

#MusicBricks

PUBLIC REPORT



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1. Context and objectives

#MusicBricks brings top academic research to market using a unique creative methodology. The aim is to transfer state-of-the-art ICT to Creative SMEs in order to develop novel business models. The methodology has three main components:

- #MusicBricks bundles new technologies into a **toolkit** that can easily be used by hackers and makers in order to create and develop new kinds of products, performances and processes.
- #MusicBricks **seeds ideas** at Creative Testbed events, **incubates** the successful projects to commercial prototype in Industry Testbeds, and **showcases** them to investors and commercial partners at Market Testbeds.
- #MusicBricks **reconfigures the commercial framework for innovation** by developing a new layer of intellectual property, and by using new guidelines based on Market Adoption Readiness Levels (MARLs).

This methodology provides an agile and rapid development framework that situates creativity at the centre of innovation. It brings different skill sets and expertise together through a shared interest in music, and provides a context in which collaborative making is encouraged and reinforced. #MusicBricks uses the fact that creativity, making and music function as a social glue that joins together people from different backgrounds: artists and scientists; academia and industry. The fertile ground for new types of products, processes and performances that this creates provides a template for innovation across all industry sectors. It also provides a model for new types of education and research, as the rapid knowledge transfer that results from combining different ways of thinking in practical and collaborative projects allows for models of learning that are suited to the contemporary context and technological environment.

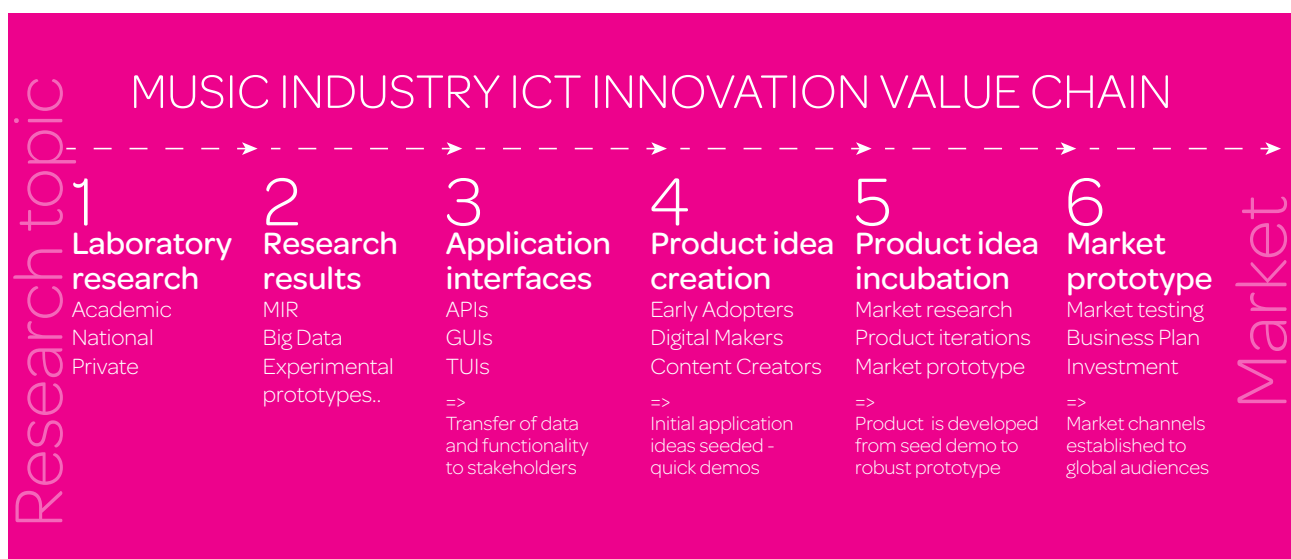


Fig 1: The Music Technology Value Chain



1.1.Context

There are two major gaps in the Music Technology Value Chain that hinder innovation (see Fig.1). Music technology research is not finding its way into the hands of creative developers, inventors and SMEs who can turn that knowledge into products for the market. There is also no clear route for innovative creative music technology applications from SMEs out to the wider industry, to investors and arts funding organisations.

The #MusicBricks project took the data and technologies created as a result of research within academic institutions, and wrapped them into Application Programming Interfaces (APIs), Graphic User Interfaces (GUIs) and Tangible User Interfaces (TUIs). The project incentivised the use of these APIs, GUIs and TUIs outside of the academic environment by engaging creative developers and artists from the music technology community in a series of Creative Testbed hack events and then incubating the best ideas that emerged in that context. Those ideas were developed into commercial prototypes that could then be channeled to global markets by facilitating industry partnerships, investment or arts funding at a Market Testbed event.

In so doing, #MusicBricks successfully closed gaps in the music technology value chain and created a seamless transfer of knowledge and novel ICT technology to European Creative SMEs in order to boost their business potential, with a built-in feedback loop to guide future research, boosting knowledge and developing skills within the community, as well as generating new knowledge and statistics to inform future policy.

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 2: #MusicBricks Fast Track to Innovation demonstrated by project Dolphin

And on the MiMu gloves ... the ingenious devices helping disabled musicians to play again

How can a trumpeter paralysed from the neck down play music again? With a little help from tech. Meet the players whose careers have been reignited by the HiNote, the Headspace and the Quirkitar



Fig 3: #MusicBricks Hi Note project features prominently in the Guardian newspaper in the UK on the 27th of May 2016 (<http://bit.ly/hinotepress>)

a) Socio-economic context

The #MusicBricks methodology was generated in response to a particular socio-economic context. In recent years the global music industry has been revolutionised by EU music technology innovation, increasing the volume of music streaming, social platforms, creative applications and novel business models. The junction of music and technology has created a unique phenomenon in Europe. Unlike other sectors where large industry players lead the way in ICT exploitation, in the music industry sector the revolution has been led by innovative music technology SMEs, with global successes such as Spotify, Deezer and



SoundCloud leading the way for hundreds of successful startups. Europe is the world leader in music technology SMEs, and these attract considerable international investment.

While large music industry corporates resisted ICT innovation for a very long time and struggled to keep their business sustainable and to digitise vast collections of music, the above SME successes have shown that music technology innovation is contributing to greater citizen engagement and novel business models. The success led by European SMEs has brought a notable shift in the music industry's global strategy, its aims and objectives. The music industry focus has been fixed on digital innovation.



Fig 4: #MusicBricks Final Market Testbed; pitching session introduced by Eric Wahlforss, Co-Founder and CTO of SoundCloud as part of the Music Tech Fest Berlin 23-30 May 2016

b) Innovation context

As an event which unites the music industry with the entire music technology ecosystem, Music Tech Fest has expanded from Europe into a global music technology network with events currently running across several continents. By developing methodologies that nurture creative collaboration, ideas seeding and incubation, Music Tech Fest has demonstrated the value of joining academia and industry, as well as art and science, in a collaborative platform. However, it had been apparent that despite the enthusiasm shown by large numbers of music technology stakeholders and the willingness to join forces, the value chain from academic research innovation to SMEs and large music industry corporates remained fragmented. In both Music Tech Fest and the more developer-focused Music Hack Day, major gaps prevented excellent research from Europe's leading music



technology centres from reaching creative SMEs that could use them in music industry applications; and made it difficult for innovative ICT applications to find their way from creative music technology SMEs to the attention of large music industry corporations, investors, and arts funding organisations.



Fig 5: Final Market Testbed at Music Tech Fest Berlin 23-30 May 2016 - presentations on the main stage. ©Johan Wallen 2016



1.2.Objectives

At the heart of the Music Tech Fest and Music Hack Day innovation activities, the central objective of the #MusicBricks project was to close those gaps in the music technology value chain and create a channel for those connections to be formed, with Creative SMEs situated as the primary catalysts for innovation, built upon European technology research.

Not only did #MusicBricks succeed in closing those gaps, it also exceeded expectations in areas where objectives had not even been set. The project achieved a much higher degree of success because the methodology did not simply provide a route for a piece of research to find its way to market, but rather provided the context for a multiplicity of unanticipated results. #MusicBricks provides a platform for rapid knowledge transfer. The interoperability of the tools themselves provides for a wide array of combinations and ideas that might otherwise have been unachievable. The 11 new startup ideas and inventions that were selected to be brought to market are diverse and impact on industry sectors other than music and media entertainment.

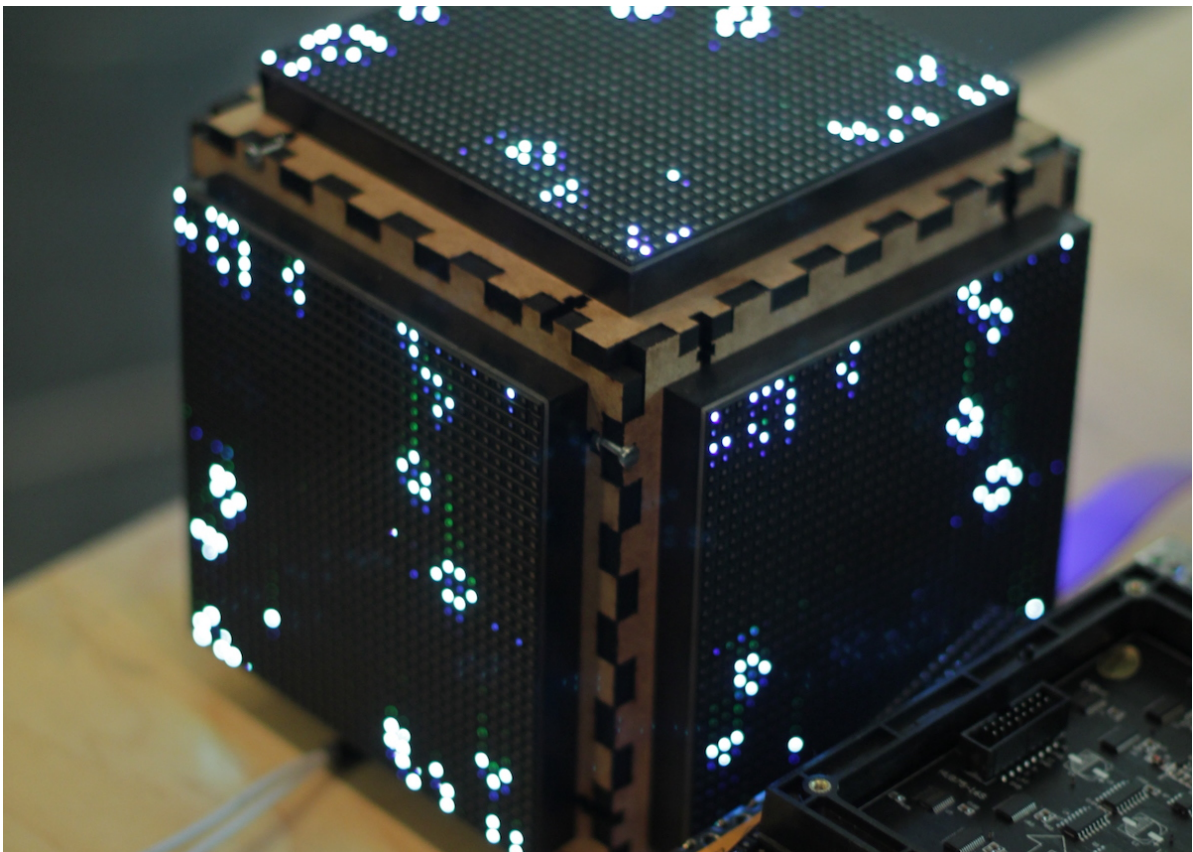


Fig 6: Industry Testbed; Interactive Cube prototype. ©Filip Koludrovic 2016

Ten of the prototypes were presented at the Final Market Testbed where incubatees pitched their prototypes to investors and industry, and showcased their projects to early adopters and technology enthusiasts. In addition, following the final Market Testbed, the



establishment of #MusicBricks as a limited company ensures several exploitation routes for the knowledge, experience, methodologies and products developed and tested during the project, as well as sustainability after the end of the European project timeline.

Results of the #MusicBricks methodology
Deployment of academic research to market;
Creation of a large number of promising creative SME startups;
Provision of a template for innovation across a wide range of industry sectors;
Establishment of a pedagogical framework for rapid knowledge transfer;
Introduction of a new layer of intellectual property for Innovation;
Creation of new business models and routes to market;
Establishment and documenting of a rich and creative Innovation Ecosystem;
Implementation and testing of new Market Adoption Readiness Levels for fast, iterative project development, early deployment, engagement with early adopters, and measuring data yield.



2. Work performed and results

#MusicBricks brought together key music technology research outputs from academic and research partners IRCAM, UPF, TU Wien and Fraunhofer IDMT and created a series of tools that could be easily deployed within creative testbeds, combined and developed into new projects, products and prototypes by makers, hackers and creative technologists.

As a series of APIs, GUIs and TUIs, the research excellence from top European institutions was brought outside the realm of academia to be integrated with current music technology innovations in the commercial realm in order to create innovative products and applications. The #MusicBricks methodology made the transfer from research knowledge to developer deployment more effective by embedding it within an existing growing multidisciplinary community.

2.1. APIs, GUIs and TUIs

At kick-off, partners planned to deploy 8 tools to the #MusicBricks Creative Testbeds. One of these tools was an innovative new Tangible User Interface for gesture-driven low-latency applications, and 7 were Application Programming Interfaces which wrapped existing tools and technologies together from within the world of music tech research in order to create specific 'bricks' that could be deployed in combination with others to make new hybrid applications. The first set of 8 tools was deployed by Month 5 of the project in time for the first Creative Testbed.

By Month 9 of the project, following the rising popularity of the #MusicBricks toolkit among developers and innovators, 2 further APIs were added by industry partners who contributed their IP stating that #MusicBricks added value to integration and deployment of their tools. A further industry IP - a data-driven Graphic User Interface - was released under MIT licence and embedded into the toolkit by Month 10. Several industry requests for addition of their tools were rejected due to their restrictive licences, however by the end of the project a further industry API, an industry GUI, and two further partner tools were added, making the total 15 tools in the #MusicBricks toolkit. Several original tools were amplified with further features in response to the requests from developers and innovators, and an official cloud platform has been accepted for #MusicBricks-driven innovations.

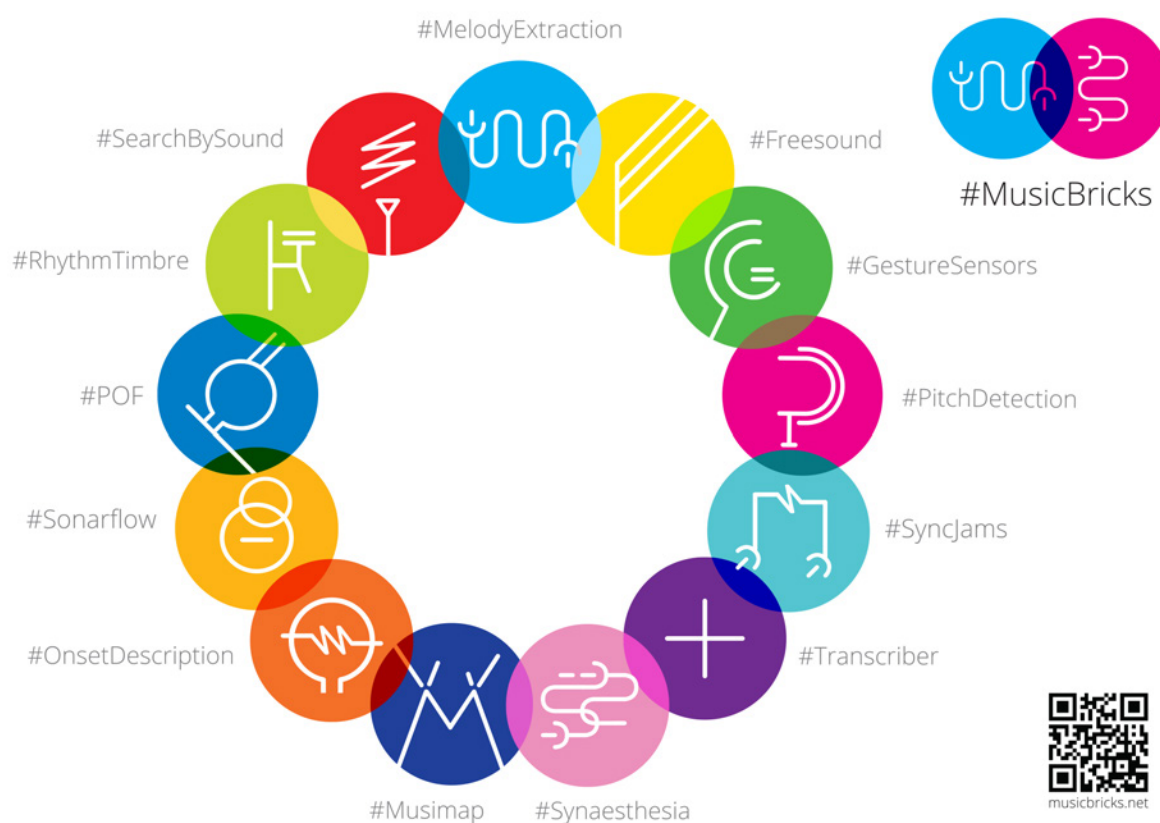


Fig 7: The #MusicBricks toolkit expanded from 8 original tools derived from European research, to 15 tools including industry IP (musicbricks.net/toolkit). ©Stromatolite 2016

2.2. Products and applications

The #MusicBricks toolkit was embedded in the existing innovation ecosystems specifically around the Music Tech Fest and Music Hack Day communities and benefitted from these large and growing ecosystems by accessing some of the top global innovation minds.

Deployment through existing growing networks of creative developers, makers and innovators at Music Tech Fest and Music Hack Day ensured early adoption and engagement with the APIs, GUIs and TUIs to a much greater extent than anticipated. The tools were so popular that partners were unable to fulfil demand at events such as Music Hack Day at the Sonar Festival in Barcelona. The tools were successfully embedded in these communities and capitalised on the substantial numbers that these events attract, but as the tools became popular they also contributed to the overall growth of the innovation community.

The Creative Testbeds at hack events provided fertile ground for the seeding of ideas and attracted a variety of experts from different areas of activity, porting knowledge from music

technology research centres to this community, but also joining the dots between the various areas of knowledge that the innovators brought to the testbeds.



Fig. 8: Winner of the Ars Electronica STARTS Prize Honorary Mention 2016: Neurofeedback combines with audio-visual feedback and generative music in the #MusicBricks-incubated #FindingSomethingBondingSound.

In order to encourage the creation of new IP on top of Research IP provided by the research partners, the Consortium Agreement was re-written to include a new area of Innovation IP, and so enabled the innovators to take ownership of their layer of IP. In one case this resulted in a patent search conducted just 4 months after the innovation seed idea. Partners agreed on licensing the tools in ways that supported and encouraged Open Innovation (mostly MIT licences), and commercial licences were offered under fair and reasonable conditions. Fast knowledge transfer was incentivised through the organisation of testbeds and direct engagement from the project's research engineers. This combined with micro-funding to ensure further prototype development.

New business models were incentivised through early exposure to audiences, partners and investors, business mentoring and active brokering of industry and investor partnerships.

Micro-funding ensured that the potential of valuable seed ideas was developed and exploited. However the largest investment was in technological support from #MusicBricks research engineers which ensured fast knowledge transfer and robustness of prototypes.



The combination of prompt funding and readily available knowledge support ensured a fast track to innovation with first results registering only 4 months after the first seed ideas.

11 new creative and commercial ideas were established at the Creative Testbeds. These ranged from performance concepts and new musical interfaces to tools for musicians with physical disabilities and gesture-driven collaborative remix applications (<http://musicbricks.net/projects>).

#MusicBricks creative and commercial projects	
Aistrument	an interactive instrument that allows a performer to improvise and create music using hand gestures
Dolphin	a wearable device that drives menus and applications in response to head movement
Enboard	a generative audiovisual experience which responds to speed and gestures of skateboarders
#FindingSomething BondingSound	a neurofeedback and audiovisual application for artists and scientists using EEG Brainwave reading technology as well as movement sensors
GIRD	a gesture-based interactive audio and lighting system that allows audiences to remix, explore and interact with music and lights through dancing and movement
Hi Note	a new accessible musical instrument which allows for highly sophisticated music making by musicians with severe accessibility needs
Interactive Cube	a physical interface for manipulating sound and a DIY kit for enthusiasts, education and professional customisation
Lightbeat	a music visualisation that controls a lighting system in real time in public and commercial environments
Manuphonia	a wearable instrument and app that creates music from movements and gestures for education and play
Snitch	a Bionic ear to help musicians get in tune and jam with others in the right key and tempo
Sound in Translation	a new way to collaborate and remix live by creating a system that responds intuitively to a performer



Fig 9: Final Market Testbed; Matan Berkowitz showcases Aistrument ©Filip Koludrovic 2016

The developers of the projects were incentivised to further develop their application or product with microfunding and mentorship from the #MusicBricks programme in an Industry Testbed.

The Industry Testbed lasted for a period of 3 to 5 months and ensured development from the 11 seed ideas created in 24-hour sprints at the Creative Testbeds to 11 advanced prototypes which could be taken to the Final Market Testbed. Industry mentoring, partnerships and investors were engaged long before the Final Market Testbed and in many cases followed the prototype development. Each incubated team benefitted from different links and inputs on a case by case basis.

Partners monitored and conducted regular interviews with incubatees at each of the Testbeds, which resulted in valuable feedback which informed the further development of the toolkit. Following the gathering and analysis of data, research teams were able to re-evaluate their tools, and introduce additional features or upgrades. At the final event for the project, incubated teams presented their products to potential customers and pitched to investors - the final step in bringing the original academic research outputs to market. As a result of the project, the #MusicBricks toolkit and methodology has established a viable route to market, closing the gap between academia and industry, and beyond the life of the funded project, #MusicBricks has been established as a Limited Company and will enable industry partners to continue to contribute toolkit components to this open platform for innovation.



2.3. Achievements

At the end of 18 months of the project, partners, incubatees, and the wider Innovation Ecosystem which has gathered around the #MusicBricks toolkit can measure the following tangible impacts on industry, the arts, research, IP and policy.

Patents and Awards

Type	Date	Owner/Receipient	Description	Awarding body
Patent	11 May 2016	Dolphin Project	Swedish Patent Application No. 1650637-0 filed - "Headphone system"	Swedish Patent Office
Award	11 May 2016	#FindingSomething BondingSound	Ars Electronica STARTS 2016 Prize Honorary Mention	Ars Electronica
Award	23 May 2016	#MusicBricks Innovation Director Michela Magas	Innovation Luminary for Creative Innovation	European Commission and Intel Labs Europe

Newly formed companies

Country	Date	Owner	Company registration	Number
Sweden	29 December 2015	Dolphin project team	Sojaner AB	559043-9195
UK	13 January 2016	Stromatolite LTD	MusicBricks LTD	9949460



Tools in the #MusicBricks toolkit

The number of tools in the #MusicBricks toolkit has increased from the 8 tools originally planned to 15.

#MusicBricks toolkit	
Tangible User Interface	1
Application Programming Interface	12
Graphic User Interface	2
Industry partner IP	5
Batch tested for commercial production	1
Industry partner cloud platform support (SoundCloud)	1

New products

11 #MusicBricks product prototypes were completed.

#MusicBricks product prototypes	
Market-worthy ideas	11
Technically-proficient prototypes	10
Performance tools	8
Business plans targeting gaming industry	3
Targeting heavy machinery industry	1
Targeting extreme sports	1
Targeting the health sector	1
Testbeds for scientific research	5
Released as an Android mobile application	3
Presented as Open Source software on GitHub	3
Tools for music and technology education	2
Targeting children's education	1
Software as a Service	1
Filed a patent	1



Exploitation opportunities

Several new layers of exploitation opportunities have been identified during the course of the project with the increase of adoption and the growth of the #MusicBricks Innovation Ecosystem.

Layers of exploitation opportunities
Exploitation of the knowledge generated within European research institutions;
Exploitation of the #MusicBricks tools themselves;
The addition of new bricks to the toolkit from external third parties;
Exploitation of the toolkit as a commercially exploitable Innovation Ecosystem;
Exploitation of the 11 innovative startup product ideas;
Implementation of those products as platforms in themselves; and
Exploitation of the Creative Content generated for those platforms.

Social media and community

Social media and community figures	
Impacts of the #MusicBricks hashtag (M9)	1449745
Impacts of the #MusicBricks hashtag (M18)	5474559
Likes on #MusicBricks Facebook page	1249
Number of posts on #MusicBricks Facebook page	113
Likes on Music Tech Fest Facebook page	3174
Number of #MusicBricks related posts on MTF Facebook page	96
Email newsletters sent using the Music Tech Fest mailing list	34
Music Tech Fest mailing list subscribers used for dissemination	4769
Mailing list growth during #MusicBricks project	1226
Website page views	123468
Unique website visitors	33399

**Presentations and performances**

The project has so far featured in 68 public presentations and performances, 27 of which were by project partners and 41 by incubatees. These presentations have included participation at the following 34 conferences and industry events.

Name	Project / Tool	Conference	Session
Michela Magas (Stromatolite)	#MusicBricks	Open Innovation 2.0 2015 Espoo, Finland	Crowdmaking", part of the 'What does Open Innovation 2.0 mean in practice?' industry track
Michela Magas (Stromatolite)	#MusicBricks	Open Innovation 2.0 2015 Espoo, Finland	What does Open Innovation 2.0 mean in practice?' - public sector track
Michela Magas (Stromatolite)	#MusicBricks	Open Innovation 2.0 2015 Espoo, Finland	The Internet of Things" special session
Cárthach Ó Nuanáin, Martin Hermant, Ángel Faraldo and Daniel Gomez	Snitch	ISMIR, Malaga, Spain	The Ear: Building a Real-Time MIR-based Instrument From a Hack
Michela Magas (Stromatolite)	#MusicBricks	ICT2015 Conference - Lisbon, Portugal	Main Stage
Michela Magas (Stromatolite)	#MusicBricks	ICT2015 Conference - Lisbon, Portugal	Music Creativity Workshop
Michela Magas (Stromatolite)	#MusicBricks	ICT2015 Conference - Lisbon, Portugal	STARTS
Michela Magas (Stromatolite)	#MusicBricks	ICT2015 Conference - Lisbon, Portugal	The innovation revolution: Creativity & Arts in ICT
Michela Magas (Stromatolite)	#MusicBricks	European Culture Forum 2016 - Flagey, Belgium	Can culture help re-launching economic growth?
Michela Magas (Stromatolite)	#MusicBricks	Net Futures 2016 - Brussels, Belgium	Closing speech with Commissioner Günther Oettinger
Michela Magas (Stromatolite)	#MusicBricks	Innovation Luminary Awards, Open Innovation 2.0 2016, Amsterdam, Netherlands	
Frederic Bevilacqua (Stromatolite)	R-IoT	SONAR Innovation Challenge, Barcelona, Spain	
Frederic Bevilacqua (Stromatolite)	R-IoT	SKAT-VG, Chateau la Coste, France	
Marta Arniani (Sigma Orionis)	#MusicBricks	NEM General Assembly, Frankfurt, Germany	



Name	Project / Tool	Conference	Session
Tracy Redhead	GIRD	Integra Labs, Birmingham, UK	
Frédéric Bevilacqua (IRCAM) and Jordi Janer (UPF)	#MusicBricks	Compute Human Interaction Conference 2016, San Diego, USA	
Juan José Bosch	Sound In Translation	BLE&Music (Barcelona Loves Entrepreneurs), Barcelona, Spain	
Frederic Bevilacqua (IRCAM)	R-IoT and #MusicBricks	The Music Innovation Expo MEDIMEX, Bari Italy	
Gaël Dubus (IRCAM)	R-IoT and #MusicBricks	Media Technology and Interaction Design, KTH, Stockholm, Sweden	
Matan Berkowitz	Aistrument	Re:Publica 2016, Berlin, Germany	
Steffen Holly (IDMT)	#MusicBricks	Re:Publica 2016, Berlin, Germany	
Xico Teixeira	FindingSomething BondingSound	TEDx Porto, Portugal	
Steffen Holly (IDMT)	#MusicBricks	SXSW, Austin Texas, USA	
Michela Magas (STRO)	#MusicBricks	TEDx Umeå, Sweden	
Michela Magas (STRO)	#MusicBricks	Sleep Talk Umeå, Sweden	
Michela Magas (STRO)	#MusicBricks	Re:Publica 2015, Berlin, Germany	
Thomas Lidy (TUW)	#MusicBricks	Music Technology and Innovation Meetup	
Tracy Redhead	GIRD	Art of Record Production Conference, Denmark (forthcoming December 2016)	
Tracy Redhead and Jonathan Rutherford	GIRD	Wired Berlin, Germany	
Juan José Bosch, Timothy Schmele, Andrés Bucci	Sound In Translation	Horizontal, Barcelona, Spain	
Timothy Schmele	Sound In Translation	Algorave, Berlin, Germany	
Matan Berkowitz	Aistrument, #MusicBricks	Experiencia Endeavor, Buenos Aires, Argentina	
Matan Berkowitz	Aistrument, #MusicBricks	Forbes Magazine 30 under 30, Tel Aviv, Israel	
Kristjan Sešek, Adrijana Bundalo, Rok Milošič, Terhi Martilla, Ernest Beličič, Maya Lekova	Manuphonia #MusicBricks	Munich Maker Faire 2016	



Scientific papers and publications

Several academic papers and two book chapters were generated from #MusicBricks results.

Scientific papers and publications	
1	Lidy, T., Schindler, A., Magas, M. 2015. MusicBricks: Connecting Digital Creators to the Internet of Music Things, <i>ERCIM News</i> [online] 101. Available at: http://ercim-news.ercim.eu/en101/special/musicbricks-connecting-digital-creators-to-the-internet-of-music-things Accessed 16 July 2016.
2	Lidy, T., Schindler, A. 2015. Klingende Bausteine für die Industrie, <i>OCG Journal</i> [online] 2. p17-18. Available at https://www.ocg.at/de/2015 Accessed 16 July 2016.
3	Dubber, A. 2016. "You have 24 hours to invent the future of music: music hacks, playful research and creative innovation". In: Wikström, P. & DeFillippi, R. eds., <i>Business Innovation and Disruption in the Music Industry</i> . Cheltenham: Edward Elgar Publishing. pp 211-228.
4	Arniani, M. 2016. "Technology, Citizens and Social Change in the Framework of European Research and Innovation Programmes: Towards a Paradigm Shift" in GOODTECHS 2015 Conference Proceedings, European Alliance for Innovation (forthcoming).
5	Ó Nuanáin, C., Hermant, M., Faraldo, A., Gomezhe, D. 2015 "Eear: Building a Real-Time MIR-based Instrument From a Hack", Extended abstracts for the Late-Breaking Demo Session of the 16th International Society for Music Information Retrieval Conference, 2015, available at http://ismir2015.uma.es/LBD/LBD29.pdf , Accessed 16 July 2016.
6	Bevilacqua, F., Schnell, N., Françoise, J., Boyer, E., Schwarz, D., Caramiaux, B., "Designing Action–Sound Metaphors using Motion Sensing and Descriptor- based Synthesis of Recorded Sound Materials" in <i>The Routledge Companion to Embodied Music Interaction</i> Edited by Micheline Lesaffre, Marc Leman, and Pieter-Jan Maes
7	G.Dubus, E. Flety, R. Borghesi, F. Bevilacqua, "A tutorial on motion data processing for real-time expressive interaction with media using Inertial Measurement Units" in <i>Sensors</i> (forthcoming)



Policy and IP guidelines

Policy advisory and guidelines		Body
1	Market Adoption Readiness Levels (MARLs) were developed for CAF recommendations for H2020 Programme 2016/17 from Section 2.1.2 of the #MusicBricks project proposal.	CAF
2	MARLs were adopted in the set of EU recommendations by the Innovation Ecosystems Work Group of the Alliance of Internet of Things Innovation in January 2016.	AIOTI
3	MARLs feature as the top 3 recommendations for Innovation in the CAF recommendations for the H2020 Programme 2018-2020.	CAF
4	#MusicBricks Innovation Methodologies feature in multiple CAF recommendations of the Innovation Working Group for the H2020 Programme 2018-2020.	CAF
5	The article <i>7 ingredients to build a successful Innovation Ecosystem</i> focusing on #MusicBricks Innovation Methodologies was published on the 30th of March 2016 as the editorial of the OISPG newsletter on the the European Commission Digital Single Market portal (https://ec.europa.eu/digital-single-market/en/news/welcome-oispg-newsletter)	OISPG
	A new layer of Innovation IP was developed for the #MusicBricks Consortium Agreement. This document is now available as reference for other ecosystem building Innovation Actions.	EC
6	#MusicBricks is referenced as best practice in 11 EU presentation documents	EC



Fig 10: #MusicBricks enabling “music as extension of the human body” with Viktoria Modesta at the Final Market Testbed, Music Tech Fest Berlin 23-30 May 2016.



2.4. Work performed January 2015 - June 2016

#MusicBricks was divided into seven separate work packages that managed each aspect of the process involved in meeting the project's objectives:

- WP1: Management
- WP2: Communication, Dissemination and Exploitation
- WP3: Application Programming Interfaces (APIs)
- WP4: Creative User Interfaces (GUIs/TUIs)
- WP5: Creative Testbed: seeding of ideas through creative engagement
- WP6: Industry Testbed: ideas incubation in industry environments
- WP7: Market Testbed: facilitating routes to global markets

Work Package 1

WP1 was aimed at coordinating consortium members in the smooth implementation and reporting of the activities described in the DoA. The objectives of the work package included administrative tasks such as ensuring the compliance with the Grant Agreement and the related reporting requirements, organisational support for project administration, meeting (?targets) and financial procedure, qualitative and support tasks like facilitating effective communication among partners, and ensuring the reach of project milestones and objectives.

It also included Innovation Coordination to monitor fast deployment of interfaces for use in events, wide dissemination to attract large numbers of innovators to the Testbeds, headhunting and selection of the best innovative minds to take on the testbed challenges, ensuring wide adoption of the tools in testbeds, choice of seed ideas with best potential for prototyping, evolution of prototypes and new business models, timely completion of prototypes and dissemination materials, early connections with industry stakeholders, ongoing support from research teams, and market-ready concepts for a fast track to innovation.

Through WP1 the following tasks were implemented:

- Administrative and financial management
- Consortium and review meetings
- Quality management and reporting

Work Package 2

WP2, led by Stromatolite, focused on Communication, Dissemination and Exploitation of the #MusicBricks project, of the toolkit and of the incubated teams. From the first creative testbed events, Stromatolite brought in commercial partners and brands to engage with



developers and makers by setting hack challenges that incorporated #MusicBricks tools, and invited industry experts to act as judges and mentors for the resulting projects.

Partners arranged for teams to meet with industry mentors face to face in their offices and encouraged mentors to connect incubatees with relevant members of their networks to foster further and faster growth from idea to market-ready realisation. Partners also conducted regular meetings with incubated teams, both in person and via Skype to monitor progress and to coach and guide incubatees. At the hack event at Sonar +D in Barcelona, Stromatolite deployed staff specifically to promote the #MusicBricks tools and encourage their use in the hack projects. Through active engagement with hackers, workshops and promotional activities and printed material including colourful laptop stickers indicating the brick(s) with which the hack team was working, partners were able to encourage much greater participation and uptake of the technologies.



Fig 11: Final Market Testbed; Fanni Fazakas of #FindingSomethingBondingSound working with Viktoria Modesta ©Maya Benainous 2016

New areas were added by Stromatolite to the final market testbed event to ensure that incubated teams and the toolkit itself were given the best opportunities to reach markets, connect with industry and investment and gain exposure to potential customers and



stakeholders - from academia to early adopters. The creation of the #MTFamplifier business networking and pitch event, the Startup Soundpit 'trade fair' area and the dedicated performance slots for #MusicBricks projects at the Music Tech Fest in Berlin, as well as the introduction of a market-facing hack challenge as part of the element14 24-hour Hack Camp ensured the maximum potential and impact for exploitation by the toolkit and the incubated projects.

In addition to the engagement with partners at the testbed events, Stromatolite focused on an intensive cross-media campaign that incorporated traditional press and PR strategies, direct mail, leverage of existing networks within partner organisations and social media promotion and community management.

WP2 activities were organised in the following tasks:

- Project branding and exposure
- Communication strategy
- Participation in external events and publications
- Organisation of dissemination events
- Exploitation

Work Package 3

Work Package 3 focused on enabling transfer of research results to creative developers and innovators in the form of several Application Programming Interfaces. End-users throughout the project were members of the creative communities that participate in prototyping (hacking and making) events. Participants of these events were mostly individuals with general technical and programming skills but not experts in audio or music technologies. Therefore the design of APIs focused on offering a clear and attractive functionality to target users, rather than present all possibilities of research algorithms.

Partners successfully identified and integrated various relevant and complementary technologies from the research partners (TUW, Fraunhofer, UPF) under the same umbrella. All technologies were widely used in the Creative Testbeds organised throughout the project. Feedback from creative users and hackers has allowed the improvement of certain aspects of the tools. For example, several users requested more real-time and easy to run tools.

WP3 activities were organised in the following tasks:

- Wrapping existing tools and technologies together
- Creating specific tool combinations for advanced features
- Extending the frameworks beyond the project



Work Package 4

WP4 was devoted to tangible and graphical interfaces in the context of real-time music interaction. As per WP3, end-users throughout the project were members of the creative communities, musicians and makers involved in hacking events for creating new instruments and objects. Typically, these targeted users are mostly individuals with limited expertise in electronics or in digital signal processing, yet willing to include advanced motion sensors in their prototypes. The goal of this Work Package was thus to facilitate the accessibility and the use of such tangible interfaces in these growing communities of makers, digital artists and musicians.

Partners produced guidelines, hardware and software solutions for the participants of the #MusicBricks events and incubations. Importantly, the project allowed partners to significantly improve their technology offer based on the feedbacks of the various users.

Specifically, the focus of WP4 was the invention of the R-IoT (for Real-time Internet of Things for Music), which became one of the most popular technologies during all the Creative Testbeds and beyond. Based on previous IRCAM interface development on wireless motion sensors, the R-IoT was consolidated as a compact wireless motion platform with specifications tuned for expressivity by focusing on low latency and high sensitivity. Moreover, the project allowed for developing an associated software environment enabling users to easily take advantage of such inertial motion units (accelerometers, gyroscopes, magnetometers).

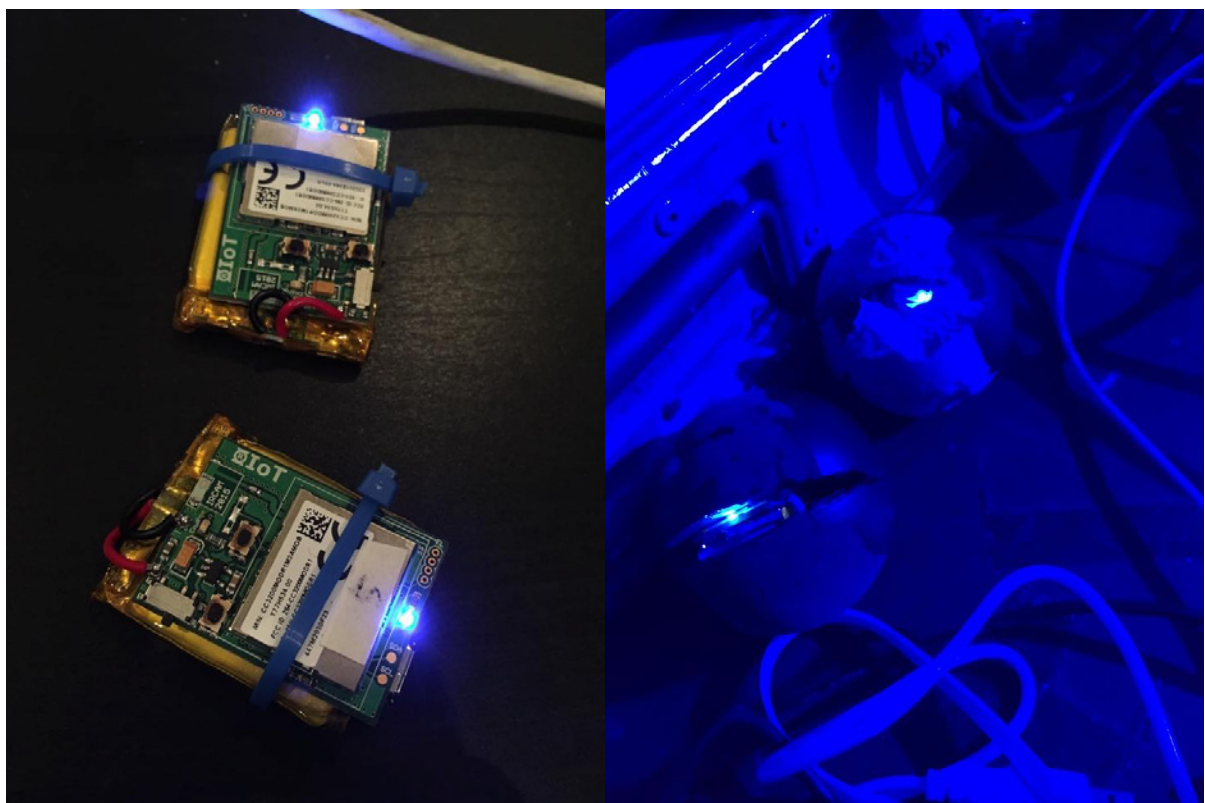


Fig 12: The R-IoT in use by Gadi Sassoon at the concert with Amon Tobin in London

WP4 activities were organised in the following tasks:

- Guidelines and specifications for low cost music TUI interfaces
- Music TUI Analysis and Rendering
- Music TUI Smart Mapping

Work Package 5

WP5 ensured early adoption of the #MusicBricks APIs, GUIs and TUIs at specially organised events which were designed to stimulate creation of seed ideas. The #MusicBricks project partners organised four core project activity events in order to disseminate the #MusicBricks toolset to the main target stakeholders and to allow for immediate and detailed observation and feedback on their use. Two of these events formed part of Music Tech Fest, an international festival and community of creative innovators; one event was held as part of Music Hack Day in Barcelona; and a fourth 'bonus' event at Waves Vienna.

At each event, hackathon participants have been given access to the #MusicBricks tools as well as to engineers able to answer related questions. The presence of industry partners setting challenges for the hackathons and sponsoring events allowed for projects to be developed that integrate the #MusicBricks tools with other technologies already available on the market. A jury made of consortium members and industry experts selected the ideas which best interpreted the challenges and made good use of the tools. The creators were offered the possibility of entering the #MusicBricks incubation phase, aimed at developing their idea into a market-ready prototype.



Fig 13: Creative Testbed experimentation with creative developers

The work was organised as follows:

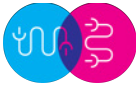
- The Creative Testbed: a series of community co-creativity collaborative disruptive creative engagement events
- Gathering of feedback and generation of new knowledge from the Creative Testbed
- Gathering of impact data and statistics from the pilot events

Work Package 6

The #MusicBricks consortium provided a total of 662 hours in assisting, communicating with, and mentoring the incubatees plus providing valuable support and feedback. This is not including the efforts to set up, prepare and coordinate the Industry Testbed within the #MusicBricks consortium. Additional effort was provided free of charge by numerous external advisors from music tech companies, and music industry players such as labels, and business advisors.



Fig 14: Horácio Tomé-Marques of #FindingSomethingBondingSound in prototyping mode ©Jasmine Isdrake 2016



All eleven incubated projects successfully completed the Industry Testbed presenting a final prototype and a video explaining the achievement and its usage and features. The mentorship provided by the consortium and partners helped the projects overcome some communication problems and blocker issues, so that all achieved their goals outlined in the initial roadmap. Several of the projects even progressed beyond their original roadmap and realized a prototype, already exhibiting more features than originally planned for the incubation period.

There was overwhelmingly positive feedback about the incubation process and mentoring, where the incubatees said they both learned and progressed a lot during the incubation period, thanks to the professional mentors. Even though funds were at a micro-funding level, incubatees were tremendously motivated and the results and outcomes are above expectations.

The work was organised as follows:

- Setting up and facilitating incubation residencies for the Industry Testbed
- Coordinating wrapper/tangibles to assist incubation development to prototype
- Recording Impact data from the Industry Testbed

Work Package 7

As part of WP7 members of the consortium identified the most prominent business opportunities from ideas which started by innovative seeding with little commercial thought. Through a process of iteration the incubated ideas were guided to develop towards the market, and to a stage where they could be assessed for business potential. Partners advised the teams on licensing issues and market research through workshops and individual consultations, and started to learn more about their possible target group and a potential business model.

It is a very positive sign that industry partners such as Abbey Road, Philips and Native Instruments are interested in future outcomes of #MusicBricks, and that the establishment of #MusicBricks as a Limited Company after the project end will enable industry partners to continue to contribute toolkit components to this open platform.



Fig 15: Tom Fox talks to Ben Heck about his winning IoT challenge using the #MusicBricks R-IoT at the element14 Hack Camp during the Final Market Testbed. ©Ben Heck Show 2016

The work was organised as follows:

- Developing a business strategy for the MI ICT Innovation Value Chain
- Engagement with global MI stakeholders and Global Markets
- Final Market Showcase

2.5. Mapping results

Objective 1: To leverage the excellence from research and capitalise on the current growth of the EU music technology sector

- Innovative technologies developed in 4 key EU research centres have been made available to innovators during 5 creative events;
- Results from research have been embedded in the growing music technology industry and ported beyond, transversally to other industry sectors.



Objective 2: To ensure early adopter market readiness at the point of large scale trials of the tools and data libraries generated through academic RTD in industry-relevant environments

- IP from research centres was wrapped into Application Programming Interfaces, Graphic User Interfaces and Tangible User Interfaces to enable access by innovative Digital Makers and Content Creators;
- Consortium members mentored creators during Creative and Industry Testbeds, receiving early adopter feedback, improving their tools and collecting new inputs for research;
- The addition of IP from industry exceeded the objectives of the action;
- Additional features and tools were developed by project partners in response to the market feedback.

Objective 3: To capitalise on the creative developer innovation ecosystems generated by the Music Tech Fest, NEM, and Music Hack Day global networks as a result of our initiatives

- #MusicBricks tools and challenges were widely promoted and disseminated to large innovator communities, particularly from the growing Music Tech Fest and Music Hack Day ecosystems, via social media channels, direct newsletters and through hands-on engagement during the events;
- #MusicBricks incubated projects were showcased during the events in order to further promote the tools and expose incubatees to investors and industry stakeholders
- The number of successful prototypes created has exceeded expectations.
- Community growth around the tools was higher than expected.
- Social impacts far exceeded expectations.

Objective 4: To incentivise the seeding of product or application ideas by early adopters of the technologies and in particular by the growing target groups of Digital Makers and Content Creators

- The Consortium Agreement was re-written to include a new area of Innovation IP, and in this way enable the innovators to take ownership of their layer of IP;
- Partners agreed on licensing the tools under licences that supported and encouraged Open Innovation;
- Testbeds gathered knowledge and expertise in one place;
- The availability of the project's research engineers ensured fast knowledge transfer;
- Micro-funding ensured further prototype development;
- Early exposure to audiences, partners and investors was enabled;
- New business models were incentivised through business mentoring;
- Active brokering of industry and investor partnerships was offered throughout.



Fig 16: Final Market Testbed: Incubatee teams in collaboration with Viktoria Modesta ©Peter Kolski 2016

Objective 5: To ensure that first creative application prototypes receive adequate resources and technological support to develop robustness and reliability for industry / performance trials

- The resources provided by #MusicBricks allowed incubatees to cover essential expenses and remain focused on developing the prototype;
- Partners provided a total of 662 hours of technical and strategic mentoring ensuring the focus was maintained and any arising challenges received immediate attention;
- The success rate at generating technically advanced prototypes has exceeded expectations.
- Market model development rates are surprisingly high at 100%. The addition of research applications and open models was not originally anticipated.

Objective 6: To support product, application or performance development into market prototype ahead of competition in a timely fashion

- Incubations lasted for a period of 3 to 5 months and ensured development from 11 seed ideas created in 24-hour hackathons to 11 advanced prototypes;
- In one case a patent search was conducted immediately after the launch of the presentable prototype, and the patent has since been filed;
- The speed of the Fast Track to Innovation far exceeded expectations.



Objective 7: To facilitate product, application or performance deployment by providing market-led testbeds and routes to partnerships, private and public funding

- Industry players have assisted selected incubatees in discovering new markets and devising novel business plans;
- 72 potential investors and partners participated in the final market showcase;
- 5 industry technologies have been added to the toolkit
- The numbers of engagements with industry have been higher than expected.

Objective 8: to enable market feedback to inform policy and influence future research directions

- Case studies were generated from interviews with incubatees from the Creative Testbeds, the Industry Testbed and the Final Market Testbed.
- At every stage of the process valuable feedback enabled research teams to re-evaluate their tools, and introduce additional features or upgrades.
- Several partners decided to invest in providing additional resources following market feedback.
- The objective resulted in several scientific publications and academic book chapters despite not being a Research Action.
- The objective had a considerable impact on policy and guidelines already at the beginning of the project. The results of the project have been presented at ICT2015, and have heavily influenced AIOTI recommendations for Innovation Ecosystems and CAF recommendations for Innovation. Guidelines and methodologies developed through this project can be clearly traced in recently adopted EC Innovation policies, as well as in future directions of the H2020 Programme.



3. Beyond the State of the Art and impacts

3.1. Technical innovation beyond State of the Art

#MusicBricks has provided engineering teams with the opportunity to gather direct feedback from creative users. For the research labs in the consortium specialising in music technology, it has been important to observe and get inputs also from outside the academic community. This type of feedback has been shown to be extremely useful for designing and improving the development of research tools.

An example is the audio analysis library Essentia developed by UPF. This library has been extended and adapted following some feature and other requests by the creative users. For example, the EssentiaRT~ modules (<http://mtg.upf.edu/technologies/EssentiaRT~>), which is a real-time implementation of the library, has been widely tested and used in the project hackathons. Additionally, a number of new sound synthesis algorithms have been added after requests from musicians and sound designers who wanted to use the library also to generate and process sounds (<https://github.com/MTG/essentia/tree/master/src/algorithms/synthesis>).

The important improvements to the readiness of #MusicBricks' tangible interfaces technology allows for a wide deployment of these technologies in several new communities beyond music technology. Specifically, the possibility of producing low-cost and compact wireless sensors such as the R-IoT enables creators to reach new markets and applications. In particular, these tools allow for new approaches in education, from school to higher education, for computing and science teaching. It is also anticipated that the fields of physical rehabilitation and sport training will benefit from such technologies that can be used to provide useful feedback to users on their movements.

The team at TU Wien translated the Rhythm Patterns music analysis library (<http://www.ifs.tuwien.ac.at/mir/musicbricks/index.html#RPextract>) to the popular programming language Python and provided it as an open source project (https://github.com/tuwien-musicir/rp_extract). Based on the feedback gathered during the incubation process, they optimized the runtime behaviour, enabled processing of live audio and extended the command line interface for improved configurability. To facilitate rapid prototyping, pre-trained models for genre classification have been provided. Further, questions asked by the incubatees have been accumulated into an improved documentation and online tutorials. The integration of the library into the Python Package Index (Pypi) has been prepared and will be completed in near future.

In response to feedback at hack events and by incubatees, Fraunhofer improved the usability and documentation of the provided #MusicBricks tools (<http://tinyurl.com/MusicBricksIDMT>). They have also delivered two additional tools to the programme, which



fill the gap between the existing tools. The first of these is the Real-Time Pitch Shifting library, a C++ library that allows for the pitch of audio material to be adjusted independently of the tempo. The other is the Goatify tool, an executable that automatically replaces the main melody in a song with a given sample. The tool is delivered with free sound samples (including that of a goat, hence the name) drawn from #MusicBricks partner UPF's Freesound tool (www.freesound.org). Inspired by the results from the testbed hack events, Fraunhofer organised an internal hackathon for engineers and scientists who would not normally interact in this way thus encouraging them to experiment using this methodology and explore novel ideas and possibilities. Fraunhofer has also developed a demo kit containing code samples and practical demonstrations of each of their tools for the use of developers and hackers.



Fig 17: Industry Testbed; Per-Olov Jernberg of Interactive Cube ©Ian Wallman 2016

3.2. Industry innovation beyond State of the Art

#MusicBricks has innovated a unique methodology of seeding ideas through creative testbeds, incubating through industry testbeds and taking to market through market testbeds. The project has not just demonstrated the efficacy of such a methodology, but has achieved results that exceed expectations.

One of the innovations of #MusicBricks that brings it beyond the State of the Art is that it creates a toolkit from cutting edge research that makes the individual pieces interoperable.



By combining the 'bricks' in different ways, new and unanticipated inventions can emerge, resulting in genuinely disruptive innovation that would not have been possible simply by attempting to take a single research output to market.

#MusicBricks has created guidelines for open innovation for business models. By embracing open development as a strategy for product improvement and dissemination, the project has demonstrated ways in which making tools for development available on platforms like GitHub could be leveraged as a commercial strategy for uptake, early user feedback and data.



Fig 18: The Dolphin project featured in an Swedish article on Infotech Umeå.

The project has discovered and documented seven potential layers of exploitation and routes to market. As an innovation ecosystem, the methodology not only fosters disruptive innovation and rapid knowledge transfer, but also creates a unique and entirely new business model with 7 layers:

1. Exploitation of the knowledge generated within European research institutions;
2. Exploitation of the #MusicBricks tools themselves;
3. The addition of new bricks to the toolkit from external third parties;
4. Exploitation of the toolkit as a commercially exploitable Innovation Ecosystem;
5. Exploitation of the 11 innovative startup product ideas;



6. Implementation of those products as platforms in themselves; and
7. Exploitation of the Creative Content generated for those platforms.

#MusicBricks has demonstrated that rather than simply providing a platform for new products in the entertainment sector, using creativity as the starting point for innovation has profound implications across all industry verticals. Inventions developed in a context that focuses on playful experimentation in the world of music and technology, can generate serious and disruptive innovation in other realms.



Fig 19: Final Market Showcase; Israeli incubatee Matan Berkowitz collaborating with Palestinian artist Ahmad Bakri on the main Music Tech Fest stage ©Steve Bowbrick 2016

3.3. Social innovation beyond State of the Art

#MusicBricks both represents and fosters the formation of Innovation Ecosystems. By bringing together academic research, creative development, market dissemination and industry expertise, the platform is a unique methodology that considers innovation to be a process that pools assets, resources and understandings.

#MusicBricks has employed an innovative approach to assessing readiness of the technologies, and making the transition from traditional Technology Readiness Levels (TRLs) to Market Adoption Readiness Levels (MARLs) that allow for low-risk technological



innovation, rapid market deployment, data and user feedback, and an iterative approach to development that yields powerful results at an early stage of development and reconfigures the relationship between consumers and manufacturers. The feedback loops engage early adopters to help shape the new products and services, leverage social interaction and make use of the expertise of the community that may lie beyond the development team.

In order to incentivise creative developers, the consortium has created an entirely new layer of intellectual property that can be deployed across a range of other projects and programmes. By adding Innovation IP to the existing Background IP and Research IP, projects may take the results of academic research to market in a way that fairly reflects the creative work contributed by the development team of hackers and makers who invent the market-facing application or product from the original research outputs.

The #MusicBricks project situates music as a "social glue" that brings together people with different expertise, specialisms and backgrounds in a context of shared understanding, where otherwise they might not have had occasion to work together or even meet. The methodology calls for complementary skillsets, interdisciplinarity and hands-on problem solving, resulting in rapid knowledge transfer and a common ground for practical collaboration.

3.4. Impact on academic and marketing research, and policy makers

Innovation Actions are short and output oriented projects, focusing on activities directly aiming at producing plans and arrangements or designs for new, altered or improved products, processes or services. For this purpose they may include activities such as prototyping, testing, demonstrating, piloting, large-scale product validation and market replication.

The #MusicBricks project has worked as an open innovation framework connecting research, market and policy making: the project activities led not only to the development of sound prototypes leveraging European music technology R&D excellence, but also to the establishment of an Innovation Ecosystem which is made sustainable after the end of the EU grant by the #MusicBricks company and the Music Tech Fest and covers the whole spectrum from research to market and policies, demonstrating how the three cannot operate in silos.

#MusicBricks testbeds provided consortium researchers with valuable feedback from early adopters involved in the testbeds. By making tools developers and adopters part of the same community, #MusicBricks enabled the opening of new R&D perspectives and confirmed assumptions such as the necessity of having tools working in real-time. On the other hand, some of the incubatees were coming from research and their work on prototypes suggested new research directions.



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.

#MusicBricks incubatees Horácio Tomé-Marques and Francisco Marques-Teixeira have further developed their ideas at the intersection of arts and neuroscience, and have been successful in their application for European funding for Neurobica. The Neurobica project aims to create an integrated system of devices available via internet for brain enhancement through training of cognitive skills. Through a system of digital "serious games" and neuro-enhancement through remote neurofeedback Neurobica proposes a breakthrough in home brain training that combines creativity and cutting-edge scientific research.

The MARLs guidelines and #MusicBricks methodologies have been presented in key policy making arenas such as the AIOTI (Alliance for Internet of Things Innovation) and CAF (CONNECT Advisory Forum), as well as events like ICT2015, the largest ICT conference in Europe, the NEM Summit, European Culture Forum and Net Futures 2016.

3.5. Impact on new business models for the music industry

Deployment of the #MusicBricks toolkit, which assembled the technologies produced by research partners, had a considerable uptake by creative developers and a high product yield, but it also created the additional impact as a valuable dissemination and exploitation vehicle for external industry stakeholders who requested to add their IP to the suite. Industry players acknowledged the value of early contact with #MusicBricks adopters, followed closely the evolution of individual projects, and observed with interest the new business models presented at the Final Market Testbed.

Although it is too early to report the long-term market performance of incubated projects, valuable tendencies have been observed during the testbeds: music technology does not necessarily find an application only in the music industry, but can be applied successfully to other sectors and develop alternative business models in a variety of industry verticals. The hands-on and collective components characterising the testbeds suggested the development of products as toolkits and the assignment of an active role to users in evolving the product.

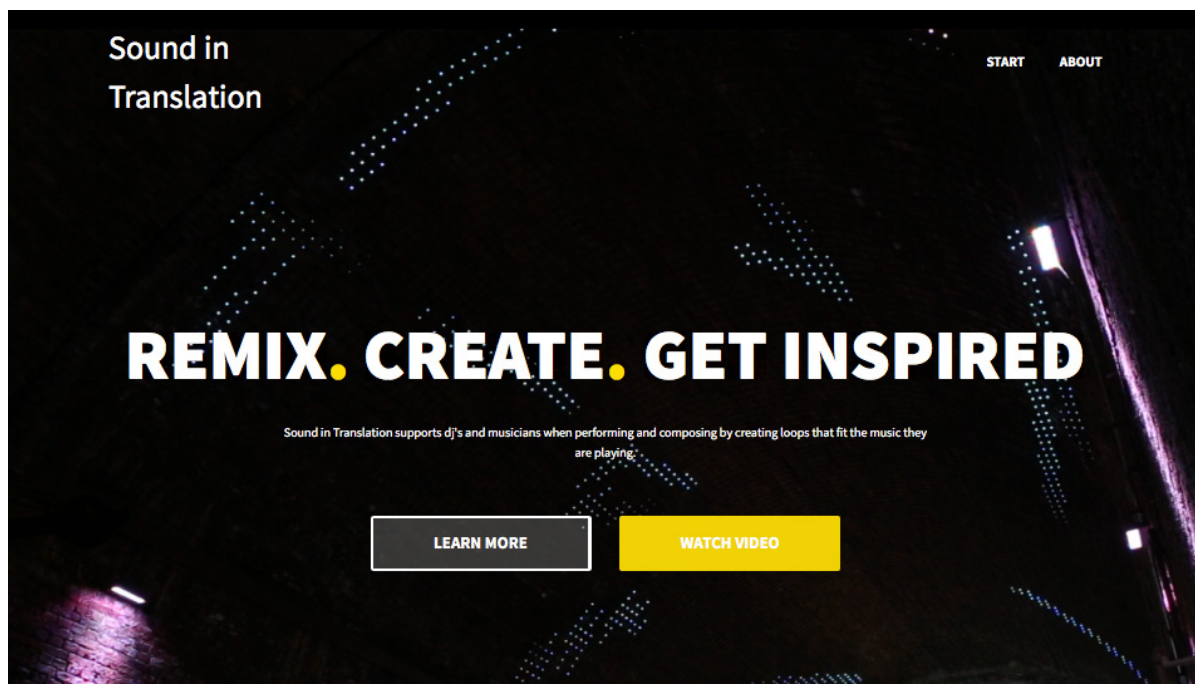


Fig. 20: The Sound in Translation product website

Experimentation with music technologies provides a very good test case for a wide variety of industry pilots. As expressed by Michela Magas (STRO) in her article “7 ingredients to build a successful innovation ecosystem” published as part of this project: “...it thrives on big data; it relies on cloud services; it attracts communities; it provides fast feedback loops for experimentation; it allows for quick prototyping and cheap testing of technology ideas; and it allows to port tested ideas successfully to other industry verticals”.

The tangible value of the project is not only in a growing toolkit of actual tools, or a growing suite of products and creative works, but in the fact that the methodology implemented has identified multiple novel exploitation routes, and can be ported over to other, larger industry testbeds across a wide range of verticals.

The #MusicBricks project proposal made the observation that disruptive and creative engagement with music is inexpensive compared to other media such as film-making or game design. Easy, large-scale access to tools and creative engagement by a mass-market of music makers contributes to a global democratisation of music. It is also a low-risk activity which can result in large scale experiments at early stages of deployment and technology readiness. As a result, music provides an excellent context for creative development and playful experimentation with an immediacy of expression as well as a way of exploring and capitalising on the creative and commercial possibilities inherent in the connection of new tools and methodologies with the new generation of digital makers and content creators.

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 through initiatives such as the Philips Transversal Experiment. Furthermore, additional target beneficiaries have emerged such as Transportation, Forestry and Agriculture as #MusicBricks-developed interfaces seek to revolutionise heavy industry sectors. The first #MusicBricks product patent registration specifically targets these sectors, and provides for an interface developed in the context of music technology experimentation to be deployed within the operation of heavy machinery.

What had not been anticipated in the proposal was the extent to which this context was the perfect ground for experimentation that could be extrapolated and deployed transversally. That is, where traditional ‘problem solving’ approaches within an industry result in incremental innovation and technical improvements, experiments with #MusicBricks provided the opportunity for disruptive innovation within industry sectors not ordinarily associated with arts and creativity, by allowing developers to engage in creative experimentation within a low-risk, low-cost and inherently ‘playful’ context.

In so doing, #MusicBricks developed a methodology which unlocked a route for data and emerging tools available as a result of the European research projects and residing within academic institutions, to get into the hands of creative developers and content makers, thereby leveraging and amplifying existing work within Europe to further contribute to the cultural and economic output - not just across the creative sector, but potentially across all industries.



*Fig 21: Final Market Showcase; Electronic Jungle used the R-IoT for their winning element14 project
©Johan Wallen 2016*



3.6. Societal impact: a reinvention of music in the digital age

Members of the #MusicBricks Innovation Ecosystem share a positive attitude towards reciprocal learning and openness which goes beyond profit and competition. In such a framework, industry is an active element of the community, and does not focus solely on exploitation and capitalisation. On the other hand, there are no simple users but adopters and creators who contribute concretely to technology implementation. The community's playful and open approach is informed by the central role of music as catalyser of talents and technologies. Music becomes thus a social glue bringing together different fields and profiles, and enabling innovations going beyond the music field.

The project found that events that had a higher focus on creativity rather than on technical skills and competence drew a higher proportion of female participants. 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. While proactive attempts to engage women's hacker groups and female developers took place across all of the creative testbeds, the Music Tech Fest hack camps were actively promoted as a collaboration between artists and scientists, and with the hack challenges framed around making and handcrafting new physical devices rather than simply around coding. As a result, these testbeds demonstrated a significantly greater gender diversity and the nature of many of the mixed team projects took on a performative and creative aspect rather than simply technical or software-focused. These collected statistics reflect the nature of the Creative Testbed events, particularly the Music Tech Fest's emphasis on creativity, and the Music Hack Day's emphasis on engineering, however both events require a strong presence of creativity at the point of seeding ideas.

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 and artists 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 and provides a space of common understanding. Bringing experts from widely different disciplines together to interact over music and technology is powerful because it provides a point of connection that allows for collaboration and sharing of ideas across a wide spectrum of technical and

creative expertise. The result is an extremely rapid knowledge transfer and a collective growth in intellectual capital. Findings from one field are mapped onto others, acting as multipliers and seed ground for new kinds of ideas that can be put into practice quickly, rather than simply an additive process of skill development. Not only are new concepts and skills passed on between participants and from the project team, but that knowledge is then immediately applied, cementing that knowledge and becoming part of the participants' core approach.



Fig 22: #FindingSomethingBondingSound at the First #MusicBricks Creative Testbed at the Music Tech Fest in Umeå, Sweden: disruptive innovation using creativity and cutting-edge neuroscience.

3.7. #MusicBricks methodology as a template for industry innovation

Since the early days of the internet, the most profound and problematic changes experienced by the commercial sector have had immediate effects on the music industries. For this reason, the music industries provide a model for ways in which industries can adapt and respond to a changing technological environment. The sector has not always responded well and many mistakes have been made along the way. In recent years, the impulse to resist innovation and change has been supplanted by the need to take the lead in this area, and the wider economy is paying close attention to experiments and developments in the music and media sectors. As a methodology, the #MusicBricks project provides an instructive template for genuine disruptive innovation for the music industries and beyond. Rather than merely 'solve problems' - an approach that can lead to incremental innovation or technological improvement, the creative experimentation of the hackathon provides 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 #MusicBricks case studies 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 industry opportunity than is an employee of a corporation charged with the task of simply improving what already exists.

**Estimated #MusicBricks reach**

Category	Persons reached	Note
Scientific Community	2 500	Estimate of reach from published articles and book chapters, symposia and conferences attended as well as academic members of the mailing list and members of the #MTFResearch network
Industry	650	Direct exposure to industry partners at Music Tech Fest events, industry publications and blogs as well as via Music Tech Fest mailing list and social media
Civil Society	300	Via mailing list and social media as well as involvement and dissemination in non-government organisations such as local musician networks, hackerspaces, fab labs and campus organisations
General Public	5M+	Dissemination through television, radio, press as well as online media such as Twitter and Facebook promotion targeted by interest in music and technologies and YouTube viewership and social sharing of #MusicBricks-related video content. Includes coverage on the BBC World Service (the world's largest international broadcaster). Hashtag reach on Twitter during M18 alone reached over 5.5 million impressions.
Policy Makers	200	Direct involvement in policy-shaping organisations such as the Connect Advisory Forum, advising directly to the European Commission and via mailing list and social media (the project is followed with interest online by key policy makers and European Commissioners with economic, cultural and technology mandates)
Media	500	Estimate based on number of media organisations to whom press and publicity materials have been sent as well as approaches by media organisations who have approached the project independently.
Investors	320	Estimate based on direct engagement with investors with respect to the development of the Music Tech Fund and #MusicBricks commercial platform, invitations to (and attendance at) market testbed event, and membership of mailing list.
Customers	1500	Estimate of potential customers for #MusicBricks incubated products as well as for the toolkit itself based on attendance at #MusicTechFest events and connection with other hack events worldwide. Customers in this context refer to exploitation avenues that include commercialisation of the individual bricks, the toolkit as a whole and the projects created by the toolkits as per deliverable D2.4.



Category	Persons reached	Note
Other (Innovation agents)	5000+	Creative developers, digital makers, hackers, content creators, inventors, developers, and artists who make up the core community which contributes to the advancement of innovation. This number is estimated based on the size of the community established by personal engagement with developers and creators at hacker events across Europe and through our mailing list of over 4,500 innovators and creators; through dissemination and sharing of our social media posts and video content and in discussion forums online.

Industry exposure

Organisations that have contributed to #MusicBricks testbeds		
4Sound	Ableton	Ars Electronica Futurelab
Axel Springer	B3 Media	Bare Conductive
Beer Studio	Bitwig Studio	Cankar Hall / Cankarjev Dom
Chirp	Costas Of Sweden	Creative City Berlin
Deezer	Drake Music	Earzoom
Electronic Sound	element14	Eve Audio
Fab Lab Berlin	FEZ Berlin	Fountain of Youth
FRET-X	GiantSteps	Gibson
Guitars The Museum	Hotel Park	HUMLab Umeå University
Infotech Umeå	IRZU	JAAK
Jagermeister	Jays	Kultur Verket
Kitmonsters	LANDR	Laser Unicorns
LOFELT	Ministry of Culture, Slovenia	MIT Media Lab
MOD Devices	MSUM	Musikanten
Musik Express	Musimap	Musixmatch
NagualSounds	Native Instruments	Ninja Tune
No New Folk Studio	Nura	Philips
Polyend	Radio Eins	Reactable
Red Bull	Region Västerbotten	Relentless
Resonate	Rolling Stone	SAE Institute

**Organisations that have contributed to #MusicBricks testbeds**

<u>Sandbox Education</u>	<u>Serato</u>	<u>SKUC</u>
<u>Sliperiet Umeå Universitet</u>	<u>Sonos</u>	<u>Soundation</u>
<u>Soundcloud</u>	<u>Spendrups</u>	<u>Swedbank</u>
<u>Tecnio</u>	<u>Teenage Engineering</u>	<u>Tiljan</u>
<u>Toontrack</u>	<u>Topi</u>	<u>U&Me</u>
<u>Ultrasonic</u>	<u>Umeå University</u>	<u>Umeå kommun</u>
<u>Ume.net</u>	<u>Uminova Innovation</u>	<u>Uminova Expression</u>
<u>Visit Umeå</u>	<u>Volvo</u>	<u>Warner Music</u>
<u>WIRED</u>	<u>YNK Production</u>	<u>Zealous</u>

Selected industry feedback**Egbert Juergens (Head of research at Native Instruments):**

"As a music technology company releasing software and hardware products with an experience of nearly 2 decades in research, we highly appreciate to be involved to the #MusicBricks environment. Very often the breakthrough of new ideas are only possible with a strong input from outside. But we have to be very careful with our resources as well and the decision of this project to keep the #MusicBricks toolkit alive after the project will end, that has changed our mind at least. After we've started to collaborate, we hope to find a way to contribute a musical brick from Native Instruments in 2016."

Dr. Ulrich Schmitz (Head of New technology at AxelSpringer SE):

"Starting with music in an open innovation environment is perfect – everybody likes it, it is emotional and it can force creativity."

Henric Hungerhoff (Assistant to the CEO Dr. Matthias Doepfner):

"AxelSpringer is only that successful in digitizing the classical media publishing business, by adopting new ideas from outside. And as a publisher of music magazines (authors comment: Rolling Stone, Musikexpress, Metal Hammer) we got to provide our audience an outlook to new ideas, how the future may look like, therefore we support the #MusicBricks."

Joerg Rheinboldt (General manager of Plug&Play Accelerator):

"We have organized a music hackathon and a media hackathon as well, but that was nothing like this, at that time we would have loved to have such a toolkit – and now we can cooperate!"



Selected industry feedback

Vincent Favrat, CEO Musimap:

"Musimap is excited to officially contribute to #MusicBricks' mission, which is to transfer state-of-the-art ICT to creative SMEs in order to develop novel business models. The European project is particularly interesting in our eyes because it creates bridges between the research and the industry, allowing to scale some of Europe's greatest brains in the field while encouraging a dialogue between best practice and know-how."

Thomas Lidy, former CEO of Spectralmind:

"We are delighted to provide our wide stack of software, catering the needs of professionals, app developers, and music consumers to the world – via #MusicBricks. #MusicBricks is the perfect platform to provide open-source tools that give people the liberty to use them together with their ideas and to create something new and bigger. #MusicBricks understands, as no other activity in the digital music domain before, to gather the right blend of people related to the music industry: tech-savvy people, creative people, artists, hackers, startups, entrepreneurs and last but not least – musicians! This ensures that not one interest dominates, but a multitude of interests is gathered together. This can be lively witnessed at any of the events that have been – and still are – organised by the partners in #MusicBricks: The diversity of outcomes is astonishing, and we wouldn't be able to imagine this breadth of applications emerging of the #MusicBricks tools beforehand. Clearly, we'd like to stay on board of #MusicBricks, even beyond the project, and to support future generations of hackers and creators."

Matt Black, Coldcut / Ninja Tune:

"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!"

Matt Fenby-Taylor, VP Creator Product, SoundCloud:

"#MusicBricks is exactly the sort of open and collaborative music creation SoundCloud is about. It opens up new options for makers and musicians to be creative and we're excited to support it and see what amazing creations are born."

Thierry Baujard (General Manager Media Deals)

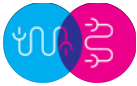
"As an investor in music and media companies, we can't miss that party!"

Artur Reimer (Accenture Consulting AG)

"I'm wondering, if we could copy this innovative space to our open innovation strategy and environments, because I would recommend that to our clients. But we have a chance as an observer here, so we will follow the #MusicBricks."

Christoph Raethke (Founder of German-Startups.de)

"We always wonder, where great ideas were born, but it is simple: just put emotion together with resources, music with technology ...!"



Selected industry feedback

Prof. Asterix Westpahl (Copyright lawyer with a chair at Popakademie Mannheim)

"I never saw that many freaks in one room, and they can even start to develop with a toolkit without asking a lawyer first..."

Tatjana Kaube, Björn Böhning (Office of the Lord Mayor of Berlin) and Katja Luckert (Head of Berlin Musicboard):

"We didn't expect to see that many new ideas, presented by a lot of people from all over the world to our city!"

Karim Bhorania (CEO & founder Jamahook AG):

"The MusicTechFest and its included #MusicBricks open innovation approach was a unique experience for me. As the CEO of a start-up company in new technologies it was exciting to see how the future of music and the industry will look like as one gets introduced to ground-breaking new tools for creating music as well as impressive new gadgets in the live performance section. The facilities of this event were astonishing to see and especially exciting to hear the different performances in the different rooms of the building. Definitely worth seeing and a must for companies in the music industry that want to be at the verge of what the future will bring."

Mark Möbius (CEO and founder of Nagual Sounds):

"When we've performed with our idea at MusicTechFest in 2014 for the first time, we were very impressed by that free and creative environment. The feedback from the community was very important for us as a young company. It was immediately clear to give back that experienced support, when a member of the #MusicBricks consortium asked me to provide knowledge and help at the final event. And by communicating with the teams of the actual project and the community, we've discovered a lot, which we can re-use while stabilising our business model and product offering."

Olaf Kretschmar (General manager of Berlin Music Commission, the network of independent labels and clubs in Berlin):

"When I first entered the building and the event, it felt like "somehow" broken, there was a lack of perfection and I was walking around like a stranger. But more and more I've dived into this melting pot of ideas and I've discovered: it is something different, something unique, because there is a community, the attendees are playing a major role, with the goal to create something at the end. Such an event with such bottom up concept is something which hopefully brings in new input to the Berlin music business scene!"