CAS

Centre for
Advanced Studies

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CAS · Centre for Advanced Studies

The JRC's Centre for Advanced Studies (CAS) was created in 2016 to help improve and bridge the interface between science and policy in order to enhance the JRC's capacity to better inform and influence the regulatory frameworks needed to address the new and emerging societal challenges confronting the EU and our societies as a whole.

By creating the conditions necessary for innovative and interdisciplinary research, as well as offering a creative and generative space in which ideas and knowledge in emerging thematic fields across different scientific and technological disciplines can thrive and flourish, CAS has become an incubator for formal inquiry, stimulating ideas and activities and providing the JRC with new insights, data projections and solutions for the increasingly complex medium and long-term challenges facing the EU, especially in the fields of demography, big data and digital transformation.

Through the performance of advanced, cutting edge research, ranging from applied research to topics of a more academic character, all within a stimulating trans- and interdisciplinary environment, CAS allows external researchers and scientists to work together with the JRC to explore and exchange new ideas and knowledge on scientific research in emerging fields of strategic societal importance, which might otherwise fall outside the policy support activities undertaken by the JRC on behalf of the European Commission.

Projects are typically led by a senior scientist with an established reputation in the research area and have a limited duration of a maximum of three years, after which they may be integrated into the JRC's core research activities.

Since 2016, there have been five projects: CEPAM, bigNOMICS, HU-MAINT, DigiTranScope, and Paradigm Shift in Communication, which are described in more detail below. Three new projects will begin in 2020, they are: on the detection of nanoplastics using a technological platform; on examining the impact of the digital age on social classes; and on capturing social science phenomena for EU policy using computational methods.

By drawing on and attracting high-level experts from outside the JRC's core activities, CAS increasingly offers a stimulating and vibrant space where scientists are exposed to new ideas and a wide and dynamic spectrum of disciplines, allowing out-of-the box thinking for new solutions, helping to increase the visibility of the JRC and allowing it to remain globally connected within the scientific community through new strategic collaborations, as well as establishing networks with research institutions and organisations worldwide.

As part of its wider outreach activities within the JRC, CAS also organises cafes and seminars, as well as policy labs and workshops, which allow and provide opportunities for visiting professors and academics to share and build expertise with stakeholders and policy makers in a particular field, and which facilitate cooperation and collaboration through research contributions going forward. For more, information on CAS, you can visit the CAS page on the the EU Science Hub.

Finally, the Megatrends series was launched in January 2018. It aims to bring the important back office work being done in CAS and the Megatrends Hub to a wider audience, by creating a platform for nationally and internationally-recognised speakers to participate in talks and discussions with policy makers, stakeholders, scientists and researchers about current and future societal, environmental and economic challenges facing Europe, in particular the EU.
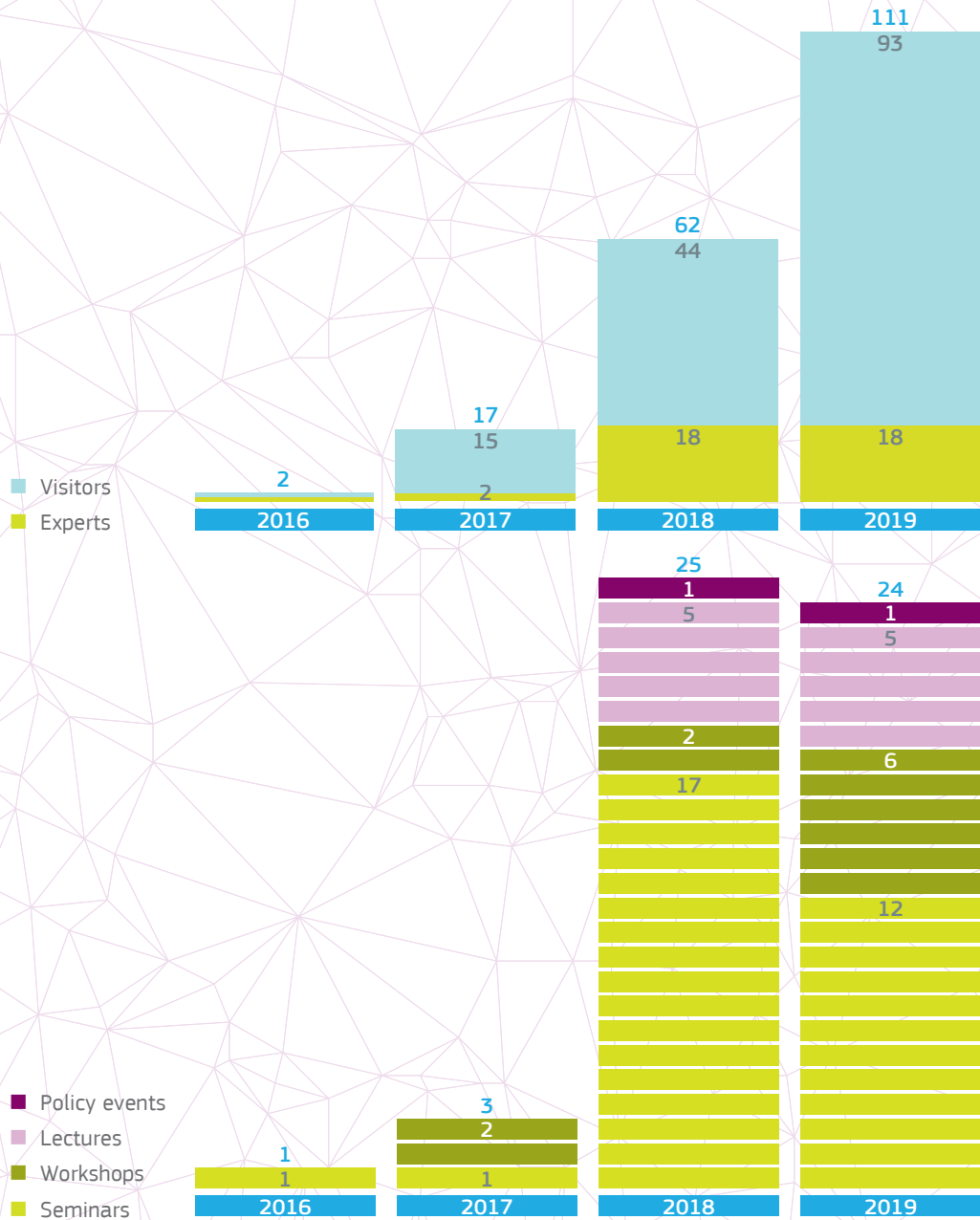
CAS in a nutshell

			Paradigm Shift	
	DigiTranScope			
	Humaint			
	bigNOMICS			
CEPAM				
2016	**2017**	**2018**	**2019**	
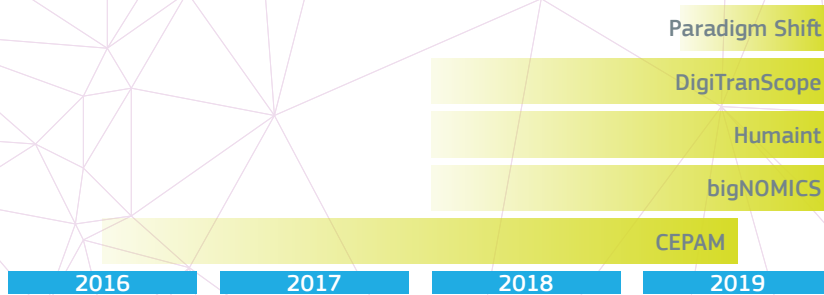
Since summer 2016, there have been five projects in the CAS. In 2019, one was successfully mainstreamed into the institutional work programme of the JRC (CEPAM) and a new CAS started (Paradigm Shift). In 2020, three new CAS projects will begin.

2016	2017	2018	2019
	10 / 5	21 / 16	21 / 16
1 / 1	5	5	5
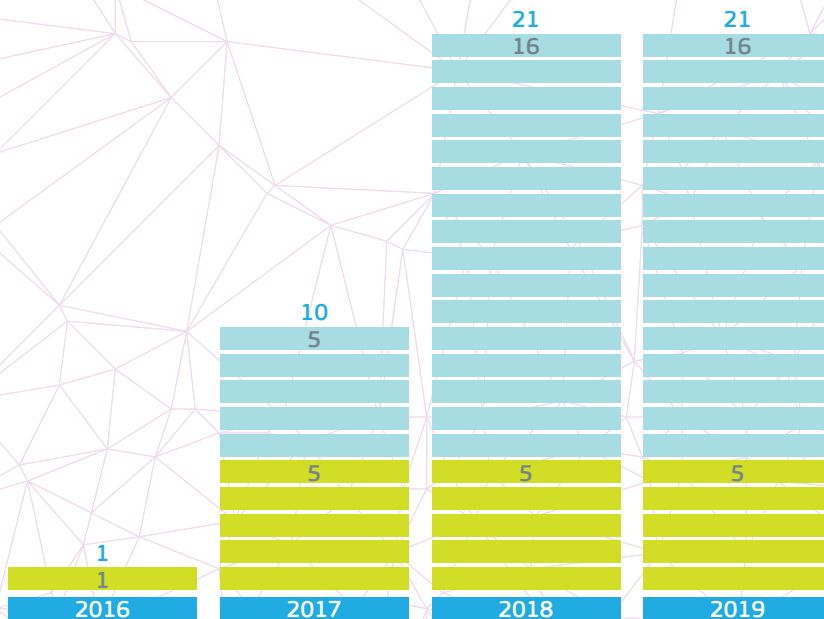
■ Postdocs

■ Lead scientist can be external experts or recruited at JRC. Some projects temporarily had 2 lead scientists.

Visitors
Experts

	2016	2017	2018	2019
Visitors total	2	17	62	111
Visitors		15	44	93
Experts		2	18	18

Policy events
Lectures
Workshops
Seminars

	2016	2017	2018	2019
Total	1	3	25	24
Policy events			1	1
Lectures			5	5
Workshops		2	2	6
Seminars	1	1	17	12

CEPAM · Centre of Expertise for Population and Migration

The Centre of Expertise on Population and Migration (CEPAM) was founded by the European Commission and the International Institute for Applied Systems Analysis (IIASA) in response to the migration events of 2015.

Despite its origins against the backdrop of the dramatic scenes of the migration crisis, CEPAM's mission was not to focus on the near or short-term, but rather to look at the medium to long-term, by providing analyses of the gradual, but consequential demographic changes taking place across the EU and beyond.

In particular, CEPAM was tasked with providing multi-dimensional assessments of future population trends in Europe, as well as in the potential regions of origin for migration into the EU. These scenarios would then be assessed, using multi-dimensional projections at the national level as well as micro-simulation models, to determine their long-term implications for the EU's labour force, social cohesion and levels of integration, so as to inform EU migration policy. The two major publications of the study are the demographic and human capital scenarios for the 21st century, and the demographic scenarios for the EU.

At the very heart of a changing society lies the number and composition of its members. Population growth has shaped the EU over recent decades and now its population is ageing. The shift towards longer-living, lower-fertility, higher-educated societies brings the EU to new demographic frontiers and with that comes challenges for societal cohesion. Facing these developments naturally prompts the questions: who will live and work in the EU in the coming decades? How many, and with what skills? To answer these questions and others, CEPAM considered key factors that would influence European demographics over the coming decades.

The CEPAM study aimed to dispel some common misconceptions around migration by moving scientific analyses forward and examining not only the role of migration, fertility and mortality, but also levels of education and labour force participation. Below are the key messages of the CEPAM study.

We are living longer and leading more productive lives

Neither higher fertility nor more migration will stop population ageing because the momentum has been set by past, long-term demographic trends. However, we are living more productive lives while observing more flexible retirement ages which will help to alleviate the economic challenges arising from changes to the conventionally defined working-age population and the increasing ratio of workers to non-workers.

A smaller better educated labour force on the horizon

The EU labour force is transforming through social development and the ageing process. The total size of the labour force is projected to get smaller over the next four decades. At the same time, the number of workers with post-secondary education is expected to grow, not just as regards their proportion of the labour force overall, but also in absolute terms.

Higher immigration volumes would increase labour force size, but much less than the essential ratio of workers-to-non-workers

While a high volume of immigration would increase the overall size of the EU labour force, it would have a limited impact on the proportion of workers to non-workers in the long-run.
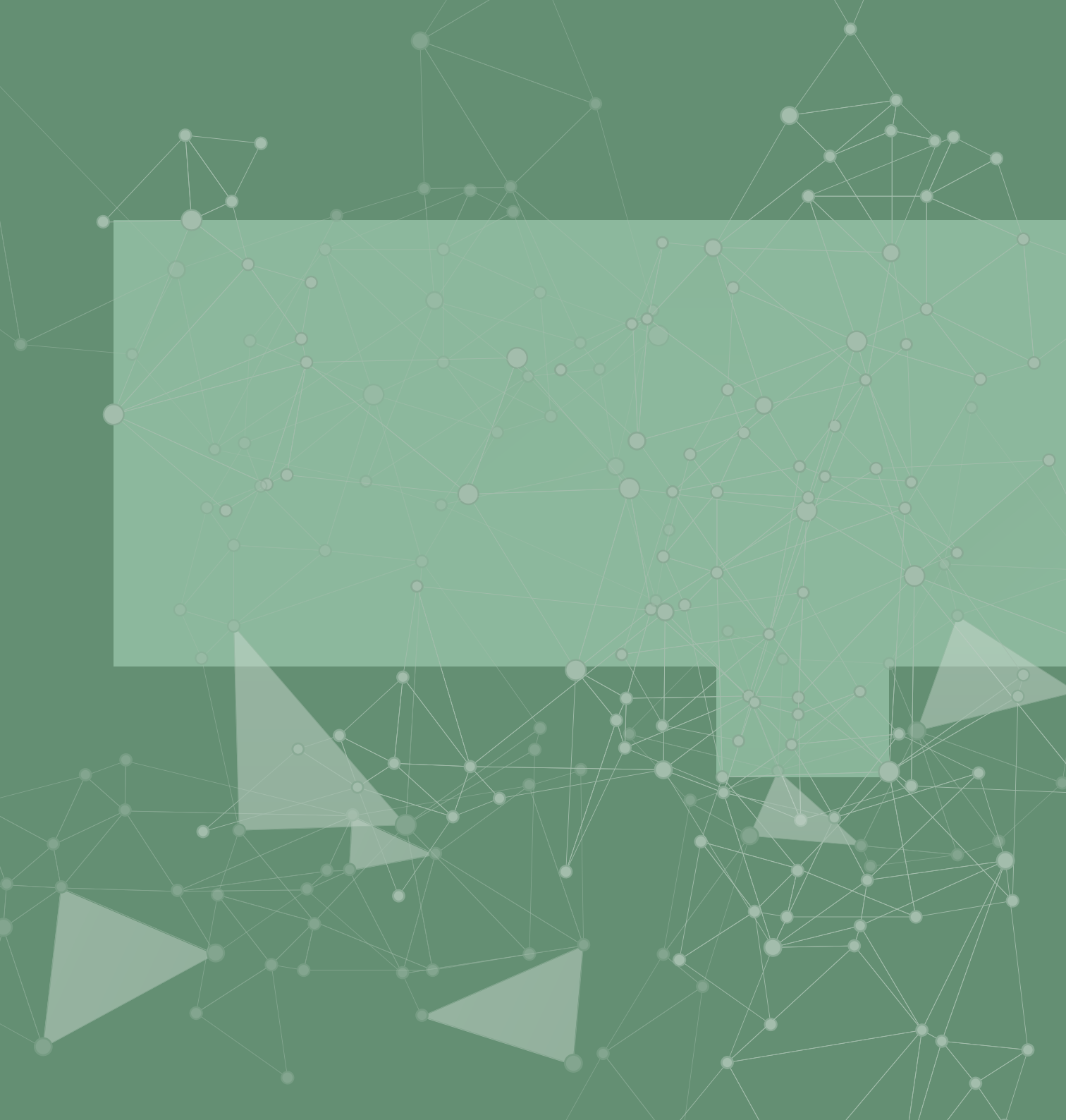
bigNOMICS · Big Data for Forecasting Economic Developments

bigNOMICS takes inspiration from the explosive growth in the amount of information collected leading to the big data era. Such a data avalanche has created new opportunities to design novel data sets that allow pressing economic policy issues to be answered. The goal of bigNOMICS is to improve our understanding of the economic and financial environment along two directions: better data and better models. First, big data makes it possible to build a set of fast-moving measures that provide early signals of the direction of the economy. However, big data in itself does not immediately result in better economics insights, if the statistical methods adopted do not account for the complexity of such data. Hence, a second goal of bigNOMICS is to adopt complex statistical models from the machine learning and artificial intelligence literature to extract relations and patterns to turn data into policy insights.

The project focuses on four important lines of research:

Exploiting economic news to improve nowcasting and forecasting economic and financial indicators

News often contains unanticipated information about the health of the economy and financial markets and their evolution over time: such as the progress of stocks and consumption, the future changes in fiscal regulations. This enables market participants to learn about recent economic events and trends, helping them to adjust their expectations about future developments of the economy and financial markets. The project collects economic news from US and European news outlets. A set of natural language processing techniques is applied to calculate sentiment indicators as well as extract emotions, such as anxiety, panic, confidence and enthusiasm, expressed by the text. These indicators are then used in traditional economic models as well as within more complex machine learning models to improve, nowcast and forecast of economic and financial indicators.

The use of loan-level data to track regional variations in household debt and default

The project analyses a dataset of millions of loans across Europe to extract proxies for the level of financial indebtedness of households in Europe, and study its evolution during the 2008 financial crisis. Understanding the drivers of the recent downturn is of paramount importance for policy makers in order to learn how to avoid socially and economically stressful events as well as decide how to optimally react should these events happen again. A further range of models from the machine learning literature is adopted to study the drivers of loan default. Many factors might influence simultaneously the decision of a borrower to default, but only few of these factors can be tuned by policy makers. A better understanding of the drivers of loan default could help policy makers to identify interventions to reduce delinquency cases, thus containing costs caused by the inefficient allocation of resources.

The trade effects of European anti-dumping

Despite the growth in international trade due to the increased integration of national economies into a global economic system, as well as advancements in telecommunications and logistics, the project observes persistent and even the intensifying adoption of trade protection measures, such as anti-dumping. Anti-dumping measures are often adopted by governments as a tool to protect domestic firms and industries. A large data set is exploited on import and exports from/to the EU at a very fine level of product detail to study the impact of anti-dumping measures on trade flows. Machine learning techniques are applied to identify early signs of duty avoidance due to the implementation of anti-dumping measures.

### Seismonomics: Measuring economy activity through seismic noise

Background seismic noise refers to the persistent vibration of the ground due to a multitude of causes, from wind and other atmospheric phenomena, ocean waves as well as human activities, such as traffic and industrial activities. Accordingly, background seismic noise is extracted to monitor human activity and use it to improve existing nowcasting and forecasting models for a set of economic indicators.
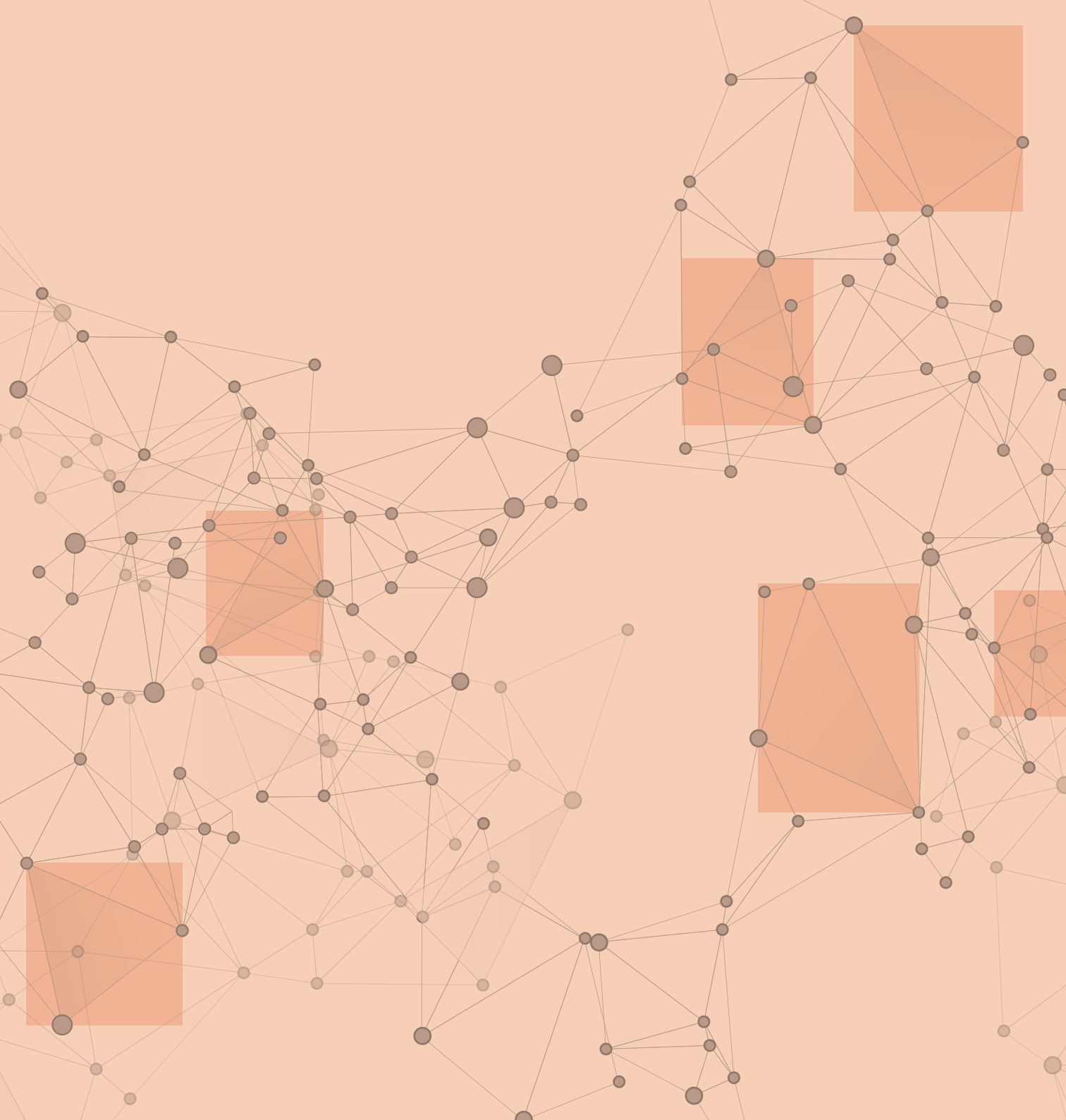
HUMAINT · HUman behaviour and MAchine INTelligence

The goal of the HUMAINT project is to provide a multi-disciplinary understanding of the impact that artificial intelligence (AI) systems have on human behaviour. The project has three main goals: to advance the scientific understanding of machine and human intelligence; to study the impact of algorithms on human behaviour, especially on decision-making and cognitive and socio-emotional development; and finally, to provide insights to policy makers with respect to the previous issues.

HUMAINT research has three main characteristics: it is inter-disciplinary, combining methodologies from machine learning, economics and cognitive science; it is reproducible: generating open publications, datasets, code and research protocols; and it is collaborative: enabling the team to work with researchers from different institutions worldwide. Through research, the project enables the promotion of value-centred and ethical approaches for the development and application of AI systems and it enables the team to actively engage in global initiatives on AI & Human Rights.
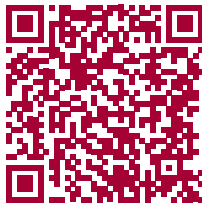
In order to have a broad understanding of the impact of AI on human behaviour, the project focuses on four different scenarios with high social impact and then it establishes commonalities between them to extract scientific and policy-relevant conclusions. A full list of HUMAINT's publications are available on their dedicated website.

The impact of algorithms on decision making in criminal justice

This scenario studies biases and discrimination in human and algorithm decision making. In particular, human and algorithm decisions for discrimination as well as the design of algorithms with performance and fairness as target outcomes are evaluated, and research is done on explaining and empirically

proving which sources of algorithmic discrimination there are. The project has looked at criminological assessments of defendants in Catalonia, and open frameworks for fairness evaluation have been created.

The impact of AI systems on the tasks we do at work

A framework for the analysis of the impact of AI on the labour market is developed by extending the task-based approach to the definition of work by cognitive abilities that are required to perform said tasks. Data from AI initiatives is used to identify AI fields with more research activity and where most progress is expected in the future, and to map these fields to the dimension of cognitive abilities. This framework is then validated on three international databases on tasks: (1) PIAAC (Programme for the International Assessment of Adult Competencies); (2) EWCS (European Working Conditions Survey), and (3) O*NET (The Occupational Information Network). Through this approach we can identify which occupations are most likely to be transformed by AI over sectors and countries.

The impact of social robots on child development

The project investigates the impact of embodied AI on the ways children develop in formal (school) and informal (play) settings. Towards this direction, various existing robotic platforms are used to conduct real-life user studies with children by designing specific robot behaviours and interaction scenarios. In the first year of the project, the impact of child-robot voluntary interaction on a child's problem-solving process and performance was investigated. In the second-year user study, the project aims to understand a child's trust development in collaborative settings in terms of robots' prior cognitive and social behaviour. In the future, the project aspires to create open-ended scenarios to investigate the role of social robots on a child's collaborative creative thinking as one of the current societal demands.

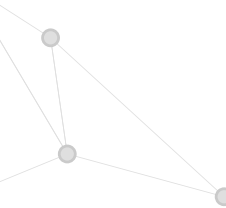## The impact of AI on music and culture

The application of artificial intelligence (AI) to music stretches back many decades, and presents numerous unique opportunities for a variety of uses, such as the recommendation of recorded music from massive commercial archives, or the (semi-) automated creation of music. The HUMAINT project addresses these two scenarios where AI can produce outcomes in a domain fully entrenched in human creativity. It intends to better understand how AI is changing our relationship with music and culture.

Finally, with regard to transversal activities, the HUMAINT project organises a yearly interdisciplinary school on AI and its ethical, legal, social and economic impact and it contributes to external research initiatives with international organisations and academic institutions worldwide.
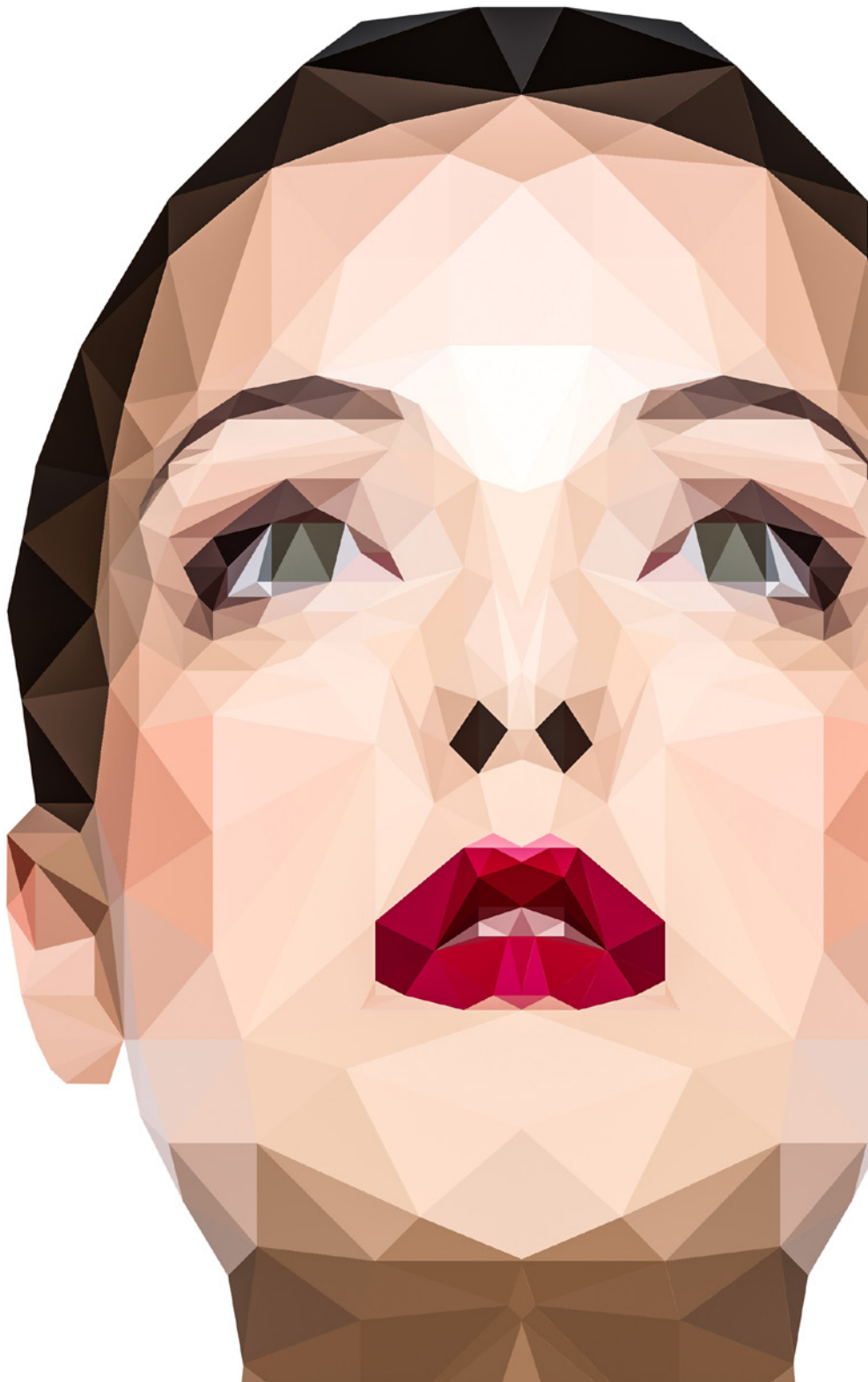
DigiTranScope
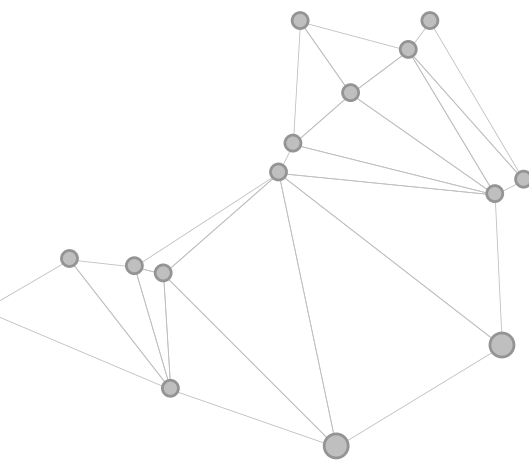
D igital Transformation (DT) refers to the profound changes taking place in the economy and society as a result of the uptake and integration of digital technologies in every aspect of human life. These changes affect both the behaviour of individuals and organisations in society and the boundaries of individuals and organisations. In particular, the processes of datafication, through which human actions and social interactions are increasingly transformed into bits of information collected by commercial companies, is reconfiguring the relationships of knowledge and power between governments, civil society, and the commercial sector.

Within this context, DigiTranScope focuses on the governance of digitally transformed human societies.

The project has two main streams of work related to the following questions:
- Is there a European way to digital transformation? What should it look like?
- What are the new forms and scales of governance enabled by DT?

The project is organised through a series of expert meetings, case-studies, primary data collection and analysis, and experiments. Through the execution of the project and the interaction with the European Commission policy DGs, the project has identified data as the crucial ground on which the governance of digital transformation is played out. For example, the Commission's Communication on Artificial Intelligence (AI) for Europe as well as numerous national AI strategies recognise that data, and increased data sovereignty, are crucial in defining a European approach to the development of AI. Therefore, one of the key challenges for Europe is to make better use of its own data (public, commercial, personal) to extract greater value for European society.

DigiTranScope contributes to this policy agenda by studying different emerging data governance models to share data between the public sector, commercial sector, and civil society, as well as the different ways in which the value generated through the integration and analytics on this data is distributed among the stakeholders. Through this line of research we identified eight data governance models that we organised into four types: corporate governance, peer-governance, public-driven governance and co-governance and are exploring them further to see opportunities and limitations of each to support European policy.

DigiTranScope is also researching ways of leveraging some of the characteristics of Digital Transformation for new forms of policy design, implementation, and evaluation.

For example, the project is looking at how the availability of digital data and the possibility to create the virtual replica (Digital Twins) of neighbourhoods, cities, and entire countries allows new forms of policy targeting using similar methods, such as the profiling in commercial platforms for personalised marketing, but rather aimed at the public good i.e. addressing first the demand of those who need it most. The project is experimenting with this in Amsterdam in the context of targeting policies to support increased energy efficiency in households.
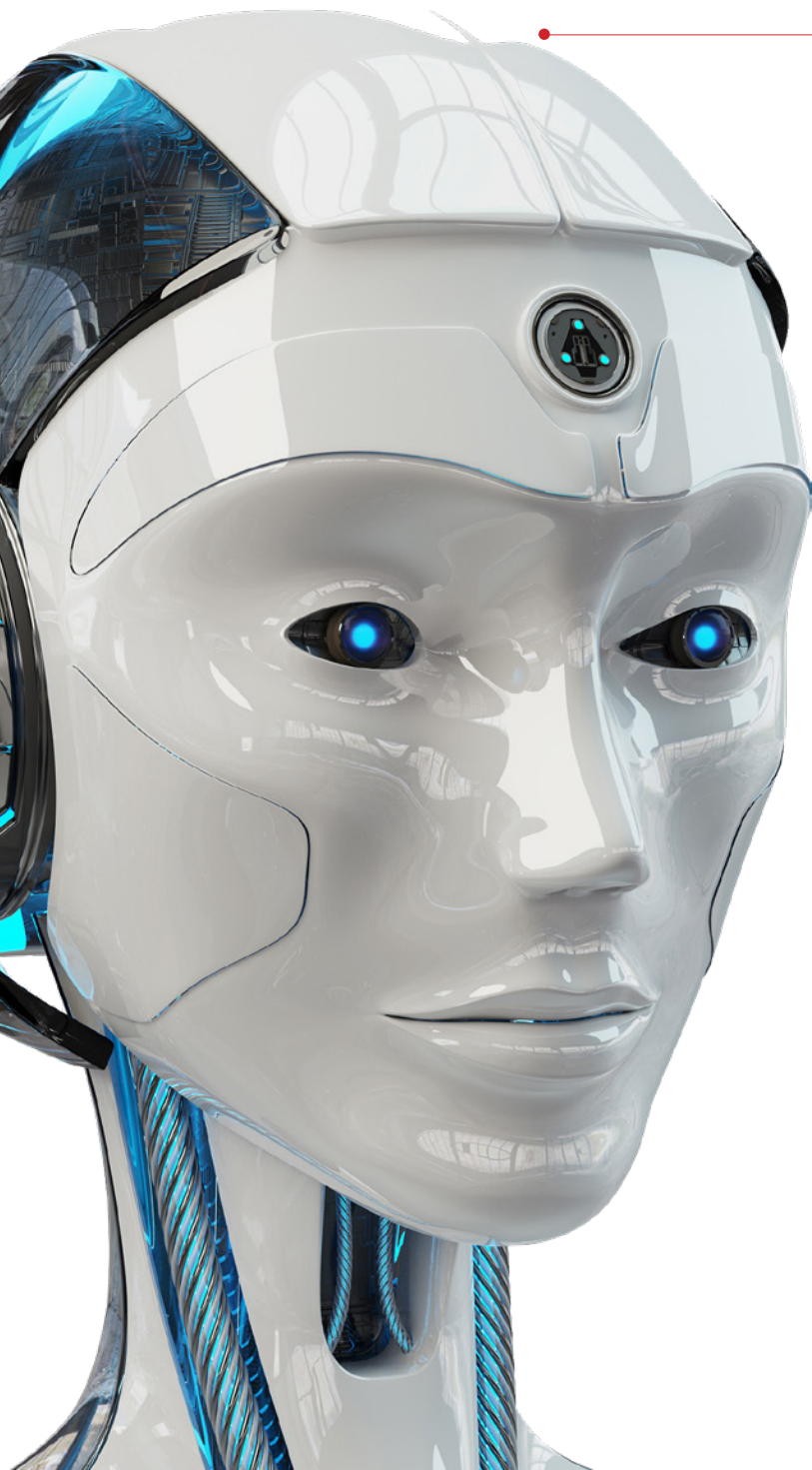
The opportunities offered by the Digital Twins and gaming environments (e.g. the whole of the Netherlands in Minecraft in the scale of 1:1) for new forms of participation and policy design are illustrated from an experiment done in June 2018 in the south of Amsterdam, where 500 children came together with the local administration, industry and academics to use this virtual model in Minecraft to help design their vision of the future for their neighbourhood. This experiment is now being replicated in Warsaw with the engagement of local schools.

A third line of work is the use of AI tools to extract knowledge from existing policy documents, e.g. by machine processing the entire body of knowledge of the Commission, i.e. all the legal texts, policy reports, and scientific articles to support impact assessments of policy initiatives.

Paradigm Shift in Communication

Starting in 2019, the focus of this project is to understand the paradigm shift within the communication realm. In particular, the project aims to draw understanding on the phenomenon of continuous and rapid growth of Internet usage as a communication means, shifting from the traditional unidirectional sharing of information to multidirectional sharing channels. This shift in particular appears to provide the very basis for the collaborative production of knowledge between citizens, scientists and policy makers, forging the ground for the former to actively participate and shape the policy frameworks at a local, regional and EU level.

The project aims to investigate the new communication role of institutions and local authorities in the digital era by exploring ways through which citizens can be empowered in their daily interactions both practically and meaningfully.

The project proposes to closely study and analyse the functions of interdisciplinary and multi-level communication and identify the possibilities arising from such a dialogue between the scientific community, policy makers
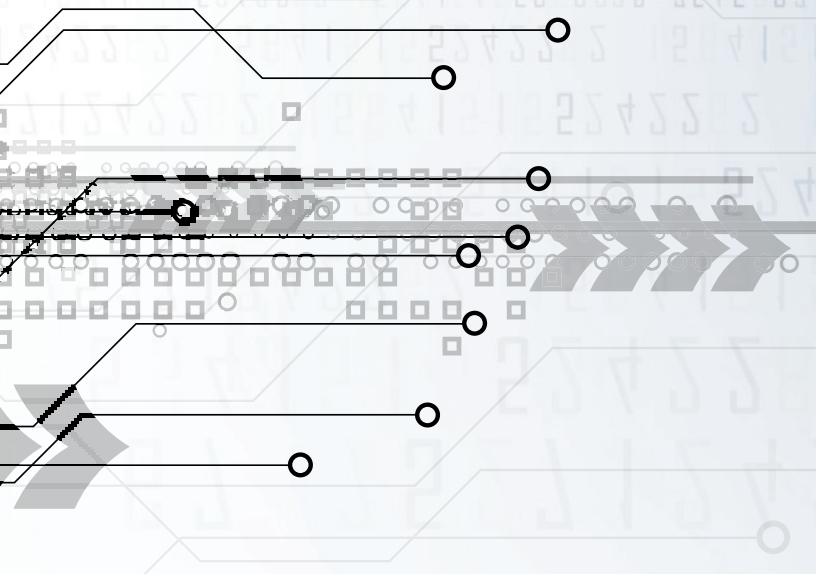
and society itself. For this purpose, the project has set the following three aims to:

- Provide a scientific understanding of the on-going paradigm shift in the communication realm and map the current trends of multi-directional communication.
- Analyse both the positive and negative impact of novel ways of interaction with citizens that allows knowledge to be produced in a collaborative fashion, while empowering citizens to actively participate in the production of scientific knowledge.
- Provide policy-making insights that will further support and consolidate the notion and practice of citizen empowerment based on multi-stakeholder approaches (citizens, scientists, member states authorities).

The Megatrends Series

The world is becoming increasingly globalised and interconnected. We are faced with novel advances that challenge the existing framework of ethics and morals, expose our societies to technologies that radically change everyday life, our work environment, industrial production and forces us to define what it means to be human.

To understand our world in its full complexity, it is not enough to study the main underlying processes in each field separately. Multi-faceted interactions and feedback mechanisms across disciplines need to be studied. New ways need to be found to capture their combined impacts on society, the environment and economy and humans themselves. We need to preserve a profound knowledge of the past, understand the present and have sophisticated reflections about likely and unlikely developments in order to make projections and scenarios for the future.

While producing robust facts and evidence remains a top priority for the JRC, the capability of framing the complexity of the scientific findings into narratives that policy makers and citizens can understand and act upon is becoming a complex challenge in itself, but one which must be met in order to preserve trust and credibility.

To this end, the Megatrend series, consisting of lectures and debates, discusses how so-called disruptive changes and innovation, or megatrends, are reshaping the social, political, economic and environmental landscape of the EU. The series has enabled well-renowned leaders in the academic, policy and business fields to inform the JRC and the rest of the European Commission of the emerging societal challenges and their perspective on how they are being tackled. The topics covered have been: megatrends (Professor Ian Goldin, pictured); migration (Gregory Maniatis of the Open Society and Rainer Munz of the EPSC); demography (Professor Wolfgang Lutz); disruptive innovation (Michael O'Leary, CEO of Ryanair); growing
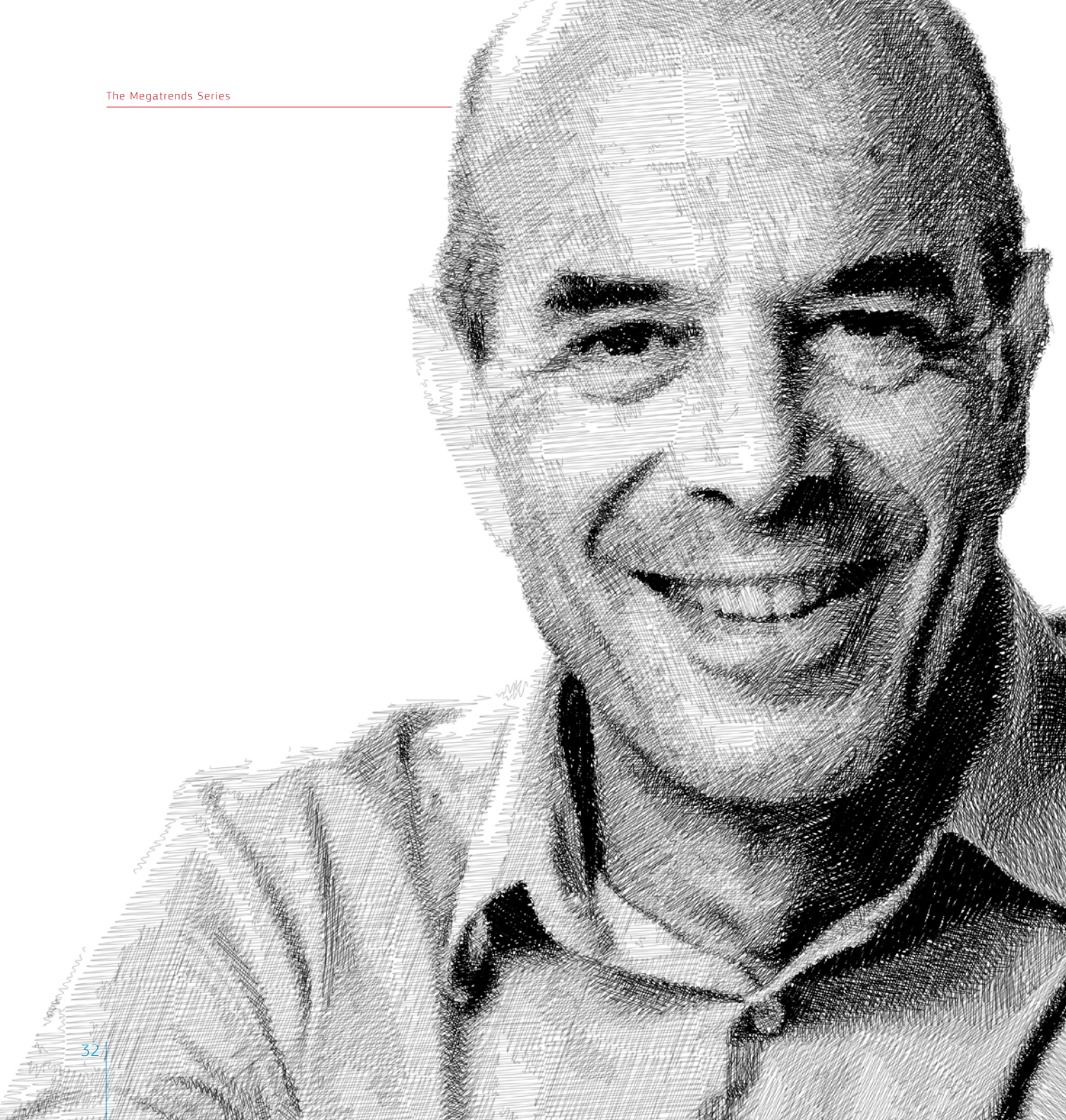
consumerism (Ian Jindal, Editor of InternetRetailing); urbanisation (Professor Saskia Sassen, Columbia Universtiy); and aggravating resource scarcity (Mr Janez Potocnik former Commissioner and Co-Chair of UNEP).

The talks have led to important follow up work and discussions with a number of line and policy DGs, including DG MOVE (on aviation transport), DG GROW (modernisation and the single market), DG REGIO (urbanisation and smart cities), DG ENER (clean and renewable energy), DG DEVCO and DG HOME (migration and demography) as well as within the JRC itself.

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