Position Paper on Future Research Directions

Opportunities for an Innovative Digital Europe

NETWORKED & ELECTRONIC MEDIA

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The principal concept embodied in this document is based on a recognition of the long-held view that a state of permanent change is the only form of stability. Heraclitus' philosophy is based on "Πάντα ῥεῖ (panta rhei)" meaning "everything flows" in ancient Greek. 2400 years ago, Plato cited Heraklitus with the words: „Pánta chorei kaì oudèn ménei" (Everything moves and nothing remains). This is ancient knowledge, but seems equally to characterise the world of our contemporary information society.

In summary, this treatise should draw our attention to the landscapes of future research and economy from the perspective of NEM, the European Technology Platform on Networked and Electronic Media. It expresses the common view of the NEM community and explains the need for public support for future collaborative research activities in the NEM domain.

This NEM Position Paper represents a high-level view for themes that would be relevant for the upcoming EU Framework Programme 8. The document is a follow-up to the previous NEM Specific Research Agenda (as found at www.nem-initiative.org). It will be updated regularly to reflect new input from NEM members. As complement to this Position Paper, NEM is publishing a list of research topics prioritised in line with comments and ideas expressed by the NEM community.

I. Where will we go? Where are the opportunities?

This document summarises the challenges and opportunities for the future European research directions in the NEM domain. Section I describes the main trends whilst Section II discusses Europe's strengths and determines Europe's diverse cultural heritage as the basis of Europe's knowledge potential. Section III concludes on innovation partnership as a means to cope with our grand societal challenges. Sections III deals with the various areas of innovations whilst Section IV orients itself to market, societal challenges and education. Sections III and IV encompass a series of precise action lines that may help to catapult Europe to the forefront of IT development. The vision is that industry and state authorities might go hand-in-hand in order to create Digital Europe, resulting in an unprecedented IT penetration within all areas of our society and our daily life.

Following is an abstract of the trends and opportunities currently identified:

Connected Society

In the not-so-distant future, everybody and everything will be connected to a network (fixed, mobile, satellite) wherever it is. This new paradigm will open many new opportunities for business, in particular in the NEM sector. For example, connected 'things' will be able to provide information that will enrich existing content. People will be able to use any type of device to access any type of content adapted to their situation (at home, on the move, driving a car, in a train, on a plane, …), and public live cameras will be accessible by anyone wherever he/she is. Network bandwidth and quality will increase significantly with fibre networks reaching closer to the end-user's point of access. Increasing bandwidth capacities of LTE/4G mobile networks will enable users to access high definition and even 3D/holographic content on the move. In addition, increasing uplink bandwidth will allow for new types of services such as online content storage, 3D videoconferencing, and tele-immersion.

All these network evolutions will help people to share in real time any type of content within their social community, to communicate with remote contacts while feeling as if they are together at the same place.

However, high bandwidth network connectivity will not immediately become available everywhere in Europe due to a number of constraints. The roll-out of fibre networks will be limited by cost factors and LTE/4G coverage cannot be expected to cover all areas of all European countries within the next few years. Consequently, mechanisms able to optimise device connectivity according to the available networks are crucial for a seamless experience from the user's point of view, and unavoidable quality fluctuations need to be minimised.

As the currently growing landscape of application stores continues to evolve, we will see the concept extend towards more online content, applications and service (cloud-based) with pay-as-you-use business models, allowing people to forget about device compatibility, updates, or additional virus protection.

We can summarise this future network paradigm as:

- *Anything, anytime, anywhere on any device.*

Knowledge Society and content availability

An impressive phenomenon of our information society is an ever-increasing amount of new audiovisual content

that is available to all. Content is created by professional producers as well as by prosumers or just by Mr. and Ms. Anybody.

High-quality production tools are no longer the preserve of audio-visual (AV) professionals. The advancement in technology is available to all. HDTV cameras are common place, the first 3DTV cameras can already be purchased, at affordable prices, by any AV amateur.

However, much content is still only available on a specific display and/or at specific locations. It remains a challenge to turn the request for "anywhere, anytime, any device" into reality. So, content scalability for seamless consumption is still an open issue in order to allow AV access at home, on the move, from the office, in the car, while abroad, etc.

As technical quality is potentially not an issue anymore (today, there is a proliferation of technically high-quality content) the perceived quality of the content comes through its intrinsic value. To distinguish valuable content from junk content is still up to personal judgement, and whether technology may be able to help in this assessment remains to be seen. Whether information in the content is actually true or false is independent of the technical production process, and cannot be related to whether the content has been created by multimedia professionals or as UGC. The research challenge is to assist citizens in finding and selecting truthful content when they wish to do so; quality content should be available to all, the younger and the elderly, for people with and without special needs.

- *A policy of all-embracing Digital Inclusion is essential in order to overcome the digital divide and to turn Europe into the most advanced IT area world-wide – for everybody. This is one of our grand societal challenges.*

User interfaces and immersive experiences

Recent years have seen a plethora of intuitive user interfaces, on various platforms, such as smart mobiles, touch-pads and game consoles. The 3D TV is catching up and IPTV is coming to our living rooms. In the near future, we will see a proliferation of 3D, immersive and beyond-HD experiences, with interfaces becoming even more intuitive, including speech, tactile and multisensory interactions.

This shift in the market opens up many new opportunities for business, particularly in the NEM sector. For example, connected TV is becoming a rich open platform, where web style applications are projected to bring another wave of economic growth in the NEM industries. Connected TVs as an open platform will deliver a multitude of new applications and services to the home, particularly for the young as well as for the aging population of Europe and globally.

The 3D and immersive experiences of this future are rich with intuitive interactions and will create new business services such as tele-immersion and tele-medicine, as well as for more traditional entertainment applications. Adding geo-location will enable Augmented Reality applications to become more broadly accepted and used, for example in tourism and cultural sectors.

Intuitive interaction and ease of use is paramount in this future. The younger generations are expecting the same ease of use on their TVs as in their mobiles and touch-pads. Multi-touch screens, audio/speech interfaces and more futuristic brain/machine interfaces will create a more direct dialogue between users and the machine, and increase the acceptance of new NEM related services.

In this future, building rich engaging experiences is the key to economic growth. For example, the ability to create shared experiences, on multiple screens at home and on the move, enriched by location-based data to build context, will allow the current content sharing paradigm to achieve its true potential of delivering rich experiences through the networked electronic media of the future.

All these advances will blend the real with the virtual, and unlock the full potential of immersive shared experiences and services with direct application to addressing some of the grand societal challenges of Europe, including the domains of transport and health. Research in immersive technologies as well as in solutions beyond 3D and HD – areas in which Europe has a strong R&D drive – is crucial. Equally crucial is to increase the speed with which this high-quality European research is taken to the market. NEM can help through our rich ecosystem and dissemination activities. We can summarise this User Interfaces and Immersion paradigm through:

- *Content is king – rich, connected, immersive, intuitive experiences are the future.*

User and usage data

The success of the Internet is mostly due to its simplicity and its ability to unify. This has been the case with the IP protocol suite at the infrastructure level, and then with the Web at the content level. With fibre to the home and 4G cellular networks, the next challenge is to make it easy for Internet users to access the massive quantity and diversity of information available on the Internet with the best possible quality. The success of this Internet of services will reside in our European ability to design and deploy a converged service means that will give access to all types of information found or to be found on the Internet: health, transportation, pictures, music, movies, power, sensors, social, etc. The Internet of Services is user-centric. It will enhance the users' experience, preserve their privacy, and offer high-quality services that improve life.

The development of new business models and opportunities for all actors in the electronic media and content industry relies on our ability to work together to design

and exploit the converged service platform. Content here is defined broadly, and encompasses power, entertainment, transportation, personal data, and sensors. We are in a closed-loop situation where network providers need customers to acquire premium content to grow their network, content creators need to bring personalised content to the customers, and customers are demanding an easy way to discover and access quality content and services. Content creators and network providers are at the heart of the challenge. There is a need to give Internet users access to a large variety of high-end personalised services and content that will be easy to discover and deliver. This will result in a faster adoption of on-demand content, online games, social networks, catch-up TV and other services such as home automation and wellness (health, power).

In order to facilitate universal adoption of online digital services based on the benefit of Future Internet capabilities, it is mandatory that those emerging services and their associated content are provided securely and in a trustworthy way between all the users who act as content providers and content consumers. To reach this objective, the Future Internet infrastructure components must be secured against intrusion, hacks and misuse. The privacy of each actor must be guaranteed and controlled especially in order to allow network authorities mandated by law, to trace illegal behaviours of connected individuals or service providers.

Content will be transformed into smart content by adding metadata during the content creation process or during exchange. This additional information will enable consumers to use any device or application to browse, search, and purchase content from globally distributed collections of content catalogues. However as users will move from one device to another, and also from their home to outside, it is mandatory that their respective smart user profile is transparently accessible from everywhere, for an easy and intelligent usage.

To boost Europe's potential for large deployment of online digital services and content, one can imagine the benefit of having access for users to shared applications for creation and distribution of new innovative services and content. These possibilities will be offered by application services located in the Cloud. The virtualization of resources will strongly impact the capabilities of users to build new innovative offers based on a lower entry ticket because of high utilisation and secure sharing of physical resources. Edge devices (like gateways or set-top boxes at home) will play a key role for enabling virtualisation implementation because they will offer the link to services and data accessible on the Cloud.

II. Europe: Where are our strengths? Diversity as an asset...

Diversity of cultures their heritages and languages

Europe is built of a variety of peoples with different cultures and cultural heritage. Europe inherits from the Greek and Latin civilisations, whilst it has been influenced over more than twenty centuries by many other civilisations, resulting in our cultural treasures of today. All European citizens share a significant common cultural framework that alleviates their communication, collaboration and living-together. We need only look to the long-lasting record of collaborative European research for proof of this statement

Large archives/collections of highest quality content

Europe's long cultural history and diversity is the source of Europe's vast collection of works, notably the archived cultural media content. There is probably no other place in the world where the density of art and intellectual production has been higher. Our archives (print, sound, film, video and other media) form the precious base for Europe's audio-visual business. Moreover, the availability of such stocks encourages the cultural community and the industry to maintain their cultural leadership by making these treasures available to all and by developing the preservation and distribution technologies to do so.

Common societal mind-set

Owing to their common history and educational traditions, European citizens have a common mind-set for societal conciseness and problem solving (despite all their individual cultural and linguistic diversities). We welcomed the Euro as our common currency, we realised the challenges of the climate change and the need for green energy and production, we agreed on a common European Commission and common policy in numerous domains.

Collaboration has a long-standing tradition

Collaborative research emerged in the Western part of Europe and has now spread, with strong momentum, to encompass the new EU countries. Cultural differences bring cross fertilisation in the approach to new topics, notably in the research domain. There are plenty of examples from space exploration, through the Airbus Industry to the Large HADRON Collider (LHC) at CERN.

High level of education (schools, universities, research centres, training of skilled personnel)

Education is a very strong point of Europe, well recognized at the international level. The dense network of universities and technical schools, which, for a long time,

have been developing contacts and co-operation, is a strong asset from which all citizens take advantage, through the training of skilled personnel and through the availability of relevant and well-structured expertise that can then be applied to our industrial production. More than any other resource, education is the pillar of Europe's prosperity and wealth.

Awareness of environmental issues and societal challenges

There are big (societal) challenges facing the global community. In practically all cases, modern ICT can significantly contribute to counter these challenges: from humanitarian interventions in cases of natural disaster and the problem of fighting poverty to the alleviation of the effects stemming from global warming or to helping the elderly or people with disabilities to live more safely and have assistance in their familiar environment. Europe has already proven its ICT capabilities in these new domains, and beyond in the classic network technologies such as GSM or DVB, both of which were developed in Europe. The tsunami alert system installed in the Indian Ocean is also a prime example. In combination with other technologies such as sensing water waves, ICT resulting from collaborative R&D work in Europe has created a decisive solution that could save many lives in the future.

Europe is cognisant of the potential of ICT for industrial export and is already placed at the forefront of applying ICT to new societal challenges. Further research should help to maintain and foster this position in initiatives concerning the application of ICT to energy savings, the ageing population, Internet for all (e-Inclusion), security etc.

Pursuit of sustainable approaches

Europe's most important task is to take advantage of all the assets listed above in a form that these assets can be exploited effectively for the benefit of the European community. It is a positive consequence of Europe's current political construction that relevant structures for initiating research programmes have been installed that, in turn, provide the basis for the implementation of a common and efficient approach to research and technical development. In fact, this model has been followed by others world-wide. The coordinated European approach is now a rule for all topics that should best be addressed at European level, to the benefit of all citizens in our Information and Knowledge Society.

Europe provides the legal framework for efficient exploitation of these assets

By establishing collaborative R&D programmes, the European Commission has created the legal framework for developing technologies which allow the exploitation of our cultural and industrial assets across national borders. European researchers have thus a long-standing tradition in collaborative projects – this by itself is a great asset in the global competition for technological and societal leadership.

Intensified international cooperation to increase significance of European technologies and standards in the world

Although there are examples to the contrary, Europe is potentially weak in getting its solutions and technologies accepted and exploited at a global level. In recent years, there has been some success, however, the way in which Europe's technologies penetrate the global market may need to be broadened from a small path to a wide avenue. Europe's influence in global businesses may need the development of bilateral cooperation with many countries that, in actual fact, are demanding Europe's technology, notably Europe's ICT technology. This is a very long process that has already started, but there is still a long way to go. One solution could be to follow this motto:

- *Put Europe at the forefront of sustainable and green ICT solutions*

III. Innovation Ecosystem and Innovation Partnership

NEM is moving towards a Technology and Innovation Platform, creating an innovation partnership geared around the grand societal challenges. This includes use of NEM technologies and research outputs, as well as design-driven and business model innovation, to fast-track solutions and to deliver innovative products and services. We would like to play a proactive role in making Innovation Partnerships happen and assist the EC in delivering the Innovation Union and Digital Agenda. We propose the following key actions:

Innovation Partnership: From NEM value-chain to NEM innovation-chain

NEM members cover the whole value-chain from R&D, corporate R&D, Education and Academia, Academic research, SMEs, corporations, industry and equipment manufacturers, content and service providers. In the online world smaller entities can innovate without the need of large infrastructures and it is therefore even more important to support SMEs and create innovation policies that put SMEs into the driving seat of European growth. To complete our value-chain into a powerful Innovation chain, we are in the process of involving and partnering with innovation catalysts including:

Education: business schools, to complement our high quality academic members and together help design curricula to improve entrepreneurial skills

Access to Finance: Venture Academies and Business Angel communities, to bridge funding gaps and bring together SMEs and other NEM innovative companies with VCs/BA. A much wider exploitation of some of the

currently available European funds should be pursued; among others: risk-sharing financial capacity, structural funds, and cohesion funds.

Broader Innovation: Innovation forums, Executive Coaching Professionals and Associations, to help corporations and their executives think through and deliver business model innovation. The concepts of "Open Innovation" and "Viral Innovation", where research, technology development and implementation of technology results (overall new innovation concepts within the Innovation Europe policy) should be exploited to their maximum extent.

Large Scale User Trials: test-beds and living labs, to test innovations in larger scale experiments and reach a broader European citizen base for acceptance testing.

Social Innovation: not-for-profit organisations that facilitate and support social innovation, social entrepreneurs and citizen organisations, to use NEM technologies for societal challenges.

Design: not-for-profit and other organisations working between art, design and technology, to facilitate product and service design and improve user acceptance

> ***Action 1:*** *Building EU Innovation Partnerships through NEM and our Innovation catalysts. We believe that NEM together with our innovation catalysts can greatly contribute to EC's efforts to set up Innovation Partnerships and we are looking forward to EC's response and to playing a pro-active role in making Innovation Partnerships happen.*

SME support and improved targets

Support for better access to private funding, though important, needs to be balanced by easy access to public funding and research programmes, particularly for SMEs and start-ups. Our NEM SME group has identified four targets specific to SME Innovation, during early think-tank debates. These help deliver faster innovation and better support innovative SMEs in Europe: 1) create research programmes suitable for SMEs and simplify participation rules and governance (faster, simpler research funding procedures and support at national/regional/EU levels) 2) stimulate and assist SMEs to participate in larger EU R&D cooperation initiatives such as European Technology platforms and public-private partnerships 3) take a wider view of SMEs, to identify cross-sector programmes and open innovation models across global value-chains and 4) share best practice between researching and non-researching SMEs.

> ***Action 2:*** *Improve access to public funding and research programmes for innovative SMEs. We are committed to improving these four targets and would like to bring the above recommendations to the EC and support its efforts to foster innovative SMEs and the conditions that allow them better access to funding.*

Proactively engaging with the EU to build Innovation Chains and Partnerships

We are in the process of creating a cross-ETP innovation workgroup, to combine best practices and facilitate Innovation Partnerships that use a systems approach to deliver cross-sector innovation.

We also believe that the cultural, art and design sectors are key catalysts in building innovative products and services and increase user acceptance. We are pleased that design and the need for a European Design Leadership Board have been identified. We recommend that this is extended to include actors such as artists working on NEM technologies and creative media industry players, and organisations that facilitate the interactions between art, design and technology.

NEM can help engage these communities with our members and together with key stakeholders from non-profit and social entrepreneurship sectors in an inspiring and results driven way.

> ***Action 3:*** *Use ETPs to build a systems approach to cross-sector innovation.*
> *We would like to bring these recommendations and approach to the Digital Agenda and we wish to play a leading role in connecting Technology Platforms into a powerful innovation partnership. We look forward to EC's response and together with the European Commission to help create Innovation Partnerships that will speed up delivery of global solutions to Europe's societal challenges.*

IV. Market, societal challenges, education

Market

The Networked Electronic Media market is moving very quickly, driven by new technologies such as smartphones, 3DTV, web tablets, but also new forms of content as well as games.

In this new situation, business models also need to change. We have already seen in the recent past the emergence of Over The Top players (Google, Facebook, Yahoo, …) we will obviously see new comers in this huge market. Fibre networks as well as LTE will be deployed in a few years, giving opportunities for new applications (cloud, xAAS, …) which will in turn give opportunities for new comers. This is a great opportunity to accelerate innovation in the NEM area but there is also the need to

work on the value chain and on the position of existing stakeholders.

> ***Action 4:*** *A need to set up specific activities within NEM and ask for specific research topics in the next work program addressing new business*

We can also see that people are ready to pay-per-use, but are less and less interested to buy a licence - this will also drive future business models. In the NEM area, people are creating more and more UGC and professionals are more and more using this content to build their services (news, TV shows,...). People will be interested to use simple services to get a financial return under any circumstance.

> ***Action 5:*** *A need to develop a standardised micropayment service in order to offer customers the possibility to monetise content exchange with anyone.*

Societal Challenges

Acceptance of technology by society

The global evolution of people's perceptions regarding networked electronic media technologies (devices, services,…) leads us to a vision of future media:

- More immersive: 3D, holographics for entertainment content as well as video-conferencing and games should take advantage of these new technologies.
- More personalised: people having access to more and more information and access to the right information at the right moment, need more generalized context awareness and information profiling. In addition, information is becoming obsolete very quickly, so there is also a need to propose information rating services.
- More collaborative: people are used to communicate and share content through social networking and to work more and more in a collaborative way. This implies that a combination of content sharing and interpersonal communication services becomes necessary.
- Anything, anytime, anywhere on any device: People use several types of devices depending on location and personal context. There is a need to be able to provide any service on any type of device, whatever the connectivity.
- All these services should obviously be in line with people's behaviour :
  - People are attracted by new technologies which answer a need (e.g. iPhone, DVB-T, …)
  - People are becoming Green and will use services which lower energy consumption
  - Elderly people are TV centric in the same way as young people are smartphone centric
  - Wireless technologies are accepted best from a usage point of view but are badly accepted from a health point of view.
  - Future high bandwidth connectivity (FTTH and LTE) will boost NEM applications and will be widely used in Europe
  - Digital Home complexity will need high level Customer Relation Management in order to help people to configure their home network
  - Privacy is a key factor that need to be addressed from a technical point of view as well as from a regulation point of view

> ***Action 6:*** *NEM ETP could be used to simplify and hide the technology for the user. All the technical complexity should be hidden so that users are able to experience new innovative services without any technical knowledge.*

Net neutrality

Future media is highly linked with net neutrality as far as most eServices will, in future, use media and content. Everyone should have access to:

- Culture, cultural heritage,
- Education,
- Public services,
- Health services.

Net neutrality is a corner stone for NEM application development; everybody should have access to information whatever its connectivity and the device used.

However, it should be possible that the QoS should not be equivalent for everybody depending on the contract and the location.

> ***Action 7:*** *Net neutrality is a corner stone for NEM activities, NEM could help through position papers to help regulators to take the right decisions.*

Link to Grand Societal Challenges

Our European society will face some huge societal challenges in the near future and obviously NEM should help in these fields. NEM is user centric and should take into account the Grand Societal Challenges mainly in:

- Global warming: Due to air pollution (industry, cars, home heating, …) and increasing levels of atmospheric CO2 causing an increase in overall global temperatures, which will have a major impact on our future life (storms, rising sea levels, increasing desertification, …)
- Tightening supplies of energy: Fossil energy will be less and less available; there is a need to find some new resources, but also a need to save energy.

- Water and food: Due to the enlargement of the world population, it is and it will be more and more difficult to have sufficient food and water for everybody.
- Ageing societies: Owing to medical advances, people are living longer and there will be need to help people to stay at home.
- Public health, Pandemics: It is in our basic instinct to live longer and longer, medicine is making great progress but there are always new viruses arising that need great efforts in research but also in public infrastructure which are more expensive and difficult to fund.
- Security: Citizens expect that their environment, which now includes communication and internet as well as their physical safety, will be secure and well protected. This is especially important now that the opportunity for cyber crime as well as physical crime represents a threat to European society.

The Main interest for NEM is Smart culture and knowledge and content: European culture is very rich and European people are so creative that we will be soon overwhelmed by information and archives. With search engines becoming more and more powerful, there will be a need to assist people with content management including helping people to "clean" their information wherever it is stored.

As influential technology platform in networked and electronic media, NEM forms a crucial part of the ICT's hyper-sector and represents an important critical mass for European research in this field. Consequently, NEM should also contribute to:

- Global warming through new immersive communication applications to avoid travelling
- Ageing society through new multimedia applications helping elderly people to stay at home and to keep in contact with their relatives

How can we ensure content/information availability and the meeting of responsibilities/obligations of companies (public services)?

- In our future society, most interactions with public services will be done through the Internet
- Public content will increasingly comprise of multimedia and should be accessible in any situation
- People should be able to join any public service using synchronous and asynchronous communication services instead of queuing
- Information rating: information still stays on the net even if it is obsolete
- Language translation: one content, many local publications

Action 8: *NEM ETP is user oriented and should lead think tanks on culture and edutainment and also contribute to Energy savings as well as to services for the ageing society.*

Regulatory aspects

People expect their political leaders to protect them, to the greatest extent possible, against the multiplicity of everyday threats. There are numerous fields where good regulation is applied to the benefit of the citizens. Standards for healthy food or medicaments are implemented and monitored by pertinent inspections as well as enforcement of rules for safe driving or working. With respect to the IT sector, individuals as well as companies expect secure data storage and protected data transfer. Personal, company or governmental data should not be accessible without prior permission by the owner of the data. This is a basic request, the fulfilment of which represents the fundament of acceptance and success of the IT technology: No trust – no business!

Action 9: *NEM is helping to implement data security and personal privacy when dealing with digital data. Pertinent research is solicited and position papers will be developed that work on the fair balance between data protection and the business opportunities available with the advent of new IT services.*

Education

According to Section III of this document, and related to "Innovation", NEM is creating an innovation partnership geared around the grand societal challenges. Among those challenges, education is a basic pillar and starting link of the innovation chain. Without a solid, comprehensive and stimulating educational period, NEM will not evolve as Europe expects it to, neither in speed, nor in quality or number of researchers.

Are students prepared for the future?

It is recognized worldwide that higher education is a great national asset, contributing to the social good, and empowering the economy. According to the recognized study by EDUCASE about "The future of higher education" of 2010, education is one of the main drivers of change and evolution for any country, and conditions its innovation and development capabilities in medium and long term planning.

Following Marc Prensky's naming ideas, our current students are "Digital Natives". They were born and have grown up surrounded by technology. They are used to receive up-to-date information, they prefer graphics to text, and they are used to hypertexts and random linking searches, multitasking and parallel processes. They do better and over-perform when they work in groups, interconnected. They do not need to "learn" the special "language" of current technology, language that the "Digital Immigrants" (not "natives") need to learn, in

manuals and user guides that the Digital Natives scarcely look up. This new profile of students needs new teaching procedures, new ways of communicating knowledge that take into account more participation, more self-search, and learning by practice.

NEM imply technology with a fast obsolescence cycle, and with a special need for actual professionals in specific ephemeral fields participating in the teaching activities. As a consequence, the students should be more deeply involved in the day-by-day activities of companies, to experience the dizziness of the idea-design-implementation-selling short cycle. Therefore, new teaching procedures and Masters programs should be launched or updated to cope with the current needs, and appropriately prepare our students for the future.

But this new education should also be sustainable, in terms of costs and environmental impact. The new teaching mechanism should be designed to preserve the social, economic and environmental ecosystem.

The future shape of higher education will be influenced by new structures and new business models, enabled by information technology. But currently, many are driven by cost, access, or novel approaches. The engagement and stimulation of students should be achieved through constant interaction, problem solving, and reflection. The educational experience is increasingly connected, experiential, flexible, and driven by individual preferences and needs. Social networking tools enable connections and collaboration, whether social, scientific, or civic, and should be considered as a basic tool for human relationships and knowledge exchange. In addition, international mobility and sharing of experiences and learning procedures clearly benefit both students and professors. The current international networks of students will become the future international networks of researchers.

New models for education

As students become more diverse and as learners' needs expand across a lifetime, more flexible models for education are emerging. Online learning and accelerated programs provide greater flexibility than traditional campus programs. To promote international exchange, transferability of credits from one institution to another becomes necessary, as time-to-degree increases and lifelong learning grows.

The creation of this new educational model requires collaboration across organizational and national boundaries, bringing together the collective intelligence of people from different backgrounds including education, corporate, and government. New educational programs should be created, with new profiles and fields of expertise, following (and promoting) the innovation strategies of the NEM companies.

New professional profiles, including Graduate, Master and Doctorate programs should be identified, involving the whole set of actors in the definition of the contents: Industry, European Technological Consortium, Stakeholders and Universities. The basic target is to obtain new professionals with a deep knowledge of the wide NEM sector, its needs, closer to the market, with a special emphasis on the needs of innovation and creativity, to promote the development of new systems and new services, according to the social evolution. The active involvement of all actors is crucial, and the international mobility of both students and teachers is essential to avoid endogamy, to create partnerships at different levels and stages of the process, and to reach a real networked educational framework.

> ***Action 10:*** *To identify new educational programs for the future NEM professional, with the involvement of the whole NEM community. Innovation, creativity and international mobility should be embedded in the new profiles.*

V. Conclusions and implementation guidelines

Working to the benefit of the European citizens, helping to let the digital divide vanish in Europe, assisting in realising the EU's Digital Agenda – these were the drivers for the compilation of this NEM Position Paper. Starting with an analysis of the future societal and business opportunities in the wider IT sector, and taking into account Europe's cultural diversity as an asset that we inherited from our ancestors, this document describes briefly a series of ten Actions considered necessary in order to achieve these illustrious goals. Clearly, new ecosystems and progressive educational strategies have to go hand in hand in with research and large, medium and small companies in the NEM field.

The NEM stakeholders and authors of this Position Paper are firmly convinced that public initiatives, such as the European Commission's ICT Framework Programmes, form a powerful and effective instrument to profoundly foster European research, development, and innovation activities while addressing the bigger picture of sustainable growth and societal challenges. Consequently, this document represents a high-level view for themes which NEM considers to be relevant for the EU Framework Programme 8.

NOTE: This Position Paper is complemented by a list of potential research topics for the ICT Framework Programme 8. That List is published separately.