NEM SRIA 2025

Community inputs gathered for a white paper on the strategic Research and Innovation Agenda in 2025 contributing to the design of the next FP9

Version 7, 25 September, 2018

Executive summary

"*The media is the air we breathe and the water we swim in*" A.López.

Digital media is defined as products and services that come from the media, entertainment and information industry and its subsectors. It includes digital platforms (e.g. websites and applications), digitized content (e.g. text, audio, video and images) and services (e.g. information, entertainment and communication) that can be accessed and consumed through different digital devices.

The Strategic Research and Innovation Agenda (SRIA) is the new strategic roadmap for the media technology research, development and innovation developed by New European Media (NEM) technology platform that accounts for both the evolution of technology as well as radical changes or 'technology shocks'.

It aims to provide a guide to future actions in public and private funding programmes to ensure that research is adequately supported and funded.

New media is marked by the very fast evolution of its products and their components, which are subject to very short Research & Development (R&D) cycles. Dynamic, disruptive, and visionary are common adjectives applied to define how the evolution of media works.

As such, research efforts need to be based on a long-term programming approach that provides continuity across R&D efforts over next years. The SRIA proposes a mission oriented R&D development that will meet the societal and market needs, will maintain and extend the industrial leadership, will be aligned with the environment protection and the energy savings, and will ensure safety and security, while prioritising research, through innovation and education.

The NEM SRIA presents 7 chapters that gather the overall vision, the market trends, the user perspectives, the regulation and policy needs, the standardisation and the technology for most of the sectors where media has a principal position, a forecast of how the sector will look in 2022 and in 2025, and the NEM agreement on the research and innovation priorities and key enabling technologies.

A detailed roadmap for the period 2020/2022 has been included as well as a high level roadmap for the period 2020-2025. They provide some proposals aiming at providing a better understanding of the research priorities that have to be studied during these two periods.

Looking to the next challenges in Europe regarding the Digitalisation of Industry and the Next Generation Internet, two specific chapters have been included in order to show the place and the potential contributions of media & content technologies within these important areas.

International cooperation is also a key topic for NEM sectors as far as there is a need to ensure compatibility and interoperability of technologies worldwide. It is also important to raise awareness outside of the European borders that the technologies developed in Europe are the best through pilots or experiments, which could help to prepare future business opportunities for European organisations.

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1) Introduction

This new version of the NEM Strategic and Innovation Research Agenda should be considered as the description of the Media&Content mission. Such a mission should have the objective to design and develop the future European immersive environment. It should be used for entertainment as well as in education but also in manufacturing design or in health services.

In order to achieve such a goal, there is a need to study and to develop a number of technologies that are necessary and also to experiment with them in several domains through large scale pilots in order to check the relevance with end users.

Most of these technologies should be part of the Next Generation Internet (NGI.eu) initiative, which should encompass the development of an immersive open platform facilitating the use of immersive technologies in many sectors.

This document is proposing a vision, the potential business impact, the standards and regulations that need to be addressed and the technologies that needs to be studied. To reach the final goal, a roadmap has been designed for 2025 in order to position the necessary research that has to be conducted on a time line.

2) Vision

The media sector current business models are being reshaped by challenging technology and market trends. The Media sector is moving to even more personalized services, conceding more power to users, aiming at having users more engaged by empowering emotional and social connectivity with the content and people.

Technological innovations will be able to break down many of the functional barriers opening a wide scenario of convergence of broadcasting, internet, and communication services. Convergence will ultimately involve seamless access to content, achieving the idea of ATAWAD (anytime, anywhere and on any device). All the potential combinations of content, networks and devices will provide very different service scenarios, providing adequate quality of experience. These paradigms are going to be further addressed by consolidating new networks capabilities (such as 5G networks) with an improved management (such as SDN - Software Defined Networks). User-generated-content and the media shared by social networks are completely changing the media flows through the network, leading to a need for a higher uplink bandwidth. Since currently the majority of Internet exchanged data is media and content, it is of utmost importance to include and promote content technologies in the new developments for both, research and business development purposes.

Next Generation Internet will take content and media experiences to a new era, going beyond improving technical capabilities such as bandwidth, intelligence, scalability and performance. It will include immersive technologies, multimodal interaction and hyper-personalized media services, including social media and social networking.

Immersive technologies are going to enable even more natural experiences and natural interactions with objects and/or remote people very similar as real-time face-to-face experiences and interactions. Immersive content will offer novel experiences aiming to improve connection, information, control, cooperation and interaction. Virtual reality (VR) and augmented reality (AR) transform the way individuals interact with each other and with software systems creating an immersive environment. Immersive experiences with AR and VR are expanding beyond visual immersion to include all human senses.

Immersive, interactive, emotional, aesthetic, entertaining experiences have become the key elements of human existence, having users, even those with no skills or technical knowledge, more active and involved in advanced and interactive experiences. Immersion encompass sensorial and interactive environments to experiment a "sense of presence" in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze and gesture tracking, auditory and immersive auditory rendering and capturing, human computer interaction, visual design/user interface (UI), psychophysics and 3D modelling. A strong interdisciplinary approach is going to offer a great opportunity to improve people's lives and jobs by transforming their experiences through immersive technologies, with technology itself tending to disappear, becoming invisible while becoming substantial.

Users demand tailor-made solutions and a personalized customer experience independent of the context of consumption, and service providers are required to achieve a successful seamless cross-device and cross-channel content delivery and user identification. Hyper-personalization aims to adapt a product, service or experience to a specific customer through a deep understanding of each individual needs, preferences and context. Each individual's demands, needs and constraints for content and services should be taken into account before providing a tailor-made solution to that person providing such tailor-made solution in real time i.e. one can have different needs and expectations depending on the situational context (location, time, behaviour, mood, …). Consumption patterns can vary significantly and affect the customer relationship in real-time impacting overall customer experience. Topics as the capturing of user behaviour, user identity and user data management, content discovery, recommendation systems and artificial intelligence become key enablers for the real application of this new paradigm.

Users demonstrated they are keen to give away much personal data in exchange for good and free of charge services. Users should be aware of the level of privacy they get in accessing a given service. The challenge is how to improve user awareness and participation in process of management and exploitation of personal data in personalized service provisioning.

The explosion of Internet of Things (IoT) will generate more synergies between devices and people, thanks to the information they exchange. All these devices generating and exchanging information will impact how we work and communicate with friends and relatives and how we spend our leisure time. The evolution of IoT is also about transforming our lives and spaces (home, work, public) into a Cyber-Physical-Social Hyperspace based on the continuous flow of enormous quantity of personal and often sensitive data.

The integrity, confidentiality and authenticity of content and users data managed within services platforms are going to be key point for the future successful deployment of media services.

3) Business & Market impact

3.1) Market and trends overview

The global Media & Entertainment market, after reaching 1.9 trillions of US dollars, continued to grow in 2017 by almost 5% achieving near to 2 trillion of $, where US market share represents around the 1/3 of the global figure [1]. Many corporations in the Media & Entertainment sector recently experienced significant convergence and moved from their traditional businesses, such as film production, news, etc., to offer a multitude of various services across the sector. The key trends nowadays which will continue in the coming period are:

- Further industry convergence and consumer involvement as creator and industry driver;
- Further development of interactive devices as technical drivers;
- Persistent piracy and lack of strong enforcement of copyright laws;
- Leading sector's areas are augmented and virtual reality, eSports, streaming and video: OTT/VOD and multichannel networks (it is expected that more than 257 million of VR headsets will be in use by 2021 [7]);
- Media development consumption will diversify continuously. Story driven content will become even more relevant and deep. Social media will mix real life and reality TV.

Due to significant increase of world population having access to the global Internet, particularly thank to the currently increasing mobile coverage practically allowing that we are all on line, overall consumption of various Media & Entertainment services is significantly growing as well. Thus, while considering humans ability for multitasking, almost 40% of people's time is spent on media consumption and usage of Media & Entertainment technical devices [2]. While analyzing the media consumption only, almost 50% belongs to digital media sources beside classical TV (~ 30%) and radio (+10%) as well as printed and other types of media.

Moreover, the Media & Entertainment market will continue to grow; in particular, in so-called low per capita markets as well as China and India, and the consumers will continue to spent more money to use the related services, but overall share of the global GDP by the Media & Entertainment sector will decrease (Fig. 1) causing also lost of revenues in the sector [3].

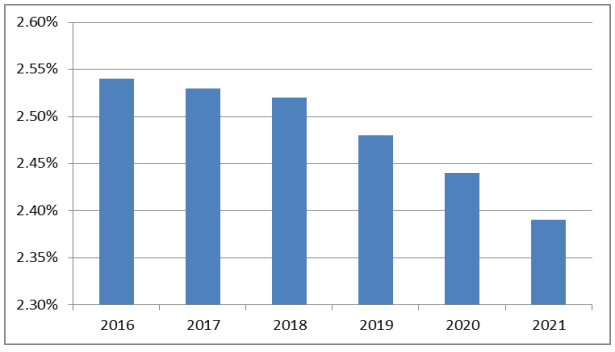

Fig 1: Global GDP share for Media & Entertainment sector

This trend is caused by several factors:

- The time people have to consume media services is finite and the same is with the consumers attention as well as their willingness and need for consumption, which is important for advertising representing the main source of revenues in the sector [4];
- The market in the sector is mature and highly competitive, so that related expenditure streams are and users' subscription models are far optimized;
- Number of free offers in the sector is still growing and their quality is increasing.

The media industry is facing battles on every front – consumer attention, advertising share, costs management, etc. but also facing a paradigm change in their businesses to have an integrated data driven strategy for the future [7]. The media industry is downsizing to cut the costs, upsizing to build the scale, etc. However, to cope with the negative trend in GDP share for the sector and corresponding consequences in development of revenues, there is a need for novel business models in the Media & Entertainment sector, going beyond traditional, mainly from advertising, revenues streams, and further technology innovation to address, among others, the following trends in the area:

- Virtual reality and interactive technologies;
- Establishment of new media services, such as e-Sports, modern TV (different from already collapsing traditional broadcaster services, such as Netflix and Prime kinds of concepts), etc.;
- More dedicated content for specific consumers/users groups instead of offers for general public;
- Data and big data to be explored and used to enhance Media & Entertainment applications;
- Artificial intelligence , expected by large majority of players in the media sector to become a significant business advantage in the future.

The innovation is a priority for the future of the media industry, where active participation of the media industry in the innovation, as well as related research, activities is a key for success at the market [7].

3.2) Future networks as driver for future media

Even difficult to predict, as already proven in the past, the prognoses show an increase of overall consumption demand on the future telecommunications networks of 71% in the period 2016-2020 [5], [6], with a further potential to grow afterwards. Beside cloud-based streaming services as well as demand coming from M2M and IoT applications and services, which are expected to grow significantly in the next period, the video consumption will be 20 times larger and around 50% of total streaming services will be consumed from the homes, mainly to consume various media content and for entertainment purposes. It is expected that video will make up to 82% of all internet traffic in 2021 [7]. One important element of the future media immersive video and other immersive technologies, to be established of end users into the media landscape, starting from storytelling/story living, which will be further enhances by increased capabilities of the future communications networks.

Also, the emerging 5G communications networks with significantly increased features able to serve services with very high demands on networks QoS are opening doors for Media & Entertainment sector to deploy

new sophisticated services and offer them to the consumers, and with it, increase revenues and improve future development of the sectorial share in the global GDP. The Media & Entertainment sector is seen as the main utilization power of the future 5G networks and their enhanced features.

Furthermore, the 5G networks are designed to enable establishment of services and applications tailored for various so-called vertical sectors (such as automotive, health, energy, etc., among media & entertainment). Here, while taking a look into the tendencies of various vertical sectors, the future verticals applications and services will significantly consist of features which can only be designed and established by industries around Media & Entertainment; e.g. assisted overtaking service will strongly depend on information/moving image gathering, processing, transmitting, and presenting.

3.3) The social media perspective

The social media is now accounting for 1/3 of users' online time world-wide and in some world regions, e.g. Middle East, the figure is doubled [8, 9]. Therefore, it is needed to consider business models and their potential impact on overall business models for the future media.

The concept of modern Internet based economy is relying on the fact that the online available information is abundant and its consumption is largely free of charge [9]. Furthermore, the most business models applied by the social media platforms today are based on end user attention; the more people are the platforms members or consuming information provided in the social media, the more advertising can be sold by the related social media stakeholders, where the advertising is in most of the cases the only revenue stream for the social media platforms. The attention based business models in social media are also seen as a driver for distribution of disinformation across networks world-wide.

Therefore, there is a need for alternative business models for social media, which might also be imposed by corresponding regulation measures. The challenge is to ensure competitiveness of the proper social media platforms, as news providers, versus so-called online disinformation/website factories.

Currently, the media and social media sector's current business models are being reshaped by challenging technology and market trends, and has already experienced digital transformation being a great example of new digital ecosystems in data-based and algorithm based economy. We live in a world where everything is or will be connected, software becomes embedded in almost everything and data is created almost everywhere becoming an essential input fueling algorithm-based economy. Converting massive amounts of data into actionable insights means that algorithms become a new competitive advantage and will prove to be central to the next wave of economic growth.

There is a need for a programme that succeeds in limiting concentration of power on having data among just few global players without compromising the technological innovation and development, from which our future depends, fostering creation of infrastructures facilitating the circulation of data along the value chains and value webs.

Some relevant statements coming from Ooyala report: State of the Media Industry 2018 [7].

"When you think about how many hours people spend watching video versus reading, the audience has already spoken."

— Chris Altchek, Chief Executive Officer, Mic, as quoted in Bloomberg

Mobile video continued its double-digit growth in Q4, and now makes up 60.3% of all video plays.

— Ooyala Q4 2017 Global Video Index

"68% of U.S. adults are now Facebook users."

— Pew Research Center: Social Media Use in 2018

"We know that we have to constantly force ourselves to shake things up.... All media companies are going through a period of change, and we're not immune from that."

— David Carey, President, Hearst Magazines, as quoted in *The New York Times*

In a 2018 survey, 194 leading editors, CEOs and digital leaders said the biggest barriers to success are not tech platforms but internal factors (36%) such as resistance to change and inability to innovate.

— Reuters Institute: Journalism, Media and Technology Predictions 2018

"Around 257.2 million VR headsets will be in use by 2021."

— PwC Global Entertainment & Media Outlook 2017-2021

"Video will make up 82% of all internet traffic in 2021."

— Cisco VNI Global Fixed and Mobile Internet Traffic Forecasts, as published in Recode

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4) User vision & requirements

4.1) Human factors

Human-factors engineering, also known as ergonomics or human engineering, is the science dealing with the application of information on physical, physiological and psychological characteristics to the design of devices and systems for human use. [Britannica] It provides a scientific approach to human-centred design, applying these "3Ps" principles to optimise the balance of people's strengths and limitations.

Human-factors engineering, as a body of knowledge, is a collection of data and principles about human characteristics, capabilities, and limitations in relation to machines, jobs, and environments. Applications of human-factors engineering have been made to such simple devices as highway signs, telephone sets, hand tools, stoves, and to a host of modern, sophisticated complexes such as data processing systems, automated factories and warehouses, robots, and space vehicles.

Human Factors are concerned with improving the understanding of human behaviour and facilitating the design and development of emerging technologies involving the process of interaction design. It refers to the design of machines, machine systems, work methods, and environments to take into account the safety, comfort, and productiveness of human users and operators i.e. gathering user requirements, designing alternative ideas, prototyping and evaluating prototypes by designing experiments and user studies, collecting and analysing data and iteratively improving the design and development of systems. So Design & Human Factors lead to the need of interdisciplinary research about the relationship between humans and technology in a wide sense, with the purpose of contributing to a more user-centered technology development. [Sharples]

Image source: Shutterstock/violetkaipa

Technology is at the forefront of all new design processes, and in a relatively short period of time, has experienced exponential growth, which has a great impact on almost everything we do, including the way we work. So, to better address this problem, we need to ask: how do we use our technology? And perhaps more specifically: how much do we rely on our technology? Thus, Human factors should play an essential role in the future of technological advances, where people and technology are being integrated more closely and more intensively than ever before as part of our daily lives taking into account physical, cognitive, affective and social aspects. Technologies for human factors/ergonomics research and practice have seen rapid technological change and nowadays are facing new challenges resulting from an increasingly complex technological environment. These technologies have largely resulted from the digital

revolution in both software and hardware and now the application of new trends in human factors relies heavily on these new interactive technologies. [AppErg]

There are many areas of activity within human factors but today, the research carried out, almost invariably relies heavily computational, information, and communication technologies in one way or another.

User Experience

User experience encompasses all aspects of the end-user's reaction and interaction with the technology through services, and products. The focus lies on the user's perceptual experience and the symbolic aspects of products and product use. User experience design as a discipline is concerned with all the elements that together make up that interface, including layout, visual design, text, brand, sound, and interaction. It's important to distinguish the total user experience from the user interface (UI), even though the UI is obviously an extremely important part of the design. These factors have become increasingly crucial for many companies' ability to create unique deals. In order to achieve high-quality user experience in a company's offerings there must be a seamless merging of the services of multiple disciplines, including engineering, marketing, graphical and industrial design, and interface design. This research area includes design theory and methodology with focus on aesthetics, product semiotics and sensory.

Technology Use and Adoption

Technology use and adoption by users, specially including companies and workers is a critical component of the process of technological change. A solid knowledge of this issue requires studies of the conditions on which people accept and adopt new technological solutions and should assess the causal effects of education on technology use and adoption by using instrumental variables.

Knowledge about how technical products are being used and what they mean in people's everyday lives is an important condition for product development, and similarly, how education impacts on the probability of using "tech tools" on a daily basis as well. A basic concept is that the understanding of users and their usage is a good starting point for, first, innovation, and then for validation and proof of acceptance. Technology use and adoption focus on achieving real understanding of the users' needs and the demands they put on technical products and systems. Functional, social, emotional and aesthetic values are all taken into account.

Human - Machine Systems

Human-factors engineers regard humans as an element in systems, and a human-machine model is the usual way of representing that relationship. Two general premises characterize the approach of the human-factors engineer in practical design work. The first is that the engineer must solve the problems of integrating humans into machine systems. This supposes to be rigorous building upon scientific methods and not rely on intuition, or common sense. For long, the complex and unpredictable nature of human behaviour was obviated.

This approach should develop methodology to analyze, design and evaluate the interaction between man and machine in the broadest sense, independently of the socio-technical complexity of the systems.

Main areas of human-machine systems are related to physical and cognitive ergonomics, interaction, learning, risk assessment and 'resilience engineering'.

Sustainability

Current human activities are seriously eroding the ability of natural and social systems to cope. Human factors and ergonomics can provide relevant skills and knowledge to assist where it can in addressing the commonly identified problem areas (waste management, energy and transport) and to answer questions regarding the technology capability to motivate and support more sustainable behavior among people.

Sustainable development "means ensuring dignified living conditions with regard to human rights by creating and maintaining the widest possible range of options for freely defining life plans. The principle of fairness among and between present and future generations should be taken into account in the use of environmental, economic and social resources. Putting these needs into practice entails comprehensive protection of bio-diversity in terms of ecosystem, species and genetic diversity, all of which are the vital foundations of life." [MONET]

Sustainability focuses on consumption and design theory and methodology with focus on design for sustainable behavior aiming at collaborating to change people behavior as well. An example of sustainable Human Factors Engineering design is of an electric vehicle system to enable energy efficient driving. From a Human Factors Engineering perspective there are a number of sibling systems to consider including the human-software interface, the human-control interface, and the human-human system interactions with passengers and other drivers. [Thatcher]

Human factors research is taking advantage of the advances of key technologies that have been established during last years; mainly virtual reality (VR, due to the fact that can be used in situations when the safety is concerned or those which are not easily replicable), whose application to the field has grown. Researchers are drawn to its interactive and immersive nature, while the intensive interaction through immersive visual fields has strong research benefits, the responses and validity of different levels of immersion remain a question and the physiological and psychological responses of humans need to be further assessed.

The other big family highly involved in human factor is the one related to user interfaces and sensors (depth sensors, accelerometers, gyroscopes, and magnetometers). Depth sensors have become very common in human factor applications. They are able to detect the distances of objects placed in front of them and can provide information useful for evaluating physical exertion and body posture. As technology progress, sensing technologies become smaller while preserving or even increasing their functionality facilitating non-intrusive, easy-to-apply tool deployment. More and more measuring devices can be held in the hand of the user, or directly worn on the body. Specialized wearable systems with multiple embedded miniature sensors can be used to monitor kinematics and physiological parameters. Even smartphones can be used as a rich potential source of parameters directly useful for human factors research as many smartphones contain multiple sensors that can be used for human factors purposes.

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The NEM community can provide the most adequate technologies to develop new generation tools for human factors practical application. The kind of interactions and developments implemented for the entertainment area fit rather well to this discipline so the evolution of interaction pushed by media area can boost a new generation of human factors applications including novel solutions for the analysis of effects of physical environments on the operator, human reliability and human information processing (going further into the concept of the human as a sensor), training, workplace design, work organization design and the allocation of tasks between humans and computers and other parts of systems.

Media technology can also provide useful inputs for other key activities in the area that include but are not limited to: training, maintenance, safety, reliability, usability, staffing, security, test and evaluation, manufacturing design, task analysis, workload analysis, task allocation (between human, teams, automation, and systems), human performance analysis, human error analysis, anthropometric analysis and risk management.

And last, to help with the sustainability paradigm, some general principles for designing new and enhancing existent approaches of human factors and ergonomics regarding their orientation towards sustainability are proposed.

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4.2) Areas of applications

The European media sector is the backbone for the huge cultural richness of Europe. Creativity, press freedom, quality journalism, plurality and diversity of media content are cultural key values to open and drive our society. These values are also important for the strength of all other European industries. Further, the huge resources of data from media sector are of strong interest of other industrial areas. With astonishing speed, the entertainment, media and publishing industries have evolved into highly dynamic ecosystems, interconnected by global digital platforms in a manner that few people could even have conceived of a few decades ago. Media technologies and data can be used and replicated and transferred across the EU industry and in a range of contexts such as entertainment, advertising, telecommunication, Publishing & Broadcasting, but also other sectors such as education, health, automotive, finance, manufacturing etc.

Here below some examples on media technologies and applications applied to different industries and sectors.

- As an example the *Data-driven Content Production* and *Personalisation* technology can support, the **telecom operators** with the new services heavily focused on content, while the *Data-driven Advertising* can also endorse and support the global **advertising market** strategy (global advertising media revenues were estimated to be 503 billion dollars in 20157). All these arguments from above prove the necessity to have a large scale project for media sector at this perfect time to innovate, while they also show the huge importance of the sector for the European data economy.
  The Media and CCI community need to become a catalyst for the wider deployment and rapid market uptake of innovation approaches involving key European industry actors whilst putting data harvesting and analytics at the core of their businesses. It will do so by creating a converged open innovation ecosystem, which will provide benefits and business opportunities for all the involved stakeholders, through Large Scale Pilot sectorial demonstrations to address the Media Industry, a sector of high significant importance for the EU industry.
- Other important technologies are *Machine learning tools and data analytics* to fight **misinformation** that can have economic effect on different domain such as **climate, finance, politic, social issues** etc.
  Europe is lacking of a systematic knowledge and data transfer across organizations to address the aggressive emergence of the well-known problem of fake news and post-truth effect. The possibility to use cross sector Big Data management and analytics, along with an effective interoperability scheme for all our data sources, will generate new business and societal impacts involving several stakeholders and targets such as:
  - ✓ Media Companies (Press agencies, news, TV Broadcaster etc)
  - ✓ Governmental institutions and organisations
  - ✓ The overall Industrial ecosystem
  - ✓ The entire society
- In recent years, several *Augmented Reality (AR)-based applications* have been created and aiming to lend support to industrial processes with regards to almost every aspect of the **manufacturing** pipeline e.g. design, planning, production, service and maintenance. Factory facility design and planning is a significant filed of industrial AR that has gained significant attention especially within **automotive** industry verticals. For example, Space requirements for new or updated machinery are

a significant concern given the investment costs of acquiring new machines for the factory floor. Apart from the obvious, "aesthetic" considerations ("what would it look like?"), additional factors need to be taken into consideration, as effective planning aims to reduce the risk of faulty layouts. The idea of using Augmented Reality to facility planning is not new; in fact, several mature attempts have been made at placing life-size holograms into locations using contemporary smart devices (smartphones and tablets) or even the HoloLens holographic wearable computer and display. The experiences are gaining significant traction with industry verticals, yet remain however isolated experiences. Investment decisions can be supported and accelerated by realistic planning simulations, yet these are still only 'simulations', relevant mainly to the design planners and should be properly and effectively communicated to machine manufacturing vendors' sales teams. On the other hand, travels and related costs for sales representatives of machine manufacturing companies are unavoidable, especially when orders need to be customized to be effectively tailored to the customer's needs and requirements.

- *Social media* used for communication purposes within **healthcare** contexts is becoming more conventional. The social media users of healthcare communication engage all the involved actors from the general public to patients, health professionals, and health organizations. Social media for healthcare communication are various provide health information on a range of conditions; providing answers to medical problems; facilitating dialogue among patients and between patients and health professionals; collecting data on patient experiences and opinions used for health intervention, health promotion, and health education; reducing stigma; and providing online consultations. With emerging advances over time, including new platforms and purposes, these uses will change and expand, increasing usability and thus providing more opportunities to use social media in connection to healthcare in the future. Also do not forget the importance of media technologies such as *image processing* and *visual representation* in the healthcare daily work.

Another important aspect is **Inclusion, Diversity, Personalization and Migration** Issues. Beyond the users demand tailor-made solutions and a personalized customer experience outlined in the NEM's vision above (chapter 2), areas of application include social and societal issues. In the following, we highlight the NEM perception:

- of future personalized access services;
- recommendations for future research and innovations;
- coming short and mid-term innovation trends;
- as well as Future EU R&D&I funding with personalization and diversity as one key dimension to succeed the integration of migrants.

Future of personalized access services

Technology is transforming the way we work, live and entertain ourselves. Yet, television (watched on a TV set or via the Internet) is still the preferred medium of Europeans: more than nine out of ten (96%) Europeans watch TV at least once a week. Europeans predominantly watch television on a TV set[1]. But television is changing. It is becoming more connected. Hybrid Broadcast Broadband TV (HbbTV) is an international, open standard for interactive TV, which enables innovative, Interactive services over broadcast and broadband networks[2]. How can the industry guarantee that as many people as possible

[1] Media use in the European Union 2014 http://ec.europa.eu/public_opinion/archives/eb/eb82/eb82_media_en.pdf
[2] http://HbbTVHbbTVHBBTV.org/overview/#HbbTVHbbTVHBBTV-overview

benefit from this technological innovation? And, if Europe is to become a world leader in accessibility, a topic raised recently by the European technology platform NEM (New European Media, 2016)[3], what steps are still needed?

Between 2013 and 2016, the European HBB4ALL project addressed media accessibility for all citizens in the connected TV/media environment. Its main challenge was to consider the delivery of multi-platform audiovisual content (anytime, anywhere, any device) and make this accessible to all. Access services such as subtitles, Audio Description (AD) and sign language have been available for some decades yet often with little research into how they can be optimized. HbbTV opens up new opportunities for the customization of these services. New access services are also being developed, such as Clean Audio (CA): Following testing as part of the project, the HBB4ALL access services are publicly available on air at RBB and ARD in Germany, at TVC in Spain, at SSR/SGR in Switzerland and RTP in Portugal.

Recommendations for future research and innovations

Accessibility research and innovation issues still to be addressed are:

- Tools to enable increased opportunities for employment in the media and creative industries
- Increased access to digital media services
- Automatic translation to sign language, and from sign language to text
- Automatic translation of subtitles (multi-languages)
- Accessible universal remote control
- Screen reader enabling those with a visual impairment to read subtitles
- Improving multimedia accessibility by design-for-all
- Collaborative work within the industries
- Building on existing media access services and innovation systems (open source and others)

Future short and mid term innovation trends include

- For broadcasting: developing and improving sign language production, Audio Description for content (videos and books) with the facility to deliver dialogue and ambiance elements of the soundtrack separately, achieving robust subtitling performance across genres and increasing interoperability, allowing users to consume personalised automatic live subtitles anywhere.
- For web access developments: industrialize existing prototypes e.g.: subtitle renderer; inlay/screen overlay (incrustation) of sign language interpreter; advanced audio functions; improve the quality of automatically generated subtitles, reliable STT technologies, improve avatar based signing services, develop and integrate additional accessibility services into existing online platforms.

From the **user perspectives**, it is important to ensure a design-for-all-approach, while recognising that very specific needs may go beyond design-for-all, like affordable, reliable and interoperable solutions, availability of continuous technical support, information about existing and future services, training support for user groups of all ages.

In terms of standards, we recommend to **build on European and worldwide standards** involving all stakeholders to create large-scale usage. Beyond media accessibility, work on issues surrounding the IoT

[3] NEM-Access Report: Opening Doors to Universal Access to the Media. February 2016. http://nem-initiative.org/wp-content/uploads/2016/03/NEM-ACCESS-Policy-suggestions.pdf

(Internet of Things), i.e. the interconnectivity of all objects that exchange data, where media access is relevant.

Moreover, clear regulations should exist not only at national level but also at a European level.

It remains crucial to **raise awareness** in the value chain through information and media, through education and curricula, by bringing stakeholders together (studies, think tanks, projects, market take-up), and include the content production industries.

This shows the need for a continuing emphasis on media accessibility, while recognizing that many strides have been taken in Europe so far. This is best achieved through education; standardisation and legislation based on sound academic and industry research and by the involvement of all members of the value chain, not forgetting the users. If design-for-all is the fundamental principle, we will ultimately all benefit from the media interconnectivity. Above thoughts and research recommendations aim to guarantee the future of media access services.

Future EU R&D&I funding with personalization and diversity as one key dimension to succeed the integration of migrants

Migration raised major societal challenges within the European Union over the last years, and simultaneously the question of inclusion and access for all through ICT, content and (social) media. Therefore, the NEM Steering Board introduced the migration topic, and organized an exploratory meeting between NEM members & UNESCO during the last NEM Summit in Madrid (30th November, 2017).

Out of experiences with migrants, it appeared that UNESCO is concerned about the role that technologies may play with regard to integration of migrants into the society. This should be placed under perspectives to promote multiple knowledge (of and about those who arrive), about cultural differences, and the economical sides: many refugees are coming to Europe, and they can impulse economic growth.

In terms of needs, the personalization of services is a first major issue: we are talking about very different profiles of people. Not just one solution expresses and addresses all those different populations. The second issue: mobile technologies can be seen as part of the solution (not THE solution). Almost 80% would do anything in order to have mobile technologies. All refugees care about being connected. Therefore, mobile technologies have to be part of the solution.

UNESCO would welcome to get European wide tools to address the refugees' needs. It is about scaling up something that works first, and international cooperation.

Basic and advanced needs are as follows:

- Basic needs in terms of education, tools for promoting communication. To help children from Syria to learn Arabic, because they have a lack of education (did not go to school). And also learn the language of the country;
- The remedial needs when it comes to education. Many children will arrive to schools that still recall when their schools were bombed (very traumatic souvenir);
- The higher educational sector. We need systems to help them to certify obtained diplomas. Does anybody address them?
- Consider the opportunity to enhance their digital skills (younger, children, and others). Digital skills are part of to live in the society, and relevant content can help them to be fully citizens in the society.

Tools that UNESCO could support, for example, are real time translations aiming at empowering human contact. Refugees need to be connected to the country's language, but also to their own language. In addition, the situation requests more qualified teachers (not only those of the receiving countries), but the need of tools and content for (social) media has to be qualified, and extra costs per child (+ 33 to 50 % compared to others) must be considered.

Industries helping to shape solutions would be much appreciated, while UNESCO can welcome any kind of proposal and push it, envisage to help to develop the system(s), and be a partner.

Future R&D1&I related topics could be related on a next public EU R&D&I funding, which considers accessibility, personalization and diversity as one key dimension.

In addition to the above mentioned translation tools, media (particularly Public Services) can serve as Educational and Knowledge Diffusion Platform for all - both migrants/immigrants and local population. Content creators, creative people, and storytellers should be "encouraged" to produce content related to immigrants (beyond news and reports based on emergency). Different navigations between different rights and administrative issues need also to be addressed. In the forefront, it is also important to collect research literature to make these topics more predictable.

Higher education is one of the issues: there should be a consolidation of treating people in a non-discriminatory way from both sides. Education institutions have to deal with it from now on. It has to be checked whether there is a lack of tools, and/ or methodology, etc. The language tools here apparently are not the big problem. For children, it might be the European Commission that comes up with bottom-line instructions.

Concerning innovation and refugees, it is important to:

- Identify ICT instruments for them: at city level, country level, European level. For example security, tracking;
- Innovate with strong PA (Public Authorities) support in order to mitigate possible societal challenges related to "the others" (immigrants).

In the coming month, NEM intends to create a NEM vision taking into account the situation, the needs and further potential NEM solutions, like i.e. create tools to help the programme makers.

5) Policy, regulatory and standardization issues

In recent years, the media sector has undergone a profound transformation process, as a result of the strong growth in video content and online entertainment, posing increasingly complex challenges to policy makers, competition and industry authorities. The Media sector plays a key economic, social and cultural role in Europe. Europe boasts a strong media industry, which creates growth and jobs and represents European life, languages, history, culture and values around the world. Those deeply changes in the media sector are due to the impact of the Information and communication technologies (ICTs) which are revolutionizing the creation, development and distribution of content today. The introduction of new technologies has produced a "disruptive" effect on the traditional media industries. Innovation has become the most important growth driver and has led to the emergence of new operators and business models.

The media landscape is undergoing a transformation, characterized by a steady increase of convergence of media services, with a visible move towards intertwining traditional broadcast and the internet. Audio-

visual media content has arrived on non-TV screens and internet content is arriving on the traditional TV screen. Moreover, the emergences of new technologies like, Virtual reality, augmented reality, IoT, blockchain applied to media sector represent new challenges to be faced and managed in terms of policies, taking in account the advantages but also the risk that they can provide to the end users.

In addition, the growing variety and availability of devices has led to a radical change also in consumer habits, expanding the options and methods of use no longer linked only to traditional devices (i.e, radio, tv). This phenomenon empowers European citizens (including young people) to be able to access seamless and interactive experiences, letting them access any content while being agnostic as to the device or geographic locations from which they interact, but not to the language of communication. Consequently, the proliferation of connected devices and the wide availability of faster broadband connections are affecting existing business models, consumer habits, creating new challenges, and opportunities for the creative industries. The growth of the language industry close to the media industry is a reality in Europe.

In this landscape, TV remains the foremost source of information and entertainment in the EU, but the audio-visual sector directly engages millions of people with other types of media, specifically available through internet, that are spreading more and more in the market. The media and communication sector is therefore increasingly becoming a digital ecosystem, characterised by the group of subjects that produce, consume and exchange information within the area bounded by digital technologies. Sectors previously distinct, such as content and media, telecommunications, information technologies, are now converging, creating a new industrial ecosystem that requires different types of companies with different corporate cultures to compete and collaborate.

Therefore, the impact of the Internet and new technologies on the media and content world is enormous: new business models, new players and new challenges await antitrust and regulatory authorities. The process must find ideas and knowledge from both the "new" and the "old" economy. At the same time, whilst maintaining the focus on the consumer rather than on protecting certain competitors, it allows the benefits of the Internet and new technologies to extend across the economy.

For that reason, one of the most relevant points on the political agenda of the European Commission (EC) is the Digital Single Market (DSM) strategy. It aims to open digital opportunities for people and business, and enhance Europe's position as a world leader in the digital economy. Within the DSM framework some regulations of the Media sector are translated into policies and regulations. In that context, it is important to mention: the regulation on Audio-visual Media Services (2010/13/EU (AVMS directive) and its proposed modification with the “COM(2016) 287; the regulations on Copyrights (1996/9/CE; 2001/29/CE; 2006/115/CE; 2009/24/CE; 2012/28/EU and 2014/26/EU) and new directive proposal COM (2016) 593 on copyright in the Digital Single Market; The directives 2006/123/CE and 2000/31/CE on cross-border portability of online content services and the new proposal COM (2015) 627; the directive 2000/31/CE on E-commerce & geoblocking and the new proposal COM (2016) 320, and the new European Accessibility Act.

The preview mentioned panorama lays the foundation for new challenges to be considered at policy level in order to support on one hand the technologies developments but on the other hand to reduce the potential risks coming from them. In this perspective issues like data protection, privacy, customers

protection but also the policy framework for supporting research and innovation in the media sector represent relevant topics to be constantly addressed for supporting the right growth of the media sector.

In Europe, there has been an increase in competition in the distribution of video content - an area controlled by traditional television operators - as a result of the following factors: the entry of new global players, starting with Netflix; consolidation, through mergers and acquisitions, by the major telecommunications operators, which allowed the development of the "quadruple play" offer, integrating voice, data with fixed and mobile Internet access and video; direct access by new players to exclusive "sports premium content", starting with football (national league and Champions League) capable of increasing demand for data and traffic on networks.

In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

Standardisation plays a leading role in creating the EU Single Digital Market . Standards support market-based competition and help ensure the interoperability of complementary products and services. Standards play a vital (albeit sometimes invisible) part in supporting economic growth by boosting productivity, competitiveness, innovation and societal welfare. The impacts of standards within businesses and their supply chains are less well understood, and the same is true of the public sector: there is sometimes a lack of awareness and information about the impact of applying standards to public policies.

CENELEC makes a classification of standards in four categories:

1. **Fundamental standards** - which concern terminology, conventions, signs and symbols, etc.;
2. **Test methods and analysis standards** - which measure characteristics such as temperature and chemical composition;
3. **Specification standards** - which define characteristics of a product (product standards), or a service (service activities standards) and their performance thresholds such as fitness for use, interface and interoperability, health and safety, environmental protection, etc.;
4. **Organization standards** - which describe the functions and relationships of a company, as well as elements such as quality management and assurance, maintenance, value analysis, logistics, project or system management, production management, etc.

The three European Standardization Organizations (ESO), CEN, CENELEC and ETSI are officially recognized as competent in the area of voluntary technical standardization. The European Union (EU) Regulation (1025/2012) which settles the legal framework for standardization, has been adopted by the European Parliament and by the Council of the EU, and entered into force on 1st January, 2013. The three European Standardization Organizations cooperate on policy and technical matters of common interest. This cooperation is coordinated by the Joint Presidents' Group (JPG). As its name implies, JPG comprises the Presidents and Vice-Presidents of CEN and CENELEC and their ETSI equivalents (General Assembly Chair and

Vice-Chairs, and ETSI Board Chair), together with the Director General of CEN and CENELEC and the Director General of ETSI.

There are some basic understanding regarding standardisation:

1. There are many agencies;
2. Participation tends to be as a representative of a state, or a private company, or trade association;
3. A standard is a very lengthy process;
4. A standard is anonymous;
5. Participation is time consuming, which can be translated into a costly activity. This is for two reasons: the time required to read, write and work in documents, and the time dedicated to meetings.

Nevertheless, it is important to work within the framework of standards since they reduce costs, improve safety, and enhance competition. The EU has an active standardisation policy that promotes standards as a way to better regulation and increase the competitiveness of European industry.

It is important to raise awareness regarding standards towards maintaining and improving the presence of EU industry in international markets since they are key to creating jobs and growth in Europe. Standards facilitate companies' market access worldwide and two main objectives are instrumental in this respect, as identified by the Communication from the Commission to the European Parliament (COM/2017/0453 final)

- strengthening the competitiveness and global reach of European industry by reducing technical barriers to trade (TBTs); and
- enhancing worldwide interoperability by using common technically aligned standards that support trade in goods and services.

These objectives can be achieved, first and foremost, by aiming for the greatest possible coherence between international and European standards, and by facilitating the use of European and/or international standards outside the EU while striking the proper balance between the European, national and international dimensions. In 2018, the Commission will intensify its policy dialogue with international standardisation actors. It will also continue to raise awareness and promote the advantages of the international and European system of standardisation in multilateral fora (e.g. the World Trade Organisation and the relevant United Nations committees) and contribute to the EU's regulatory/policy dialogues with economically relevant partners and to negotiations on the TBT chapters of free trade agreements.

Also from the annual Union work programme for European standardisation for 2018 states that "A year after the publication of the Commission's priorities on ICT standardisation , the actions outlined in the 5G communication networks, Internet of Things (IoT), cloud computing, cyber security and (big) data technologies as priority domains as well as the sectorial domains on eHealth, intelligent transport systems and connected & automated vehicles, smart energy, digitising industry, smart homes, cities and farming are progressing, in collaboration with the ESOs, global SDOs and the standardisation community. In the same

way, the Commissions has initiated actions to improve the ICT standardisation ecosystem including work with ESOs and stakeholders on possible measures to improve the Standard Essential Patents (SEP) ecosystem, promotion of open source and its interaction with standardisation, and to strengthen the EU presence in international ICT standardisation. The Mid-Term Review on the implementation of the Digital Single Market Strategy presented the overall implementation of the standardisation actions.

Certain actions are implemented through the related Public Private Partnerships , such as the Alliance for Internet of Things Innovation (AIOTI) , the 5G Infrastructure Public Private Partnership, the Big Data Value Association (BDVA), Factories of the Future PPP, the European Cyber Security Organisation (ECSO) and through Horizon 2020 research and innovation projects . In addition, the ICT standardisation needs in support to EU policies are outlined in the 2017 version "Rolling Plan for ICT Standardisation" 16 , which is established by the European Commission services in collaboration with the Multi Stakeholder Platform (MSP) on ICT standardisation and has been aligned to reflect the priorities identified in the Communication on ICT standardisation priorities. This work is also useful for the accessibility of products and services in the EU. In addition, effort to mainstream accessibility following a Design for all approach should be step up to mainstream disability issues in relevant standardisation processes.

The ESS is an integral part of Europe’s global competitiveness, economic growth, consumer confidence and capacity for innovation. CEN, CENELEC and ETSI agree that the following principles are shared in common in their role as ESOs within the ESS.

The following seven common principles inform each organisation’s strategy implementation in their role as an ESO within the ESS:

1. Create standards, both directly and through relationships with other bodies, that consolidate and strengthen the European Single Market and are used globally supporting European industry in the global markets;
2. Use standardization to remove technical barriers to trade, support economic growth, promote well - being and address societal challenges;
3. Antici pate market, scientific, demographic, social and environmental trends and identify emerging opportunities and innovative and converging technologies that would benefit from early, coherent standardization;
4. Encourage European public and private research programmes to use standardization as a means to codify new knowledge and to impact the market;
5. Deliver market - relevant, cost - effective, timely, usable flexible standards, other deliverables and services;
6. Engage with and reflect the diversity of stakeholders and the breadth of their interests in standardization;
7. Invest in awareness - building activities, education programmes and technical training that serves to attract the next generation of standards makers.

Apart from the EU standardisation agencies, there are well known agencies such as ISO, IEC or ITU, and NEM should take an active role in the EU Joint Initiative on Standardisation, as foreseen under the Digital Single Market Strategy.

6) Enabling technologies

Based on the papers already developed last year, the NEM community should address:

Immersivity

Immersive technologies are consolidating as one of the most intriguing topics of the content sector. Advances in the generation of 3D Virtual/augmented reality services and the gradual appearance of a variety of devices (glasses, 3D Screen, windscreen display, ...) open the opportunity for holographic content, i.e. true 3D volumetric media, give an idea of how fast immersivity is emerging.

Improved VR headsets, which currently are positioned for VR gaming and 360-degree video, are evolving towards consumption of Free Viewpoint video. Contents are being provided for any kind of genres currently positioned for 360-degree video: (live) sports, musical performances, virtual tourism, educational content, adult content, fiction, news and documentaries, eSports video streams. User generated content (UGC) are expected to constitute the second wave of content, in the form of short video clips in a social media context of messaging and sharing and live streams shared on social media platforms. Handhelds (smartphones and tablets) with auto-stereoscopic multi-view capabilities will allow users to enjoy the cases described above when they are not in a position to put on a VR/AR headset.

Immersivity challenges include:

- Robust algorithms to create volumetric media from multiple cameras, stereo cameras, smartphones with multiple cameras and/or depth cameras, multiple robotics cameras (e.g. follow-me drones). Hybrid approaches combining local preprocessing and cloud-based synthesis. Calibration-free set-ups.
- Novel volumetric media representation formats, balancing compression processing requirements, compression efficiency, bandwidth and manipulation capabilities. (UGC holographic communication will require manipulation capabilities similar to current visual messaging like beautification, stickers and comments, backdrop changes, fun masks and transformations etc).
- Bandwidth efficient delivery of volumetric video. Streaming of the complete holographic video is bound to pose substantial bandwidth challenges. Research into novel networking solutions that stream personalized perception-based holographic video to users from CDN's, taking into account bandwidth, latency and cloud/local processing loads.
- Human-machine interaction. Many types of human-machine interaction will be developed in the near future, allowing consumers a wider range of activities and a broader spectrum of experiences that can be gained from their engagement with media. New developments are expected for avatars and robots, haptic sensors, Brain Computer Interfaces (BCI), Enhanced Sense of Presence (ESP), sensing and monitoring, Quality of Experience (QoE), audience monitoring and analysis.

- Usage of multiple audio-visual capturing sensors for creation of multi-angle content for creation of free-viewpoint video for consumption with VR and AR HMDs. Capturing modalities include visual, audio and depth (radar, sonar, lidar, time of light), and could incorporate ground-based tele-operated and autonomous vehicles and airborne drones and balloons and definition and implementation of capturing strategies for robotic camera teams.
- Media orchestration tools for managing multiple, heterogeneous devices over multiple, heterogeneous networks, to create interactive and immersive experiences.
- Video 4D (volume capitation) will bring a better experience to end users as they will be provide 6 degrees in a tri-dimension environment

Hyper-personalisation

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitisation of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process by paralleling a lot of actions all along that value chain and reducing the production time from capture to access. This diversity often challenges established businesses and their business models, requiring them to be involved in the latest technology research and innovation activities of their sector.

This process opens the sector to apply new paradigms as hyper-personalization bringing new opportunities and challenges technological, infrastructural and regulatory by means of disruptive and focussed approaches.

The European society is based on diversity and only by giving a broad and flexible response, with the assistance of the hyper-personalization paradigm, will this diversity be a resource and not a restriction.

The global trend towards the extreme differentiation of offerings in products and services cannot be foreign to the sector, from the recommendation of content to the integration of the final consumer in the design processes. Hyper-personalization through very precise targeting not only ensures the best potential impact but in parallel increases the added value of products and services.

Hyper-personalization technology will allow the gap between providers' business needs and consumers' desires to be closed, allowing consumers to enjoy an increasing range of products whilst service providers battle against the fragmentation of retailing and media across multiple channels and platforms. Appropriate control should be given to consumers to empower them to tailor and tune how hyper-personalization works to meet their needs.

One of the key challenges will be to give back the control of personal data to the end users. These data are key for hyper-personalisation but should be under the control of the end user instead of being managed by each service providers with a global inconsistency.

Content distribution

The media sector is looking for new business opportunities as its current business models are being reshaped by challenging technology and market trends. Media is moving to concede more power to users,

to achieve higher levels of personalization, and aims to get them engaged by powering emotional and social connectivity with the content.

These paradigms need to be addressed by consolidating new networks capabilities with an improved management. Content distribution strategies need to be supported by technological advancements driving more appealing user experience within the entertainment & media industry. User-generated-content and the media shared by social networks are completely changing the media flows through the network, leading to a need for a higher uplink bandwidth.

Important pan-European initiatives as Big Data PPP and 5G PPP, especially when referring to content distribution, are taking into account media and content singularity. Content and media are, on the other hand, exceptionally useful material to assess the real potential of both technologies and can really bring European innovation horizon at their maximum performance. Since currently the majority of Internet exchanged data is media and content, it is of utmost importance to include and promote content technologies in the new developments for both commercial and research purposes in Big Data and 5G domain.

Content distribution should be the cornerstone of the so-called New Generation Internet which should take content and media experience to a new era. In the way of offering an answer to this reality, content distribution must go beyond improving technical capabilities such as bandwidth, intelligence, scalability and performance. The integrity of content and the confidentiality, authenticity and integrity of private data of the users managed within content services are key to the deployment of successful use cases.

One of the key challenge will be the design of a (or several) 5G slices adapted to media&content requirements and offering open APIs able to give access to media&content producers to a number of network function parameters .

Social Media

Social Media used to be defined as a set of computer-mediated technologies that facilitate the creation and sharing of information, ideas, and other forms of content and applications via so-called virtual communities taking advantage of modern network and communications infrastructures. Social media uses web-based technologies to create a variety of interactive platforms through which individuals and communities can share, create, modify, and discuss different types of information and digital content which is available in the global Internet landscape. It can be stated that during last one-two decades the social media applications introduced significant changes to way people communicate, as well as businesses, and more over entire communities organized through common interests. Moreover, the recent developments in Internet and communications technologies, media and entertainment sectors, as well as many other spheres of professional activities and life show that social media becomes a standard part of different services and applications offered to people through a variety of communication and consumer devices; computers, tablets, smart phones, smart watches, etc. Furthermore, so-called classical media services, such as broadcasting and even traditional “paper” based media, are more and more introducing and using various social media technologies, to improve the overall user experience and further extend their offers and businesses.

The social media is currently being used to infer social behavior and derive tendencies, in combination with the big-data analysis tools. Its capabilities are tremendous to obtain information about the acceptance of a new product or service, identification of needs, or even the determination of ways to influence particular social acts and events. A practical example of the above ideas is the still open question of whether social media, in combination with big-data analysis tools, influence world-wide elections or not. Furthermore, a concern about digital competition is acute in Europe because quite often digital markets and the social media platforms are dominated by few, big and foreign companies, accumulating volumes of exclusive operating data on their platforms and services and using it as the raw material for artificial intelligence or machine learning could have an insuperable competitive advantage over new entrants. Users gain good services, and often free of charge, from such platforms but there are also some potential drawbacks; e.g. using a predominant position to collect data (even improper), keeping that data exclusive in order to maintain monopoly power, which even might obstruct further innovations and creation of new ideas, or using it to prevent customer to change the platform providers. Therefore, from the competition point of view it is also desirable to ensure Personal Data and Profile Portability in the future social media services.

We can conclude that in the near future it will be more and more difficult to distinguish among traditional media, if we may say so, and social media. Where is or will be the border between traditional media and social media (e.g. shift from off-line to on-line media) as well as the border between social media and any future type of service or application, or will there be any borders in the future? What is and how will the future social media look like, how we are going to get there, and what has to be done to enable the future social media? This White Paper elaborates inputs received from broad European media community, to answer these questions and define a set of actions needed to be taken in a coherent and coordinated way in the next period to enable establishment of a future European social media landscape.

Immersive cloud platform (I²C)

Today's audiovisual media industry is considerably fragmented and whilst it has made large in-vestments to deliver content to consumers, efforts have not been made in a consistent manner. The proliferation of media producers and distribution channels is driving key players to seek forms of increasing the quality of their offer. Approaches that do not require additional large in-vestments and that potentiate fast ROI whilst meeting the customers needs and expectations are being investigated. Another aspect that should be considered within this entangled and pro-liferated world of media producers and distributers is that this fragmentation, although having brought a lot of flexibility and choice to the user, did not necessarily bring in all cases increased content quality, as many small producers do not have technological and infrastructural capacity albeit having contents that strike the consumer's interests. In light of this scenario, it is becoming clear to big intervenient players that it would make much more sense to adopt a global and hori-zontal technology, instead of dedicated specific equipment. In particular, IP-based/Ethernet transmission technology and Commercial Off-the-Shelf (COTS) equipment. Virtualised and cloud-based services are also envisaged and may bring additional benefits by making possible to democratise high-quality media production for the benefit of an open economy and the final user.

Human-Machine Interaction

The use of audiovisual media has nowadays become ubiquitous in almost any area of application, businesses, economy sectors or socially. However, in many cases A/V content is merely presented to the user with limited interaction possibilities. Additionally, resorting only to these two senses to illustrate real-world events or to pass information to users may reveal to be insufficient. New forms of interactions with machines and immersive environments should be devised incorporating additional senses other than sight and hearing, which could have a strong impact in our professional and private lives. It is envisaged the use of spatially distributed sensing devices and different rendering technology to provide multi-modal, interactive, augmented reality and immersive experiences to users and replicate such experiences in multiple locations.

Machine Learning and AI

Content creation and distribution methods should evolve in such a way as to embed computational intelligence and semantic knowledge into the media and throughout the media processing, communication and presentation infrastructures. This would enable:

- to increase the ability to dynamically adapt media to the users, different contexts and technical environments;
- to generate more realistic digital models of real-world events, registering multiple sensorial properties of the physical space, allowing to replicating those events elsewhere and enabling content repurposing ;
- to improve user experience by developing new input/output interaction paradigms and considering additional sensorial properties other than auditory and vision.

Special attention should focus on **challenges** that develop systems for the automatic production of subtitles and sign language of video content using recent developments in Artificial Intelligence applied to machine translation.

3 major technological challenges for the media and creative and cultural industries have been identified:

1. STSME Automated + Multilingual: the goal is to develop solutions that automate the production multilingual subtitles;
2. Automated sign language representation by avatar: the objective is firstly to produce a sign language representative for video content, and secondly to synthesize this representation through an avatar;
3. Big Data - Real Time: it is important to produce solutions that can handle large volumes of data in acceptable times, and also to build various large corpus needed to use deep learning.

The NEM position paper *"AI in creative Industries",* to be published at the end of 2018, explores the market, user and technical related aspects in more detail.

Cultural heritage

A coherent strategy should be devised to help preserving audiovisual archives as a means to contribute to democratising the access to digital cultural heritage and fulfil the aim of content re-usability. A vast collection of archived records could be open to the public and a common strategy for digitisation, annotation and openness, would stimulate and facilitate the use of valuable material for multiple purposes, namely education and dissemination of culture, expanding public access to important historical and cultural assets. This strategy should focus in particular on the definition of a workflow, data model and usage rights, but as well on the use of COTS equipment and on the possibility of having the contribution of a large community for digitising and annotating assets. This kind of openness, whilst reducing times and increasing the volume and diversity of digitised assets, will create additional challenges namely, the necessity of controlling both the type of content and annotations as well as the quality.

6.1) Position with regards to DEI & NGI

The European Commission has launched two key initiatives that should influence the NEM community as far as Media&Content are one of the main domain embedded in the Digitalising European Industry initiative and in the Next Generation Internet Initiative. The first one is addressing the facilitation of usage of Media&Content technologies in European Industry as the second one is defining and structuring the next generation internet that should be more human-centric and respective of the digital privacy rights.

6.1.1 Digitalising European Industry

The European Commission has launched the Digital Innovation Hub initiative in the context of the Digitalising European Industry program aiming at facilitating the adoption of ICT technologies in European Industry.

Media & Content industry have key ICT technologies that could help European industry in their daily life such as Augmented reality, Virtual reality in the design phase of new products but also hyper-personalisation in the commercial phase and also Social media as well as Media analytics to help customer needs identification.

Today, 11 NEM clusters are part of the DIH catalogue and 20 other organisations declared to address media & content activities.

Following a recent survey, it appears that almost 20 organisations are ready to join such a NEM DIH network. Such a network should offer a number of activities supporting DIH are their daily life and NEM Initiative is ready to support this network.

The objective of the EC is one DIH in each European region and also 27 National DEI initiatives able to coordinate regional initiatives

The following action plan is proposed to go further in the Media & Content sector: organisation of workshops in key regions with all DIH in order to present existing services, platforms and share best practices and also infrastructures

Many DIH have infrastructures open to their local ecosystems, it will be good to make them known outside the local / regional ecosystems and open it to any industry in Europe or even duplicate it in other DIH if any interest. There is also a need to align standardization in order to facilitate interoperability.

- Identification of Key regions for Media & Content (several DIH in Smart specialized region);
- Management of the heterogeneous missions of DIH and identify complementarities.

A survey has been carried out asking Media & Content DIH registered in the catalogue about their interest to join such a NEM DIH network; a number of them have responded YES meaning that today 14 organisations are ready to join the NEM DIH network.

Objective of a NEM DIH Network

The network of Media & Content Digital Innovation Hub (NEM DIH) will play a fundamental role in building the community of developers adopting and contributing to Media & Content technologies adoption in European industry, acting at local level. The NEM DIH Programme aims at supporting the creation and the operations of Media & Content DIH nodes worldwide.

Business hubs, determined to incubate and encourage new services, play an important role in the global ecosystem that Media & Content is spinning. As in webs, all nodes are essential to build a lasting and strong structure; but, in this case the wider the web, the stronger the structure. To encourage the growth of the digital economy, NEM DIH enables local digital hubs to enrich their services, to spin a network of enabling communities and to further support new internet-based business creation at local level. It is an effort to expand the reach of Media & Content technologies, so that as many companies or even individual developers as possible can have an easy first contact with Media & Content and take full advantage of it.

Mission of a NEM DIH Network

- To support the growth and consolidation of the Media & Content community by working locally on disseminating and introducing the technology to interested parties;
- To build local communities where the position and role of Media & Content would be developed, boosted and consolidated;
- To develop usage of “media and content products and solutions” inside the different industries of their territory.

Activities of a NEM DIH Network

- Providing local training and support;
- Supporting the acceleration of SMEs and Startups locally;
- Strengthening the links with domain stakeholders. Connecting with the local academic world and defining action plans;
- Connecting with leaders of R&D programs at a local level;
- Instructing about the Programme and impelling its adoption by more hubs, pushing the Programme a step further;
- Sharing best practices within NEM DIH and between local DIH;
- Operating a Media & content competencies exchange;

- Connecting market business needs and competencies;
- Ensuring promotion of training for students but also SMEs workers (online training).

6.1.2 Next Generation Internet

One of the most important concerns in European landscape is security&privacy linked with service personalisation. Hyper-personalisation is part of the NEM Agenda and related research topic proposals have been clearly identified in dedicated NEM Position Paper. In this context, trust is one of the key ingredients to develop the Next Generation Internet fitting user needs and wishes.

IoT will also be one of the largest sources of content in the future, which should contribute to hyper-personalisation but also augmented reality content.

To achieve such a goal, there is a need to manage and analyse all these big amount of data using new algorithms provided by artificial intelligence, cloud computing and big data technologies.

Worth to say that there is also a need for governance and law in order to avoid problem with such a "Big Brother" running with no rules. Such governance is a huge task, not to be handled by NEM, but NEM would like to alert the European Commission about such a risk. Data protection is one of the key topics to be regulated at European Union level.

Media&content should have a great contribution in order to bring the entertainment dimension to the NGI. Today most of the social media usages are around pictures&vidéo sharing and NGI should encompass this domain in order to reach the objective of a human centric Internet.

The NEM members have identified the following technology areas and research domains as the most relevant for NGI:

1. Personal Data Spaces;
2. Internet Of Things;
3. Blockchain;
4. Artificial Intelligence;
5. Distributed architectures and decentralised data governance **(dedicated call in ICT-24-2018 (NGI Initiative)**;
6. The future of Social media;
7. New forms of interactions and immersive environments; **(dedicated call in ICT-25-2018 (NGI Initiative)**
8. Other important technologies:
    - **Discovery and identification tools (dedicated call in ICT-24-2018 (NGI Initiative);**
    - Software defined technologies;
    - Networking solutions beyond IP;

*Human centric: At the service of the people and the society, Address present issue, Make "internet for the people"

- NGI: shall enable the next wave of innovations in digital services for citizens and businesses, and shall accelerate industrial transformation and social inclusion including learning and skills
- Secure, energy-efficient and high performance NGI network and service infrastructures

  - NEM contributes media use cases for beyond 5G connectivity and SDN, to drive the developments with regard to bandwidth, latency, reliability and robustness;
  - NEM adds the human/user aspect to the Internet of smart things, towards the Internet of Abilities/Skills, for e.g. industrial transformation and social inclusion.
- Advanced consumer applications
  - highly personalised access to digital/virtual objects, information and content, including social media and networks → here NEM contributes to both key enabling technologies (search, metadata, recommendation, …) as well as identifying requirements for the application of such personalized access, for e.g. news, learning, entertainment, accessibility, …
  - ensuring better user control of data;
  - ensuring better user control over hyper-personalized applications and the models that underpin them;
  - leveraging new interactive technologies (language and interaction modality of choice; mixed real and virtual world) → here, NEM could argue the importance of extended reality technologies (i.e. spanning the reality-virtuality continuum) in general, as the most likely interface at the intersection between the digital and physical worlds, for interaction, communication and consumption.

6.2) Research topics

In order to achieve the vision and the challenge that Europe have ahead in the Content and Media sector, there is a need to address a number of research topics, they are :

1. Sensing and Interpretive technologies - creating and deploying technologies that capture and preserve data from multiples sensors, extract relevant features, and infer relations from an increasing array of data and sensor inputs;
2. Wireless sensor networks, immersion and multi-sensory data;
3. Interpretative and semantic technologies and metadata;
4. Design and human-machine interaction;
5. Human-human interactions through devices;
6. Augmented reality and virtual reality;
7. Holography;
8. Immersion and multi-sensory data;
9. Semantic technologies and metadata;
10. Human-machine interaction including BCI, haptics, vocal;
11. Storytelling;
12. Data visualization;
13. Design;
14. On-demand cloud resources;
15. Security including block chain;
16. Multi-cloud environments (private, public, multipurpose, specific);
17. Virtualization including 5G slices for media&content;
18. COTS and open architectures with self-describing, well-documented APIs;
19. Annotation and metadata;
20. Crowdsourced digitization;

21. Interoperable and user-friendly DRM;
22. Quality control (end2end);
23. Online catalogues and data visualization;
24. Multi-platform access;
25. Multi-device reading software to read standard formats and with accessibility features;
26. Standards and tools for the interoperability of learning platforms;
27. Standards and tools for the management of copyright information and licences, and rights data management in general;
28. Standard technologies and tools for production and distribution of accessible digital books for visually impaired and print disabled people;
29. Content discovery online ATAWAD;
30. Infrastructure for the use of Big data by SMEs, i.e.: how to transpose the tradition of precompetitive collaboration of the sector about data (with elements such as the ISBN and the books-in-print databases, which allowed ecommerce being launched first in the book sector) to the big data environment;
31. Personal data management;
32. Personalised language technology (e.g. machine translation with emotions, gender, or other different contexts);
33. Blockchain for language services (e.g. machine translation and post-editing);
34. Multimodal content (e.g. processing image, video, speech and texts in one framework and targeting different outputs);
35. Next generation language translation (e.g. AI-driven machine translation with continuous learning capability and with human in the loop);
36. Explainable language technology (e.g. making the results of natural language processing and machine translation explainable);
37. Greener technology for content (e.g. current AI systems are relying on powerful computational resources, such as GPU, memory, storage space, which are not environment friendly. Green technology will make AI more compact and efficient with low resources, but more applicable and deployable).

6.3) Detailed roadmap 2020/22

From 2020 onwards, it is sure that the content digitalization will be quasi definitive and the digital technologies mastering will be key for content creators. Digital creativity will reach whatever corner of the creative world. Creation will be linked to a lot of cooperative objects that will interwork with the end user and the content, promoting cross fertilization of contents. Immersivity of content will be a must, while cyber security of access to content will continue to be a key factor for end user and content creators.

Digitization, (online) globalisation and new media are offering many opportunities and challenges. They are changing the way we connect, interact, participate and co-create and it causes or at least boosts social innovation. Now, there is a growing need for ways to rethink the products and services offered from the creative industries from publishers to game developers, from content generators to multiple business sectors using media as a key element in their value chain.

Technology will allow creating increasingly enhanced and interactive contents, possibly exploiting the opportunities of the IoT in certain sectors; augmented reality could be one a relevant feature of future

second screen applications and books, and gamification will play an important role. Social consumption will be increasingly significant. Real-time productions will incorporate social media interaction into story-lines to define new storytelling leading to shared and participative activities within media content.

High-quality content will be available on new kinds of devices improving quality and user experience (e.g. immersive experiences). New formats will be complemented with richer metadata so they will be easily discovered, integrated in smart data engines and automatically adapted to multiple platforms. Content can be defined as atomised, personalised, immersive, and adaptable.

Advances in content processing will provide robust algorithms to create volumetric media (from calibration-free set-ups) from multiple cameras using video information and depth. The innovation in this area will also deal with novel volumetric media representation formats, balancing compression processing requirements, compression efficiency, bandwidth and manipulation capabilities. Multiple robotics cameras (e.g. follow-me drones) will be integrated in complex generation environments and taught to auto-analyse scenarios (multi-modal data fusion and orchestration). Hybrid approaches combining local pre-processing and cloud-based synthesis supported by edge computing will guarantee computing needs involved. 5G networks will complete the scenario providing reliable network conditions to work.

Non-professional content coming from users as creators/contributors will be increasingly created and shared through social media channels. Crowdsourcing will rise among media-based content creation activities. The use of these contents by traditional channels will bring new developments regarding content analysis (i.e. for feedback, audience tracking and analysis and content shaping), business models (i.e. advertising) and copyright approaches in order to respond to this trend.

User engagement will be the cornerstone of content management. New ways of engaging the online generation in created content will be the main focus of new business models. New routes for engagement through enhanced user interfaces and produced content that utilises multi-sensory engagement through visual and audio immersion, haptic interaction and heightened sense of presence will be a dominant presence in the market.

eSports will exponentially grow, and user generated content related to gaming and gaming experience will become trending. Tele-immersive gaming will include immersive experience both as player or viewer and will be easily deployed taking advantage of edge computing and low latency networks.

Content communities will concentrate many development efforts. They can be engaged through social media based contact or within content platforms aimed at defined social groups who can engage with each other and share information and thoughts within the context of a piece of narrative or informational content based around shared activities (cultural, learning, political, leisure) or interests of many types. Well-known environments in terms of user profiles and preferences will boost personalization capabilities and the creation of new and reshaped services.

Improved user profiling via implicit behavioural analysis will improve the knowledge of final users and targeting, then ROI. Social media interaction will be used by means of big data analysis to improve the “

just-in-time" offers. New storytelling and branding experience will promote the engagement of users. Respectability, trustworthiness, and loyalty will become the main objectives of branding. Multi-access through different platforms will not be longer a problem as more accurate user identification through deep analysis will allow recognizing the end user at the end of the chain, even out of logged environments. Big data technologies and artificial intelligence will support the transformation and edge computing will supply real-time needs.

New media should support the design for all concepts to provide with the most powerful user experience for everyone. Multi-lingual accessible content will be indivisible part of content generation; the same for multiple kinds of content re-purposing. Content media factories built on the cloud and integrating new AI capabilities will be providing customized content. This kind of capabilities will strengthen integration as well.

Audio and music will thrive around 3D experience. Music consumption will be associated to big streaming platforms while new connectivity and network capacity will enable new consumption experience. Even creation will be integrated in this new "platform of integrated services" concept. Immersive systems including 3D audio will allow an improved music experience enabling customizations as selecting specific instruments, moving around orchestras and concerts, and mixing different players and scenarios.

Next content revolution will be leaded by new ways of interaction. Many types of human-machine interaction will be developed in the near future, allowing consumers a wider range of activities and a broader spectrum of experiences that can be gained from their engagement with media. Voice and gestures will become the natural control interface for media services empowering users through an easy but powerful usability.

Fundamental part of this evolution will be the increasing use of (and the innovation developments around):

- Avatars and robots;
- Haptic sensors;
- Brain Computer Interface (BCI);
- Enhanced Sense of Presence (ESP).

Gaming evolution will be built upon big on-line collaborative and immersive experiences that can be hold in different devices, even if the way the game is played need to be adapted or customized. Wereable elements integrated in gaming experience to expand the gaming landscape out of the houses and to integrate interaction with city elements (through IoT and AR) as part of the storyline, besides enhanced real-time tele-immersion (as aforementioned for eSports) will live together as the two biggest innovation in the area, providing a complete new experience and boosting creativity.

Internet of Things will be integrated in almost any sector or service. Sensing capabilities will be present in any aspect of daily live collecting valuable info and feeding prediction and personalization algorithms. The

information processed under Big Data schemas will take autonomous systems to next level: driving, energy efficiency, climate control, logistics ... will benefit from the real-time data acquisition from cyber-physical systems and real-time processing at the edge.

First implementations of 5G networks will offer new capabilities and opportunities to the different actors of the value chain. Topics like decentralization of network caching, new methodologies of media processing and application execution, advanced security, privacy and trust of the content within the network, better QoS/QoE for end-users, improved capabilities and reducing network resources with a flexible architecture, new and enhanced market opportunities for small ISPs and SMEs to join the market of audio-visual content delivery, are expected to be supported by 5G. Another issue to be solved is the increasing need for higher uplink bandwidth as user-generated-content and the media shared by social networks are changing completely the media flows through the network in a way that has not been previously considered.

The role of consumer and its relationship with industry will be completely different. Currently, the costumer is usually located at the end of a product's lifecycle. However, by 2020 "crowdsourced design" will have become a serious method for product life cycles. That means the customer will be very actively involved in product design or choice in variants. Consumers form opinions and make decisions about products, using input from a wide variety of sources, necessitating innovative and diverse marketing strategies. Additionally, consumers will provide more input into the design process. Designers will adopt crowd-sourced collections, and sellers will be able to customize their purchases in a variety of ways. This user-centered approach will lead to a new manufacturing model in parallel with the classic product life-cycle of nowadays (e.g. footwear and dresses will be designed, customized and even printed in 3D directly from customers).

Media technologies will support the digital transformation known as Industry 4.0. The integration of design and manufacturing including detailed modelling of manufacturing processes to enable joint optimization of design, manufacturing and organization will be the key in the near future. Design and simulation advances getting closer to implementation will empower industry capacities and speed of reaction to improve competitiveness. Virtual reality for simulation-based learning tools will speed-up the future workers learning curve and will improve security. Problem-solving decision will be supported by methods to capture and catalogue implementations and developments issues through intelligent analysis and visual tools.

Demand for on-trend and in-season products accounts for the explosive growth of fast-retailers–growth outpacing that of specialty retail stores. Vertically-integrated retailers will speed-up product manufacturing in short cycle times, expediting the delivery of them. Wholesalers and department stores are increasingly adopting vertical brand strategies to meet consumer demand for on-trend and in-season product. Deep profiling and behavioural analysis will feed the model both with trend patterns and individual rich personalized information.

Social media will promote not only a new framework for content generation and sharing, but it will enable new models of managing knowledge that involve formal and informal communication, collaboration using a variety of applications. By means of enhanced Platforms (SMeP) for the management of knowledge work (communication and collaboration), new social media-based services will provide mechanisms to support

the sharing of workflows within and across multiple communities. They can also provide an answer to global work trends as globalization, supermobility, cloud-based infrastructures, big data and analytics, intelligent devices and distributed computing resources and the proliferation of context rich systems. By adding social networking and crowdsourcing to companies' workflow through social media collaborative tools to boost collaborative behaviors, a new potential to improve organizational agility, increasing productivity, supporting decision making and sparking idea generation is quite easily added to the company work power.

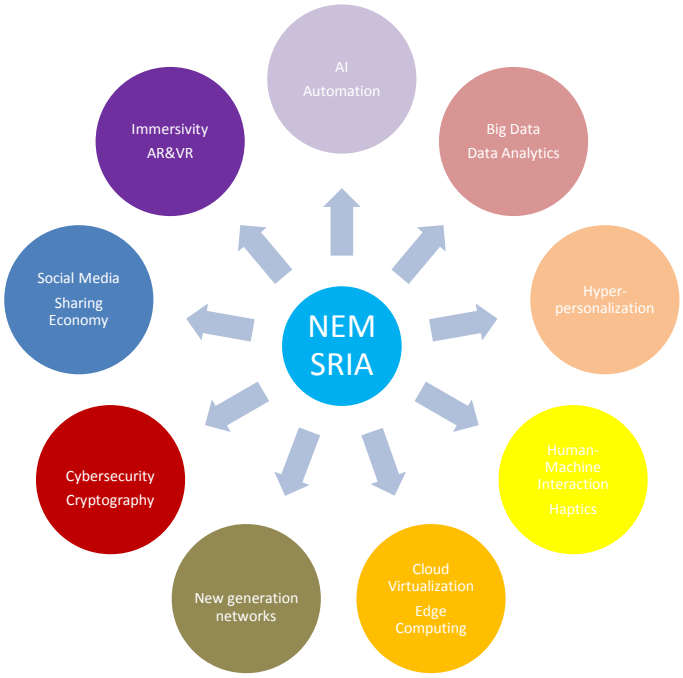
The increasing digitisation of education will boost the creation of digital learning environments, with a high degree of personalisation, specifically to integrate new skills related to most demanded technical-based knowledge. This way, teachers can enhance their roles as coaches of the educational process, giving students more motivation and aligning teaching methods to the students' individual needs and capabilities. AI will be key part on providing adaptable contents to different learning levels. The establishment of sandbox games will empower teachers to utilize digital gaming technology for learning in classroom environments. Trans-media and collaborative methodologies will fuse to enable the teaching of transversal skills. Educational series for civility, inclusion and inter-cultural knowledge can benefit from gamification. However, all stakeholders involved (teachers, schools, publishers, etc.) need to work together to ensure that ICT and digital materials are properly embedded in a pedagogic strategy, that teachers have the required skills and confidence and that the technological infrastructure (including hardware and connectivity) allows a smooth and safe use of digital learning materials. The implementation of the tools for educators to manage the digital transition will be a big part of the developments of next years.

6.4) High-level roadmap 2020/25

Content and Creative Industries, while locally, regionally, and/or nationally implemented or even governed, are moving to a worldwide framework, thanks to the digitisation of the whole value chain, from creation through distribution to consumption. These industries are updating the whole process by paralleling a lot of actions all along that value chain and reducing the production time from capture to access. This diversity often challenges established businesses and their business models, requiring them to be involved in the latest technology research and innovation activities of their sector.

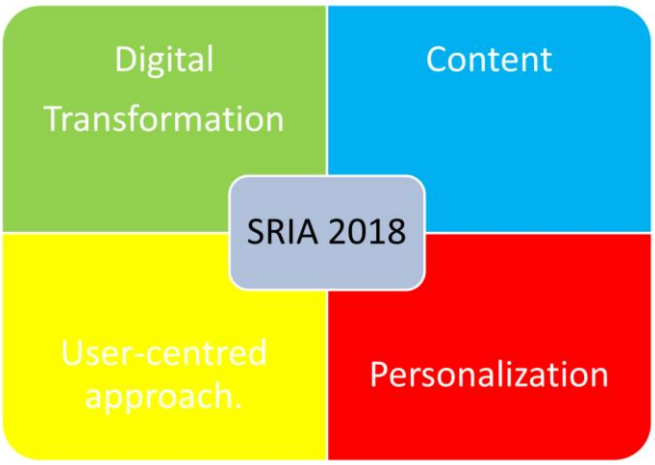
Media technology and its potential to disrupt conventional workflows and to provide innovative tools and services for many sectors is drastically influencing European competitiveness. These approaches lead to a consolidated strategy where the foreseen provision of connectivity, networked entities, real-time data, intelligent analysis, pervasive data, natural language and haptic interactions, among others are key topics to be taken into account.

The European media and creativity environment is in perpetual evolution. In order to develop the SRIA we had to consider existing technologies / solutions / services / threats and their possible evolution. In addition, we also have to consider the current and future ICT and ICT market. We are entering a period of transformation due to the nature of systems and services, including new generation networks as 5G, IoT, big data and AI, and more.



The increasing number and complexity of technologies being developed to cope with the on-going societal challenges and industrial disruption needs calls for holistic views of the ecosystem. For this purpose, VITAL MEDIA has worked on a technology roadmap to support the delineation of the strategic research agenda. VM's roadmaps serve as a framework for technology innovation. It can also be considered a visionary document about the future technologies European media companies are planning to deploy to support the business needs of the user community.

New media is marked by the very fast evolution of its products and their components which are subject to very short R&D cycles. Dynamic, disruptive, visionary, are common adjectives applied to define how media evolution works. Following, some (certainly not exhaustive) high level "**market evolutions / needs**" that may be used to justify the investment are presented. For instance, It should be consider the following phenomena:



Digital transformation

The rapid developments in the digitalisation of economic activities and societies, the emergence of new technologies and the rise in digital connectivity and interconnectedness have revolutionized all market sectors. The media sector is not alien to this reality; in fact, it is one of the most important engines in the development of this new approach.

This deep transformation, initially focused on the digitalizing of the workflows, has finally brought a wave of empowerment that has hit industry transversally, this time, on the side of consumers.

These changes has leaded to traditional product companies are transforming themselves into providers of services and ecosystems, even experiences; while, service companies are promoting the integration of physical products into their customer experience. However, the capabilities of real-time interaction have empowered users and enabled companies to include them anywhere their feedback provides value.

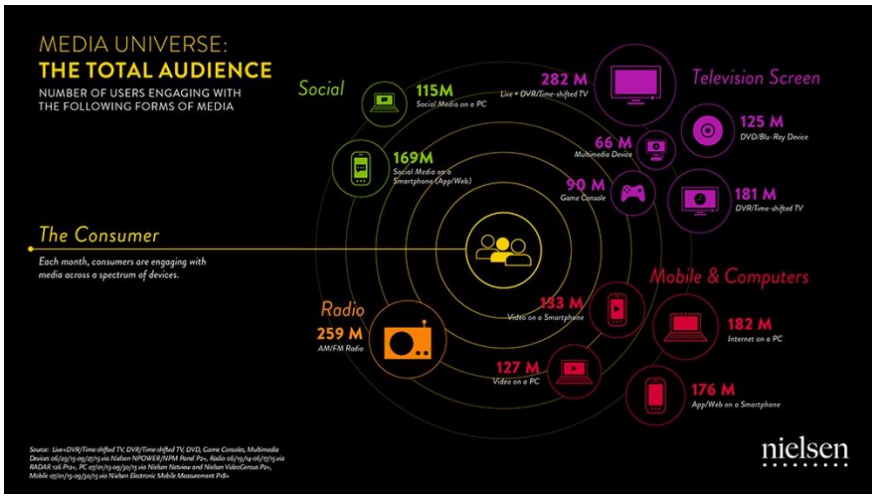
The digitalization of the media industry has been driven by changing consumer behavior and expectations, especially among younger generations who demand for new media services focusing on convenience, education, premium content and video-on-demand and instant access to content, anytime, anywhere (ATAWAD).

Additionally, other big trend is the industrialization of the media. New digital processes are changing how media is created, distributed and monetized. From a media industry historically focused on creating content and optimizing distribution, to a new reality where many companies are automating the creation, by writing algorithms to create content. Alongside the move toward greater collaboration across the industry, digital transformation is pushing companies toward the industrialization of their content-creation workflows and the automation of their content distribution processes.

Content

Much of the disruption is being driven by one overwhelming force: content. One of the most powerful current trends is the convergence of entities from formerly separated spheres: the creators and the distributors. On the other hand, traditional media and entertainment operators are contending with telco companies, social media platforms, and other newcomers reshaping every aspect of the industry. What new performing roles, new structures and partnerships will be established in the industry?

A big part of the challenge will consist of making content suitable. Content production has moved to provide material to a wide spectrum of application consumption. This includes digital platforms (e.g. websites and applications), digitized content (e.g. text, audio, video and images) and services (e.g. information, entertainment and communication) that can be accessed and consumed through different digital devices. All these channels have increased the demand of the volume of content produced, and in parallel, have opened to the users themselves the opportunity of providing content. However, social consumption has the clear lead in terms of sharing user generated content.



Nielsen has collected the number of users engaged with different forms of media across a spectrum of devices and viewing platforms.

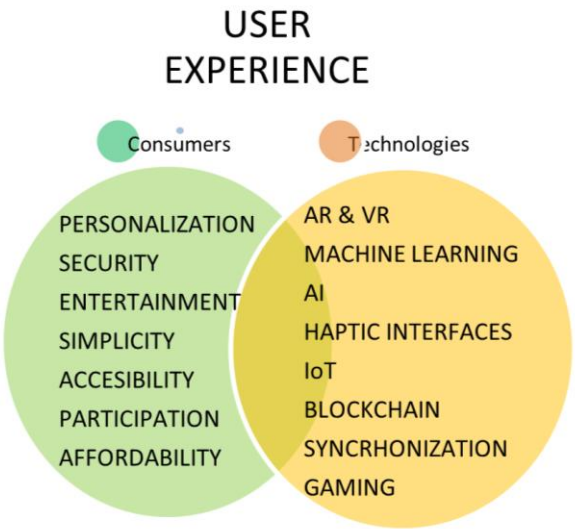
The popularity of social media continues to grow. After all, social content is one more step towards human-centered content where the consumer becomes an active node in the flow of media content, as a producer, distributor and collaborator. One reason that social media appeals to users is that it allows them to build up communities focused on particular interests.

New content formats and new type of interactions aiming at revolutionize the experience of the user are crucial part of the roadmap. A great content, along with great user experience, built upon advances in enabling technologies provide the makings of a virtuous circle. Engaging users enables the acquisition of data that feeds the understanding of them and the reconfiguration of services.

CONTENT TRENDS	The rise of the amateur content creator
	Content curation
	New content/engagement policies (storytelling, branding,...)
	DRM, security, privacy, trust for content services

User-centered approach. User experience

Media ecosystem is going through big changes in technology, user behaviour, and business models. Today's digital consumer/customer has transformed in a demanding beast. They want what they want, and they want it immediately, and want to be reached in new and exciting ways. So, "products" have become "experiences". Besides attractive content and excellent distribution, services should offer innovative user experience. Products, services, and environments—both physical and online—are converging to anticipate and meet rising customer expectations.



The steady march of digital technology has ushered in a more direct-to-consumer environment characterized by greater choice and user control. In this scenario, the user obtains greater attributions about the flow of content for himself and his social network. From a human-centered perspective, media content becomes the context of social interaction between people, which allows viewers to recommend, annotate, meet and influence the content and consumption of it.

However, these advances have created a gap between how consumers want to experience infotainment and how companies are able to produce and distribute their offerings. And closing this gap, a priority, as the solution may provide the most coveted objective, user engagement. Thus, engaging and intuitive user experience becomes a primary objective.

To engage new audiences, media businesses will need to partner with consumers to co-create and crowdsource material. Enabling audiences to interact with content creators has the potential to build more loyalty and engagement with the content, particularly if seamless second-screen support for an interactive, community-based experience can be designed.

Hyper-personalization

Hyper-personalization considers the different aspects of maximizing opportunities to customize content to consistently target the right audience throughout the customer lifecycle.

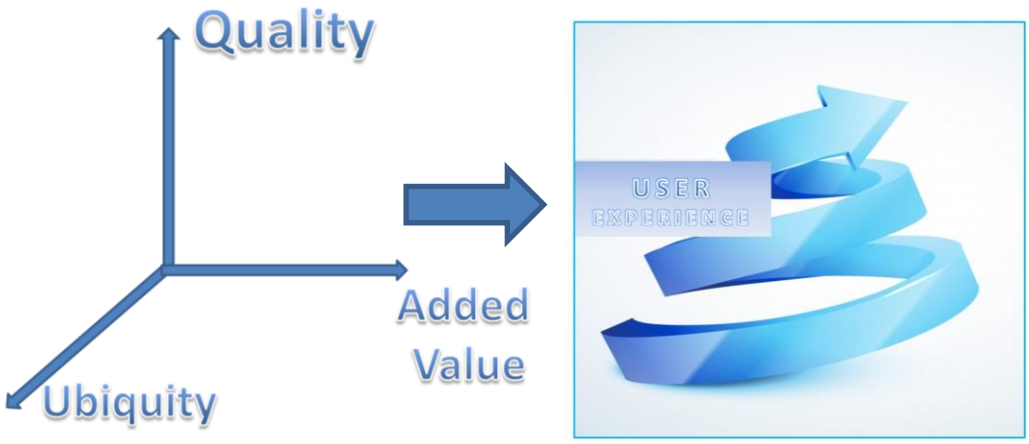
The global trend towards the extreme differentiation of offerings in products and services cannot be foreign to the sector, from the recommendation of content to the integration of the final consumer in the design processes. Hyper-personalization through very precise targeting not only ensures the best potential impact but in parallel increases the added value of products and services.

Hyper-personalization technology will allow the gap between providers' business needs and consumers' desires to be closed, allowing consumers to enjoy an increasing range of products whilst service providers battle against the fragmentation of retailing and media across multiple channels and platforms.

Here are some **technologies** to consider:

New content formats

Next years will be defined by flexible, predictive, and precise content creation, including the rise of user and community content generation. On the other hand, by the exploitation of improved computing capabilities to enrich content and to create new immersive formats that aim to provide a completely new user experience.



Immersivity will tackle with immersive communication enabling natural experiences and natural interactions with remote people very similar as real-time face-to-face experiences and interactions; and immersive content offering novel experiences aiming to improve connection, information, control, cooperation and interaction.

Immersion encompass sensorial and interactive environments to experiment a "sense of presence", allowing for performing activities in the digital world (immersive capability to engage people), in artificial, interactive, virtual created scene or 'world' within which users can immerse themselves. It also raises important questions about the embodiment of the user in his/her digital representation. Many applications also expect transfer of experience or skills from virtual reality to real world.

Immersion and Interactivity with content and technology is possible by encouraging users to take a more active role, involving them in more advanced and interactive experiences, even if they have no skills or technical knowledge.

Immersivity tackles with a lot of related technologies: visual rendering and capturing, gaze, gesture, physiological and psychological status tracking, auditory and immersive auditory rendering and capturing, audio/video correspondence, avatar representation and control, human computer interaction (interaction design and user-centered design), information architecture, usability the service has to be easy to use and attractive, visual design/user interface (UI), psychophyisics and 3D modelling.

Mobile technology

As we move further into the digital age, consumers' usage of mobile devices has become ubiquitous. Thus, content and networks continue to evolve together.

The buzz in the industry on future steps in mobile technology (5G) has seen a sharp increase, with attention now focused on enabling a seamlessly connected society in the 2020 timeframe and beyond that brings

together people along with things, data, applications, transport systems and cities in a smart networked communications environment.

The development of the next 5G network will not only provide more bandwidth and lower latency but also better convergence between networks (fixed and mobile) and also new possibility to configure the network according to the applications needs (SDN/NFV). Powerful NFV and SDN solutions, coupled with open source hardware and software, will be implemented over time to gradually automate network operations to optimize use of spectrum and network resources fundamentally shifting the economics of delivering mobile data. Another key trend is the distribution compute power. 5G takes a cloud-native approach to network design. While the cloud is usually associated with services and hardware centralized in a remote data center, the ultra-low latency of 5G will command a movement of compute power toward the mobile edge.

Another big challenge will deal with user content/data privacy because nowadays people are reluctant to put confidential data in the cloud, we will need to work on data placement and also synchronization in order to offer to end user standard ways to store content (at home, in the cloud, in device, …).

ICT convergence

All the main trends and technology evolution are mainly software based. In fact, softwarisation and virtualization are included as main paradigms in ICT main evolutions. Scalability and flexibility are two of the main goals, flexible architectures, cloud platform and good automation techniques enable treating software architecture as code, so evolution gets simpler and service deployment more agile. This way, infrastructure, networking, servers, services and interconnections all defined and managed through version controlled text files, and long-time decision related to architecture and infrastructure can be easily moved as new aspects are taking into account.

However, a special commitment to manage risk and opportunities to converge security functions/capabilities in a “Software Defined” approach should be taken. And all softwarisation career should rely on improved cyber-security systems.

Finally, the XaaS (X as a Service) approaches will remain trendy, moving the industry to consumption of services instead of by system property.

Cyber-physical systems (CPS)

CPS are complex embedded systems integrating sensing, computing, communication, networking and control. Nowadays, every single device can provide continuous interaction and deep fusion for open embedded computing, real-time communication, remote managing and planning.

CPS uses embedded sensing devices to acquire data and information, transfer data via the connected network systems, store and process the data and information (with intelligent logistic systems) and make decision according to the results.

The widespread availability of cheap sensors, personal connected devices, as smartphones, and cloud computing, are enabling to reach the potential of The Internet of Things, a network of connected machines delivering smart services, which will offer the media industry a whole range of opportunities to create seamless, personalized services.

Big data technologies

With the growth in data, content, and end-users, information will need to be metered and managed. 2020 will see the rise of predictive analytics, collaboration and workflows that impinge upon all aspects of media business.

Big Data can open up the lane to fast success to businesses in the entertainment and media industry. It can help negate the biggest risk factor in the industry – changing customer behaviour.

Big Data can help have a steady pulse on the shifting customer preferences. It helps reduce customer churn, creates alternate revenue channels and also boosts customer acquisition and retention through data intelligence.

In the end, it creates a new ecosystem where customer experience is put as the centrepiece.

Artificial intelligence

In many interactive systems and medias, AI tools, and notably machine learning, could be used to computationally model the users of such systems. In particular, according to users' input, e.g., their behaviour and interactive patterns, a model of the users traits, states, skills and preferences could be built. This model could then be used in order to provide users' with personalized contents and experience, adapted to each user.

As a matter of fact, recent technological developments keep pushing the boundaries of intelligent systems in creative applications. Simultaneously, the exploratory nature of the creative process is raising important technical challenges for AI such as the ability for AI-powered techniques to be accurate under limited data resources, as opposed to the conventional "Big Data" approach.

Other **non-technical aspects** identified as key in the SRIA an integral part of the roadmap:

- Education, training, skills development.

One of the central problems in contemporary information society is the gap between rapidly evolving technology and the slower production rate of new content for emerging media. To avoid this gap, a new type of education is needed.

Digital skills are in high demand across all industries; new roles are emerging and should be assumed by the entities in charge of providing well-trained people to enter the working world.

- Machine learning and artificial intelligence;
- Digital marketing;
- Distributed and additive manufacturing;
- Internet of things;
- Automotive infotainment and connectivity;
- Big Data and analytics;
- Cryptocurrency;
- Cybersecurity and fraud detection;
- Fostering innovation: development of a creative and media innovation ecosystem and boosting SME's and start-ups.

Innovation speed is clearly needed within media sector to face the quick evolution of technology-driven opportunities and user expectation. Small and focused enterprises usually are more suitable to cope with this environment, so SME's and startups' activity has become a thermometer of innovation potential within sectorial markets. Talent, access to technology and a 'change the world' attitude are allowing these companies to bloom across the world, creating new businesses and lean models. Once this breed of company reaches scale, it invests both in raising the quality of its content and in offering new services, putting competitive pressure on traditional media companies. Anyway, these companies may flourish as established innovation ecosystems are deployed, and this fact should be guaranteed and pushed through networking and research frameworks where media can be solidly developed (including appropriate funding schemes).

- Redefining the new content value chain moving to user-centered approach

Good user experience dictates that users' needs take priority. A user-centered approach to creating and packaging content focuses on the end-goal the organization has for the audience and the impact the organization wants to have on their audience's behaviour. To increase the ease of usability, readability, and audience engagement, content should be presented with a flexibility that takes into account users' appetites for information.

So, the involvement of users/consumers/citizens in the innovation system developed by a content creator leads to the development of a great deal of ideas, knowledge, and experiences and greatly increases the capacity of innovation of all parties involved.

- Policies: Standardisation, regulation and certification

In an increasingly complex context of convergence and social media, where continuous innovation changes are taking place due to the entry of new players into the market and the need for traditional stakeholders to transform themselves, the policies and regulations governing this sector need to be discussed and reviewed on the basis of changing needs. In this perspective, the cooperation of all the stakeholders involved to exchange ideas, current and new needs deriving from these changes becomes fundamental to build in a balanced way an appropriate policy framework that can support the future economic and technological development of the convergence and social media sector.

In terms of standards, the trend aims to build on European and worldwide standards involving all stakeholders to create large-scale usage.

- Societal aspects

Regarding societal aspects, inclusion, diversity, and migration are the main topics.

Additionally, the ability to send and receive messages is required at an increased level in a modern information society. In Europe, there is a continuous need for people with an understanding of society, cultural identities and media. However, one should not underestimate the importance of technological knowledge; it is essential in bringing out humanistic views.

6.5) International cooperation

Involved in the digital economy with R & D & I, societal challenges, industry led media, creative clusters and professional associations/federations/platforms, NEM and its members are ideally positioned to foster excellence of research through worldwide level objectives.

Back in 2014, the NEM EG-group conducted a short survey among NEM members questioning their interest with regard to international cooperation. Since then NEM stakeholders deployed international actions, and thanks to EU financing, various extra European platforms (some are listed below in Figure 1) started – still very modest, but existing – research activities at regional levels.

Figure 2: Worldwide Clusters in connection with NEM members

Today, it still appears important to develop a European international research and innovation cooperation strategy. Many European companies are successful in the Europe, but internationalization, in terms of research and innovation, export and sourcing remains a challenge and only a few reach beyond EU borders. Therefore it appears crucial to:

1. Foster excellence of research: attract the best researchers around the world to cooperate with European researchers in the field of NEM technologies;
2. Promote NEM projects and results, in order to:
    a. Widen applicability;
    b. Disseminate project outcomes;
    c. Favour exploitation and go to the market.
3. Share the NEM vision and SRIA;
4. Take into account specific needs from other worldwide regions: foster international projects with mutual interests;
5. Help the European industry to develop products/services outside Europe;
6. Establish strong links with non-European stakeholders (addressing NEM activities):
    a. Local clusters and platforms: to reach out easily all stakeholders including SMEs and web entrepreneurs;
    b. Industry representatives (with R&D departments);
    c. Academia.

The idea is to develop international-based excellence; for example, through artificial intelligence for media and access services, but not only, allowing Europe to compete clearly with the US and China.

Between Europe and other world regions, common grounds out of previous surveys are, for example: content search, content processing, data analytics, storage/cloud, user interaction, big & open data, new

formats (UHD, 3D video and sound), virtual and augmented reality, metadata, brokering/aggregation, accessibility, publishing, books and text based digital media, emotional monitoring, user behavior and to some extent rights management.

Raise awareness and address bottlenecks (through the clusters/TPs) remains a priority

Feedback from international clusters clearly indicates that awareness creation among the stakeholders about what a cluster/TP is needs time. The concerned communities see as major issue to bring over an abstract concept and become operational locally. Individual investments are necessary to get concrete results. These are common experiences for all EU Coordination and Support Action (CSA) related projects.

The message to repeat and develop is all about being “strong together” with common NETWORKING, SRIA set-up, LOBBYING, contribution to public calls and societal challenges, COLLABORATIVE work to prepare the future and get collaborative PROJECTS, on an industry led basis. NEM, in strong cooperation with the European Commission should be able in the future to identify and support local clusters and communities to facilitate cooperation. After INCO project times clusters are expected to become / should become a strong vector for sustainability of international cooperation.

Special attention and awareness creation should be paid to SMEs and emerging countries and local clusters as they are very few involved in R&D processes. Perhaps the European Commission could envisage co’-financing and allow European industry leaders to play a key role in developing media and content related research and innovation in those countries, especially as industries may bring long term R&D opportunities against short term business needs in most of these regional businesses.

How can NEM members contribute concretely on international cooperation?

Globally, the NEM interest in other regions of the world is economically driven and of strategic interest in terms of R&D/innovation.

NEM members have the following interests in international cooperation:

%	Interest in international cooperation
47,6 %	1/ Business development / Market diversification / Global take-up of products and services for R&D activities
30,6%	2/ Knowledge transfer / Knowledge sharing
16,6%	3/ Networking and partnership building
4,7 %	4/ Cooperation for Trustworthy ICT

To achieve this, the members (academia, industry, SMEs, clusters) would bring at different levels the following actions, for example:

- Share relevant information and best practices in a specific domain and experience;
- Participate to identify and promote intra/extra European clustering activities;
- Share international experience in given regions;
- Supervise a publication;
- Conduct international workshops;
- Integrate a NEM commission and be active;
- Provide and facilitate contacts in different regions;
- Matchmaking with content industries and SMEs;
- Attending networking events for NEM and preparing specific projects and calls;
- Offering research results;
- Organize seminars / symposia / WS, invite colleagues to WS and conferences;
- Expanding the range of partners;
- Establish collaboration agreements;
- Enlarge the NEM community bringing CCIs and ICT incubators working in the cultural and creative sector coming from those countries.

Beyond those actions. NEM stakeholders intend to play a role in education through media, online disinformation eradicating, and inclusion through media, which means to work on artificial intelligence and deep learning, get involved in IoT, the blockchain technologies, and other already highlighted issues above (see section 7.2). For coming initiatives, it goes without saying that NEM members will involve international cooperation clusters still operating in different regions and in order to capture their priorities: Maghreb (MOSAIC), Africa (African Media Initiative), Latin America (Connecta2020), East Europe (EECA Horizon), India (EU-India FI-MEDIA[4]), ASEAN (Connect2SEA), USA (Picasso) and others.

[4] http://www.bic-fimedia.eu/ Funded by Delegation of the EU to India https://eeas.europa.eu/delegations/india_en

7) Conclusions

The NEM SRIA 2018 is providing an update of the vision and the corresponding research that needs to be made in order to achieve the objectives of the NEM Technology Platform.

In the next Horizon Europe program, NEM SRIA is mostly contributing to the Next Generation Internet (NGI) Initiative and the question that NEM is willing to address are the following one:

"How should the Future European Media ecosystem be like?" The NGI already provides a strong *leitmotiv:* it should be human-centric. Recent events have proven the relevance of research and innovation areas that contribute creating a **trustworthy, pluralistic and sustainable European media and creative industries ecosystem**.

"How can the New European Media Initiative contribute to that vision"? NEM's efforts should foster the development of **technologies and knowledge** that will make possible a European media ecosystem that is concurrently:

(i) safe, inclusive, humanist; and
(ii) innovative, competitive and sustainable.

Most of the research topics identified above should contribute to such a goal, we can summarize them in the following tables:

Strategic goal	**Research and innovation areas**	**Focus**
Safe, inclusive, humanist media		
Mainstreaming accessibility-by-design.	Standards, technologies and tools for intelligent, auto-adaptive contents and experiences are accessible for all people.	**Intelligent, autoadaptive, multimodal contents and experiences** for people with diverse hearing, movement, sight, and cognitive **abilities**; and/or **languages**.
		Methods for **hyper personalized assessment and adaptation of multimodal content delivery** and display to suit user specific needs (abilities, languages).
Safeguarding the rights of children and other vulnerable groups.	Methodologies, technologies and tools for enforcing restrictions and protocols meant for protecting vulnerable groups.	End-to-end **privacy-enhanced methods for preventing access to inappropriate or harmful contents**, as defined by common laws, by minors and vulnerable populations.
		Privacy-enhanced safeguard systems for the **prevention, detection, mitigation and countering of potential infringement and misuse of own image** in media contents or for media benefit; including undue profiling, exploitation and abuse.
Ameliorating the weaponisation of information.	Methodologies and software tools for automatically detecting harmful actions, effects and contents	Self-regulating methods for mitigating AI-generated **filtering bubble effects**.
		Detecting and countering the actions of **fake news bots**.

	(including multimodal), sources, and propagation patterns that can be used for early warning and campaign containment without restoring censorship or hampering freedom of speech.	**Automatic detection and countering of harmful multimodal contents** that contravenes law or international agreements (e.g. hate speech, apology terrorism, etc.)
		Automatic methods for **detecting and countering manipulated multimodal contents**.
		Detecting and countering **deliberate manipulation of information flows**.
Maintaining collective memories; imagining futures.	Standards, methodologies, and tools for enhanced enjoyment, preservation, management and reinterpretation of tangible and intangible cultural heritage, as representative collective memory on top of which imagine common futures.	Piloting of interoperable, non-invasive, **immersive experiences for facilitating enjoyment and learning in diverse cultural spaces**.
		New methods for **capturing, preserving and collectively curating intangible cultural heritage, including contemporary practices** in all their richness - not just a cultural manifestation, but the wealth of knowledge and skills they convey.
		Open, reusable, multimodal assets and environments for the creation, recreation and representation of collective memories and shared futures.
Innovative, competitive and sustainable		
New accessible software and hardware solutions for the creative industries.	Enhanced, cost-efficient technologies for the capture, processing, hosting, displaying and distribution of multimodal contents in the converged era; includes environmental impact of devices, energy consumption, etc.	Novel **immersive content capture HW and techniques** (360 cameras and microphones, multi-camera, light field, hybrid technologies, acquisition technologies) sustainable and including eco-friendly materials.
		Standards and formats for the **representation, processing and distribution of interoperable multimodal and hybrid** contents.
		New methods and technologies for **optimizing production and post-production processes**: automation relying on emergent technologies (e.g. AI, cloud, IoT..), multimodal editing, collaborative editing, immersive/interactive content production tools etc.
		Novel and improved **HW and technologies for the consumption of new forms of media content** (interactive, immersive, personalized, multimodal) that increase realism and sense of presence, prevent audience isolation and preserve user privacy.
	Seamless, non-invasive sensing, sensing inducing and interpretive technologies for effective multisensory integration in immersive experiences.	**Sensing and interpretive technologies** for capturing, processing and preserving data from **multiples sensors**, extract relevant features, and infer relations from an increasing array of data and sensor inputs useful **for human-machine and human-human interactions**.
		Smart **sensing inducing technologies** for evoking **multisensory sensations** in collaborative and interactive environments.
	Monitoring and assessment of QoE and novel quality	Advanced **QoE definitions and metrics** for the characterization, modelling, manipulation and

	measures for new media and contents.	evaluation of sensory processes involved in **immersive storytelling**.
		Privacy-enhanced and cost-efficient methods, SW tools and applications for **enhanced user-aware monitoring and evaluation** through precise QoE measurements in real environments.
		Automatic quality control functions, including predictors, for optimizing end-to-end content production processes.
Fostering new business models, services and products for next generation media and contents ensuring plural and quality media and CCI ecosystems	Boosting a transparent, fair, participative, accountable and ethic data-centric economy.	New **Social Media network paradigms** and enabling technologies for **community-owned social media networks and platforms, social connectivity, and social media services**.
		Methodologies, standards, platforms and tools for the **valuation and management of copyright information and licenses**, and **rights data management** in general, including a focus on **user-generated-content ownership** and copyrights.
		Methodologies and tools for **estimating and managing the information and economic value of user data** hidden in big data (e.g. personal data, data coming from sensors, etc.) and **new sustainable models for exploiting the user data** in personalised service provisioning.
	Hyper-personalized media and seamless CCI services in a converged environment	New **privacy enhancing technologies and methods for mass customization, user profiling, targeting** and seamless **user-tailored experiences delivery** (e.g. cross-device, cross-channel)
		Development of methodologies and platforms for **detecting bias and discrimination in automated decision making** by algorithms operating in the open web (e.g. targeted advertising, e-commerce and online price discrimination).
Empowering users and consumers to play active roles in a rich, transparent, plural and competitive European media ecosystem	Distilling and transferring necessary knowledge for CCI stakeholders to effectively adopt and exploit the novel media and content technologies.	Systematization and standardisation of new languages and narrative possibilities, including **notation, composition rules and storytelling guides for new contents** (e.g. immersive media).
		Piloting and fostering early adoption of novel technologies in CCI vocational training to obtain feedback from young, creative and future CCI professionals, while increasing their competitiveness due to early exposure.
		Creation and maintenance of **open repositories of multimodal content assets, commons, and environments, protected by open licenses,** for the use of in-training and job seeking CCI professionals (e.g. practice, portfolio creation).

	Promote media literacy and digital skills initiatives, at all ages, for increased transparency and user awareness.	Mainstreaming **media literacy contents into early education curricula, and fostering educational activities that expose and explain how media content technologies work**, and how they contribute shaping public perceptions, identities and opinions, and consequently culture and society.
		Tools for **opening up and giving visibility to collective dynamics and interaction patterns on online participation platforms, and knowledgebase (e.g. Wikipedia)**, in order to improve collective awareness and foster effective and transparent deliberation, and collective creation processes.