ONLINE COURSE SKILL DEVELOPMENT:

Questionnaire participants were polled on what areas of digital competencies they would be interested in developing through an online platform, this line of questioning was used to establish a want - needs basis model to aid in the development of the online platform.

Of the five areas of learning that were outlined as options to survey participants the results showed that craftspeople were most interest in developing an understanding in the process involved in digital production, 3D printing and laser cutting with 91% of participants citing an interest in these competencies. 88% of participants cited understanding modelling software for 3D design as a desired skill to acquire through the digital platform. 75% of questionnaire participants also named CNC milling as a desired skill that they wished to develop through the Craft 4.0 platform.

All five of the stated learning outcomes showed overwhelmingly positive interest from survey participants, highlighting that the skill sets outlined are desirable by the sample survey of craftspeople from across all ten countries surveyed.
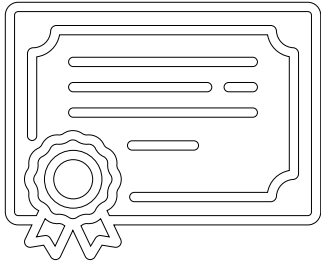
Certificates
73% of people

ONLINE COURSE
SKILLS RECOGNITION:

Questionnaire participants were also polled on how they wished their training would be recognized upon completion of the digital training platform, from the responses received 58% were interested in the possibility of receiving a badge of completion. 73% of questionnaire participants were interested in the possibility of receiving a certificate of accreditation upon completing training.

97% of surveyed craftspeople cited the possibility of peer-learning and knowledge sharing as important aspects to include in the training platform, this result emphasises the community like nature of the craft sector and demonstrates the importance that craftspeople place upon the dissemination of craft skills.

Peer Learning
97% of people
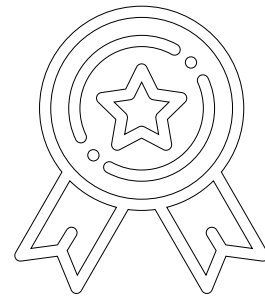
Badges
58% of people

*online
survey*
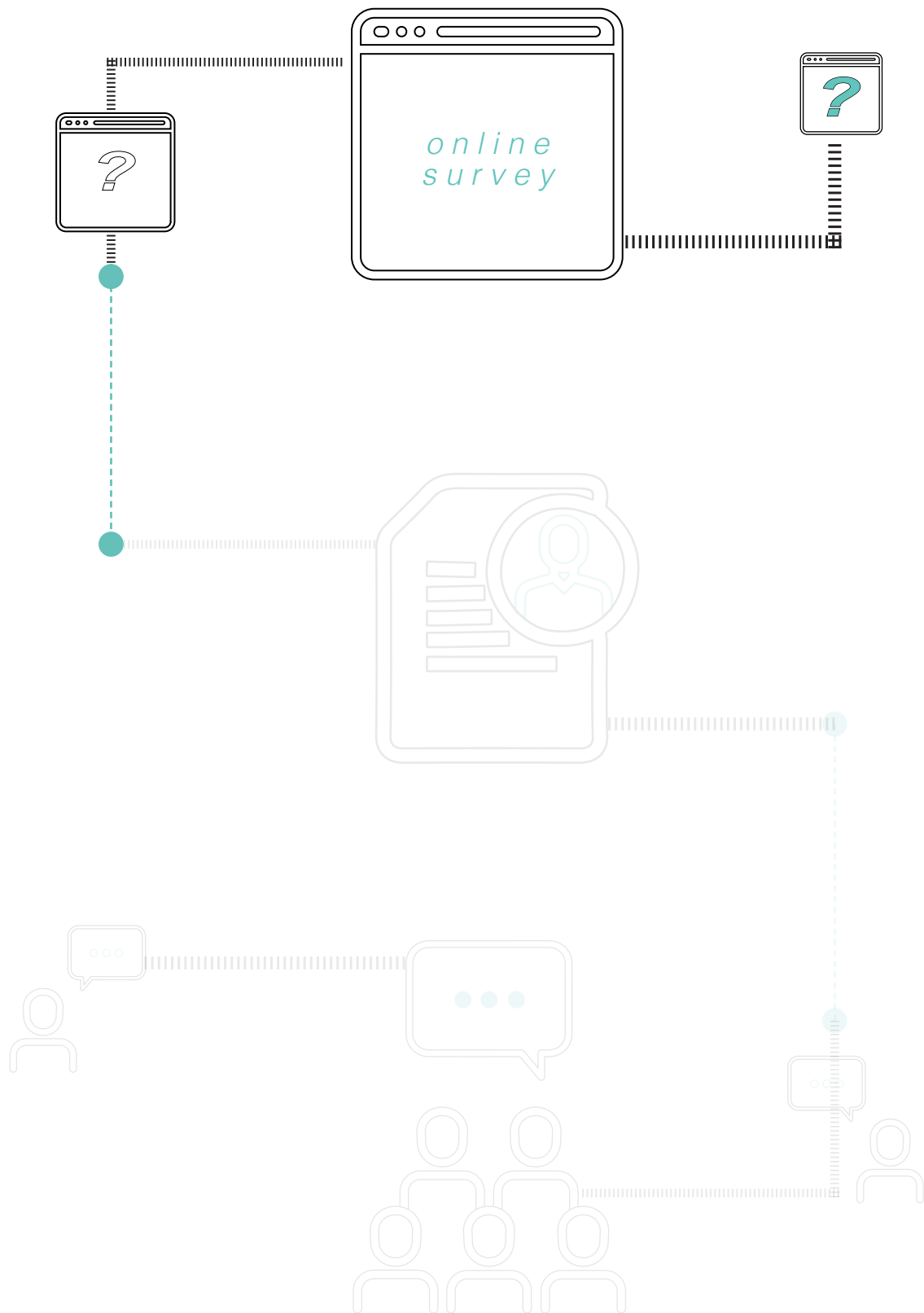
QUESTIONNAIRE SUMMARY OVERVIEW:

The craft sector covers a broad and expansive field, diverse materials and techniques are now being applied by craftspeople within their practice to create craft objects; this is clearly evident from the questionnaire results received. The results of the questionnaire showed that this modern craftsperson is interested in developing competences in digital technologies and participating in a training strategy for 3D printing and digital modelling with 93% positive response rate. Additionally, results received aligned the development of digital competencies with the development of the craft sector itself, as surveyed craftspeople placed a high importance on the development of these skills and competences in digital technologies within the craft sector.

All five of the stated learning outcomes (understanding in the process involved in digital production,3D printing, laser cutting, CNC milling and digital modelling) presented received positive interest from survey participants, emphasising that the skill sets outlined are desirable by the sample survey of craftspeople.

Surveyed craftspeople cited a methodological approach of peer-learning and knowledge sharing as significant to the training platform, this result highlights the community like nature of the craft sector and demonstrates the importance that craftspeople place upon the dissemination of craft skills.

This summary provided direct insights from craft professionals that will be employed in the development of a focused training strategy in 3D printing and digital modelling. Furthermore, this summary report has underpinned the potentiality of adaptation of digital technologies by craftspeople using traditional methods in the sector, providing initial considerations that will be utilised to further advance the digital platforms development.
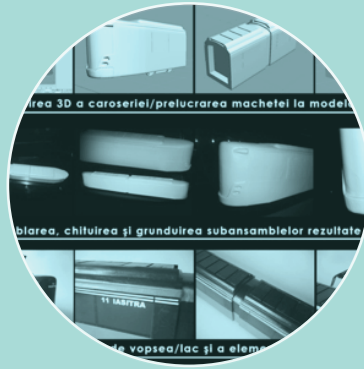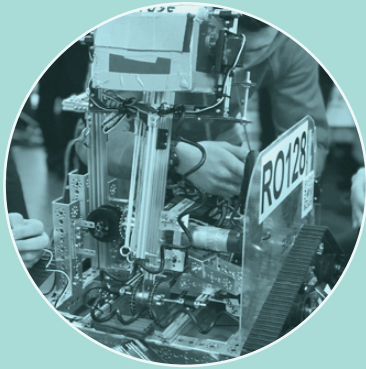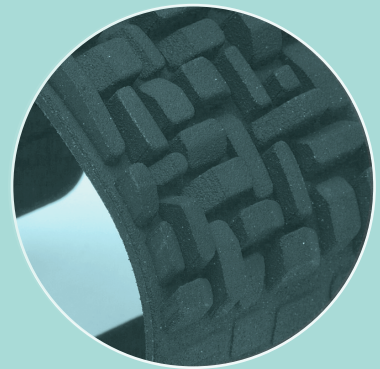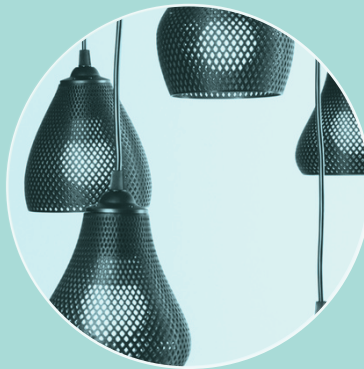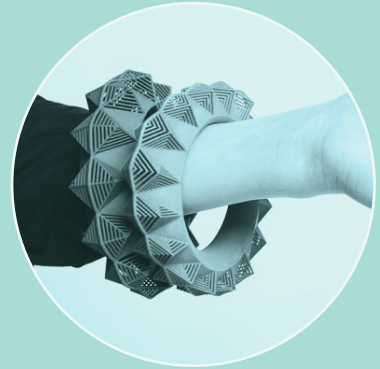
THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR:
CASE STUDIES.

"A sample selection of case studies chosen by the project partners provide examples of craftspeople who have adopted digital modelling, 3D printing and other digital tools into their practice. These case studies showcase the potentiality of digital technology in the production of craft objects. Furthermore, the information gained from conducting the case studies has provided direct insights from craft practitioners into their paths of learning and personal experiences in adapting digital technologies into their practice."

CASE STUDY PARAMETERS:

The case studies are outlined in a series of interview style questions in order to firslty establish the background of the designer/craftsperson and then to ascertain how they have adapted digital technologies into their practice. As established digtial practitioners interviewees were questioned on the barriers they perceived to adopting digital making for new adapters to digital technology. The interviews concluded with a request for recommendations of beneficial content to be included on the digital training platform.

PARTICIPATING DIGITAL PRACTITIONERS:

- *Stayko Tsenov*
- *Manoel Yanev*
- *Theresa De Jager*
- *Leo Scarff*
- *Matteo Meraldi & Simone Colombo*
- *Selvaggia Armani*
- *Serseniuc Radu Constantin*
- *Teodor-Stanciu Silviu*
- *Cristina Noguer*
- *Laura Fernandez-Martinez*
- *Barrett Michael Sauter*
- *Catharina Carlsson*

Stayko Tsenov

Automotive Engineering
Sofia, Bulgaria
stayko@tzenovs.com www.http://b2n.bg/

"I'm 24 years old and I've recently graduated Automotive Engineering in the Netherlands. During my study, my interest in any type of technology grew exponentially, as did my ability to handle it. The "Formula team" of the university I attended for 4 years helped greatly to this end, where we designed, built and competed a small car every year. My strongest skills are CAD 3D modelling and Finite Element Analysis computer simulations. I am currently taking a six-month Java programming course at Telerik in Sofia."

How did you start using 3D printing/ digital technologies?

"My newly developed CAD skills then kept me interested in developing a variety of functional and decorative designs. When I learned about 3D printing and that it became available enough, I ordered my first Chinese printer (Zonestar) which came disassembled. I will never forget how it took me two whole days to put the printer together without using any instructions, because I thought they forgot to include them in the package. It wasn't after I finished, when it turned out that the manual was uploaded in the SD

card which came with the kit! This sparked my interest in this technology and thanks to the fact that it had just started to develop globally, there was already a lot of sources on the Internet from which one could learn and improve its printing quality."

How has use of these technologies enhanced your craft/ business?

"I've learned through our formula team that one of the most precious resources out there is time. 3D printing has allowed us to make quick prototypes to validate a design before launching it for expensive aluminium production in a CNC machine, for example. There were also components that remained in 3D printed version, if their quality complimented their application afterwards. In the comfort of home, 3D printing has also found its application. My apartment in the Netherlands was filled with printed functional and decorative gadgets - hangers, headphone stands, hinges, coffee capsule holders, Tyrannosaurus Rex, etc."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"As an engineer, I can immediately point out the inability to guarantee the strength or behaviour of a component with great precision (in FDM printers in particular), which makes its application difficult when it comes to structural purposes. Another obstacle is speed.

Yes, the technology is very fast for prototyping and introducing changes, but not for mass production. Something that also needs to be addressed in the near future is the recycling of 3D printed components. As we all know, the decomposition of the polymers we print is an extremely long process, so responsibility dictates, to build a recycling mechanism or develop components for near eternal life and application."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"I can't really say that there should be a primary focus. Rather, a set of topics that need to be covered. Here is an example division in my opinion:
- *Main differences between 3D printing technologies (FDM, SLA, SLS etc.) strengths and weaknesses.*
- *Software – the variety of slicers.*
- *Materials - strengths and weaknesses.*
- *Basic settings and their impact on 3D prints.*
- *Modelling and printing techniques, supports, brims, rafts etc.*
- *Troubleshooting.*
- *Responsible design and environmental/ ecological aspect."*

Manoel Yanev

Part-3D
3D printing, Design of machine and mechanisms, rapid prototyping
Sofia, Bulgaria
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"I have a bachelor's degree in the field of "Precision Engineering and Optics" and a master's degree in the field of "Material Handling and Construction Equipment". After graduating the Technical University of Sofia in 2012, I worked as a Mechanical Engineer for different companies in variety of fields, like casino equipment, automotive and medical equipment. In parallel with my regular work I've also been developing my own business with my 3D printers, designing architectural models, statues, machine parts and auto accessories."

How did you start using 3D printing/ digital technologies?

"The first time I heard about the 3D printers was when I was in the university. The idea that I could create all kind of things I liked, from a thin air was fascinating. I imagined the replicators from Star Trek… Than the research started and about a year later I bought my first 3D printer. It wasn`t easy in the beginning, there was so many new things I had to learn until I managed to make prints with good quality. Now, 5 years later I already have two 3D printers which I use a lot, almost every day."

How has use of these technologies enhanced your craft/ business?

"My business started with the 3D printing. Since I started using the technology, I had to learn a lot of new things, not only about the 3D printing itself, but also a lot of different programs used for design of difficult shapes and forms. Also, I had to learn more about architecture, 3D scanning, programming…This gave me the opportunity to become fluent in many different areas which were not part of my education and because of that I can now offer a bigger variety of services to my clients."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"Buying a 3D printer is only the first step. Then, there are a lot of things that have to be learnt in the process. For people without engineering background usually is much more difficult to understand the process, the relationship between temperatures, speeds, different materials. Every once and a while the machine have to be repaired and maintained. Also, these people have to learn how to use 3D software and how to program the machine."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"First of all, at least basic in CAD programs and graphic programs, such as 3D Studio Max or Z-brush. After that, what is the 3D printing technology, how the printers work, what problems they may have in the beginning, such as under-extrusion, warping…. How to fix problems like nozzle clogging and printer calibration. All of these are specific technical aspects of the 3D printing. And finally, slicer programs and how to program their 3D printers."

Theresa De Jager

Pistol and Peach Design Studio
Jewellery
South Africa, Ireland and UK

info@pistolandpeach.com www.pistolandpeach.com

"Born in South Africa, I completed my schooling and post grad degree in Ireland. Having studied Jewellery Design in Cape Town between 2005 - 2009. I started to use CAD CAM and 3D printing aspects within my work when starting my MA degree at NCAD Dublin in 2011. It was there that I fully tried and tested how to immerse this type of additive manufacturing into my project and my practice. In Ireland I received awards and funding from Future-makers. Highlighted exhibitions for me with a collection of 3D printed work were 'Jewellery As Art' in the Cill Railgh Gallery, Kerry and MAD's LOOT exhibition at the Museum of Arts and Design in New York. Currently I am based in Sheffield in the UK where I have a small jewellery studio practice called Pistol and Peach and have been based here since 2016."

How did you start using 3D printing/ digital technologies?

"I had some training during my undergrad in Cape Town in a 3D computer graphics and computer-aided design application software. This was part of our jewellery design degree as its been used extensively within the jewellery industry for years - it lends itself perfectly to casting applications. I hadn't seen it used much in a creative or craft applications until I came to Europe to do my post grad. In 2011 there were big discussions about 'What is Craft?' Questions about handmade; making, ideas of preciousness within the jewellery industry really interested me and my tutors at the time. I began to research how 3D printing can be applied within my jewellery collection, I made it imperative that

I needed to use it in a way that it would be impossible to hand make these adornments. What followed was two years of modelling, testing and production in collaboration with some 3D printing companies based in Belgium and Holland."

How has use of these technologies enhanced your craft/ business?

"Between 2011 and 2013 I had a go od amount of exposure in terms of exhibition opportunities for the collection, I think that had a lot to do with the fact that it had been 3D printed. Having that kind of experience has definitely aided me in how I approach jewellery design and also how I see product design in general, it's given me a greater understanding of methods and processes, even a greater appreciation. I found the development for 3D printed work, slow in comparison with hand manufacture. In contrast to people believe it is almost a 'fast' or 'quick' manufacturing method. It is, but it's all the planning, testing and modelling that takes time. There is a huge amount of work involved and having experience in both manufacturing methods gives an added bonus when developing work or taking on a commissions, it is a powerful tool in your toolbox."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"Makers may have the designs, ideas and inspiration but its' the application of those into CAD CAM that can create relevant craft. Ultimately we are reduced to the limits of our skills.

Just in the same way that we invest in skills training for hand skills, one should do the same for using 3D printing. I think many makers are put off by delving into 3D printing due to a lack of knowledge in terms of the software used, the processes and the materials involved. Secondly is access to state of the art 3D printers. These are expensive and there are not many facilities around that can offer the right materials and quality printing fit for finished products. The ones that do are mostly in Europe and are costly to use. When developing a design the costs can quickly rise through the prototyping phase."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"The main focus in my opinion should be on software training for 3D printing. There are various different types of software that lend themselves better to different types of products. This training needs to be filtered throughout a design institutions teaching faculty. I ended up receiving tutoring from an industrial design tutor as at the time there was no tutor in my department that had the skill set needed. So perhaps more cross departmental teaching and skill sharing? This training could include how 3D printing can be used in various craft applications within a process not necessarily for the final product. In other words, the variety of its applications. This was something that was never taught to me and I had to do all my own research into how this technology

Leo Scarff

Leo Scarff Design / Hiberform
Furniture & Lighting Design & Manufacture
Ireland
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"Leo is a designer, design lecturer, mentor, consultant and exhibition curator originally from Dublin now based in Manorhamilton, County Leitrim since 2009. He has over 25 years' experience in the art and design world, set up his studio in 1997 and has lectured on design and design history since 1999. He was a founder member of the Irish Furniture Designers Network and has exhibited at trade fairs in Europe and the US. Leo has particular knowledge of product production, materials sourcing, digital fabrication and creative brand development and is a passionate promoter of Irish Design, Art and Architecture. He has lectured extensively in design thinking, interior design, furniture, lighting design, innovative materials and professional practice. In 2014 he co-founded Fablab Manorhamilton which facilitates many initiatives and courses on digital fabrication throughout Ireland and is the only mobile Fablab in southern Ireland."

How did you start using 3D printing/ digital technologies?

"My use of digital technologies began back in 1993 when a college project to design a furniture collection for manufacture by laser cutter gave me exposure to the power and practicality of industrial lasers. Ever since I have been fascinated by the accuracy and speed that digital design and production tools can offer creative industries. The majority of our studio's work uses digital technology of one type or another and over the last 10 years we have moved from outsourcing all our digital production to establishing inhouse laser cutting, CNC and 3D printing."

How has use of these technologies enhanced your craft/ business?

"Over the years I have experimented with various other CNC technologies such as water jet and CNC routers for wood, plastics and metals. In more recent years 3D printing has become more and more useful for custom parts production for commercial projects. Using CAD modelling packages to design parts and digital machinery to manufacture is not incredibly fast but enables small businesses to make small batches with ease. Also the accuracy of the machined parts mean we can take on projects where tolerances are key to assemblies or custom builds"

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"Until recently, access to the software and hardware for 3D printing was limited since much of the technology was expensive however, today good quality 3D printers like Creality 3D can be bought for less than a standard laptop and there are many free 3D modelling packages available such as Fusion 360 or TinkerCAD. Having lectured in digital fabrication for many years I think it's always a great idea to do an introductory course with a local Fablab or Makerspace to gain an understanding of the breath of possibilities of all the technologies and how to integrate them into your specific craft practice. Fablabs throughout Ireland run regular 'Digital Crafting' workshops where each participant brings in examples of their work and facilitators give lots of examples of how specific software, machinery, electronics and innovative materials could be used to expand their repertoire or get specific parts made."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"Once participants have acquired a basic understanding of creating 2D and 3D models the next step would be to have a section dealing with setting up parts and files for production with the various machines. Methodology around this is available online from many sources including most of the main machine brand web sites. For me, learning by example is always the best. Craft workers want to see how something was made and how a technology can be of specific use to their own work. I'm interested in how all the technologies can crossover. For example we've given workshops in 3D scanning to ceramic artists and shown them how they can perhaps use their scans to make 3D prints of particular forms or make moulds for casting into. We've shown fine art print makers the range of possibilities of a laser cutter in printing by making templates or etching metal plates. The platform should have lots of examples of digital cross over into traditional forms of art and craft as this helps break down the barriers. Good starting points would be to refer to designers such as Neri Oxman, Skylar Tibbits, Joris Laarman or Iris Van Herpen."

Matteo Meraldi & Simone Colombo

FORMALIZ3D
Light Design

Milan, Itlay

https://www.formaliz3d.com/ info@matteomeraldi.com

"This project was born from the mind of two industrial designer, Matteo Meraldi e Simone Colombo, who met during their studies at the European Institute of Design in Milan. Formaliz3d is a trademark of Fare3d, a Milan-based company that deals with prototyping, sale of 3D printers and resale of products designed by artists and creative designers."

How did you start using 3D printing/ digital technologies?

"The project was born in 2015, the aim was to create and implement a limited series production of lamps using production virtuous processes. 3D printing and craftsmanship methods, maintaining a high value of Made in Italy.They use 3D printing technology combined with other technologies such as CNC milling and laser cutting and engraving."

How has use of these technologies enhanced your craft/ business?

"In the world of design, being able to take advantage of scale models for your own prototypes is certainly very useful,thanks to the three-dimensional modeling and 3D printing these prototypes can be made in no time. In particular in my case, I started my career by focusing on 3D printing, creating entirely printed capsule collections of lamps.'

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"The aim should be to allow young talents to remain in the world of craftsmanship, which is now becoming less and less attractive for young people.The insertion of new forms of craftsmanship can be an interesting meeting point between craftsmanship 1.0 and 2.0, where the first is made by skilled craftsmanship, the second by technological skills (young people)."

Selvaggia Armani

Paint, Fabrics, Jewellery & Lighting
Itlay
art@selvaggiaarmani.com www.selvaggiaarmani.com

"Selvaggia Armani was born in Trento in 1968. After high school she attended the Politecnico of Milan studying Architecture, and from where she graduated in 1994 with a dissertation on the design of new exhibition spaces in the museum. During her university studies she cultivated the interest for the Graphic Arts, attending for a year a course of illustration at the European Institute of Design in Milan, developing in the meantime some research in the painting field.In 1995 she took part in a group exhibition highlighting young artists at the Galleria delle Arti in Bologna and launched her own exhibition at the Galleria "L'Isola" in Trento, publishing a catalogue of her works.Since 1996 her research has extended to the world of textiles, working with various companies of the industry.In 2006 she began to paint fabrics, jersey, linen, cotton, creating unique pieces of clothing using various types of graphics and embroidery.."

How did you start using 3D printing/ digital technologies?

"In 2009 she collaborated with Exnovo, one of Italy's leader companies in 3D digital printing for which she designed various kinds of lamps and home accessories, which were presented in different editions of Maison & Objects (furniture fair in Paris) and various editions of the Fuori Salone in Milan, as well as in an edition of the Salone del Mobile in the section Euroluce (2013). In 2012 she designed an entire collection of jewellery for the new brand, . Bijouets, using the 3D digital printing technique.'

How has use of these technologies enhanced your craft/ business?

"Due to the 3D printing production system, no product is absolutely the same as another and each object becomes unique for its intrinsic characteristics.She says that it is a technique that allows you to create the object in real time and to modify it at will. In this way, the barriers imposed by traditional technology using moulds are overcome. The machinery used for this process exploits the nylon powder and the laser beams that shape the material in layers: the operation resembles that of the CT scan."

Serseniuc Radu Constantin

MindUP
Robotics
Iasi/Romania
serseniuc.radu@gmail.com www.mindup.ro/

""Fuse" project started from the initiative of several high school students to build robots and participate with them in the First Tech Challenge competition. This is a global and interdisciplinary competition for high school students that combines the STEM fields (Science, technology, engineering, mathematics). Our project spans several years/seasons of the competition. In the previous season (2018-2019) our team won the title of national champion. The connection of this project with the areas studied by Craft project, appears in several places: the design of the robot in a 3D modelling software (We use Solidwork, the company being one of our sponsors and giving us free access to the software created by them), designing specific

parts for the robot (parts of pivoting systems, rotary systems, chassis, transmission axles, adapters, gearboxes and gear assemblies, etc.), printing them using 3D printers (either on our printers or the sponsors' printers) or their cutting on a CNC mill (however 3D printing is more often used and is even essential in our project)."

How did you start using 3D printing/ digital technologies?

"The use of modern digital technologies appeared when we encountered problems that can no longer be solved with the pen on paper, for example:
•designing the robot and testing it in the virtual environment before the construction and

assembly process
•the necessity of parts specifically designed for our needs, to a precision that can only be provided by a qualitative 3D printer.
We understood that if we want to win the robotics competition, we must take all these manufacturing processes seriously and approach things in a professional way, and not just amateur."

How has use of these technologies enhanced your craft/ business?

"Without access to these technologies we could not have won the competition. They facilitated a way to drastically improve the quality of work that team members have done. Also, it should be noted that both virtual tools (such as Solidworks) and physical tools (two 3D printers we own, plus access to more precise 3D printers and a CNC mill) were helpful."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

The most obvious barriers are lack of knowledge, lack of equipment and high costs:
•The lack of knowledge consists of several sources: the small number of qualified personnel, the lack of learning sources in the Romanian language, the lack of adequate teaching programs for the use of modern equipment and technologies (within our project we had to be self-taught, we learned alone, from the Internet and sharing new knowledge, from English materials; unfortunately we were inefficient and it was a long process that could have been drastically shortened if there were

some more accessible bases, materials or teaching programs)
•Lack of equipment and high costs are a deciding factor: even if there are qualified people, we can work if we don't have the equipment. We hardly bought the 3D printers we have we had to rely on the money raised from the sponsorships and contributions we made, and we also had to buy this equipment from abroad. There is also the problem of the unavailability of these devices on the domestic market and at the same time (and perhaps even more important) the lack of professional maintenance services. The barriers are limiting the possibilities of local producers and are reducing the chances of long-term survival in this field."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"In order to create such a platform, the current problems and some other aspects must be taken into account, these include:
•A better method of teaching these technologies, using comprehensive and up-to-date materials (also teaching on qualitative software such as those developed by Autodesk and Solidworks)
•The attempt of specific targeting to the high school students, as they are the most suitable target group for learning such skills.
•As a secondary target group, many adults with technical specializations can be integrated, especially those who don't want to remain behind by the increasing demands of the labor market
•The availability of technical support so that participants can apply the learned techniques."

Construirea 3D a caroseriei/prelucrarea machetei la n...
Asamblarea, chituirea și grunduirea subansamblelor re...
11 IAȘITRA
...urilor de vopsea/lac și a...

Teodor-Stanciu Silviu

National University of Arts „G. Enescu" Iași/Asociația Tramclub Iași
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"Graduate of the Faculty of Visual Arts and Design, Design Specialization, National University of Arts "George Enescu" Iași, with a master's degree in Product Design and a PhD in Visual Arts, held within the same educational institutions, currently occupying the position of assistant professor PhD in Design Specialization. I am also coordinating the activity of the non-profit association Tramclub Iași. The professional activity is closely related to the collaboration with the Ethos cultural society and with the company Electroputere VFU Pașcani, specialized in the modernization and reconstruction of railway rolling stock. Within the company I was involved in the realization of the concept of relocating the tram type GT 4 for the city of Iași and of the Wegmann tram for the municipality of Timișoara (project "Armonia"). Within the association I coordinate cultural, artistic and educational projects by involving FVAD Iași students, one of the most important being "Iași - the city of painted trams", an urban regeneration project through the graphic personalization of the public transport means in Iași."

How did you start using 3D printing/ digital technologies?
"We have assimilated the use of contemporary digital technologies during the higher studies

at the Faculty of Visual Arts and Design within the National University of Arts "George Enescu" Iași. In the faculty I learned to use digital 3D processing programs and to use 3D printers for the layout of the design projects."

How has use of these technologies enhanced your craft/ business?

"The use of 3D modelling software facilitated the establishment of partnerships with various companies, 3D simulations making it possible to present alternative variants of the product. The use of 3D technologies has led to the increase of the quality of the products made by the contracting companies, through successive modifications on the 3D model, in a short time, with a minimum financial investment."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"As a result of the experience assimilated by the coordination of the students of the Faculty of Visual Arts and Design in Iași, we found that there are two types of barriers, a financial one, being necessary to purchase a high-performance computer, software and 3D modelling equipment and a second one related to personal openness/desire to assimilate the use of programs and machines, with a high degree of complexity"

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"I consider the following objectives to be particularly important:
- *making well illustrated and explained tutorials for assimilating specialized programs;*
- *creating a database with modern equipment and facilitating their access to purchase;*
- *creating a database with people who work in the field and have successful careers (photo / video gallery with their work, interviews, etc.);*
- *making a glossary of specialized terms."*

Cristina Noguer

Existe Agency
Product

Spain

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" I hold an MFA in Interior Design from Parsons, The New School, New York, as well a double degree in Industrial Design Engineering and Product Development. I worked for several years in India, Chile, and New York on social and educational projects. In 2014, I joined Puig, a multinational luxury goods company to create the Ideation Department. Over five years, I developed several publications on materials and technologies. I also built the first in-house materials library and materials showroom. Finally, I created the IdeationLab, an in-house FabLab with a network of professionals: programmers, technologists, theorists, researchers, creatives, makers, craftsmen, designers, photographers and illustrators that helped to envisage the future of the perfumery industry. In February 2019, I decided to re-shape my career, branching out into working with companies, universities, and institutions providing consultancy, research, and workshops organization. This allows me to have a wider vision to create a business model based on values, empathy, truth and abundance, putting research and innovation at the service of the earth, plants and all living beings."

How did you start using 3D printing/ digital technologies?

"I started with a university project in which we had to test one specific material. I decided to use pyrite. I wanted to understand the volume of the piece, so I started scanning it, which took me quite a while since at that time the scanners were very different. I had to paint it because otherwise the faces were reflected, then I was testing for a week ..

... the scan of the piece was a project itself. My idea was to be able to reprint the piece and to have several copies of a piece that was unique. The use of digital technologies was not necessary, but I had the right tools at my disposal, and I looked for an excuse to experiment with them.
Then I continued working with tools of this type in the Puig company. I mounted an internal Fab Lab in which we bought several additive manufacturing machines (for resin, filament, ceramics), with numerical control and a laser."

How has use of these technologies enhanced your craft/ business?

"It allows to reduce costs and above all to think faster. I imagine a shoemaker who wants to make a new design. He can scan his foot, edit it on his computer and print a last and have it available in two days. If he has to do it in the traditional way it would take much longer. You can test ideas that seem impossible. You think: how much does it cost to try it? 2 days?Well, I am going to do it. Suddenly you have much more mental flexibility."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"I see an accessibility barrier. It is not obvious what a 3D scanner is, how its tools and software work, who can help you to use the printer. People who master these topics and could help

the craftsmen speak a much more technical language and the craftsmen do not feel comfortable with this.
In Catalonia there is a gap between these two worlds, while, in Holland the Fab Labs are much more open. You can develop a complete artistic and craft project with very accessible equipment."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"It should be linked to physical spaces where you can print projects, test the machines, etc. An option could be to collaborate with Fab Labs or other companies such as The Manufacturing Athenaeum from Barcelona, the TMDC workshop, the CIM foundation or the store Tres de Nou."

Laura Fernández Martínez

Laura De Olga
Jewellery

Asturias, Spain

lauradeolga@gmail.com www.lauradeolga.com

"Laura De Olga was created because of the need to find a career opportunity and to apply my jewelry and setting studies done at the School of Handicrafts of Oviedo. After working for other jewelers and dedicating several years to other jobs, I decide to start my own company in order to exclusively dedicate myself to a job that I like. It allows me to create things with an added value, such as the sentimental value of a jewel, the meaning that it can have for the person who carries the piece and, of course, the satisfaction given by the creation and design processes."

How did you start using 3D printing/ digital technologies?

"After proving that purely handmade work is not appropriately valued, after observing that competitors could develop much more with other techniques, after seeing the potentialities of 3D printing in supporting my creativeness, in spite of the fears, I decided to invest in a design software that allows to create pieces that by hand would be almost impossible to do.
The needed impulse to overcome those fears come from professionals of the sector guild who were already immersed in that process, and finally, with their encouragement I decided to go for it. In order to start,

I had to make an investment in the software (the most expensive) and obviously, in the training. Because license of the software is worthless without having the proper knowledge and the proper experience."

How has use of these technologies enhanced your craft/ business?

"*At economical level, it is still early to make a proper assessment, but, at personal level, it has provided me with new business visions, it opened doors to other types of markets, it facilitated the possibility of creating metal parts that before I could not afford, due to the high prices of such materials. It has also given me confidence in myself, thereby getting to think that my profession can have a brilliant future."*

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"I would say that the first one is the cultural barrier. The different artisan guilds are reluctant to adopt new technologies, as they consider that these can undermine the value of craft definition itself. Something difficult to understand when at practical level they use a thousand tools that have not been purely craft tools for years. Another important one is the economic barrier: the artisans always (and I stress always) invest enormous amounts of working hours, because of this, saving becomes complicated and the prices of the software, courses, etc. are high."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"It should focus on informing and re-educating the guilds, in order to teach them that new technologies are not a threat for their work, but an opportunity. This re-education should include raising awareness so that they could look for trainers and official programs. There are a lot of fake teachers and several software are offered for free, which causes people not to have enough knowledge or the appropriate tools. From there, the training platform should offer specific software for each guild, and it should be based on a deep knowledge of the possible applications of each software for each of the different artisanal fields. Lessons should be easily accessible and highly understandable. It would be essential for craftsmen to access it at any time and the course should not have strict schedules, they should be able to access videos at any time and be supported by tutors on demand."

Barrett Michael Sauter

Metal sculpture using CNC milling as well as other metal tooling
Västerås, Sweden

barrett.m.sauter@gmail.com   www.wireinthecity.com   Instagram: @wireinthecity

"I started making mobiles from quite a young age. My classic story I tell is that I had a lot of glow in the dark stars, pencils and thread, and so one evening, I balanced the stars, hanging from pencils on multiple tiers, until it formed my first mobile. At night, it glowed and looked like a moving solar system. Over the years, I continued to develop my craft, partially by own experimentation, and partly by taking multiple art classes, where I was finally introduced to Calder. I mimicked his works, until I learned how to apply the same techniques to my own. At the time, I was making everything in paper and plexiglass, and I had a vision to make large moving sculptures that would hang in large cavernous entry halls, or large stabiles that would move gracefully around in a public park. With this in mind, I decided to start a mechanical engineering degree, where I would learn all I needed to make my vision come true, including how to design using 3D modeling, manufacturing, and logistics."

How did you start using 3D printing/ digital technologies?

"I first came in to contact with digital technologies through my engineering education, including 3d modeling and CNC machinery. I experimented forward with the different techniques in my sculptures, first by 3d modeling my sculptures and then manufacturing different parts by CNC milling. I started with using wood, and then eventually moved on to metal. I encountered hardships after the switch in materials due to the metal parts being much

thinner, and easily lifting in the machine, which would destroy the part. I eventually developed unique processes so I could manufacture the metal parts successfully. This technique adds substantial additional time to the process, so I am even looking to take the next step, and find a metal laser cutting facility to decrease the amount of time. Having this instant access to the tooling and 3d modeling skills definitely enabled me to integrate the technology more easily."

How has use of these technologies enhanced your craft/ business?

"The technology enables me to produce parts in metal which are difficult/impossible to produce any other way. By producing my sculptures in metal I feel that they have reached a professional and finished level, which have enabled me to portray and sell them at a higher level as well."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"I see barriers including knowing what technologies are available and how to use the technologies (especially to their fullest potential). Using the technologies include general 3d modeling and instruction and limitations of the machinery. To successfully manufacture a part, it needs to be designed specifically for that process."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"I think an excellent way would be for users to upload their work which they have brought forth from using digital technologies, and a description and thought process of how they brought the work to life, as well as answering similar questions such as in this questionnaire (How has use of these technologies enhanced your craft/ business?). It would be good to allow others to reply on the post and start conversations. I think this would inspire others to try out new technologies and start the brainstorming process on how they could incorporate it into their own work."

Catharina Carlsson

Se Carlssons Design AB
Millinery and Graphic design
Umeå,Sweden
se@carlssonsdesign.se www.catharinacarlsson.com,

"A very early interest was to draw and sew, always, started taking painting classes at the age of 14. Made clothes and made interiors for my dolls and then clothes to myself. Had two aunts that taught textile and my mother sew her own clothes. My father has been very good with his hands building stuff and from both sides of my family there has been a lot of craftspeople. After the gymnasium I went to a folkhögskola for two years, learning more about sculpture, painting and graphic. After that I took a Master in Graphic Design at HDK in Gothenburg. Freelanced as a Graphic Designer for about 25 years and then went back to school learning Millinery for two years and took a journeyman in that just a couple of years ago.

Millinery had then been my hobby for about 10 years. Today I freelance as both a graphic designer and milliner."

How did you start using 3D printing/ digital technologies?

"It was at "Sliperiet" in Umeå on the free open evenings they had once a week and they also got a Laser cutter my last year at Tillskärarakademin in Gothenburg. I don't remember how I first heard about the possibility to explore these new assets, but I once went there by myself and was hooked."

How has use of these technologies enhanced your craft/ business?

"There is no end to how these machines have opened up possibilities in my craft. I have mostly used the laser cutter and some 3D shaping that I have made into 3D objects by slicing and then cutting in the laser cutter. I have laser-cut flower petals and leaves. I have made stamps, I have embossed fabric, made my own hatblocks and stands for hats and so on."

What do you see at the barriers of entry to 3D printing for people in the craft sector?

"You have to be willing to learn some of the programs that are usable, there is some easier to start with but even that can be hard if you are not used to work with a computer. I had it easy since I already was very familiar with many programs, 3D programs is still hard for me since I don't work in them regularly. Another barrier can be to actually have a place to go to where you can use these machines. 3D printing is pretty cheap nowadays but it is easier to go somewhere where you can get some help in the beginning. To own a laser cutter is not really in any crafters budget I guess. There should be Workshops all over the country for the public with these new machines and also traditional tools for woodworking, sewing, welding and so on."

What do you think should be the main focus of a digital training platform in 3D printing aimed at the Craft Sector?

"One would have to start really basic and repeat the basic steps so that they stick, even have repetitions after the finished training, stuff that you don't do regularly will be forgotten. Even though I work daily by the computer I still have to check up how to do some things that I seldom do. It is therefore also important to know what is possible to do. If you know that, you can always google to find out how it is done."

online
survey
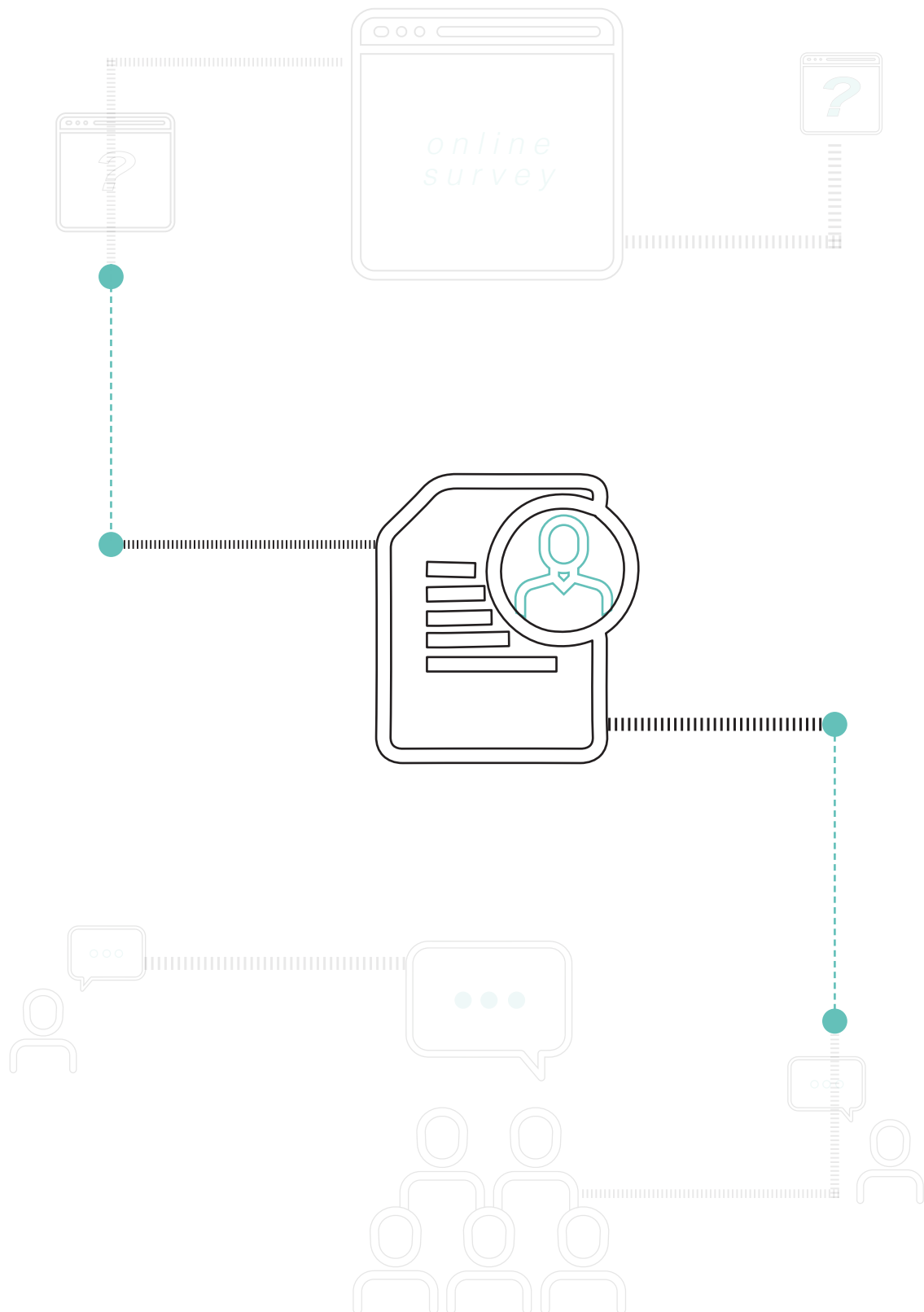
CASESTUDIES SUMMARY OVERVIEW:

This compilation of case studies provides insights from adapters into paths of learning and the craftsperson's experience in adapting digital technologies into their practice. These case studies were undertaken in order to provide Craft 4.0 evidential context to ensure transferability and clarity within the proposed training tools in digital modelling and digital/additive manufacturing. The case studies emphasised a number of repeating issues and remarks, in regards the use of digital technologies as part of the craft sector and recommendations for the implementation of a digital training platform.

Recommendations from interviewees included offering examples of digital cross over into traditional forms of craft as it helps break down the barriers by promoting digital technologies capabiltiy to provide added value to craft objects.

Through this promotion it would also integrate the individual craft sectors into the platform itself, allowing opportunity to offer specific software for each guild, basing recommendations on the possible applications of each software.

Including descriptive notes in regards software types and digital making technologies to understand best fit for the craftsperson. Furthermore, the platform would provide clear information and guidelines for the processes and the materials involved in production such as setting up parts and files and the various machines, that are available.

Recommendations from interviewees for methods of learning on the platform included: video learning, learning through example, pre recorded- tutorials and face to face interactions. Opportunities for the provision of practice sessions also featured as a recommended platform element. Echoing questionnaire survey results, interviewees also cited peer learning for support and social integration on the platform as a proposed valuable asset to the digital training platform.
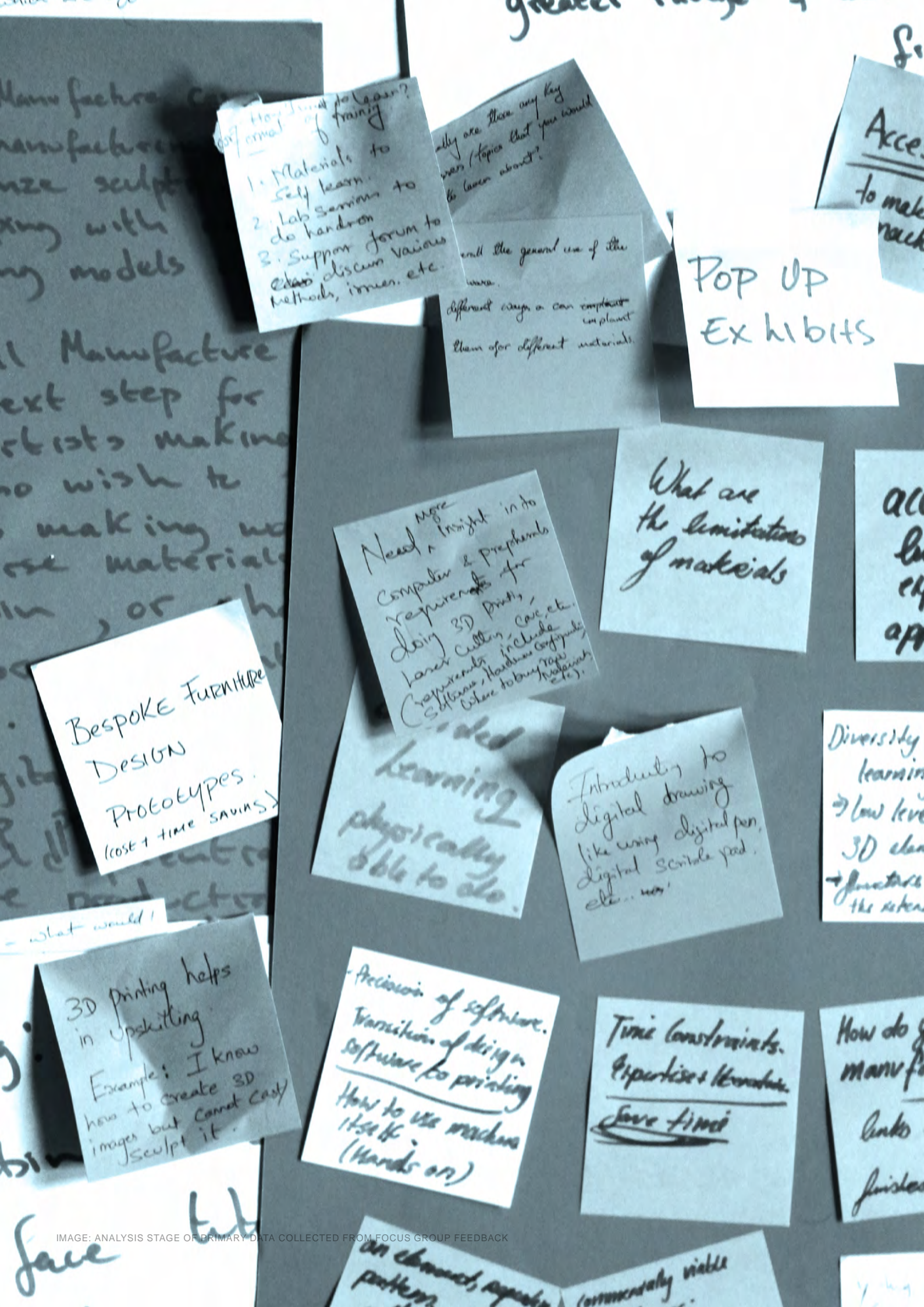
1. Materials to self learn.
2. Lab sessions to do hands on.
3. Support forum to discuss various methods, issues etc.

POP UP Exhibits

What are the limitations of materials

Need More insight into computer & peripherals requirements for doing 3D printing, Laser cutting, carve etc. (requirements include Hardware Configurations, Software, Where to buy raw materials etc.)

Bespoke Furniture Design Prototypes. (cost + time savings)

Learning physically able to do

Introduction to digital drawing like using digital pen, digital scribble pad, etc...

Diversity learning
→ low level 3D classes
→ structures

3D printing helps in upskilling. Example: I know how to create 3D images but cannot easily sculpt it.

- Precision of software. Transition of design. Software to printing
How to use machine itself (Hands on)

Time constraints. Expertise & knowledge. Save time!

How do manuf links finishes

THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR:

FOCUS GROUPS.

"Utilising the primary findings from the previously undertaken questionnaire and case studies; focus groups were led by each partner in the form of ideation and feedback sessions in order to further inform the design of the proposed training content for Craft 4.0. Secondly the focus groups were utilised to inform participants about the Craft 4.0 project and the proposed platform, while simultaneously providing craftspeople with relevant sample applications of digital making technologies within various craft sectors."

PARAMETERS:

The exact format varied slightly between each focus group as each project partner conducted individual events. However, each focus groups aim was universal; to facilitate and record an interactive discussion among artisans, craftspeople, associations and other interested parties.

Focus group event content included:

- Expert presentations and demonstration on 3D printing and digital technologies.

- Presentations of questionnaire results and case studies.

- Visual examples of 3D prints and craft objects made with digital technologies.

- Ideation sessions in varying format from round table discussions to direct questioning by the focus group moderator.

![ADR logo - Agenția pentru Dezvoltare Regională NORD-EST]

Day 1: *The Faculty of Visual Arts and Design of the "George Enescu" University of Arts from Iași.*

Participants: *iincluded students from the Invention and Robotics Clubs from the "Petru Rareș" National College and the National College of Informatics from Piatra Neamț, Representatives of the Association of Popular Craftsmen - Prut Crafts from Iași, Teachers and students from the Faculty of Visual Arts and Design, Graduates of the Faculty of Visual Arts and Design involved in the craft sector and the NERDA staff.*

Agenda: A presentation of the Craft 4.0 project followed by discussions on the main findings from the questionnaires and presentation of the case studies identified by the project consortium.
The initial introduction was followed by a representative of the Association of Popular Craftsmen – Prut Crafts, who highlighted the way in which the utilisation of digital modern technology can bring added value to their work. They spoke of the constraints that craftsmen have to comply with, the underlying preservation of national and local traditions in the craft sector, the use traditional and specific tools that are unaltered, the physical labour,

the connection to natural raw materials and the authenticity of symbols and chromatics of objects from an ethnic/local area. A presentation was made by the graduates of the Faculty of Visual Arts and Design involved product development, inclusive of the craft sector. They presented examples that were designed and produced using digital technologies .The meeting from the first day ended with a working visit in the faculty workshops.

Day 2: *The Conference Room Unirea Hotel in Iași concluding with a workshop.*

Participants: *The students and teachers from Piatra Neamț and the representatives of NERDA.*

Agenda: A discussion of the topics that should be included in the training course and the types of educational resources that should be used in order to sketch the training plan and the course curriculum to be proposed in the project consortium.

FEEDBACK FOR TRAINING PLATFORM:

Advantages to Emphasis:

- The possibility to customize the products, fulfilling the clients' needs and requirements.
- Precision and perfection of the product, obtaining exactly the desired shape.
- The production time would be shortened and the fact that a 3D printer can work 24 hours a day is a great advantage for artisans.
- The production process will shorten by using standard models that are already designed
- Streamlining the creative process and making pieces that could not be obtained using only conventional tools. These technologies can also help in the design stage which is essential for the realization of a product.
- New horizons are opened for craftsmen, they can be more creative and will keep up with today's technologies. The platform should show that modern technology can improve the craftsperson's work and not substitute it.

Topics to Cover:

- The learning process should be continuous, as this type of technology continuously develops.
- A chapter dedicated to marketing, in which craftsmen would learn how to get the best use of these technologies.
- In order to learn how to use the 3D printing, the students must learn a few basic steps. Once you understand these steps the fabrication process will be easier and shorter, emphasising that the initiation process in using these technologies is not so difficult as at appears to be.

- This course should contain the types of programs that a craftsman can use for digital modelling, how a 3D printer/CNC milling machine works and what types of materials can be used (material resistance, malleability etc.)
- The course should contain a chapter dedicated to mechanical and technical issue as the machineries can have jams/errors that have to be solved locally.

Formats for Learning:

- Step by step video, as this is the easiest way of understanding the information presented
- The program should incorporate mixed delivery methods, each of them having its role. More than that, I think that at the end of every module/chapter a "challenge" should be added. This way, the student will apply the newly learned skills and obtain a tangible result.
- Opportunities for face to face meetings for strengthening the community
- The online platform should include a discussions forum (with FAQs) in order to increase the interactivity between members.
- The forum should have an administrator that can give feedback or can answer to the requests made by the students.
- Face to face meetings or streaming live were also proposed as delivery methods

Participants: *included current students and staff from the Dublin School of Creative Arts, members of the Design and Crafts Council of Ireland (DCCOI), members of Visual Artists Ireland, members of the Glass Society of Ireland, members of Interior Designers Association, members of the Institute of Designers Ireland (IDI), members of the Dublin based creative hub -Fumbally Exchange, members of the Irish Guild of Embroiderers and the Irish Wood Turners Guild.*

Agenda: The day began with an initial presentation of Craft 4.0 outlining the intended outcome of the project and the aim of conducting the focus group. As most of the focus group participants had no prior experience with digital technology and 3D printing the initial introduction was followed by a technical presentation on 3D printing and laser cutting. This presentation included an overview of software options, processes and file types. A visual presentation of Craft 4.0 case studies and example craft objects that have been produced through the utilisation of digital technology, provided focus group participants with visual examples of the craft applications and capabilities of digital technologies within the sector.

Live demonstrations of 3D printing and laser cutting followed the visual presentation, the demonstrations also included the opportunity for a question and answer session, prior to discussing the training course and the proposed training platform. After the demonstrations a roundtable ideation session was conducted using 5 key guideline questions:
• *How could 3D printing help in developing my practice/ sector?*
• *How would I envisage incorporating 3D Printing into my work?*
• *What would I need to learn in order to use 3D printing?*
• *Specifically, are there any key processes/ topics that you would like to learn about?*
• *How would I like to learn/ what format should the training take?*
These five questions were chosen to limit subject deviation while gathering participants opinions and ideas relevant to the digital training platform. The day concluded with a workshop allowing focus group participants the opportunity to utilise the digital technologies that they had discussed and observed.

FEEDBACK FOR TRAINING PLATFORM:

Advantages to Emphasis:

- 3D printing can be used to produce samples, prototyping and in envisaging products as it would allow for less error and minimise cost.
- 3D print/digital manufacturing can support existing manufacturing processes in the craft sector, for example mould making.
- It would also help with marketing products for example an artist could print smaller more low budget pieces/copies of larger sculptures to sell or use as promotional material.
- 3D print/digital manufacturing can push the boundaries of what can/ can't be achieved with traditional materials.
- Digital making processes would allow the student in their practice to adapt and change finishes, to make individual personalised tools and specialised jigs.

Topics to Cover:

- The platform should highlight finished craft objects using 3D and digital technologies.
- The platform should allow the student to fundamentally understand the software and its multiple use: to learn which hardware and software is most suitable to my sector.
- The platform should provide insight into the computer and peripheral requirements for doing 3D prints, laser cutting and cnc etc (requirements include software, hardware configuration, where to buy raw materials etc).
- The platform should outline the full 3D print life cycle, with practical hands on training on how to use the printer, how to create and edit 3D files.

- Providing insight into how items can go beyond ideation into a final product.
- The platform should allow the student to transition from design software to printing and using the machinery involve while providing a understanding of the maintenance process of the machinery.
- The platform should include rreferencing or follow ups concerned with retaining information acquired through platform.

Formats for Learning:

- Format of learning: video, step by step tutorials and sample projects, demos, studio work, online tutorials and downloads.
- Blended learning a mix of tutorial options and hands on experience.
- An understanding within the formats that there are different levels of learning, if the platform could incorporate the traditional aspect of craft learning and understand the gap between hands-on learning and computer learning.
- Training platform should allow space and time to experiment with the various machines and technologies.
- The training platform should provide mentor support to advise/guide better practice.
- The training platform should provide lab sessions to do hands on work, or access o materials and machines if the platform could provide an access list to expertise/applications, and facilities to use the learned skills.
- Support forum to discuss various methods issues etc.

MÄLARDALEN UNIVERSITY SWEDEN

Participants: The focus group interview was conducted at MDH for about 90 minutes and included twelve participants including two researchers. The conversation participants represented; laser cutting professionals focusing the craft sector, metal artisans using CNC machines, robotics and electronics engineers utilising 3D printers, senior university lecturers in craft and design, pottery professionals, the artisan and craftspeople union and policy makers. The participants collective competence represented the focus for CRAFT 4.0.

Agenda: A focus group was held with people that broadly representing craft stakeholders. The focus group interview was not conducted in accordance with marketing literature, but rather like a conversation among peers. Notebooks with easy rip-off pages were handed out for the participants to take notes, reflect or scribble and at the end all pages were collected and used as empirical material for grounded theory analysis. The interview design proved to be fruitful as the participants expressed personal views on the matters discussed. Analysis from the survey and case studies resulted in three themes that guided the conversation: material and material consciousness,

quality drivenness and craftsmanship excellence, and sustainable development. All themes were followed up by a brief discussion on learning.

The findings point at two axes; namely that of materials and processes ranging from traditional to new and experimental, and that of sustainability in ecological, economic and social senses. We suggest the learning platform curricula to address material specific knowledge about and in digital tools and processes, as well as general knowledge with and through various digital production resources. The training strategy should be based on the concepts of about, in, with and through in relation to convergent and divergent learning outcomes. To include only convergent learning in the digital learning platform would be to reduce potential knowledge generation to mere instrumental procedures and lead to no creative development at all, which would neither attract learners to engage in courses nor contribute to the development of creativity and competitiveness in the craft sector. This line of thinking should guide the learning strategy and development of curricula for the on-line learning platform

FEEDBACK FOR TRAINING PLATFORM:

Advantages to Emphasis:

- The participants suggested that the learning platform also could support the transition from hobbyist to professional, for instance by combining it with a webshop, incorporate web shop functionalities, or in some other way support the commercial aspect of crafts. Moreover, the commercial perspective can also create limitations, because there is little time to learn new things, here the learning platform can provide support.
- Another incentive to take courses or log in to the learning platform can also be based on a need. The participants suggested that needs such as creating tools to help the craft, or a need for new tools that spur the need for new knowledge.

Topics to Cover:

- The learning platform curricula to address material specific knowledge about and in digital tools and processes, as well as general knowledge with and through various digital production resources. The training strategy should be based on the concepts of about, in, with and through in relation to convergent and divergent learning outcomes.
- A good general understanding of the technology before you begin: to know the technology's "techishness." It is also important to negotiate your technology competence with yourself to retain your creative expression.
- All too simple tasks and exercises as well as all too difficult ones tend to ruin motivation and therefore different entry levels may be necessary. Divergent learning in interaction with a specific material using specific digital tools and processes poses a huge challenge since a digital learning platform cannot contain any actual material, therefore no reflection-in-action, and learning outcomes are difficult to evaluate or measure.

- Besides the learning platform, we would need to provide a way of sharing resources. 3D printers are affordable, but not cheap, you would not buy one just to try it out. The people you want in a lab environment are not those who come spontaneously. This also relates to social sustainability.

Formats for Learning:

- No manuals! There are already plenty of them. What is the technique in the digital? The challenge lies in charging the machine with what is in your head. A combination of digital computer competence and material consciousness.
- Peer-to-peer learning. There are existing examples to learn from: thinginverse.com, slojd.nu, instructables.com. We need to find a way, perhaps thought positioning, to guide users to lab environments for experimenting, for example Makerspace, Fablab, collective workshops. Peer-to-peer learning also includes the significant meeting, to see each other in the physical space, to meet, test and make.
- Combined with workshops for different groups, where there may also be workshops on the learning platform. The platforms may also support the important interface at different levels within the organization, between customer, craftsman and manufacturer.
- This relates to the commercial and economic sustainability of the learning platform. Learning on the web platform should be based on socio-cultural concepts of mediation, appropriation and situated learning on various entry levels.
- The platform should offer possibilities for spontaneous group formations so that participants start interacting based on common interests.

INNOBRIDGE
Business & Innovation Centre
Ruse, Bulgaria

Participants:

The CRAFT 4.0 focus group was organized on the 25th of February 2020 at the University of Ruse "Angel Kanchev". The participants were second- and third-year students from the faculty of "Industrial design" and their respective lecturers, a total of 20 people. BIC INNOBRIDGE was represented by two of its staff: Ayri Memishev and Maria-Denitsa Georgieva.

Agenda:

BIC INNOBRIDGE started the event, by presenting the organisation and its initiatives. That was followed by a CRAFT 4.0 project presentation i.e. the group was informed about the aim of the project, its partners, the envisaged outputs as well as what has been done so far. BIC INNO continued by presenting the CRAFT 4.0 survey results from Bulgaria. The case studies collected during the first phase of the project were also presented and additional information was given.

The participants were asked a series of questions in connection to the future CRAFT 4.0 training program and the following feedback was captured:

FEEDBACK FOR TRAINING PLATFORM:

Advantages to Emphasis:

- In terms of a using a 3D printer, it could be useful in order to better visualize a product i.e. would be a nice testing ground.

Topics to Cover:

- Specific tasks or exercises should be given to the pilot participants in order to gain some practical experiences.
- Online content would be useful in order to track your progress in the pilot training.

- Additional sources of information should be created.
- Audio-visual training materials should be included.
- Additionally, organise a CRAFT 4.0 contest which will facilitate the pilot training and the created products (if any) could be given to relevant stakeholders by organising a final "showcase" event.

Formats for Learning:

- The training would be most useful if there's someone to guide you through it e.g. a facilitator, a field expert or a trainer.
- The pilot testing should have a face to face session dividing the participants in working groups.
- It could be useful to have access to an actual 3D printer in order to witness the whole process of creating a product, including its creation via the dedicated modelling software.
- Certificates are will be something that they would be looking for.

Participants: *The European Digital Learning Network organised a focus group involving artisans, associations, stakeholders in the field of arts and craft, teachers and trainers in the field of arts and crafts and policymakers. The recruiting basis for the focus group was the survey: the same people were in fact invited to take part to the group discussion.*

Agenda: The focus group main purpose was to interview the involved target group on their needs, thoughts, opinions and eventual suggestions about the situation of craft and arts sector they are working in and experiencing daily. The focus group wanted as well as to discover which processes, methods and digital skills/ devices should be made available, used and selected to enhance the sector in Europe.
The focus group organised by the European Digital Learning Network took place in Milan, Italy and its format was a group interview and consequent conversation directed by a moderator around a set of questions, preceded by a general overview on CRAFT 4.0 project, its outcomes and purposes. The asked questions were the following:

- *How could 3D printing help in developing my practice/ sector?*
- *How would I envisage incorporating 3D Printing into my work?*
- *What would I need to learn in order to use 3D printing?*
- *Specifically, are there any key processes/ topics that you would like to learn about?*
- *How would I like to learn/ what format should the training take?*

The focus group with craftsmen, artisans, teachers and trainers in the field of crafts and art contributed to disclose and analyse in depth the attitudes, views and advices of this target group towards 3D printing and the learning platform curricula. In particular, the first three questions used by the moderator to direct the conversation and ideas exchange were precisely addressing the topic of 3D printing in artistic and crafting work while the last question led the way towards the preferred subjects to learn and master and the format and methodologies for doing so.
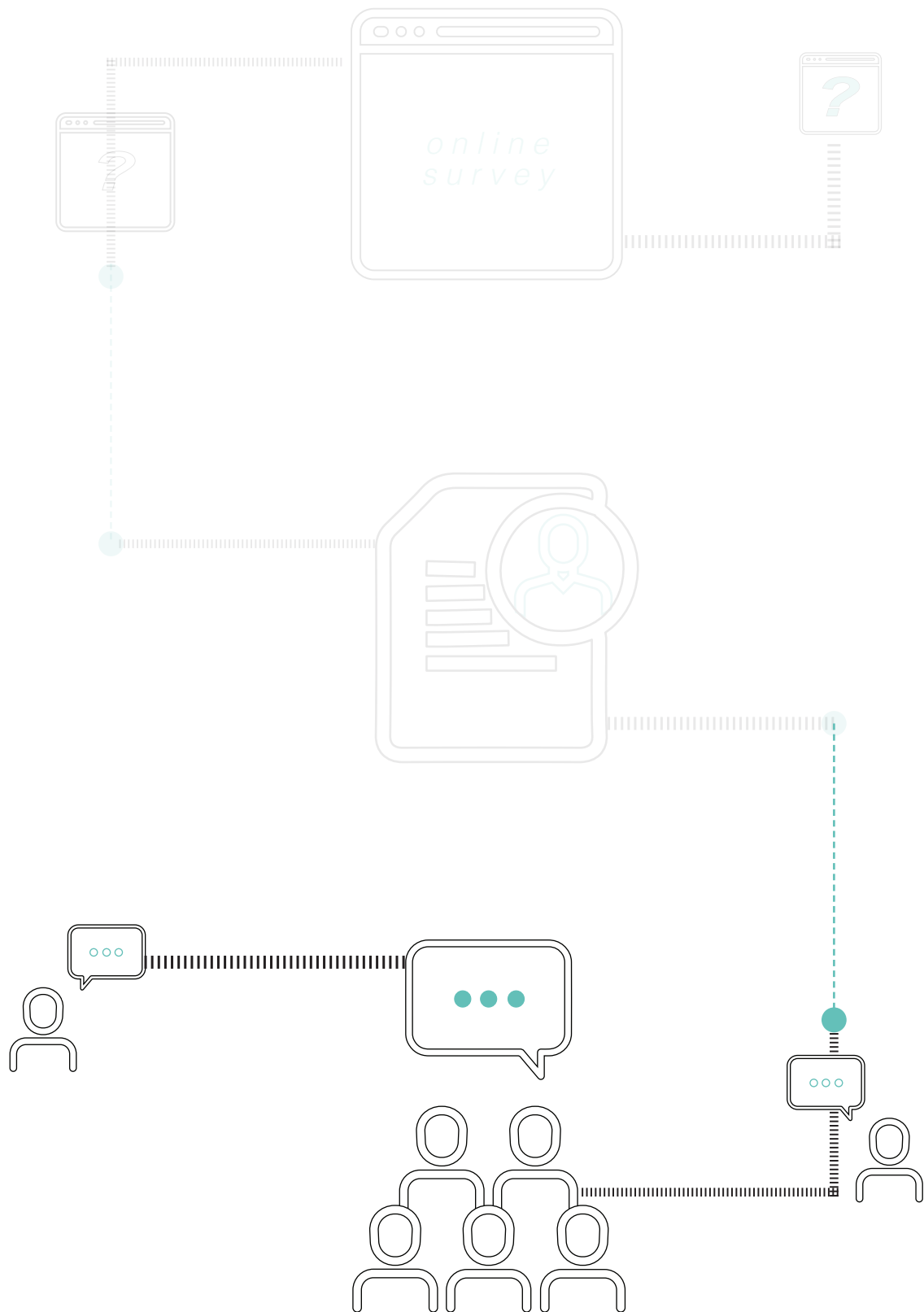
FEEDBACK FOR TRAINING PLATFORM:

Advantages to Emphasis:

- 3D modelling, printing and manufacturing, according to the participants to the group interview, offers a plethora of advantages in terms of further development of practices.
- The technology can be applied to many materials and for different products: industrial pieces and components, cloths, arts pieces, furniture, jewels, etc.
- The limited risk of errors and mistakes existing when applying additive manufacturing and digital printing to the creations and craft works. The end costs therefore are also limited, helping to maximise profit.
- 3D print/digital manufacturing allows for an increased creativity for the users, since it makes possible to use new materials, sometimes unconventional and to build objects and products in very different sizes. Creativity is boosted and the willingness to go beyond the usual application of crafting know-how and competence is also triggered by the potentialities offered by advanced digital tools.

Topics to Cover:

- The content should allow for a full understanding of how 3D digital manufacturing software works and the different usages possible within it, the focus group underlined the importance of having complimentary links to digital skills training in order to be better prepared when facing the platform and curricula.
- The training content should also highlight finished craft objects using 3D and digital technologies.

- The training content should provide information on how the machinery operates and its maintenance.
- The learning platform should be a repository of teaching and training material addressing digital processes and tools, with the relative needed skills and competences, as well as some more sectorial and specific knowledge about resources, materials and so on.
- The platform should provide access to more links, materials, external resources, and follow ups where participants can eventually deepen their knowledge on the covered topics.
- The platform should not only be a mere training and learning tool but also a virtual space for workers where to exchange ideas, tips, advices and start eventual collaboration: the exploitability in terms of commercial purposes and networking is therefore another key aspect emerging from the discussion.

Formats for Learning:

- An interactive format allowing users to access resources which are easy and immediate to find and understand, in particular videos, downloadable instructions, tutorials and demonstrations.
- The learning peer-to-peer was indicated as the preferred format of learning.
- A few participants expressed the preference for traditional handbooks/manuals complemented by tests and self-assessments.
- Blended learning method, combining different styles, was the overall suggestion.

online
survey

FOCUS GROUPS SUMMARY OVERVIEW:

The ideation and feedback sessions provide insights and recommendations for the development of the digital training platform from artisans and craftspeople who are interested in developing digital competencies within their practice. Despite each focus group covering individual topics for the purpose of developing the digital training platform the feedback received was aligned to fit under three categories; advantages to digital making technologies, requested training platform content and formats of learning on the Craft 4.0 platform.

Feedback from several focus groups in relation to the advantages in utilising digital making technologies placed an emphasis on the new opportunities that digital making technologies afford the modern craftsperson. This angle of emphasis would also highlight the improved competencies and new avenues of creativity digital making would afford the craft sector in pushing the boundaries of what can and cannot be achieved. The individualistic nature of digital making combined with the opportunities it provides the craftsperson were other notable recommendations that featured across the focus groups.

Feedback across focus groups for platform content featured the request for the inclusion of recommendations of suitable digital programmes for each typology of digital making e.g. laser cutting, 3D printing and CNC milling, the intention behind this recommendation is that the student may follow up with the existing training material for each individual programme. Additionally, the focus groups cited mechanical and technical aspects of the digital making process as preferred featured content. As focus group participants stated they would benefit from gaining an insight into the transition between the digital making software and the print/making process itself.

Formats of learning that the focus groups recommended as beneficial methods included: video, tutorial, demonstrations and interactive learning. Forum engagement and the opportunity to construct a peer network were additional recommendations made by focus group participants as beneficial to the delivery and engagement of the intended end users.

TRAINING CONTENT.

online
survey
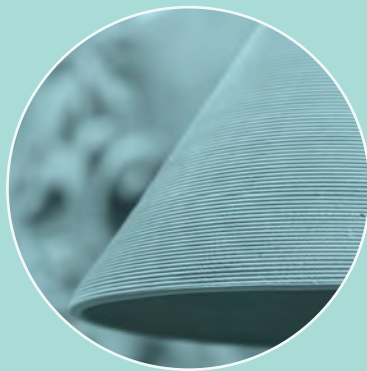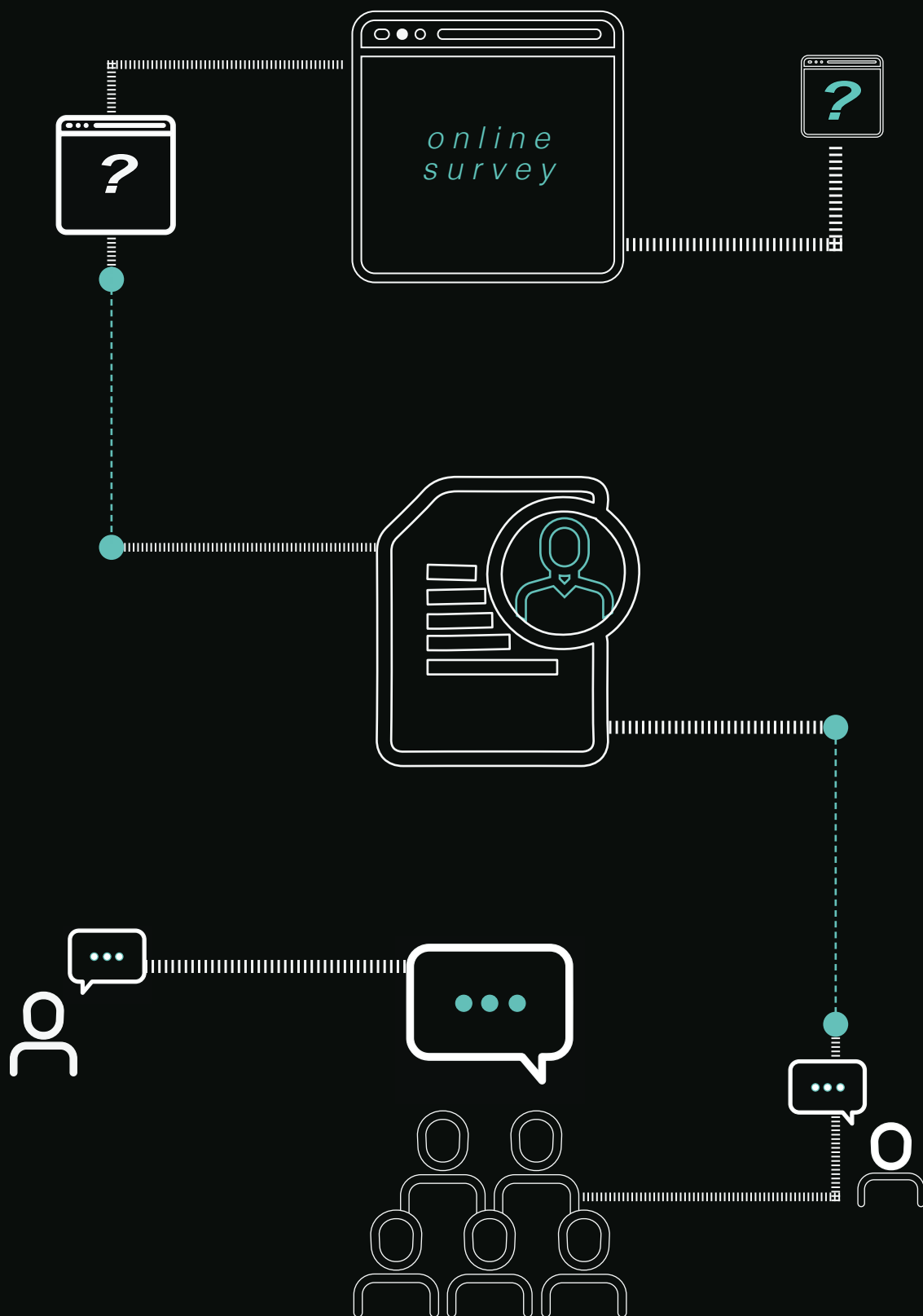
PROFILE OF THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR.

The aim of Craft 4.0 is to create training tools and a peer network for craftspeople in the areas of digital modelling and digital/additive manufacturing. Furthermore, Craft 4.0 aims to improve digital competences in the sector through skill development. The platform will provide training content that will allow craftspeople to acquire a set of innovative technological skills, that will enhance the craft making process, increase sectoral networking locally and internationally and increase customer engagement, with the purpose of improving and developing individual craft businesses.

This interim report focused on the activities that were undertaken in order to produce Intellectual Output One (IO1). This first phase developed the project concept through focused and in-depth investigatory primary research in order to provide a training model which ensures transparency, transferability and clear learning outcomes. The feedback from participants collected via interviews, questionnaires and focus groups has been utilised to provide guidelines and recommendations for the digital training platform functionality and content.

 Initially the direct insights captured in the questionnaire report underpinned the potentiality of the platform as a viable learning resource. The questionnaire result showed that the craftsperson placed a high importance on digital competencies skill development. Desirable learning content of survey participants included; the digital production process and the processes involved in 3D printing, laser cutting, CNC milling and the digital modelling. Responses received from the survey placed an emphasis on peer-learning and knowledge sharing as significant aspects to consider including on the digital training platform.

The case studies reinforced the questionnaire results by providing direct insight from established adapters of digital technologies in their respective sectors, by providing evidential content of pre-existing paths of learning and the craftsperson's experience. The case studies highlighted the benefit in including examples of existing digital cross over in traditional craft sectors on the platform. As this would aid in the breakdown of preconceived barriers in the adaptation of digital technologies by craftspeople. Through this promotion it would also integrate the individual craft sectors on the platform, offering opportunity to recommend specific software for each guild that would be most beneficial to their practice.

Finally, the focus groups ideation and feedback sessions provided insights directly from potential end users of the digital platform. Results of analysis of the focus groups feedback showed that participants placed an importance on the platform emphasising the advantages that digital making technologies afford the craftsperson. Feedback across focus groups reinforced the recommendation of case study participants for the inclusion of an outline of suitable digital programmes for each typology of digital making. Focus groups participants further expanded on this recommendation stating that this inclusion would allow the student to follow up with the existing training material for each individual programme. Additionally, the focus groups cited mechanical and technical aspects of the digital making process as preferred featured content. Formats of learning that the focus groups recommended as beneficial methods included: video, tutorial, demonstrations and interactive learning. Correlating with the questionnaire and case study results, forum engagement and peer networking were cited by focus group participants as beneficial to the delivery and engagement of the intended end users of the platform.

"The feedback from participants collected via interviews, questionnaires and focus groups has been utilised throughout to validate and improve the approach of the project. Participating craft professionals have expressed their training needs/issues which will be used as a basis for the definition of the training plan that will assist the development of the next phase. Utilising the feedback and response received throughout IO1 a module outline has been constructed. Building upon IO1 in the second phase, the project partners will work together to translate the project vision into working content and tools aligned to the target audiences needs and requirements."

THE MULTIDIMENSIONAL CRAFT ENTREPRENEUR:
OUTLINE OF PLATFORM MODULES

MODULE 1:
CRAFT DESIGN AND DIGITAL MODELLING.

This module will provide:

- An introduction into digital manufacturing, and it's history.
- An explanation of general tools (e.g..... extrude, loft sweep revolve, etc.) This will include practical knowledge in how technical terms are applied and used.
- An outline of the differences in 3D printing, laser cutting, CNC, types, materials, slicers and process.
- An understanding of the different types of modelling options available e.g. parametric, 2D, surface, solid..
- An outline of available software options for digital moddelling, including an outline of optimal software relevant to each sector in craft.

MODULE 2:
FROM DIGITAL TO PHYSICAL - MAKING IT REAL
-LASER CUTTING, 3D PRINTING, CNC.

This module will provide:

- An understanding of working in both 2D and 3D.
- Setting up laser cutter, laser focusing, bed orientation and ventilation(safety). An explanaitonof the difference between cut, scan and etch options.
- Output file types for 3D: what type of file you need for each function: STL, OBJ, SAT, STC.
- An understanding of supports function and need, workflow and overhangs.
- An understanding of part orientation and trouble shooting and errors that may occur: (watertight objects, exposed edges, plate orientation).
- An introduction into CNC milling, an explanation of the process and an expanded outline of how it can be utilised within the craft sector.
- An introduction into 3D scanning, an explanation of the process and an expanded outline of how it can be utilised within the craft sector.
- Resources: Example 3D printers and prices FDM/ FFF in depth, SLA/ DLP, SLS.

MODULE 3:
DIGITAL CRAFT:
-HOW DIGITAL TECHNOLOGIES CAN RELATE TO MY PRACTICE?

This module will provide:

- Explanations of typical applications of digital technologies. An introduction of intricate shapes and complex forms will highlight to the student that 3D modelling allows the maker the opportunity to make things they feasibly couldn't before.
- Explanations of a-typical applications of digital technologies e.g. producing wax casting moulds, supports/frames, slip casting, prototyping before using expensive materials. (showing the student 3D printed items do not have to be the finished object)
- An outline of how digital technologies can add value to existing practice i.e exploration of scale in craft objects, multiplicity and reproduction/ adaptation. (Adaptability and manipulation through digital tech.)
- This module will emphasise the ability to create personalised content, highlighting the value for both small-scale manufacturing and for makers in the craft sector as it allows for unique and individual outcomes.

MODULE 4:
CRAFT FUTURES.

This module will include:

- An outline of sustainability and enviromental concerns associated with digtial making technologies. Including but not limited to the material consciousness of making and the ethical implicatins of sourcing materials.
- An explanations of Intellectual Property rights when utilising digital making technologies to produce craft objects.
- Digital Craft and Business: Improving and developing individual craft businesses: increasing sectoral networking locally and internationally and increasing customer engagement.
- Digital Craft Theory.

MODULE 5:
DIGITAL CRAFT EXEMPLAR 1: WOOD - *FURNITURE*

This module will provide:

A discipline specific module for craftspeople who produce craft furniture.

MODULE 6:
DIGITAL CRAFT EXEMPLAR 2: *CERAMICS*

This module will provide:

A discipline specific module for craftspeople who produce ceramic and glass craft objects.

MODULE 7:
DIGITAL CRAFT EXEMPLAR 3: *TEXTILES*

This module will provide:

A discipline specific module for craftspeople who produce craft objects with textile materials.

MODULE 8:
DIGITAL CRAFT EXEMPLAR 4: *WEARABLES*

This module will provide:

A discipline specific module for craftspeople who produce craft wearables such as jewellery.

**In the second phase of the project the partners will work together to expand and translate these core module outlines into full working content for the platform that is aligned with the target audiences needs and requirements.