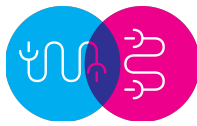|	
Project Acronym:	**#MusicBricks**
Project Full Title:	**Musical Building Blocks for Digital Makers and Content Creators**
Grant Agreement:	**N°644871**
Project Duration:	**18 months (Jan. 2015 - Dec. 2016)**

D5.3 Case studies, impact data and statistics from the Creative Testbed

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n°644871
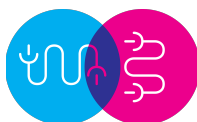
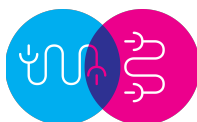The #MusicBricks project consortium is composed of:

SO	Sigma Orionis	France
STROMATOLITE	Stromatolite Ltd	UK
IRCAM	Institut de Recherche et de Coordination Acoustique Musique	France
UPF	Universitat Pompeu Fabra - Music technology Group	Spain
Fraunhofer	Fraunhofer-Gesellschaft zur Foerderung der Angewandten Forschung E.V	Germany
TU WIEN	Technische Universitaet Wien	Austria

D5.3 - Case studies, impact data and statistics from the Creative Testbed ▪ January 2016 ▪ Stromatolite
The#MusicBricks project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement n°644871

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Revision Control

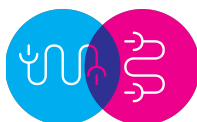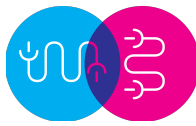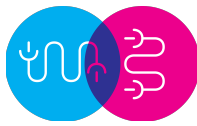| Version	Author	Date	Status
1	GEOFF HOWSE (STROMATOLITE)	22 January 2016	Initial Draft
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8	ANDREW DUBBER, MICHELA MAGAS (STROMATOLITE)	29 January 2016	v.0.6
9	MICHELA MAGAS (STROMATOLITE)	30 January 2016	Final Review
10	MARTA ARNIANI (SO)	30 January 2016	Final Review and Submission

Table of Contents

Executive summary

The present document is a deliverable of the #musicbricks project, funded by the European Commission's Directorate-General for Communications Networks, Content & Technology (DG CONNECT), under its Horizon 2020 research and innovation programme.

Case studies following observations of methodologies at the WP5 events have revealed successful entry points for accessibility specialists, workshops leading to technical results, productive transversal experiments in sound and light and the witnessing of creativity as social glue.

The three core project activity events and single bonus event have disseminated the #MusicBricks toolkit, now totalling eleven tools, to main #MusicBricks target stakeholders. Three new tools were added by external industry partners wishing to include their own innovations.

The Creative Testbeds facilitated 25 creative concepts adopting #musicbricks tools into their designs, leading to eleven seed ideas being taken forward to the incubation Industry Testbed stage. Gender balance at the events was good relative to the music technology sector with #MTFScandi achieving 33% female participants. 249 creative stakeholders took part across all Creative Testbeds.

The WP5 events further offered a fertile platform for extensive knowledge transfer between partners and creative innovators and have led to far reaching and sometimes extraordinary impacts on economy, research, policy, society and industry.
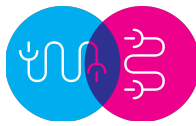
1. Introduction

The aim of this deliverable is to outline the measurable impact of the creative ideas seeding process at all the Creative Tested events; #MTFScandi, Sonar+D Music Hack Day, #MTFCentral and Waves Vienna Music Hack Day. Data is provided about social impacts of the adoption of the tools and includes statistics about the participants countries of origin, skills and gender balance at the events.

The document begins with text on the creative developers methodologies of involvement, learning, inspiration and collaboration observed during the course of creative idea generation, presented in the form of case studies and summaries. The document continues by outlining statistics relating to the different types of participants and the number of creative concepts generated at each WP5 event, followed by data on those selected for the incubation stage.

The final part of the document reports valuable impact data on some of the more extraordinary results achieved in the first 12 months of the project.

2. Case studies

Some of the following case studies have already been included in less analytical form in D5.1. They are included again here with additional studies and new observations as an overall record of observed methodologies across all Creative Testbeds.

2.1. Open methodology

As a result of deliberately open-ended challenges, the projects created by participants were especially varied. The affordances of the high quality tools provided by the partners allowed for a wide range of creative responses to the conceptual provocations provided at the Creative Testbed. Providing participants with a range of adaptable and open technologies that can be applied in different ways and in different combinations, and by seeding ideas rather than being overly prescriptive, the range of potential approaches and innovations was greatly expanded. As a result, the projects that emerged from the #MTFScandi Testbed were extremely diverse, ranging from a head tracking motion control platform to new musical interfaces and a performance project involving brainwave scanning and emotional feedback remixing sound and visuals.

The quality of the provided tools and the clarity of the associated documentation encouraged participants to work outside of their comfort zones or usual areas of expertise. Participants were guided by their imagination rather than their customary skillset and were able to engage in a process of free experimentation around the open challenges that allowed for much greater ambition. They were supported in doing so with the presence of expe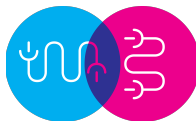rt representatives from each #MusicBricks partner and as a result, some highly innovative and well thought-out projects were created with those tools. Given the freedom to experiment and explore ideas rather than simply solve a problem or build a specific category of object, as well as the substantial support and technological expertise represented by the partners who had created the tools, the participants were able to implement the #MusicBricks tools in much more creative and innovative ways than might otherwise have been possible.

2.2. Rapid knowledge transfer

Both the intensive 24-hour nature of the hackathon events at the Creative Testbeds and the hands-on approach to building new objects with the #MusicBricks tools during that period provide the opportunity for learning and skills development that is uncommon outside of that environment. Not only are new concepts and skills passed on between participants and from the project team, but that knowledge is then immediately applied and put into practice, cementing that knowledge and becoming part of the participant's core approach.

An excellent example of this at #MTFScandi was a hackathon event participant local to Umeå who described himself as a highly proficient C# coder but who had never made coded a music/audio related project. The participant was particularly interested in physical interaction and after the #MusicBricks partner presentation decided to use the IRCAM R-IoT sensor board in his project. During the 24-hour hackathon event, he was mentored by Adam John Williams, the Hacker Manager (Stromatolite) while he worked on his project. His first approach was to read the messages coming from the board as OSC-packets directly within the C# environment that he was familiar with. From the Hacker Manager's experience it seemed likely that this approach would prove time-consuming and potentially mean that a working demonstration of the idea would not be completed in time to present.

After exploring together the extent of the complex technical work which had already been integrated by the IRCAM team into the provided Max MSP patches which accompanied the R-IoT board, the participant became more confident with the new workflow and programming environment. The Hacker Manager spent a few hours through the night with the participant and provided him a personalised Max MSP masterclass. Not only did they work together so that the participant could integrate the new skills he had learned into his

project, but he was able to put those skills to immediate practical use, thereby becoming familiar and confident with the workflow. As a result, the participant created a successful demonstration of his innovative and accessible gestural controller for music selection and playback, and his project was selected by the judges to go forward for #MusicBricks project funding.

2.3. Ease of integration of various #MusicBricks

At the first Creative Testbed, it became clear that the clarity of documentation, the level of available personal support and the simplicity of the #MusicBricks tools afforded an ease of implementation that allowed the participants to incorporate multiple #MusicBricks tools within their projects. By wrapping the technologies in APIs, GUIs and TUIs for use by the participants, and by using open standards that ensured the individual #MusicBricks tools were cross-platform compatible, data could easily pass between the components in a way that allowed for complex hybrid projects to easily integrate several tools from different institutions into a single creative project. This led to the realisation of several highly ambitious projects that merged research outputs from separate institutions that would otherwise not normally be connected.

One such example integrated the IRCAM R-IoT sensor board with music analysis APIs from both TU Wien and UPF to create an instrument that would enable people of varying levels of musical and physical ability to play along to songs of their choice using simple & intuitive hand gestures.

2.4. Rapid ICT skills transfer to design professionals

Although many hackathon events specifically target computer programmers, the creative hackathons at the Testbed events encouraged and welcomed a wide range of complimentary skillsets and professional backgrounds. The potential of the #MusicBricks toolkit as a platform from which to respond to the open challenges presented at the Creative Testbed inspired three designers to create a simple wooden musical interface with the intention of integrating #MusicBricks technology to provide functionality. The participants were not experienced programmers, though they were proficient at using 3-D printing and laser cutting technologies and so were able to execute the physical product idea very well.

With some tuition by the Hacker Manager at #MTFScandi they were able to master the programming basics that allowed them to explore their creative concept. Even though the project was not sufficiently realised during the 24-hour period to have a fully-working prototype, #MusicBricks judges felt that the project had great potential and that the team should be encouraged to progress the idea further.

#MusicBricks partners Fraunhofer offered to mentor the team to develop a commercial prototype, and encouraged them to progress towards the third Creative Testbed at #MTFCentral. Two members of that team attended the creative hackathon event at #MTFCentral and worked with a computer programmer to further develop their ICT skills and collaborate on another project.

As a result of the mentorship and practical experience gained at the two Testbed events, the designers developed a winning hack project that was commended for its integration of user-centred design principles and technological implementation. While this project was not a #MusicBricks incubation winner, it provides a demonstration of the methodology that facilitates rapid knowledge transfer across disciplines. In addition, the knowledge transfer was not simply a one-way accumulation of computer programming skills by the designers. By interacting with the designers in a context usually reserved for ICT professionals, fellow participants in the creative hackathon were also able to integrate principles of good product design into their own projects, which contributed to the overall quality of the projects at the Creative Testbed.
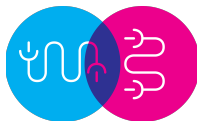
Fig 1: Rapid ICT skills transfer in the case of first-time hackers who hitch-hiked from Berlin
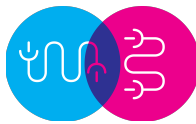
2.5. Knowledge exchange with accessibility specialist

A participant from #MTFScandi dedicated to the design and production of digital musical instrument interfaces for people with varying physical ability was interested in continuing this work at the Music Hack Day event using the #MusicBricks R-IoT Gesture Sensors which he had seen demoed by Hack Camp participants at #MTFScandi. Having limited programming skills and having missed the workshop day, he found help from a student at Universitat Pompeu Fabra in Barcelona.

This work focused on making a mouth instrument, especially adapted for disabled people. It allows the musician to play only with the head and mouth, without the use of the arms or other body parts. The team expressed their interest for several #MusicBricks tools but focused on the first that would help them to achieve their primary goal: the R-IoT board from Ircam. Detecting the orientation of the instrument, the sound generated would be of higher or lower pitch. This task is one of the main capabilities of the R-IoT and the Max/MSP tools provided by Ircam. However, the creative developer team decided to incorporate a breath sensor (working in and out) that would control the amplitude of the sound, which is critical for the instrument's expressivity. The technical challenge for the team was to add the sensor to the Ircam board. With some help from the Ircam team, they were able to achieve this objective and add this feature.

From this example, the #MusicBricks partners learned that it was possible and relatively straightforward to augment and further develop the component. However it was also clear that documentation requires rigorous updating in such cases, and that documentation should be extth a 'how to' section. It also became apparent that it was important to enable code update to the microcontroller from any platform as soon as it was technically possible (it was restricted to Windows).

As a result of this feedback the Ircam #MusicBricks team team have improved the documentation http://ismm.ircam.fr/wp-content/uploads/2015/10/R-IoT-Programming-Flashing-Guide.pdf?ca825b. The revised design uses a USB / Serial chip driver which features a "break condition" that allows the R-IoT to be turned in download mode. It is now possible to update the code of the micro-controller from both OSX and Windows. The initial design assumed that the former chosen manufacturer (Silicon Labs) for the serial chip would have provided a proper driver, unfortunately, they implemented it properly only for the Windows

platform, but not for iOS. The team therefore went back to the initial chip (FTDI branded) which works on both Mac and Windows. They are also confident the FTDI driver works properly on the Linux platform too.

2.6. Identifying specialist developer needs

Another team at Music Hack Day Sonar focused on enabling people with no musical skills to enter a jam session. This system analyses the music generated in realtime and offers a simple interface (simple pads like the Akai MPC or Ableton Push), using pre-selected samples that fit the current context (harmony, timbre, rhythm). The challenge was to use the current technology in a realtime environment. They used a real-time version of the UPF Essentia tool.

The partners realised that this example illustrates one clear need for the creatives during those sessions: they want realtime #MusicBricks tools. If the tool is not realtime, they could still find ways to use them with their limitations, but partners should focus on offering as many realtime versions of the bricks as possible.

In response to this identified need, partner UPF further developed the audio processing library Essentia (http://essentia.upf.edu), and has implemented suggestions from the feedback received from creative users. These efforts are found in EssentiaRT~ (http://mtg.upf.edu/technologies/EssentiaRT~), a real-time subset of the tools implemented as an external library for Pd and Max/MSP. The development plan of EssentiaRT~ is to extend the number of algorithms that are available as real-time processing modules.

2.7. #MusicBricks chosen as preferred platform for innovation

At all of the Creative Testbed events, #MusicBricks were offered alongside a range of other technologies for experimentation. Use of #MusicBricks tools was not a condition of participation in the creative hackathon events. Even so, in all cases, the #MusicBricks tools were those overwhelmingly selected as the preferred vehicle for invention by the teams of creative developers. There were several reasons for this. First, the simplicity of the tools and their interoperability afforded ease of integration into projects and a clear use case for each tool, while the connection of multiple tools provided the opportunity for teams to make sophisticated and unique hybrids.

Second, the documentation and on-site explanation of the #MusicBricks tools allowed for participants to understand the workings of the tool in depth before being presented with the opportunity to select components for their creative projects. For instance, during the pre-event at MHD Barcelona, one day before the MusicHackDay at Hangar in Barcelona, each partner presented an instructional workshop that explained their #MusicBricks tools, followed by a hands-on session that cemented the knowledge with practical experience, and gave the #MusicBricks partners the opportunity to respond to feedback and develop the tools in response to user requests.

Third, particularly in the case of MHD Barcelona, three members of the Stromatolite team were sent to the event specifically in order to ensure that uptake was high. Stromatolite team members raised awareness of the #MusicBricks tools through an internal marketing initiative that involved a great deal of personal interaction with development teams, as well as small, fun conversation-starting gestures like colourful #MusicBricks stickers for participant laptops. As a result, despite the availability of competing technologies including appealing products such as Nao robots, Epson smart glasses and the RapidMix project, a third of all projects at MHD Barcelona used #MusicBricks tools.
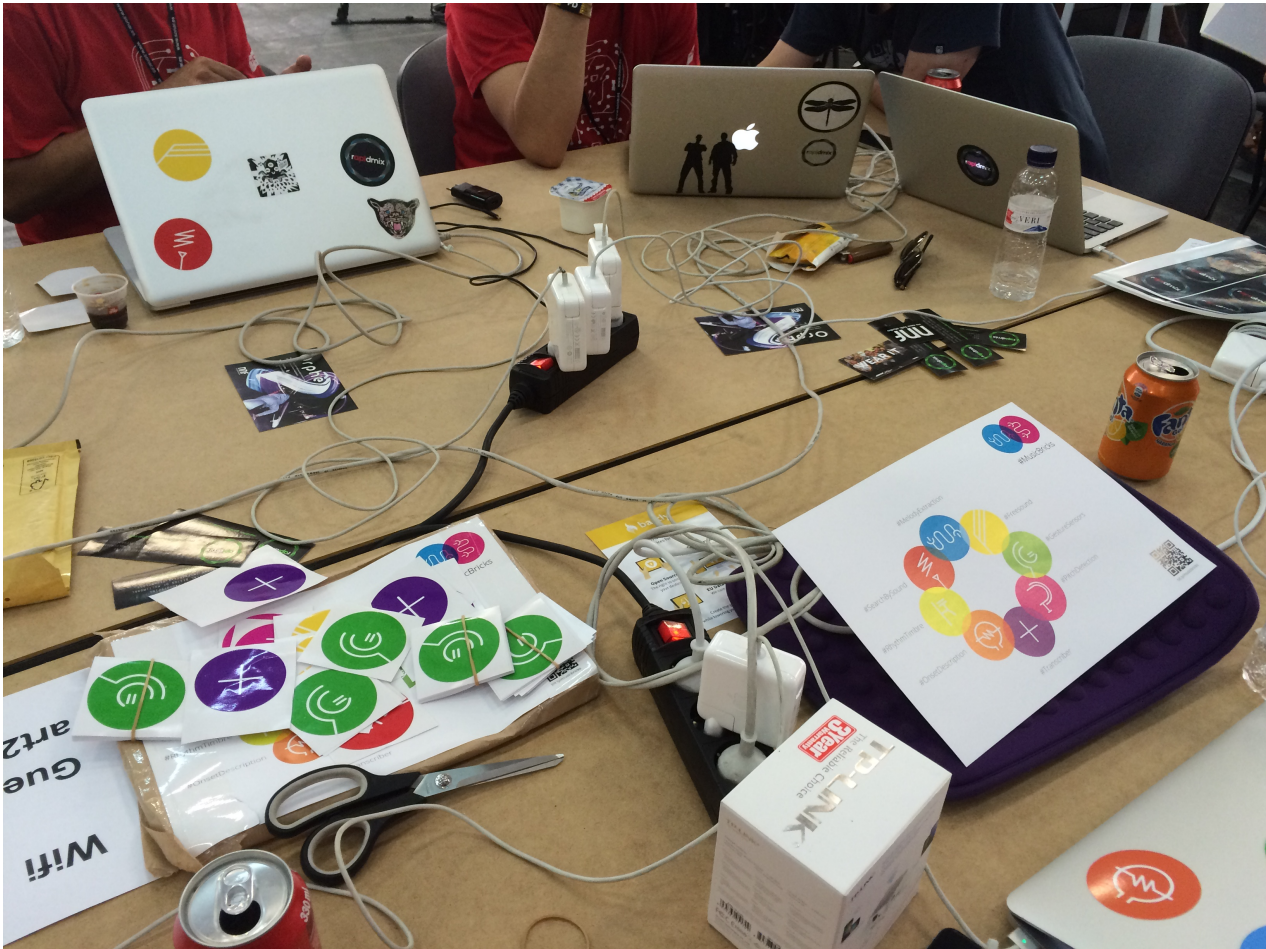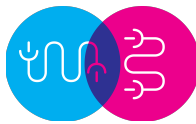
Fig 2: #MusicBricks chosen as the preferred platform for innovation at the MHD Barcelona

2.8. First transversal experiment combining sound and light

Prior to the #MTFCentral event a partnership was forged between Music Tech Fest and Philips. Organisers discussed with Philips representatives the potential for new innovation involving interactions between sound and light, and in particular how such interactions might be of benefit within fields such as therapy, communication and performance.

As a result of these discussions Philips Hue Lights developer kits were made available to participants during the 24 hour hack camp as part of a first transversal experiment. The following open creative challenges were developed in order to inspire and encourage the teams to work with the Philips lighting kits in combination with #MusicBricks technologies:

Interactive sound and light therapy

Light and colour can be powerful tools when creating a personalised environment. Calming light can make a huge difference for those with mental disabilities, for example in a sensory room where the participants can observe the lights and listen to the music, but they can also interact with them as well if they wish. Design a system that creates a tailored, interactive environment.

Translate music into light, translate light into music

Light and music mapping/language: how can we assign light to music and vice versa? What makes sense to link? Staccato with brightness or tempo with saturation…?
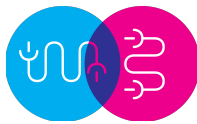
Generate with music and light

Gestures and sounds can also trigger changes in light and colour. A system can be created that allows the performer to trigger the entire stage environment. Using Hue alongside musical instruments, create sound & light scenes that can be saved and recalled.

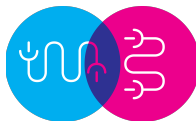

Fig 3: Philips Hue lighting as part of the transversal experiment between sound and light at #MTFCentral

Projects arising from these Philips challenges included the following experiments by Creative Testbed participants:

Hue-wee Jam Session used audio analysis to track music being played which was then converted to allow the Hue Lights to respond accordingly. Through the use of #MusicBricks tools the device achieved significant detail in the data it could pass on to the lighting kit, analysing the pitch, density and loudness of the music being played, which was then mapped to colour, saturation and intensity levels.

Project **LightTime** used the Hue Philips lighting system to create an alternative to clock-timers and mental-countdowns to design a more relaxed interval-training experience for exercise. A sample python program was used to control the hue light, intensifying and brightening it during a workout session, and dimming to a more relaxed state to intuitively indicate when to relax and prepare for the next step.

Hue Makelight combined the Hue kits with the Makelight platform for mobile phones, which was demoed at the festival, allowing a colour light show on mobile devices to be synched to the Hue bulbs and equally, a Hue colour scheme to flood mobiles with colour. This project showed great potential for live performances allowing acts to set up stage lighting that is also reflected on audiences mobiles.

2.9. Creativity as social glue attracts outstanding innovators

Another project that combined the #MusicBricks tools with the Philips Hue Lighting kits at #MTFCentral was GIRD (Gesture-based Interactive Re-mixable Dance Floor). One member of the creative development team had already presented her research on songwriting for new interactive forms of music at #MTFScandi. While she did not identify as a hacker, she expressed an interest in the creative collaborative environment of the Hack Camp Creative Testbed. Although not a participant of the hackathon at that event, she witnessed the seeding of exciting concepts and projects, and was introduced via both presentations and partner interactions to the #MusicBricks toolkit and the creative potential of the tools.

She returned for the #MTFCentral event in Slovenia with an experienced developer working for the Ars Electronica organisation. The two formed a team that participated in the creative hackathon event. They explored the themes surrounding the Transversal Experiment Combining Sound and Light, and created the GIRD project: a system that uses the Hue Lighting System to create a gesture- based interactive dance floor experience that allows a performer to interact with music in an immersive environment using a #MusicBricks R-IoT board. The data produced from the gesture sensor manipulates the HUE lights allowing users to interact with the music through movement.

Judges remarked upon the creative flair and technical accomplishment of the team, and the project was awarded #MusicBricks incubation. GIRD then went on to participate in the Creative Testbed at the Waves Vienna Music Hackday, and developed the product further to incorporate perspex light paneling containing programmable LEDs. The most recent results from this project place it very highly as a contender for full productisation and market deployment.

2.10. Knowledge transfer allows new creative concepts to build on old ones

At Waves Vienna Music Hack Day one team of creative developers were a start-up that provides a platform to dynamically select music to suit people within real-world social environments. They attended a presentation by partner event organisers TU Wien about the Hue-Wee Jam Session project that had been developed at #MTFCentral and was presented as an example of strong creative concepts which have emerged from the #MusicBricks Creative Testbeds. The project had originally been chosen by judges for #MusicBricks incubation but the decision had to be overturned by the #MusicBricks consortium because its creator was an employee of TU Wien.

The team at Vienna Music Hackday felt the Hue-Wee blueprint shared common aims and concepts with their start-up company and so during the hackathon, with support and encouragement by the TU Wien partners, they developed a project using WiFi connected Philips Hue LED light bulbs to visualise music playing from a mobile device.

The new project, entitled LightBeat, adapted the #MusicBricks Transcriber from Fraunhofer to detect audio beats as a source for controlling the Philips Hue lights. Working through difficulties with a time delay between beat detection and controlling the lights, the team came up with a solution that preprocessed the audio and kept everything tightly locked in sync. This innovation, along with the team's creative concept that built on prior creativity, saw them awarded as the 11th incubation project for the #MusicBricks Industry Testbed.
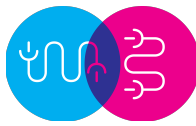
3. Methodologies observed and derived

Through observation and analysis of the above case studies emerging from the Creative Testbeds, several methodologies can be observed to have a positive impact upon the process of innovation. Rather than merely 'solve problems' - an approach that can lead to incremental innovation or technological improvement, the creative experimentation of the hackathon provided the context for disruptive innovation.

While the abstract concepts contained within the open-ended hack challenges provide a seed for ideas, the purpose of the creative hackathon event is to create actual concrete projects and products. Those projects need not necessarily be intended as music business enterprises (and, in fact, seldom are considered in that way). However, as a piece of communication in response to a provocation and the embodied expression of an idea that may or may not ultimately become codified in a business plan, the experimental 'hack' is not simply an intellectual game, but a process of making things and putting them into the world. It is a material practice - and an act of thinking out loud, embodied in physical and working objects.
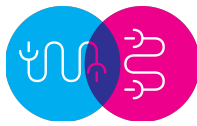
The opportunity for new business innovation is not always clear in this space – though that it exists is not disputed. Projects that are developed in fun or to explore a particular creative provocation may contain within it the seed of an idea that could revolutionise the way in which fans interact with music performance or it might contain a process that may be applied transversally to other sectors.

It can be observed from the case studies above that the mere act of experimentation contains within it the opportunity for unexpected discoveries and unintended consequences. These discoveries can provide the starting point for new business opportunities as yet unanticipated. The seed project provides a starting point for new ideas based on existing tools, materials, systems, processes and repertoire. Providing access to these building blocks facilitates innovation. Participation in the process of innovation need not (and perhaps should not) take place within the confines of an existing industry organisation. Access to new, simple and interconnecting tools such as the #MusicBricks toolkit, coupled with a range of different literacies of digital making such as those shared within ad hoc teams that form within creative hackathon events, provides a seeding ground for innovation and enterprise, and these ingredients seldom lie exclusively within the domain of a single individual or organisation.

Participants in creative hackathon events do not, by and large, set out to invent the future of music business – but through repeated experimentation, repurposing, rebuilding and playing with the TUIs, GUIs and APIs, code, electronics and content that provide the building blocks of these hackathon events – and supplied with open challenges that engage their imagination – music hackers are statistically far more likely to stumble upon the key to a new music industry opportunity than is an employee of a music corporation charged with the task of simply improving what already exists.

Through the interaction with developers across a number of Creative Testbed events, the #MusicBricks partners were able to observe and establish best practice methodologies such as clear documentation, responsive development of the core building blocks in concert with the demands of the creative projects. The projects are not self-contained phenomena that exist without reference to the external world. Developers bring their own experience or professional interests to the table; projects that are not selected for incubation go on to develop outside of the #MusicBricks initiative; developers build on the creative ideas of previous projects from other Creative Testbeds and teams gather organically around ideas that attract participants with different skills, backgrounds and interests for a range of different reasons.
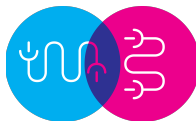
In addition, by using open and common standards, the tools were able to be used in an interconnected fashion, which enabled new and unimagined possibilities. Connecting the #MusicBricks components together radically expanded the affordances for creative ideas that could be incubated and developed to commercial prototype.

The #MusicBricks project has demonstrated clearly that the process of making is itself a pedagogical methodology. By expressing ideas through experimentation with physical computing, wires and software, participants in the Creative Testbed not only showed what they were already capable of creating, but became capable of creating much more because of the rapid knowledge transfer opportunities within the intensive environment of the 24-hour event, and surrounded by engaged, curious and creative developers with complementary skills. By putting their new skills immediately into practice with both a time constraint and an expectation of peer evaluation as the projects are presented on stage at the end of the hackathon event, participants learn quickly and deeply.

The activity of making and inventing within these creative contexts also provides a social glue. It removes barriers and social unease as strangers from incredibly diverse backgrounds work together to solve problems, address challenges and make something that did not exist in the world prior to their coming together.

The academic researchers that form the #MusicBricks developer teams are able to place their research into the hands of people who will test it to its limits, and situate theoretical and intellectual results within real world environments that place unanticipated strain on those research outputs. By responding in real time to the needs and ambitions of the participants in the hackathon events, the #MusicBricks team were able to strengthen their tools and make them more flexible, more robust and ultimately more useful within a commercial environment.

4. Event participation statistics

This chapter focuses on the analysis of the statistics gathered during the Creative Testbeds in order to throw light on the importance of creativity on innovation seed ideas, an improved gender balance, and correlations between a balanced seeding environment with successful innovation results.

Part of the data shown below has already been included in D5.1 ,and D2.1 to illustrate the impact of the first two Creative Testbeds. We include this data here again, complimented by data accumulated from the third and fourth Creative Testbeds, to give a complete overview for analysis.

4.1. Gender statistics

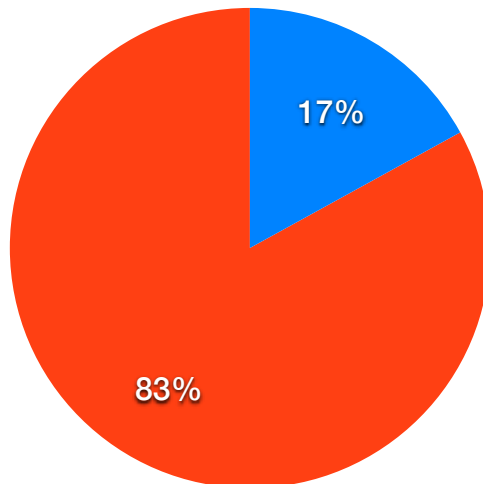Partners are particularly proud to have reached 33% female innovators at the first Creative Testbed #MTFScandi. This is a considerable improvement on any previously known music technology hackathon, except for those organised specifically for female participants.
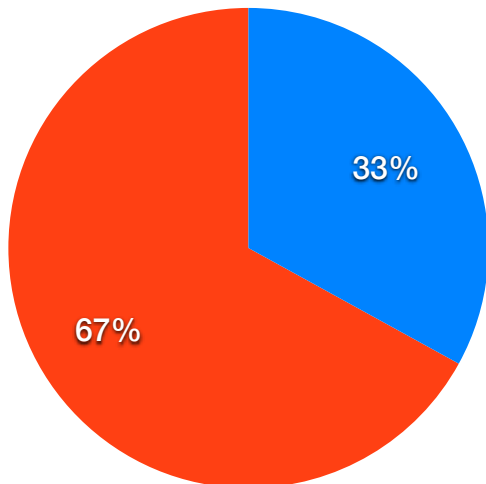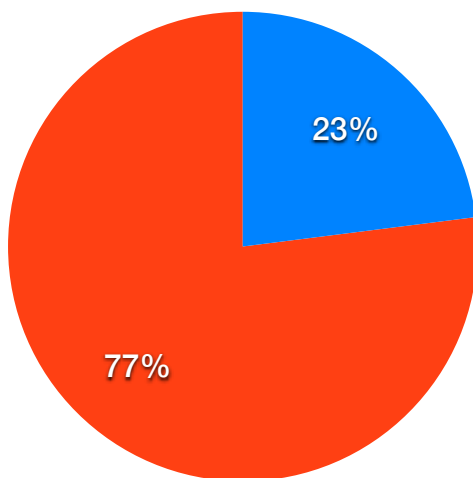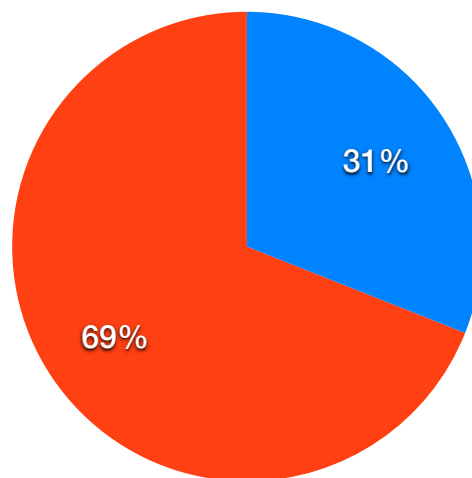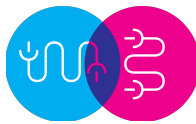

#MTFScandi innovators by gender

MHD Barcelona innovators by gender

#MTFCentral innovators by gender
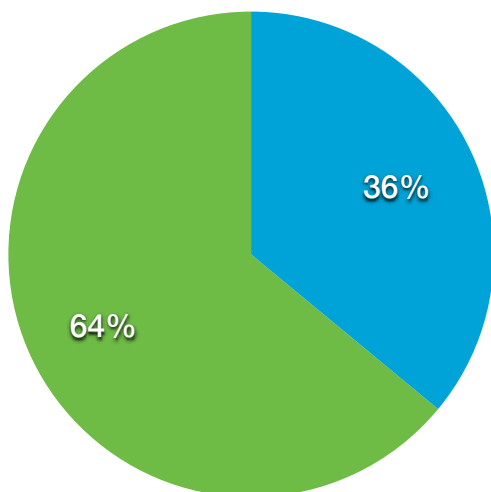
MHD Vienna innovators by gender

The higher presence of female innovators appears to be related to the emphasis the Creative Testbeds made on creativity and transversal applications. This attracted participants from the wider creative industries and other research and industry sectors, and many of those were female (see section 3.2 below).

Overall the statistics average as 26% female and 74% male innovators. Among the awarded incubatees, 5 are female and 25 male. The larger number of male teams is due to the legacy of strong teams of engineers who have previously worked together or have studied together and who typically attend hackathons with a well figured out workflow. However the teams with the strongest creative component have up to three female innovators.

4.2. Dominant skill statistics

Closely related to the above gender analysis is the innovator's self-defined dominant skill. Participants defined themselves as predominately Hacker, Coder, Researcher, Designer, Artist or Musician, and in some cases specifically as e.g. Marketing Expert, Entrepreneur or Video Editor. Below we have divided these professions into the dominant creative and non-creative skills, in order to get a clearer picture of the importance of creativity in innovation.

#MTFScandi innovators by dominant skill
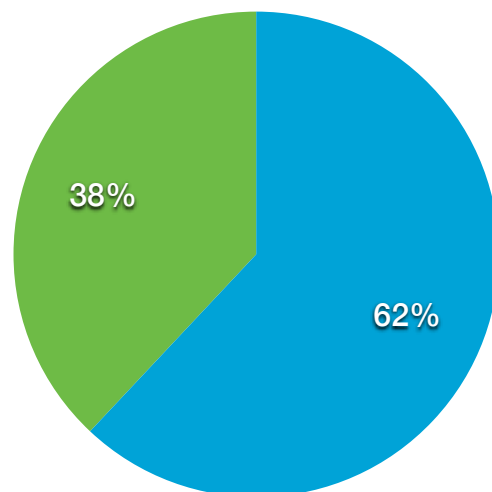
MHD Barcelona innovators by dominant skill

#MTFCentral innovators by dominant skill

MHD Vienna innovators by dominant skill

The resulting statistics reflect the nature of the Creative Testbed events, respectively the Music Tech Fest, with its emphasis on creativity, and the Music Hack Day with its emphasis on engineering. However both sets have a strong presence of creativity, which appears as integral to the innovation process, particularly at the point of seeding ideas.

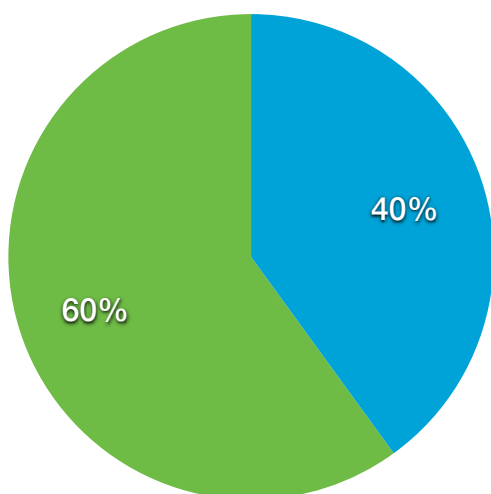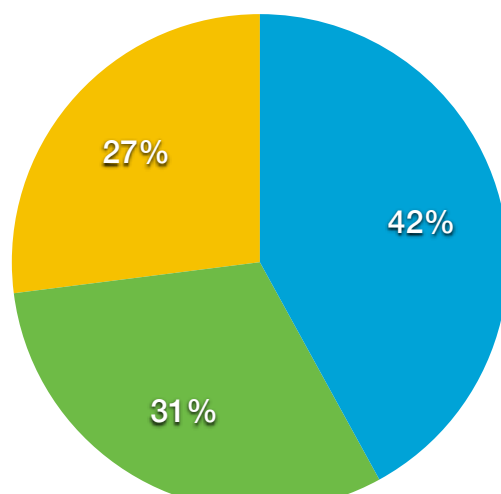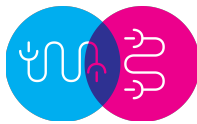There appears to be a direct correlation between the strongly creative #MTFScandi or the strongly engineering-oriented MHD Barcelona, and the percentage of female innovators present. Creativity is therefore also essential to achieve a good gender balance.

4.3. Provenance statistics

Fig 4: Creative Testbed participants traveled from 35 countries worldwide

Participants from a far greater range of countries than expected traveled to take part in the Creative Testbeds. This has resulted in most #MusicBricks incubated teams being of mixed provenance:
- Dolphin: Sweden/Iran
- Airstrument: Israel/Germany
- FindingSomething_BondingSound: Portugal and Hungary
- Interactive Cube: UK/Italy and Sweden
- High Note: UK and Spain
- Enboard: Spain/Colombia
- Sound in Translation: Spain and Germany
- Bionic Ear: Spain
- Manuphonia: Slovenia, Bulgaria and Finland/Germany
- GIRD: Australia/Austria
- LightBeat: Austria

Working across borders has not been successfully managed by all of the teams. There is notably a direct correlation between the teams who made an effort to invest their incubation funding to travel to work together with other team members in other countries, and the market potential assessment of those teams (high or very high) in the Business Strategy document (see D7.1).

4.4. Age statistics

The prevalent age group of innovation participants was 26-39, followed by the age group 20-25. This age matches the prevalent age of Google's Generation C - Content Creators:

> *"Why are they known as Gen C? Because they thrive on Connection, Community, Creation and Curation; they're engaged and they want their voices to be heard. They're not a generation in the traditional sense – about 65% of Gen C are under 35.."* [1]

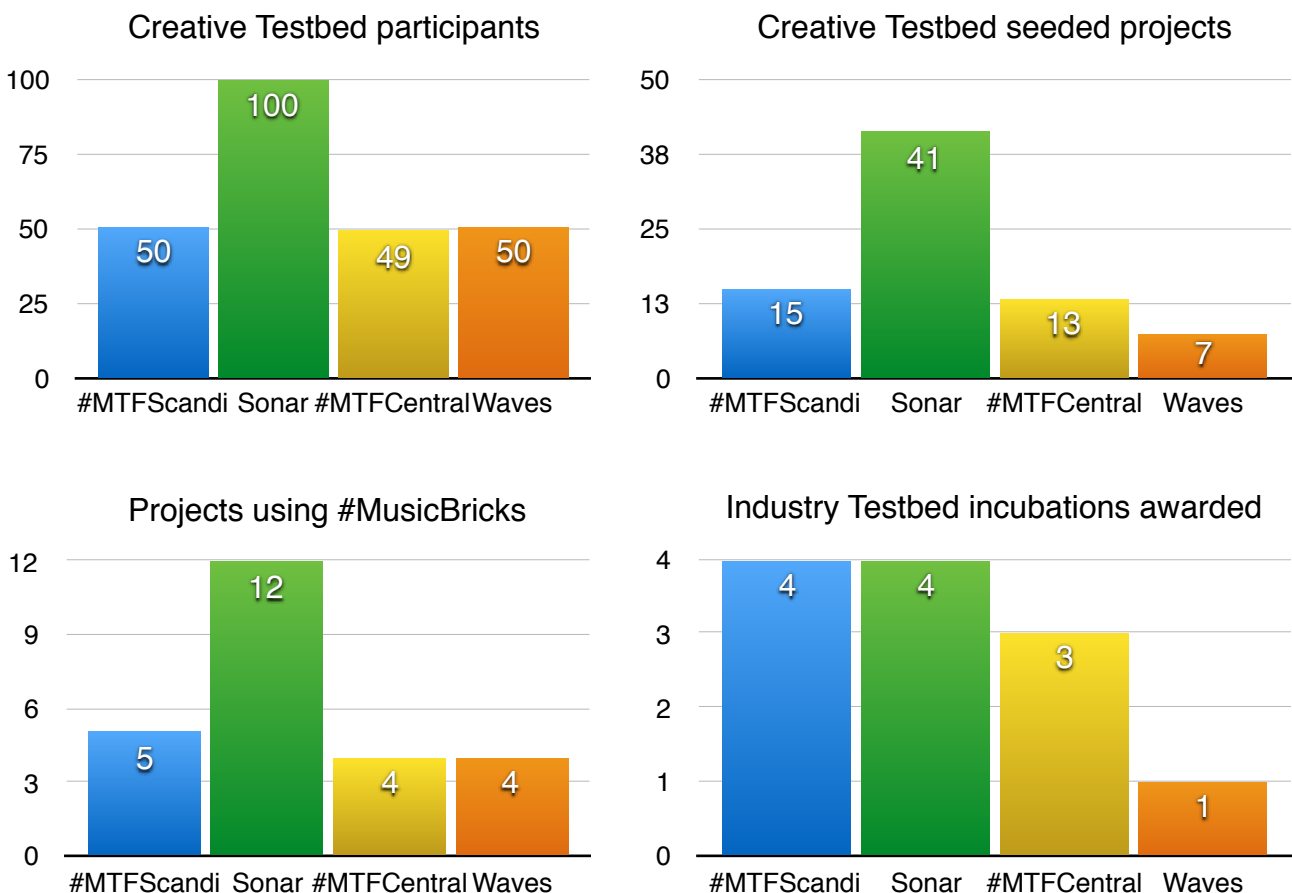This generation which thrives on community and creation is the prime target of Creative Testbeds, regardless of whether or not their knowledge extends to seeding ideas for technological prototypes. For instance, a surprising 70% of participants at Music Hack Day Vienna had never visited a hackathon event before.

4.5. Statistics of #MusicBricks usage

A total of 249 participants took part in the innovation hackathon Creative Testbeds, 76 of which successfully entered project prototype submissions. 25 of the entered projects used #MusicBricks tools in their creations, and 11 of those projects were incubated through the Industry Testbed.

Creative Testbed participants

	#MTFScandi	Sonar	#MTFCentral	Waves
	50	100	49	50

Creative Testbed seeded projects

	#MTFScandi	Sonar	#MTFCentral	Waves
	15	41	13	7

Projects using #MusicBricks

	#MTFScandi	Sonar	#MTFCentral	Waves
	5	12	4	4

Industry Testbed incubations awarded

	#MTFScandi	Sonar	#MTFCentral	Waves
	4	4	3	1

By far the largest demand for the use of #MusicBricks was at the Music Hack Day at the Sonar Festival in Barcelona. This Creative Testbed had the capacity to take 100 hackers, and a large number of these

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[1] Ipsos MediaCT YouTube Audience Study, June-August 2013 and TNS Australia Pty Ltd YouTube Audence Study, 2012-2013
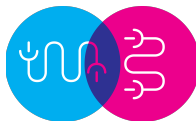
requested particularly the R-IoT microboard. With only 12 boards available to the hackers at that event, only 12 teams were able to work with the #MusicBricks TUI.

The high demand for #MusicBricks at MHD Sonar Barcelona was due to several contributing factors:
- joint intensive dissemination by both partner UPF and continuing intensive dissemination from the preceding #MTFScandi Creative Testbed
- specially organised #MusicBricks workshop organised just prior to the event
- additional partner engagement - in addition to each partner's technical support teams, Stromatolite sent three members of staff with the specific task to engage hackers with the tools during the hackathon
- attractive dissemination materials including colourful stickers representing each tool were very popular with the hackers who displayed them on their laptops

In contrast to MHD Barcelona, out of 13 completed projects at #MTFCentral, only four used the #MusicBricks toolkit. This event served to facilitate face-to-face knowledge transfer and support for the 8 already incubated teams, focusing on technical advancement of existing projects. This meant that less time was available for the #MusicBricks partners to aid the seeding of new ideas and concepts using the #MusicBricks toolkit and therefore fewer were able to receive the necessary focus. However the four projects using the bricks received full support, and two were consequently selected for incubation. For more information about #MTFCentral and the incubated projects see **D5.4**.

4.6. Fast route to innovation

MONTH 1	MONTH 5	MONTH 9	MONTH 10
PROJECT START **no toolkit => no possible productisation**	CREATIVE TESTBED **first toolkit ready => seed idea prototyped**	INDUSTRY TESTBED **working product prototype**	MARKET TESTBED **product patenting initiated**

Fig 5: The speed of innovation with the #MusicBricks incubated project Dolphin

The #MusicBricks incubated project Dolphin illustrates the speed of innovation possible within a well conceived and managed Innovation Ecosystem. Several factors have enabled such a fast speed of progress from seed to patent:
- first availability of the truly innovative low-latency postage-stamp-sized R-IoT #MusicBricks component
- incubation microfunding support from seed idea to first working prototype
- introduction of Innovation IP as incentive to innovators in the Consortium Agreement
- regular mentoring and assistance in solving technological and business problems
- local government business incubation support in combination with EU innovation microfunding
- a motivating and inspiring community of research experts and fellow innovators

It is worth noting that the above patent is aiming for a compelling use case in the agriculture, forestry and construction sectors, despite having originated from experimentation in the creative industries.
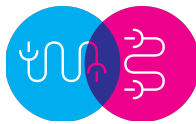
5. Impact Data and Statistics

The following impacts of the #MusicBricks project were presented as part of the "Innovation Revolution" session at ICT 15 in Lisbon (see http://bit.ly/1HBRS1J).

5.1. Impact on social media

5.1.1. Social impacts from events reach 1.5 million

The popularity of the tools has been reflected with **1,449,745 impacts** on Twitter during the Creative Testbeds in Month 6 and Month 9 of the project. This is a direct result of the extensive effort towards promotion and dissemination (See Deliverable D2.1 for details on dissemination) but also reflects the success and innovation of both the #MusicBricks tools and the WP5 events.

5.1.2. 1171 views of #MusicBricks presentations

#MusicBricks tagged presentations on the Music Tech Fest channel, covering presentations from #MTFScandi and #MTFCentral, have reached 1171 views.

5.2. Impact on economy

5.2.1. New IP from industry added to the toolkit in Month 9

3 tools have been added to the #MusicBricks toolkit by external industry partners, making the total 11. Industry partners recognised the broad appeal and reach of the toolkit, and applied to embed their IP into #MusicBricks to complement other tools. This outcome had not been anticipated in the DoW.

Matt Black, eminent artist and founder of industry partners Coldcut/Ninja Tune, highlighted the reasons for his decision to add SyncJams and POF to the toolkit:

> *"Really happy to be joining the awesome #MusicBricks project. The whole concept of making tools freely available, providing space for makers and hackers and then supporting what's made with them is just brilliant. This is a new cooperative Win strategy. Looking forward to see what comes out of our #MusicBricks offerings. Onwards!"*

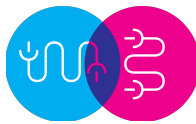#### 5.2.2. Further requests from industry in Month 10

Further requests by industry have been received, both in terms of submitting tools into the toolkit (companies from Asia and Europe) and requests for shipments of #MusicBricks to the US by major US companies and organisations.

5.2.3. Patent already initiated in Month 10

One patent has already been initiated by #MusicBricks incubated project Dolphin from their seed prototype (see section 4.6). The project was initially aimed for gaming industry but found a new valuable application area in the heavy construction industry. The idea is to enable workers using ear protection headphones to operate integrated communication devices using a new set of hands-free gestures.

5.2.4. #MusicBricks TUI already batch tested in Month 11

One #MusicBricks tool, the low latency, gesture driven R-IoT Microboard from the Ircam team, has already been batch production tested. The device proved so popular and demand has been so high that Ircam have been exploring mass production options and are currently working with an SME on progressing marketing and distribution.

More recently (in M12) **element14**, the biggest distributor of componentry worldwide and manufacturer of the Raspberry Pi, expressed interest in partnering with #MusicBricks and scaling up the production and distribution of the R-IoT.

5.3. Impact on research

5.3.1. Four peer reviewed papers accepted by Month 10

Four peer-reviewed papers on #MusicBricks have been **accepted for publication by Month 10** of the project, with two further submissions by Month 12. This has been a surprising result considering that the project is an Innovation Action and therefore research is not its primary focus.

However this result confirms the level of knowledge generation and transfer in the rapidly evolving #MusicBricks Innovation Ecosystem.

5.3.2. Book chapter accepted for publication

A book chapter about #MusicBricks authored by Prof. Andrew Dubber of partner Stromatolite, was accepted for publication already in the first quarter of the project and has been published at the time of reviewing this deliverable on the 29th January 2016 (see ***http://www.e-elgar.com/shop/ business-innovation-and-disruption-in-the-music-industry***).

The title is one in a series of books called '*Business Innovation and Disruption in the Creative Industries*'. The book is edited by Patrik Wikström and Robert DeFillippi and is published by Edward Elgar Publishing. The chapter specifically discusses #MusicBricks and is titled '*You Have 24 Hours To Invent The Future of Music: Music hacks, playful research and creative innovation*'.

5.3.3. Interdisciplinary research possibilities

The impact on interdisciplinary research can be seen in the quote from partner TU Wien:

> *"#MusicBricks implicitly initiates a large network of people across many disciplines, with backgrounds as researchers, creators, artists, entrepreneurs, etc. This network provokes exchange of ideas far beyond the traditionally technology-centred aspects that a technical university usually focuses on and therefore opens up inter-disciplinary research aspects that were not considered before."*

5.4. Impact on policy

5.4.1. Introduction of MARLs (Market Adoption Readiness Levels)

The #MusicBricks proposal identified a need to challenge the widely adopted Technology Readiness Levels system and introduce further parameters appropriate for low-risk, creative applications. This led to the proposal of **MARLs (Market Adoption Readiness Levels)** as part of the CAF (Connect Advisory Forum) recommendations for the programme 2016/2017. The guidelines have since featured in a TED talk at TEDx Umeå by the #MusicBricks Innovation Director Michela Magas, and have recently been proposed by industry partners in both CAF discussions with Commissioner Oettinger, and by AIOTI (Alliance of Internet of Things Innovation) as one of the drivers of Open Innovation Ecosystems for the programme 2018/2019.

The new system of guidelines assesses early adopters, early data yield, and levels of risk in creative applications. This system of guidelines is particularly appropriate for Open Innovation Methodologies and Innovation Ecosystems, and is being tested as part of the Business Strategy for the #MusicBricks incubated projects (see D7.1).
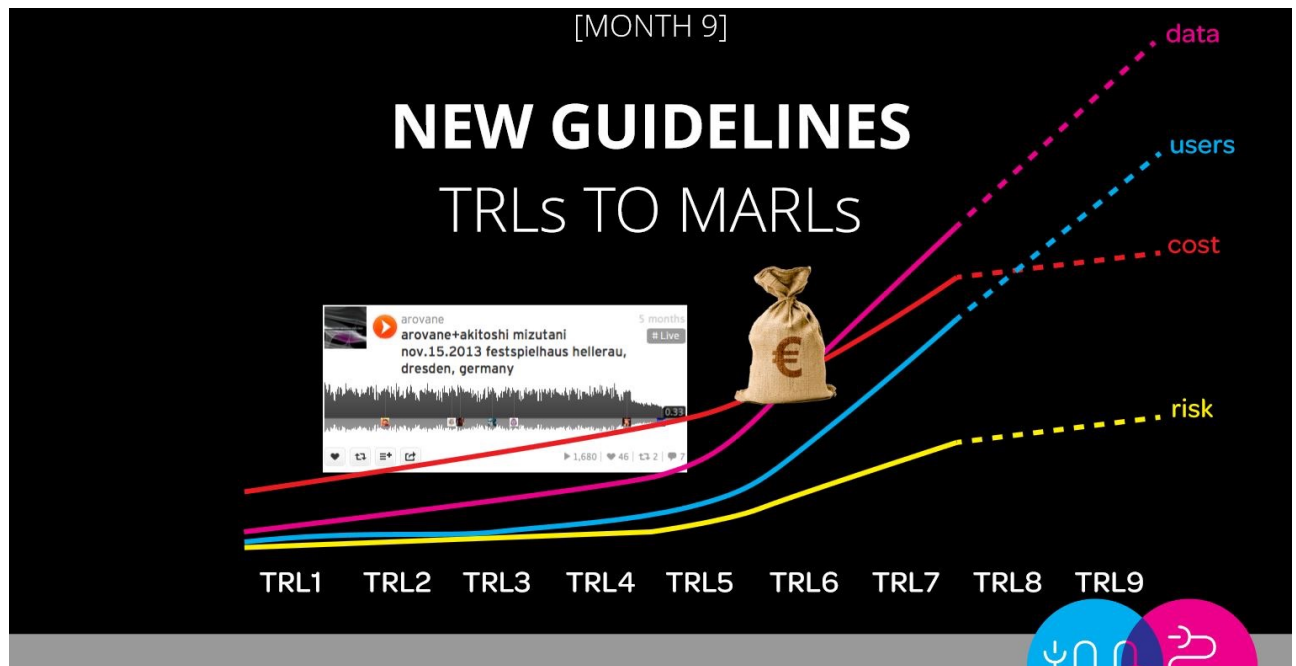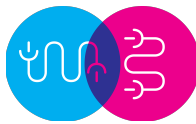
Fig 10: slide from "Innovation Revolution" at the ICT 15 in Lisbon.

5.4.2. Successful test ground for Open Innovation Methodology

*The project has successfully provided the test ground for a three-stage **Open Innovation Methodology** with rapid development and market testing results:*

1) **Creative Testbed:** innovation hackathons which form the core activity of the Creative Testbed have generated a large number of creative innovation **seed ideas**.
2) **Industry Testbed:** has enabled **prototyping** and development of the seed incubated projects.
3) **Market Testbed:** has already begun to analyse **feasibility** and routes to market.

5.4.3. A new Intellectual Property model

A new **Intellectual Property** model was developed especially for the #MusicBricks Collaboration Agreement. In order to incentivise developers, creatives and entrepreneurs to engage with the #MusicBricks toolkit and create an Open Innovation value chain, the **Innovation Results IP** category was introduced to the project CA, differentiated from the Research Results (for more information see D7.1). This model is now being taken up by other H2020 Innovation Actions.
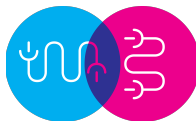
5.5. Impact on society

5.5.1. Creativity as a social glue

The Creative Testbeds have demonstrated that **creativity is a social glue, allowing for valuable and unique crossovers and spillovers.** The #MusicBricks events operate transversally, uniting artists and scientists, researchers and industry, and experts from a broad range of fields, from neuroscience to entrepreneurship, making for an extremely fertile platform for innovation ideas.

5.5.2. 33% female innovators

The first #MusicBricks creative testbed achieved participation of **33% female innovators.** 5 female innovators are currently being incubated.

5.5.3.Rapid knowledge transfer

The effect of the extremely **Rapid Knowledge Transfer** enabled by the #MusicBricks and Creative Testbed methodologies can be seen in the quote by Rojan Gharibpour, one of the #MusicBricks incubated innovators:

> *"I have managed to code the machine learning to recognize 3 different gestures with accuracy close to 100% and I'm so excited about it. I used your suggestions... and now, the machine recognizes the static data up to 100% accurate...It is so cool. I am loving this Machine Learning algorithms. Thank you for your help…"*

5.6.Unexpected impacts

5.6.1.Toolkit as product

While the DoW was focusing on building a toolkit so that products could be developed with it, the first Creative Testbed successes showed that the toolkit itself was being considered as a product by stakeholders. Requests to ship the entire #MusicBricks toolkit have come in from organisations including Spotify, Sonos and NYU.

5.6.2.A four-layer Open Innovation Ecosystem

The #MusicBricks Innovation Ecosystem grew organically when it was recognised that some of the incubated projects have potential to become a Product-as-Platform for Creative Content.

This resulted in a new **Four Layer Open Innovation Ecosystem,** where each layer has the potential for monetisation:

1) **Components Toolkit**
2) **Production Prototypes**
3) **Product as Platform**
4) **Creative Content**

5.6.3.The first transversal experiment

At the Creative Testbed events #MTFCentral and Music Hack Day Vienna a unique **Transversal Experiment** was undertaken through Music Tech Fest's partnership with Philips and the incorporation of Hue lighting developer kits. This led to new innovation proposals in sound and light for therapy, communications and performance, incorporating generative sound and light (for more information see section 2.8).

5.6.4.A transversal heavy industry application

Despite the seed industry of Music Technology and its key partner creative industries of Gaming and Entertainment, **#MusicBricks Transversal Applications** now incorporate sectors including Health, Lighting, Communications and Lifestyle though initiatives such as the Philips Transversal Experiment.

Furthermore, additional target beneficiaries are emerging such as Forestry and Agriculture as #MusicBricks-developed interfaces seek to revolutionise heavy industry sectors. More information about the latter will be available with the first #MusicBricks product patent registration as mentioned in section 2.4.
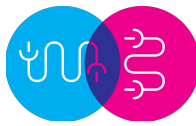
6. Conclusions

The case studies reveal how the Creative Testbeds have allowed for extensive knowledge gathering through the methodologies observed and developed during the course of the creative idea-generation activities. Target stakeholders thrived in the motivational and inspiring collaborative environment provided by the innovation hackathons, underpinned by the #MusicBricks partner teams.

In addition, beneficial results have been registered through the gender and background mix of audience and stakeholders, partner / stakeholder knowledge transfer and the spread of the tools.

Impacts from the #MusicBricks Creative Testbeds have been multi-faceted and far-reaching; significant exposure has been registered on social media, as well as substantial impacts demonstrated on economy through the advancement and expansion of the toolkit with new industry additions, the development of 11 working seed prototypes and one patent.

Further gains have been made in research through papers and publication contributions, and in policy through the adoption of new #MusicBricks methodology guidelines.