Guild mission proposals for the next EU Framework Programme for Research and Innovation

Aarhus University
University of Bern
University of Bologna
Ghent University
University of Glasgow
University of Göttingen
University of Groningen
Jagiellonian University
King's College London
University of Ljubljana
University of Louvain
University of Oslo
Paris Diderot University
Radboud University
University of Tartu
University of Tübingen
Uppsala University
University of Vienna
University of Warwick

The Guild of European Research-Intensive Universities • Rue du Trône 98 • B-1050 Brussels
Phone +32 (0)2 2740 500 • office@the-guild.eu • www.the-guild.eu

implementation of digital solutions for society also relates to ethical principles for scientific research (e.g. informed consent and transparency) that need to be revisited and reconsidered. Fundamental ethical questions are raised by new digital technologies, such as the role and responsibilities of intelligent machines, and access to and ownership of data. Europe should become a forerunner in ethically reflecting on the effects of the processes of digitalisation, including foresight, and early warning and monitoring.

4. Technology and digitalisation

Unequal access to technology and communications represents an important aspect of the digital divide. For example, (mobile) broadband is available to (86%) 71% of European homes in urban areas, but only to (36%) 28% in rural areas. This limits the possibility to innovate in e-agriculture, e-farming, e-commerce, e-working and e-government across Europe. In addition, the development of an effective e-infrastructure is essential for effective e-education innovations, which are needed to build digital competence among citizens, students and workers. The digital economy depends on affordable access to effective communication, computing, data flow and data storage. Thus, supporting research and innovation in e-infrastructure is an essential part of a strategy to eradicate the digital divide.

In addition, data-security and privacy-protection play an ever more important role in a digital world. We cannot afford an erosion of the trust we have in the digital infrastructure, since trust is a condition for normal economic transactions and inter-human communication. Security relies on both technological solutions and users' competencies. To build a resilient digital infrastructure, promote inclusive and sustainable industrialisation, and foster innovation, it is imperative to provide data-security for all sectors of society. Also, the development of sufficient competencies among relevant user groups can be seen as the basis for the advancement of businesses, for science, and for society in general.

B. **Impact of the mission on society and science: What could be achieved through the mission? Which UN Sustainable Development Goals (SDGs) would the mission address? What would success look like and how could it be measured?**

1. Democratic development (SDGs 16, 17)

By 2026 the innovation processes of digitalisation are responsible, transparent and ethically well-argued. The impact of this mission would be measured indirectly by looking at trust and confidence levels in political governance, the European ICT infrastructure, and by incorporating academic studies that focus societal problems.

2. Research-based Education (SDGs 4, 8, 9, 10)

By 2026 Europe has eradicated the digital divide and 'skills gap' within and across countries. Challenges regarding work, basic skills, democracy as described will be reduced.

3. Ethics (SDGs 5, 16, 17)

By 2026 the innovation processes of digitalisation are responsible, transparent and ethically well-argued. The impact of this mission would be measured indirectly by looking at trust and confidence levels in political governance, the European ICT infrastructure, and by incorporating academic studies that focus societal problems.

4. Technology (SDG 9)

Effective and secure communication, computing, and data storage, are available for everyone. There is also widespread access to new business opportunities, and careers in computing, data storage and security. This, in turn, leads to a general boost for innovation in high-tech fields due to the availability of communication, super-fast computing and data storage.

5. Behavioural change (SDGs 9, 16)

By 2026 citizens, companies and public bodies on all levels in Europe are fully aware and educated to take responsibility for (their own) cybersecurity and -privacy, equivalent to the security and privacy measures citizens take in the physical world. Awareness and measures taken by citizens and employees have become common use: like locking your front door when leaving home. It could be measured by significant reduction of attacks – and their impact – by hostile hackers.

6. Infrastructure

Security and privacy protection should also be ensured within the ICT infrastructure. This includes malware detection and removal, intrusion detection and prevention, trustworthiness of networks and hardware, software security, security of SCADA/industrial control systems (ICS), and secure operating systems.

C. **Interdisciplinarity**

The proposed mission requires an interdisciplinary as well as transdisciplinary approach. It would require the contribution of the hard sciences, especially information and communication sciences, informatics, mathematics, and the social sciences and humanities, including among others, sociology, political science, economics, educational and learning sciences, media, law and cultural studies. These would all have an important role to play in this mission.

Generally, by applying a notion of basic and transferable skills for knowledge and learning, the humanities, and the social and learning sciences provide rich traditions of insight into basic properties, practices, and knowledge potential through writing, imaging, movement, and mediated and interpersonal communication. In a situation in which competencies and media platforms are shifting rapidly, it is vital to connect the skills for one particular technology and platform to basic and transferable skills.

For example, the human, and the social and learning sciences' contributions to a mission for closing the digital divide would include: (1) concepts for the further advancement of basic and transferable competences to foster knowledge creation in situations where competencies and media platforms are shifting rapidly; (2) specific digital tools for learning that are based on research insights from the three aforementioned science areas.

Similarly, the learning, educational, natural and computational sciences should cooperate to educate the teachers of the future, and to enable the flow of computational scientists and innovators by: (1) preparing students to work with intelligent machines by lifting the digital competencies of teachers throughout Europe, through strong, computational research, and innovation clusters tied to their local communities and cultures; (2) educating a new generation of digitally competent students with cross-disciplinary experience who are motivated to establish research and industry throughout Europe.

D. **How is the mission relevant to citizens?**

Digitalisation is a process everyone is personally connected to and, thus, all citizens will be affected.

A participation process must be developed to safeguard a researcher's ability to ask the right questions. This same participation process must also foster citizens' engagement with research processes using well-established and new methods, e.g. early-phase co-design activities, roundtables, and scenario workshops, among others. Moreover, citizens can help researchers generate data about everyday life in Europe (whilst ensuring that privacy rights are upheld), and in the formulation of the possible consequences of research results.

For example, by focusing the mission on education, interdisciplinary knowledge, and educational research (in a broad sense) across the whole educational spectrum, future generations will be able to handle and develop the digital information society. Projects done in cooperation with schools at different levels will serve as a meeting arena for citizens and researchers.

Mission 4 - Personalised prevention, precision medicine and healthy ageing: two more healthy years for all EU citizens by 2025

A. **Description of the mission**

"The promise of PM is so great, it is almost daunting. It seems futuristic – a departure from traditional medicine that could be difficult to embrace."

- Professor Ara Darzi, Lord of Denham & Dr Victor Dzau[1]

Precision medicine is a rapidly emerging approach based on identifying subgroups of patients with distinct mechanisms of disease, or particular responses to treatments. This approach enables doctors and researchers to identify and develop treatments that are effective for particular groups of patients. Ultimately, precision medicine will ensure that the right patient gets the right treatment at the right time, in contrast to the current 'one-size-fits-all' approach. It is widely expected that precision medicine will have a disruptive effect on future healthcare, with significant impact on healthcare providers, the pharmaceutical industry and the medical technologies supply chain. Technological advances such as DNA-sequencing would also allow for personalised prevention leading to healthy ageing.

In addition to the benefits precision medicine will bring to patients, its economic impact promises to be significant. The global drug market is now projected to grow to $1.4tn by 2020. However, a significant proportion of first drugs prescribed, ranging from 62% (antidepressants) to 25% (cancer), are ineffective, imposing significant costs on healthcare systems. In the UK alone, of the £124bn per annum spent on healthcare, medicines account for £12bn or 10% of the NHS budget. In Scotland alone, the NHS spent £150m more on drugs in 2014/15 than in 2012/13. The savings across Europe will be massive in the context of national healthcare budgets. The adoption of precision medicine will be a key factor in managing the increasingly unsustainable level of spending on medicines due to an ageing population, and provide incentives for the pharmaceutical industry to repurpose existing or failed drugs and develop companion diagnostics.

A precision medicine approach will reduce development times, lower failure rates, and significantly decrease development costs. As the aforementioned technological advances provide insight into diseases 'beneath' the clinically presented symptoms, allowing for an early disease subtyping, the 'correct' pharmaceutical intervention may already be selected much earlier than in the conventional approach based on empirical response to sequentially tested pharmaceutical interventions.

Globally, there are many initiatives underway to create national implementation strategies for personalised prevention and precision medicine, to translate science to clinical practice. However, many of these efforts lack the collaboration that is essential to come to an integrated optimised approach to precision medicine. The FP9 mission provides an unprecedented opportunity to

[1] Dzau, V., Ginsburg, G., Finkelman, E., Balatbat, C., Flott, K. and Prestt, J. (2016). Precision Medicine: A Global Action Plan for Impact. [Online]. In: *World Innovation Summit for Health*, Doha, 29-30 November 2016. Available from http://www.wish-qatar.org/wish-2016/forum-reports [accessed 20 November 2017].

accelerate the pace of discovery and translation into clinical practice across Europe, and provide global leadership of precision medicine.

B. **Impact of the mission on society and science: What could be achieved through the mission? Which UN Sustainable Development Goals would the mission address? What would success look like and how could it be measured?**

- Good Health & Wellbeing (SDG 3): There would be a direct benefit for patients across a very broad range of disease prevention and chronic diseases, which are the leading cause of mortality and morbidity in Europe, and will impose an even larger burden in the future.
- Decent Work and Economic Growth (SDG 8): The mission could lead to the creation of quality jobs and skills for the life sciences supply chain, and reduce the economic burden on national healthcare systems in the EU. Chronic diseases depress earnings, workforce participation & productivity, and increase early retirement, job turnover and disability.
- Industry, Innovation & Infrastructure (SDG 9): Successful implementation of personalised prevention and precision medicine will drive innovation and collaboration between academia, industry and healthcare providers. It will also reduce the number of prescribed pharmaceuticals, that form an ecotoxicologial burden on the European bodies of surface water.
- Reduced Inequalities (SDG 10): There are currently inequalities around access to expensive modern drugs, such as cancer treatments, due to affordability and limited efficacy. This inequality would be reduced by allowing medicines to be prescribed to those who will definitely benefit from them (which would be more affordable and effective).

C. **Interdisciplinarity**

Successful implementation of personalised prevention and precision medicine will require collaboration between academia, industry and healthcare providers.

Disciplines will include (but will not be limited to) disease-specific researchers (basic science and translational), clinical medicine, genomics, epigenetics, metabolomics, imaging, clinical physics, bioinformatics, health economics, medtech and diagnostics, engineering, data science, machine learning, and business. The aspects of healthy ageing will involve geriatricians, eHealth experts and social scientists. The implementation of preventive analyses and treatment will also require participation of patient groups, on a psychological and sociological level to ensure that implementation will optimise patient well-being.

D. **How is the mission relevant to citizens?**

The mission would be directly relevant to citizens as there would be a direct benefit for patients across a very broad range of chronic diseases. Citizens would be engaged with the mission through focus groups, healthcare advocacy organisations, and public engagement. Personalised prevention and precision medicine are new areas of science, and both patients and citizens have understandable concerns about providing and authorising the sharing of their genetic and personal information. The 2016 World Innovation Summit for Health report on Precision Medicine identified that the persistence of these concerns arguably presents the most significant barrier to precision medicine's promise.

Topics of interest to citizens would therefore include the benefits to patients, as well as delaying and preventing chronic diseases, but also the use of patient data, the ethics of genome sequencing, the role of industry in healthcare, access to expensive new treatments, etc. The patient will also take over important roles conventionally held by the caregiver, such as the periodic measurement of health through sensors and point-of-care technology. This will lead to radical changes in the analytical information content of the resulting data that now will be collected by the major untrained stakeholders in the healing process.

Mission 5 - Take arms against anti-microbial resistance (AMR): halving the number of infections and extra deaths by 2027

"Take Arms against a Sea of troubles, And by opposing end them."

- William Shakespeare, *Hamlet*

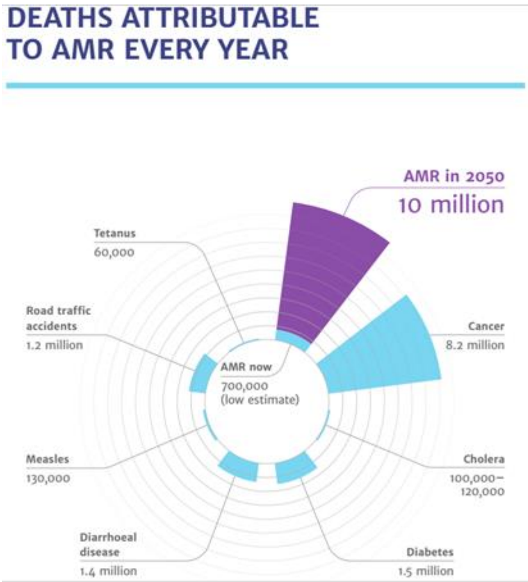
A. **Description of the mission**

The discovery of penicillin by Alexander Fleming in 1928 marked the dawn of the antibiotic age and ignited the modern era of drug discovery. It revolutionised healthcare, and to this day these drugs remain the cornerstone in the treatment and prevention of infectious diseases. It also enabled many important medical breakthroughs including safe surgical procedures, organ transplantation and chemotherapy for cancer treatment. Unfortunately, the emergence of resistant bacteria was detected soon after the first anti-microbials were introduced.

In Europe, where by 2050 up to 30% of the population will be 60 years or older, the demographic transition across lifespan will have a decisive impact on health care, leaving patients more susceptible to infections. Healthcare will allow for more invasive and complex surgical therapies using medical devices. The number of immunocompromised patients will increase. In consequence, healthcare associated infections will rise steeply. At the same time human and animal migration and globalisation will increase the intercontinental spread and the fast rates of resistance development of pathogenic microorganisms, which threaten public health. Up to 90% of the antibiotics used in livestock farming end up in the environment, with unknown consequences for water, soil, and biodiversity. Disappointingly, a very low number of new antibiotics have been discovered and/or developed due to a multitude of problems: poor efficacy, delivery issues, difficulties in setting up clinical trials and the huge costs associated with these, and generating an adequate return on investments into the development of antimicrobials.

We have to invest in innovative smart antibiotics, personalized medicine, novel diagnostics, alternative therapies and innovative drug delivery, preventive measures, and (targeted) treatment of unbeatable infections caused by multi- and pan-resistant microorganisms. If we do not act now we risk many millions of **extra** deaths worldwide by 2050. This AMR threat is eminent and affects us all; it calls for an immediate, coordinated and coherent multidisciplinary and inter-sectorial approach.

The goal of this mission for the EU is to reduce in the next 10 years, the more than 30 million infections and 1 million extra deaths by 50%.



B. **Impact of the mission on society and science: What could be achieved through the mission? Which UN Sustainable Development Goals would the mission address? What would success look like and how could it be measured?**

This mission mainly targets the SDG 3 - ensure healthy lives and promote well-being for all at all ages. AMR is the consequence of societal changes. Due to international movement of people, upscaled non-sustainable industrial developments (e.g. livestock and food production) as well as lack of access to pure water supply and emission of antibiotics into the environment and the food chain, AMR has direct and an indirect influence in SDG 3 and in SDGs 6, 9, and 12. SDG 4 and 9 are required to combat AMR.

We must ensure that we will always have strategies to inhibit further development of AMR. We need antibiotics against any occurring multi-resistant pathogenic bacterial strain. This requires a continuous inter-sectorial effort, because bacteria will find ways to get resistant again. We are never done! This was the mistake we made in the past. We trusted we had enough effective antibiotics, and the new development slowed down significantly.

C. **Interdisciplinarity**

Novel intersectoral strategies need to be developed that simultaneously address:

- Antibiotic development from discovery and synthesis towards approved drugs: e.g. microbiology, molecular biology, biotechnology, bioengineering, nano-biotechnology, materials science, biostatistics, biochemistry, pharmacy, medicinal chemistry, natural compound. In addition, microbial/evolutionary genetics.
- AMR prevention: e.g. epidemiology of infectious diseases, biomathematics, stewardship, behavioural sciences, psychology, global health policy, vaccinology, veterinary microbiology, environmental & marine biology (plus fisheries).
- Patient care: e.g. medical microbiology, novel (personalised) medicine and diagnostics, eHealth, IC-care, innovative implant-technologies, targeted delivery (incl. localised activation of anti-microbial agents).

Facing off transmittable AMR **needs a paradigm-change in healthcare**, switching from production-economic to prevention-economic incentives to promote health-span. Systems health research (former public health), combining different scientific disciplines as well as co-creative collaboration with partners outside academia (industry, politics, NGOs), is a *conditio sine qua non*. Finally, boundaries between frontier-led research and clinical/translational research need to be overcome, reaching out to problem-solving implementation science.

Future implementation of the results of such cutting-edge research requires a solid understanding of the wider societal context of AMR, leading to a call to strengthen the social sciences and humanities (SSH) agenda. **SSH research provides essential knowledge** regarding social and structural drivers of AMR. Historical analyses of AMR show how governance and health system failures have led to, and continue to feed, AMR.

D. **How is the mission relevant to citizens?**

In Europe and throughout the world, citizens will be safe from infections due to drug-resistant microbes. Modern medical treatment will only be possible if novel and smart antibiotics and antimicrobial therapies are working, and the increase of AMR is not accepted. There will be no risk of outbreak of life-threatening diseases that cannot be cured by antibiotics. Regions, countries and as a major goal the whole EU will be maintained free of life-threatening infections due to multi- and pan-resistant microorganisms.