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Journal

BIG DATA & digital audit

"The EU should lead through a sound ethical framework

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EUROPEAN COURT OF AUDITORS

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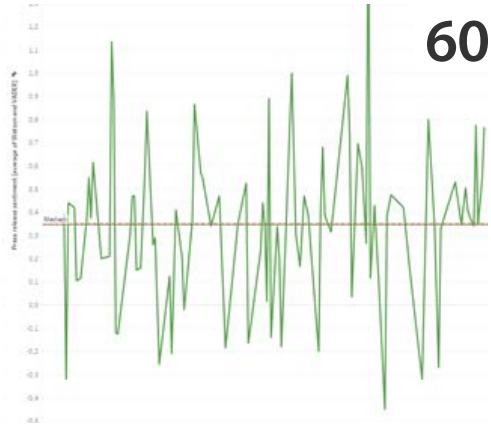

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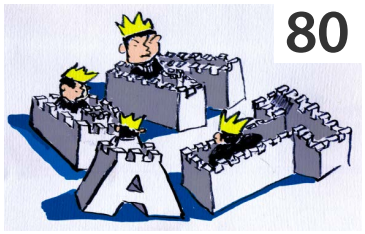

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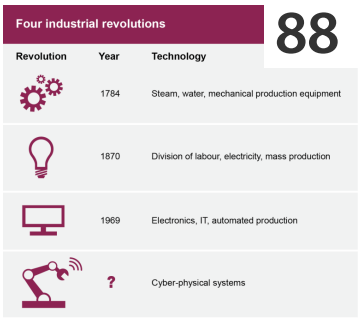

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PRODUCTION

Editor in chief:
Gaston Moonen
Tel.: +352 4398 - 45716
E-mail:
antonius.moonen@eca.europa.eu

Deputy editor:
Derek Meijers
E-mail:
derek.meijers@eca.europa.eu

Desktop publishing: Nicolas Toulas

Distribution:
Directorate of the Presidency

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For more information:
European Court of Auditors
12, rue Alcide De Gasperi
1615 Luxembourg,
LUXEMBOURG

eca-journal@eca.europa.eu
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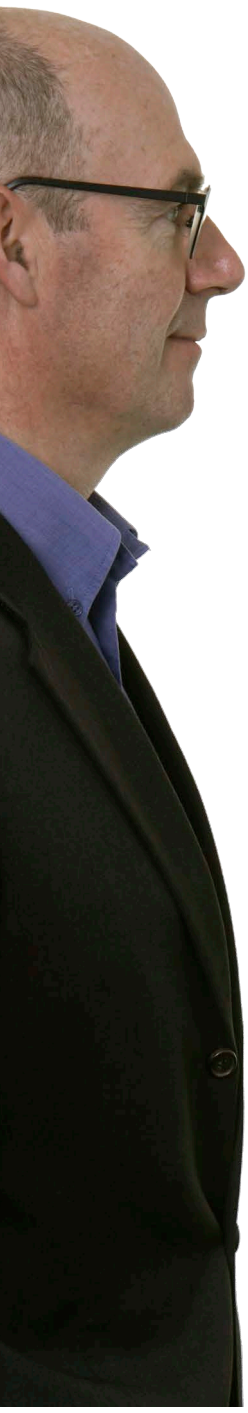
Editorial

Accountability in a black 'digital' box?

'How can they know this?' This is a question I sometimes ask myself when I look at my computer screen or mobile phone, which shows tailor made advertisements and traces of recent personal activities. The digital traces we leave as users of digital services - provided by tech giants such as Google and Facebook - reveal who we are, what our interests are and anticipate what our next steps might be…with – just around the corner - the risk of our being manipulated when taking those next steps, for financial gain or other interests, be it security or political.



How widespread is this? Are we indeed living in a world where big tech companies from the private sector (and in almost all cases non-European) increasingly know more about our citizens than our own governments? Or, alternatively, with more and more personal, financial, security, or medical data available electronically at low cost, people might also suspect that their governments might start mining this data to obtain insights, illegally, into their citizens' activities. That is, if they did start mining this data.

However, the other side of the coin should not be forgotten, which should also appeal to public sector auditors looking at performance. The Fourth Industrial Revolution, as Klaus Schwab from the World Economic Forum in Davos calls this digital revolution, has been going on for a while and brought us the internet, smartphones and AI, creating a hyper-connected world with terabytes of information available at an unprecedented speed … in the palm of your hand, a privilege we already take for granted. With big data, AI will enable us to do things with far less effort and at lower cost than we currently do them, but also completely new things that we are not yet even aware of, ranging from search machines to self-learning robotics, to health care improvements, to data processing and analysis…and the application of these new technologies is increasing tremendously. Digital and related big data is a worldwide phenomenon, which, if it disappeared today, would create serious problems not only for tech companies, but also for citizens and traditional businesses.

As much as people depend digitally on big tech companies, these companies depend very much on their users. Not only because their users work with the platforms they have created but also because they *provide* most of the data on which these platforms run. During the last thirty years, citizens have changed from an occasional data provider to the essential spinning wheel in several tech companies' business model, almost continuously providing data to these companies, ranging from surfing on the internet or leaving pictures or GPS trails when using your phone. The experts of Eurostat in this Journal call this the 'datafication' of our society rather than speaking about 'big data' (see page 112).

In this regard, an important question concerns the ownership of data. And related to this, the question of user's conditions and, as for example MEP Eva Kaili points out (see page 92), also the 'monetisation' of the value of these data: transferring the benefits of use of the data by others to the ones who create these data – that's mostly you and me. If the user's conditions are not already a black box, since they consist mainly of legal jargon, most often their sheer length is longer than Shakespeare's *Macbeth*, which already has 17 121 words. For comparison: this editorial has 1123. Both elements are part of the ongoing ethical discussions around digitalisation, big data, and even more prominently, AI and the criteria used to create them.

How is all this relevant to public audit? After all, public sector auditors look, in particular, at the reality, and the way this is codified, whether analogue or digital, is secondary. In the end, their reports must reflect that reality, whether good or bad.

Two aspects stand out here. First the opportunities. While the need to check reality is not in doubt here, the possibilities to tap into the data, more and more of which is available in digital format, have changed dramatically during the last three decades, with unprecedented speed. As several experts in this Journal argue, using digital technologies for audit purposes - data analytics, process or text mining, using or creating a distributed ledger, undertaking full population audits – will not only enable auditors to provide better and more information regarding accountability. Besides efficiency gains in doing so, it also enables auditors to increase the assurance that auditors can deliver and thereby contribute to providing trust in the system.

The second aspect also relates to the issue of trust, albeit this time from a different angle: addressing peoples' concerns on what is done with their data: transparency and accountability on the safeguards used - or not used – to ensure that the digital systems used in the public realm, but also in the private realm, respect certain conditions commonly agreed upon. And that the guiding principle of these conditions is not financial gain, but fairness, transparency and accountability: the more so if the parameters for checking the data are in the hands of a few.

Such concerns are expressed not only by MEPs, the European Data Protection Supervisor (see page 122) or academics (see pages 8 and 27), but also by peers of the ECA. Audit institutions, such as the U.S. Government Accountability Office (see page 88) or the French Cour des comptes, are looking into algorithms to elaborate on the auditor's role when it comes to the built-in criteria - if not bias - and the transparency applied in relation to new techniques and particularly machine learning technologies, such as AI. This may include activities looking beyond the AI governance framework, since auditors tend to check theory against practice.

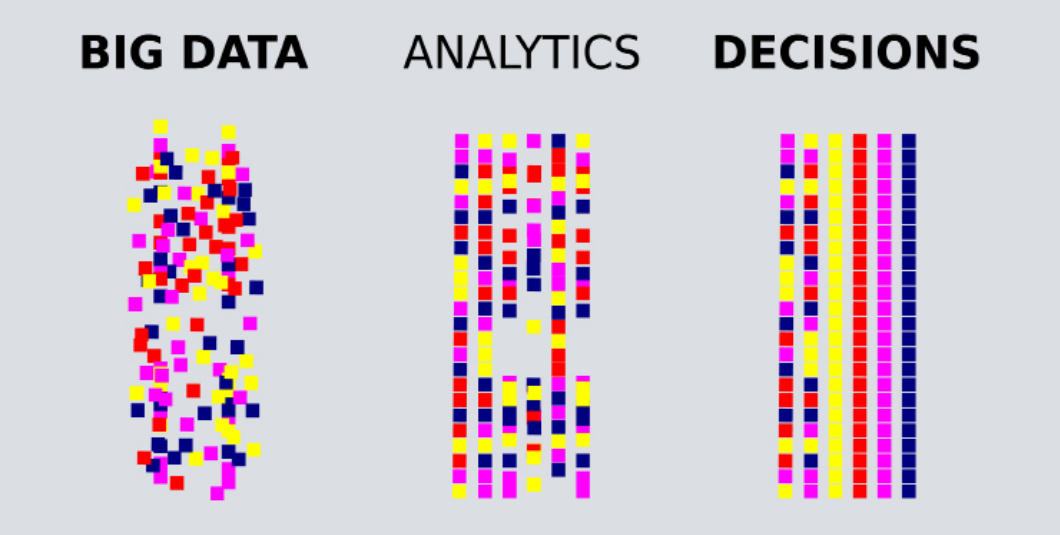
Digital systems can codify the past and offer opportunities for the future. But, as Cathy O'Neil says in her book *Weapons of Math Destruction*, inventing the future requires moral imagination. Such imagination and creativity is something only humans can provide. She pleads for big data models that follow ethical leads, decided upon by…humans. Or, as some of our contributors put it: one continuously needs to connect the digital means with the *humanware*.

This is where auditors will have to use their professional judgement, and a wide variety of skills will be needed for the future auditor to apply several criteria, including something as unquantifiable as fairness - sometimes also called 'common sense.' This will also require courage and imagination. And, as John Maynard Keynes already pointed out in the 1930s: 'The difficulty lies not in the new ideas, but in escaping the old ones, which ramify, for those brought up as most of us have been, into every corner of our minds.'

Gaston Moonen

Big data for the social good

By Professor Dino Pedreschi, Fosca Giannotti, Valerio Grossi, and Roberto Trasarti – University of Pisa (Department of Computer Science), and Institute of Science and Technology of Informatics 'A. Faedo'



Source: Shutterstock / Cyber Kristiyan

Most people will agree that during the last two decades data have become an ever more present part of our lives, whether it is in our communication, our analysis or decision-making. Dino Pedreschi is Professor of Computer Science at the University of Pisa and a pioneering scientist in mobility data mining, social network mining and privacy-preserving data mining. Together with his colleagues Fosca Giannotti, Valerio Grossi and Roberto Trasarti – respectively director and researchers at CNR in Pisa – he gives an overview of some key issues relating to data. The authors consider the advent of big data is an opportunity for boosting social progress, and Artificial Intelligence tools are triggering new services with a clear impact on our daily life. They also touch upon how big data and AI help us to make more informed choices, underlining the need to achieve collective intelligence without compromising the rights of individuals.

From data to knowledge

In order to understand the role of data in our society, let's start by talking about the word *datum*. It comes from the Latin for 'something given,' and the Oxford English Dictionary defines it as a 'piece of information,' 'as a fact'. Our life is a generator of facts that can be stored and analysed. *Human interactions* leave traces of our phone calls or emails in our social networks. *Our lifestyle* is evidenced by records of purchases, while our movements are described in the records of our mobile phone and GPS tracks (see **Figure 1**).

Figure 1 – Mobility traces in Rome

Source: KDDLab & OctoTelematics

Artificial Intelligence (AI) is becoming an integral part of all areas of our daily lives, from smartphones and smart watches to personal digital assistants such as Amazon Echo and Google Home, to autonomous vehicles, smart cities, Industry 4.0, and beyond.

Transforming data into value; into knowledge it is not an easy task. On the contrary, it requires an interdisciplinary and pervasive paradigm where theories, models and artificial intelligence tools support each other. Experiments and analyses across massive datasets are essential, not only to the validation of existing theories and models, but also to the data-driven discovery of patterns emerging from data, which can help scientists design better theories and models, yielding a deeper understanding of the complexity of social, economic, biological, technological, cultural and natural phenomena.

In this context, a new revolution has happened due to three concurrent developments arising from the digital transformation of society:

- the advent of Big Data, which provide the critical mass of factual examples to learn from;
- the advances in data analysis and AI techniques that can produce predictive models and behavioral patterns from big data;
- the advances in scalable high-performance computing infrastructures that make it possible to ingest and manage big data and perform analytics.

The availability of data creates opportunities but also new risks. The use of data science techniques could expose sensitive traits of individual persons and invade their privacy. In particular, social mining approaches require access to digital records of personal activities that contain potentially sensitive information.

Depending on the course that this revolution takes, AI will either empower our ability to make more informed choices or reduce human autonomy. It will expand the human experience or replace it; create new forms of human activity or make existing jobs redundant; help distribute well-being for many or increase the concentration of power and wealth in the hands of a few; expand or endanger democracy in our societies. Europe bears the responsibility of shaping the AI revolution.

The choices we face today are related to fundamental ethical issues about the impact of AI on society; in particular, how it affects labour, social interaction, healthcare, privacy and fairness. The right direction cannot be found through a random selection of possible alternatives but only by a lucid public with renewed confidence in (scientific) research and technology.

Big data for science, industry and social good

The advent of big data is an actual opportunity to improve our society, to boost social progress, and the social good. It can support policy making, can offer novel ways to produce high-quality and high-precision statistical information, empower citizens with self-awareness tools, and it promotes ethical uses of big data. Several examples below show why big data are important for society.

Modern *cities* are perfect environments, densely traversed by large data flows. Using traffic monitoring systems, environmental sensors, GPS individual traces and social information, we can reorganise cities as a collective sharing of resources that need to be optimised, continuously monitored and promptly adjusted when needed. It is easy to understand the potentiality of big data exploitation by considering terms such as urban planning, public transportation, reduction of energy consumption, ecological sustainability, safety and management of mass events.

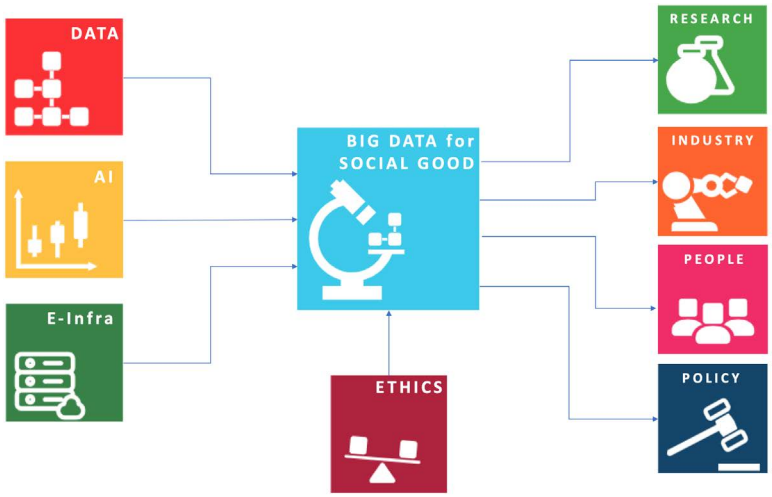
In the *biological sciences*, scientific data are stored in public repositories for use by other scientists. There is an entire discipline of bioinformatics that is devoted to the analysis of such data, e.g. network-based approaches to human disease can have multiple biological and clinical applications, especially in revealing the mechanisms behind complex diseases.

In *energy* and the *environment*, the digitisation of energy systems allows the acquisition of real-time, high-resolution data. Coupled with other data sources, such as weather data, usage patterns and market data, efficiency levels can be increased immensely.

In *manufacturing* and *production* with growing investments in Industry 4.0 and smart factories with sensor-equipped machinery that are both intelligent and networked (see internet of things, cyber-physical systems), in 2020 production sectors will be some of the major producers of data. The application of data science in this sector will bring efficiency gains and predictive maintenance.

These represent only the front line of topics that can benefit from an awareness of the gains that big data, in principle, might provide to stakeholders. As shown in **Figure 2**, scientific, technological and socio-economic factors play and interact, creating a complex ecosystem. The combination of data availability, sophisticated AI techniques, and scalable infrastructures is changing the way we do business, socialise, conduct research, and govern society.

Figure 2 – Impact of data, AI and E-infrastructures impacting key societal issues



Source: KDDLAb at University of Pisa & CNR

If we want to exploit data in order to face global challenges and make data a determinant factor in sustainable development and the social good, it is necessary to push towards an open global ecosystem for science and industrial and societal innovation, addressing multiple dimensions with interdisciplinary approaches. We need to build an ecosystem of socio-economic activities, where each new idea, product and service creates opportunities for further ideas, products and services. An open data strategy, a 'new deal on data,' open innovation, interoperability and suitable intellectual property rights can catalyse such an ecosystem and boost economic growth and sustainable development. This also requires 'networked thinking' and a participatory, inclusive approach.

Big Data ecosystem: the role of research infrastructures

Over the past decade Europe has developed world-leading expertise in building and operating e-infrastructures. They are large scale, federated and distributed via online research environments. They are meant to support unprecedented scales of international collaboration in science, both within and across disciplines, investing in economy-of-scale and common behaviour, policies, best practices, and standards. They shape a common environment where scientists can create and share their digital results, such as research data and research methods, by using a common 'digital laboratory' consisting of agreed-on services and tools.

Research infrastructures (RIs) play a key role in the advent and development of big data analytical tools for society. Resources - such as data and methods - help domain and data scientists in transforming a research or innovation question into a responsible data-driven analytical process. RI platforms offer easy-to-use means to define complex analytical processes and workflows, bridging the gap between domain experts and analytical technology. Well-defined thematic environments amplify new experiments'

achievements towards the vertical scientific communities and potential stakeholders by activating dissemination channels to society.

Figure 3 – The SoBigData Research Infrastructure

Source: SoBigData Project

In this context, the 'SoBigData Research Infrastructure'[1] is an ecosystem of human and digital resources, comprising data scientists, analytics and processes. It is designed to enable multidisciplinary scientists and innovators to carry out experiments and to make them reusable by the community (see **Figure 3**).

The e-infrastructure of SoBigData provides researchers and practitioners with a uniform working environment where open science practices are transparently promoted; AI and data science practices can be implemented by minimising the technological integration cost. SoBigData provides users with domain-specific resources, and core services supporting data analysis and collaboration among users. It provides:

- a *shared workspace* to store and organise any version of a research artefact;
- a *social networking area* to have discussions on any topic and be informed on happenings;
- an *analytics platform* to execute processing tasks;
- a *catalogue-based publishing platform* to make the existence of a certain artefact public and disseminate this information.

SoBigData promotes and adopts ethically grounded collection, management and analysis of big data. Privacy enhancing tools ensuring that RI analyses are also fair and non-discriminatory. Scientists and other stakeholders, including citizens and policy makers, can access and use such facilities continuously and transparently, facilitating publishing of science according to Open Science principles of transparency and reproducibility.

1 SoBigData is EU-Funded under the program Horizon 2020: Research and Innovation - Grant Agreement No. 654024 - http://www.sobigdata.eu/

Individual and collective intelligence

Social dilemmas occur when there is a conflict between individual and public interest. Such problems also appear in the ecosystem of distributed AI and humans, with additional difficulties due, on the one hand, to the relative rigidity of the trained AI system and the necessity of achieving social benefit, and, on the other, the necessity of keeping individuals interested. What are the principles and solutions for individual versus social optimisation using AI, and how can an optimum balance be achieved? The answer is still open, but these complex systems have to work on fulfilling collective goals, and requirements, with the challenge that requirements change over time, and change from one context to another.

Every AI system should operate within an ethical and social framework in understandable, verifiable and justifiable ways. Such systems must in any case operate within the bounds of the rule of law, incorporating protection of fundamental rights into the AI infrastructure. In other words, the challenge is to develop mechanisms that will result in the system converging to an equilibrium that complies with European values and social objectives (e.g. social inclusion) but without unnecessary losses in efficiency.

Interestingly, AI can play a vital role in enhancing desirable behaviours in the system, e.g., by supporting coordination and cooperation that is, more often than not, crucial to achieving any meaningful improvements. Our ultimate goal is to build the blueprint of a socio-technical system in which AI not only cooperates with humans but, if necessary, helps them to learn how to cooperate, as well as other desirable behaviours. In this context, it is also important to understand how to achieve robustness of the human and AI ecosystems in respect of various types of malicious behaviour, such as abuse of power and exploitation of AI technical weaknesses.

We conclude by paraphrasing Stephen Hawking in his *Brief Answers to the Big Questions*: the availability of data on its own will not take humanity to the future, but its intelligent and creative use will .

Towards a digitally transformed European Commission

By Gertrud Ingestad, Director-General for Informatics (DG DIGIT), European Commission

Source: European Commission

In her Political Guidelines for the Next European Commission 2019-2024, as President-elect, Ursula von der Leyen identified 'A Europe fit for the digital age' as one of her top three priorities. She then mandated Commissioner Johannes Hahn, reporting directly to President von der Leyen, to drive the modernisation and full digitalisation of the Commission. What are the ambitions of the new European Commission in this area and how does it want to achieve them? As Director-General, heading the European Commission's Directorate-General for Informatics since early 2016, Gertrud Ingestad stands at the heart of EU discussions and developments in this policy area. Below she defines some of the key goals for her DG and what a digital transformation means for the Commission itself, the implementation of its policies and the promotion of Digitalisation of Public Administrations throughout the Union.

Using technology as a means…to serve people

No question: the scale and the scope of the digital transformation that we are witnessing is unprecedented. Technological changes are pervasive, persistent and extremely rapid:

- the rise of data and artificial intelligence;
- the increasing ubiquity of mobile devices;
- the growing reach of social and collaborative networking;
- the power of cloud and increase in computational performance.

But evident as it is, this focus on technology is not the whole story. Because technological advances such as data processing, analysis and connectivity give us the means, as never before: to reach out to the individual, to address the needs of the citizen and of communities, to serve people where they are, especially the weakest, to listen to the opinions of civil society, and to respond to questions and concerns and to explain.

Digital has the potential to transform public administrations, help them deliver their services in a stable, reliable and secure manner, to focus on user needs as never before. An unprecedented quality leap for the public sector, in its fundamental *raison d'être* of 'serving the citizens. We see evolving:

- a cost-effective public administration that will help complete the single market, by allowing businesses to operate securely across borders and by giving individuals trusted access to services. This will help making the four freedoms – free movement of goods, capital, services, and labour - a reality internally and reinforce the European Union's position in the global competitiveness landscape;
- a responsive public administration, which is close to citizens through user-centric services. This will strengthen trust and cohesion and will close the gap between citizens and institutions;
- accountability and transparency in policymaking, which will enable a dialogue between institutions and stakeholders based on evidence, fairness and trust. This will help to fight disinformation and contribute to inclusive political discussion and decision-making.

These changes will have a profound impact on the content of, and ways of conceiving and delivering, public policy, on the ways of interacting with stakeholders (citizens, businesses, administrations), and on the ways public administrations operate. Together, they will change the role of public administration, as we know it. And data is at the core of this process: the way public administrations collect, process, share, analyse, visualise, render public and make data accessible; the way this is done legally, securely, interoperably and with a full audit trail.

To rise to these challenges, the European Commission is pursuing a parallel strategy. One objective is to radically transform the Commission itself. The Commission has adopted a digital strategy that sets the goals and roadmap to become a digitally transformed, user-centric, and secure data-driven public administration. The second objective is to help public administrations across Europe, at all levels, in their digital transformation and to support them in connecting their services securely across borders.

A data-driven European Commission

President Ursula von der Leyen set out in her Political Guidelines for the Next European Commission 2019-2024 that it should 'drive the full digitalisation of the Commission, putting in place new digital methods and digital diplomacy tools.' The digital transformation of the Commission is a unique opportunity to exploit the potential of digitalisation to create innovative solutions for a more trustworthy, effective, efficient, transparent and secure EU public service. The European Commission Digital Strategy and the Synergies and Efficiencies Initiative have set a roadmap to build a digital eco-system by 2022 with the following features: secure by design, privacy by design, interoperable by design, digital by default, cross-border by default and open by default.

Digital transformation is about rethinking the organisation, the way of conducting business, working in a high-tech, digital ecosystem. Policy departments must accelerate the adoption of a digital-first reflex and culture, while IT must become more agile and faster to be able to align technology speed and policy outcomes. We need a collective and distributed digital delivery model inspired by a collective working ethos, where policy and IT departments work together. This is also an opportunity to reinforce co-creation and synergies with other European institutions and agencies. An opportunity I see very positively evolving with the European Court of Auditors .

The digital transition requires balancing disruptive change and running policies without interruption. We advance in a series of iterations, focusing on continuous improvement to ensure there is sufficient digital transformation momentum. The planning process relies on strong corporate governance at Commission level to prioritise activities and allocate limited resources.

In practice, the Commission's digital transformation means:

- evidence-based policymaking: create a data-ecosystem to integrate Commission data with external data (e.g. Member States data) and create a stack of digital services to support the discovery, management and dissemination of data. This means making extensive use of emerging technologies, such as artificial intelligence, modern business intelligence and advanced analytics – e.g. powered solutions for predictive analytics, modelling, impact assessment at the stage of policy design, implementation and assessment. Examples are: assessing policy sustainability, comparing different scenarios, monitoring and evaluating the performance of European policies;
- digital maturity and skills: upskill the entire Commission workforce, including staff designing digital solutions and staff using technology, ensuring that all staff have the digital skills they need;
- a secure Commission: ensure top-level cybersecurity by developing automated threat detection systems to protect the Commission's information assets, based on advanced data analytics to assess the potential risk behaviour associated with cyber-attacks;
- a lean Commission: transform fundamentally the business and policy processes (through simplification and streamlining) rather than just replicating current activities electronically. Digitise these processes using a solid foundation of reusable platforms and blueprints. Provide staff with a modern and effective digital workplace. Improve staff engagement and productivity through new modern working methods and tools. And provide a strong digital infrastructure based on a hybrid cloud architecture.

Connect European public administrations delivering seamless public services

As the EU is moving towards a data driven economy, public administrations need to use and share data in a secure, efficient and trustworthy way. This is a key enabler for introducing artificial intelligence tools and better cross-domain and cross-border data availability. It is also a pre-condition for creating value for citizens and businesses across Europe and for the further development of the Digital Single Market.

Indeed, in a functioning internal market, public services need to be able to 'follow' their users' needs across administrative entities, policy sectors and borders. This means articulating processes with digital solutions in the public administrations at all relevant levels in the Member States, be it national, regional or local.

The actions of the European Commission, and specifically DG DIGIT, aim mainly (i) to ease and accelerate the digital transformation of the public sector across the Union, (ii) to implement European policies through the deployment and use of digital technologies, and (iii) to find synergies in the EU funds used for the implementation of the e-Government principles across the Union.

The 2017 Ministerial Tallinn Declaration on eGovernment, by which all EU Members States and EFTA countries committed to building user-centric digital public services, explicitly underlines the importance of adopting the main e-Government principles, such as 'interoperability by design' and 'openness.'

The same challenges exist in different flavours in every setting, across the EU and at various levels of public administration. In the Commission and in Member States a lot of work is being put into solving them. However, most efforts so far are not coordinated, which leads to duplication, fragmentation, higher costs, lower quality solutions and sometimes new barriers to data sharing. At the core, the challenge is the same. This is why common standards and shared solutions can solve many similar issues and reduce problems of delays, cost overruns and incompatible digital solutions.

Even though overall eGovernment and interoperability performance is moving in the right direction, the transformation and digitalisation of public administrations requires additional efforts, in particular regarding 'digital capacity' building, and the provision of reusable and interoperable digital tools for the efficient implementation of EU policies and legislation, and improvement of administrative and judicial cooperation.

The European Commission aims to work closely with Member States in order to modernise public administrations in the Union, use technology to bring government closer to citizens and businesses, and to simplify public administrations' modus operandi. Cross-border interoperability, user-centric public services, streamlined administrative processes and open data are the four key areas where further action is needed.

(1) Ensure cross-border interoperability between businesses, citizens and public authorities

As referred to in the European Interoperability Framework (EIF)[1], cross-border interoperability connects directly with the use of open common specifications and standards. Interoperability is seen as a priority in sectors such as transport, border control and security, justice and health. According to stakeholder consultations, harmonisation of digital infrastructures and standards is a crucial driver of digitisation to build cross-border digital services. Therefore, the upcoming Digital Europe Programme (DEP) aims to continue to assess and promote existing common specifications and standards, create common specifications and standards if needed, and oversee the implementation of the EIF.

Firstly, a more holistic approach and a clear strategy plan are needed to evolve towards cross-border interoperable public services in the EU. Secondly, there is scope for improved communication with the programme stakeholders to ensure adoption and reuse of interoperability models and building-block solutions. Finally, more efforts need to be directed to ensuring interoperability across policy domains, as horizontal interoperability is missing in domain-specific implementations.

(2) Provide citizens and businesses with high quality and user-centric public service

Member States confirmed their commitment to implementing the eGovernment principles in the Tallinn Declaration on eGovernment and the Commission is ready to support Member States in providing high quality, user-centric digital public services to both citizens and businesses.

(3) Streamline processes within public administration

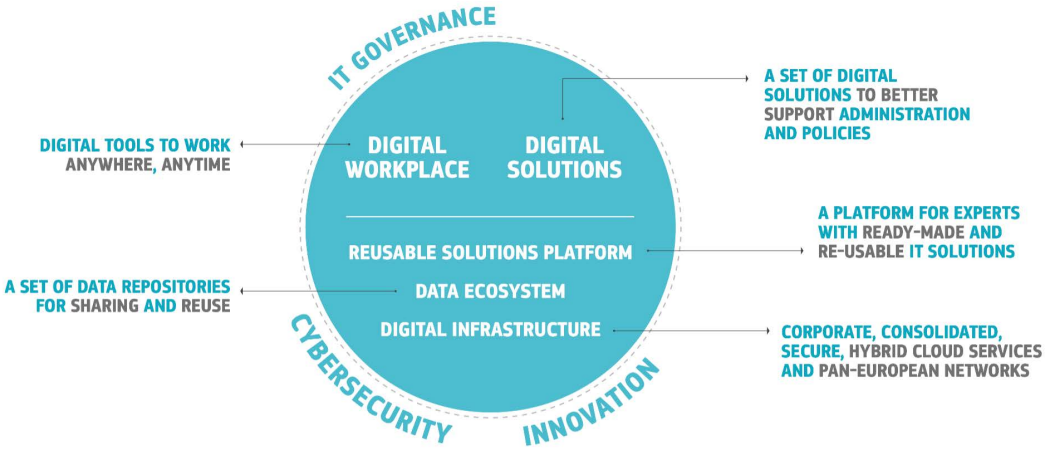
As confirmed by stakeholder consultations, the public expects more from digital government than just putting public services online. Governments should harness ICT to improve the efficiency of processes and delivery of services in sectors such as Health, Justice or Transport. For example, in order to fully enforce EU competition law, it is essential to further intensify and deepen cooperation between the Commission and national competition authorities by adopting state-of-the-art, interoperable digital solutions allowing for the swift exchange of data.

(4) Common EU Government Interoperability mechanism

To this end, a future common EU Government Interoperability mechanism could build on the efforts of existing interoperability programmes such as ISA^2 - Interoperatiblity solutions for public administrations, businesses and citizens - and CEF Digital – Connecting Europe Facility - and related Digital Single Market policy initiatives, in order to address digital skills gaps, promote the use of open data, strengthen cybersecurity, and harness new technologies (artificial intelligence, blockchain and big data) for European public administrations.

1 COM(2017) 134 final, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, European Interoperability Framework – Implementation Strategy, 23.03.2017

Figure 1 – A "co-everything" Digital Strategy for the European Commission



Source: European Commission

Digitally transforming European public services

The public sector, including the audit profession, traditionally operates with the concepts of Economy, Efficiency and Effectiveness to guide and measure its action. Digital technologies give us unprecedented means to deliver on these quality requirements, ensure accountability and demonstrate the impact of public action. Ethics rightly has long joined these three 'Es,' as an expectation of the public about how public services and policies need to be designed and delivered: fair, unbiased and transparently. The welcome and necessary public European debate around 'ethical AI' is a good example, and highly relevant for a public sector expected to develop AI-powered services. To these four 'Es,' I would like to propose adding a fifth: Engagement. Reaching out to citizens and civil society, actively seeking their input, analysing data in a controllable fashion, visualising options for debate and informed decision-making is technically feasible today, as it never has been before.

Indeed, the digital transformation of the public sector is not just another technical iteration. It truly transforms how the public cause is organised, how decisions are prepared and taken and how policies are explained, implemented and enforced.

Workplace innovation practices

By Stavroula Demetriades, European Foundation for Improvement of Living and Working Conditions (Eurofound)

'Making the Union fit for the digital age', one of the key priorities of the Von der Leyen Commission, is often linked to innovation. For many people the nature of public sector activities makes it difficult to identify them as innovative. And yet, innovation in the public sector is central to economic and social life; public organisations instigate and implement policies that affect the economic and social wellbeing of millions of citizens and businesses, including when it comes to their digital future. As Senior Research Manager at Eurofound, Stavroula Demetriades is responsible for research in the areas of innovation, workplace practices and job creation. She is also adjunct professor in the Business School at University College Dublin. In her article she discusses workplace innovation practices in the public sector, which she considers crucial to deal with today's challenges. A topic which is also relevant when it comes to the use of innovative digital audit techniques by auditors.

Workplace innovation practices

Enhancing public sector performance and stimulating innovation within public organisations are important prerequisites for improving services and addressing the big challenges our European societies are faced with. Innovation, even though it is not always acknowledged, has been key to the public sector. Indeed, as is demonstrated in Eurofound research, workplace innovation in the public sector is practised by various organisations in the Member States.

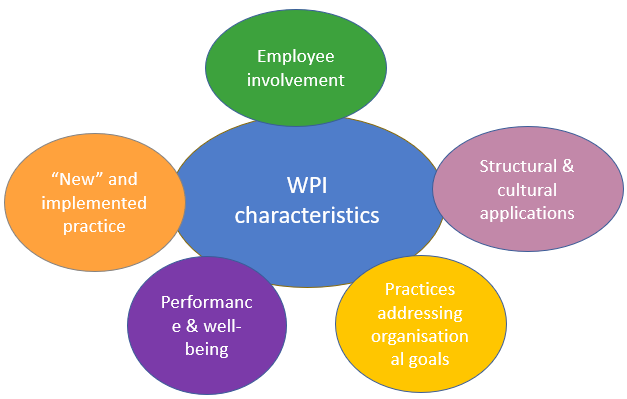
In Eurofound's workplace innovation research we asked managers, employees and employee representatives about their work practices with a view to exploring the organisations' pathways, motives and outcomes.

What exactly is *workplace innovation*?

In our research we define *workplace innovation* as a newly implemented practice or combination of practices that enable employees to participate in organisational change and renewal either structurally (how work is organised) or culturally (in terms of empowerment of staff, motivation, attitudes, etc.) and hence improve the quality of working life and performance. The main characteristics of workplace innovation are (see also **Figure 1**):

- practices that are new to the organisation and have been implemented;
- interventions that change the culture or structure of the organisation;
- addressing a specific organisational goal;
- involving employees in organisational change or innovations;
- enhancing the organisation's performance and well-being.

Figure 1 - Workplace innovation characteristics (Eurofound concept)



Source: author

Motivations and outcomes of the workplace innovation practices introduced

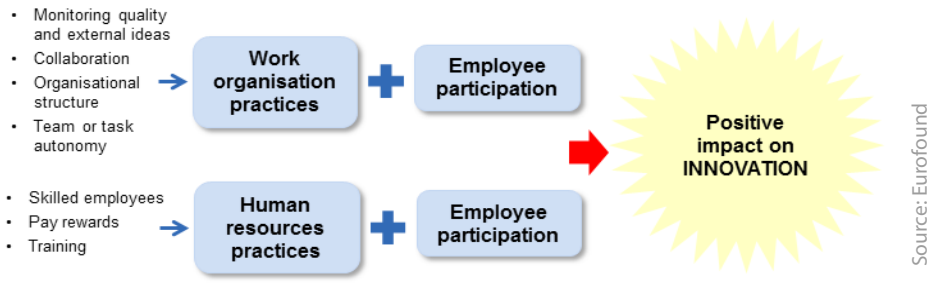
We all know that change is not always welcome in organisations and often comes at a cost. So we were keen to understand what *motivates* the case study organisations to introduce these workplace innovation practices and what outcomes they achieve. Why they wanted to do things differently, devote time and other resources to this endeavour. Overall, the most frequently cited reason for initiating workplace innovation was to *improve efficiency* and enhance *innovative capability*.

The implementation, the *how*, is often not given enough attention and this makes a big difference to the success of a workplace innovation practice introduced. A workplace innovation practice that works well in one organisation can be implemented in a demoralising fashion in another one and thus gets very different results. The case examples showed that new technologies were introduced to support the workplace innovation practices. Without a clear focus on what is intended to be achieved, advanced technological solutions on their own will never be the answer. What drives the successful implementation of the practices are *employee participation* and the *commitment of top management* followed by leadership.

With regard to the outcomes and impacts of these practices on organisations, employees and their representatives, managers reported improvements in employee engagement, sustainability and performance. Employees also mentioned increased learning opportunities and more interesting jobs. The voice of employee representatives was also strengthened.

Eurofound's research evidence on innovation in the private sector and the role of workplace practices suggests that certain bundles of workplace practices are more likely to be linked with innovation. Combining bundles of work organisation with employee participation practices, and Human Resource Management (HRM) with employee participation (see **Figure 2**) have a positive link with innovation (in products, services, processes and marketing).

Figure 2 - Workplace practices and their association with innovation



Public sector examples

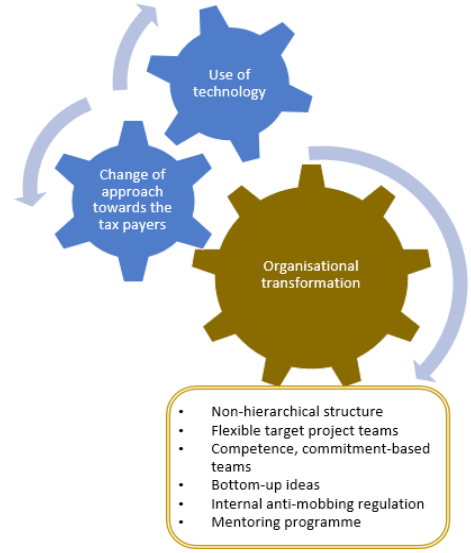
The public sector examples presented below, are illustrative of the adopted practices.

A tax office with high customer satisfaction reports

It is astonishing that a tax office, collecting citizens' and businesses' money would enjoy high levels of customer satisfaction but this Polish regional office (in the town Wieliczka) was determined to promote modern solutions by raising the quality of their services. This is a tax office with a mission.

The main elements of the workplace innovation practices they introduced included the following: organisational transformation, change of approach towards service delivery to taxpayers and use of new technologies to facilitate internal organisation (**Figure 3**). Flexible project teams carry out their tasks combining competences of different functions in a non-hierarchical structure. With a focus on raising the quality of the service and a citizen-centred approach, they adopted modern solutions suitable for the new era. Management and employees agreed on prioritising anti-corruption and anti-mobbing practices. Stimulating employee participation with mentoring programmes, innovative HRM solutions and concern for employee well-being were at the core of their workplace innovation practices.

Figure 3 - A tax office with a mission



Source: author

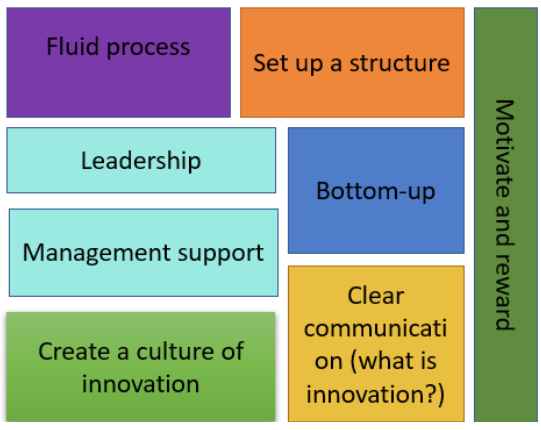
Thanks to its change of approach and practices, the tax office registered an increase in its level of tax revenue. The head of the Tax Office in Wieliczka is aware that this effective performance would not have been possible without the involvement of the employees. Employees feel empowered and motivated: they feel that their voice does matter in the organisation and they have real influence on the functioning of the organisation.

Organisational focus - innovation lies in every single employee

Lietuvos energijos gamyba is an organisation active in the energy sector and of strategic importance because of its role in national energy security. The organisation wanted to increase its service efficiency, transparency and response to consumers' (and citizens') interests. The employee-driven innovation pathway chosen has continuous cycles of innovation at its heart. The Innovation Committee invites employees from every corner of the organisation to submit ideas at regular intervals for new or improved processes, products and services. They have identified two priority areas: i) technological; and ii) organisational innovations - related to the company's overall working culture, business model, etc. Incremental and smaller innovation ideas approved by the Innovation Committee were sent to the relevant unit(s) for implementation. Larger-scale projects and ideas involving substantial financial resources were allocated sufficient budget to see the projects through to their implementation. Feedback was given to employees on innovation ideas which had not been selected and rewards were given to selected suggestions turned into innovation projects. These work practices were supported by the trade union, which contributed its own ideas as to how to reward employees in a meaningful way and in line with public sector regulations.

The essential elements of this workplace innovation practice included the following: a systematic approach to innovation (rather than ad-hoc practices), bottom-up action, creating a culture, leadership, clear communication, rewards and trade union support (see **Figure 4**). One of the lessons learned by this organisation in the process is that unless there is an enabling culture and environment, any new innovation practices introduced ad-hoc will not have a chance to take root and flourish.

Figure 4 - A systematic approach to workplace innovation



Source: author's elaboration

Addressing future challenges

We have entered an era which has ushered in much more complex societal challenges and simple solutions will not suffice. As the US essayist HL Mencken wrote, 'For every complex problem there is an answer that is clear, simple and wrong.' For instance, addressing the climate change challenge or disruptive developments in digitalisation will require more than one unit, more than one department and more than one government: coordinated EU responses are needed. Preparing organisations for change will require more than adopting ad-hoc practices such as suggestion box schemes or innovation committees. It requires a systemic approach addressing cultural issues (e.g. behaviour, being risk averse),

structural interventions, alignment with strategies, etc. Organisations need to start with the challenges they are faced with, invite employees to participate, and then set objectives to innovate actions, experiment, implement, measure, grow and scale. Activities need legitimacy, staff and suitable budgets.

There has been a tendency in the last years among public sector organisations to use experimentation so that they can more confidently shape the future public space. Practice and experience in the public sector in the last decade show that there has been a change in the language, moving away from 'innovation' to 'transformation.'[1] This suggests a perceived need for more fundamental changes rather than small-scale innovative solutions.

Perhaps it is not a coincidence that international organisations such as the United Nations Development Programme (UNDP) have recently decided to launch 60 acceleration labs across the globe. Starting from innovation labs in their early innovation efforts, which tested and prototyped solutions, now they are exploring systemic solutions.

European institutions and agencies have also been promoting innovation labs, sharing knowledge on innovation, experimentation and design approaches. Eurofound initiated co-creation sessions and experimental approaches. The European Court of Auditors already runs its own innovation lab and promotes innovation within the service. Public auditors help policy makers to shape the future. In their audits, they cover different perspectives, can make use of machine learning or AI and need to experiment with new approaches in an environment that enables and stimulates innovation.

As the Eurofound studies show (see **Box 1**), pioneers in workplace innovation in both the private and public sectors, have chosen different pathways. However, the role of the human factor is crucial for organisational innovation, performance and sustainability in both areas.

Box 1 – Recent Eurofound studies on workplace innovation

Eurofound (2017), Innovative changes in European companies

Eurofound (2016). Win-win arrangements: Innovative measures through social dialogue at company level.

Eurofound (2015), Third European Company Survey – Workplace innovation in European companies

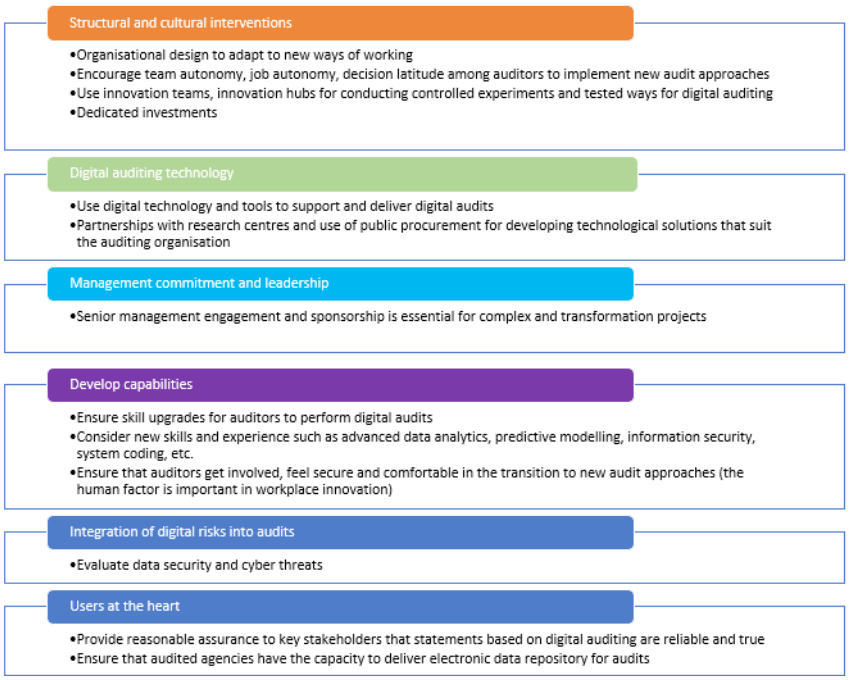
Eurofound (2015). Third European Company Survey – Overview report: Workplace practices – Patterns, performance and well-being

Applying workplace innovation practices in public audit organisations

Regarding the public sector audit organisations themselves, introducing workplace innovation practices could be beneficial for the entire organisation. External and internal drivers of change continually affect public audit services in the form of new policies, technological developments, perceived needs for improved services, etc. As a result, the auditors' focus changes to redefine audits according to the new reality and its possible futures. Making use of workplace innovation practices within auditing services may contribute to improving the service and the auditors' work. The process always starts from defining concrete organisational goals (see **Figure 1**) on what needs to be improved within the audit organisations and why. It is important that the needs are clearly defined, and the likely complexity is appreciated. For instance, digital auditing could be introduced by auditors as a means of enhancing efficiency and innovation within the service using metrics on performance and well-being. However, it should be made clear at the outset that this is not a technology-driven exercise; technology is used to meet the organisation's goals. For such important changes, auditors should also consider how to manage innovation risks in a controlled environment while allowing space for experimentation and the involvement of auditors. **Figure 5** below demonstrates a workplace innovation approach to applying digital innovation.

1 See for example Bason, C. (2019), Leading public sector innovation: Co-creating for a better society (second edition), Policy press.

Figure 5 - Digital auditing with workplace innovation tools



Source: author

It is equally important to appreciate the role of auditors in reviewing other organisations' workplace innovation practices. In that role, auditors could encourage, stimulate and assess such practices within the audited organisations. The Australian National Audit Office created a Better Practice Guide whose aim was to provide a decision-support framework so that public organisations could better manage innovation. The guide also aimed at encouraging an innovation culture within the Australian public service. In a way, this is an innovative role for the auditors themselves: they provide the tools to other public organisations for innovative behaviour and practices.

Public sector auditors reviewing the workplace innovation practices within the audited organisations could follow a similar approach to the one presented above. The introduction of workplace innovation practices by the audited organisation is premised on the assumption that these will improve organisational performance. Hence, the auditors should seek evidence demonstrating the following - an indicative list:

- concrete organisational goals that the new practice addresses;
- identification of practices (what are the actual practices adopted?) and how they contribute to the organisational goals;
- role of employees in the process;
- structural changes (for example, new organisational units), cultural interventions (leadership support, innovation culture);
- investments in developing new capabilities in the organisation in line with the new practices introduced and with a view to meeting the organisational goal;
- costs and risks;
- performance outcomes and impacts: measurement of outcomes (concrete ways of measuring the impact of the new practices in organisational performance and well-being).

With substantial changes taking place in the external environment, the public sector needs to adapt fast. Adopting workplace innovation practices could help audit organisations to contribute to better public services and innovation.

Auditors of the future – what are the skills needed in a digital age?

By Mike Suffield, Association of Chartered Certified Accountants (ACCA)

Source: shutterstock/EtiAmmos

Over the last decades we have seen the digitalisation of our environment, which progresses at an increasing speed. Creating and using data has become a daily aspect of our lives, including for auditors. Mike Suffield is the Director of Professional Insights at the Association of Chartered Certified Accountants (ACCA) and prior to that worked at the National Audit Office of the UK. He explains how the changing audit environment, as influenced by technology, is shaping the audit profession and identifies which skills are needed for auditors to be future proof.

ACCA's take on a changing audit profession

Like many parts of our personal and working lives, the power of digital is extending its reach to the audit function. Data drives our lives, and the audit profession is not immune from this fact. This is as relevant to the audit of public services, which are currently undergoing a fast digital transformation, as it is to purely commercial entities.

To examine this fast-developing environment, the Association of Chartered Certified Accountants (ACCA) has published in June 2019 a report called 'Audit and Technology', together with the Chartered Accountants of Australia and New Zealand (CA ANZ) (see **Box 1**).

.Data and drivers of change

As with all technological developments, there are several key drivers signalling the need for technological change in audit. Such drivers include the rapid increase in the sheer volume of data, the changes in business models, the shift towards automation and the demand for a proactive and forward-looking approach to audit.

Box 1 – 'Audit and Technology' – a report by ACCA and CA ANZ

This report provides an overview of the various technologies currently affecting or likely to affect the audit profession soon. We developed this report so we could better understand this future and explain what it means for auditors. In this report, we were able to explore this, with the human relationship between client and auditor emphasised, because this remains important for the audit.

The report also provides an understanding of how the changing audit environment is shaping technological change in auditing – summarising how different technologies could be expected to impact its future and what this means for auditors as people.

Ultimately, *Audit and Technology* provides insights for both organisations and auditors themselves on how they may adapt most effectively in the face of significant change. Supported by existing research, panel discussions held in Greece, Czech Republic and Slovakia and by interviews with leading practitioners, the report details the latest advances in technology – many of which promise significant benefits for the audit profession.

This is equally the case with new digital ways in which public services are delivered, and in which public service entities are dealing with taxpayers, service users and broader stakeholders. Measuring the value of technologically-enabled and delivered public services presents new challenges to public auditors engaged in performance audit work. These developments mean that auditors need to be technologically sound to enable them to continue servicing businesses and to execute high quality audits.

Such technologies include distributed ledger technology (DLT), data analytics, robotic process automation (RPA), drones technology, artificial intelligence (AI) and machine learning (ML), natural language processing (NLP), and deep learning (DL). The ACCA's report also touches upon smart contracts and cloud technologies.

In the era of Big Data, the structured information accessible to auditors is only a fragment or an abstraction of the much wider universe of data. But this 'dark matter' exists in unstructured formats: the ability of DL to analyse a range of internal and external sources means that Big Data can potentially supply complementary audit evidence and feed into the narrative requirements of audit.

Auditor's adaptability is a must

Our research found that auditors need to adapt to the changes in their clients' delivery models, including the need to understand the various technologies used. Data analytics was found to be the most mature of the technologies currently used by most audit firms, while machine learning is still not at the stage where it is embedded in everyday audit practice.

Taken as a whole, technology is also a catalyst that will help shift the focus of the audit process from a retrospective view to one which is prospective. Key findings in the report revealed:

- auditors need to adapt to the changes in business models;
- among the available technologies, data analytics is currently the most mature and is currently used by most firms;
- the audit profession is still at a very early stage with AI and has not embedded it as deeply as it could;
- the human relationship between client and auditor remains important: not everything can be replaced by technology;
- auditors will need to be more adaptable to change in future.

Technology offers the ability both to improve the quality of audit and to add value to it: audit is moving from being a reactive, backward-looking exercise to a proactive, predictive, forward-looking one, working in real time. It provides an opportunity to help clients by providing timely insights. Even in its traditional context, technology now offers an opportunity to produce higher-quality audits that better serve for their existing purpose. Nonetheless, if AI and related technologies are fully implemented, it could raise questions about the auditor's independence.

What skills are needed for this tech future?

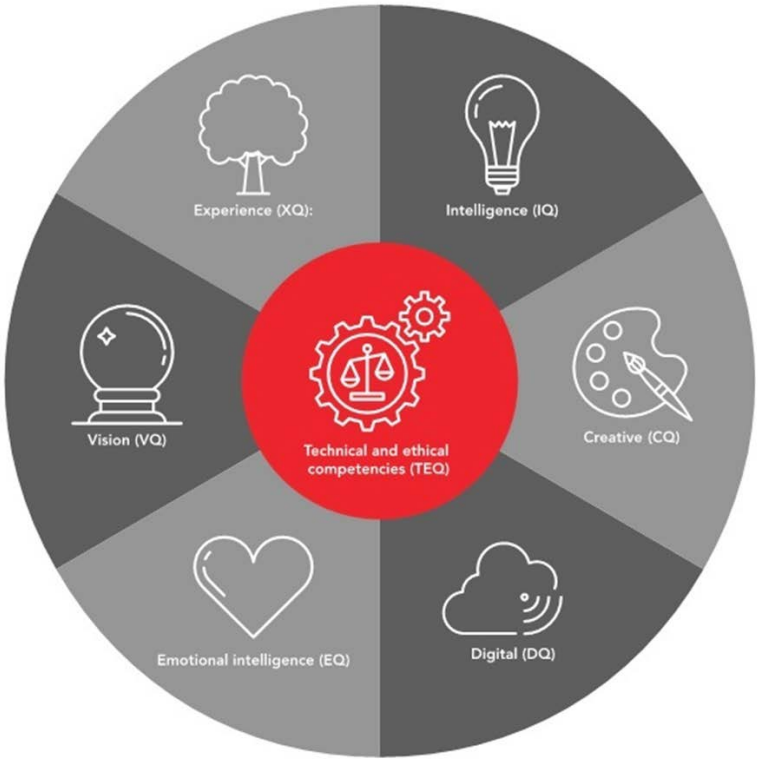
As part of this research, we also examined what competencies and skills would be needed in the future to manage and cope with these technological developments. Technological empowerment can be a double-edged sword. IT skills are paramount yet extremely short-lived. Even trained IT professionals who find themselves out of the workplace for an extended period rapidly suffer 'skills erosion' and can struggle to re-enter the workplace.

A key skill for auditors – at least during the coming years – will be the flexibility to adapt to a working environment which will continue to evolve. Employers need to be

hyper-attuned to this and cannot simply delegate this to staff but will need to consider carefully the design of emerging roles.

ACCA research provides insights into the required future skills mix and how they may change, including the 'digital quotient', as discussed in *Professional Accountants – the Future: Drivers of Change and Future Skills*. This report identifies a range of quotients (see **Figure 1**), in addition to the traditional technical and ethical skills quotient, that are needed now and in the finance function of the future.

Figure 1 – Quotients for the future auditor



Source: ACCA

These are:

- Technical skills and ethics (TEQ): The skills and abilities to perform activities consistently to a defined standard while maintaining the highest standards of integrity, independence and scepticism.
- Intelligence (IQ): The ability to acquire and use knowledge – thinking, reasoning and solving problems.
- Creative (CQ): The ability to use existing knowledge in a new situation, to make connections, explore potential outcomes, and generate new ideas.
- Digital (DQ): The awareness and application of existing and emerging digital technologies, capabilities, practices and strategies.
- Emotional (EQ): The ability to identify your own emotions and those of others, harness and apply them to tasks, and regulate and manage them.
- Vision (VQ): The ability to anticipate future trends accurately by extrapolating existing trends and facts, and filling the gaps in knowledge by thinking innovatively.
- Experience (XQ): The ability and skills to understand customer expectations, meet desired outcomes and create value.

Communication skills will be among the most important competencies across all specialist areas and have been identified in ACCA's research as an area where there is a large skills gap. Professional scepticism and independence will also remain important despite the role of the auditor changing in significant ways. This will be a challenge to recruiters as they seek to attract scarce talent and new personality types to an audit profession that will take some years to transition fully to new models.

Using technology to lead a changing audit profession

The auditors of the future should be technologically sound with excellent project management skills, the ability to adapt to change, adept at telling their audit narrative and aware of the technological development that can help them do their job. The role is changing, and this moment is a chance for the audit profession to use technology to lead that metamorphosis.

Smart Audit: the digital transformation of audit

By Professor Miklos A. Vasarhelyi, Assistant Professor Soohyun Cho and Arion Cheong, Chanyuan (Abigail) Zhang, Rutgers University

Source: Shutterstock/Everything possible

To what extend are audit methodologies, audit standards and audit practices keeping up with the technical possibilities offered in this digital age? Do audit rules facilitate or complicate innovative developments to enable more added-value to be delivered by internal and external auditors? Professor Miklos A. Vasarhelyi, Assistant Professor Soohyun Cho, Arion Cheong and Chanyan (Abigail) Zhang, are all working at the Department of Accounting and Information Systems at Rutgers University and have done a lot of research in this area, particularly in the framework of the Continuous Audit and Reporting Laboratory they have created at Rutgers University's business school. Below some key insights in their analysis of some major developments that, in their view, should herald considerable changes for the audit profession.

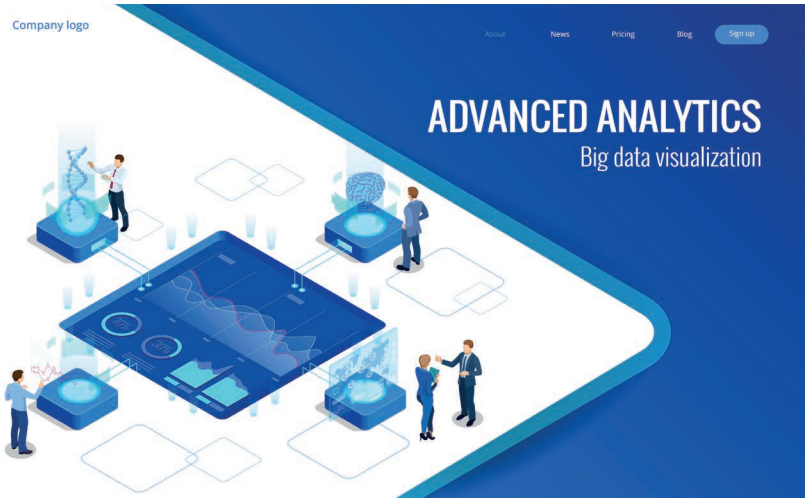
Change in audit

The world is changing at digital speed, but the accounting profession does not seem to notice it with arcane measures and old-fashioned assurance. The forthcoming data ecosystem (Cho, Vasarhelyi, and Zhang, 2019) will consist of a large chain of interlinked data sources and many constantly acting intelligent agents[1] (Vasarhelyi and Hoitash, 2005) performing assurance tasks and drawing exceptions in some form of continuous audit (Vasarhelyi and Halper, 1991). It is reasonable to assume that business measurement (reporting) will evolve to a much wider set of information including partially what is called today's non-GAAP (GAAP standing for Generally Accepted Accounting Principles) measures. Many of these measures will have to be assured on a close to a continuous basis. Meanwhile, a set of evolutionary steps is needed which are described below.

1 Software apps that perform some type of function activated either by conditions (i.e. *Daemons*) or by time clocks (i.e. *Krons*).

Smart audit and big data

For more than 500 years, the crux of accounting had been represented as the double-entry bookkeeping system, formalized by Fra Luca Pacioli in 1492. How about for auditors who were born after the introduction of an Enterprise Resource Planning (ERP) system or the Internet? The reasonable answer will be data analytics. The age of the smart audit is arriving where auditors utilize big data and are assisted by advanced audit analytics tools. In fact, clients' data are getting larger, much larger than the auditor to handle. The auditor should know how to examine the data to find the answer to meet the audit objectives. In accordance, more tools, namely audit analytics, are introduced to the auditors to deal with big data. Further, automation tools such as Robotic Process Automation (RPA) are making the audit hands free. The tools are not only making the auditors smarter but also making them focus on more productive tasks.



Source: Shutterstock/Golden Sikorka

Notably, the big data and the data ecosystem had brought up an expansion of assurance products. As more information is available, more information needs to be validated for decision-making. In the past practitioners, had agreed-upon metrics (e.g., GAAP measures) or suitable criteria that have been used to examine the subject matter. In the modern era, auditors have to derive appropriate measures to support their opinion while that is not provided by GAAP (i.e., non-GAAP measure).

Obstacles for transition

Although the digital transformation in audit is promising, obstacles exist that can slow down this process. First, public accounting firms serve multiple clients, and most likely, each client has data of different formats. The heterogeneity in clients' data makes it challenging to use audit automation or analytics tools. Therefore, to achieve audit automation, standardization is needed to homogenize clients' data (Moffitt, Rozario, and Vasarhelyi, 2018; Cohen, Rozario, and Zhang, 2019).

Furthermore, many auditors have not yet gained the skills needed in a more automated audit workflow and are not ready for the digital transformation. Examples of such new skills are data analytics, programming, and acquaintances with emerging technologies (Zhang, Dai, and Vasarhelyi, 2018).

Finally, many are concerned about the 'black box' issue of some machine learning methods, which can make predictions of future events based on historical data and can identify patterns and extract features from big data. The difficulty of explaining how an algorithm reaches its decision makes the machine-generated conclusion less appropriate to be accepted as an audit evidenced by today's audit regulation.

Future steps: audit data standards

To leverage smart audit practices to improve audit assurance and audit quality, it is critical for policymakers to develop appropriate audit standards and relevant analytic

technologies for big data by integrating and clarifying considerations of practical needs and business trends (Coffey, 2018). For quality audits, new auditing data standards must be developed in terms of data management and relevant technologies (Tang and Karim, 2017). The standards should encourage companies to manage internal data in effective and consistent ways and to validate exogenous data continuously for sufficient evidential matter and assurance (EY, 2015a).

In addition to data management, new standards should be developed to examine and regulate the adoption of new technologies for analytic purposes (such as blockchain and artificial intelligence) in audit procedures. More innovative auditing standards for big data and analytics can be a driving force for progress in smart audit practices and enhanced audit procedures.

Future steps: awareness of the audit firms

Audit firms and auditors currently have a wealth of assignments that can move them toward adopting smart audit practices. However, despite their professed awareness of the importance of smart audit practices, 70% of audit firms are only in the initial or elementary stages of applying big data and analytics to their auditing procedures (Deloitte, 2018).

Moving forward, audit firms must develop strategic plans for data management and analytics and exert greater efforts to implement such methodologies in their organizations. By providing appropriate training and incentives, audit firms can encourage auditors to incorporate big data and analytics into their fieldwork in order to generate better insights. In addition to organizational efforts, audit professionals should seek to nurture positive attitudes toward the ways that big data and analytics can enhance the auditing process and should strive to acquire the appropriate skillsets and competencies (EY, 2015b).

New Roles for auditors

Changes with automation

Digital transformation or the automation of audit is changing the roles of auditors. Although auditors today are equipped with computerized tools (e.g. Microsoft Excel, CaseWare IDEA, Galvanize, etc.) to document audit working papers and conduct audit procedures, manual work is still prevalent in the form of repetitive keystrokes, client data cleansing, data migration, and rule-based data analysis (Moffitt, Rozario, and Vasarhelyi, 2018; Cohen, Rozario, and Zhang, 2019). With audit automation tools built, based on audit data standards (ADS), such manual-intensive work can be significantly reduced. This not only can save a notable amount of time but also can ensure fewer errors generated in the process.

Indeed, machines are intrinsically better than humans at performing tedious and rule-based tasks. When auditors do not need to spend most of their time performing repetitive and basic tasks, they can focus their effort on more challenging and critical tasks, especially those related to the assessment of the risk of material misstatement. This 'man-machine cooperation' is the future form of audit (Zhang, 2019).

Changes with data analytics

The usage of data analytics has been present for many decades but the evolution of digitization, the increasing capabilities of computation, and the emergence of exogenous data (Brown-Liburd and Vasarhelyi, 2015) are totally changing the framework for assurance from a passive *after-the-fact review* to an active *when-it-happens process* that can not only benefit audit processes but also increase substantially the accuracy of transactions. Rigid controls will convert to instance-aware intelligence agents, transactions with faults will either be autocorrected or blocked from flowing downstream. The instant measurement will give aggregated rating system status. Most of all automation agents will perform boring tasks automatically but dimensionally more often than current capabilities.

Research in Smart Audit

Continuous audit

Over 35 years ago AT&T internal audit through its Bell Laboratories research center endeavored into the monitoring and assurance of its larger biller that was core to its 'take back' (direct contact with customers) strategy (Vasarhelyi & Halper, 1991). This effort, that monitored in the pulse of the process - many stages in a very large and cumbersome customer management system, allowed for exponentially improved assurance and process improvement. However, concepts such as materiality and the separation between control and data analytics became blurred.

Likely, just like evolving digital services, new conceptualizations and experimentation[2] are necessary by the standard setters. Considering the current lag in accounting and assurance functionalities, this must be done urgently as the description of the ensuing section will show the dramatic ensuing changes in technology.

Robotic/Intelligent Process Automation

Broadly speaking, Robotic Process Automation (RPA) refers to software that can operate on other software instances to automate tasks that are deterministic and have structured data (Moffitt et al., 2018; Zhang, 2019). Some research has shown the potential of RPA in audit tasks with the premise of ADS (Cohen et al., 2019; Huang and Vasarhelyi, 2019; Rozario, 2019). However, open questions still remain, such as evaluating the RPA tools and RPA implementation stages.

Different from RPA, Intelligent Process Automation (IPA) combines artificial intelligence modules with RPA to deal with inference-based processes (Zhang, 2019). Though IPA has been used in some businesses like banking and insurance, it is yet to be explored in accounting and auditing. It is of interest to examine how RPA/IPA can facilitate continuous audits since audit automation is both the necessary and sufficient condition of continuous audit. Moreover, the cost and benefit analysis of RPA/IPA adoption and the impact of RPA/IPA on auditors' allocation of time can be discussed as well (Zhang, 2019).

Machine learning and AI

Machine learning algorithms can make an inference or perform the task 'without being explicitly programmed.'[3] Recently, machine learning algorithms became more cost-efficient and effective due to advanced computing capability. The strength of machine learning is the ability to learn the factors (or patterns) that are not easily observable to humans. For auditors, the major concern is whether these disruptive technologies will replace 'humans.' The technology cannot yet fully replace human auditors, however, it can perform specific and narrowed tasks more effective than humans.

The major challenge for machine learning algorithms is their limited capability to make professional judgments. Auditors make a number of professional judgments during engagements. Every major judgment should be documented and cannot be a 'black box.' Nevertheless, such technology can provide exploratory insights to the auditors even it yet cannot be recognized as confirmatory evidence. Thus, machine learning and AI can become a supportive tool for the auditors to make a professional judgment.

Predictive audit analytics

In the past, most of the audit analytics were descriptive while limited to several primitive predictive methodologies (e.g., linear regression) (Appelbaum et al., 2017). Due to the development of machine learning algorithms and AI, auditors now have access to better predictive audit analytics. Instead of focusing on 'what happened,' the auditor can now infer 'what could and will happen.' Further, based on the analysis given by descriptive and predictive audit analytics, the auditor can be suggested: 'what should happen' (IBM, 2013).

2 Martinov-Bennie and Vasarhelyi (2018) project proposal to CPA Australia.

3 The definition of machine learning is given by Andrew Ng. For more details, see at https://www.coursera.org/learn/machine-learning

Change in the data ecosystem is making analytics even smarter. Exogenous data such as customer reviews in the social network can be captured on a real-time basis. Such exogenous data can be analyzed as they happen which would provide more timely and relevant information to the auditor (Appelbaum et al., 2017). Therefore, these analytic tools can reduce uncertainty caused by audit risk (Cao et al., 2015).

Blockchain, Smart Contract, and Cryptocurrencies

Blockchain, or Distributed Ledger Technology (DLT) in general, is transforming businesses like banking, stock trading, and insurance (Dai and Vasarhelyi, 2017). Blockchain's functions of data integrity protection, instant information sharing, and programmable and automatic controls of processes via smart contracts could facilitate the development of a new accounting ecosystem and enable a certain level of automatic assurance (Dai and Vasarhelyi, 2017; Rozario and Thomas, 2019; Rozario and Vasarhelyi, 2018). As businesses are participating increasingly in transactions involving cryptocurrencies, 'it is becoming common for financial statements to show material cryptocurrency balances and to reflect the results of cryptocurrency transactions' (CPA Canada, 2018).

Exogenous variables

Exogenous data play a critical role in smart audit practices by providing complimentary audit evidence that helps internal and external auditors fulfill their investigatory requirements. Exogenous data are usually defined as data from third-party sources rather than internal accounting records of corporate entities (i.e., traditional audit evidence) (Brown-Liburd et al. 2019).

In the current era of big data, auditors can collect exogenous data from various sources such as social media and the Internet of Things. In addition, sophisticated data analysis techniques using automation and computerization enable auditors to process data in increasingly effective and efficient ways (Yoon et al. 2015). Hence, auditors with well-analyzed exogenous data have access to more suitable and appropriate audit evidence and can potentially reduce the likelihood of material misstatements and auditing lapses (Bell et al. 2005).

Overall a widening gap between technology and accountancy and assurance

As technology evolves, the accounting profession has been lagging, with a set of anachronistic rules of disclosure and assurance. Both in the government and the private sector, the lag between technological practice and accounting and assurance have further and further widened. More discussion – and action on the nature of this gap, and the characteristics of technologies that are being used and also can be used in the measurement and assurance of business, needs to be encouraged.

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Auditing the digital reality

By Spyridon Pilos, Information, Workplace and Innovation Directorate

Source: Shutterstock/Peshkova

For auditors, the terms digital audit and data analytics are often interrelated and a key issue to be tackled in their future work. But what does a digital world actually mean for audit and what are some of the key elements that come into play? Spyros Pilos is Principal Manager, working on a daily basis with technology and data in relation to audit. Below he touches upon some key elements of digital audit and how they impact auditors' work and their aim of providing independent insights to promote accountability and transparency.

Digital is becoming reality

The world is becoming more and more digital. Today the reality is data. Rules are implemented as electronic procedures and algorithms. As a consequence, audit should become more and more digital to cope with a changing reality. This is a commonplace statement. But the next question is: 'What does this mean in practice for our audit work?'

Today's reality is also digital.

Automation and analytics

The first major component of what we can call digital audit is the *automation of data collection and data preparation*. This may include *automation of the audit documentation process* by establishing a single process for all information exchanges between auditor and auditee. This may even start already with the evidence, for which we could use distributed ledger technologies (blockchain) to have, for example, the end beneficiary of EU funding register invoice payments and other documents - that can potentially become audit evidence - the moment they are generated, and then give access to financial management and audit offices as required. This would introduce 'control by design' in the financial management process.

It may also include *automation of the audit data preparation activities*, i.e. validation, extraction and processing. In this case, the auditor may be assisted by software that can be programmed to do basic tedious and repetitive tasks across applications and data sources imitating human action, what is also known as robotic process automation or RPA.

The second major component of digital audit is *data analytics*. Once the first data sets are there and the auditors are relatively confident that they fulfil certain criteria, then they can start analysing them. Data can be structured, for example excel tables, database extractions, log files or forms. It can also be unstructured, for example text documents, images, sounds or videos.

There are different tools and methods that can be used to help auditors make sense of the typically large amounts of data in ways that can allow them to identify risk and gain insights in order to assist them to exercise their professional judgement, basing their opinion on facts. A *Toolbox for data* (T4D) in this sense may include statistics, data visualisation for analysis, data mining, process mining, big data techniques, Artificial Intelligence and machine learning.

Digital input requiring specific audit skills

If we look back into the audit process (digital or not) we see that what is important for the auditor is to *trust the input*: the evidence should be relevant and reliable (i.e. authentic, true, etc.) and the information on the process should be complete and up-to-date. Nowadays *the input is digital*: data is digital; it is typically kept in IT systems (databases or others); 'rules' may be implemented through code; processes and decisions may be taken by machines based on algorithms. The digital reality requires new roles to be involved in the audit process.

The basis of everything is data: we need 'data auditors' who will inspect the data at hand, reconcile them with reality, and confirm that they are suitable for the purpose, the analysis that they are meant to be used for. Algorithms should be transparent and explainable; we need 'algorithm auditors' who can confirm that the process and decision rules are implemented as they should be and produce predictable results. Data and algorithms typically live in IT systems: we need more 'IT auditors', able to go deeper into this kind of analysis and assess the systems, their processes and their output.

We also need to manage the sheer volume of information available: the auditors should be able to identify what needs to be audited in depth. Sampling on the full population is compulsory when it is not possible to identify and process a representative sample in a reasonable amount of time. This is even inevitable when evidence and rules are available in physical form, for example on paper. However, in the new digital reality it may be possible for the auditor to process and visualise all the information available before deciding which cases need a closer look. Experts in 'data visualisation,' 'data mining' and 'data analytics' should be working hand in hand with auditors, searching for potentially interesting insights, supported by data, that can guide them to risks.

Digital shift with the human factor as the key focus

Today we have most of the information and data needed for audit in electronic form. Technology is available at affordable prices to manage, process and analyse this data in a reasonable time and produce usable outputs. This trend is sure to continue in the coming months and years. However, the shift towards digital audit still requires a review of the working methods and organisation of audit institutions. The purpose of the audit function has not changed: with its focus on accountability and transparency, it aims to foster stakeholder trust concerning the efficient, effective and economic use of resources. The methodology on how this is to be achieved and the related regulatory framework should be reviewed to ensure they correspond to the digital reality. New expertise needs to enter the audit process. New job profiles will emerge for audit and the existing job profiles will need to evolve in order to cope with the changing reality. The human factor remains critical as the ultimate guarantor of the validity of the audit process both overall and in its partial steps.

It may be impossible to predict the impact of the emerging technologies. It is evident that the regulatory framework for audit will evolve more slowly than technology. Audit institutions can already do something about the future, though. We need to be prepared. We need to experiment with new methods in innovation labs. And we need to learn from each other through cooperation and exchanges. This is a major change and it can only succeed if audit institutions and audit professionals understand and endorse it.

‘ECA audit goes digital’ with the Digital Steering Committee

By Eva Lindström, ECA Member

Digitalisation in the audit sector is not stopping at the ECA’s door. The College of the ECA has decided to set up a Digital Steering Committee to guide the digital transformation of the ECA’s audits. This committee is chaired by Eva Lindström, ECA Member. Below she explains the “whys” and “whats” of the Digital Steering Committee and the related project team, by looking at its mandate, composition and key activities.

Digital transformation: key for our audit work

Supporting digital transformation is a priority for unlocking future growth in Europe. According to the European Parliament Research Service , existing research suggests that a deeper and more complete single market in the digital field could raise the long-term level of EU28 GDP by between €415 and 500 billion per year (3 to 3.6 % of EU GDP). Digitalisation, including the opportunity of open and big data and the potential of new findings using data and artificial intelligence, was a key part of the speech given by Ursula von der Leyen, the European Commission President, at the European Parliament on 27 November 2019.

Digitalisation is having a fundamental impact on all professions and audit is not an exception. At the ECA, I think we have already been making progress for some time with different initiatives and pilots, and this journal shows you some of what we has been happening. I am convinced that it is strategically of utmost importance to undertake a digital transformation of our audit work in full. In February 2019, the College of the ECA adopted its conclusion on ‘Foresight for ECA,’ in which we committed to move forward on foresight – establishing a Strategic Foresight and Advisory Panel – and we identified an urgent need for the ECA to undertake a digital transformation of its audit work . This is where the Digital Steering Committee (DSC) comes into play.

The ECA’s Digital Steering Committee and project team

The DSC was set up in May 2019. Its mandate is to drive the digital transformation of the ECA’s audit work in the coming years, in line with its current 2018-2020 strategy. In turn, its work on the digital transformation of the ECA will provide valuable input for the ECA’s next strategy.

January meeting of the Digital Steering Committee. Not on the photo Ivana Maletić, Member
From left to right:
First row: Leo Brincat, Phil Wynn Owen, Iliana Ivanova, ECA Members
Second row: Geoffrey Simpson, Director, Mariusz Pomienski, Director, Project owner; Ioanna Metaxopoulou Director, Magdalena Cordero Valdavida, Director, Eduardo Ruiz García, Secretary-General; Eva Lindström, ECA Member; Alex Brenninkmeijer, ECA Member; Katharina Bryan, Head of Private Office; João Figueiredo, ECA Member; Julia Pilarczyk, Project Manager

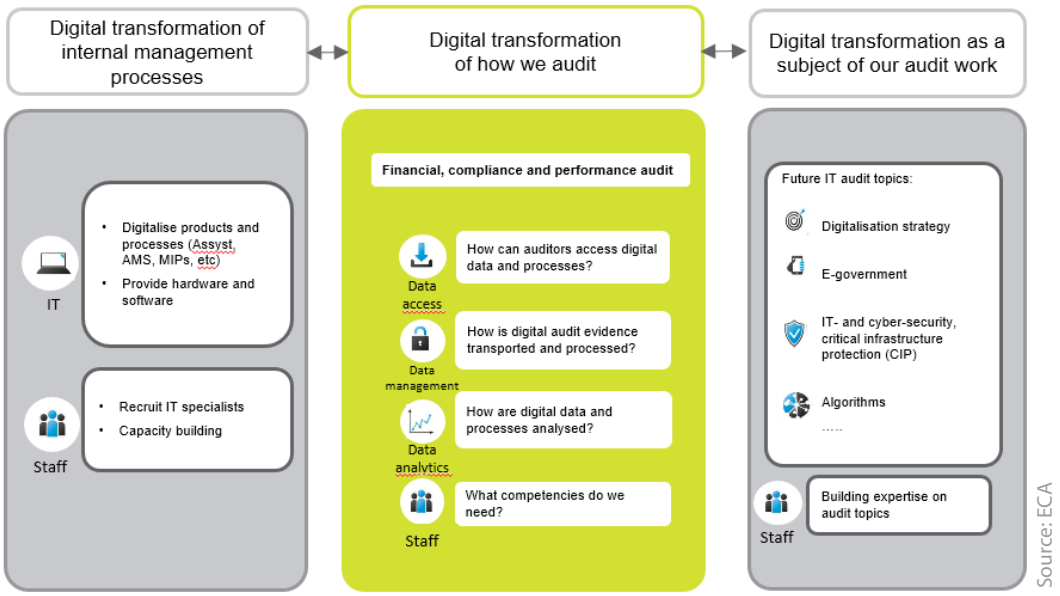
The Members of the DSC are Alex Brenninkmeijer, Leo Brincat, Iliana Ivanova, Phil Wynn Owen, Ivana Maletić. My colleague João Figueiredo, as Chair of the Strategy and Foresight Advisory Panel, is also joining our meetings to ensure that the development of the ECA’s strategy goes hand-in-hand with our work on digitalisation. As head of administration, the Secretary-General, Eduardo Ruiz García, naturally plays an important role in any change process and takes an active part in our work.

Director Mariusz Pomienski, from the Financing and Administering the Union audit chamber, is the project owner. Magdalena Cordero, as the director responsible for Information, Workplace and Innovation, has been driving the ECA's digitalisation and I see her as an important engine for the transformation. For me it was important to fully involve audit methodology, and Geoffrey Simpson, the director responsible for quality control, also supports the Committee's work. The project manager is Julia Pilarczyk, an experienced financial and compliance auditor who will be supported by a multidisciplinary team.

What does the digital transformation of the ECA's audits entail?

Digitalisation of our audit work is about using the potential of technology to deliver better and more information for the accountability process to our stakeholders. This transformation is *about the way we audit*. The project will not include digitalisation as an audit topic or the digital transformation of internal management processes (see **Figure 1** below). However, these parts are interrelated. For example the competences we will gain will also be useful for future audits.

Figure 1 - Scope of the Digital Steering Committee



What could a digital transformation mean in practice?

From my perspective, digital audit is about doing audit differently, not only digitalising how we work today. For example, transformation could imply examining a whole set of transactions and payments rather than a small selected sample. It is about being more efficient and, in the long run, this should reduce cost and thereby enable us to focus more on results and the impact of the EU budget and policies. Also in this respect, digitalisation is about getting more value for money.

Time is moving fast. In 2015, when I was not an ECA Member yet, the vision was that, in 2040, the ECA could use a high degree of automation in its audit procedures. For instance, algorithms would spot irregularities and artificial intelligence could detect performance patterns in large data sets. In this scenario, auditors would be able to focus their work on asking the right audit questions rather than on verification of documentation. Today, this vision is no longer for 2040 but much closer. I think we will see this happen at the ECA already in the next three to five years.

To start with, we are digitalising how we work now, but the next step will be to change how we give assurance on information reported by others. This requires the commitment of the auditees to becoming digital, including the development of more embedded controls in their systems - known as 'control by design'.

As this ECA Journal shows, quite a lot is already going on at the ECA. We have started to use more and different technologies in different areas, for example, by providing more

quantitative analysis or interactive graphs in our performance audits. We are also doing a pilot audit on some of the stages of the checks we carry out when auditing selected EU agencies.

Time schedule

The Digital Steering Committee should be in place for as long as the digital transformation project lasts. Being such an innovative project, its total duration will depend on the complexity and breadth of the actions the ECA will undertake. We have started with a status quo analysis, which we will be working on in the next months. This first stage of the project will involve taking stock of the current state of digitalisation of audit, both internally and externally.

First, we will map where we are as an institution in our financial, compliance and performance audits, as well as for the Statement of Assurance work, both in terms of IT audit tools at our disposal and skills and competences.

Second, we will collaborate with supreme audit institutions (SAIs) particularly advanced in digitalisation to learn and collaborate. Our team has already been to the French Cour des comptes and we will visit the UK National Audit Office and the Finnish SAI in early 2020. We are also envisaging exchanges with the Estonian SAI. We will also analyse the state of the art on digitalisation of audit in the private sector. Big private audit firms are investing significantly in new technologies and new competences.

Third, we will stay in close contact with our auditees, and in particular with the European Commission. Much of our work will depend on accessing the data in our auditees' (both the Commission's and the Member States') databases and IT applications.

Combining efforts within the ECA and collaboration with the European Commission

Collaboration within our organisation and between its different services will be important. We need to bring IT, quality assurance and audit together. The digital transformation will need to be driven and implemented by the audit directorates. The IT department will also be a key actor in this change. We need to be very agile, as digitalisation is a fast-moving target.

The ECALab initiative was, in my opinion, an excellent starter to help our first practical examples on the way. However, to scale up and transform we will need to think of how we can mainstream this type of collaboration. Digitalisation is about innovation and we should consider how we best foster innovation within our organisation.

In our Statement of Assurance work, we will continue our approach on relying on others in accordance with the strategy. Close cooperation with the European Commission is therefore essential and we envisage both high-level contact with the new Commission as well as contacts at different operational levels. It is also necessary to strengthen our cooperation in this area with the SAIs of Member States. The recent conference on big and open data that was organised by the ECA saw the establishment of cooperation on exchanges at a very practical level.

Change requires leadership

I think it is clear that digitalisation will be a *disruptive change* requiring leadership. It will also require good communication, both internally and externally. It will also inevitably entail some risks. In this regard, we must be prepared to accept failures along the way. We will also have to undertake this change step-by-step and with appropriate resources. The payback will probably take some years. In the meantime, we will need investment both in software and in human resources. Support and commitment to the project at all levels of the administration will be crucial to the endeavour. However, digitalisation is necessary if we as auditors want to continue to deliver added-value and to keep abreast of developments in the audit sector and society. It is a challenging but very exciting project to be involved in. In my view, as the EU's external auditor, the ECA cannot afford not to take the lead in transforming audit and fully harnessing the potential digitalisation offers.

The ECALab – our in-house incubator for applying data analytics, data visualisation and process mining to audit

By Emanuele Fossati, Information, Workplace and Innovation Directorate, Clare Reilly, Deloitte, and Carmen Schnell, private office of Annemie Turtelboom, ECA Member

In 2017, the ECA launched the ECALab as a centre for exploring ideas and technologies and building on the new possibilities offered by digitalisation. In this article Emanuele Fossati, ECALab coordinator, Clare Reilly, a former ECA trainee who is currently employed at Deloitte in Dublin, and Carmen Schnell, assistant in the private office of Annemie Turtelboom, ECA Member, zoom in on the role of the ECALab.

Technology and audit

Technological advances provide a great opportunity for audit. New tools could see a shift from traditional sampling techniques to real-time whole population audits, allowing for results that are more accurate as well as greater accountability and transparency. Automating repetitive tasks could free up valuable audit time, while data visualisation and data analytics may facilitate a more investigative analysis in the early stages of an audit. The potential of predictive auditing is equally vast.

However, these opportunities also entail major challenges for auditors. Testing entire populations and managing a greater number of outliers will undoubtedly change the role of the auditor. The ECALab serves as an in-house incubator for exploring new ideas in audit and offers auditors a variety of techniques that can assist in achieving individual audit goals.

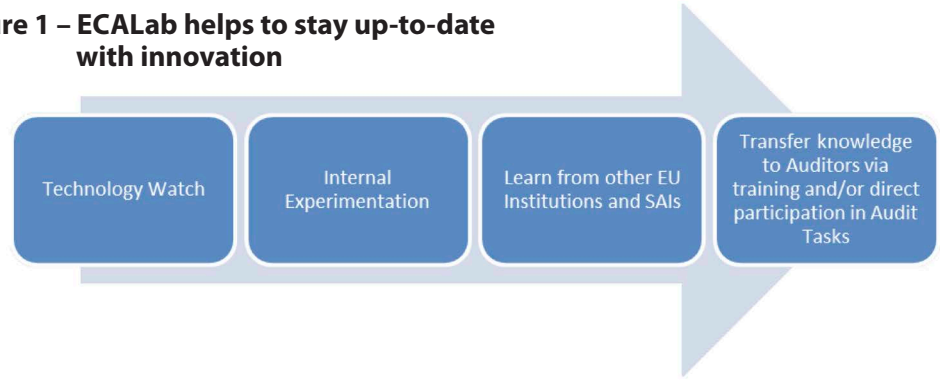
Box 1 – Why the ECALab?

Emerging technologies not only allow auditors to efficiently manage the changes prompted by digitalisation, but also improve processes and create rewarding new opportunities for audit. For many years, the private sector audit firms have been exploring how to make best use of data-driven audits. The Big Four audit firms have embraced the opportunity to explore areas such as artificial intelligence (AI) and blockchain, so why should supreme audit institutions not follow the same path? In 2017, the ECA responded to this question by launching the ECALab, an in-house centre for research and innovation. This space for sharing ideas, exploring, testing and implementing technologies in the audit process is part of the ECA's digital transformation initiative. The ECALab is comprised of data science enthusiasts and expert auditors who cooperate on finding tailored solutions to audit tasks and audit-related projects.

Staying up-to-date with innovation

The work of the ECALab is crucial in ensuring that the ECA will stay up-to-date with innovation, as technological advances are occurring at an unprecedented rate. This involves a continuous technology watch, internal experimentation, learning from other EU institutions and supreme audit institutions (SAIs) and the transfer of knowledge (see **Figure 1**).

Figure 1 – ECALab helps to stay up-to-date with innovation



The ECALab therefore helps our auditors to make practical use of innovative approaches like data analytics, data visualisation and process mining in their audits. Other new technologies, such as blockchain, text mining, etc. are also tested and applied in the ECALab.

Data analytics – techniques for identifying patterns and outliers

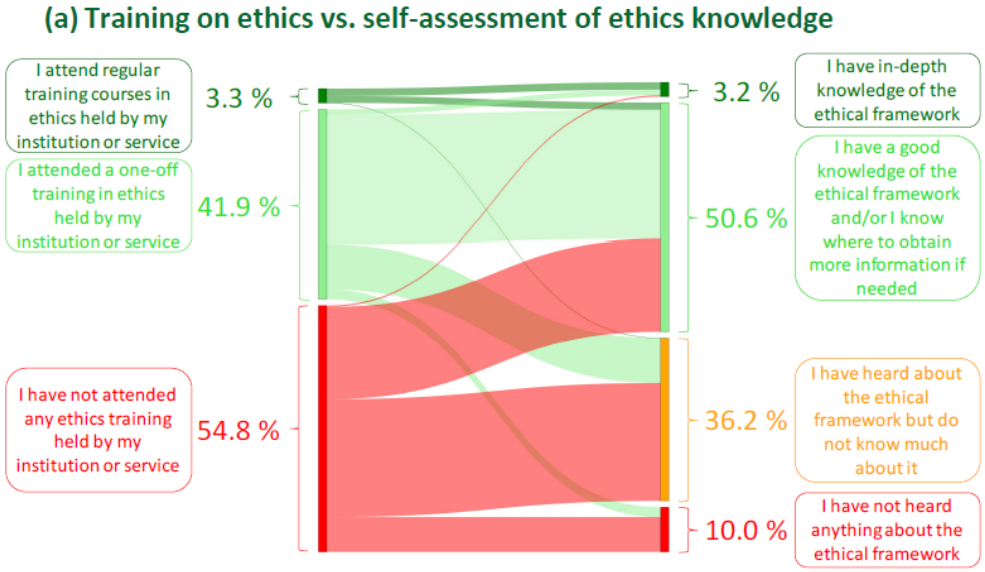
Data analytics is the science of analysing raw data and drawing conclusions from the process. It is all about discovering and examining patterns. Not only does it help auditors manage and interpret an ever-increasing amount of data, but it also allows them to gather further audit evidence by analysing large populations rather than small non-representative samples. By identifying patterns, clusters and outliers, auditors gain an enhanced vision, allowing them also to detect and judge the relevance of causality during data analysis.

Technology can help identify previously unrecognised patterns or clusters of interest and therefore raise questions which would have otherwise been overlooked. Such an open approach is valuable in that it permits the exploratory analysis of audit evidence and has the potential to increase the audit scope. Data analytics could bring further added value to audit by enabling the projection or forecasting of future events. However, this would see the role of audit shift from reliable historical cost accountancy to estimations and forecasts and should therefore be treated with utmost caution to avoid separating audit from verifiable facts.[1]

Data visualisation – translating data analytics into visual format

A more advanced area of data analytics is the visualisation of both structured and unstructured data. By extracting, processing and translating raw data to visual formats, data visualisation software makes content more accessible and easier to interpret. Just like data analytics, data visualisation allows auditors to analyse entire data sets and thereby identify outliers, patterns and irregularities. While both techniques can help raise further questions and thereby expand the audit scope, data visualisation also acts as a valuable communication tool. Intertwined with text, it can help to convey essential information. Informative data-driven visuals can assist auditors in writing reports that tell an engaging, coherent and conceivable story.

Figure 2 – Example of a data-driven visual



Source: Example taken from ECA special report 13/2019: "The ethical frameworks of the audited EU institutions: scope for improvement".

1 Jonathan Ford and Madison Marriage, 'The big flaw: auditing in crisis', *The Financial Times* (London: August 1, 2018) < https://www.ft.com/content/29ccd60a-85c8-11e8-a29d-73e3d454535d> [accessed 1 June 2019].

Data visualisation not only enhances reports visually, but also contributes to making them more memorable. At the ECALab, data scientists are already creating interactive visuals by using tools, such as Tableau, PowerBI, Gephi (visualisation of networks), Maltego, and Plotly , which allow for an even more dynamic and engaging reading experience and deeper analysis. These provide an overall picture of the data and enable the reader to zoom in on specific statistics of interest. This technique can be applied to any kind of visual, be it maps, timelines, bar charts or others.

At this stage, interactive visualisations are particularly interesting for communication purposes following the publication of a report. However, as the audit world sees a shift towards electronic reports, the role of interactive data visualisation is set to become more prevalent in the future.

Process mining – combining data analytics and data visualisation

Process mining is one of the technologies tested at the ECALab which could play a significant role in the digital transformation of audit. It combines data analytics and data visualisation to allow auditors to analyse and detect patterns and irregularities in both static data and entire procedures. It works by extracting event logs to reconstruct and visualise processes. Due to the increasing digitalisation of auditees' processes and records, log data has become more accessible, and auditors can now examine very detailed audit trails. See also p. 68 on this topic .

The ECALab was established as a place where people can experiment with new ideas and technologies, organise demos and discuss their results with colleagues. As testing always works best on real cases, why should the wealth of real information found at the ECA not be used for experimenting and learning? **Box 2** provides two recent examples of how this can be done.

Box 2 – Two examples of the ECALab's contribution to recent audit tasks

In September 2017, in the context of an audit task which resulted in the Landscape Review 'Putting EU law into practice,' a mixed team of ECALab data scientists and auditors worked together to merge data from various sources in a single integrated model. This allowed for innovative ways of presenting data graphically and greatly facilitated the task of data analysis.

As auditors often have to handle hundreds of documents, a tool allowing them to navigate through these by extracting summaries, prioritising by relevance, connecting similar paragraphs from different documents, etc. could help save time and resources. This kind of AI solution was exactly what another audit team had in mind when it recently approached the ECALab. Text mining or, more generally, natural language processing can be one of the major assets of AI. While the ECALab was not able to provide immediate added value for the task, work it had done previously contributed to the prototype of a useful new tool, the 'Document Navigator', which will be made available to all auditors in future.

The ECALab – key activities ahead

The ECALab will have to focus on the following priorities in the next few years:

- Further increasing internal capacity. This will mean training staff volunteers, creating a network of proven external experts and hiring new staff with specific skills in data science. One issue in this context is that data scientists tend nowadays to come from various other business disciplines and therefore cannot be expected to master IT security and/or system administration.
- Further developing interinstitutional cooperation. In view of the significant investment needed to keep up with technological developments, it is immediately obvious that a single (audit) institution cannot go very far. For this reason, the TINA (Technology and Innovation for Audit) initiative was launched during the recent Big and Open Data conference for EU SAIs (see also p. 108).

As regards the ECALab's continuing role as the in-house incubator and consultancy service for innovative approaches in audit, we will need to cautiously manage our customers' expectations. Auditors usually bring interesting needs to us and are willing to experiment with new ways of doing things. In some cases, while technology and methodology are heading in the right direction, they will not immediately be productive. This may lead to disillusion and prevent auditors from expressing good ideas in the future. To avoid this kind of scenario, the ECALab only rarely dismisses ideas as 'not possible', preferring to adopt a 'try it and see' approach. Even if this does not bring the hoped-for results, it will still provide a valuable learning experience for everyone.

Most importantly, however, maintaining close cooperation through different teams of auditors and data scientists will remain an essential factor that will determine the success of the ECA's digital transformation.

IT audit at the ECA – assessing the digital environment in policy areas

By Franck Noël, Audit Quality Control Directorate

Source: shutterstock/By Wright Studio

In our modern society, it is difficult to imagine a policy initiative or programme that would be implemented without the support of IT systems. So, auditing any policy often means assessing the quality of the underlying IT systems. But how aware are auditors of this fact? Even more importantly, how well equipped are auditors to make such assessments? Franck Noël is a Principal Manager with extensive experience in working with IT systems at both the European Commission and the ECA. Here he presents some key aspects of the IT audit assessments done at the ECA and the different domains that making up the digitalisation of audit.

The world is already digital

These days, many discussions refer to 'digitalisation'. Digitalisation of our society, digitalisation of policies, digitalisation of audit. In fact, though, western societies and economies have already been digital for a while. Bank accounts are simply records in databases; our favourite songs are electronic files stored on servers in the cloud; university courses are accessible online.

Back in 2007, Wolfgang Schäuble, then Germany Minister of Interior, said that any political project involved or would result in an IT project. This was 12 years ago. Indeed, the free movement of goods within the European Union relies on the new computerised transit system; security policy is implemented with the help of systems such as the Schengen information system (see **Box 1**); carbon emissions are traded via the Emission Trading System.

Against this background, auditing means auditing in a digital environment and, increasingly, auditing digital evidence in a fully digital environment. Whether it is for a financial or a performance audit, auditors collect data and documents that are natively digital. Determining the reliability of such data and thus the trust that can be granted to such data, depends on our capacity to fully understand how these data are loaded, processed and extracted by the systems storing them. This is where IT audit plays a role.

What is IT audit?

The International Standards of Supreme Audit Institutions (ISSAI) 5300 Guidelines on IT Audit define such audits as 'an examination and review of IT systems and related controls to gain assurance or identify violations of the principles of legality, efficiency, economy and effectiveness of the IT system and related controls'. Such audits may be carried out either as a stand-alone exercise to assess the performance of an IT system, or as part of a financial, compliance or performance audit of an entity (its integrity and capacity to deliver) or subject matter where an IT system (or a component of that system) plays an important role.

IT systems belong to information systems, which also comprise processes and the people operating them, and are controlled by the overall IT governance framework in place at the audited organisation. Therefore, an audit of an IT system encompasses not only technicalities but also the decisions and decision-making processes impacting their lifecycle. Operational aspects must also be considered to ascertain the reliability of the data of these systems. The scope of an IT audit may therefore cover fields as varied as cybersecurity, data protection, governance and business processes.

Box 1 – ECA special report 20/2019 on EU information systems supporting border control

The creation of the Schengen area, which abolished border checks between 22 participating Member States and four other European countries, increased the importance of effective control and surveillance of the area's external borders to prevent crime and terrorism and to control migration. According to estimates, the EU budget provided over €600 million to set up the IT systems to facilitate the work of border guards.

The ECA examined how well the main IT systems for border control allowed border guards to check individuals entering the Schengen area at authorised border-crossing points – land, seaports and airports. The audit aimed to identify aspects in the design and use of these systems that helped border guards do their job more efficiently. The IT systems concerned checks on people and objects, visas and asylum applications, fingerprint comparisons and passenger records.

The ECA concluded that the IT systems were a strong tool increasingly used by border guards performing border checks. However, some data was not yet included in the systems, while other data was either incomplete or not entered in a timely manner. This reduced the efficiency of some border checks. The border control authorities should focus more on entering complete data promptly in the EU's information systems involved in supporting surveillance of the Schengen area's external borders.

IT audit at the ECA

Many audits we carry out have an IT dimension to a greater or lesser extent. IT audit is therefore an important field for us. In recognition of this, and eager to improve related practice, the ECA launched an IT audit self-assessment in November 2018, using a method developed by the IT Working Group of the European Organisation of Supreme Audit Institutions (EUROSAI).

The IT audit self-assessment involved a group of auditors filling out a questionnaire to assess the IT audit function of their SAI, and then attending a workshop to discuss the results and define steps for improvement. External moderators from Switzerland and Malta facilitated the process. Overall, participants in the IT audit self-assessment perceived the maturity of the ECA to be moderate, with an average score of 2.2 for IT audit aspects on a scale from 1 to 5.

Table 1 shows that participants aim for around a level 4 in all aspects of IT audit, thereby demonstrating the appetite for IT audit at the ECA, as well as the need to take concrete action to develop this field internally. The disparity between the maturity and ambition assessments clearly shows there is still some work ahead of us.

Table 1 – IT audit aspirations: results of the 2018 IT audit self-assessment at the ECA

	DESIRED LEVEL
External requirements	4.1
Internal requirements - Input & Resources	4.2
Internal requirements - IT audit process	4.2
Internal requirements - Output (Reports & Quality Assessment)	4.2
Quality Management, Control & Monitoring	3.9

This assessment pinpointed areas where our procedures could be improved. As a starting point, considering IT risks inherent to a policy area or a specific audit is not yet part of our standard practice. One of the axes for improvement is thus to raise awareness about IT risks, including in policy scans, in the programming cycle and, of course, during the planning phase of an audit. In this respect, knowledge of the European Commission's information systems landscape appears to be of utmost importance.

To assess IT risks in a systematic manner, audit guidance and methodology should be adapted to make sure that our audits consider IT elements wherever necessary and relevant. The review and elaboration of such guidance will of course require the attention of a dedicated team. It may also result from collective intelligence work conducted by an internal network of IT auditors.

Several auditors at the ECA hold an IT audit certification. They should form the kernel of a new internal network – or 'knowledge node' to use the ECA jargon – whose role would be to contribute to and review methodological guidance on IT risk assessment and IT audit, and to support specific audits should the need arise. This network should of course be open to all interested ECA staff, in particular auditors but also IT professionals.

Such a network should also identify emerging training needs in the IT audit field. Training courses on IT audit may need to be reassessed in the light of the IT audit self-assessment, with the possible addition of new modules. All aspects of IT audit should be tackled, for instance, cybersecurity, auditing IT in the cloud, and IT governance frameworks such as COBIT (Control Objectives for Information and Related Technologies) – a framework for IT management and IT governance.

IT audit, digital audit, IT support to audit

The world and modern organisations, such as the ECA, have gone and are increasingly digital. When it comes to the digitalisation of the audit discipline, we must distinguish between three separate domains: IT audit, digital audit and IT support to audit.

IT audit refers to the examination and review of IT systems and possibly of the wider IT environment, as described in this article. *Digital audit* involves using advanced techniques to perform an audit, for instance, data mining or software robots. So, the former concerns the object of the audit, the latter concerns the audit technique. *IT support to audit*, by contrast, relates to the set of IT tools that are built to facilitate and document the work of auditors. It of course covers audit documentation systems, but could also encompass digital exchange platforms between auditors and auditees to, for instance, securely collect audit evidence or share findings with a view to implementing an online clearing exercise.

As a modern public audit institution, the ECA strives to progress in all three domains by understanding and listening to the needs expressed by its stakeholders and staff, and by identifying and embracing the possibilities offered by technology.

Digitalisation of audit procedures: a pilot project for the financial audit of the European Commission's executive agencies

By Valeria Rota, Regulation of Markets and Competitive Economy Directorate

In the private sector auditees and auditors are looking more and more for smarter ways to capture business processes digitally and transform the way in which audits are conducted. In public audit, too, there is an appetite to follow this path. But this requires certain levels of standardisation and design harmonisation. In 2019, in order to move the annual EU agencies audits towards digital transformation, the ECA started a digital audit pilot project focusing on the European Commission's executive agencies. Valeria Rota is a Principal Manager deeply involved in the financial audits the ECA carries out annually on all European Commission's agencies . As she is following closely the pilot project that is 'experimenting' with audit automation, Valeria is well positioned to provide some insights.

Putting commitment to digital transformation into action

Digital technologies are transforming the world at an unprecedented speed. With the creation of its Digital Steering Committee (DSC), the ECA identified an urgent need to undertake a digital transformation in the way we audit. The aim of this transformation is to use the potential of technology to deliver our audits more easily, quickly, accurately and extensively than ever before and provide more useful information for the accountability process.

Digitalisation, the development of robotic process automation (RPA), artificial intelligence, machine learning capabilities and big data analytics provide substantial opportunities for compliance and financial audits to become more precise and comprehensive. The characteristics of millions of entries can be checked in a few minutes, immediately flagging any exceptions so that auditors can concentrate on higher risk transactions. The increased processing speed means that instead of checking samples, auditors can analyse full populations of transactions. For example, a mock demonstration of a partial automation of two audit procedures already led to a significant increase in the processing speed - of nearly 96%. The plan is to no longer simply discuss the opportunities and challenges of digitalisation for the audit profession, but to put audit automation into practice.

Pilot project auditing EU executive agencies

Within the ECA, the audit chamber dealing with the regulation of markets and the competitive economy is carrying out the first pilot project on digitalisation of audit procedures at the ECA - the Digital Agencies Audit Project. We identified the financial audit of the six executive agencies of the European Commission as the ideal environment to start with. Executive agencies share similar administrative procedures and similar IT systems. An ECA project team composed of auditors (specialised in the financial audit of the agencies) and IT experts has been exploring ways to perform the audit of accounts and transactions, to the greatest extent possible, with automated procedures. Since the agencies use the information systems of the European Commission to deal with some administrative procedures, the experience gained will also be useful for other non-agency audits, particularly for the audit work for our Statement of Assurance.

ECA staff members participating in the Digital Agencies Audit Project, from left to right: Spyridon Pilos, Denis Navarre, James McQuade, Zsolt Varga, Paulo Oliveira, Ioanna Metaxopoulou, Frank Verheyen, Magdalena Cordero Valdavida, Claudia Albanese, Hans Christian Monz, Konstantinos Chatzis, Andreja Pavlakovic-Milosavljevic. Valeria Rota, not depicted here, is also member of the project team.

The project started in mid-2019 with the mapping of the existing audit procedures - around 180 of them according to our audit programmes. This exercise consisted in sorting the data sources and the tasks to be carried out for every existing audit procedure and identifying the potential for automation. This included exploring possible modifications of existing audit procedures and working methods, in particular in respect of how to obtain paper-based information in electronic format in order to move from manual to automated processes.

Based on this mapping, two main technologies for automation have been identified - Data Analytics (DA) and Robot Process Automation (RPA):

- DA is not a new technology but has gained significant importance with the development of data warehouses, clouds and other powerful storage capabilities. Today, ECA auditors already have access to several data sources for the agencies which can be used for DA. Auditors can use DA for data extraction, analysis and/or interpretation to support the identification and assessment of risks, or the planning and performance of audit procedures;

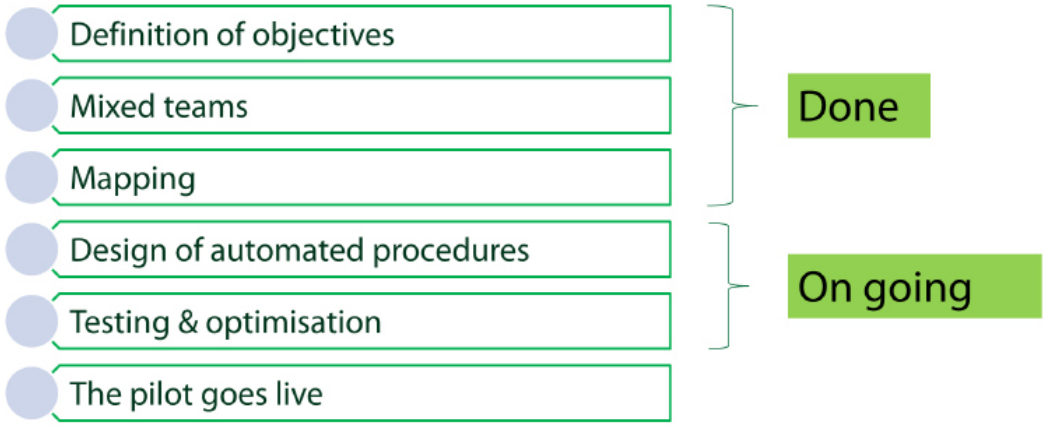
- Robot Process Automation (RPA) software provides advanced macro-like capabilities that can be deployed at an enterprise or business unit level. In this case the robot is computer-coded software, which is used for automating repeatable and rule-based tasks. The robot is programmed to perform the sequence of steps that a human user does, e.g. downloading documentation and other data from agencies' IT systems and organising the files for the transactions audited. The robot can interact with the same applications a human would use, but operates much faster and can be run at any time.

The focus of the Digital Agencies Audit pilot project is on the audit of the accounts and on the audit of the commitments and payments of the executive agencies, as well as substantive testing of the salaries. Consequently, the pilot covers both financial and compliance audit procedures. We identified suitable audit procedures and analysed them in detail. Most of these procedures could be automated by using DA, some others by combining DA and RPA. Naturally, the scope of the project is changing as it is developed and implemented, as new things are learned and assumptions are challenged and tested within the ECA project team. Some of the procedures cannot be automated at this stage, as they would require the use of artificial intelligence systems, which are still under development in auditing.

The first set of audit procedures implemented at the ECA are using DA. The objective is to run specific checks on the full population of transactions (e.g. payments) and to produce an exception report that will be followed up by the auditors on the spot. We will use RPA to prepare the documentation related to these exceptions, as far as it is available in the IT systems of the agencies.

In the pilot phase (see **Figure 1** for the different stages and status), many of these exceptions might not result in audit findings but rather may be linked to the algorithm(s) used for the checks. Our project team will analyse the results of this phase and will refine the checks to make them more reliable, if necessary. The auditors will also test the controls around the evidence to ascertain their authenticity and reliability.

Figure 1 – Pilot project stages and status



Pilot project going 'live' in parallel with regular audit work

The Digital Agencies Audit pilot is scheduled '*to go live*' in the six executive agencies in March 2020, in parallel with normal audit work. The results of the pilot, as well as the next steps, will be assessed and reported by mid-2020. This is the first wave and the lessons learned can be used for the next steps, which can hopefully be taken for the subsequent annual exercise. Possibilities we anticipate are that:

- more audit procedures can be automated for the executive agencies;
- the project can be extended to the decentralised EU agencies and/or the EU Joint Undertakings. It has to be noted, however, that the IT systems and administrative procedures of these bodies are less homogenous and that automated procedures would have to be tailored for groups of these entities;
- the experience gained from this pilot project can contribute to automation of audit work for the ECA's Statement of Assurance. However, given the extent of this task, a considerable effort still has to be made to analyse the thousands of underlying audit procedures, in order to identify those with potential for automation.

Design change needed to facilitate and enable digitalisation

This pilot project is only the first step in a fundamental transformation process at the ECA and in leveraging the use of automation in its audit work. A key success factor in this digital transformation journey remains the strong commitment and close cooperation of all stakeholders involved – including auditees. Our ambition is to design business processes controlled by design to facilitate, and even automate, audit. Combining IT and digital working methods with auditors' professional judgement promises to be the most successful way forward into the future.

New technologies for monitoring the Common Agricultural Policy

By Richard Hardy, Sustainable Use of Natural Resources Directorate

The ECA has undertaken an audit on the use of new imaging technologies to monitor the Common Agricultural Policy (CAP). In this article Richard Hardy* Principal Manager in the ECA's directorate responsible for auditing the CAP, provides some details about our audit and the latest developments in the use of technologies to monitor and control CAP spending. He also discusses the use of imaging technologies and digital audit techniques in the ECA's wider audit work on the CAP.

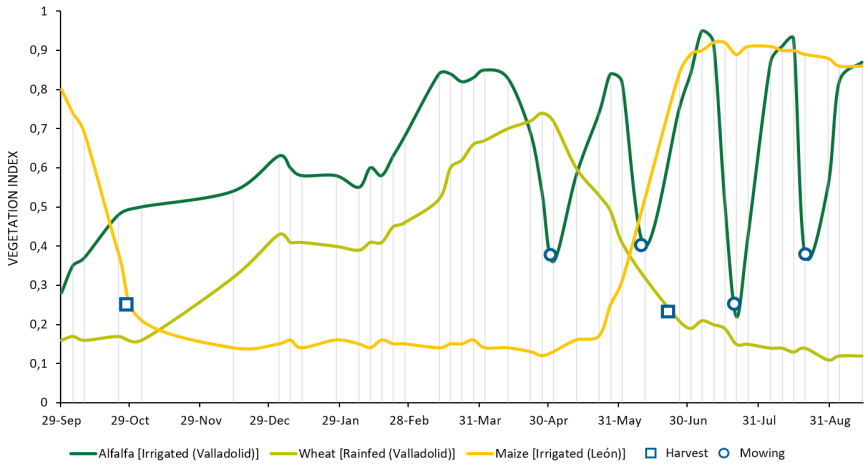
Checks by monitoring: a major change in the management and control of the CAP

The Common Agricultural Policy (CAP) has a long history of using aerial photographs and satellite images to check some of its area-based support. Currently, paying agencies in the Member States use a computerised geographic information system of agricultural land parcels (the 'Land Parcel Identification System' - LPIS), which is based on aerial photographs and satellite images. The paying agencies use the LPIS to verify that they pay aid only for eligible agricultural land and only once for a given area of agricultural land.

The paying agencies update their LPIS imagery in general every three years. The LPIS does not show the crops or activities taking place on a given land parcel during the year (planting, harvesting, mowing, etc.). Therefore, the paying agencies have had to carry out field inspections for a sample of around 5 % of farmers, which is both time-consuming and costly. Since 1992, paying agencies have been able to adopt an alternative approach for inspecting agricultural parcels via high-resolution satellite images, called 'checks with remote sensing'. This approach is less costly, but still requires human intervention in the form of operators to interpret satellite images, using computer-assisted photo-interpretation.

Since June 2015, the Sentinel 1 and 2 satellites, launched under the EU's Copernicus programme, have been providing freely available high-resolution images. As these images are taken frequently, automated processing of time series data throughout the growing season makes it possible, without human intervention, to identify crops and monitor certain agricultural practices on individual parcels (see graph at **Figure 1**). Different crops reflect light in different ways, which is measured by the 'vegetation index' (the y axis in the graph). In this way, the variety of crop (e.g. wheat, maize) and agricultural activities taking place during the season, such as harvesting and mowing, can be identified.

Figure 1 – Example of a time profile of Sentinel-derived information showing



Source: Instituto Tecnológico Agrario de Castilla y León

* He acknowledges Els Brems, Jindrich Dolezal and Paulo Braz from the new imaging technologies audit team, Zsolt Varga from ECALab and Ramona Bortnowschi (private office attaché) for their most valuable input to this article.

Changes in the vegetation cover for different crops

Since May 2018, Member States can use such automated processes based on Copernicus Sentinel data for continuous monitoring of the whole population of aid recipients, rather than only checking samples of farmers. This new approach is called 'checks by monitoring.' In 2018, Italy used it in the province of Foggia (Puglia). In 2019, 15 paying agencies in Belgium, Denmark, Italy, Malta and Spain used the new approach for some of their area-based payment schemes.

The processing of large quantities of data (e.g. through machine learning) provides the paying agencies with information on crop types and agricultural activity. They then assess the parcels using a system of coloured flags (see **Picture 1**) and can carry out targeted field visits as necessary, improving the efficiency of their controls.

Picture 1 – Simulation of possible outcome of parcels' assessment

Source: JRC simulation

The European Commission, paying agencies, other stakeholders and experts agree that this approach represents a major change in the management and control of the CAP, with the following key benefits:

- increasing compliance, by helping farmers to meet aid scheme requirements through ongoing communication on potential non-compliance with specific requirements;
- reducing administrative burden and improving cost-effectiveness both for farmers and paying agencies;
- improving farm management, increasing farmers' economic benefits and helping to reduce the negative environmental impacts of some agricultural activities.

ECA audit of the use of new imaging technologies to monitor the CAP

The ECA is currently finalising an audit to assess the EU's use of new imaging technologies to monitor the CAP. As we indicated in the audit preview published in August 2019, we examined whether the Commission and Member States have taken sufficient steps to unlock the potential benefits of new imaging technologies for CAP monitoring. We assessed whether the Commission effectively encouraged widespread use of the new technologies and whether Member States had taken adequate action to deploy them. We also sought to identify examples of good practice in the use of new technologies for CAP monitoring, as well as shed light on obstacles hindering their wider deployment.

An assessment of the progress made is especially relevant now, as the results of our audit could be applied in the post-2020 CAP. The increased use of new technologies for CAP monitoring may affect the future audit approach taken by national and EU audit bodies.

The new imaging technologies included in the scope of our audit are Copernicus Sentinel satellite data, images taken by drones, and geotagged images. Our audit did not cover the use of Copernicus Sentinel data for smart farming applications, crop yield forecasts or areas outside the CAP. We performed the audit fieldwork from April to September 2019 and expect to publish the special report at the end of January 2020.

During the audit, we organized a panel with experts from research institutes, universities, paying agencies, private companies and the European Environment Agency. The panel was very helpful in better understanding the impact of the new technologies, the progress made in their use, as well as the challenges for their wider deployment. We also organized a seminar for ECA staff on the use of new technologies for CAP monitoring. The seminar included presentations on relevant EU research projects, paying agencies' experiences, and the potential of new technologies for monitoring climate and environment commitments, which led to lively discussions about the advantages and drawbacks of the use of new technologies in the CAP.

Perspectives for auditing the CAP with new technologies

In line with the ECA strategy, we are looking to develop digital audit techniques in our financial and compliance audit work, contributing to the ECA's yearly Statement of Assurance (SoA), work on the CAP. We increasingly use the orthophotos and satellite imagery available in the paying agencies, together with other digital solutions (e.g. Google Earth), in order to assess the eligibility of land declared by farmers. This has enabled us to avoid on-site visits to farms in many cases, saving resources and increasing efficiency. In the 2019 SoA, we expect to obtain sufficient audit evidence from orthophotos and satellite imagery for more than half of our sample of direct payments to farmers under the European Agricultural Guarantee Fund.

We have also initiated a pilot project to examine the possible application of process mining techniques in our SoA work. This project is being carried out in cooperation with a Member State paying agency (see **Box 1** below).

Box 1 - Pilot project: Process mining

In collaboration with colleagues from ECALab, the ECA's centre for research and innovation, we are undertaking a pilot project in process mining in order to analyse the processing of aid applications and payments to beneficiaries at a selected Member State regional paying agency. Building on ECALab's previous experiences with process mining, we will examine to what extent currently available commercial and open-source process mining software can be used for audit purposes. As process mining is one of the candidate technologies for the audit of entire populations of transactions, we will focus on the processing steps of all aid applications and payments in the paying agency within a specific timeframe, with special attention to checks, controls and segregation of duties within the process. The project will require close cooperation between the ECA and the paying agency, especially during the data acquisition phase, and to ensure the correct interpretation of the processing exceptions we may find during the analysis.

There are also possibilities to use digital techniques for performance audit. Some of the new and emerging technologies, such as natural language processing and semantic document search could allow us to rapidly process non-structured textual data relating to aid applications, tenders and procurements. The use of exogenous 'big data,' such as the automated collection and analysis of online news articles, scientific papers and public documents can also provide supplementary or corroborating audit evidence for performance audit projects.

All in all, we believe that the ever-increasing volume of new data available in a digital format, will be a major step forward for our audit of the CAP, both for assessing compliance and performance aspects. This is not only a question of making savings in the use of audit resources, but will also allow us to engage in full population audits, rather than concentrating on samples of transactions. We will be able to focus on outliers and other 'red flag' cases. These developments should not only contribute to further improving the financial management of the CAP, but also farm management as such, including the climate and environmental aspects related to agricultural activities. The new data and techniques, in combination with our traditional 'analogue' fieldwork, makes auditing EU's agricultural expenditure more varied and interesting than ever.

ECA's big data pilot to help analyse news references to EU agencies

By Di Hai, private office of Alex Brenninkmeijer, ECA Member

In 2017, the ECA created the ECAlab as a place where auditors and data scientists can find each other and where ideas for technology and innovation can be nurtured and put into practice. Over summer, a combined team of auditors and ECALab experts used big data methods to analyse online news references to all EU agencies at the ECALab. This was done in the context of an ongoing performance audit on EU agencies planned to be finished in 2020. As it was the first experiment of this kind in support of an ECA audit, it was called the big data pilot at the ECA. Di Hai, attaché in the private office of Alex Brenninkmeijer, was a member of the team working on this big data pilot and provides insights into what it entailed.

Matching the context and building a team of innovators

In February 2019, we started our performance audit on EU agencies, led by ECA Member Alex Brenninkmeijer. In this audit we assessed the role of EU agencies in the delivery of EU policies and EU cooperation in general, and we identified for the first time some common factors that contribute to the good performance of all 43 EU agencies, despite their very different missions and institutional organisation. During the kick-off meeting of the audit, the reporting Member proposed that, besides pursuing more traditional audit methods, the team should explore the use of big data methods, following the ECA's strategy of digital transformation in audit. This idea of experimenting with big data methods to corroborate findings in a performance audit - using the performance audit on EU agencies as a pilot case - marked the beginning of a journey that has brought together some very creative minds in the organisation.

At the ECA, a performance audit takes 13 months to complete on average. However, if we exclude the time needed for planning, fact clearing and report drafting, then only something like around five months are left for the actual audit field work and analysis. This places many constraints on what we can do in a big data experiment, and how we can do it. Basically, this meant that we had to streamline the entire big data experiment according to the tightly scheduled audit process, i.e. organising the experiment in three months, from July 2019 until September 2019. July was dedicated to data collection and to the conception of initial ideas, August was dedicated to full testing of the ideas, and September was dedicated to fine-tuning the results and to reporting.

In hindsight, these three months were part of the most intensive period during our audit; there were many contacts between the auditors and the data scientists to discuss what we wanted, in addition to other audit areas the auditors were already more familiar with. In an organisation like ours, where data analytics and technology is emerging as a new domain, we are still experimenting with how to best organise interaction between auditors and data scientists. That is why it is important to have a team that is very much engaged with the experiment and is willing to do more than what they feel accustomed to; the auditors must learn to reason like data scientists, and the data scientists need to think like auditors.

Team members of the big data pilot project discussing the project's progress. From left to right: Joaquin Hernandez Fernandez, auditor, Emanuele Fossati, ECAlab, Claudia Albanese, ECAlab, Eddy Struyvelt, head of audit task, Di Hai, Member's private office, Zsolt Varga, ECALab

Selecting big data and their analysis

For our experiment, we cooperated with the Joint Research Centre (JRC)[1] of the European Commission to gather over 200 000 news articles related to all 43 EU agencies that are located in 23 Member States of the European Union. These news articles covered the period from January 2018 until July 2019 when our analysis was launched. These news articles originated from all around the world, they came from over 5000 different sources, in 169 different countries, and in 66 different languages.

Based on these data, we carried out three types of analysis. First, we examined the dataset and conducted summary statistics. A single article about an EU agency often does not reveal a lot of qualitative information about that agency, whereas a collection of articles may illustrate certain trends and patterns that are relevant to the agency's performance. In particular, we looked at:

- the total news coverage per EU agency;
- news duplicates;
- news outliers;
- the geographical distribution of news.

News duplicates are news that attract a lot of public interest and are for that reason 'copied and pasted' by other news sources. They can be considered as the blockbuster movies that the media like to talk about. News outliers are related to the time distribution of news, when at certain moments an EU agency suddenly receives more media attention then its average news coverage, due to (a) certain event(s). Our analysis revealed that, typically, events related to public safety and public health generate significant news duplicates and news outliers. Examples are the crash and subsequent grounding of a type of airplane, or the detection of a hazardous ingredient in food products. This first type of analysis was designed to answer the audit question about the external scrutiny of EU agencies, i.e. to what extent are EU agencies held accountable for their performance by the outside world.

1 In particular, we made use of the Europe Media Monitor (EMM), which is an online news monitoring tool developed by the JRC. See more on https://ec.europa.eu/jrc/en/scientific-tool/europe-media-monitor-newsbrief

The second type of analysis that we carried out was the network analysis. Here we looked at the co-occurrence of an EU agency with another entity in the same article. That other entity could be another EU agency, a Commission service, a Member State authority, or an international organisation. By identifying the co-occurrence and co-reference of an EU agency and another entity in the same article, we tried to depict the network of relationships and cooperation and their relative intensity.

The third type of analysis that we attempted was the sentiment analysis (see also the article on p. 133 (Scholtes). The idea of a lexicon-based sentiment analysis was to identify positive and negative words in news articles about the EU agencies in order to estimate public sentiment towards the performance of the EU agencies. We carried out some initial testing with available glossaries that teach the computer which words are positive and which words are negative, on articles published in English, as no such glossaries exist for all languages.

In this context, it was important to understand how the general topic of an article impacts the sentiment analysis. This is particularly the case for articles dealing with risks such as disease and crime – areas where EU agencies play a role. For example, many news articles on Europol – the Union's office to coordinate the work of national police forces - refer to terrorism and other types of serious crime and might contain negatively coloured words without being necessarily negative about Europol's performance. Overall, the sentiment analysis remains a challenge to be explored in future audits.

Becoming familiar with data visualisations as an analytical tool for audit

As public auditors, we generally use visuals with the intention of presenting certain messages. Traditionally, we introduce data in a spreadsheet and define the horizontal and vertical axes to create our visuals. This type of visual is, however, rather 'subjective' because it shows what we want to communicate to the readers of our report. Visuals used in big data analysis are of a different kind, they are more 'authentic.'

Based on the dataset, in our case the news articles consisting of lines of texts, our data scientists create scripts and algorithms that instruct the computer how to transform unstructured textual data into quantitative insights that allow for numerical calculation, sorting and comparison. The results are presented in a visual that allows further analysis. These analytical visuals can be very complicated and dense with information, such as 'word clouds' (see **Figure 1**), to identify the events that are behind the outliers, 'matrices' and 'correlograms' to show network relationships, 'choropleth maps' to illustrate geographical distribution (see **Figures 2 and 3**), and are also available in dynamic and interactive modes which allow users to change parameters 'live'. They are not always suitable for publication in an audit report. An auditor is needed to further select information from these visuals and to artificially create a visual that focuses on transmitting certain messages. This iterative process is based on both technology and the auditors' analysis.

Figure 1 - Example of big data visual on word clouds summarizing the content of articles

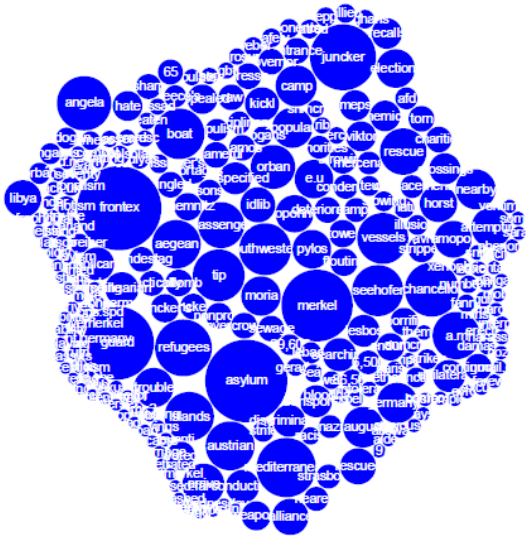


Figure 2 - Example of big data visual on geographical distribution

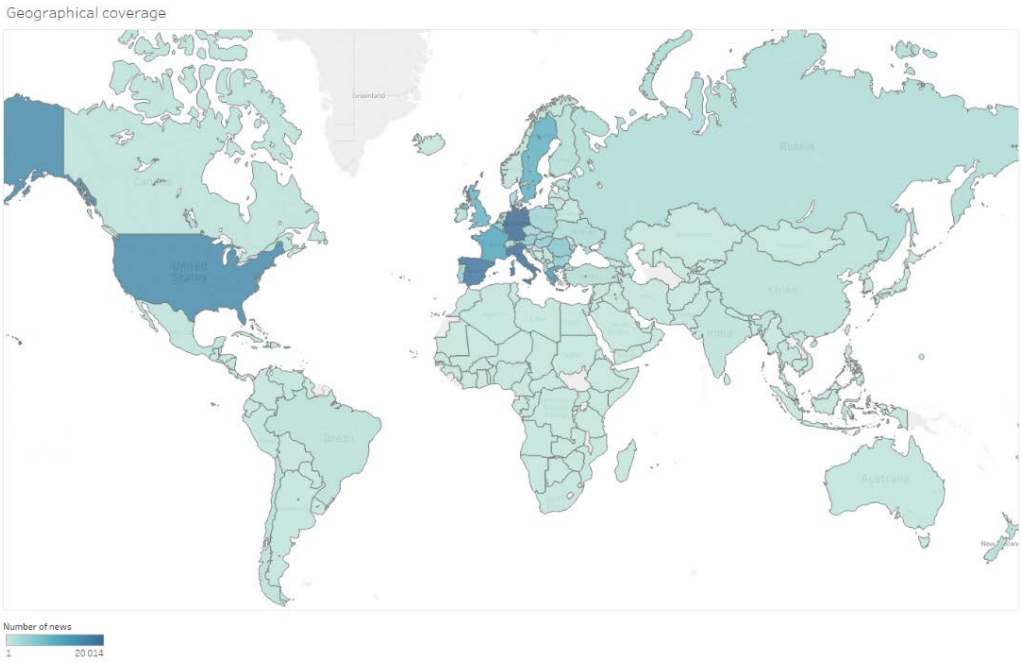
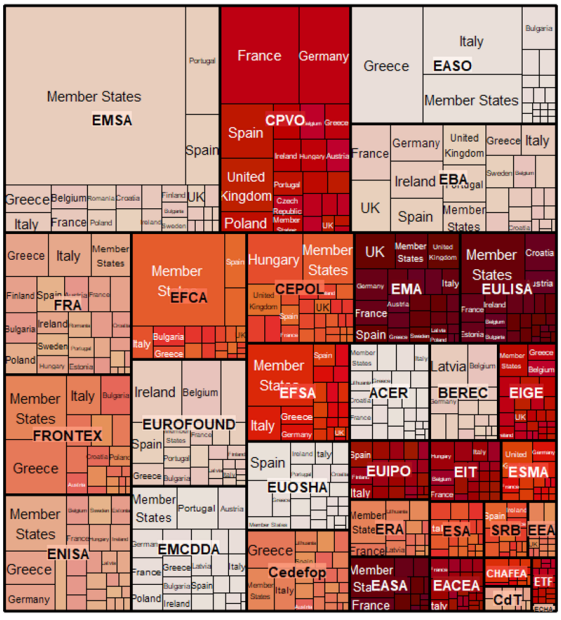


Figure 3 - Example of big data visual on network relationships between agencies and countries



Why is this big data pilot important for us?

We think this big data pilot has changed our team's view on what kind of data can be used for an audit. Traditionally, our data have been provided by our auditees, mainly the European Commission and Member States' authorities, and our data consists of primarily official documents written in black and white. In fact, according to our mandate (TFEU Article 287), we can ask our auditees to provide any document we consider necessary to conduct our audits. So there does not seem to be much need to look around. In recent years, we have increasingly been using stakeholder surveys and expert panels for our audits, as well as collecting publically available data from 'online' sources related to a specific audited EU action or project, as complementary sources of data. However, some auditors still have mixed feelings about to what extent we can use and rely on these data from what are called 'unofficial', 'unconfirmed', and 'unlimited' sources.

Perhaps this has something to do with what we understand as being what an audit organisation entails and how it relates to data. Perhaps we think that our strength lies in our ability to get access to certain documents that no other entity can get; or it is the exclusive access that makes us unique, not necessarily the data itself. What technology has changed is exactly the ease of access. Larger quantities and a greater variety of data have become accessible through technology, and this category of data from what are known as 'unofficial,' 'unconfirmed,' and 'unlimited' sources has become more and more representative and mainstream. If we want to maintain our position as a data-oriented organisation, then a shift from focusing on official documents to also including other types of available information, using modern technology, seems unavoidable. We think this pilot, showing numerous possibilities to look at 'non-traditional' audit data, has been a first step on this long journey.

The European Blockchain Services Infrastructure is coming, and the ECA has a role to play

By Mirko Iaconisi, External Action, Security and Justice Directorate

Source: EBSI website

In discussions about the future of accounting and audit, the term blockchain most often pops up as an innovative way to establish a secure trail of transactions. Initially related to cryptocurrencies and peer-to-peer payments, this technology can also serve as a platform for offering services related to the notarisation and tracking of digital assets. Mirko Iaconisi, ECA auditor and ECALab contributor, is one of the ECA's blockchain experts. Here, he discusses the European Commission's European Blockchain Services Infrastructure initiative, in which the ECA is also an active participant.

From hype to game changer for the future?

For 2020, *blockchain* tops the list of the most in-demand hard skills globally, according to data from the LinkedIn social network. This technology, which emerged in 2009 from the world of cryptocurrency, has been evolving ever faster over the past few years and has generated a wave of hype due to its disruptive potential.

A blockchain is essentially a distributed ledger of transactions maintained collaboratively by a network of different actors. It is designed to be secure, resilient, immutable and verifiable by any stakeholder. Blockchain promises to eliminate intermediaries and provide trusted (fully digital) ledgers, which can be used to make payments, track digital assets or notarise digital documents, to name but a few applications.

This technology has been controversial due to its association with cryptocurrencies, lack of standards and energy consumption. Nevertheless, the European Union recognised the potential of blockchain to transform digital services in Europe and was among the first institutional actors to take a clear, favourable, position.

The EU approach to blockchain

In October 2017, the European Council asked the European Commission to come up with an EU approach to blockchain that would enable the EU to take a lead role in exploring this emerging industry. In response, the Commission created the EU Blockchain Observatory and Forum in February 2018. Two months later, the EU Member States and the Commission established the *European Blockchain Partnership* (EBP) with the aim of aligning policies and regulatory approaches to blockchain and other distributed ledger technologies (DLT), and developing a trusted *European Blockchain Services Infrastructure* (EBSI). The partnership currently has 30 signatories: the 28 EU Member States, plus Norway and Liechtenstein.

The EBSI is the partnership's flagship initiative and aims to build a trusted blockchain infrastructure, operated by Member States and EU Institutions, able to deliver EU-wide cross-border public services. The ambition is to comply with the highest standards in terms of privacy, cybersecurity, interoperability, and energy efficiency. The first operational version of this infrastructure will be up and running in February 2020, allowing EU Member States to start testing its initial capabilities. Since 2019, the ECA has been actively contributing to the EBSI initiative by working with Commission and Member States on a very concrete use case.

The ECA's participation in the EBSI initiative

The ECA has been exploring blockchain since 2016, when an initial article was written on the subject . In 2017, two awareness-raising conferences were organised and the ECALab carried out its first technical experiments for educational purposes. In 2018, the ECA worked together with a Luxembourg start-up, Compellio, on a concrete proof of concept. The company had developed software that was able to record unique evidence (hash) of documents on public blockchains. Due to the immutability of the blockchain ledger, this evidence constituted a long-lasting reference for anyone who later needed to verify the authenticity and integrity of the originating documents. This type of application worked as a notarisation service for digital documents, able to generate a trusted and reliable audit trail of document evidence. Thanks to the contribution of a group of colleagues interested in the technology, we identified three promising use cases (see also **Figure 1**) for this type of notarisation service:

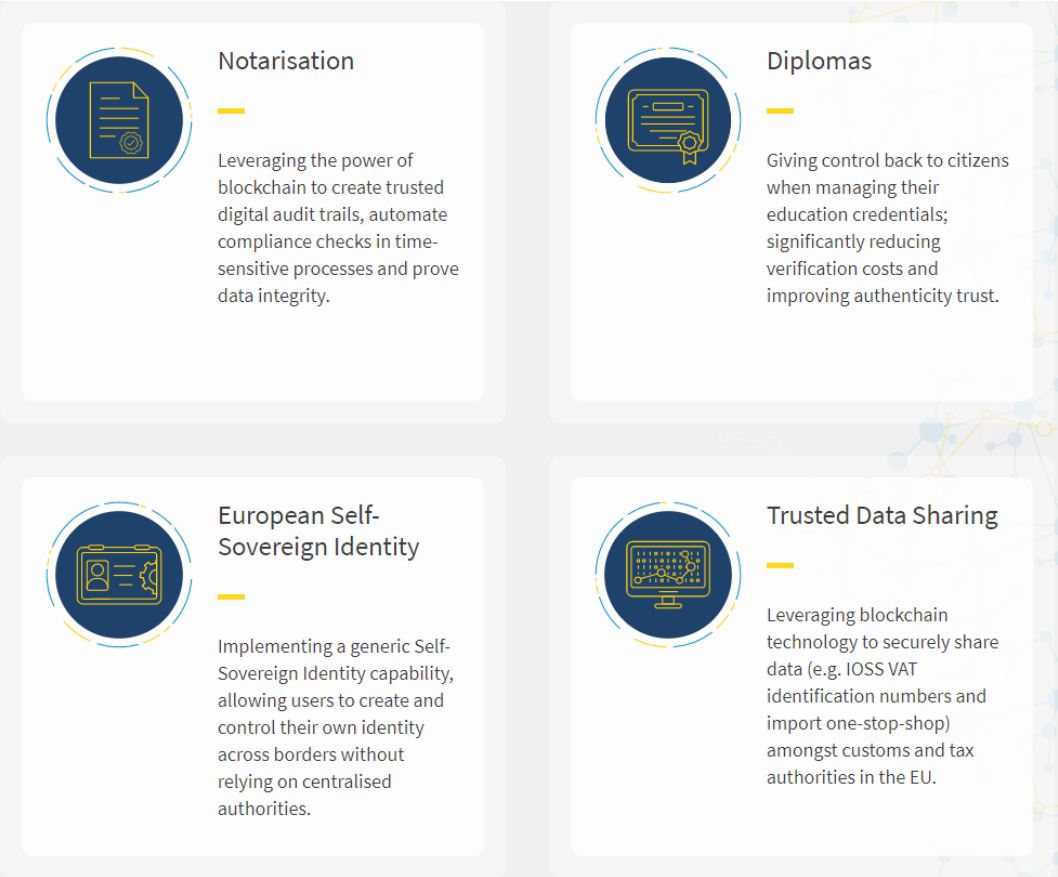
- notarisation of audit documentation;
- protection of ECA publications; and
- notarisation of public procurement procedures.

The proof of concept lasted three months (March to June 2018) and led to the creation of the *ECA Registry*, a web-based notarisation service able to demonstrate practically the three above-mentioned use cases. One interesting feature offered by the application was built-in General Data Protection Regulation (GDPR) compliance, as the process allowed users to give trusted third parties (such as audit institutions) explicit consent to access their notarised documents and notarisation data whenever needed.

The *ECA Registry* was presented on 08/11/2018 at the interinstitutional conference *Blockchain: opportunities and practical applications for EU expenditure control*, and attracted the attention of several stakeholders. Around the same time, the ECA took part in the call for proposals of the nascent European Blockchain Services Infrastructure, submitting two of the use cases explored with the proof of concept.

The 'notarisation of audit documentation' was selected as one of the first four use cases to be developed within the framework of the EBSI, alongside European Self-Sovereign Identity, Diplomas and Trusted Data Sharing. This means that the features that demonstrated their value with the *ECA Registry* proof of concept will now be (re) developed as open source in the context of a brand new EU-wide infrastructure. A team of developers coordinated by the European Commission and funded by the Connecting Europe Facility (CEF) is currently building the EBSI.

Figure 1 - An overview of the first 4 use cases that will be available in the EBSI



Source: EBSI website

As well as being the initiator of the *Notarisation* use case, the ECA is also one of the most active contributors, providing input and leading discussions with the Commission and Member States. The functional requirements for the *Notarisation* module were completed in autumn 2019 and the development team has already delivered the first basic functionalities. In addition, the original *ECA Registry* is now connected to the brand new EBSI blockchain and is ready for further testing.

What next?

We are very close to the EBSI launch. In mid-February 2020, the core team will present the first version of the infrastructure to the Member States. While this initial version will offer only the basic capabilities of the four use cases, more advanced features will be released over the course of the year. This new infrastructure will offer a trusted blockchain solution for the EU and we hope that it will help familiarise Member States and EU institutions with the technology, promote innovation and pave the way for a new generation of cross-border public services.

Looking beyond the EBSI, the ECA will continue to explore and gain expertise on blockchain, together with other interested supreme audit institutions. In this context, the new *Blockchain for Audit (B4A)* stakeholder network will offer a forum for experts to continue sharing their experiences and to discuss the implications of this technology for public audit.

Spinning negative messages? A closer look at the tonality of ECA audit reports and press releases

By Claudia Spiti, Directorate of the Presidency, and Nunzia Squicciarini and Zsolt Varga, Information, Workplace and Innovation Directorate

Research has shown that 'negativity' is one of the main criteria that determine newsworthiness: 'bad news sells'. This is reflected in our daily media consumption. To a certain extent, it also influences the way corporate communication operates to attract journalists' attention. This poses a specific challenge for public auditors, whose mandate is to look at risks and identify shortcomings. From the start, an audit report should be expected to be worded rather negatively. Since the media are generally more interested in 'bad news", it is also reasonable to expect storytelling to focus on negative aspects. But how can you make sure that the press releases accompanying reports do not unduly accentuate negativity and criticism? The ECA communication team, together with the ECALab, has looked into this issue and, using some artificial intelligence tools, examined whether there is a 'negative' bias in ECA press releases. Claudia Spiti, press officer in the Directorate of the Presidency, Nunzia Squicciarini, data scientist trainee in the ECALab, and Zsolt Varga, data scientist in the ECALab provide more information on this innovative study.

Bad news sells

Public auditors have a reputation for being negative and critical. When reporting the results of their audits, they focus on risks and any shortcomings and deficiencies they have found. As the EU's independent external auditor, the ECA is no exception to this. It is reasonable to expect our reports on the implementation of EU policies and programmes or EU spending to be worded negatively rather than positively. Moreover, to communicate about our work the ECA's communication team – part of the Directorate of the Presidency – issues press releases which must reflect the tone of the corresponding audit report in less technical language. Carving a press release out of a report also entails a 'storytelling' process, building on the key messages in the report. **Box 1** provides more details on how we draft our reports and press releases.

Box 1: How do we draft reports and press releases at the ECA?

The subject matter of our audit reports and reviews is often complex and technical. However, because ECA reports are drafted for the attention of *the interested but non-expert reader*, who will not necessarily be familiar with the audit context, we seek to adopt simpler, non-jargonistic forms of language.

The press release on a report is one of the key elements of the ECA's corporate communication activities. Press releases are addressed to a very specific audience of journalists. They need to be short and written in the form of *a news story*. Research in communication has demonstrated that 'negativity' is one of the main factors that determine whether (a) an event/publication is noticed by a news organisation, (b) a story is written about it, and (c) the story ends up being published as news.

Research has shown that 'negativity' – or the 'sentiment' of negativity – is one of the main criteria that determines newsworthiness: 'bad news sells'[1]. This is reflected in our daily media consumption. To a certain extent, it also influences the way corporate communication operates to attract journalists' attention. Against this background, we wanted to know: Is there a negative bias in ECA press releases?

1 See also *Audit Institutions in the communication of EU finances to citizens: demands, perceptions and gaps*, Directorate General for Internal Policies of the Union, November 2018 https://op.europa.eu/en/publication-detail/-/publication/cb4c3d67-0fd6-11e9-81b4-01aa75ed71a1/language-en/format-PDF

Our research: aims, structure and methodology

The heart of our study was to verify whether the corporate stylistic choices used in communicating the ECA's work – trying to attract media attention, aiming at increased coverage – still faithfully reflected the inner 'narrative' of audit reports in terms of sentiment and tonality. Or whether we have been spinning the 'negativity' of our reports by using press releases to unduly accentuate the negative messages of reports.

Our analysis covered the period 2016 to 2019 and all types of audit publications. Overall, we examined 129 special reports, 27 reviews, 12 opinions and 30 audit previews, all in the original English versions, between September and December 2019. We tested for significant differences between the tonality of a report and that of the associated press release (see **Box 2**). The project provided a great opportunity to demonstrate how natural language processing and AI technologies can be used in practice to answer an important business question. Sentiment analysis/emotion mining is a powerful tool, but it needs to be used in the right context, with an appropriate selection of algorithms, if it is to deliver robust results (see also pages 52 and 133. As such, sentiment analysis is rather a descriptive than a prescriptive tool.

We used two complementary tools for our analysis: Watson, a market-leading AI software tool from IBM, as the main algorithm; and VADER (Valence Aware Dictionary and sEntiment Reasoner), a lexicon and rule-based open-source sentiment analysis tool, as a control algorithm. The two algorithms produce tonality scores in the same range, between -1 (fully negative) and +1 (fully positive) for each text.

We then used customised programming scripts written in R and Python to obtain a general overview of the data (distributions, averages, outliers) and perform statistical hypothesis testing to make sure we understood what was behind the numbers. We focused on comparing tonality scores – analysing the differences between document scores and press release scores – rather than fixating on the scores of specific documents. The main reason was that the algorithms have not been standardised for the types of texts the ECA publishes (they are mostly trained on social media and Wikipedia), thus absolute scores are less informative than comparisons.

The final part of the project was a statistical analysis of the results, which is a very important phase in experiments using machine-learning models. We computed means, medians and variances for the results from the different models, performed comparisons, analysed timelines and, finally, verified whether we could state with reasonable confidence that there is a significant difference in tonality between ECA documents and press releases.

Box 2: What is sentiment analysis?

Sentiment analysis is the automated process that uses artificial intelligence to identify positive, negative and neutral messages in written text. Sentiment is 'hidden' behind words, and sentiment analysis tools can only examine linguistic features and textual patterns. Contextualised information is necessary to fully grasp a sentiment: computer algorithms, including even the best AI systems, do not have the same abstraction skills and background knowledge as humans. The sentiment score derived by an algorithm for a specific document might be less relevant than comparing the tonality of a group of documents with each other, as this latter approach can provide interesting and useful insights about the whole document collection. In the context of our work, such a document collection might consist of our own publications, textual answers to surveys, feedback from stakeholders, etc.

There are several approaches to sentiment analysis. Natural language processing (NLP) models and tools range from systems that focus on polarity (positive, negative, neutral) to systems that detect feelings and emotions (angry, happy, sad, etc.) or identify intentions (e.g. interested versus not interested). From a technological point of view, there are rule-based (dictionaries and guidance for calculating a tonality score) automatic (machine-learning techniques) and hybrid systems.

Key findings

The tonality of ECA publications is slightly on the positive side

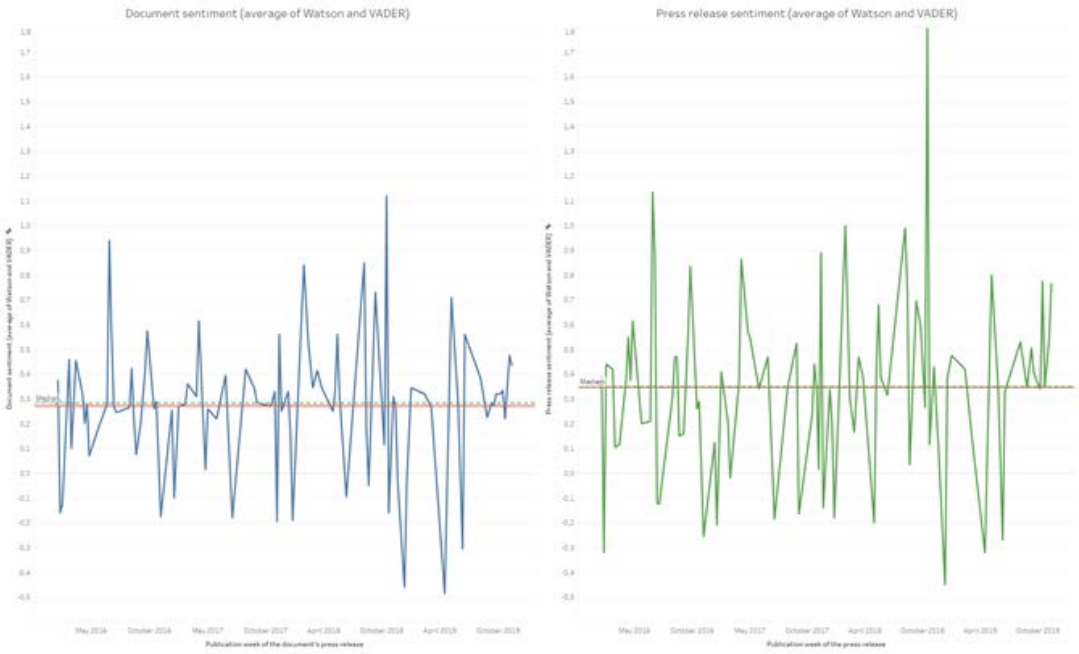
Surprisingly, as shown in **Figure 1**, our research indicates that, on average, the *tonality of ECA publications is slightly on the positive side*. IBM Watson and VADER agreed on this, despite the fact that special reports mainly focus on areas where the audit has identified shortcomings. This overturns the usual perception that our audit reports are always, or overly, negative.

ECA publications other than special reports (such as opinions and audit previews) also usually score positively for tonality. This is less surprising, since opinions often suggest improvements to legislative proposals, while audit previews are more neutral, fact-based documents which do not seek to make an assessment or draw conclusions.

Press releases contain more tonality information ('subjectivity') than ECA publications

Both algorithms also gave a wider range of scores for press releases than for documents, i.e. press releases exhibit longer positive or negative 'spikes'. This suggests that, as we expected, press releases contain more tonality information ('subjectivity') than the underlying reports.

Figure 1 – Tonality scores of documents and press releases



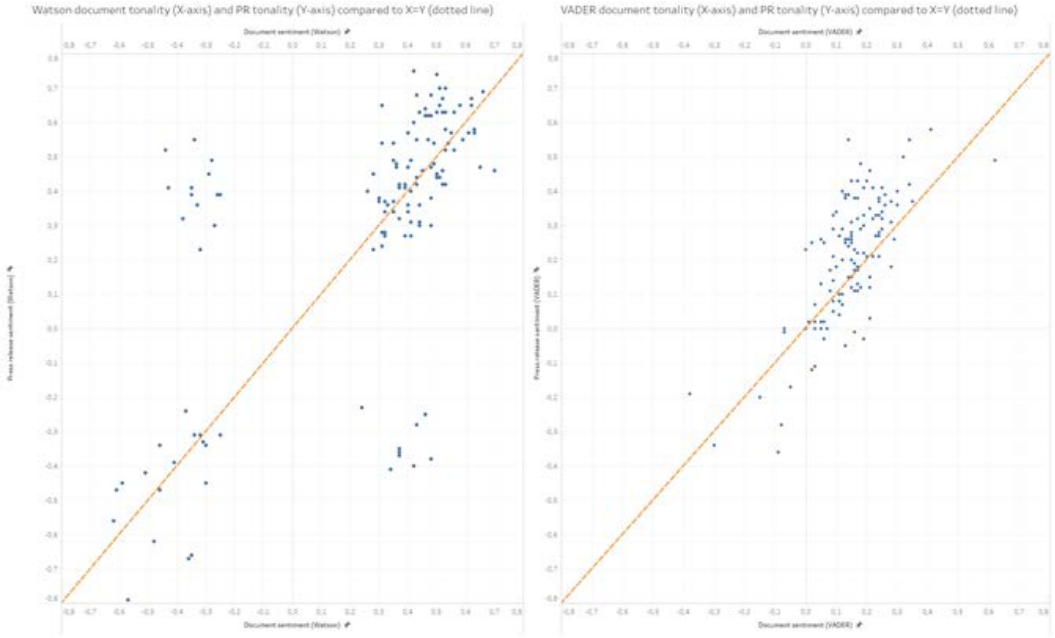
Note: continuous red lines indicate the average score, green dashes the median document score.

The tonality score of ECA publications correlates well with the tonality score of press releases

Importantly, our analysis found that the tonality score of most ECA publications correlates well with that of the associated press releases. The correlation level is around 70%, which is *very strong in the context of text mining/sentiment analysis.*

The dashed diagonal orange line in **Figure 2** plots the 'ideal' situation of identical (100% correlating) tonality scores for documents and press releases. Each circle represents a document-press release pair. Most circles are scattered around this theoretical line for both algorithms, though IBM Watson shows more outliers than VADER, owing to differences in how the two algorithms measure tonality.

Figure 2 – Comparative overview of the results from IBM Watson (left) and VADER (right)

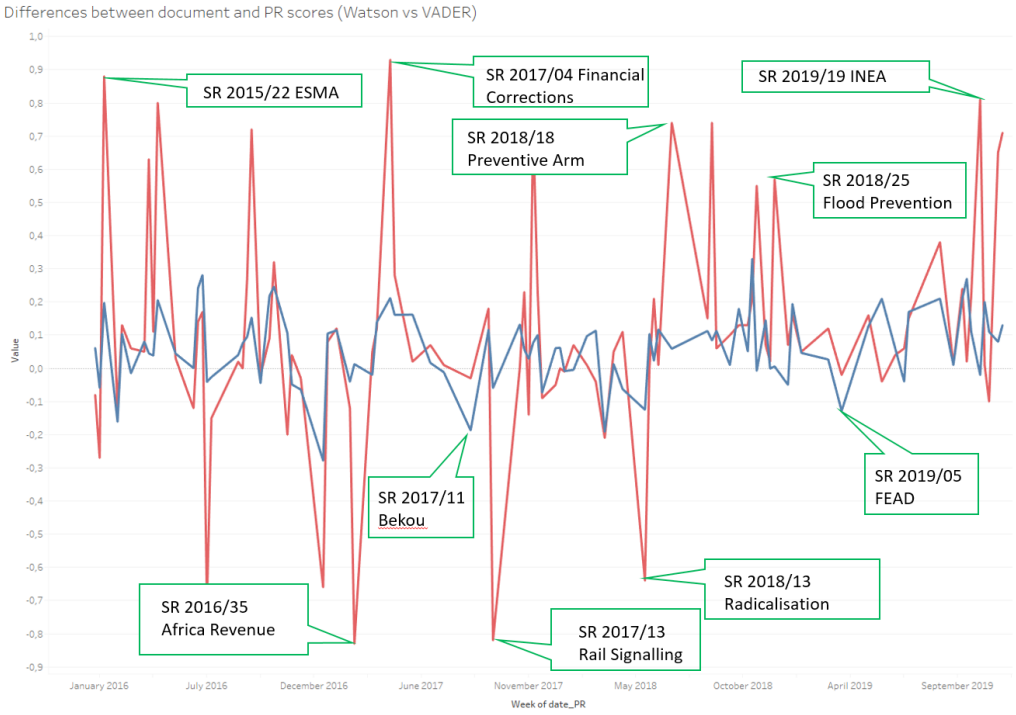


In particular, when looking only at special reports, there are *no major differences in tonality between documents and press releases*. For all other ECA publications (reviews, opinions and audit previews), the press releases tend to be more positive than the underlying documents.

There is also *no evidence for an upward or downward trend in special report and press release tonality*. The annual averages for both special reports and press releases were fairly constant between 2016 and 2018, with a slight drop in 2019. Another interesting finding is that Watson measures a slight positive shift in press release tonality for 2018, and for each year there are significantly more positive reports and press releases than negative ones.

In a few cases a report with a positive tonality score has a press release with a negative score, but in a number of cases the opposite is true. The most pronounced red and blue peaks in **Figure 3** show for which special reports there is a large *difference in tonality between a report and the press release*. The differences gradually become smaller, and from July 2018 the peaks are mostly positive. In other words, over time the tonality scores of reports and press releases have become more aligned and, where there is a significant difference, the tonality score of the press release is generally more positive.

Figure 3 - Differences between special report and press release tonality scores (Watson in red, VADER in blue)



Note: a positive difference means that the press release is more positive than the report, a negative difference denotes a relatively more negative press release.

No systematic 'negative' bias in our press releases to make the headlines

Our objective was to examine, using sentiment analysis, whether there is a systematic bias in the tonality of our press releases compared to the underlying reports. In simple terms: do our press releases tend to be more negative than our reports, perhaps as a way of making the headlines? Based on our findings, the answer is no. On the contrary, we found that there is a strong statistical correlation between the tonality of press releases and reports. This is particularly the case for special reports.

By their nature, given that they need to attract notice in newsrooms, our press releases contain more tonality information ('subjectivity') than our publications, so they tend to be more polarised towards positive or negative sentiment. Despite these differences, however, our analysis shows no systematic 'negative' bias in our press releases.

Our results suggest that we are achieving the aims of our corporate communication: the balanced and fair reporting of our audit findings and communication with the media that faithfully reflects the tone of our reports. It is encouraging to obtain confirmation, with the aid of AI tools, that what we are aiming for is working out in practice.

Six questions for Martin Weber, Director of the Presidency, on the project to assess the tonality of ECA reports and press releases

From left to right: Martin Weber and Gaston Moonen

By Gaston Moonen

What was the trigger for this project?

Auditees rarely consider an auditor's report as being overly positive. Our audits focus on areas where we see specific risks and normally also identify shortcomings. So being somewhat accused of conveying negative messages comes with the auditor's job. What we aim for, however, is balanced and fair reporting. And reports that can be understood by non-expert but interested readers. We do not want to over-emphasise negative findings, we want to report things as they are. Including when things work well.

> *... we want to report things as they are. Including when things work well.*

In recent years, however, we have increasingly faced questions, particularly by some of our auditees, about the tonality of our reports and, more importantly, how we 'sell' our reports to the media. There was a feeling that our press releases were over-emphasising negative findings. Behind this, obviously, was the assumption that we would do this intentionally to increase media interest in our reports. We thought it would be good to have a look ourselves at whether there is any truth to that. Fortunately, we have the ECALab in house, and we asked them to carry out this research using their technical capabilities.

What is your responsibility and role as director concerning ECA press releases?

At the ECA, audit reports are drafted in a decentralised manner, by audit teams under the supervision of a reporting Member. They are generally debated and adopted in the audit chambers, and subject to an external quality review process. And they are systematically discussed with our auditees to ensure that the facts are right. Obviously our audit methodology department has issued guidance material and drafting instructions to ensure a certain house style and quality provisions. Press releases, on the other hand, are part of our corporate communication, done centrally by a team in my directorate. They are drafted once a report has been adopted. Before they are sent out to journalists, together with the report, they are reviewed by several people within my department as well as by the reporting Member and the audit team. It is extremely critical for us that our communication is fair and balanced, and that our messages are those in the audit report.

> *It is extremely critical for us that our communication is fair and balanced...*

Is uptake of ECA reports in the media an important performance indicator for the ECA? What are other indicators?

Obviously, we are pleased if our reports attract public interest, but our ultimate aim is to initiate changes that help to improve the implementation of EU policies and programmes, to reduce waste and address all kind of shortcomings. At the same time, public opinion is often the best ally of auditors. It is much easier to get changes implemented if there is public awareness. Plus, we have the obligation to inform EU citizens about our work, and media helps us to do so. This is why we also measure the media uptake of our reports, like all other supreme audit institutions in the EU.

In this context, it is maybe of interest that we have been more active in our communication policy in recent years; maybe this is why is now more attention paid to our press releases. And it is also true that people quite often form an opinion based on the press release, rather than reading the entire report. Which makes the wording of these press releases a very sensitive aspect of the entire communication around the report.

> *...the wording of these press releases [is] a very sensitive aspect of the entire communication around the report.*

The ECALab was heavily involved in the project, providing AI tools for the tonality analysis. Which element(s) do you consider key in their involvement?

First of all, I think it was important to have someone doing this analysis who is not part of the communication team here in my department, to avoid the perception of a conflict of interest. Because this research was meant to be open-ended.

Second, we have worked together before and I knew that they have had some prior experience with sentiment analysis. So I was confident that they were capable of doing something like this. The use of these AI tools allowed them to cover the entire population of all publications done in the last four years. Which would have been impossible to do in any other form of analysis. So rather than going for specific expert judgements, these tools allowed for a very cost-efficient, quick and comprehensive way of looking at nearly 200 publications, of around 70 to 80 pages each, and their accompanying press releases over four years. This is a massive amount of data with which we would have had difficulties in dealing with otherwise.

Third, using AI tools also takes away the element of subjectivity. Experts individually assessing reports and press releases on tonality would inevitably lead, at least to some extent, to the personal and subjective views of the individuals involved. AI tools may not be free of some bias either, but this is also why we used two different tools to see whether they came to similar conclusions.

A last important element worth mentioning is that for this analysis the team applied scientific standards. This means that anyone using the same tools and the same data could replicate this research and come to the same conclusion. So this is not a traditional in-house analysis anymore, but something that is potentially up to external scrutiny if someone wants to challenge it.

> *... anyone using the same tools and the same data could replicate this research and come to the same conclusion.*

What did you find most striking about the outcome of the analysis? And about the project as such? Do you intend to repeat the exercise in the future?

First, let me say that I was rather agnostic about the outcome. Despite the fact that we have quite robust quality control and review procedures in place, I did not *per se* exclude the possibility that our press releases would be more critical than the reports. As they say: 'Bad news sells better …'. I was positively surprised, and a bit relieved, that this was not the case.

> *... I did not* per se *exclude the possibility that our press releases would be more critical than the reports. (...) I was positively surprised, and a bit relieved, that this was not the case.*

Second, I was also surprised by some of the reports for which the AI tools identified a difference in the tonality of the press release and the report. Because I would have expected others to be outliers. But this is maybe because our auditees had focused their attention on other reports, presumably on those audits where our findings were particularly significant or politically sensitive.

A third aspect was that both AI tools judged the tonality of our reports and press releases to be rather on the positive side, albeit by a different degree. There were differences between the tools in how they assessed individual reports, but overall both came to the same conclusion. What is also interesting is that there has been no change in results during the last four years. Which perhaps also shows that there is some consistency in the reporting of the ECA.

What other opportunities do you see for the further use of AI tools, and ECALab support, in your particular area of work – not only communications but also, for example, foresight and strategy development?

To be very clear: we are not aiming at assessing the shades of grey of individual reports. This kind of analysis cannot, and will not, be applied to do ex-ante checks on the tonality of our reports or press releases before publication.

> *... innovative work carried out by our colleagues in the ECALab will be used more and more ...*

But I think that the kind of innovative work carried out by our colleagues in the ECALab will be used more and more: by audit teams, but also by support services like ours. In particular, when there is a need to analyse these huge amounts of data. And unstructured data. In this example, we had just text. The ECALab was able to get a meaningful analysis out of this, using openly available tools. In general, all kinds of unstructured data we are struggling to deal with, or that we spend a lot of time in structuring, may be interesting. Personally, I find it fascinating how they can deal with such data, and I was very impressed that we have colleagues here at the ECA who are capable of doing this.

Connecting data and processes in audit – some considerations about the use of process mining

By Gilberto Moggia and Zsolt Varga, Information, Workplace and Innovation Directorate

Today's potential for capturing and processing data digitally, on an unprecedented scale and at hitherto unattainable speeds, uncovers new opportunities that public auditors can ill afford to neglect. But incorporating analytics into audit is not without challenges. How can auditors move in this new scenario? Gilberto Moggia, responsible for knowledge management projects at the ECA, and Zsolt Varga, data scientist in the ECALab, report about some current uses of process mining in audit and suggest avenues to be explored in the quest for data-led audits.

There are no magic recipes

'Without data you're just another person with an opinion.' 'If you can't describe what you are doing as a process, you don't know what you're doing.'

Two quotes by W. Edwards Deming (1900-1993)

Before focusing our attention on the use of process mining in audit, it is worth starting with a helicopter view on the impact that data technologies are having on audit. Whether we like it or not, the transformation by technology is taking place before our very eyes. In fact, the massive volumes of data available and the power of data analytics technologies, now affordable for a growing number of organisations, are fundamentally changing audit and assurance. But the availability of data as a new source of information is not only a blessing for auditors, it is also an arduous operational challenge for audit organisations.

The capacity for auditors to work with great bodies of data is no longer an optional add-on in the future, but has rather become an essential requirement for the profession to remain relevant and continue having an impact. In the not too distant future, 'increasingly capable systems' (Susskind &. Susskind, 2017) will take over many of the routine tasks now performed by auditors. To avoid any risk of losing relevance, it is vital for auditors to adopt an experimental mind-set and start developing new (data-led) audit practices.

An increasing number of public audit institutions have started developing their own analytical capabilities, but incorporating data-centric methods into audit is not without its challenges. For sure, the change will not happen overnight and certainly not by a simple implementation of new technology. As Tytti Yli-Viikari, Auditor General of Finland, put it, 'we should not await some external magical solution to show us the way forward.' In other terms, there are 'no magic recipes' ready for use, but rather several technological options that we should start testing, experimenting with and embedding in our audit practice (Yli-Viikari, 2018).

Process mining is one of the most mature technological options for auditors to extract evidential value from data and data flows, especially (but not only) for financial and compliance audit purposes (Jans et al., 2014; Werner, 2017).

Box 1 – What is process mining?

Process mining is designed to discover, monitor and improve real processes (i.e. not assumed processes) by extracting knowledge from event logs readily available in today's information systems. Process mining includes automated process discovery (i.e. extracting process models from an event log); conformance checking (i.e. monitoring deviations by comparing model and log); social network/ organisational mining; automated construction of simulation models; model extension; model repair; case prediction; and history-based recommendations.
(Gartner, *Market Guide for Process Mining*, June 2019, Analyst: Marc Kerremans)

See also*:*
The Process Mining Manifesto, IEEE Task Force on Process Mining. http://www.win.tue.nl/ieeetfpm/downloads/Process Mining Manifesto.pdf
Process Mining: Data Science in Action – Online Course – Instructor Prof Wil van der Aalst: https://www.coursera.org/learn/process-mining
Process Mining http://www.processmining.org/

Process mining for audit was one of the main topics of the ECA 2019 Summer School on digital audit. The presentations by renown experts, including Wil van der Aalst and Miklos A. Vasarhelyi, are available at https://ecademy.eca.europa.eu/course/view.php?id=8

Process mining - a practicable way to go

Process mining is designed to discover, monitor and improve real processes (i.e., not assumed processes) by extracting knowledge from event logs readily available in today's information systems (van der Aalst, 2016). Despite the omnipresence of such data, it is still uncommon for auditors to use this source of data for a fact-based identification of problems in their auditee's business processes.

We believe, however, that there are very good reasons for auditors to make extensive use of it:

- First, process mining enables us to carry out what is called 'conformance checking,' which makes it possible to compare, in terms of compliance, a process model (expected or approved behaviour) with an event log of the same process. It is used to check if the real execution of a business process, as recorded in the event log, conforms to the model and vice versa. For instance, there may be a process model indicating that a procurement chain requires three or more bids. Analysis of the event log will show whether this rule is followed or not. Another example is the checking of what is known as the 'four-eyes' principle, which stipulates that a particular activity should not be executed by only one person. By scanning the event log against a model specifying these requirements, auditors will discover and visualise deviations that deserve closer scrutiny. To sum up, conformance checking can be used by auditors to detect, locate and explain deviations from expected behaviour, and to measure the severity of these deviations.

- Second, process mining can already be applied to entire populations of real-life event logs. Given the time and cost constraints, sampling in audit (testing only a representative sample of items and extrapolating the results to the entire population) has been the accepted practice for several decades until now. Based on the use of event logs to analyse business processes such as payment chains, process mining is a mature digital technology revealing a new audit opportunity that can make the goal of 100 percent testing (using all the data and not just a representative sample of it) affordable and achievable.

- Third, process mining can help auditors focus on performance by auditing the underlying processes in terms of their economy, efficiency and effectiveness. Moreover, it can facilitate the task of auditing the control systems in place in order to assess their adequacy and efficiency. Audit findings and consequent recommendations obtained in this way can not only discover and monitor, but also help improve real processes and thus overall performance.

Box 2 –Linking data and processes – the importance of Process Mining (*)

The interest in data science is rapidly growing. Many consider data science as the profession of the future. […] Data ("big" or "small") are essential for people and organisations and their importance will only increase. However, it is not sufficient to focus on data storage and data analysis. A data scientist also needs to relate data to operational processes and be able to ask the right questions. This requires an understanding of end-to-end processes. Process mining bridges the gap between traditional model-based process analysis (e.g. simulation and other business process management techniques) and data-centric analysis techniques such as machine learning and data mining.

A quote by Prof. Wil van der Aalst, considered the 'father' of process mining, and the author of a seminal book on the subject (see details in **Box 1**).

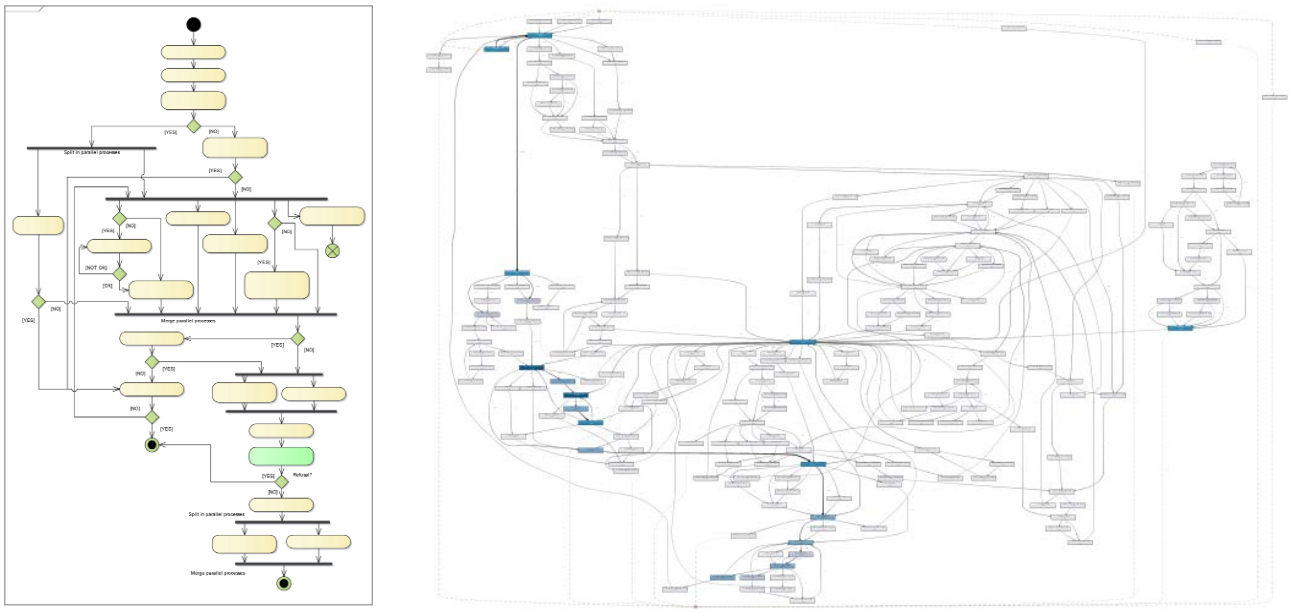
To sum up, process mining offers auditors actionable ways to *dive* into data flows without *getting lost*. It provides auditors with a tested and mature technology for extracting useful information about business processes, enabling them to *navigate* throughout the huge quantity of data stored and displayed in financial and management information systems. Process mining for audit was one of the main topics of the ECA 2019 Summer School on digital audit (see also p. 130). Let us now analyse some uses of process mining in audit.

Patterns in data – connecting data and processes

One of the most important questions when auditing an entire population is how the data actually looks. Are there any unusual patterns? What is the proportion of exceptions? The event logs of business logic and database applications contain valuable information about how the business processes are implemented in reality. By examining these logs with 'big data' methods one can identify audit-relevant information, such as payments without approval or violation of controls.

Process mining is a very different approach to evidence collection and analysis, as it does not focus on the 'content,' e.g. the value of the transactions and its aggregations, but on the path of transactions and the transactional processes themselves. It is thus a powerful tool for tests of controls, such as those for segregation of duties. Process mining is also applied to the population of data rather than to a sample as in traditional auditing procedures. Even though the focus is not on the content of the transactions, the 'sub-populations of interest' identified through automated tests of controls can be cross-referenced with data stored in financial systems for tests of details.

Figure 1 – Differences between the 'de jure' (left) and 'de facto' (right) process of an auditee based on



2 million events

Process mining consists of the analysis and detection of patterns and irregularities in procedures. It is a combination of data analytics and data visualisation as processes are reconstructed and visualised through the analysis of event logs. Event or transaction logs comprise a database that underpins the what, when, how and why of a process. This includes timestamps as well as information related to involved parties, resources and more. Although process mining has been traditionally used for improving the performance of manufacturing and business processes, it also has great potential to be used for compliance and performance audit. The digitalisation of an auditee's processes and records means that log data is now more accessible, leaving auditors with rather detailed audit trails to examine. An increased amount of event data has created a new kind of audit trail and process mining is an innovative way to explore it.

Some current uses of process mining at the ECA

The ECA's ECALab started its first process mining experiments in 2018 and we are now ready to carry out two pilot projects relating to the 2019 financial year. Process mining can be used on 'small' and 'big' datasets alike, ranging from hundreds to millions of items. We have used process mining to model the steps of European public consultations, payment processes within a European agency and the claims administration procedures of an auditee. The visual nature of process analysis makes it very intuitive in respect of spotting deviations, exceptions and bottlenecks.

Figure 2 - Process model of public consultations

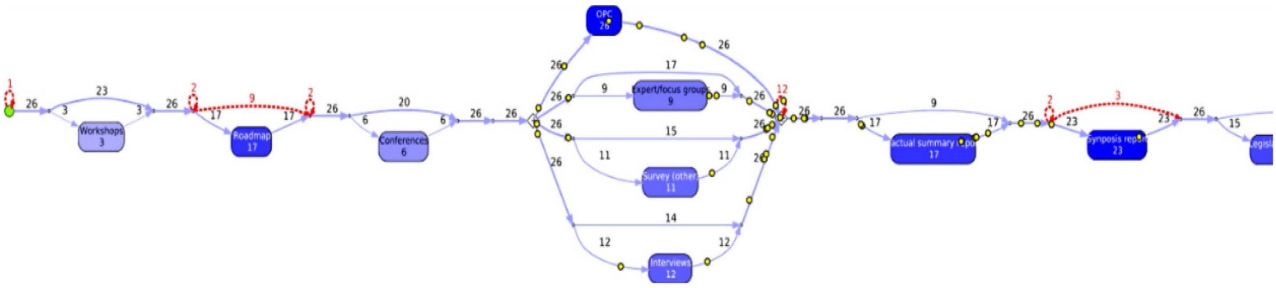


Figure 2 shows the different stages of public consultations along the timeline in order of their most frequent occurrence. Deviations from the most frequent process path are shown in red fragmented lines. For example, we can see that nine public consultations did not have a roadmap while three did not complete a synopsis report. Likewise, the shade of blue assigned to a given event is indicative of its frequency, with events missing from some consultation processes presented in a lighter shade of blue.

Figure 3 – Process model with 'exceptions' in red

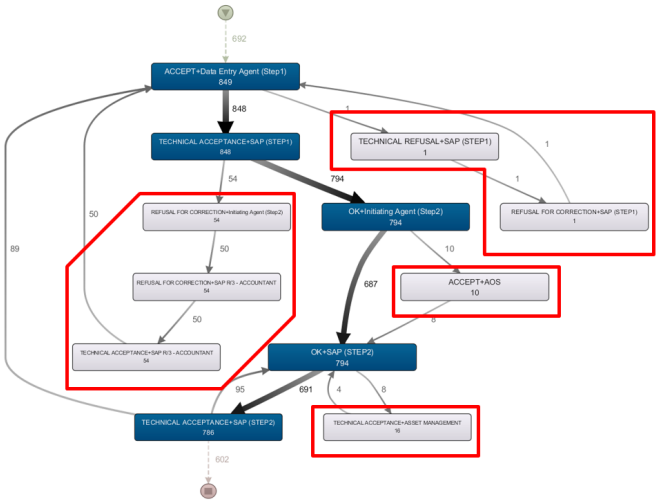
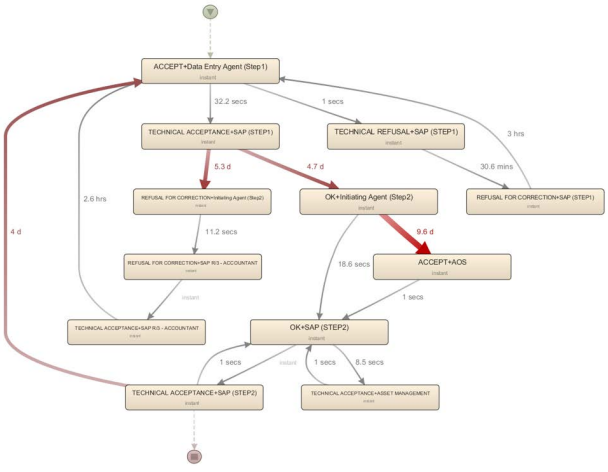


Figure 4 – Process model with median transition times



Figures 3 and 4 depict the payment process of a European agency. It is based on the entire population of their invoice payments for a financial year (4 thousand events and 700 payments). **Figure 3** shows the most frequent activities and their interconnections, the blue rectangles indicate the 'ideal' process, while the exceptions are highlighted in the red rectangles. By observing the entire population, we can see exactly how many invoices were rejected at what steps in the process, by which staff members. **Figure 4** shows the same process, but from a performance point of view. In this figure the wider the red arrow is, the slower the transition between two process steps. We can see that the main bottleneck of this process is the waiting time before the initiating agent or the authorising officer rejects or approves the invoice.

Process mining also allows additional details to be checked, such as segregation of duties, payment deadlines, the completion of the required authorisation steps, etc. A process model based on large amounts of historic data could even be used to make predictions about the possible outcome and duration of a transaction.

Process Mining and the audit standards

The emergence of process mining techniques better tailored to audit and a more widespread adoption of the use of event data for audit purposes have the potential to challenge accepted audit standards and the traditional role of the auditors. If we examine the entire population instead of sampling, more exceptions requiring follow-up actions are likely to be detected, and this could increase the time and effort spent on audit. New methods, such as visual analytics, will be necessary to deal with a greater number of outliers.

Figure 5 - Invoice payments vs commitments in an entire population

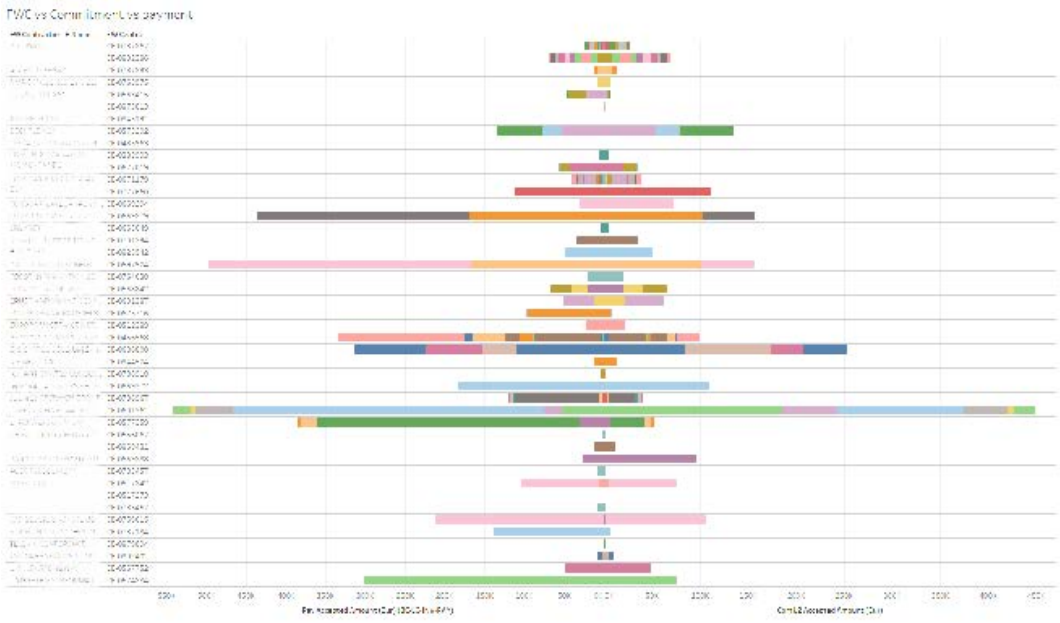
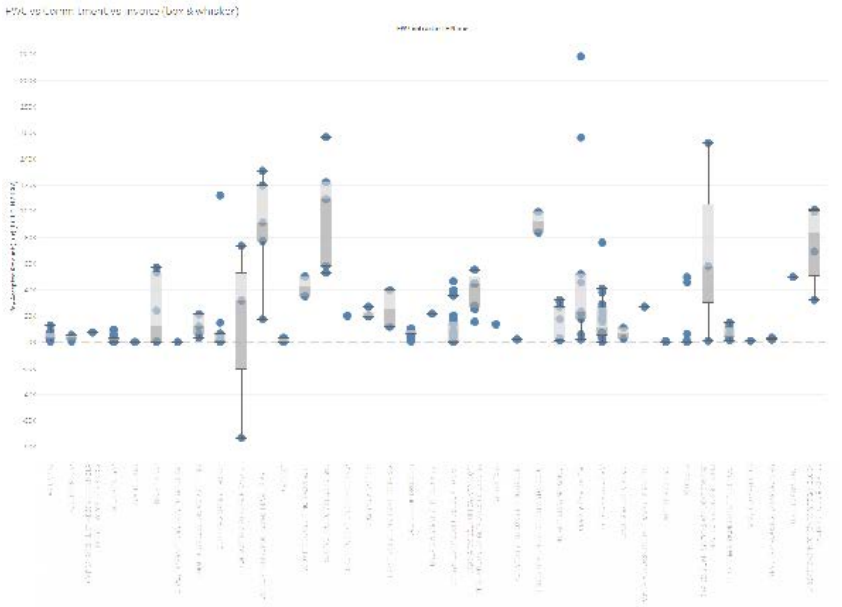


Figure 6 - Outliers in the entire population of payments



Visual analytics applications allow the auditors to explore entire populations or sub-populations to identify risks and areas of interest, while traditional reporting formats and spreadsheets listing rows of exceptions are more likely to create potential blind spots for those seeking a full picture of their data. The examples in the figures above show different views of the entire population of invoice payments for an auditee. **Figure 5** gives an overall view of the consumption of commitments by framework contract, allowing the auditor to intuitively identify the biggest counterparties and potential cases of overconsumption. **Figure 6** shows the distribution of payment amounts to business partners, so that the auditor can easily spot outliers and points of interest for further tests of details. The combination of visual analytics and process mining can also easily identify data integrity issues, such as missing or non-matching identifiers, unusual activities by privileged users and suspiciously short processing times.

Preparing ourselves for the future

As experts confirm, artificial intelligence will certainly play a decisive role in internal and external audit in the not too distant future (Financial Reporting Lab, 2019). This will happen, however, in forms and ways that we cannot precisely predict now. The shift towards data-led audit, however, has started already. We believe that process mining is a smart way for auditors to achieve mastery over the data and turn it into actionable insights.

Box 3 – References

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Making digital audit part of the ECA's DNA

Interview with Magdalena Cordero and Mariusz Pomienski, ECA directors

By Derek Meijers and Gaston Moonen

Mariusz Pomienski and Magdalena Cordero

Digital transformation is one of the key objectives of the ECA for the upcoming years. But how to put such objective into practice? Where do you start and who do you need to involve? And how does it affect work processes, auditors' skills and relations with the auditee? Magdalena Cordero is Director of Information, Workplace and Innovation and has been working for years on innovation and digital transformation at the ECA. Mariusz Pomienski is Director of the Financing and Administering the Union Directorate in charge of the financial and compliance audit work that underpins the ECA's annual Statement of Assurance and he is closely involved in the project 'ECA audit goes digital.' We interviewed them to discover their views on what digital transformation means for ECA auditors and what the two directors consider to be the key ingredients to make the transformation happen.

The 'ECA audit goes digital' project as stepping stone

Magdalena has been working on digitalisation and audit for quite some time. 'I started facilitating international working groups on the use of digital tools in audit and, little by little, you see things moving, with a take-up in several audits and in several countries. But there comes a moment when further progress requires clear decisions, and I think this moment has arrived for the ECA. To make things happen pressure is required from different positions: from the top of the organisation, bottom-up, and also from the sides, from peers and facilitating services.'

For Mariusz, digital transformation has so far not been his daily 'bread and butter': 'I got more involved in digital transformation through the project 'ECA audit goes digital,' the project that is led by the ECA Digital Steering Committee consisting of six ECA Members and chaired by one of the, Eva Lindström. This Committee was set up in Spring 2019 and is supported by three directors – Magdalena, Geoffrey Simpson, the director responsible for quality control, and myself. The project manager is Julia Pliarczyk, an auditor from the Investment for Cohesion, Growth and Inclusion Directorate.'

Mariusz explains that the project's objective is the digitalisation of audit at the ECA. 'People all around in the ECA are faced with digital reality on a daily basis. We live in a digital world - whether we like it or not - and auditors, naturally and intuitively, often try to get a grasp of it. Quite a few initiatives have been developed already, many of them channelled through ECALab with the help of Magdalena's directorate.' He adds that now they want to take good stock of what we already have at the ECA before setting up a development phase, and of what else needs to be initiated to achieve this digital transformation in the ECA's work. 'We are currently at stage 1 of the project, which is the *Status Quo Analysis*, meaning that we first identify what has been happening until now within the ECA. An important part of this first phase is also looking at the Commission - our main client, our main auditee. Because we foresee that quite a lot will depend on how they react to our digital progress, as auditors. If they do not go digital, or digital enough, we might find it difficult to become as digital as we would like to be.'

> *If they [the Commission] do not go digital, or digital enough, we might find it difficult to become as digital as we would like to be.*

Mariusz underlines that none of the auditors are excluded from the 'ECA goes digital' project. 'But for now, the main focus in the early phase will be financial and compliance audits where the audit procedures are more standardised.' His hope is that focusing on this audit domain will bring recurrent benefits. 'Such as improving the processes, also from an automation point of view.' In this connection he also refers to an ongoing pilot project at the ECA in relation to auditing executive agencies (see also p. 45). 'They have identified processes that could be subject to automated audit procedures. I am sure their results and experiences will show real benefits and feed into our financial and compliance audit work.'

Magdalena explains that the bottom-up instrument for her was the ECALab. 'It was my dream years ago and I'm very proud we have got to where we are now. It was very important to have this instrument in place, combined with what I call the 'lateral' pressure.' For her this means information on what the ECA's peers are doing: talking with others, taking initiatives to facilitate exchange. 'From one year to another we see the progress other supreme audit institutions [SAIs] have made. This exchange with the outside world is very important, and it will contribute to the realisation of my new dream: creating a centre of excellence and knowledge on public audit, linked to the ECA.' She conveys that this is linked to another dream of hers: to create in Luxembourg - preferably in the historical Schuman building - a centre of knowledge on the construction of the EU. 'But coming back to digitalisation: for me that is already a reality, it will happen with or without me, also for the ECA. This is not always easy, but we will get there, we are now taking concrete steps in that direction. In the end it is about cultural change.'

> *But coming back to digitalisation (...) In the end it is about cultural change.*

Searching and finding inspiration…

It also became apparent during the conference the ECA organised on Big and Open Data (see p. 108), that others have become aware that the ECA is taking concrete steps. When discussing what inspires the ECA to take these steps Magdalena is clear: 'You need to be inspired by those who were there before you and since it is very unlikely that you have a genius who sees things and can convince you that you should do them, you

often look outside.' She adds that there are many different ways to innovate. 'You can innovate because you change your process; you can innovate because you change your product; sometimes there is a way of innovating that is called positioning – you take what others are doing in another domain and you apply it to your domain. When you do that, you see that, suddenly, you have a new line of innovation.'

She gives an example. 'Take the 'smart data' approach Eurostat has launched. We can learn a lot from it and bring that knowledge inside our house and see how we can apply it to our own processes, to our own organisation.' For her, digital audit, a term used by her directorate since 2017, contains three core elements. 'One is automation, as was also mentioned by Mariusz: automating things that were or are done manually.' An important aspect here is to optimise this automation by bringing in 'control by design,' meaning that some key control issues are already embedded in the automated process. 'The second one is data analysis. This is not only relevant for financial and compliance audit but also for performance audit.' She argues that too often performance auditors think of data as numbers, as structured data. 'Data includes text, images, data is all kinds of information that is digitalised, for example, social media are also data.'

On this issue, Mariusz continues that the environments of private auditors and public auditors are not necessarily the same. 'Private audit firms mainly focus on financial audit. Many of our audits, on the contrary, are mainly focused on non-financial information. In our compliance audits, checking the legality and regularity of transactions, we compare the reality with what the Commission, or other management authorities, tell us. In this picture the accounts are only a small part of this reality.' He explains that most of this information is non-financial, and often non-structured. 'This is also why private audit firms may advance differently than we in public audit do, and is what makes our auditee a different type of auditee in digitalisation than their clients. And what makes the challenge for us regarding digitalisation much greater.' Magdalena concurs: 'In a way our audit questions and our audit environment are more complex.'

For Magdalena the third core element of digital audit is the audit of digitalisation itself. 'In the past we would speak about IT audit and this third element builds on that. As auditors, our role is to contribute to trust regarding the systems and processes used. And since the system is more and more digital, then the role of auditors is to provide trust in that digital environment.' She refers to an audit case brought forward by the French SAI. 'They were auditing an algorithm that was used when assigning people to universities. As auditor you need to verify and ensure that there is no bias in the tool used.' She underlines that, unlike the former role of the IT auditor, who was auditing mainly IT governance and project management, the audit of digitalisation goes further. 'We need to assess whether the system has any bias, we need to audit the algorithms, and assess whether the system is secure so nobody can modify the data at some moment in time, and if they do, then with clear trails; cyber-security is one of the big risks of digitalisation. All this relates to trust, the core of an auditor's profession.'

> *"As auditor you need to verify and ensure that there is no bias in the tool used.*

… to strengthen the foundations of audit

Mariusz adds that he could not agree more. 'The bottom line is that the foundations of audit will not be changed by digitalisation: we will continue to provide our judgement, applying professional scepticism. But with this ever growing component of IT, of digital, in our life, it will also be a growing component in our work. With the data we get from our auditee, every stage of our audit activity becomes more digital. It will impact our risk assessment, our planning, our preparations, our audit ideas, audit implementation, and our reporting and communication about it.'

On this issue Magdalena explains further that, with digitalisation, analysing reality as it was when it was created is crucial. 'With an information system you can 'build'

information in any way you want, even on wrong data. And you can try to prevent others from following the right ways to find out. Creation and modification of data needs to be recorded so that auditors can analyse what happened. We need this extra layer of security and blockchain can help in this context.' She refers to Estonia, where a lot of personal information is used for public administration purposes. 'People can access this information - or not - but all this is registered in a blockchain, the logs of those transactions are there and immutable.'

For Mariusz the prerequisite for digital audit remains the same as in the past: the data must be reliable. 'But for me the most tempting thing about digitalisation is that we simply give better assurance, better information to our stakeholders. It enables us, hopefully, to provide assurance on testing the whole population. Which is an auditor's dream, in the sense that you are close to 100 % sure.' He explains that in this way you can elminate certain risks involved in sampling or extrapolating.'

> *... testing the whole population. Which is an auditor's dream, in the sense that you are close to 100 % sure.*

Magdalena presents another advantage. 'With sampling, a transaction containing an error is considered as an error. But if you analyse the full population you may discover that there are 500 or 1000, or even more transactions that follow the same pattern. So what before was labelled an error can then be identified as possible fraud' Another example she gives relates to process mining. 'It is about processing the logs. Any activity in an information system is registered in the log. The analysis of the logs allows you to easily identify transactions that didn't follow the "normal" path, and the auditor can concentrate the analysis on these cases. This analysis can produce interesting results from a performance perspective.'

Assessing the digital architecture

Auditing digitalisation means for Magdalena that auditors have a role in looking at the digitalisation process since the starting point. 'The construction of new information systems represents an enormous investment for the public sector that must demonstrate performance and value for money. A solid IT architecture is the foundation for building a real transformation.' She refers to the 2017 Ministerial Tallinn Declaration on eGovernment by which EU Member States committed themselves to building user-centric digital public services, highlighting interoperability and openness. 'The new European Commission has committed itself to a digital Union and will invest a lot of money in it. As auditors we need to see that the systems work and that they protect EU citizens' interests. This includes looking at the architecture of these systems.'

> *As auditors we need to see that the systems work (...) This includes looking at the architecture of these systems.*

Mariusz is more cautious as to what extent auditors can play such a role. 'Regarding the external auditor's role in the whole building process of the IT - or broader – internal control systems, I think it might be quite a challenge to reconcile this with our independence and our ability to then audit ex-post, the way we traditionally work. There is this fine line that we need to be careful not to cross, becoming a type of consultant.' An important argument for him is that the auditor's role is later to provide assurance on what is being produced with the system. 'I think there is a bit of a grey zone. 'Our tool is audit; we can audit the design, we can look at it, but guard our distance vis-à-vis the auditee and also not become part of the management.'

Failure as part of the learning process

As the Director of Information, Workplace and Innovation, Magdalena has the role of facilitator, innovator and enabler for auditors with regard to digital audit. One of the core elements in doing this has been the ECALab, launched in 2017 (see page 38) for more details on the ECALab). She explains that with the ECALab the intention was to experiment, to raise awareness and to create an appetite, not only for technology, but stimulating the right questions on what can be done with the digital means available.

'Now the appetite is there and when there is a new audit task several ECA Members – but not all of them yet – and directors will consider using the ECALab. It is "à la mode," quite different from three years ago. Now everybody talks about digitalisation and about digital.'

However, she underlines that the ECA needs to move forward and perform a real organisational transformation. This means designing structural training programmes for auditors, going beyond what we did in Pisa (see page 130). She underlines that the idea is not to create an enormous ECAlab. 'Auditors need to build their own capacity, the audit chambers need to understand that they need to train their staff and recruit new profiles. This requires a cultural change, an understanding that moving to digital audit also means allowing room for experimentation. And if people experiment this means that in some cases they will succeed, and in some cases they are going to fail.'

For Magdalena, it is clear that this concept of failure is not easy for an audit organisation. 'The feedback I get is sometimes, "We cannot make the same mistakes our auditees are making." But why should we assume we are better? Of course, we are going to make some of the same mistakes as they do. As our chair of the Digital Steering Committee, Eva Lindström, has indicated, we need to allow failure. Otherwise we cannot progress as fast as we should.' In her view, auditors should not be afraid to fail and management should allow room for that. 'You need to try. We can lead by example by allowing room for that. For the EU and digitalisation, to make it happen, you have to experiment…and fail now and then. Otherwise, we will lag behind the rest of the world. In some elements of digitalisation we are already lagging behind.'

> *"For the EU and digitalisation, to make it happen, you have to experiment…and fail now and then.*

Magdalena underlines that the cultural change needs to start at the top. 'Senior management needs to be generous, meaning that they need to allocate permanent resources to experiment for digital audit.' She quotes an example. 'The Finnish Auditor General, Tytti Zli-Viikari, said: "Any financial auditor must be an IT auditor," thereby underlining the importance of digital.' She continues with another example from the same audit office. 'She put together a number of people, not auditors, and asked them to come back with an example of use of AI in audit, a team with expertise in different fields.' She points out that if you want to transform – in this case transform digitally - you need people who have an understanding of what it is about, you need people who have the skills, and people who have vision. 'This transformation doesn't necessarily require a deep change in current organisational structure, it can work just by allowing for organic growth. This can work well. But there are also other ways, perhaps more disruptive, like the approach we see in the Finnish SAI.'

> *"Senior management needs to be generous [and] allocate permanent resources to experiment for digital audit.*

As to whether the auditor can go faster on digitalisation than the auditee, she comes back to the digital architecture and controls by design. 'I was working at the statistical office in Spain in 1986 when Spain joined the EU. At that time, Eurostat was receiving all the data on paper. I was assigned to an international working group on telematics networks, aiming to create a network allowing any Member State to send information already in digital format so it would be filed automatically when arriving at Eurostat. Imagine, this was 1986/87. Eurostat, the European Commission, provided equipment to every Member State, if needed, to achieve connectivity, including paying for the line. Because they wanted to make it happen.'

She points out that the ambitions of the new European Commission for a digital Europe offer new opportunities to build in controls by design. 'With Digital Europe…big investments will be made and we should use that opportunity to stimulate controls by design. 'Some organisations have taken the initiative to contribute to the digitalisation of the auditee. The World Bank is building a system on blockchain to help the auditee to register all financial documentation, including smart contracts and even a full financial process. When the ECA launched its pilot on blockchain, our intention, although less

ambitious, was similar: to simplify the process for the auditee by means of digitalisation.'

Outlook for digital audit

When it comes to where the ECA would be five years after the start of the 'ECA audit goes digital' project, Mariusz takes a modest view. 'I think, of course, it is progressing well. But my experience with the pace of change is such that, whatever I think of what is going to happen, or where it is going to be in five years, will probably be obsolete by the time we get to that point.' In his view, it is clearly a moving target. 'But I do think that in five years from now, for sure, we will be auditing differently. How differently will depend, on the one hand, on how successful we are in changing our organisation, in following-up the successful pilots, extending their scope, going step by step.'

However, he also believes it depends on how the Commission will move forward. 'In the private audit world, obviously, the auditee is very much interested in helping their auditor to become digital. Simply because they will not only get a better product, but also it will be faster and presumably cheaper. I hope the Commission will have the same incentive, namely that they are interested in us, as a public auditor, being faster, better, and cheaper - of course that remains to be seen. But I do hope that five years from now both of us, the Commission and the ECA, will be in a changed reality and that audit will look profoundly different in practice, but fulfil the same basic objective as now.'

> *... five years from now both of us, the Commission and the ECA, will be in a changed reality and that audit will look profoundly different in practice...*

Magdalena shares Mariusz's sentiment on the pace with which changes can take place. 'So I would not like to look further than five years from now. For sure, digitalisation is going to happen. The process has started already and it will not stop just look at the world around us and our audit peers.'

She summarizes her perspective around three key aspects. 'First of all we need to ensure that the results of our audits are relevant. This is not easy, because the world is evolving and we need to be sure we keep up with that.' The second aspect for her is trust. 'Trust in the digital world will be essential. This is where the auditors need to work a lot. I would like to see that the ECA is able to contribute substantially in the digital world of the EU, in any context.' The third and last aspect for her is speed. 'We will need to work at a certain speed and that must take into consideration the speed of the auditee. This means that in some cases we need to run because we are behind. But in others we need to provide help to the auditees in order to keep them up to our level. Because we are the ones who want to work in a different manner, providing more added value.'

> *Trust in the digital world will be essential. This is where the auditors need to work a lot.*

For all of this to happen Magdalena reiterates the need for cultural change. 'With the – as I like to call it – generosity of senior management. Digitalisation of audit is a dream for me any longer. My dreams are always about all those initiatives where I need to talk and persuade people at different levels, and share my ideas and convince them! And the digitalisation of audit is already a reality, it only requires hard work.'

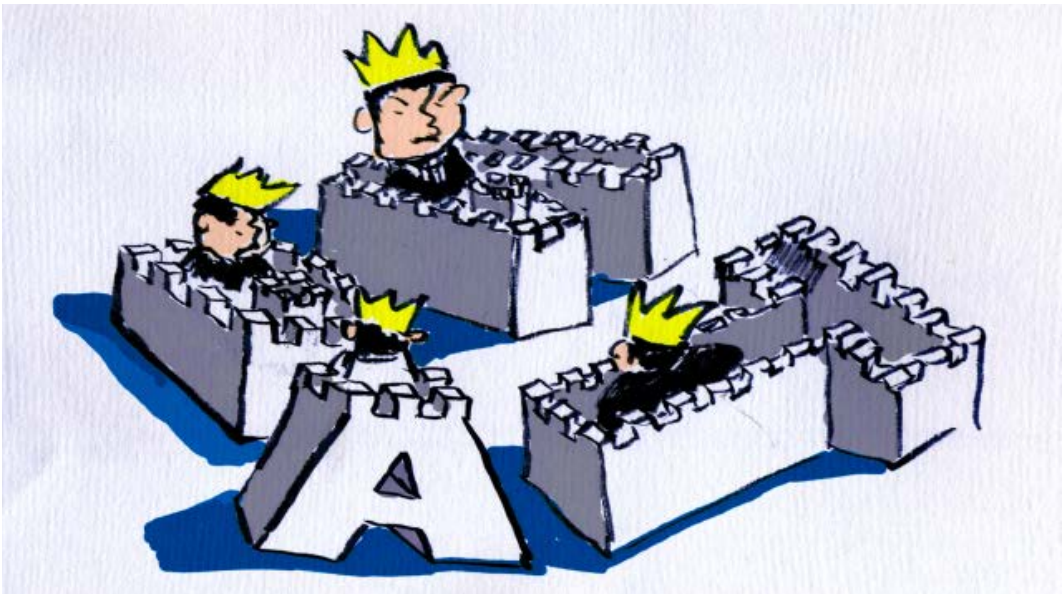
‘Big data’ analysis and modern supreme audit institutions: tearing down the walls of data kingdoms

By Janar Holm, Auditor General, National Audit Office of Estonia

Estonia has adopted e-solutions that have made the country one of the world’s most highly developed digital societies. This digital journey has had a considerable impact on its businesses, but also on its citizens. How has this shaped and impacted the work of the National Audit Office of Estonia and its own institutional development? Janar Holm has been Estonia’s Auditor General since early 2018. Prior to this, he held several functions in the Estonian government, including being (deputy) Secretary-General of several ministries. In his contribution he explores the concept of big data, what it means for audit offices, including providing examples of how the National Audit Office of Estonia uses data analytics to add value through its audits and to stimulate a better data exchange environment.

Looking behind the phenomenon called ‘big data:’ two questions to be asked

I am frequently asked about digital innovation in Estonia and how we, as a supreme audit institution (SAI), are using this success to our advantage – for instance, to what ends are we utilising data from our auditees to generate influential suggestions and what are the examples of big data analysis in our office? When asked such questions, I usually reply with another question – what do you mean when you talk about big data? Because, as a matter of fact, the definitions are somewhat obscure. This time, as I have been given an opportunity to address this issue in a prominent public auditing journal, I would like to raise an additional question – what is the role of a modern public auditor in data analysis, be it big data or not so big data?



Source: Artur Kuus © 2019

My kingdom, my data!

What do we mean when talking about ‘big data?’

The flow of data that constantly surrounds us is beyond common understanding. For instance, during the past month in small Estonia, the number of queries made by various information systems to access interconnected databases via the exchange platform X-road (see **Box 1**) was around 110 million, and this was only information on accessing certain data, not the data itself! Some would call this data, based only on its volume, big data.

To make a distinction between whether we are dealing with big data analyses or simply analysing large amounts of data, I feel it is really important to understand the concept behind this phenomenon called 'big data,' a term which is spreading rapidly in mainstream audit institution language. Our field is known for punctuality in terminology and we expect this from our auditees, so we must practise what we preach.

When looking at prominent definitions today, we must go back to 2001 when Gartner stated that 'big data is data that contains greater variety, arriving in increasing volumes and with ever-higher velocity.' Simply put, big data is large in volume (nowadays reaching petabytes), complex in format (taking data from several sources such as unstructured text, maps, sound, video, etc.) and prompt in pace (so that regular data processing power and software are inadequate). During the last decade, two other aspects have been adopted: value (data has its intrinsic value) and veracity (there are always questions about the reliability of data).

Box 1 - X-Road initiative

X-Road is a centrally managed distributed Data Exchange Layer (DXL) between information systems. Organizations can exchange information over the Internet using X-Road to ensure confidentiality, integrity and interoperability between data exchange parties. The X-Road is an open source data exchange layer solution that enables organizations to exchange information over the Internet, providing a standardized and secure way to produce and use services.

The first X-Road iteration was developed and launched by Estonia's Information System Authority (RIA) in 2001. In February 2018, Finland's and Estonia's data exchange layers were connected to one another. In 2017, Finland and Estonia established the Nordic Institute for Interoperability Solutions (NIIS) to continue the development of the X-Road core.

X-Road can be monitored online https://www.x-tee.ee/factsheets/EE/#eng.

Data analysis in a modern SAI

We can probably agree on the following aspects of our work as public auditors:

- our audit offices are acquiring data in large quantities, but I believe we are managing only gigabytes of data in one project, not tera- or petabytes;
- we are using data from various sources but mainly rely on (and check the integrity of) structured databases generated by our auditees (or we try to generate them ourselves);
- usually in an SAI, we deal with data that are not volatile. Generally, we also generate suggestions based on a fixed point in time.

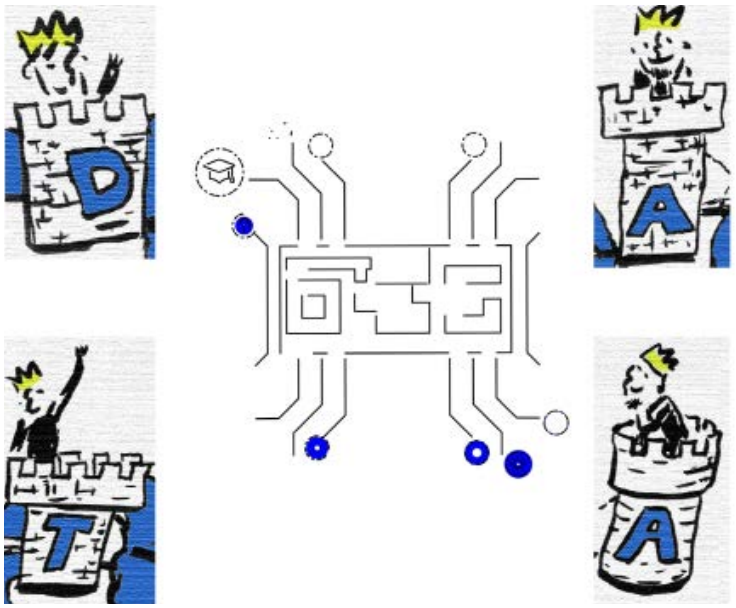
One could argue that we have to apply several methods of data analysis to tackle the challenges of large quantities of data, for example, in some cases, traditional Excel does not suit the job and can become unstable. Then we turn to alternative analytical means such as Python or R programming language for example. Speaking of big data, the data sets we are trying to consider are so voluminous that we cannot manage them without an unusual amount of effort. Nowadays, European SAIs are easily capable of handling quantities of data believed impossible 10 years ago, using the tools suitable for their auditor's expertise. Having different digital tools for different tasks in our toolbox, however, does not imply that we are dealing with big data. Putting up a swing for your child with a professional drill does not mean you are a megaproject constructor.

Regardless of definition, in this new data area, the modern SAI is usually involved in some form of data analytics that requires looking into millions of data fields, comparing various datasets from multiple domains and sometimes even using algorithms to predict potential scenarios. Estonia is no exception – almost all audit planning and implementation requires data mining: mapping appropriate sources, acquiring and investigating data and looking for patterns previously undiscovered. We have combined datasets from various ministries and found ways to enhance their services. For instance, in a relatively straightforward case this year, we gathered data on expenditure in the IT sector in all ministries and their ICT services-providing institutions. Doing this for the first time ever in Estonia, we were able to point out the potential lack of funding for newly developed IT projects and for the sustainability of the sector altogether.

Data use, analysis and exchange instead of data collection

Providing new insights into the data matrix offers great potential for supreme audit institutions but also conceals the threat that an obsession with big data analyses, data mining and gathering becomes a means in itself, not a tool for advancing a state's decision making and improving the wellbeing of people. Instead of generating a massive data warehouse and analytical system in our office, we in Estonia prefer information systems and analytical online tools provided by our stakeholders. Before diving into comprehensive analysis, we investigate what has previously been done in the field. You cannot be effective in pointing out potential problems if you are tied down by reinventing the wheel that is available in the field.

Although a SAI can and should provide value through innovative ways of data management, I believe data analysing should not be duplicated by an SAI and instead we should nudge stakeholders to perform influential analyses themselves. The complementary role is verifying the accuracy of these analyses and promoting the implementation of changes based on these analyses.



Source: Artur Kuus © 2019

X-Road linking the Kingdoms in Estonia!

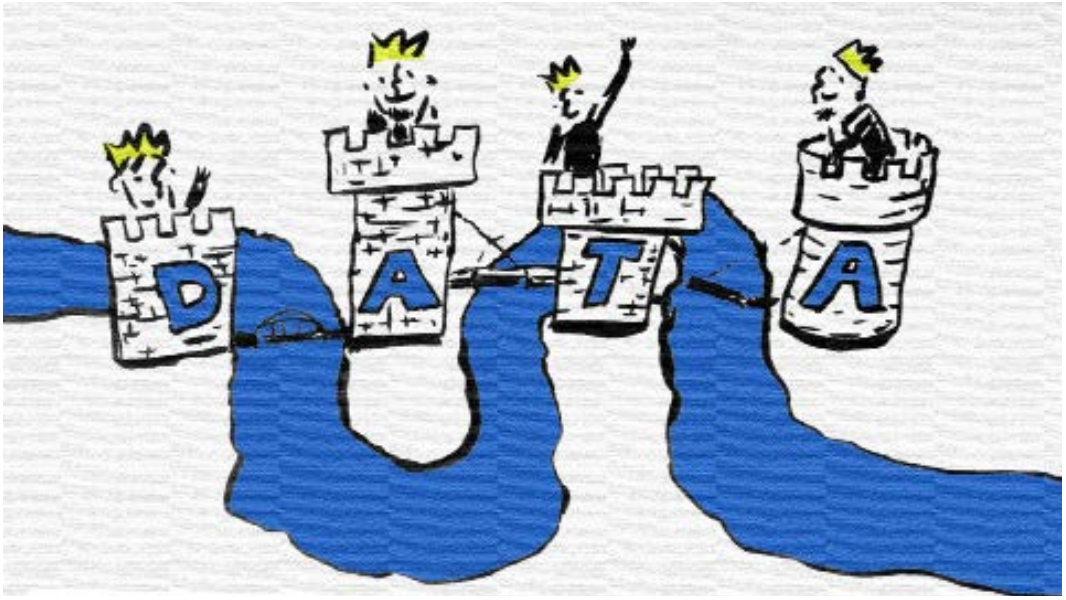
As I pointed out at the XXIII International Congress of Supreme Audit Institutions (INCOSAI) in Moscow in September 2019, we in Estonia see the role of the modern audit institution as more of a promoter of data exchange environment creation and better performance of data analysis by our auditees. An audit institution's role is to dismantle data kingdoms and build bridges between authorities. Freedom to manage data should be a fundamental right for every public authority seeking to serve its citizens better. We are in a unique position as the government has developed X-Road in Estonia, providing a secure exchange layer for all public institutions to utilise. Unfortunately, however, this is still not the case, as data is gathered in silos and even in one field, we found that officials face obstacles when obtaining data from inside their institution.

Spreading best practice of data analysis between different public sectors

In one of our audits, which is currently being finalised, we see various stakeholders in Estonia performing cutting-edge analyses in order to provide better services and even saving lives through better data usage. For instance, the Rescue Board of Estonia is currently mapping all buildings taking data from the buildings registry. They are cooperating with local authorities to obtain data on abandoned buildings and help people who are prone to fire incidents, etc. To do their best in fire prevention, they are using multiple datasets from several institutions, even data from private companies, and neighbours from Nordic countries are visiting to learn from their best practices. So, we do not have to teach the stakeholders how to analyse data, sometimes we should learn from them.

At the same time, we see several authorities lagging behind because they have not taken the time to investigate all the data available, and additionally there are data quality and technical issues that hinder the usage of data. There are problems with blurry responsibilities when developing and executing state services, and the mindset of certain organisations is tangled up in the old way of performing their duties. For instance, in our healthcare system, there has not been any advancement in getting citizens to participate in voluntary cancer screenings. There is not enough data on people who should be in potential focus groups and there is significant potential in using IT to reach out and get in touch with them. When looking for solutions, institutions are pointing at each other and the flaws in information systems, but this has lasted for many years and the solution is nowhere to be seen.

Promoting best practices and pointing out the bottlenecks hindering the usage of data analytics is the main goal of our audit this time. I believe that this is more influential than performing an audit in one single field only to find out that services are not provided in the most efficient and economical manner. Benchmarking data usage for better decision making in multiple fields simultaneously prevents institutions from using their usual argument, 'everybody has the same problems.'



Source: Artur Kuus © 2019

Our kingdom, our data!

Developing data analytics capabilities to build bridges

Tearing down the walls of data kingdoms and being a constructive partner for our auditees, modern audit institutions are facing huge challenges even without adopting big data in our vocabulary. We must develop the mind-set and skills of our auditors so they can ask the right questions, find the answers and the analysis available now, and use the tools necessary for data mining and advanced analysis.

In our new strategy - which we are developing at the moment - the National Audit Office of Estonia will introduce a focus on developing its data analytics capability, and we are looking forward to sharing our expertise and learning from best practices all over the world. This is also a topic we are pushing forward when taking over the IT working group of the European Organisation of Supreme Audit Institutions (EUROSAI) and developing a working programme for the next three years in cooperation with our colleagues across Europe.

Ways to move forward for modern audit institutions

Building on what we have already put in place, and what remains to be done, there are three main propositions we - as public auditors around the world, but also here in Europe - should act upon when it comes to data:

- promoting the creation of a data exchange environment at governmental level and nudging the auditees to perform relevant data analysis;
- identifying best practices and pointing out the bottlenecks hindering the usage of data analytics;
- sharing our expertise and learning from best practices all over the world.

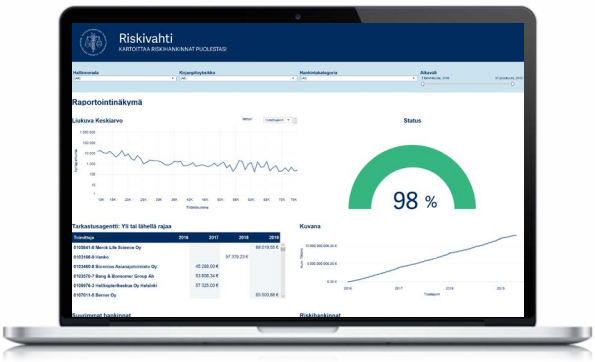
Public auditors preparing for digital transformation – the case of the National Audit Office of Finland

By Pirkko Lahdelma and Ines Gullichsen, National Audit Office of Finland

Source: NAOF

The National Audit Office of Finland (NAOF) has recently adopted a new strategy and organisational set-up. Like many public audit bodies in Europe, the digital transformation of audit is a major topic for the NAOF. Digitalisation also provides an opportunity to challenge established practices and innovate. Pirkko Lahdelma has worked as Director of the NAOF's Digitalisation Competence Centre since May 2019. She was previously Strategy Director, responsible for renewing the NAOF's strategy, and has also worked in performance audit focusing on digitalisation and ICT. She highlights some of the changes introduced at the NAOF, while her colleague Ines Gullichsen, a Project Advisor, gives a more personal account of her experiences as a participant in the NAOF's Young Professionals' Programme.

Digitalisation as a stepping stone towards renewing audit



Source: NAOF

Digitalisation, technological development, artificial intelligence and big data are hot topics among the community of supreme audit institutions (SAIs). Awareness of the need for digital transformation has grown considerably, and nearly every SAI is now considering how to take the next step on the path to digitalisation. We all are busy talking about digital audits where we use algorithms to automate our audit processes and mine big data with sophisticated analytics to obtain new insights. Rapidly developing technology and exponentially larger volumes of data offer us many opportunities to renew the whole auditing industry. The question now is how to recognise and seize those opportunities.

Strategy as a mindset

At the National Audit Office of Finland (NAOF), we recently launched a new strategy emphasising future-orientation, change, and the need for innovation. This strategy is not only a long-term plan but also a statement of intent for everyone working at the NAOF. It defines the organisational culture we wish to foster.

With our strategy, we have chosen to support the innovative renewal of public governance. When making this statement, we also realised that if we want to promote innovative renewal, we must serve as an example ourselves. As part of our own innovative renewal, we are investing in digitalisation.

Building skills for the future

In the light of our new strategy, we have recently discussed the skills needed for the future. We agree with the report by the World Economic Forum (2016), which states that 'many formerly purely technical occupations are expected to show a new demand for creative and interpersonal skills'.

As regards digitalisation in our own organisation, one of the skills that will be required is creativity combined with critical thinking. Investing only in technology without changing anything else can easily lead to a situation where we have simply converted

our analogue processes and practices into digital ones. The benefits of this kind of approach are likely to be marginal.

Instead, we must be able to challenge our current practices, procedures and thinking. Are the premises, assumptions and beliefs on which we have built our activities and operations nothing but a legacy from the analogue era? The key to successful digital transformation is actually finding the right problems to be solved.

Leadership promotes creativity

Another skill we wanted to focus on is leadership. Leadership plays a vital role in promoting creativity in organisations. Creativity requires a safe environment for trial and error. For the purposes of creativity, leadership is about encouraging, inspiring and motivating.

It is obvious that we also need technical knowledge and skills for the digital transformation to succeed. However, what kinds of technical skills are really needed? We have identified the following three:

- being able to understand the potential impact of new technologies on our business;
- being able to determine how to use new technology efficiently in our daily work;
- knowing how to acquire expertise to develop and maintain technical solutions that are not only sustainable but also affordable.

Especially for a small organisation like the NAOF, it is almost impossible to have a large number of staff whose knowledge and skills regarding the latest technological developments are constantly up to date. Instead, a small organisation should have the knowledge and skills it needs to find and cooperate with trustworthy and competent partners, and thus expand its technological knowledge base.

Multilevel learning through experiments and pilots

As well as cooperating with relevant stakeholders, we are building capacity for digitalisation by improving our creativity, critical thinking, and technical skills. Out-of-the-box thinking requires a leadership style that is different from the one we have been used to. Such a style emphasises empowering staff, enabling teams to manage themselves, and supporting them with coaching.

However, learning and adopting a new leadership style does not happen overnight. Many people in our organisation have always worked in strictly top-down-managed organisations. They have therefore grown up in a culture where people are given strictly defined assignments and instructions. That is why we have decided to test the new leadership style first in small experimental projects to gain experience and learn how it works in practice. These projects include our Young Professionals' Programme and, with it, the 'Risk Detector'.

The Young Professionals' Programme is not a new concept as such: different kinds of trainee programmes have been on the market for decades. However, we wanted to develop it by incorporating an experiment on a new leadership style. Mentoring and coaching were therefore an important part of the Programme.

During the one-and-a-half-year Programme, the young talents who were selected learned by participating in different types of audits, but also by being moved between units. In addition, they were assigned a task of their own, which they were to carry out as a team in parallel with their other activities. The outcome of this assignment was the 'Risk Detector', which proved to be a success story.

Encouraging an open approach to digitalisation

As part of our digitalisation process, we are exploring new ways and methods to use new data sources and integrate them into our audit processes. The assignment given to the young talents was linked to this (see **Box 1**). At the beginning of the project,

the team was given objectives, but no instructions on how to achieve them. In addition, the objectives were suggested rather than precise, and were thus open to development during the project. We set up a steering group to support and coach the project team in solving problems, thinking out-of-the-box, and developing the objectives during the process.

As a result of the programme, we obtained a tool that combines data from open data sources and enables new analyses in a visually attractive way. At the same time, we gained experience on new methods for acquiring technical expertise from external partners: the 'Risk Detector' was created in a reverse hackathon, which allowed the team to approach the problem in an agile and flexible manner.

Lastly, we also obtained great results from testing our new leadership style. Coaching and encouraging this new style enabled the team of youngsters to flourish: as a team, they managed to maintain high motivation levels and turn drawbacks into successful learning experiences. We obtained evidence that we are on the right track with our strategy. We will take advantage of these experiences as the NAOF is transforming from a hierarchical organisation into a matrix where we will be working in project teams. Last but not least, the next Young Professionals' Programme is under way – this time being implemented by our young talents.

Box 1 – An innovative approach

Ines Gullichsen works as a Project Advisor in the NAOF's Executive Office, and participated in the Young Professions' Programme. Below are some of her experiences and impressions.

The Young Professionals' Programme, which is now coming to an end, had two components. First, there were our supervisors, who had planned the programme and were responsible for it. For them, the Programme was a leadership experiment which achieved the goal of providing an innovative landscape for the NAOF's practices.

Then, there was the Young Professionals component, which consisted of multiple phases and features. As well as being introduced to the world of auditing, we were also expected to bring fresh ideas and approaches into the office. To highlight the emphasis on new thinking, our Auditor-General assigned us a development task. This essentially entailed introducing an artificial intelligence tool into the office, thereby contributing to an increasingly digitalised operational environment.

We studied the basics of data analytics to get an idea of where we stood at the time. We interviewed colleagues in the governmental sector to understand what other officials were experiencing. We met with the data analytics teams of other SAIs, and studied what the private sector had to offer. We also relinquished our initial plan of action and had to reorganise our whole approach.

Then, finally, the overall picture began to take shape. Having understood the basic principles of data analytics (figuring out what was happening nationally and internationally, and finding an external partner to provide us with a tool), the next crucial phase was to engage our auditors. We could not imagine developing a digital tool for helping auditors in their work without having some of them participate in the prototype planning phase. We initiated cooperation through a workshop, and workshop-like engagement continued throughout the coding phase led by our supplier.

Seen from our current perspective, the AI task actually consisted of elements that were well known from descriptions of innovative experiments – starting with an idea, becoming familiar with it, implementing it, failing, and then learning from our mistakes. We really could not have succeeded in our task without persistent cooperation and open communication.

The tool we developed is now the internationally renowned 'Risk Detector Tool'. Its focus is on helping auditors to detect risky procurements. We also managed to introduce an element of AI into the tool, in the form of a bipartite network recognising buyer/supplier relations. Looking at the big picture, the innovation of the Young Professionals' Programme led to another innovation, the Risk Detector tool. The lessons learned on both of these journeys are countless and, of course, 'documented' – if we can still use this word in the digital age.

A is for Accountability - oversight in the age of artificial intelligence

By Taka Ariga and Stephen Sanford, U.S. Government Accountability Office*

Artificial Intelligence (AI) is becoming an important phenomenon in our ever more digitalized life. AI solutions are tools used for decision-making in areas ranging from financial services to criminal justice, from cybersecurity to investigations on irregularities. But at the basis of all AI solutions used rests the human factor, not only technically but also regarding integrity and bias, in short: ethics. Taka Ariga, Chief Data Scientist and Director of Innovation Lab, U.S. Government Accountability Office (GAO) and his colleague Stephen Sanford, Director of the GAO's Center for Strategic Foresight identify a pivotal role for their organization when it comes to reviewing governance, oversight and ethical standards used in AI solutions. Below they highlight some of their institution's actions and considerations in this area.

AI – moving from technological to ethical questions

In our digitally connected world, data are often referred to as the *new oil* because of how critical it has become to powering our information economy. The scale at which we collect, process, and understand data today is increasingly reliant on complex systems of algorithms and models to help organizations make real-world decisions. These artificial intelligence (AI) solutions are growing in ways that represent a significant force behind what the World Economic Forum has dubbed the 'Fourth Industrial Revolution.'

Four industrial revolutions

Revolution	Year	Technology
	1784	Steam, water, mechanical production equipment
	1870	Division of labour, electricity, mass production
	1969	Electronics, IT, automated production
	?	Cyber-physical systems

Source: GAO adapted from Schwab 2016a; GAO and Art Explosion (images). | GAO-16-659SP

The development of AI solutions so far has focused primarily on testing and deploying algorithms and automation as quickly as possible. Data scientists have been eager to apply evermore exotic machine learning techniques and leverage greater access to increasingly abundant data against complex challenges to quickly answer the question of *can we?* The emphasis on speed and accuracy accelerated the growth of AI's footprint in our lives. However, sometimes this meant that governance-related considerations like *should we?* took a backseat.

We are now entering an important time when more observers and researchers are exploring the potential unintended consequences of AI algorithms. There is recognition that the capacity of AI to consume data and generate decision points not only carries many potential benefits but also could unintentionally create or magnify adverse societal consequences.

In her seminal book, *Weapons of Math Destruction*, Cathy O'Neil galvanized the data science community to pay more attention to important issues surrounding AI solutions such as biases, lack of transparency, and privacy. There are grassroots efforts among commercial providers, public sector organizations, and academic institutions looking at how best to establish and sustain robust AI governance frameworks. This marks an important pivot for the evolution of AI, where ethics is now established as one of the core responsibilities among data scientists and organizational stakeholders.

* The views expressed in this article are solely those of the authors.

Reviewing AI on its governance

The trend of AI adoption in the foreseeable future is decidedly heading only in one direction-up. When the Comptroller General of the United States convened an expert forum as part of a 2018 technology assessment on AI, GAO explored the implications of AI's use in high-consequence activities such as cybersecurity, financial services, automated vehicles, and criminal justice.[1] Our work, and the experts we spoke to, underscored the need for careful consideration of AI from a governance standpoint, including ethics, bias, explainability, and security. Without a governance structure, entities that develop, purchase or deploy algorithmic systems will face potential risks. This is where supreme audit institutions (SAIs) will play a pivotal role in the future.

For auditors, AI presents some important questions:

1. How can SAIs purposefully integrate AI capabilities across audit activities in ways that move the needle towards continuous auditing and 100% sampling?
2. How will the SAIs-absent of a uniform policy and regulatory framework-approach oversight of AI solutions *when*, not *if*, they are asked to provide assurance?

The direction towards creating robust AI governance on algorithmic development is certainly encouraging, but it is not sufficient when it comes to addressing accountability. *Trust but verify*, after all, is a guiding principle for auditors. SAIs must look ahead and be prepared to audit algorithms in ways that include both empirical as well as inferential evidences to draw assurance.

GAO's Innovation Lab and Center for Strategic Foresight

GAO is addressing both challenges head-on. Our Innovation Lab, established in 2019 as part of GAO's new Science, Technology Assessment and Analytics unit, is driving AI-based experimentations across audit use cases.[2] Our Center for Strategic Foresight, established in 2018, conducts research and identifies near-future challenges and emerging issues affecting government and society.[3] This Center is part of GAO's office of Strategic Planning and External Liaison, which directly supports the Comptroller General.

Our technology assessment on AI demonstrated the power of using the tools of foresight and technology assessments to examine potential future implications of AI developments. That study surfaced several important considerations which will have a potential impact on auditors. For example, access to data and data reliability takes on a whole new meaning in the realm of machine learning, where data has been used to train systems to make decisions with algorithms. An auditor may be asked to examine actions and outcomes emanating from a system where the training data may be absent, outdated, or biased.

Whether a particular algorithm will be explainable, or its decision-making process can be examined or repeated by an auditor, will also be a crucial question with dependencies on both technology and intellectual property. Moreover, the use of data for training algorithms raises issues of data governance, data sharing, and data security. The governance challenge is further amplified when AI solutions are considered proprietary, dependent on 'blackbox' techniques, or rely on commercially available models.

1 *Technology Assessment - Artificial Intelligence: Emerging Opportunities, Challenges, and Implications.* GAO-18-142SP, 28 Mar 2018 (Washington, DC). https://www.gao.gov/products/GAO-18-142SP

2 For more information and GAO's science and technology work, see https://www.gao.gov/technology_and_science or https://blog.gao.gov/2019/10/29/our-innovation-lab-building-a-sandbox-for-audit-tech/

3 For more information about the Center for Strategic Foresight, see https://www.gao.gov/about/what-gao-does/audit-role/csf/

Developing an AI oversight framework

GAO is in the early stages of developing an AI oversight framework. We recognize the need to remain adaptive as AI capabilities evolve along with the importance of collaborating across an ecosystem of stakeholders to formulate best practices. There needs to be a contextual balance between conducting oversight without hindering continuous innovation. **Table 1** below illustrates how we are thinking through different types of empirical and inferential questions for a risk-based assessment.

Table 1 – Governance related questions on AI

GOVERNANCE	EMPIRICAL QUESTIONS	INFERENTIAL QUESTIONS
Explainability and Transparency	• Do traceable audit trails exist behind each model prediction? • What are the input and output dependencies across models? • Are model outputs described in natural language with sufficient details?	• What documentations exist behind models customized from commercially available algorithms or application program interfaces (APIs)? • What are the criteria and contexts that govern use of supervised, unsupervised, reinforcement, and alternative or 'blackbox' techniques?
Bias and Fairness	• Do underlying training and validation data sets meaningfully represent constituent groups? • What is the diversity makeup of AI development teams across skill sets, experiences, domain knowledge, and backgrounds?	• What is the strategy to continually evaluate macro- and micro-level disparate impacts across constituents? • What is the process that governs disclosure, review, and appeal stemming from automated decision making?
Integrity and Resilience	• What are the performance stability metrics of models across different operating environments and conditions? • What are the confidence and error rates behind labeled data and models? • How are the models deployed, scaled, and orchestrated?	• What is the governance behind model training, validation, and re-training? • What security procedures are in place to protect models from adversarial attacks?
Data Quality and Lineage	• How are data taxonomy, lineage, transformations, and metadata governed across sources? • Do audit trails exist for labeled data and imputed values? • How is data quality verified?	• What are the criteria and contexts that govern remediation strategy of data quality issues? • How is lifecycle of data managed and governed across the organization?

Source: GAO

Shaping the future of accountability

Addressing oversight challenges posed by the breakneck pace of AI adoption means that SAIs need to build capacity now and start planning for any possible cultural disruptions. As a leader within the SAI community, GAO is embarking on a transformational journey through the Innovation Lab and the Center for Strategic Foresight, to help shape the future of audit and accountability within our overall strategic plan. Considerations for achieving such a transformation could include the three pillars as reflected in **Table 2.**

Table 2 – Identifying different impacts

CULTURAL IMPACTS	WORKFORCE IMPACTS	INFRASTRUCTURE IMPACTS
• Reducing the risk from innovation by decoupling experimentation from standard methodology • Adopting user-centric design principles towards development of AI solutions • Implementing a merit-based, problem definition-oriented innovation system • Contributing solutions by including potential policy options	• Embedding data science capacity across mission teams to tackle oversight as well as operational needs • Establishing an audit-focused data literacy curriculum that provides technical training as well as empowering managers to drive data-centric conversations	• Integrating 'As-a-Service' cloud-based operating model on infrastructure, software, and platform for an adaptive and scalable computational environment • Integrating continuous security, privacy, and legal evaluations to address evolving requirements • Enhancing efficiencies through automation, where appropriate

Source: GAO

Ushering in a new age of algorithmic accountability will require more from SAIs. They will need to reconsider their approaches to auditing data-driven automated systems from a culture, workforce, and infrastructure standpoint. There will likely be strong demand from legislatures and the public for accountability and assurance about governmental use of algorithms. SAIs need to be ready to answer this call. The field of AI is rapidly evolving, and its known and unknown effects will have a growing impact on government and society. SAIs need to start planning today for what tomorrow will bring.

Digitalisation – EU can lead by creating a sound ethical framework

Interview with Eva Kaili, Member of the European Parliament

By Gaston Moonen

Source: Eva Kaili

MEP Eva Kaili in the European Parliament

Eva Kaili has been a Member of the European Parliament since 2014, so is currently serving her second term as an MEP. During her first years in the job, technology and digitalisation were high on her political agenda, and in 2018 Politico described her as one of the 'leading MEPs addressing the digital revolution'. That same year she received the 'European Award' for her work on the Digital Agenda for Europe. More than enough reasons to interview Eva Kaili for the ECA Journal on issues such as digitalisation and the EU and what role she sees for auditors regarding digital developments.

Digitalisation affects all policy areas

When speaking with Eva Kaili about digitalisation one of the things that immediately stands out is her clear and spontaneous enthusiasm for the topic. She explains why she, very consciously, decided to focus her political work on digitalisation in the European Union. 'When I arrived at the European Parliament in 2014, coming from Greece, a country that was in crisis, I realised we had to find solutions for the problems we faced on centralisation of services and the need to have a Union that could protect the Member State from the problems caused by the economic crisis. For me it was clear that we should find solutions in emerging technologies, to stimulate inclusion and also to have new tools to actually help citizens understand the Union. Since my election campaign was substantially based on social media, I realised the impact they could have, and that they would be an essential tool for politics.'

She decided to work on the digitalisation of the single market through several committees. 'I felt I had no other choice, working on this topic through the Parliament's Committee on Industry, Research and Energy – ITRE, the Budget Committee, and other

committees. It is relevant for any committee: in any sector you have to understand the impact of digital technologies and data.' She quotes the example of the Budget Committee. 'When deciding on the allocation of EU funding we should be able to understand how this funding can have an impact. Here the ECA can help us. We need to see whether we actually focus on the right sectors and priorities. And see how we can make better use of new tools to control funding and public spending. And save money, for example, on transaction fees. With new techniques – think for example about blockchain - huge amounts of these fees – possibly going into billions - could be saved. And this could be added to the EU budget. And when checking and reviewing the funding there are many ways we can use digital tools, in the end transforming the budget.'

> *... in any sector you have to understand the impact of digital technologies and data.'*

She reiterates that digitalisation is everywhere. 'When we talk about agriculture, we talk about smart agriculture, we talk about creativity, using technology to save materials, resources. For that you need research, for research you need data. So I would say that you cannot disconnect things, not unbundle them from digitalisation. In the committees we try to understand emerging technologies, in different sectors at different levels. Get the information and the data that we need for politicians to be able to legislate, maintaining the principle of open innovation and technological neutrality. The name here is technology options assessment: technology serving to provide options to citizens, to politicians, about how we see technology, allowing us to make decisions on how to proceed with it.'

> *... you cannot disconnect things, not unbundle them from digitalisation.*

Digital single market

When it comes to creating a digital single market in the EU, Eva Kaili believes that creating a secure digital infrastructure will be essential. 'Take for example the Capital Markets Union and the Banking Union, where we still have some steps to take. We know how we should achieve that but we have not managed to harmonise the 'environment' to be able to use all the tools. To create a digital single market you need to make sure, as with the Banking Union, that Member States are willing to cooperate and exchange information. To do that we should make sure that citizens trust us, policy-makers, to guarantee their security.' She underlines that if the EU wants to get the benefits of trade and fee movement, the basis - the infrastructure - for a digital single market needs to be there.

One aspect of digitalisation Eva Kaili touches upon is AI. 'AI is basically a tool, using an algorithm, to achieve solutions to challenges we have. We automate these solutions to create a mechanism of decision making. How much control will you have over this mechanism, that is the point that citizens are concerned about!' She points out that giving away control also means that decisions are made that we cannot understand anymore. 'Scientists using algorithms, in combination with large amounts of data, may culminate in a process that is difficult for us to comprehend, to follow how they achieved certain results. Citizens have the right to get a second opinion, to get assurance that the data were accurate and of good quality, and to have transparency on how the algorithm was made.'

For the MEP it is clear that Europe has to go its own way when it comes to AI and algorithms. 'We have to make sure that this is not just going to make money and profits for only some people. We need to use it to find better solutions for problems in society, to get better decisions. But not at the cost of eliminating privacy, security and transparency, elements we dearly value in the EU.' She explains that in the EU there is a different culture, a different mentality from some other parts of the world. 'The EU should lead by having a sound ethical framework, ethical guidelines for companies, so that we do not go in the same direction as the US, or fall into the trap we see in China.`

> *The EU should lead by having a sound ethical framework...*

While Eva Kaili speaks about citizens' rights regarding digitalisation developments, she underlines that they should go hand in hand with policy initiatives to support digitalisation for small and medium enterprises (SMEs). 'Innovation and ethics can actually be the best result that we would like to have. Take for example the General Data Protection Regulation - GDPR. GDPR got its momentum, for example when the issues related to Cambridge Analytica came up, and we realised that there was no law effectively forbidding a company to do what they did, to manipulate perceptions by using the data they had obtained. So we said: there should be consent and awareness. And companies should not be allowed to move in this direction, either for profit or anything else, because this would have a huge impact on society.'

Eva Kaili points out that GDPR is actually setting global standards, based on European values. 'With specific principles we try to make sure that data are in good hands. There are big fines if something goes wrong – so a deterrent has been created regarding the misuse of data, your data. You have to be aware and give your consent to companies to use your data. So these are ethical standards set through GDPR, becoming more and more global. And with the new European Commission we are going to see the next phase of the digital single market: to improve and expand the principles that we have to follow when using data for AI.' She concludes that innovation and ethics can actually be the best results of this process. 'I do not think there is a risk of stopping innovation, because the principles are there. Guidelines are improving and knowledge is being built up in each country on how you can comply with these regulations, GDPR and others. I think we are on the right track!'

> *... ethical standards set through GDPR, [are] becoming more and more global. (...) I think we are on the right track!*

Digital sovereignty … with financial benefits

Speaking about data also raises the ownership question: whoever owns the data decides what to do with them. Here Eva Kaili wants to turn this into a business model… for citizens. 'At the hearing with the current Commission Vice-President Margrethe Vestager, I heard that we have to achieve digital technological sovereignty and avoid protectionism. I think the balance here is crucial.' She hopes that during the coming months more information, with expert views, will be provided on how to achieve that. 'We need to find ways to use data based on the principle of reciprocity. Not only to protect EU companies from the US or China, but really enable innovation to happen, while avoiding having companies disrespect our values regarding the use of our data.'

In relation to this she gives the example of somebody getting your data and subsequently leaking them. 'The company responsible for that will pay once, and that's it. But the data are still out there, always vulnerable to companies that can acquire them, they cannot easily be retrieved.' Eva Kaili underlines that these problems need to be addressed but also sees opportunities. 'I think the question should be: how we can assure that citizens are not only able to give their consent on the data they own, but also able to benefit from use of these data by others - lending them, getting some of the fees when money is made with them? While the company using them has to provide assurance that your data, particularly sensitive data, are protected.'

> *... how we can assure that citizens are (...) able to benefit from use of these data by others...*

ECA to assess policy implementation efforts, also when it comes to digitalisation

For Eva Kaili it is clear that, with the wide mandate the ECA has, it can help policy makers in many areas, at many levels. 'Besides helping us to better streamline public spending by identifying possible savings, the ECA can, for example, help us by evaluating how spending on innovation is working. We need to understand what works, how we can be able to create and control a trusted environment. And, of course, citizens should know where their money goes, so you also give recommendations on what can be improved.'

> *... the ECA can, for example, help us (...) to create and control a trusted environment.*

She also believes that making impact assessments for politicians to better understand the data, providing advice on what needs to be corrected and options where more can be invested, would be most helpful. For her this includes assessing how guidelines and rules relating to AI work in practice, thereby contributing to citizens' trust on what works well and what does not. 'In addition, the ECA can also give MEPs a toolbox, a method to evaluate policy decisions.' She adds that the ECA's advice and guidelines will help politicians to achieve a better political strategy, thereby becoming more relevant.

She adds that, for the short term, she is particularly interested in hearing from the ECA its findings regarding the funding of innovation, or what is in the pipeline. 'I am keen to see the ECA's impact assessments and advice on how to improve EU funding of innovation, including the ECA's recommendations on how we can make corrections within a financial period, instead of at the end of it. I also hope to get views on this from the Commission's Joint Research Centre, and, together with input from the ECA, such advice can be used for the discussions and changes to be made on innovation for the 2021-2027 multiannual financial framework.`

Opportunities for blockchain technology

When it comes to blockchain, and the opportunities created by this technology, Eva Kaili is optimistic and at the same time down to earth. 'We already see a clear commitment by the new European Commission to invest heavily in blockchain projects and pilots. Once this impressive technology shows what it is capable of, I think nobody will hesitate to use it.'

However, she also identifies several issues that need to be addressed. 'There is the issue of scalability, of security issues, also energy. We will need a bit of time to develop these technologies in specific projects and when they prove to be beneficial for citizens then they will step on board.' Eva Kaili thinks that with the full application of blockchain, the benefits could be substantial. 'If one sees the transaction fees, not hidden anymore, then we could save billions. Such money could be used for other purposes, for example, as a minimum wage to make sure that people have access to education, health care, and other basic services.'

She underlines that innovation will often take extra efforts at first. 'Let's take the energy impact often associated with blockchain. We definitely need to find solutions, but any technology that is new will require some time in order to find smarter ways to be viable. Even when we were trying to develop solar energy and wind energy, we initially thought: "It is so expensive to build the infrastructure, to produce the panels, etc." And now the technology has become so cheap it makes sense to have solar panels. But there was a point where it did not make sense to invest.'

> *... any technology that is new will require some time in order to find smarter ways to be viable.*

Understanding the value of data

With her specific focus on the digitalisation agenda Eva Kaili has become more conscious of how important it is for citizens to have a better understanding of data as such. 'Citizens are worried about AI and want to be prepared. We need to help them with the tools, the regulations, with laws that have a real impact, a positive one, on their lives.' In her view this means engaging them. 'Basically, we need to make sure that it is more simple for citizens to control and understand their data. If we want to be clear about citizens' rights in the digital era we have to provide them with more options in what I call a 'grandma friendly' approach!' She points out that this does not mean you enter your IPhone and check your settings. 'Then you quickly enter a labyrinth and you don't know how to get out. No, we will have to make it more simple for people. A key element here is motivation, and what could actually help here is to improve the data 'benefits' I referred to earlier. We need to 'monetise' these benefits for people to stimulate their understanding of the value of our data.'

> *... We need to 'monetise' these benefits for people to stimulate their understanding of the value of our data.*

She realises this will not be easy, in view of the differences between the many data, and the ways they are created, processed and managed. 'But this is the challenge for the next five years, to 'monetise,' to understand the value of data and have options you might not have in China or the US. This starts with having an ethical framework that is useful and understandable for citizens, not just a theoretical one.'

She reiterates that this is a huge challenge, calling it 'difficult magic.' 'I am not sure you must have the right to sell your data. You must have the right to give access to your data, but you should always keep ownership of your private data.' She explains that citizens may not be aware that selling their data, or giving access, could also have consequences, besides profits. 'To achieve this, they have to be made aware, they have to have the right to retrieve access. That is why I believe that if we set up an appropriate ethical framework we can all benefit. And avoid a decrease in our quality of life that these technologies, if maliciously used, could bring about, even very quickly. I am eager, as many of my colleagues are, to collaborate, also with the ECA, to have this discussion, and manage to protect citizens' rights, to ensure we develop a society, also from a digital perspective, that everybody would like to live in, in the future!"

> *"You must have the right to give access to your data, but you should always keep ownership of your private data.*

Innovation and digital auditing – the journey of the European Commission's IAS towards state-of-the-art technologies

By Felipe Castro Barrigon, Internal Audit Service (IAS) of the European Commission

Source: Shutterstock/Photon photo

In a working environment that is increasingly digitalised both internally and externally, auditors must act and react to ensure not only that they make optimum use of the new audit possibilities on offer, but also that they provide advice on where and how their auditees can improve. This also applies to the European Commission's Internal Audit Service (IAS). Felipe Castro Barrigon is team leader of the IAS's 'Innovation and digital auditing' Working Group. In this capacity, he is at the forefront of exploring new developments that are relevant for the IAS and translating them into daily work practices. Below, he shares some of the key features of the journey the IAS has undertaken and the approach the IAS envisages for the years to come.

Setting off…

The need to keep pace with technological developments is something the internal audit profession cannot afford to ignore. The sheer speed of change means that we have to anticipate, plan and react in ways which many might have found unimaginable only a few years ago. The European Commission's Internal Audit Service (IAS) is no different. We have to leverage those tools and technologies that allow us better to assess not just the risks the Commission faces in this ever-challenging environment, but also the controls put in place to mitigate them. However, we also need the right talent and skills to do this in what is a very competitive market. So how are we tackling this in the IAS?

These challenges have been at the forefront of our thinking for some time now, particularly at our last three IAS annual conferences. In 2017, we discussed 'Innovation and creativity in internal audit: myth or reality?' and in 2018, 'Internal Audit: Embracing the challenges of the future.' Most recently, in November 2019, we tackled 'From hindsight to insight and beyond: how Internal Audit may contribute to foresight'.

A constant theme has been the extent to which we, as auditors, struggle to understand how different trends and technologies have an impact on our profession. The very clear message to us here in the IAS was that we simply had to do something. We had to start that journey so as better to understand and tackle the challenges head-on, even if this meant diverting key resources away from other tasks. However, like many such journeys, it is not always clear which path to take and what is really feasible in practice.

To make a start, at the end of 2018 our Director-General, Manfred Kraff, asked the IAS's IT audit unit to carry out an initial analysis of the new trends and technologies that could be relevant for our work. After this preliminary phase, he decided to set up a dedicated team in the IAS to identify specific areas for further exploration and progressively build up the requisite audit capacity and knowledge. The group's primary objective is to stay abreast of developments at the European Commission and other EU bodies, but also, more generally, in the public and private sectors. Secondly, it will assess this environment and evaluate its potential impact on the IAS's work. This thinking is very much in line with a range of ongoing action plans at the Commission to modernise the workplace and improve overall efficiency.

…the journey…

Ever since, we have been exploring different initiatives linked to the European Commission and other EU bodies so as better to understand their objectives and scope, and the impact on the Commission's operations, and to discuss openly how they can affect and improve our auditing procedures. The areas we have looked at include data analytics, artificial intelligence (AI), blockchain, data visualisation techniques and enhanced digital publishing of our audit documents.

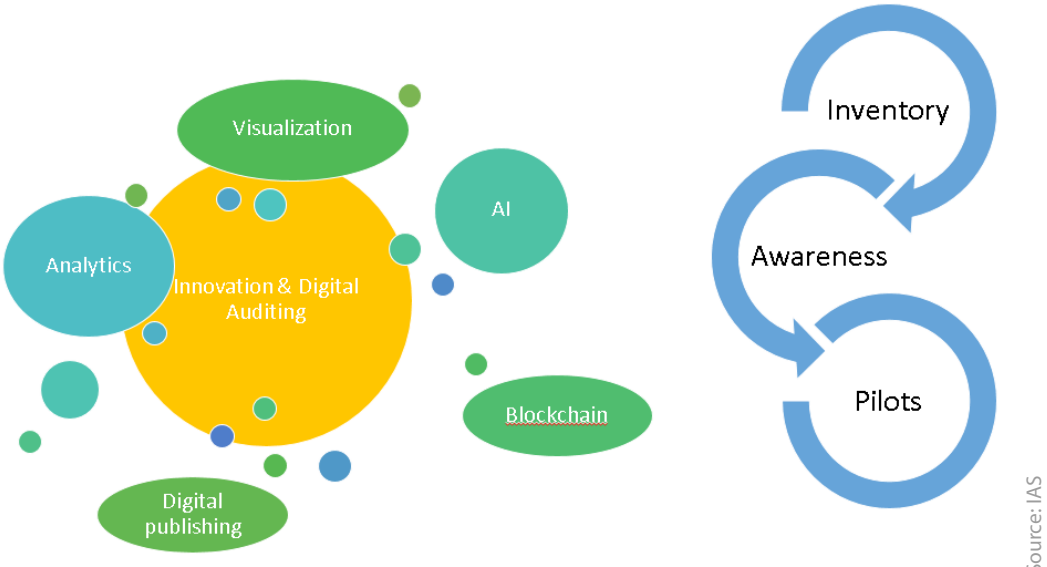
Our approach is based on three types of actions or 'strands' for these five different areas (see **Figure 1**):

1) *Inventory*: benefit from a knowledge-sharing experience, where auditors can learn from their peers in other Directorates-General and reuse what is already available as much as possible. We have chosen informal 'brainstorming' exercises, where we position ourselves very much in 'open-mind' and 'learning-listening' modes.

2) *Pilots*: creating 'playgrounds' where we can experiment and learn with a 'hands-on' type of experience.

3) *Awareness raising*: Informal 'TED-TALK'-style presentations to interested IAS staff to share what we learn and capture feedback and ideas.

Figure 1 - Five areas and three strands in the IAS initiative



Source: IAS

We have been in contact with most of the European Commission's Directorates-General and the EU's decentralised agencies to gather more information about ongoing projects and tools. At the same time, we have also contacted other public organisations, such as the Dutch Ministry of Finance, the Vlaanderen Lokaal Bestuur (Flanders local government and municipalities) and, of course, the ECA. I am happy to say that this has proved to be very useful. Not only has the experience confirmed that we are not alone in facing these challenges, but – more importantly – these organisations have also inspired us further and provide much food for thought. In particular, we have strengthened our contacts with the ECA, notably the ECALab team and its various initiatives with analytics, AI and blockchain.

We are currently in the process of bringing all these results together, but I can already share some possible outcomes by providing a few examples. In the area of AI and data analytics, we are looking into textual analysis by going beyond current searches for key terms towards semantic searches. We found some interesting use cases in the Directorates General for Competition, Communications Networks, Contents and Technology (Connect), and at the Joint Research Centre (JRC). For example, combining searches for and tagging of specific content in multiple documents, and then linking them to audit papers. Another example is the automated summarising of documents or sentiment analysis for surveys. These examples could help us to make the audit review and documentation process more efficient, particularly during fieldwork.

We are also looking at how we can extract unstructured information (e.g. text in pictures, pdf documents, etc.), then convert it into structured information in relational databases before ultimately comparing and cross-checking the result for completeness, accuracy, etc. We have worked hand-in-hand with our Directorate-General for Informatics and the Directorate-General for Budget in order to build a successful proof of concept.

In the area of blockchain, we were very much inspired by what the ECA has done. Initially, this topic was relatively unknown and seen as less relevant for our internal auditing activities until we looked at the ECA's use case. We joined the ECA, the Directorates-General for Informatics (DIGIT) and Connect, and EU Members States in creating a European Blockchain Service Infrastructure (EBSI) initiative. We are also contributing with functional requirements, and are considering creating a pilot to explore blockchain usage in our audit execution process.

In addition, we are exploring data visualisation tools in certain key areas. Our risk analysis exercises could benefit very much from real-time access to databases providing risk indicators and drill-down capabilities in the Commission's datasets. We could select our audits in the audit plan, and scope them much better and quicker. During our audits, we could also gain a better understanding of operational data created during process workflows by moving to a different category of performance analysis, for example, by improving our understanding of the bottlenecks in grant-management processes or the performance of workflows in IT systems.

Lastly, another area we are exploring – albeit very tentatively at this stage – is the publication of digital reports. As things stand, we generate 'traditional–style' reports, which some regard as lacking what might be termed 'a rich user experience.' We are looking at how better citations could provide more contextual information and/or help to measure the impact of our reports, akin to the approach adopted for scientific publications. We are also exploring the use of reference vocabularies currently in use at the Commission to ensure more consistency. We would like to make better use of metadata in our reports, as this would allow us to isolate the different elements in the reports and make them more easily accessible for specific purposes; this is similar to the approach the EU Publications Office would like to use for the publication of the Official Journal.

… and the rewards

Even though the journey is far from complete, it has already been a very rewarding experience. All the initiatives have yielded some unexpected – but very welcome – outcomes. The initial inventory of activities was full of surprises in that it opened up a brave new world and left us wanting to know more, while at the same time reminding us that we needed to keep our focus. The real challenge now will be to translate this into concrete actions in the medium and long terms. We plan to produce a position paper in the first quarter of 2020 that summarises the results of our work so far. This can be used as a basis for defining an action plan and for estimating the resources we will need.

In my view, and regardless of the 'final' result - if it can ever be called 'final'! - there are already many positives to draw upon. This initiative helps to provide a better understanding of the 'state of the art' in a number of key technological areas and the projects our colleagues are carrying out. It also helps us better to appreciate the work of many colleagues at the European Commission who are pushing to make improvements in their working methods. We have vastly broadened our network of contacts both at the European Commission and in the other EU institutions. Additionally, a more open, learning-based attitude helps us to build relationships with auditees beyond the usual audit engagement work. Lastly, and very importantly for us, it helps to pave the way for a better working environment, and thus attract new skilled and motivated auditors, thereby making the IAS an exciting and challenging place to be in the near future.

Digital audit – providing more added value with new techniques and through new skills

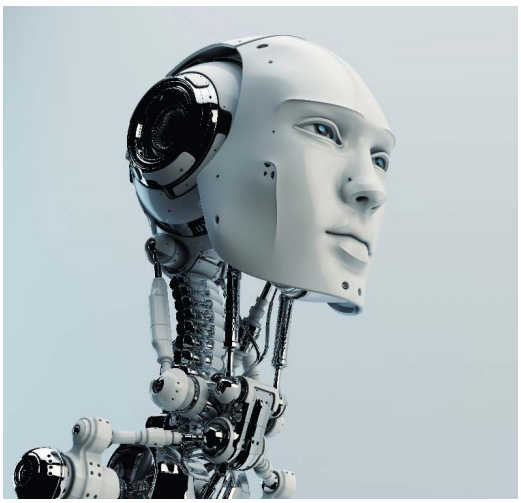
By Ferry Meuldijk, Deloitte Accountants Nederland

In a data-driven society, the private audit sector needs to follow suit, because their clients increasingly ask for innovative added-value services made possible at low cost by new technologies. What challenges does a big private audit firm such as Deloitte see, and what features does it use and already offer to its clients? Ferry Meuldijk is Audit Innovation Manager in the Professional Practice Department – Innovations & Analytics at Deloitte in the Netherlands. He highlights some of the key techniques Deloitte Netherlands is using, but he also stresses that ultimately, professional judgement remains the pivotal element in an auditor's work.

Digitalisation is changing professions of all kinds, not just audit

The *Fourth Industrial Revolution* will create many new jobs within our profession in the coming years. These new jobs do require rather specific profiles. On the other hand, we also face the disappearance of an enormous amount of jobs as a result of new technologies. This threat exists mainly when it comes to accounting activities with a highly routine character, such as copying and reconciling data.

This trend is not only visible in our profession. The private sector is generally expected to be hit hard as it has higher rising staff costs than other sectors , such as the public sector or the non-profit sector. This makes the use of robots even more interesting, because they can easily take over processes in which many repetitive tasks are performed.



Source: Deloitte, the Netherlands

More and more employees are becoming aware of the fact that their profession is changing. In our sector, there is a huge demand for additional training such as Digital Accounting and we see an increasing amount of colleagues showing an interest in joining in our innovation and analytics projects during low season. We invite our colleagues to become frontrunners by developing and adopting innovation and analytics solutions, thus building up the skillset needed for the auditor of the future. This is because we believe that the real change will take place in the profession within engagement teams. They can make a real impact by adopting innovative tools to develop their profession.

An audit is a traditional product within a static, regulated framework. Methodology and control mechanisms in use under current laws and regulations are outdated and based on concepts from a vastly different time. For example, our employees and clients have data analytics applications available to them which can provide very accurate predictions. However, the use of such solutions is held back by our regulators who are not developing at the same speed. The results of some of the most innovative applications are therefore only used to *support* traditional audit activities.

Stakeholders and their expectations change and there is a huge demand for an innovative audit approach. Digitalisation is currently embedded in business operations and has a serious impact on the object of research. The use of smart applications also increases the dynamics. With the use of innovative applications, auditors can now make an immediate impact in comparison with the early years of most auditors' careers which then consisted mainly of traditional 'box-ticking.'

Automating the Data Driven Audit

By using innovation solutions to read, interpret and process big data, a new risk is created: the reliability of these systems. Especially when they are intended to replace the current control mechanisms in the future. There are quite a few conditions that need to be met before an auditor can use automated solutions and applications in the field of data analytics. The main condition is that the current control process needs to be optimised.

The first step in this optimisation is to *standardise* all procedures and processes. Within our organisation, we work worldwide with the same applications, working papers and specific workflows. This can also be seen in the private sector, where there is a continuous urge to standardise processes so that collaboration can be used more efficiently, financial data exchanged in compliance with the Payment Services Directive 2 (PSD2) and blockchain used, this maximising the transparency of all relevant information. This development will change the angle for third party trust providers. This exemplifies our view that all parties involved in the audit process remain equally important, but are different from before.

The second step in our optimisation is to *centralise* specific work and/or processes. By setting up audit delivery centres, specialised departments are being created with a focus on a particular part of the audit. In this way, we increase quality but there are also numerous advantages when it comes to efficiency. By experimenting centrally over recent years with new innovative solutions in automation and data analytics on a small scale, several components have been automated successfully.

As a final step, we *automate* parts of the audit process and transform how we do our work by using existing technologies in a scaled-up way. Robotic Process Automation (RPA) is hot. Almost everyone is doing it. But we have learned that making a robot is not the challenge. The real challenge is building robots in a scalable and reusable way.

At Deloitte in the Netherlands, we have invested heavily on a robust target-operating model and have now established a Centre of Excellence. We are running a cloud-based RPA infrastructure and have incorporated the robots in our standardised processes. The infrastructure is fully compliant with Dutch regulatory provisions and the highest risk and quality standards for responsible robotics.

Intelligent Process Automation

Clearly, we have been learning along the way. RPA was a first step. Intelligent Process Automation (IPA) is a combination of technologies to automate and integrate our audit process. Combining our robots with an emerging set of new technologies such as Natural Language Processing allows us to perform end-to-end process automation.

Natural Language Processing is a form of Artificial Intelligence, which allows us to extract key audit information from documents. This is done by defining the data points that we wish to extract, teaching the system where to find them and then training the system on multiple documents. The software analyses data in a way that a human could not, recognising patterns in data and learning from past decisions to make increasingly intelligent choices.

How does this work? We have integrated this cognitive automation into the RPA infrastructure. The robot will pick-up the audit evidence from our management system or client portal and transfer the data to one of our Natural Language Processing solutions. The software automatically captures, classifies and extracts key audit data from semi-structured documents like invoices and bank statements. The robot creates a working paper with an overview of the extracted data and matches it with the sample selection or general ledger.

RPA *support* in speed and efficiency by mimicking human actions to reduce labour-intensive tasks, such as copying or re-typing data. The AI solution *supports* by extracting the relevant audit evidence but the auditor is needed for professional judgement.

Artificial Intelligence in audit

We have also deployed a smart software application that innovates document interrogation and analysis by adding the power of hundreds of virtual eyes to the team. Leveraging Artificial Intelligence, this software solution uses advanced Machine Learning techniques and Natural Language Processing to quickly process, highlight and extract key information from electronic documents while learning what matters most throughout the process to make more precise extraction suggestions in the future.

The solution visualises (1) the similarity of contracts in a population, (2) the frequency of certain extraction fields in a document and compares contracts to a standard contract and (3) highlights the differences. A powerful search and analysis tool that enables our teams to spot issues and trends across documents. This solution again *supports* the auditors and manual labour-intensive tasks have been replaced by a machine. We are now able to examine entire populations. However, the conclusion cannot and should not be drawn by the machine. We need the innovative auditor to interpret the outcome of the analyses and take action.

It is not only in the Interim and Year-End phases that automation and Artificial Intelligence are used to *support* the auditors. During the planning phase, data analytics solutions are used to import processes and financial information in real-time. We have created an Artificial Intelligence solution that can be used during our risk assessment.

Source: Deloitte the Netherlands

New technologies making collective knowledge available to the auditor

How to unleash the collective knowledge of all auditors, to help them to define a strategic audit plan? Imagine if we could leverage the strategic audit plans from thousands of other engagements and offer that in an efficient way to our auditors, *supporting* and challenging them when creating your audit plan. We have built algorithms based on the historical data from engagement files. Based on engagement characteristics the solution suggest risks, challenges risk classifications and risk strategies like a personal assistant would do. It asks 'how does your engagement compare to other engagements?' enabling more consistent and higher quality risk assessments. It improves efficiency by providing input instantaneously, *supporting* auditors in the decision-making process.

We have long heard that technology will impact audit, accounting and professional services. New technologies are here and they are not going away. They are not there to replace you but to support you. It is the synergy between accountants and delivery centres embracing new technologies. All are needed. None are replaceable. Embracing new technologies and innovations allows us to reimagine our audits, aiming to provide a smarter, better, and different type of audit.

Auditing and accounting services for technology clients - a niche market for audit firms like Joinson&Spice

By Louis van Garderen, Joinson&Spice

Increasingly auditors face demands to adapt to the digital way business organises themselves internally, using their digitalised structure to the fullest extent possible. Some private audit firms quickly identified these new needs, and jumped into this initial niche in the audit market. The audit firm Joinson&Spice is one of them, dealing mainly with tech firms. Its founder, Louis van Garderen, explains how this works out in practice, also in comparison with the Big Four audit firms.

Technology clients

A key trigger for me to set up the audit firm Joinson&Spice was that I experienced a world of difference between the traditional financial auditor and the scenery of technology clients. This difference is especially clear in the IT-orientation of both parties: auditors are by nature rather risk-averse and therefore seem, in a sense by virtue, reluctant to embrace new technologies. This type of client on the other hand, typically asks for an active approach to technology. This gap may lead to an audit process that might not properly fit or is misunderstood by the client and auditor alike.

In another sense, it is all about culture. The tech scene has such a specific company culture that auditors need to adapt to the 'language' of the auditee. Modern communication techniques are the default for technology firms, one could think of the tooling that is used (such as direct communication like Whatsapp, Slack, Discord, etc.) but also in the way clients develop (e.g. scrum techniques) or act (like a loose type of control). Failing to recognize this world of difference in culture, communication and application landscape when auditing technology firms, may result in a biased intuition or analysis of the risks of the auditee.

Data first approach

Joinson&Spice specialised in engaging the technology sector in a way that matches the challenges and perception of tech companies. Our mission is to offer clients in the technology area auditing and accounting services through *in-depth knowledge of the technology-sector*, combined with an organisation-wide *data-first approach*. This means that digital audit is a key element of our development; with clients that think, act and breathe IT. Data is not just a part of the process but an essential part of our audit and innovation processes.

Clients expect their auditors to understand their business. Which led our firm to invest in building up knowledge in, amongst others, the following fields of expertise:

Box 1 – Joinson and Spice: some facts and figures

Focus on auditing and accounting of technology clients

Founded in 2013

Based in Amsterdam

Current staff: 10 staff members (8 fulltime equivalent)

Gender balance: 50%

Turnover 2019: €1 150 000; current growth rate 35%

Average turnover per client: €28 000

Winner of the Exact Cloud Innovation award 2018/2019

- specific law and regulations, such as GDPR, PSD2, KYI;
- fraud risk (money laundering, IT risks);
- IT general controls;
- cybersecurity risks;
- the technology business models (which can be very different from conventional models).

This expertise helps our auditors to better understand and adapt to the risk profile of our clients. On top of that, it can often result in additional work in an advisory role through the management letters and other related services. In order to prevent loss of independence, wehave invested in an independent network of third party advisors that may be of help in finding the best solutions for our clients. This network in return also provides knowledge on the side of the auditor which is a very beneficial synergy for clients, third party advisors and - again - the auditor.

Innovation is a must, not an option

Most of the technology firms that are a client ofJoinson&Spice have some IT-environment built in-house, in order to sell their products, services and systems to clients. These environments not only support the business model of the auditee but are often the business model in itself, and require an audit that is fully adaptable with the finesse of these individual IT systems.

Constant improvement of the audit approach is key for success in this field of audit. As clients rapidly embrace new developments, auditors have to keep up with these same developments. Exploring the influence of clients' steps with blockchain, AI and robotising requires a similar response from our side in both knowledge and an appropriate 'toolbox.'

Within Joinson&Spice this led to a constant innovation agenda. With the help of a designer and a unique set of design techniques, the limited resources of a company our size are optimally used for rapid development, flexibility and fast integration. For example, we developed an in-house data warehouse that established a platform to work together with clients. New initiatives like robotising and analytic tools can subsequently be built on top of this same environment. This brings tremendous speed and unique data and communication integration in our audits.

Implications of the choices made

The path we choose also presents another side of the coin : the choices made are also a limitation. The first years of our company were tough: the vision was recognised by outsiders, but we needed a few first moversthat were able to convince the market that Joinson&Spice were a viable alternative to existing, often much larger, competitors. Sticking with the initial vision has proved to be the key.

Not every client is welcome – or can be welcome. Our company grows organically, but keeping the sector focus and properly tailoring to our needs, requires active work, sometimes including saying 'no.' The limited resources require maximum effort in building the knowledge of this sector, which sometimes means turning down clients that fall too much outside the sector, as this would only distract from the company vision. Not always an easy thing to do.

An even more important challenge is the labour market: it is hard to attract tech-savvy auditing and accounting staff. Staff in this sector is hard to find, especially with the level of affinity to the technology needed. This is why training is so important. Expertise inprogramming has become an important part of an auditor's tool, so all our staff takes programming courses. Python, R and Java are good examples.

Field of competition

The market for audit firms like Joinson&Spice is currently very small in the Netherlands, but also in other Member States. But from the presence with some working groups - such as the Accountech initiative of the Royal Netherlands Institute of Chartered Accountants (NBA) - we know that we are working on the same innovation topics as the Big Four, albeit at a much different scale. Our flexibility – read agility – gives us, however, a strength that should not be underestimated: what we developed yesterday, is what we test today and may be written off tomorrow if it does not meet our standards and/ or our client's expection. And this speed in development is matchless compared to the Big Four.

The advantage for technology clients

For our technology clients we aim to be an auditor that can very easily adapt to their developments, which brings an understanding that the external auditor is well aware of the risks and other ins-and-outs of their internal control systems. As many of these clients are invested through funds, they can additionally take advantage of the outcome of the audits in management letters and other forms of reporting, thus giving additional comfort from the auditor towards their investors.

Another advantage is the fit itself: working in a similar culture works efficiently and brings positive energy to the working relationship – an effect that should not be underestimated e.g. when tough discussions have to take place between auditor and auditee related to problems or challenges occurring during the audit.

As the data are at the heart of the audits, new and alternative ways of working bring also new insights that, with a somewhat old-fashioned way of working, could well have been left out. For example, as in more and more cases the data is made available at large, more and more segments of the audits can be tested very substantively and in several cases it makes sense, from an efficiency point of view to audit 100% of the data collections. This can brings great outcomes to clients, in some aspects comparable to process mining.

Finally, an alternative

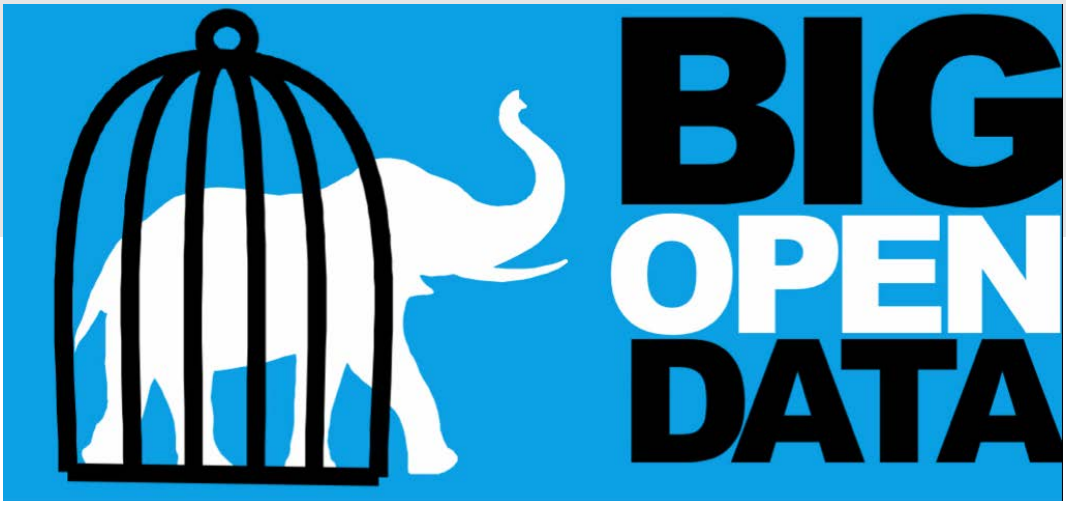
As mentioned earlier, the Big Four are working at a high level and are a good solution for the audit of technology firms. Still, many of the scale-ups do not really fit with the strength of these large audit firms. But the high level of expertise required in the audits is well noticed by the auditees, which leaves them with a challenge. With our focus, and our size Joinson&Spice aims to fill this gap. In addition, due to the market, we have no licence for listed companies. This takes away part of the burden that the larger firms encounter in their compliance compared to this auditor. This being said, compliance is of course taken serious as well.

Outlook: using our specific expertise also in other markets

We believe that the way we execute our audits will open up new opportunities also in other markets. For example logistics, governmental organisations, hospitals and more are auditees that are very suitable for a data-oriented audit due to their extensive data sources. Not only from a financial perspective but also compliance or performance-wise a data-oriented approach can shed new light.To sum it up: our own BHAG – Big Hairy Audacious Goal – is to be *the* auditor for technology firms in the Netherlands and to focus our development on the niche of audits in technology.

ECA's Big and Open Data conference for EU SAIs: TINA is born

By Spyridon Pilos, Information, Workplace and Innovation Directorate



On 27 and 28 November 2019 the conference 'Big and Open Data for EU Supreme Audit Institutions' was held at the ECA's premises in Luxembourg. The ECALab – the innovation lab of the ECA – organised the conference, which targeted those working with technology and innovation at the supreme audit institutions of the EU Member States. The conference was also the launch event for TINA – the Technology and Innovation Network for Audit. Spyridon Pilos, Principal Manager in the ECA's Information, Workplace and Innovation Directorate, looks here at the main topics discussed during the conference and what TINA entails.

The EU common framework for SAIs

What is so special about the EU supreme audit institutions (SAIs)? Well, they operate within a common institutional, policy and regulatory context which is specific to the EU. In their respective Member States they are the external auditor of policies and spending schemes of which many are ultimately decided upon at EU level.

Moreover, all EU SAIs, though independent external auditors, are also part of their countries' public administration. They are thus subject to rules applicable across the EU, such as the General Data Protection Regulation and the public sector information directives. At the same time, they can use tools and resources that are specifically available to public authorities in the EU and its Member States. These include, for example, the European Commission's secure neural machine translation tool ('eTranslation') and the EUSurvey platform for running surveys in all EU languages. But also many other services which were developed with EU funding through programmes such as ISA (Interoperability Solutions for Public Administrations).

Sharing new horizons

By bringing together practitioners and policy-makers from the EU institutions (Commission and ECA) and audit professionals from the EU SAIs, the conference aim was to kickstart a fertile exchange of experience from which all could learn, opening up new horizons for cooperation and progress towards data-led audit. Over 70 people attended the event, from the SAIs of twelve Member States (Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Lithuania, Malta and Romania), four Commission Directorates-General and the ECA.

There's a lot of data out there…

Eva Lindström, ECA Member and chair of the digital steering committee, opened the conference. She recalled that 'digitilisation in audit is not only about using technology but also about how we work and how we can build control and assurance into the process.' The ECA established its digital steering committee to 'drive the digital transformation of our audit work in the coming years in line with our strategy.' Data is central to the digital transformation of audit. Magdalena Cordero, ECA director, addressed the role of SAIs, pointing out that they do not produce data but mainly ensure that it is reliable and can be trusted.

And there is lots of data out there! Daniele Rizzi from the Commission's Directorate-General for Communications Networks, Content and Technology (CONNECT) referred to the open data obligation for Member States. The new Open Data Directive (2019/1024/EU), which was adopted in June 2019, extends the obligation beyond public sector information to include data held by certain public undertakings and access to research data resulting from public funding. It also covers the enhanced re-use of dynamic data via application programming interfaces and free re-use by default. And it introduces the concept of high-value datasets (HVDs) which have to be made available – a full list of these will be established in an implementing act (possibly a regulation) in 2021.

Kimmo Rossi, also from DG CONNECT, described what has been done to allow the re-use of 'closed' data (proprietary, confidential, personal, etc.). This issue is also related to the topics of big data and artificial intelligence, which are themselves closely linked. Research and innovation are looking into the way privacy-preserving technologies, such as multi-party computing, homomorphic encryption and distributed ledger technologies (like blockchain), can be used with closed data. These technologies and methods throw open the possibility of accessing and processing closed data where it is held and just extracting the output of processing. There are also two new services available to Member States: the 'Big Data Test Infrastructure', which helps public entities manage large data volumes and capture valuable insights from their data and analytics, and the 'Context Broker', which enables public and private entities to share their data in real time when it is most needed.

On artificial intelligence, Kimo Rossi referred to the High-level Expert Group on AI, which has published guidelines on ethics and policy and investment recommendations for trustworthy AI. AI can be a powerful tool for auditors (e.g. pattern detection, fraud detection, analytics, trends). However, this also means that AI systems need to be auditable. The expert group therefore recommends developing appropriate auditing mechanisms. 'This should allow public enforcement authorities as well as independent third party auditors to identify potentially illegal outcomes or harmful consequences generated by AI systems, such as unfair bias or discrimination' (paragraph 29.4 of the HLEG policy recommendations).

Corina Buruiana and Nataliya Rozbroj Jasinskaja, from the Publications Office of the EU, presented the two EU open data portals, which are accessible at data.europa.eu . The first of these, the open data portal of the EU institutions and bodies, includes applications, visualisations, tools and training material. The ECA has already started making its reports available on this portal. T he two speakers also presented examples of apps that use the contents of this portal and have won awards at the annual *EU datathons*.

The second portal is the European Data Portal, which is the single point of access to open data from about 980 000 datasets on more than 80 portals in the EU Member States The Commission also publishes an annual *Open Data Maturity Report* on the progress of opendata development in Europe.

Representatives of EU SAIs described some of their open data activities. Emil Thylin, Adviser at the Danish SAI, presented a project on the interactive visualisation of government open data. Asta Riukienė, Chief Adviser at the Lithuanian SAI, reported on how open data on the implementation of recommendations is presented in Lithuania.

Ines Julia Gullichsen, Project Adviser at the Finnish SAI, presented a risk detector tool using open data which has been piloted in Finland, while Maria Eugenia Heyaca, Deputy Director of Methodology and Data at the French SAI, presented the French approach to openness, which goes beyond data and also covers code. Finally, Richard Baxa, Auditor from the Czech SAI, invited participants to the first international Hackathon on open data, which will be organised in Prague on 3-5 March 2020.

Participants in the ECA's Big and Open Data conference on 27 and 28 November 2019

Big data for audit

Konstantinos Giannakouris and Fabio Ricciato, from the European Statistical Office (Eurostat) then presented the work done by their organisation on bringing big data closer to official statistics. They clarified that they no longer use this term but have labelled what they try to produce 'trusted smart statistics.' These should be explainable/auditable so that they can complement (and not replace) official statistics. They elaborated on the need to move from 'pulling data in' from its sources – bringing it to the statistical (or audit) office to compute output locally – to 'pushing computation out' to where the data is , i.e. getting only output from the sources. They also stressed the need:

- for strong social control over data use, as misuse presents a social and economic risk;
- to develop methodology collaboratively, as technology evolves too quickly. We need not only new methodologies but also new ways of developing methodologies. This is valid both for statistics and for audit.

Peter Koß, Audit Manager at the German SAI, presented the challenges of deep learning and data analytics from the auditor's point of view when auditing automated decision-making and algorithms. Two other presentations were related to the analysis of media information: Meeli Saksing, Auditor, and Kaia Philips, Senior Adviser, both from the Estonian SAI, discussed how text mining was used to audit the publicity efforts of local authorities in municipal newsletters, while Di Hai, attaché in the private office of ECA Member Alex Brenninkmeijer, presented an experiment run with the ECALab on using news aggregated by the European Media Monitor service to assess performance.

Koen Van der Bracht, Junior Auditor at the Belgian SAI, briefly presented the activities of the DataLab, the innovation laboratory established by his SAI on the model of the ECALab. Niels Dyhrberg-Noerregaard, Special Adviser at the Danish SAI, presented

experiments on the use of process mining to investigate the efficiency of case management processes, while Mihai Razvan Sanda, Deputy Regional Director of the Romanian SAI, described the ongoing work on the ISO 21378 standard for audit data collection, the final draft of which was approved on 10 October 2019.

Welcome to TINA

This ECA conference showed that auditors at the EU SAIs share similar concerns, face similar problems and are trying a range of solutions when working with data. This is precisely why the ECA used the event to launch the Technology and Innovation Network for Audit (TINA), which brings together professionals from the EU SAIs and the ECA.

The network members will be sharing knowledge, advice and tools through a platform that the ECA will put in place early in 2020 and events such as an annual TINA conference in Luxembourg. In this context, Alex Brenninkmeijer indicated in his closing speech the direction we should take: 'Data is power. Data is contact and participation. Data is trust.'

‘Big data’ – a whole new world for statistics, also in Europe

Interview with Fabio Ricciato and Kostas Giannakouris, Eurostat, the EU’s statistical office.

By Derek Meijers and Gaston Moonen

From left to right: Fabio Ricciato and Kostas Giannakouris

Big data is a big buzz word, and many people see it either as the solution for - or alternatively - the cause of many future problems. One of the many questions is how governments will (be able to) use those data, or what the ever-increasing ‘datafication’ of our society will mean for public institutions that need to distil reliable and useful information from increasingly vast amounts of data. To find out what Eurostat is doing to ‘tame’ the big data beast, we interviewed Fabio Ricciato and Kostas Giannakouris. Both Fabio, having been in telecommunications and having broad academic experience regarding data, and Kostas, who has had a long professional career in Eurostat, were members of Eurostat’s Big Data Task Force. They are both members of Eurostat’s Methodology and Innovation in Official Statistics team. They were also speakers at the ECA Big and Open Data conference, held on 27 and 28 November 2019 (see also page 108).

Big what?

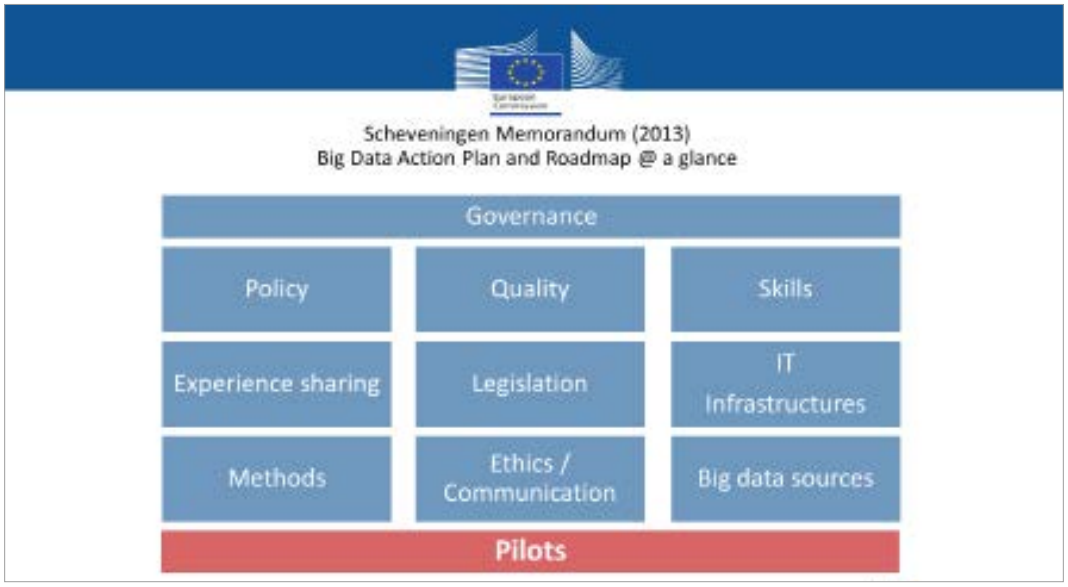
IIn 2013, the European Statistical System, the network of Eurostat, national statistical institutes (NSIs), and other national statistical authorities of the EU, published the *Scheveningen* Memorandum on big data and official statistics. Kostas: ‘At that time, everyone was talking about big data, sometimes without even knowing what it really meant. It was a term *à la mode* and used by everybody who was trying to create value out of all the new data that became available.’

The phenomenon of big data attracted a lot of attention in the tech world. Eurostat, together with Statistics Netherlands, launched an initiative on big data in official statistics: ‘Following the Scheveningen Memorandum, Eurostat developed an action

plan and a road map to understand the phenomenon "big data", and position it within the activities of the European Statistical System' (see also **Figure 1**). Fabio adds: 'Even scoping the work of the taskforce was no easy task considering the fact that the term "big data" means different things in different contexts. I find it actually a bit misleading in the context of official statistics, because it focuses attention on the size of source data, which is not the most important aspect for us.'

> *[...] big data means different things in different contexts. It is actually a bit misleading in the context of official statistics, because it puts attention to the size of statistical data, which is one of the least important aspects.*

Figure 1 – Key elements of Eurostat's Big Data project



Source: Eurostat

A step back is necessary to understand the meaning of big data in the statistical context. It would be essential to look at official statistics and how they were produced before the 'arrival' of big data, he explains. Fabio: 'Statistical systems were developed to produce information in a world where data was a scarce resource. Think of living in the eighties of the last century. Times in which most people did not create much data at all during their entire lives.' To illustrate this, he points out that, in those days, you would generally only create data when certain types of events occurred, say when you changed your residence or registered a car. 'You only created data when you had to register something somewhere, but you could live for weeks and months without producing a single bit of data. There was no GPS, hardly any electronic devices, most purchases would be paid for in cash. Sure, there were some *digital* technologies but no *data* technologies. In other words digital traces were scarce and, anyway, barely stored, hence they did not transform into data!'

> *... digital traces were scarce and, anyway, barely stored, hence they did not transform into data!*

Big data or big *data*

Fabio explains that scarcity of available data implied that statistical offices were the only go-to place for policy makers, journalists, and anybody else who needed to get quantitative facts about society, the economy or the environment. 'The main task of statistical offices was to produce statistics. In a world of scare data that implies collecting the source data in the first place, and then processing them to transform them into statistics. The collection process was especially costly.' He raises the question of data collection methods: 'Traditionally – by asking all or a selection of people, in censuses or surveys, or, a bit later, by relaying on what people have declared for administrative purposes, for example when changing residence or buying a car. These are the traditional data sources.'

Fabio points out the prominent role of survey data for statisticians. 'Surveys enable us to design the data we will retrieve by deciding whom to ask, what to ask, and when to ask. Because we can control and engineer the data collection, statisticians save costs in not asking all people but only a statistically representative sample, and the subsequent processing of such data is much simpler. This is less true for the administrative data that were generated for administrative purposes and then re-used for statistics. Still, administrative and survey data require an active declaration by the person concerned or by an administration.'

Fabio notes that the effort to collect data through such traditional channels represented a big share of the total cost of statistics production, to the point that 'producing statistics' and 'collecting source data' could be seen as almost overlapping concepts. Instead, he points out that data collection is *instrumental* to producing final statistics, and the relation between collection and other process components, and most prominently processing, depends on the nature of the data at hand. 'At the change of the millennium, with the introduction of the internet, the World Wide Web, smartphones, GPS, Internet of things, online social networks, within a few years our lives became digital. Nowadays, we have even digitalised our physical life. Our smartphone may record our steps, heart rate and sleep rhythm.' Fabio: 'If I were to ask you now, would you know how much data you produce as an individual, or as an organisation? You produce data every millisecond! Quite a difference compared to the few times per year thirty years ago!' Then, again laughing: 'We use the analogy of an individual as a data fountain that is continuously producing, or better, spouting data, and leaving a comprehensive data trace behind. And, there are many companies that, like buckets, are continuously collecting your precious data!'

> *You produce data every millisecond! Quite a difference compared to the few times per year thirty years ago!*

It's not (only) about size

The two Eurostat experts explain that, in the world of official statistics, the term 'big data' came to refer basically to any other data source apart from survey data and administrative records.

In this context, Kostas mentions the issue of 'datafication.' 'This means that we produce data with everything we do. By expressing our opinion on social media, tracking our fitness, navigating to places, or storing our photos, routes or favourite music online, we live a great part of our lives in the data cloud and through our smartphones.' He explains that for a statistician, big data is a rather specific concept. 'If I had to give a definition, I would go in the direction of 'anything that is left behind when people use information and communication technologies – from cameras to sensors – can be considered big data.'

According to Fabio the term 'big data' is actually quite misleading in this context for two reasons: 'First, the size of the data is not the most important dimension in our field.' He explains that some new data types are even smaller than, for example, traditional survey data. And that, even if you have a big amount of data, aspects other than size have more important implications in the context of official statistics. 'Actually, it is the nature of the data, its characteristics, the way it was produced, by whom and for what purposes, that matters for the way you access and interpret the data. It's much more about the *quality* of the data than about their *quantity*!' For this reason, Fabio prefers to use the term 'non traditional data' instead of 'big data' when talking with colleagues from official statistics offices. He acknowledges that size of data is a key dimension in other fields, e.g. in computer science. His second argument is that big data is used as an umbrella term for very diverse classes of data. 'Any meaningful statement referring to the whole "big data" universe can only be on an abstract level. When discussion gets operational, you must start referring to particular classes of data, e.g. satellite data or data from the Internet or mobile network operator data, and so forth.'

> *It's much more about the quality of the data than about their quantity!*

Another common mistake, according to Kostas, is the assumption that big data is a uniform concept. 'My experience has shown that there is not that kind of uniformity where you have a single data source, data class and a related statistical process with statistical indicators. On the contrary, you have to look at various data classes, types, and sources in order to be able to use them in a statistical process with meaningful statistical indicators.' He adds that at Eurostat they want to produce statistics based on multiple sources. 'So big data is going to be just another source next to surveys, census, or administrative information.'

When Eurostat first started exploring big data for official statistics, the focus was on raising awareness among its staff and trying to understand why and how big data could be used to produce valuable statistics. Kostas: 'We should keep in mind that the goal is not to use new data sources for the sake of doing so, but in order to produce better statistics. Using new data makes sense only if they lead to better statistics.'

> *Using new data makes sense only if they lead to better statistics.*

Fabio underlines that the goal is, and has indeed always been, to produce useful information. 'In a world where we need to invest 80% of our effort into data collection to be able to produce valuable information with the remaining 20%, we obviously run the risk of mixing the collection and production phases. However, at the end of the day, the goal of statistical offices is not to collect data, but to produce information.'

Difficulties when obtaining data

Regarding data access, Kostas explains: 'The current system - in which national statistical institutes collect and process national data, after which some of this processed data is shared at the European level - does not always fit for new data sources that are often collected by the private sector.'

There is another aspect to it. Fabio: 'Clearly, we see a need to close the legislative gap between the question about who holds the data – either the individual citizen, a private company, or a public body – and official statistics systems that need to extract statistical information from this data.' Adding to this, he notes that there is no need to move data away from the place where they are collected in order to process them. With new computation technologies, we can move the processing towards the data. And this is also true if the data are scattered around multiple data holders. He explains that this model is very appealing for new classes of data, especially when data are confidential or privacy-sensitive. 'Sure, all kinds of public data, such as data about tenders or contracts, must and will remain publicly available. But fine-grain personal data, such as my individual financial transactions, the places I have visited, etc. should not be moved around. Bringing together personal data from the entire population to a single place is not a good idea, regardless of how secure that place would be, because data concentration causes risk concentration.'

> *Bringing together personal data from the entire population to a single place is not a good idea, regardless of how secure that place would be...*

According to Fabio this is not only unwise from a technical point of view - as it is inefficient to move large amounts of data - but also because that would mean concentrating the risk of misusing the data in one central and publicly known honey pot. 'That would not be the right approach for comprehensive and sensitive personal data. And bear in mind that we are not merely talking about your marital status or your health status, but about your every single encounter with other people and your every heart beat!'

Using data without sharing data

Fabio explains that an organisation such as Eurostat is not interested in collecting and saving individual personal data, but only in producing aggregate statistics based on such data. 'This means that, instead of bringing your data to me, I can bring the computation methods, the analytics, to you. By using certain cryptographic techniques, from the family of what are known as Privacy Enhancing Technologies, the algorithm

> *... instead of bringing your data to me, I can bring the computation methods, the analytics, to you.*

that runs on your data extracts only the component of such data that is needed to build the statistics. It encrypts this data component in a special way, so that I am not able to decrypt it – it remains protected even from myself. But still it allows me to compute the final statistics.' He refers to a simple application of such technologies that is now being evaluated, along with others, in Eurostat. 'These technical solutions enable statisticians to use personal data for the production of statistics, but not to see the individual data as such. We can, for instance, compute the average salary of a large population without being able to find out anyone's individual salary. Similarly, I can compute how many people vote for red or blue without knowing which individuals voted for red or blue, or how many people are in a certain district without seeing the individual positions, etc. In order to extract global statistics, we no longer need to see the individual data points.'

> *In order to extract global statistics, I no longer need to see the individual data points.*

Kostas underlines that this approchof 'getting statistics out of the data, but not the data' is an important way to build trust. "As a citizen, I will more easily allow the statistical office to apply a certain algorithm to my data, along with the data of many other people, when I know it is technically impossible for them to retrieve my individual data.' Adding with a smile: 'Making something technically impossible is always stronger than making it legally forbidden! Blockchain is another example of secure technologies that cannot be tempered with, and help build trust into the process.' He believes that in the future we will be working in some kind of a network where aggregate information will flow, but not raw data as such. 'We must share computation, algorithms, logs of what algorithm was run on what data by whom, we must share everything … except the raw data! I think this is part of a paradigm shift. And these new possibilities mean we have to come up with new questions and new solutions for data and knowledge sharing. And although we are still in a learning phase, the future looks very promising!'

> *Making something technically impossible is always stronger than making it legally forbidden!*

The new system augmenting, not replacing the legacy system

According to Fabio the big data work at Eurostat is still in a pioneering phase where, as According to Fabio and Kostas statistical offices around the world are still in a phase where their staff are familiarising themselves with what this new world is about, with the new technologies that enable and at the same time motivate a profound paradigm change in the way official statistics will be produced tomorrow. Fabio continues: 'Big data is about data, technology and people. We have to re-engineer a socio-technical system.' He then refers to three layers of the socio-technical system: the hardware, the software and … the humanware. 'The humanware refers to the regulatory framework, the organisational process, corporate culture and all the human side of the system. You may see it as another level of coding, above the software and the hardware. Just a bit more abstract than software for the time being.' He explains that we have to upgrade the humanware level as well. 'Likewise, for new software updates, and in general for any other technological system, we need to maintain backward compatibility with the previous version. 'Fortunately, engineers in different fields know how to develop new systems that augment but remain compatible with legacy systems.' As examples, he refers to black & white TV, which was still available when the colour TV was introduced. Or stereo radio, with mono radio still compatible and existing next to that older system. 'Trusted smart statistics will be compatible with the legacy statistical production processes for traditional data: it will augment it - not replace it - with new data, new technologies and new statistics.'

> *The humanware refers to the regulatory framework, the organisational process, corporate culture and all the human side of the system.*

Fabio and Kostas say that the first exploratory activities about big data within the European Statistical System led to framing the problem in the right way, which is half way towards finding the right solution. 'As for every scientific or research challenge, asking the right question is the most difficult part. If the question is clear, it is not so difficult to find the solution. And vice-versa, when the solution cannot be found, it is very likely because the question was wrongly formulated. Asking the right question and convincing other institutions to see things in a different way, this is what takes time and effort. And the solution must be sought collaboratively. With such complex problems, the solution is not "found" but "built" together. In methodological research for instance, it is not about choosing between your methodology or mine, but about collaboratively developing our new methodology.' Fabio gives an example related to algorithms. 'Like a network, you have to document your analytics and your algorithm to ensure it is executable by machines and understandable by humans that will eventually improve it in the future. This tight interplay between the software and the humanware must be kept in mind when we re-engineer each of the two levels. For instance, what is known as the literate programming paradigm means that codes must be written and documented in a way that can be understood by both, machines and human experts.' For him this is just one example of where statisticians have to learn from other communities and fields.

> *... asking the right question is the most difficult part. If the question is clear, it is not so difficult to find the solution.*

> *... codes must be written and documented in a way that can be understood by both, machines and human experts.*

Trusted smart statistics

The two Eurostat experts explain that Eurostat has coined a new term to refer to such a deep paradigm shift: *Trusted Smart Statistics*. Kostas adds that they saw the need for a systemic approach, identifying statistics as the output of smart systems that produce the new data types. 'And our computation or algorithms tap into that data stream to process it and produce the statistics. We added the word 'trusted' – which could be interpreted in different ways – to highlight that the statistics we produce are trustworthy, which we can guarantee because they are produced by using proper data that were developed in proper ways.'

But there is more, Kostas specifies: 'Another more profound reason to mention trust is that it means that the statistics system is trustworthy as well!' Both Eurostat experts consider this important as it means that, as a statistician, one might be able to access very sensitive data from citizens, but because of all this technology and process referred to earlier, it is technically impossible to link the data to an individual or to misuse it. Fabio adds: 'And this means the trust works both ways. Because, if we as citizens do not fully trust the statistical office about how our data are used, we will not make our data available to them, or we will lie. And this will reduce the quality of the final statistics, and people's trust will suffer.' Laughing: 'Trust is a bi-directional path, a closed loop. Either we mutually trust each other, or we mutually distrust each other. If I do not trust you to use my data correctly and in a trustworthy manner, you cannot trust my data, because I will tell you a lie or nothing at all.'

> *Trust is a bi-directional path, a closed loop. Either we mutually trust each other, or we mutually distrust each other.*

Kostas underlines that this is an important understanding: 'By using humanware, software and hardware properly, we can make it impossible to misuse data for any other purpose than the one written in the code that everyone can check. And by making this type of misuse technically impossible, on top of legally forbidden, we can build real and solid trust into our system.'

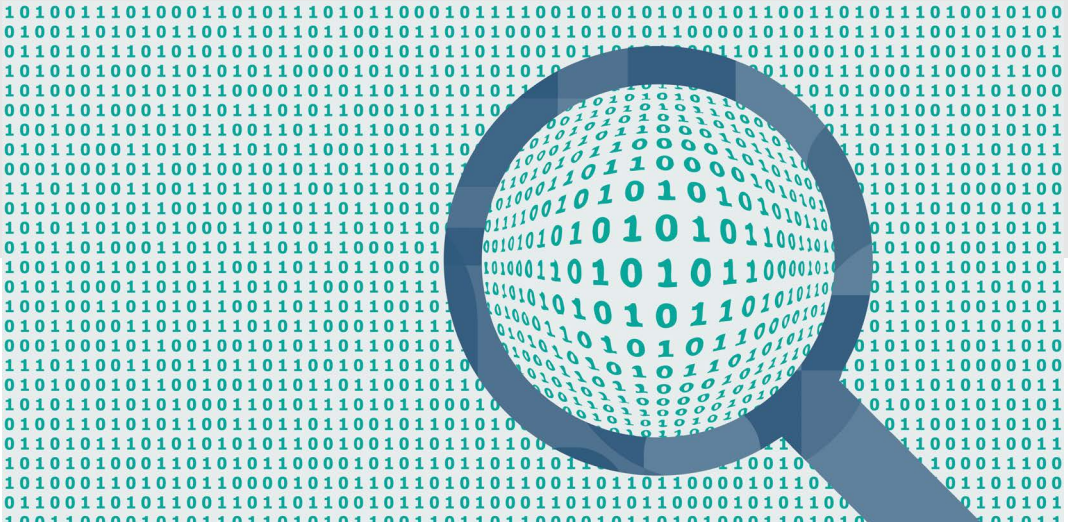
> *By using humanware, software and hardware properly, we can make it impossible to misuse data for any other purpose than the one written in the code that everyone can check.*

Both Kostas and Fabio underline that the key in the whole approach is *trust*. Fabio adds: 'One important question in the future will be to decide whether we are able to access data directly from the fountain, i.e. from the citizens, rather than from the buckets, i.e. from private business companies. We have these two channels, Citizen-to-Government (C2G) and Business-to-Government (B2G). He explains that with trusted smart statistics, such as trusted smart surveys, or even a trusted smart app that citizens can install and that guarantees an individual's privacy, an important step has been taken in the direction of developing statistics that citizens can trust and share with the statistical office without being worried how their information is treated. 'Especially when we have made it technically impossible for malicious parties to misuse algorithms or the data they produce about citizens.'

Kostas concludes that one of the main challenges is that, nowadays, everybody has become a data provider and data are very easily accessible through various channels. 'That is where we would like to make a difference as an official statistical office: being the 'to go-to' trustworthy source of reliable official statistics of high quality to help other institutions, both at EU level - such as the ECA - and the national level, to continue to build trust in the years to come.'

Data: an enabler of more efficient and effective auditing

By Maria Rosaria Coduti and Julie Sors, Directorate-General Communications Networks, Content and Technology (DG CNECT), European Commission



Source: shutterstock / By Magic pictures

With its objective of making Europe fit for the digital age, the European Commission wants to put the EU and its Member States at the forefront of digitalisation. This includes promoting the availability of data from both public and private sectors. Maria Rosaria Coduti and Julie Sors work in the Data Policy and Innovation Unit of DG CNECT at the European Commission. They can see great potential for auditors to benefit from the ongoing transformation to create a common European data space, with access and re-use of the multiple data flows, both as users and providers of data. The two experts zoom in on the EU's data strategy and the possible gains for auditors.

Data as a key resource for auditors

Artificial intelligence, the Internet of Things, sensors, connectivity, industry 4.0. These words have entered our everyday vocabulary and exemplify the world we live in. Data is the foundation of all of these. It is the enabler of the digital transformation that is pervading every aspect of our lives, from the management of traffic flows in cities and improved use of natural resources in farms, to more efficient factories and better diagnoses and clinical decisions in hospitals. Data enhances the ability of stakeholders to innovate, create job opportunities, boost growth and competitiveness, deliver services to citizens and make their actions sustainable for the well-being of individuals and our planet.

Data is being generated and collected all around us at every moment; for example, geographical information, statistics, weather data, research data, transport data, energy consumption data or health data. The increasing capacity to make sense of 'big data,' thanks to the advance of data analytics and management tools, is leading to technological innovation and the development of new services and products.

For example, high-resolution satellite data from Copernicus Sentinel satellites allows for the real-time monitoring of natural water resources to prevent drought or pollution. Such data brings considerable benefits to public authorities, researchers and private companies in terms of providing innovative services.

Auditors need to embrace the digital revolution

The digital transformation is not leaving the world of auditing untouched. On the contrary, auditors are already beginning to embrace the digital revolution in order to execute their functions in the most efficient and effective way. The availability of non-traditional datasets, together with enhanced data analytics technologies, represents a great opportunity for auditors in fulfilling their duties. For example, auditors can now more easily combine datasets to analyse a particular phenomenon, e.g. performance of farmers across different countries at the same time. In doing so, they can better identify weaknesses, inefficiencies and trends in order to make recommendations to auditees.

Audit processes should continue to harness the latest technological developments in data analytics, machine learning and artificial intelligence, to allow auditors to perform their financial, compliance and performance audits in a faster and more innovative way, drawing conclusions that would have been impossible to reach via traditional statistical sampling. By automating data collection and processing, these tools could spare auditors from time-consuming manual data collection and analyses, thus allowing them to focus more directly on the analysis of insights to identify potential risks and fraud cases more easily. Finally, digital auditing – using digital means available to arrive at an audit opinion – is set to improve the transparency and accountability of public authorities towards the citizens they serve.

To gain maximum benefit from the digitisation of auditing in the near future, it is crucial that auditors are equipped with the digital skills and capabilities needed to use the new technologies available.

Auditors as producers of data

Auditors – from both supreme audit institutions (SAIs) and the private sector – are not only users and beneficiaries of the vast quantities of data produced every day, but also produce data themselves. Such data, along with other public sector data, can be extremely relevant not only for boosting the economy and developing more sustainable and efficient products and services, but also for developing more evidence-based decision-making and helping policymakers understand which priority areas to focus on. The insights from auditing procedures are a valuable resource for public authorities to perform ex ante or ex post evaluations of different types of interventions, e.g. legislative interventions or financial support, to mention but a couple. The need for SAIs to make more data available is therefore clear. The ECA, for example, has published eight datasets on the EU Open Data Portal , which gives access to open data published by EU institutions and bodies. All the data stored in the Portal's catalogue is free to use for commercial or non-commercial purposes . The ECA has released the annual reports on the implementation of the EU budget from 2010 to 2017. The opinions that the ECA gives on the extent to which the annual accounts are reliable, and on whether income and spending transactions comply with the applicable rules and regulations, are important to demonstrate to EU citizens that the European Commission and EU Member States spend the EU budget – to which citizens contribute through taxes – properly and responsibly. In turn, the Commission obtains useful information to evaluate its action and better plan for the following years. This illustrates that if more data from auditing activities were made available, stakeholders could benefit from such guidance. By making more of its data available on the Portal, the ECA could help contribute to this objective.

EU data strategy

The European Union is at the forefront in terms of promoting the availability of data from both public and private sectors – for access and re-use – in order to benefit the economy and society, and foster the uptake of artificial intelligence and other data technologies. The ultimate aim of the EU's strategy is to create a common European data space – a seamless digital area with the scale to enable the development of new products and services based on data – as a building block of the digital single market.

Under the data economy strategy, the European Commission has developed several strands in order to make at least some data flow more easily in the economy. Its April 2018 Communication 'Towards a common European data space' sought to address the re-usability of data from different sources in a holistic way. Its main legislative element is the revision of the Directive on the re-use of public sector information (PSI Directive). This new Open Data Directive significantly improves the availability, usability and socioeconomic impact of public sector information in the EU. In particular, by enabling an EU-wide release of high-value datasets, such as geospatial, meteorological, statistical and mobility data, the new rules will be instrumental in the development of artificial intelligence solutions by SMEs and start-ups. These high-value datasets will be made available for free, in a machine-readable format and via application-programming interfaces.

As part of the data package, the 'Recommendation on access to and preservation of scientific information' was also updated to improve the availability of data generated in the context of publicly funded research. Finally, a guidance document on sharing private sector data, which also contains a number of key data-sharing principles, is expected to help break down data silos and create fair markets enabling smaller actors to innovate.

The increased availability of open data will benefit auditors. It will provide them with more data that they can use in their audit processes.

Access to private sector data benefits auditing

In the era of the data revolution, it is not only the public sector but also the private sector that produces and collects huge quantities of data. Such data represents a key resource for public authorities to address public interests. For this reason, the Commission is currently focusing on facilitating, in certain circumstances, access to private sector data in both business-to-business (B2B) and business-to-government (B2G) contexts.

In this context, an expert group was set up in October 2018 to formulate a set of recommendations on future policy or legal measures to take forward the EU's policy on B2G data sharing for public interest purposes. Access to private sector data is relevant for both public and private auditors because, for example, it can facilitate a better understanding of European economic behaviour. The expert group will finalise its report by the end of 2019.

What is next?

Data and digitisation are key priorities for the new Commission. In the political guidelines for the 2019-2024 Commission, President von der Leyen stated that 'data and AI are the ingredients for innovation that can help us to find solutions to societal challenges' and that 'the public sector has an important role in stimulating digital transformation'. Auditors, as producers and users of data, can contribute to this goal while benefiting from the data revolution.

Data protection: how can we safeguard this fundamental right best in a digital world?

By Wojciech Wiewiórowski, European Data Protection Supervisor (EDPS)

Source: EDPS

In the European Union data protection - and particularly personal data protection - is clearly embedded in the Charter of Fundamental rights of the EU (article 8). The digitalisation and thereby 'datafication' of our society has only accelerated the need for clear data protection rules, and for organisations monitoring compliance with these rules. While there are several non-governmental organisations active in this area, in 2001 the EU created a supervisory authority, whose duties, powers and institutional independence were further developed in an EU regulation adopted in 2018. Since 5 December 2019, Wojciech Wiewiórowski has been the European Data Protection Supervisor, heading an organisation that cooperates intensively with the data protection officers that each EU institution has. Below he elaborates on the new challenges digitalisation and the new technologies pose from a data protection point of view, and the pioneer role the European Union can and should fulfil to protect the fundamental rights that underpin the European ideal.

Data protection and EU policy

The biggest challenges of the coming years include the development and deployment of AI systems, biometrics and facial recognition, blockchain and quantum computing and encryption techniques – for all of which data protection rules can and should provide important guidance.

This is a statement I made during my hearing at the European Parliament on 25 November when discussing data protection issues on the occasion of my hearing as a candidate for the EDPS post.

Data protection affects almost every EU policy area. It also plays a key role in legitimising and increasing trust in EU policies. Europe is the world's leading proponent for the

Box 1 - the European Data Protection Supervisor – EDPS

The European Data Protection Supervisor (EDPS) is the European Union's (EU) independent data protection authority. Its general mission is to:

monitor and ensure the protection of personal data and privacy when EU institutions and bodies process the personal information of individuals;

advise EU institutions and bodies on all matters relating to the processing of personal data, on request or on our own initiative. In particular, we are consulted by the European Commission on proposals for legislation, international agreements, as well as implementing and delegated acts with impact on data protection and privacy;

monitor new technology that may affect the protection of personal information;

intervene before the Court of Justice of the EU to provide expert advice on interpreting data protection law;

cooperate with national supervisory authorities and other supervisory bodies to improve consistency in protecting personal information.

Regulation (EU) 2018/1725 lays down the rules for data protection in the EU institutions. It also lays down the duties and powers of the EDPS as well as its institutional independence.

protection of fundamental rights and human dignity; it is therefore vital that the EU plays a leading role in shaping a global standard for privacy and data protection, centred on these values.

It is the role of the European Data Protection Supervisor (EDPS) to ensure that the European Union's institutions, offices, bodies and agencies respect the fundamental rights to privacy and data protection. This includes when they process personal data or when they are involved in developing new policies that may require the processing of personal data.

Regulation (EU) 2018/1725 sets out the data protection rules that the EU institutions must follow, as well as the role and powers of the EDPS in enforcing these rules. However, the strong set of powers conferred upon me as the EDPS should also be used to engage and educate EU bodies in responsible data practices in the spirit of accountability - accountability being one of our keywords in this new era of digital data protection practice. At the same time, as EDPS I recognises that, in an ever-changing technological landscape, legislation on data protection can only be effective up to a certain point. We need to remember that the principal aim of data protection is not to protect personal data itself, but to protect the individuals connected to this data.

With this in mind, we have recently focused specific attention on the development of Digital Ethics. We need to question the way in which we use new technologies, to assess the impact they have on our rights and values and determine how to address them. Our aim is to foster a continuous, global debate on what is ethical in the digital sphere. We have invested considerable effort in this endeavour, with the aim of launching a global debate on how we can ensure the protection of human rights and fundamental values in the digital age. We hope that this will provide us with the foundation to confront the challenges presented by the digital revolution, which threatens the traditional frameworks used to ensure respect for our rights to data protection and privacy.

Addressing the challenges of new technologies

Our technological capabilities are developing at an increasingly rapid pace. Yet, while new technologies have profoundly changed the way we live, determining how best to regulate the development of these technologies is not an easy task. Over the past five years, one of the main priorities of the EDPS has therefore been to help ensure that data protection goes digital, and with technological development unlikely to slow down any time soon, it will continue to be a focus of our work in the years to come.

One of the ways in which I endeavour to do this is through the promotion of technologies to enhance privacy and data protection. Under the General Data Protection Regulation (GDPR) and Regulation 2018/1725, controllers are required to respect the principles of data protection by design and by default. For technology developers and manufacturers, this means that there is a need to build privacy and data protection into the design and development of technological solutions. To help prepare for these new requirements, my office has set up the Internet Privacy Engineering Network (IPEN).

Launched in 2014, IPEN brings together experts from a range of different areas to encourage the development of engineering solutions to privacy problems. Through supporting projects that build privacy into new and existing digital tools, the Network aims to promote and advance state of the art practices in privacy engineering. With new EU rules on data protection now fully applicable, IPEN's focus is on establishing a more specific and practical understanding of privacy-friendly technological development.

Ensuring effective data protection without technological expertise is now impossible; the digital revolution has forced Data Protection Authorities and other regulators to develop skills in this area, with my office consistently aiming to lead this trend. One of the ways in which we promote dialogue on modern technologies is through the publication of our TechDispatch newsletter, launched earlier this year. Each issue aims to explain a different emerging technology, providing information on the technology itself, a preliminary assessment of the possible impact it could have on privacy and the protection of personal data and links to further reading on the topic.

Another initiative aimed at fostering technological expertise is the EDPS Website Inspection Software, a software tool designed to support the work of data protection professionals. Originally developed to carry out inspections of EU institutions' websites, it allows technical amateurs to collect automated evidence of personal data processing.

Through publishing information and tools such as this, we aim to contribute to a shared pool of knowledge that all Data Protection Authorities (DPAs) and other interested parties can benefit from.

Working together with a common aim

The coherent enforcement of fundamental rights in the age of big data presents a significant challenge for regulators across the board. There is mounting concern about the concentration of market power and personal data in fewer and fewer hands. With this in mind, we identified a need for authorities to work together more closely to protect the rights and interests of individuals, such as the right to privacy, to freedom of expression and non-discrimination. The Digital Clearinghouse is one of our collaborative initiatives, set up to facilitate this cooperation.

Data protection, consumer and competition law each in theory serve common goals, but in reality, these sectors tend to work independently. We believe that each branch of the law has its own role to play, but that they would be more effective if they worked in tandem. The Clearinghouse meets twice a year and acts as a forum for cooperation between competition, consumer and data protection authorities, willing to share information and ideas on how to make sure web-based service providers are more accountable for their conduct. We hope that, through working together, regulators in these fields will be better able to address the challenges posed by the digital economy and coherently enforce EU rules relating to fundamental rights in the digital world.

There is a pressing need to increase transparency, user control and accountability in big data processing. Having control over our personal data means being able to determine what data are being used, for what purpose and by whom. It also means being fully capable of exercising individual data protection rights. While this might seem simple in theory, the automated and complex processing of personal data, the use of algorithms to make decisions and the sheer quantity of personal data that is collected, supplemented and shared freely by numerous actors in the modern economy - particularly online - has made this process considerably harder.

As the supervisory authority for the EU institutions, I am dedicated to ensuring that the EU institutions are able to lead by example in increasing the accountability and transparency of their work. By providing training and guidance and working in close cooperation with the data protection officers (DPOs) of the EU institutions, we aim to provide them with the tools to do this, but we also monitor the activities of EU institutions and bodies closely and, in 2019, we launched two high-profile investigations. These were aimed at ensuring that the EU institutions uphold the highest levels of data protection compliance, thus ensuring the highest levels of protection for all individuals living in the EU.

Through our work with the EU institutions, we hope not only to improve their data protection practices, but also to contribute to efforts to improve data protection across the EU and globally. We want to do this by increasing awareness of data protection principles, as well as possible issues and concerns - especially in relation to new technologies - many of which are reliant on the processing of big data.

Auditors, and in particular the European Court of Auditors, can - and must - play an important part in this digital environment too. The ECA review on EU cybersecurity policy, issued on 19 March 2019, is one example of this. Another could be the protection of personal data. When examining the programmes, operations, management systems and procedures of bodies and institutions that manage EU funds to assess whether

they are achieving economy, efficiency and effectiveness in the use of those resources, auditors might also come across issues related to personal data protection, such as non-compliance with the legal obligations of data protection by design in IT-systems. In order to improve the EU's accountability in data protection matters, these issues should be reported to the EDPS.

Looking to the future

In early 2015, the EDPS set out its vision of an EU that leads by example in the global dialogue on data protection and privacy in the digital age. With the priorities of the new European Commission now beginning to take shape, it is clear that developing an EU that is fit for the digital age will also be a priority for EU policy in the years to come.

This aligns with my vision for the mandate I received as EDPS, which began in December 2019. The EU administration should be smart and innovative. It should be able to adapt new technologies and business models and use them also to make data protection smarter and modern. In the same way, the office of the EDPS itself should also be smarter: making full use of the latest technologies, listening to a broad range of stakeholders from industry, civil society and academia on the 'best and worst in class' when it comes to using personal data.

Source EDPS

Wojciech Wiewiórowski when speaking at the EDPS Strategic Review presentation in Brussels on 3 December 2019.

However, as the EDPS initiatives described above demonstrate, meeting the challenges of big data is not something that can be done by data protection authorities alone; there is a real and urgent need for cooperation across all disciplines and among all regulatory bodies, including between the EU's bodies and institutions.

The digital revolution is relentless in producing unprecedented challenges in the realm of data protection and other areas. New EU proposals on artificial intelligence, a Digital Services Act and competition policy, for example, are ambitious and necessary aims, but in the age of big data we must make sure that we do not lose sight of the fundamental rights which underpin the European ideal. As the European Data Protection Supervisor I will keep human dignity at the centre of our work when assessing how to navigate this unchartered terrain.

Exploring the link between big data, cybersecurity and audit

By Michiel Sweerts, External action, Security and Justice Directorate

Auditors provide trust and assurance on the basis of (among other things) their verification of the data underlying the assertions made by others. The digital revolution has brought new risks to these data , concerning their reliability and intrusion by others. In March 2019, the ECA published a briefing paper on the challenges to effective delivery of the EU's cybersecurity policy. This paper aimed to provide an overview of the EU's complex and multi-layered ecosystem regarding cybersecurity, as well as providing points for reflection for policy makers and practitioners. As head of task, Michiel Sweerts, a Senior Auditor at the ECA, was responsible for this review. He is also currently developing the ECA's cybersecurity knowledge node. In this article, he explores the relationship between big data, cybersecurity and audit.

Trust in data matters, even more so in the fourth industrial revolution

Trust lies at the heart of cybersecurity, big data and audit. Without adequately securing our hardware, software and data, users' trust will be eroded and technological innovation will suffer. Without trust in the veracity of our data, how can we ensure its quality and use? And without the trust that audit can provide to provide assurance that what organisations say about their security levels reflects reality, not only will share- and stakeholders ask if their money is safe, but also their data. As the fourth industrial revolution continues apace, the linkage between these three will continue to grow in importance.

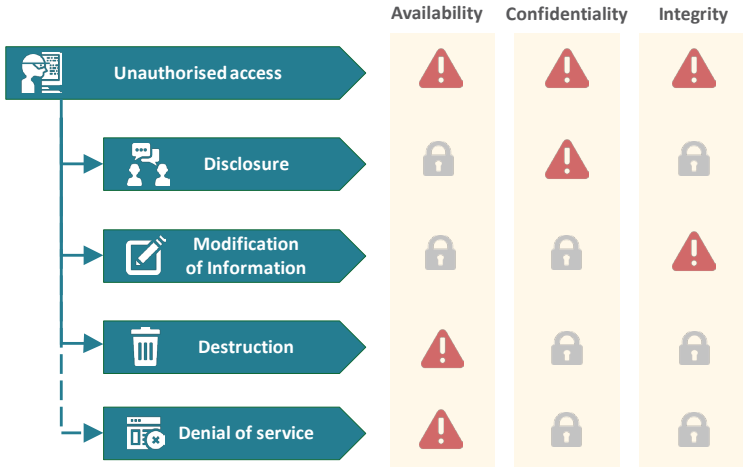
Protecting data through cybersecurity

Broadly speaking, cybersecurity is all about the safeguards and measures adopted to defend information systems and their users against unauthorised access, attack and damage to ensure the availability[1], confidentiality[2] and integrity[3] of data. It involves preventing, detecting, responding to and recovering from cyber incidents. These incidents may be deliberate or not and range, for example, from accidental disclosures of information, to attacks on businesses and critical infrastructure, to the theft of corporate and personal data, and even interference in democratic processes. All can have wide-ranging harmful effects on individuals, organisations and communities.

The types of cybersecurity threats are myriad, for example, ransomware, distributed denial of service, social phishing or advanced persistent threats. They can be classified according to what they do to data – disclosure, modification, destruction or denied access – or by the core information security principles they violate, as shown in **Figure 1** below.

1 Ensuring timely and reliable access to and use of information.
2 The protection of information and data from unauthorised access.
3 Guarding against the improper modification or destruction of information, and guaranteeing its authenticity.

Figure 1 – Threat types and the security principles they put at risk



Source: ECA, modified from a European Parliament study[1].
Taken from ECA Briefing Paper 'Challenges to effective EU cybersecurity policy'

Using cybersecurity to strengthen big data, or big data to strengthen cybersecurity?

Big data is used to describe very large data sets that are mined and analysed to identify patterns and behavioural trends. The explosive growth in data is being driven by various factors, including digital transformation, ever greater access to mobile applications, the falling cost and ease of storing data, the advent of the Internet of Things (IoT), and the advent of machine learning.

The traditional 3 V's of big data are volume (the scale of data), velocity (analysis of streaming data) and variety (different forms of data). To these have been added in recent years, veracity (uncertainty of data, i.e. is what the data shows true?) and value (intrinsic worth of aggregated, machine-readable structured and curated, unstructured data that drives decision-making). One V that is not named in association with big data, but is certainly worthy of critical consideration is *vulnerability*: the more data that is put out there, in ever more complex forms of storage, and shared among ever more individuals within organisations, the greater the risk that this data could be accessed by malicious actors ('collect everything and throw away nothing'). Much of this data is personal - think of mobile phone records, social media activity, web server logs, internet click stream data - so protecting personal and sensitive information must be a top priority for any organisation.

Data is accessible from so many points today through mobile and cloud services that it is no longer possible to cordon this off. Data has also been steadily 'democratised' throughout organisations where it has been made increasingly available to all levels. On the upside, this can potentially serve to maximise the data's value as it can lead to greater operational efficiencies, product developments or enhanced customer experiences. On the downside, staff have access to more data than they need, and this represents a security risk: people still represent the greatest threat to organisations, with insiders accounting for the largest part of breaches. These elements converge to result in an ever-increasing attack surface, leading to a shift from 'perimeter' protection of network and information systems towards the monitoring and detection of malicious activities inside these networks and systems. This means defending the data itself. And because this data represents so much of an organisation's value nowadays, it is hardly surprising that it is therefore at greater risk than ever before.

1 European Parliament, Cybersecurity in the European Union and Beyond: Exploring the Threats and Policy Responses, Study for the LIBE Committee, September 2015.

Effective cybersecurity measures are therefore needed more urgently than ever to protect networks, systems and data from intrusion. The numbers vary – depending on who you read – but they all point in the same direction: cyber-attacks are surging. And while it is clear that cybersecurity exists for the benefit of protecting amongst other things - big data, can big data be used to benefit cybersecurity?

Box 1 – ECA briefing Paper 2/2019 – Challenges to effective EU cybersecurity policy

The objective of the briefing paper, which was not an audit report, was to provide an overview of the EU's complex cybersecurity policy landscape and identify the main challenges to effective policy delivery. It covered network and information security, cybercrime, cyber defence and disinformation. We identified ten challenges, as shown in **Figure 2**. Achieving a greater level of cybersecurity in the EU remains an imperative test. In addition, we included a series of reflection points for policy-makers, legislators and practitioners. The paper is also being used to inform the ECA's future audit work in this area.

As cyber attacks increase in their sophistication and frequency, traditional software is often no longer capable of offering the necessary protection needed. Big data analytics and machine learning (itself a big generator of data), can enable a near real-time analysis of information, which in turn may provide not only useful threat warnings but also the possibility to develop suitable counter-measures to fend off attacks. For example, using multiple data sources and machine learning to analyse authentication and authorisation log reports, network activity, and resource access can help to correlate this information, to identify changing behavioural and use patterns, to detect vulnerabilities, and to compare what is normal versus what is not expected.

Improving incident response can also be powered by big data. Some of the largest breaches that have taken place to date show that while the attacks themselves can spread incredibly quickly, sometimes within minutes, the corporate responses lag significantly behind – exacerbating the damage and loss caused. As more information is collected about attacks and how they are reacted to, so this will enable the development of automated playbooks that enable intelligent and instant incident responses.

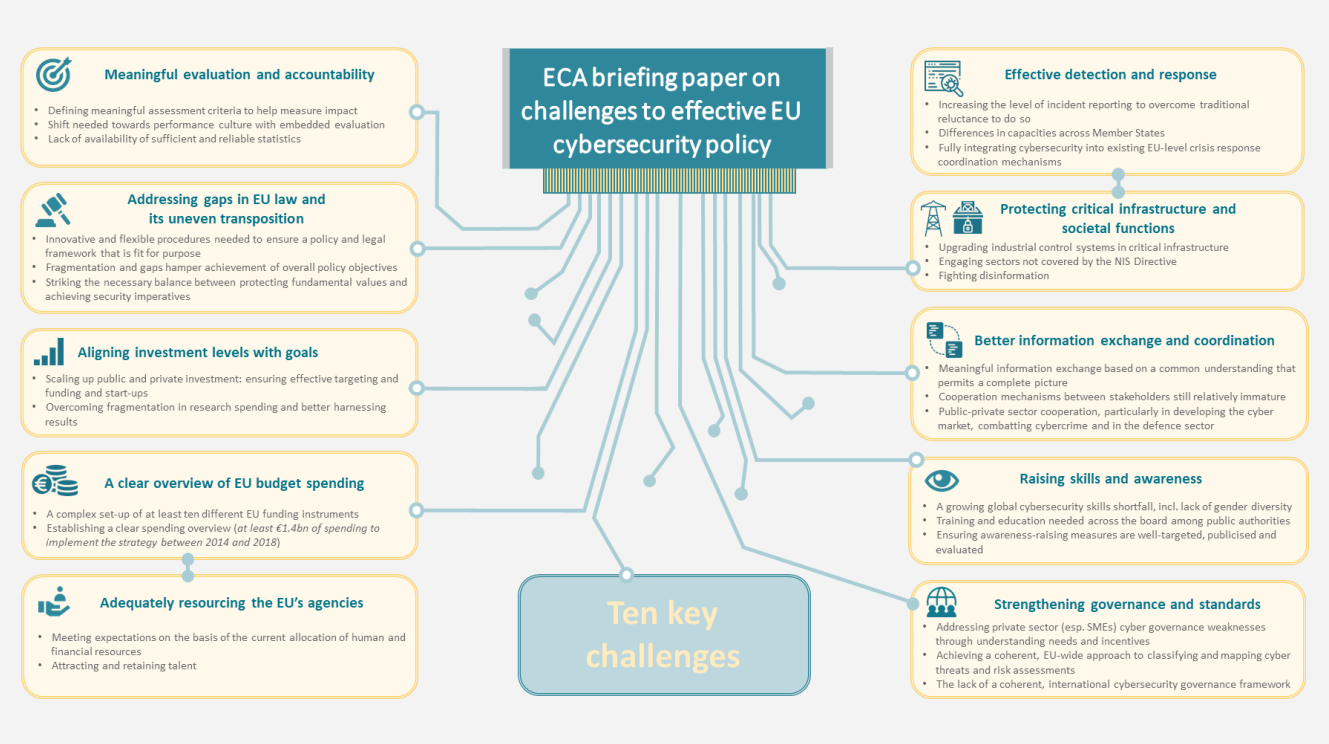
The growing need to audit cybersecurity governance

A major challenge for the cybersecurity profession is to shift the wider public's thinking on the nature of cybersecurity. For too many in leadership positions in both the private and public sector, cybersecurity continues too often to be perceived as an IT problem or technology issue to be dealt with, rather than a significant business or organisational one. To address this requires effective cybersecurity governance in all organisations, especially those with growing valuable data; it is well-established that weaknesses abound today in cyber governance. Developing a culture of cyber hygiene is incumbent on all who interact with organisational data – be they corporate insiders or external parties like auditors.

This will therefore have repercussions on audit as well: there is an increasing need for effective cybersecurity audits to ensure that organisations are protecting themselves against cyber threats. Cybersecurity audits should not merely focus on the technical aspects of security controls, but go much further to assess the effectiveness of the controls in place to identify the threats, risks and vulnerabilities faced by the organisation. This would also include governance, risk management, awareness-raising and training, legal and regulatory compliance, information security policies and procedures, and so on. And as the technology evolves and the location of information and (big) data shifts to the cloud, will existing controls suffice? Or will they need to be modified, or even replaced altogether?

For national supreme audit institutions (SAIs) and the ECA, this will increasingly need to become a part of the periodic audit landscape. Our briefing paper has provided us with the impetus to audit the EU institutions' own cyber-governance arrangements in the foreseeable future (see also **Figure 2**). In Australia, for example, the ANAO has carried out five performance audits since 2013 covering 17 government entities' compliance with the Australian Government's Information Security Manual.

Figure 2 – EU cybersecurity policy: ten key challenges



We must also bear in mind the question of how – given our unique access rights to client data – can we ensure that, as auditors, we are sufficiently cybersecure ourselves to avoid providing a backdoor access to hackers who wish to target our clients? What we expect of auditees should be mirrored in our audit organisations. Auditors' reputations depend on their trustworthiness. While no system can guarantee 100% prevention of cyberattacks, auditors must lead by example by ensuring that they are beyond reproach in securing their own networks and the client data they hold. Any breach of our own systems as auditors that may expose highly sensitive information would be highly damaging.

Integrating cybersecurity into the normal audit process

Organisations, politicians, consumers and citizens want to be able to trust that the data they share is secure, that the data used for decision-making is trustworthy, and that auditors not only provide assurance that can be trusted, but also that they are trustworthy custodians of the data they have been provided with. Big data and cybersecurity will continue to reinforce one another, and auditors must ensure that going forward, cybersecurity becomes integrated into the normal audit process.

Back to (the 2019 ECA summer) school… to go digital with colleagues from all over Europe

By Chrysoula Latopoulou, Investment for Cohesion, Growth and Inclusion Directorate

Promoting the change towards digital audit in an organisation requires more than a commitment by management. It is just as important to engage auditors, show them what is possible and provide them with the skills to make the switch to digital auditing. This is why the ECA chose digital transformation of audit as the key topic of its 2019 summer school in public auditing and accountability. One of the participants was Chrysoula Latopoulou, a senior auditor at the ECA. She shares her experiences of the ECA summer school, where she went from a prudent 'wait and see' attitude to the conviction 'I can go digital'.

Digital – a la moda

It was a Monday morning in July and I was waking up in a dark room that revived memories from the past: the glorious years when I was at university. A simple room to cover my basic needs was all I had. The previous night, after a flight and three changes of train, I had arrived at this convent. 'Why they had to bring us here?' I grumbled. 'Is the air more inspiring than in Luxembourg?' Laughter from the garden disturbed my muttering. My colleagues, or should I say my co-students, were having their breakfast. 'And why are they so happy?', I continued with my morning ritual.

I was in Pisa, Italy, to participate in a recent ECA initiative, the summer school in 'Public Auditing and Accountability'. This was being organised for a second year in conjunction with the University of Pisa and ACCA to focus on emerging global issues relevant to audit. 'The ECA is having a face lift' (you know me, if I can't comment I die…). This year's topic was 'Data mining and analysis: Digital transformation of audit'. At least the subject looked interesting, and it was certainly '*molto a la moda*'.

Box 1 – Pisa summer school initiative

The Pisa summer school, which ran for the first time in 2018, is an initiative of the ECA, the University of Pisa and the Association of Chartered Certified Accountants (ACCA) that focuses on emerging global issues relevant to audit. To keep pace with innovation, auditors and audit organisations must monitor and understand new trends and technologies. Instead of concentrating on traditional audit practices, the organisers decided to create a new learning opportunity in the field of audit innovation.

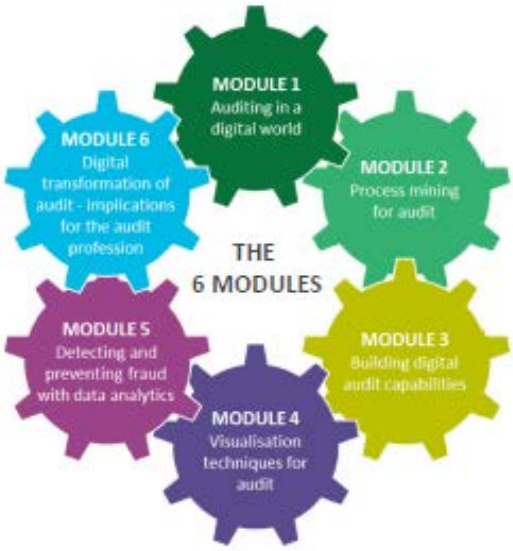
The 2019 topic was 'Digital Transformation of Audit'. During the week, academics from leading universities and research centres, together with renowned practitioners, provided participants with original insights into current trends. The programme covered:

- the theory and practice of digital audit;
- new ways of auditing;
- the opportunities offered by digital technologies;
- methods and solutions;
- audit tools and technologies;
- ideas for updating professional practice.

Speakers came from the University of Pisa, Deloitte Nederland, RWTH Aachen University, Rutgers University (USA), Copenhagen Business School, the Netherlands Court of Audit, PwC Italy, the European Commission (DG EMPL and IAS), Central European University (Budapest) and the the Association of Chartered Certified Accountants (ACCA). In addition, staff from the national audit offices of Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Italy and the UK presented topics of interest on the subject of audit digitalisation.

The ECA summer school: an open event combining theory and practice

Figure 1 - The six modules of work for the ECA's 2019 Pisa summer school



The agenda (see **Figure 1**) was appealing. Six modules that seemed well-structured, maintaining a balance between theory and practice; academics and practitioners, with names that looked as important as they were complicated, from leading universities and research centres; terms and tools I might have heard of but had certainly never used; and a full schedule from 9:00 to 18:00 for five days. 'And in the evenings? Are we free to do student stuff?' My eyes sparkled.

Sharing experiences is one of the key objectives of the ECA summer school. We were a total of 18 students from the ECA and another 48 from national audit institutions, the European Commission's Internal Audit Service (IAS), OLAF, researchers, etc. 'The ECA is in the frontline of innovation and maybe can even lead change…' – my first constructive thought of the day!

During the week, the speakers addressed the theory and practice of digital audit. We explored and experimented with new ways of auditing, analysed the new audit opportunities offered by digital technologies, evaluated methods and solutions, appraised tools and technologies, and reflected on how best to update our professional practice.

Not a choice but a must

The numerous experts explained concepts such as data mining, process mining, big data, blockchain, machine learning and artificial intelligence. We also discussed examples of the use of data analytics in the detection and prevention of fraud. Finally, since today's readers are used to absorbing challenging presentation formats, we tackled the important topics of visualising audit findings and the concept of design thinking.

'But I'm an auditor, why do I have to know these things?' I continued, stubbornly resistant to learn. What the presenters succeeded in showing us was that some digital tools not only can, but really must, be integrated into audit practice, so that we, as auditors, can navigate through an increasingly digitalised audit environment and make our reports more appealing to the wider public.

The diverse speakers included Professor Vásárhelyi , who emphasised that the cost and benefits of performing an audit have changed and will continue to change with automation, and also that process mining is expected to bring radical changes to the traditional (sampling-based) approach to compliance and financial audit in the near future. Professor D'Onza showed that digital technology is transforming the nature of audit in both the private and public sectors, in the sense that auditors find it challenging to fit audit evidence derived from data analytics into the current evidence model. He even concluded that auditing standards need to be revised and that the concept of audit evidence and its reliability have to be redefined.

Box 2 – Key concepts presented in Pisa

Data mining – practice of examining large databases in order to generate new information

Process mining – family of process management techniques that support the analysis of business processes based on event logs. In process mining, specialised data mining algorithms are applied to event log data in order to identify trends, patterns and specific other details. The aim is to improve process efficiency and the understanding of processes.

Big data – The IT field that concerns ways of analysing, systematically extracting information from, and otherwise dealing with data sets that are too large or complex to be tackled using traditional data-processing applications. Big data challenges include capture, storage, analysis, searching, sharing, transfer, visualisation, querying, updating, privacy and sourcing.

Blockchain – a list of records ('blocks') that are linked over time using cryptography. Each block contains an encrypted algorithm of the previous block, a timestamp and transaction data. By design, a blockchain is resistant to data modification. It can be used efficiently as an open and publicly accessible ledger recording transactions between two parties in a verifiable and permanent way.

Machine learning – practice whereby computer systems study algorithms and statistical models to perform a specific task without requiring explicit instructions, instead relying on patterns and inference. Seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as 'training data', in order to make predictions or decisions without being explicitly programmed to perform the task.

Design thinking – methods and techniques for finding innovative solutions for visualising the findings in audit reports. Covers a wide range of design approaches.

The participation of ECA staff in the event was instrumental, both in terms of organisation and for presenting the institution's vision for the audit digitalisation era. The ECA's roadmap to digital audit and the creation of the ECALab attracted my attention. The first consists of concrete steps in the short, medium and long term, focusing on re-using existing tools and knowledge, experimenting so as to identify the impact of digitalisation on the audit process and, finally, 'industrialising' ideas and proposing new ways of working – e.g. redefining processes and creating an analytics tool to be used autonomously by auditors. The second issue, our ECALab, was created as a first step towards establishing data services that are tailored for audit (for more information see page 38).

I can go digital!

At the end of the week, I knew what my main takeaways from the summer course would be. Firstly: 'I can go digital! I know I can do it!' There is plentiful in-house support in terms of training and staff that can help us explore such tools. And secondly: 'The ECA can really lead change.' We have the resources and the critical mass to take a lead role among audit institutions in the EU.

I guess you are still wondering about the summer school evenings in Pisa. A photo can say more than a thousand words. Marina di Pisa is only a 30-minute bus drive from the venue of the event, and sharing a view - and a pizza - on the beach close to Pisa would take anyone back to their student years. So… yes, the air in Pisa is more inspiring than in Luxembourg for the ECA summer school…

Sunset at Marina di Pisa.
Source: Chrysoula Latopoulou

Text Mining and eDiscovery for Big Data Audits

By Professor Jan Scholtes, University of Maastricht

Source: Shutterstock.com/ By Jirsak

With quantitative data becoming more widely available, the step towards data mining appears to be a small one. However, for their performance audit work auditors from public audit institutions are spending more and more time assessing policy efficiency and impact, reviewing policy documents, policy programmes - often formulated in qualitative terms in text. With the quantity of text and diversity of sources available, more and more techniques have been developed for text mining, which can be used to assist the auditor. Professor Jan Scholtes holds the Extra-ordinary Chair in Text Mining from the Department of Data Science at the Department of Science and Engineering of the University of Maastricht. He is also Chairman and Chief Strategy Officer of ZyLAB, a company developing software for eDiscovery and information risk management. He has been involved in deploying in-house e-Discovery software with organisations such as the UN War-Crimes Tribunals, the FBI-ENRON investigations, the EOP (White House) and the fraud investigators of EC-OLAF. Below he explores the different techniques of text mining and eDiscovery, and how they can help to find complex relations in electronic data sets.

Recent developments in deep learning

To auditors, the field of *data mining* is undoubtedly better known than that of *text mining*. A good example of data mining is the analysis of financial transactions. A wealth of algorithms and analytical methods are available to find patterns of interest or fraudulent behaviour in such data sets.

However, 90% of all information is unstructured information in the form of text documents, e-mails, social media or in multimedia files (speech, video and photos). Searching within or analysis of this information, using database or data mining techniques, is not possible, as data mining tools only work on structured data in the form of columns and rows, as used in databases.

In addition, fraudsters are more and more knowledgeable about the inner workings of audit and compliance algorithms, so they tend to make sure that the transactional aspects of their actions do not appear as anomalies to such algorithms. The details of what is really going on, can often only be found in auxiliary information such as email, text-messages, WhatsApp, agreements, side letters, voice mails or discussions in a forum, such as a chat box[1] or the dark web.

Meta-data extraction (normal and forensic), machine translation, optical character recognition (OCR), audio transcription, image and video tagging have reached highly reliable levels of quality due to the recent developments in deep learning. Therefore, text can be used as a good common denominator describing the content of all electronic data, regardless of the format. The next step is to use techniques from the world of text-mining and eDiscovery to assist today's auditors. This is what we will discuss in more detail in this article.

Text mining

The study of *text mining* is concerned with the development of various mathematical, statistical, linguistic and deep-learning techniques which allow automatic analysis of unstructured information as well as the extraction of high quality and relevant data, and making the complete text more searchable. High quality refers here, in particular, to the combination of the relevance (i.e. finding a needle in a haystack) and the acquiring of new and interesting insights.

ECA Journal Short Read

Text mining - The process of deriving normalized, structured data from large quantities of text using deep learning such as AI and algorithms, with the aim of using the data for analysis and identifying patterns.

Text mining and audit - Besides quantitative data mining, text mining is increasingly being viewed as a useful asset in the audit process. Ninety percent of all information takes the form of textual documents, and new tools such as meta-data extraction, machine translation, audio transcription, image and video tagging are proving to be increasingly more reliable in terms of providing information in a structured manner, also to the auditor.

eDiscovery - Stands for legal fact finding missions dealing with large amounts of electronically stored information, most often dynamic and unstructured. eDiscovery is proving to be a standard approach when dealing with cases pertaining to regulatory requests, the General Data Protection Regulation, Freedom of Information Act requests, compliance investigations and the preparation of mergers and acquisitions.

eDiscovery and text mining - This combination is the perfect tool for early case assessment, offering many methods to understand the structure and content of large data sets in an early phase to reply to basic questions like who, where, when, why, what, how and how much. Different text mining techniques can help here, such as Topic Modelling, Community Detection, Topic Rivers, Emotion Mining and Event Detection.

New techniques, also for audit - Combining the real-world data of eDiscovery technology with the isolation of patterns of interest in text mining will aid our understanding of complex relationships between variables in big data. These tools will help auditors and investigators to get to the essence of a case quickly and efficiently.

A textual document contains characters that together form words, which can be combined to form phrases. These are all syntactic properties that together represent defined categories, concepts, senses or meanings. Text mining must recognize, extract and use all this information. Using text mining, instead of searching for words, we do in fact search for syntactic, semantic and higher-level linguistic word patterns.

'Text Mining: The next step in Search Technology - Finding without knowing exactly what you're looking for and Finding what apparently isn't there ' was the title of my inaugural acceptance speech for the Extra-ordinary Chair for Text Mining at the University of Maastricht in 2009. There I explained the difference between consumer search engines such as Google, which are highly optimized for precision, and other search engines that are more optimized for recall. The latter are obviously more suited for investigators. High precision search engines only find the best solutions, but not all of the relevant

1 Monitoring or analysis of Bloomberg chat-boxes is standard procedure in the USA as part of investigations involving financial traders.

ones. High recall engines do find all of the potentially relevant ones, whilst preserving a reasonable level of precision. *Precision* - also called positive predictive value - is the fraction of relevant instances among the retrieved instances, while *recall* (also known as sensitivity) is the fraction of the total amount of relevant instances that were actually retrieved.[2]

Internet search engines such as Google, but also Lucene, are fine tuned to give the best answer or the most popular answer. Fraud investigators or lawyers do not only want the best or most popular answers, they want all possible relevant documents. Furthermore, in an internet search engine everyone does his or her best to get to the top of the results list. Criminals and fraudsters do not want to be at the top of the results list in a search engine; they actively try to hide what they do. With text mining algorithms, we aim to find someone or something that does not want to be found.

Fraud investigators have another common problem: at the beginning of the investigation they do not know exactly what they must search for. As using encryption for such communication would have the effect of a red flag to an auditor, such communication is often in plain open text, using code words. Investigators do not know such specific code names, or they do not know exactly which companies, persons, account numbers or amounts they must search for. Using text mining, it is possible to identify all these types of entities or properties from their linguistic role, and then to classify them in a structured manner to present them to the auditor.

For instance: one can look for patterns such as: 'who paid who,' 'who talked to whom,' or 'who travelled where' by using searches for linguistic matches. Subsequently, the actual sentences and words matching such patterns can then be extracted from the text of the auxiliary documentation and presented to the investigator. By using frequency analysis or simple anomaly detection methods,[3] one can then quickly separate legitimate transactions from the suspicious ones, or identify code words.

eDiscovery

Another set of interesting developments for auditors can be found in the field of *eDiscovery*. When discussing big data in relation to law, we may confidently state that legal fact-finding missions, also known as eDiscovery, deal with the biggest legal data collections of all. Today, an average eDiscovery easily involves several tera-bytes of electronic data, holding hundreds of millions of documents with highly dynamic and completely unstructured information. These data sets consist of a variety of languages and distributed sources in many different electronic formats and shapes (including legacy and corrupted files); to put it more bluntly: eDiscovery data is truly tough big data to deal with.

eDiscovery (also called *electronic discovery*) originated in the United States. It refers to the process of discovering facts in legal proceedings. Discoveries are a part of a pre-trial procedure under which one party can request evidence from the opposing party. Discovery is all about fact-finding, and ultimately, truth-finding. Over the years, eDiscovery (US style) has become the standard approach in Europe for use in cases, such as arbitration, answering regulatory requests, (internal-, government- , and criminal) investigations, freedom of information act (FOIA) requests, public records requests, compliance investigations, preparation of mergers and acquisitions (M&A) and recently also Right to be Forgotten Requests under the General Data Protection Regulation (GDPR). [4]

2 See https://en.wikipedia.org/wiki/Precision_and_recall for a detailed explanation of the terms precision and recall.

3 For instance, by comparing the extracted distributions of the components of such patterns to those of a verified language model of normal language.

4 See https://www.zylab.com/en/corporations/resources/big-data-analytics-for-legal-fact-finding for a detailed overview and the history of eDiscovery.

eDiscovery and text mining for Early Case Assessment

The combination of eDiscovery and text mining is the perfect tool for the more strategic application of what is called *early case assessment*. When an organization is confronted with litigation, a regulatory request, or an (internal) investigation, the initial eDiscovery can generate terabytes of electronic data. It is not easy to start comprehending what a case is about, let alone making well-informed strategic decisions. This is where early case assessment can help. Early case assessment is an umbrella term for many different methods to understand the structure and content of large unstructured data sets in order to make better decisions in an early phase of eDiscovery without the need to have to review all documents in great detail in advance.

Depending on the type of eDiscovery case, there are different dimensions that may be interesting for an early case assessment: custodians, data volumes, location, time series, events, modus operandi, motivations, etc. As described by Attfield and Blandford in 2010,[5] traditional investigation methods can provide guidance for the relevant dimensions of such assessments: *Who, Where, When, Why, What, How and How Much* are the basic elements for analysis.

Who, Where and When can be determined by Named Entity Recognition (NER) methods. *Why* is harder, but personal experience of the first author in law enforcement investigations shows that data locations with high emotion and sentiment values also provide a good indication of the motivation or insights into the *modus operandi*.

Below I provide a few examples of such analysis derived by using methods from the field of text mining.

Answer the What question with Topic Modeling

An example of the visualization of the *What* question can be found in **Figure 1**. The Non-negative Matrix Factorisation (NMF) topic modeling is combined with clustering and basic visualization. This visualization allows users to dynamically browse eDiscovery document sets based on the automatically derived topic hierarchy.

Figure 1 - Visualizing the What question in eDiscovery

Source : ZyLAB Technologies BV, Amsterdam, the Netherlands.

5 S. Attfield, & A. Blandford, 'Discovery-led refinement in eDiscovery investigations: sensemaking, cognitive ergonomics and system design,' Artificial Intelligence and Law, 18(4), 387-412, 2010. doi:10.1007/s10506-010-9091-y.

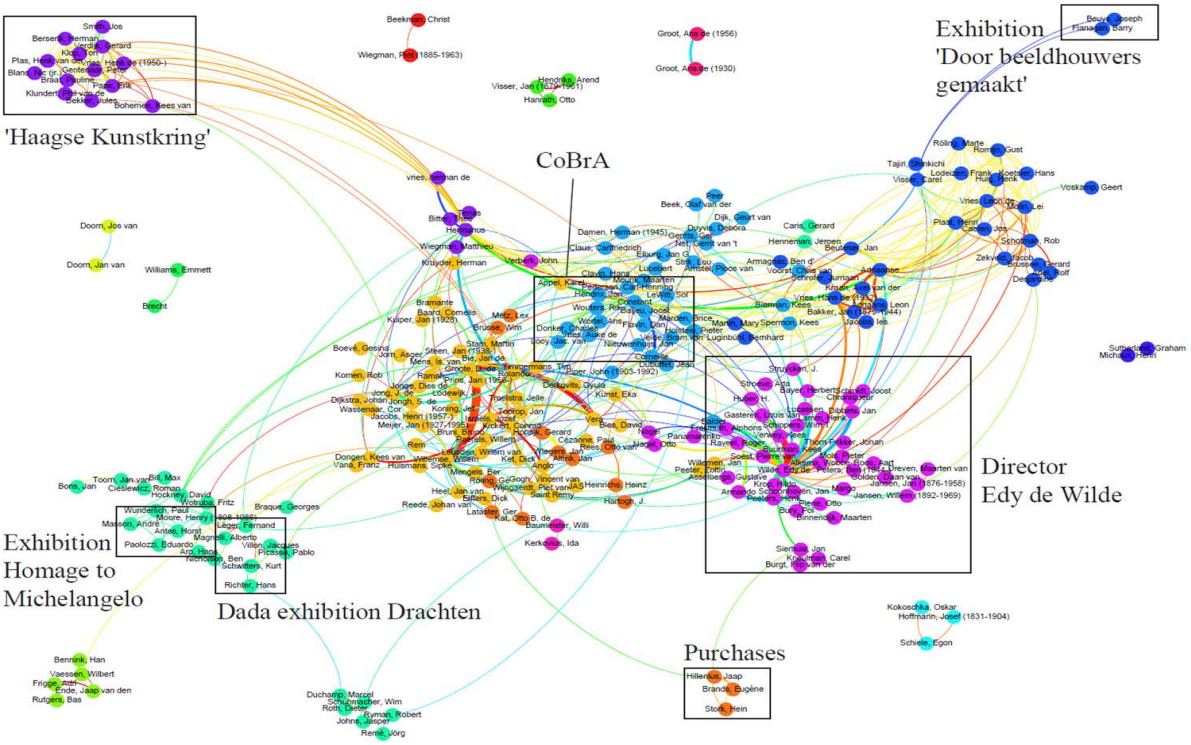
Figure 1 represents two adjacent visualizations of the *What* question: on the left side a traditional text hierarchical tree view and on the right side a so-called Word-Wheel representation. Both can be navigated interactively. For the text this is done by clicking on a line and for the graph by clicking on an area in the graph, one can either enlarge it, make it smaller, or navigate to the documents containing a specific topic that is most dominant. An example of text clicking is as follows. Clicking on the red entry on the left side 'golf hole woods holes round' will show the documents describing Tiger Woods successes in the 1996 World Golf tournaments. All these topics and corresponding labels have been recognized by the topic modeling algorithm using unsupervised machine learning, the algorithm does not need any labeled or other initial information to build such topic models. This method is also language and domain independent.

Answering the Who question with Community Detection

Once the Who's are identified by using Named-Entity Recognition, methods from social network analysis can be used to identify relevant groups and communities, allowing the reviewers to prioritize the review better by focusing on the data of individuals that are communities in close vicinity of the main suspects.

An example of such Community Detection in correspondence of the Museum of Modern Art in Amsterdam will lead us to the automatic derivation of communities.[6] See Figure 2.

Figure 2 - Community Detection in Communication from the Stedelijk Museum of Modern Art Amsterdam, the Netherlands



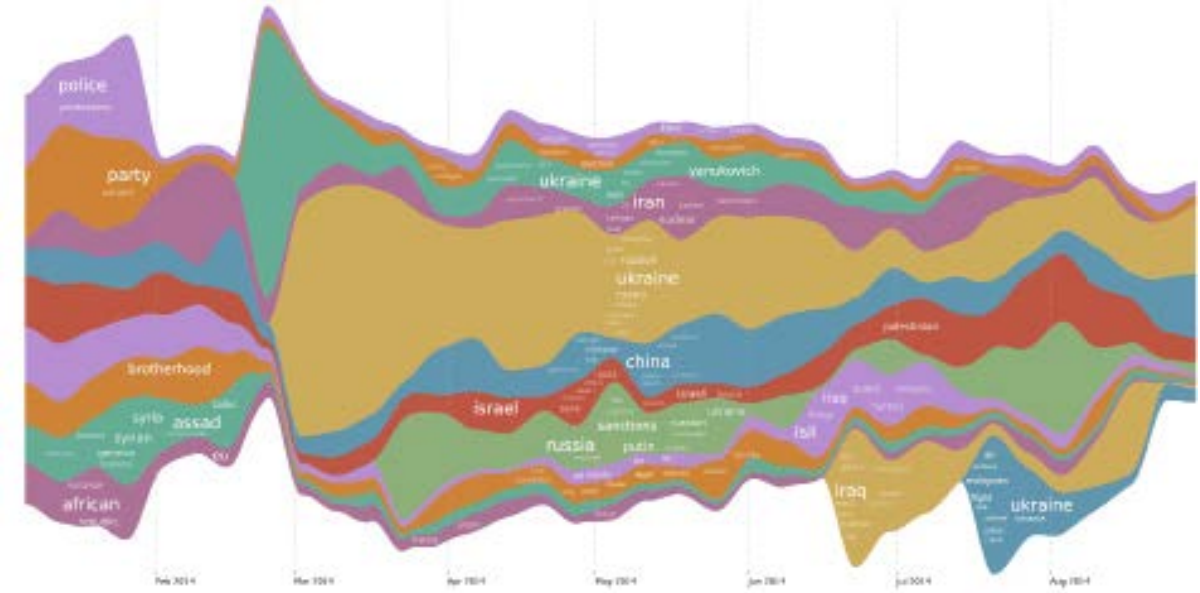
Source : ZyLAB Technologies BV, Amsterdam, the Netherlands.

6 J. Smeets, J. C.Scholtes, C. Rasterfoff & M. Schravemaker, 'SMTP: Stedelijk Museum Text Mining Project.' Digital Humanities Benelux (DHBenelux), Luxemburg, June 2016.

Answering the *What-When* questions with Topic Rivers

Another dimension of early case assessment can be obtained by combining more complex overviews such as *What-When*, a form of dynamic topic modeling, also referred to as *Topic Rivers*.[7] **Figure 3** displays the visualization of so-called Topic Rivers in 8 months of Reuters news from 2014. For each week, the system determines (in this case) the 20 most dominant topics. Next, for each period, the number of new, growing or declining topics is determined and connected to corresponding topics in the previous and next period. In the resulting graph, the invasion in Ukraine can clearly be observed in March 2014, pushing aside all other news. Other topics, such as the Israel-Palestine conflict can be seen to be present in the news for the entire year. Another anomaly is the blue one on the right-side bottom of the graph, representing the news when Malaysia Airlines Flight MH17 was shot down over Ukraine.

Figure 3 - Answering the What-When question: Topic Rivers in 8 months of Reuters News from 2014



Source : ZyLAB Technologies BV, Amsterdam, the Netherlands

Answering the Why questions with Emotion Mining

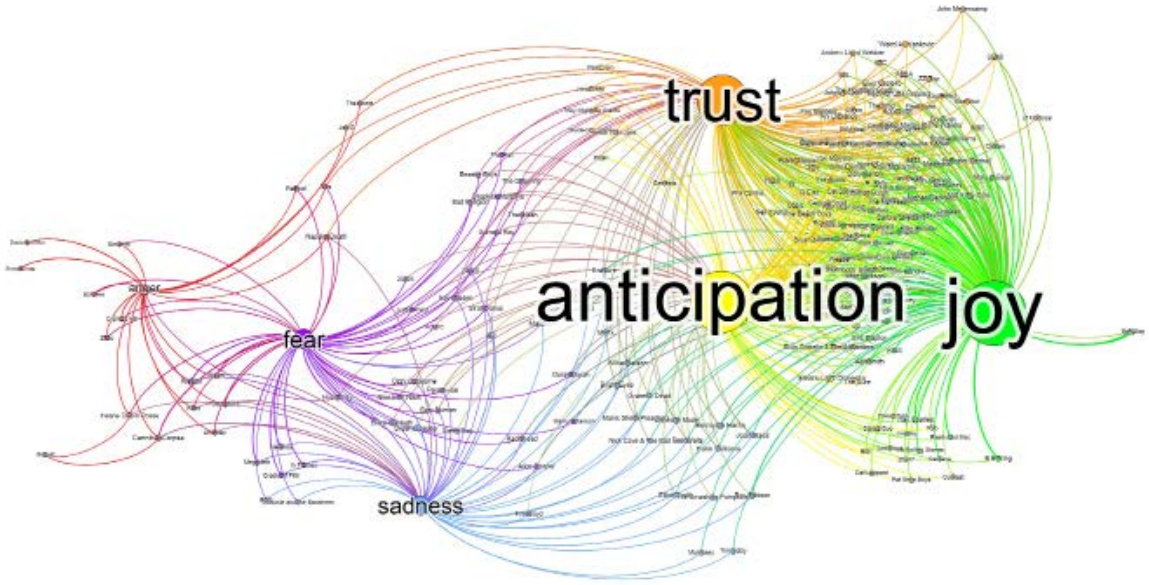
Emotions and sentiments often lead to interesting emails in eDiscovery. Both can be measured. Combining emotions with custodians (persons) can lead to the discovery of relevant issues or insights into the modus operandi and sometimes even code words, that could be the starting point of further investigations.

For this reason, part of the Why question can often be identified by looking at the communication with the highest levels of emotions of negative sentiments. By identifying these and linking them to the persons expressing them, one can obtain an answer to the Why-Who question.

An example of how well one can determine emotions from text is provided in Figure 4, where we can observe the analysis of the text from 220 000 pop song lyrics for the basic emotions: Trust, Anticipation, Joy, Anger, Fear and Sadness. The name of the pop artist is displayed on the lines connecting the most dominant emotions in their songs. As we can observe, rappers are in the left bottom corner around Anger and Fear. Elvis, the Beatles, and David Bowie are more in the top right corner around Joy, Trust and Anticipation. Similar analysis has been made of movies, books and other content, leading to similarly satisfying results. These techniques have also been used for court cases.

7 M. Tannenbaum, A. Fischer & J.C. Scholtes, 'Dynamic Topic Detection and Tracking using Non-Negative Matric Factorization,' *Benelux Artificial Intelligence Conference* (BNAIC), Hasselt, Belgium, November 5-6, 2015.

Figure 4 - Answering the *Who-Why* question: Emotion mining in 220.000 song lyrics and the corresponding artists



Source : ZyLAB Technologies BV, Amsterdam, the Netherlands

Many other combinations, analysis, clustering and visualization methods can be created, and we will most likely see more of these in future research.

Using Text-Mining for Event Detection

In a number of recent research projects, the above mentioned ideas have been taken one step further: by using *open information extraction*, text collections can be converted into graphs of linguistic patterns. This can be done by first extracting patterns of *objects, predicates and subjects*. Next, as similar words are used both as *objects* and *subjects*, these patterns can be represented as graphical structures. Extending this idea with a temporal component, it is then possible to create dynamic graphs that change over time, where changes to the *objects, predicates and subjects* result in a time-lapsed representation. It can be observed that major changes in such networks, appear to relate to major real-world events. Early experiments on news messages and on emails from the ENRON data-set, have shown interesting early results which have resulted in a number of on-going current research projects.[8]

Instead of investigating changes in graphs derived from *objects, predicates and subjects,* one can also just investigate graphs representing communication patterns between individuals (without taking the actual content of message into consideration). Using nodes as individuals and the number of emails (or text messages) as the edge between the nodes we can create a graphical representation as well. Such a graph can be presented in time, also resulting in a time-lapsed representation of all communication.

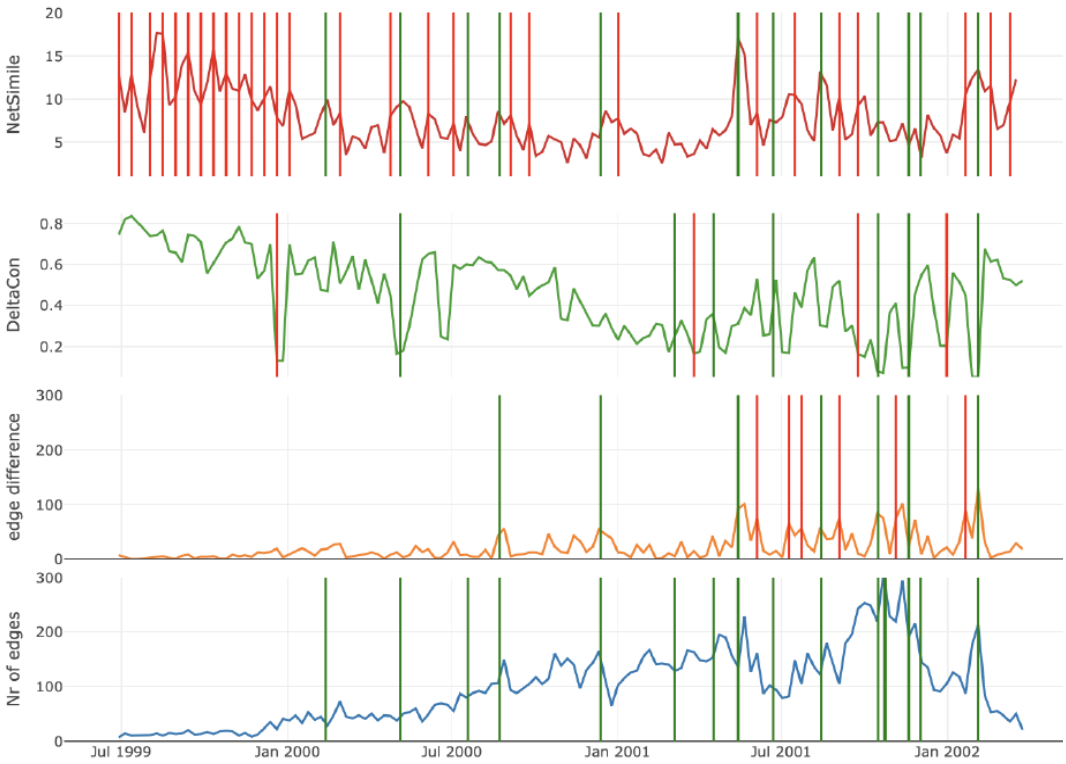
Major changes in such a network can then be linked to major events during an investigation. The challenge is to determine which changes are relevant. To do this, a variety of algorithms can be used. The most common ones are NetSimile (first graph), DeltaCon (second graph), or one could even just measure the edge difference (third graph). The fourth graph represents the ground-truth of the interesting events in the Enron investigation. One can observe that DeltaCon finds almost 65% of all events with a relatively low number of false positives. NetSimile finds almost all events, at the price of a larger number of false positives.[9] This field, too, is subject to additional research,

8 Heinrichs, B. and Scholtes, J.C. (2018).‚Detecting Anomalous Events over Time Using RDF Triple Extraction and a Dynamic Implementation of OddBall.' Benelux Artificial Intelligence Conference, Den Bosch, The Netherlands, November 2018.

9 Helling, T.J., Takes, F.W., and Scholtes. J.C. (2018). 'A community-aware approach for identifying node anomalies in complex networks.' The 7th International Conference on Complex Networks and Their Applications December 11-13, 2018, Cambridge, United Kingdom.

which is currently underway at ZyLAB in collaboration with a number of universities in the Netherlands.

Figure 5 - Events in Enron between June 1999 and February 2002



Source : ZyLAB Technologies BV, Amsterdam, the Netherlands

In this graph, three different methods have been compared to detect important events in the Enron investigation. Note that the lowest graph in the figure illustrates the ground-truth events shown with green lines. For the other three measures, the green line is when one of the ground truth events is correctly flagged as an anomaly, while the red line is an event that is incorrectly flagged as an anomaly (aka a false positive). [10]

New techniques… for the same purpose

eDiscovery technology taught us how to deal with real-world big data. Text mining taught us how to find specific patterns of interest in textual data. The combination of eDiscovery and text mining will teach us how to find even more complex (temporal) relations in big data and ultimately train our algorithms to provide better decision support and assist investigators in detecting anomalies and moments of incidents in our ever growing electronic data sets.

This is a rapidly evolving field, where new methods to understand the structure, meaning and complexity of natural language, are being introduced at an ever accelerating speed. These developments will result in tools that will be essential for auditors and internal investigators to keep up with the ever-growing electronic data sets and get to the essence of a case as quickly and efficiently as possible.

10 From Thomas Helling. 'Anomaly detection in real-world networks.' Master of Science. Leiden Institute of Advanced Computer Science (LIACS), Leiden University.

Professional impact of digital audit - thinking beyond the realm of audit standards

By Professor Giuseppe D'Onza and Federica De Santis, University of Pisa

Source: shutterstock-Alexander Supertramp

Auditors in the private and the public audit sector, be they internal or external, seem to be realising more and more that they need to grasp the opportunities that the digitalisation of their work environment offers. But how should they reconcile these 'digital' developments with the audit standards they normally work with, and which often serve as crucial beacons for an auditor's day-to-day work? Giuseppe D'Onza is Professor of Risk Management and Financial Auditing at the Department of Economics and Management at the University of Pisa. Federica De Santis is a lecturer and researcher at the same department. They have both contributed to the last and previous ECA summer school programmes. They identify some key opportunities for auditors that digitalisation offers and argue that standards should not be a straightjacket and an end as such, but a means to provide quality work.

Digitalisation and digitisation, also for auditors

In today's business environment an increasing number of private and public organisations are moving toward digital transformation to increase the value created for their stakeholders. At the core of such transformation is the need to exploit the opportunities digital technologies offer to enhance the organisation's customer value proposition, to create new products and services and to increase the effectiveness of the organisation's operational model (De Santis, 2018). This digitalisation has an impact on how work gets done, creating new revenue schemes.

The digital transformation is becoming more and more pervasive among organisational departments, moving beyond the marketing and sales functions to permeate every part of an organisation. For example, companies are investing significant resources to generate intelligence from the large volume of data that digitisation – the conversion of analog to digital – has made accessible, to improve procurement and supply chain processes (Alles, 2015a). Even accounting processes are affected by digital transformation (Vasarhelyi, Kogan, & Tuttle, 2015).

In such a scenario, auditors cannot remain deaf to what is going on in their environment and ignore the fact that this massive volume of data needs to be used to deliver high-quality audits by using appropriate tools and techniques. Studies (Issa, Sun, & Vasarhelyi, 2016; Kokina & Davenport, 2017) have amply highlighted that digital technologies can be employed to automate single auditing tasks, as well as the whole auditing cycle, to improve audit planning, execution and communication.

Opportunities for greater assurance

In this article we focus our attention on the digital transformation of the Internal Auditing Functions (IAFs). Empirical surveys[1] indicate that an increasing number of IAFs have started to use digital technologies even though the digitalisation of this function progresses more slowly, on average, than for other organisational departments. IAFs in multinational companies and in banks seems to move faster toward digitalisation than in other contexts as they probably work in organisations in which digital transformation projects have already been implemented in other business functions (D'Onza, Lamboglia, & Verona, 2015; Rikhardsson & Dull, 2016).

Additionally, an increasing number of IAFs are using process mining techniques to analyse the data stored in the Enterprise Resource Planning system, with the aim of testing the population of companies' transactions and discovering anomalies, bottlenecks, duplication of activities and other process inefficiencies (Jans, Alles, & Vasarhelyi, 2014). Leading-edge IAFs are also investing in big data analytics and have started projects to integrate machine leaning and artificial intelligence in their operational and compliance audit processes (Kokina & Davenport, 2017). These projects are usually carried out in cooperation with external consultants, which support the IAF team in embracing new digital technologies.

The aforementioned studies also indicate that the use of digital technology increases the IAF's ability to provide its Board of Directors, Audit Committee and the CEO with greater assurance about the real functioning of corporate business processes, internal controls and risk management activities. We see three key developments here:

- the level of assurance provided is much greater than internal auditors can provide using traditional audit techniques based on sampling (Alles & Vasarhelyi, 2010; Chan, Chiu, & Vasarhelyi, 2018);
- the use of process mining and other data analytics helps to improve understanding of other functions that already use these tools, and increases the quality of the IAF's recommendations;
- these tools improve communication with the IAF's stakeholders by increasing the appeal of the presentation of audit engagement results, which is also important for the IAF to be perceived as a value adding function (Appelbaum, Kogan, & Vasarhelyi, 2017; Rakipi, De Santis, & D'Onza, *forthcoming*).

Digitalisation is indispensable for adding value

Overall, in many organisations internal auditors are seeking to understand how to use digital technologies to evolve the way they work. At the same time, a large number continue to perform their activity in a traditional and somehow anachronistic way. There are also IAFs that have not modernised their toolkit in response to the digital transformation of their organisation. When this happens, the consequence is that the IAF's work is not aligned with the organisation's needs or the expectations of the IAF's stakeholders. The consequence is that the IAF cannot be perceived as a value adding function by the Board of Directors and senior management, and is inevitably marginalised (Sarens & Lamboglia, 2014).

1 See for example Cangemi, 2016; Li, Dai, Gershberg, & Vasarhelyi, 2018; Vasarhelyi, Alles, Kuenkaikaew, & Littley, 2012; Rakipi, De Santis, & D'Onza, forthcoming.

As we know from the definition of internal auditing provided by the Institute of Internal auditors that the ultimate goal of the IAF is to add value and improve an organisation's operations, it is clear that the IAFs cannot lag behind and ignore the advantages this function can obtain from digitalisation. The most obvious are: a more effective and robust understanding of the company's risks; greater assurance for the board and senior management by testing populations instead of subjective or random samples; better quality of audit evidences; an extension of the scope of audit testing, and the automation of previously manual processes. All these benefits can be summarised in a few words: they enhance the quality of internal auditors' work (Schneider, Dai, Janvrin, Ajayi, & Raschke, 2015; Vasarhelyi et al., 2015).

Audit standards as a means, not an end

The enhancement of audit quality should be the main purpose of audit standards. We know that the auditing profession is awash with standards (De Santis, 2016; Knechel, 2013). But auditors should not confuse means and ends: standards represent just a means to an end, which is audit quality. In other words, internal auditors should worry about the quality of their work instead of the degree of compliance with standards. This is particularly true nowadays, since the diverse sets of auditing standards (e.g. financial audit standards, internal audit standards) do not reflect the new technological environment in which auditors operate.

Discussing the need to update financial audit standards, researches have highlighted that many of them are too anachronistic, as they ignore the potentialities that digital technologies offer to enhance the financial statement quality audit. Standards usually lag behind audit practice and this phenomenon is recurrent and physiological within certain limits. The International Auditing and Assurance Standards Board (IAASB) is moving ahead to fill this gap (see for example the International Standards on Auditing (ISA) 315 revised) and other auditing standard setters (e.g. Institute of Internal Auditors, ISO) are also moving in the same direction. So such a lag between standards and practices need not be a limitation on innovation in respect of internal audit techniques (Alles, 2015b; Alles & Gray, 2016).

Digital transformation of audit is crucial, also for chief executives

In conclusion, digital technologies offer the IAFs the opportunity to add more value for their organisations and increase the satisfaction of the IAF's stakeholders. As many organisations are under pressure to increase their profitability, IAFs cannot continue to work in an anachronistic way, using an obsolete toolkit and employing people that do not have the right skills and competencies to implement a digital strategy in the IAF. Otherwise, internal auditors will be perceived as unprofessional and will inevitably lose their organisational relevance (Rakipi, De Santis, D'Onza, *forthcoming*).

We therefore believe that all IAFs should take steps toward digitalisation and work on the conditions to make the digital transformation of the IAF successful. Many commentators believe that the IT competencies of internal auditors are crucial for such a transformation. We agree with this view, but we also believe that Chief Audit Executive (CAE) leadership (Martino, D'onza, & Melville, 2019) is much more important. CAE leadership is a precondition for obtaining adequate financial resources to attract auditors with the skills and competencies to carry out such a transformation. We also believe that CAE leadership is crucial to building positive relationships with key actors within the organisation and, in this way, ensuring the IAF has a central role in the organisation's digital transformation processes.

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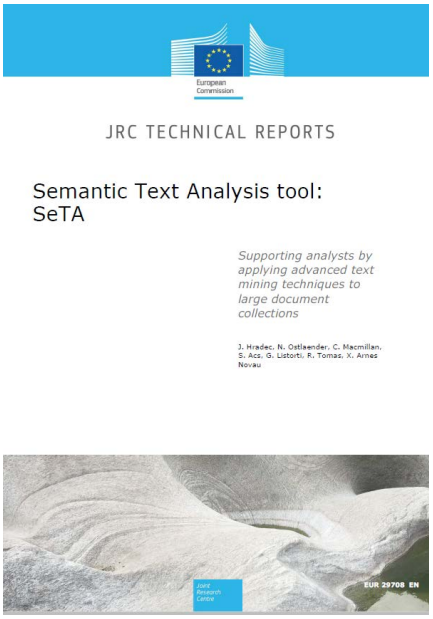
Finding information – how the Commission's Joint Research Centre uses language processing for policy support

By Jiri Hradec, Charles Macmillan and Nicole Ostlaender, Joint Research Centre (JRC)

Trustworthy information is a key element of accountability. Who does not dream of a fact-checking device to confirm that the information they are reading, or a sentence they are writing, is factually correct? Specific claims could be easily confirmed or refuted. Does this sound like science fiction? The European Commission's Joint Research Centre (JRC) is working on such an application – called SeTA, or Semantic Text Analysis tool – building on its enormous in-house repository of data that is only a click away. Jiri Hradec, Charles Macmillan and Nicole Ostlaender, all three of whom work at the JRC, explain what the SeTA application entails and hint at what it is capable of at this stage.



Source: JRC

What is SeTA and why does it matter?

Searching for information is the story of our lives. It is like trying to find your staff card on a Monday morning after you've spent the weekend with your kids in the mountains. You try desperately to find it in the huge pile of stuff which, as tired parents, you have yet to clean up after a late Sunday night arrival. You usually put it next to the front door in its designated box, but where on earth could it be this time?

Information extraction suffers from exactly the same problem: usually organised, sometimes not; high-value facts are usually stored in designated databases, sometimes not. However, 'usually' is not enough, especially in situations that require quick action and a comprehensive overview. What we need is a powerful assistant that provides us with this overview, and gives us quick access to the information we need.

SeTA, or Semantic Text Analysis tool, is a web application that is accessible on the European Commission's network to provide support for its staff. It depends on a set of neural networks[1] that have been trained on the practically complete corpora of public European Commission documents (EURLEX, the EU Bookshop, etc.) from 1953 right up to last night. We have chosen English-language texts due to the sheer volume of available material and because the majority of important documents exist in an English version. The key advantage of SeTA – which is currently a prototype – is its ability to grasp the meaning of terms, and the changes in those meanings over time. Using this ability, it builds up a comprehensive ontology which makes it possible to carry out semantic searches in more than 500 000 Commission documents. A dedicated Technical Report contains a detailed description of the application, together with a host of examples of its application in real-life policy support scenarios.[2]

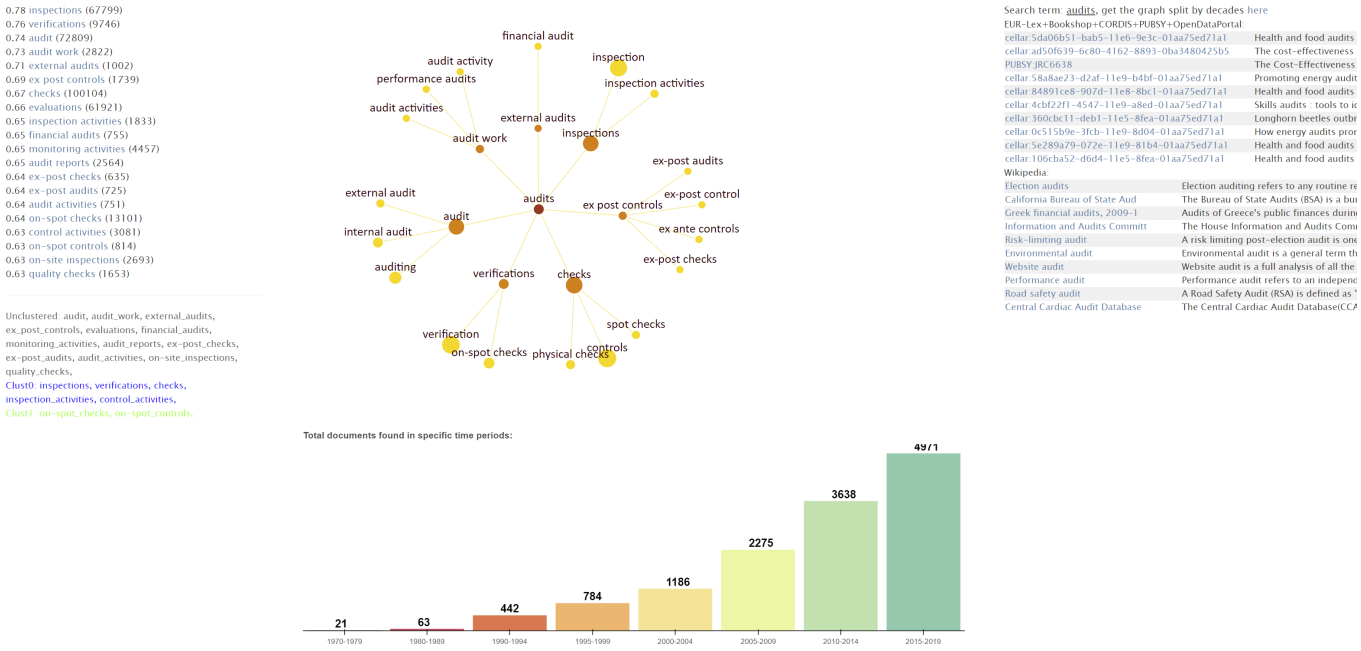
1 Word2vec and FastText word embedding are explained here: https://towardsdatascience.com/word-embedding-with-word2vec-and-fasttext-a209c1d3e12c

2 J. Hradec, N. Ostlaender, C. Macmillan, S. Acs, G. Listorti, R. Tomas, X. Arnes Novau, Semantic Text Analysis Tool: SeTA, EUR 29708 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-01518-5, doi:10.2760/577814, JRC116152

The English linguist J.R. Firth postulated in 1957[3] that 'You shall know a word by the company it keeps.' SeTA is a vector space – imagine a cube – where the position of words and phrases determines their meanings and similarities. Thus, the most similar terms to the word *auditor* are *external auditor* and *internal auditor*. As we have trained the neural network using our policy-related document corpus, the most similar term to *eca* is *European Court of Auditors*. And while Google gives *hat*, *lid* or *limit* as synonyms for *cap*, it obviously means *Common Agricultural Policy* to us.

Our approach goes beyond mere term similarities. A well-known application of vector logic trained on general texts is *queen-woman+man,* which gives *king*. Although this does not work in our vector space as our texts are generally gender-neutral, *Water Framework Directive – water + waste* yields *Waste Framework Directive*. And if we know that *Water Framework Directive* is actually a *directive* and we are interested in *indicators* that are linked in the vector space, we get *water indicators, water quality indicators*, but also *spatial indicators* and *ecosystem service indicators.* Sounds like science fiction? No: just the application of a mathematical principle. We learn by learning to ask, and the learning curve can be pretty steep (see **Figure 1**).

Figure 1 - On-the-fly generated ontology surrounding the term 'audits'

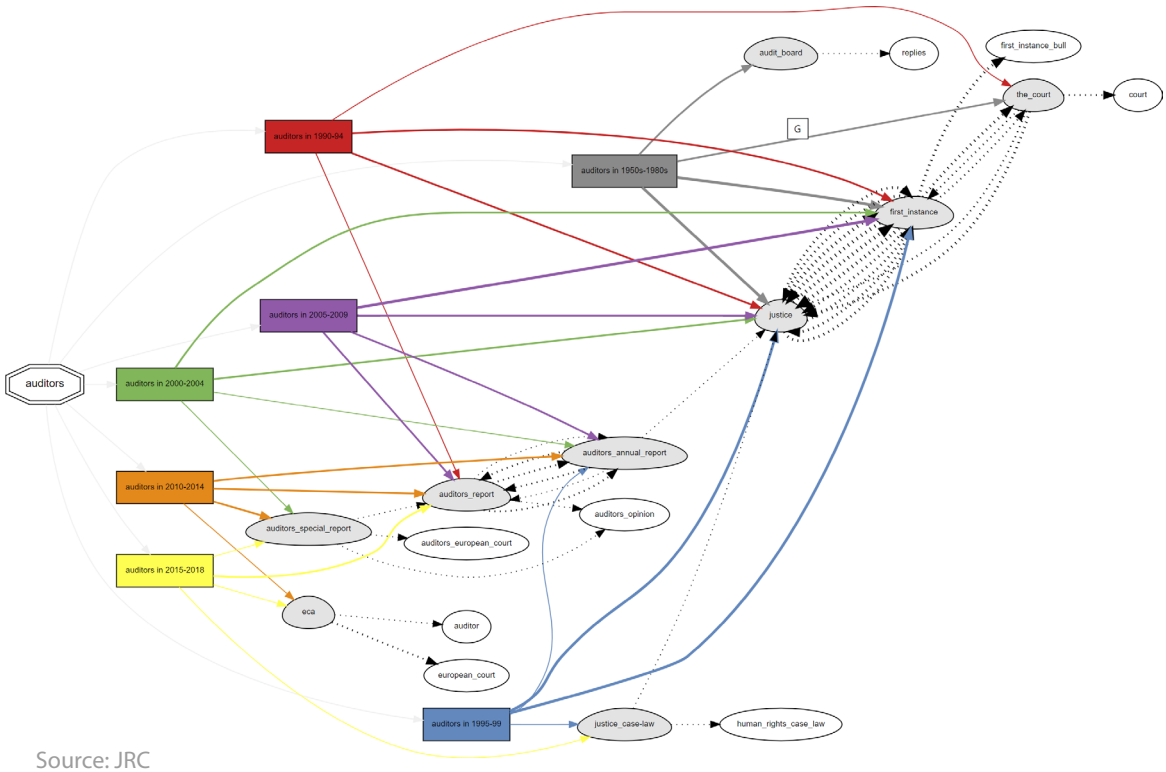


Source: JRC

By training networks by half decades to capture the language specific to each new Commission, we also extract how the meaning of a term changes over time in a given policy context (see **Figure 2**).

3 Firth, J. 1957 "A Synopsis of Linguistic Theory 1930-1955," in *Studies in Linguistic Analysis,* Philological Society, Oxford; reprinted in Palmer, F. (ed.) 1968 *Selected Papers of J. R. Firth,* Longman, Harlow.

Figure 2 - Evolution of the term 'auditors' over decades, reflecting contextual change in policy documents and technical reports



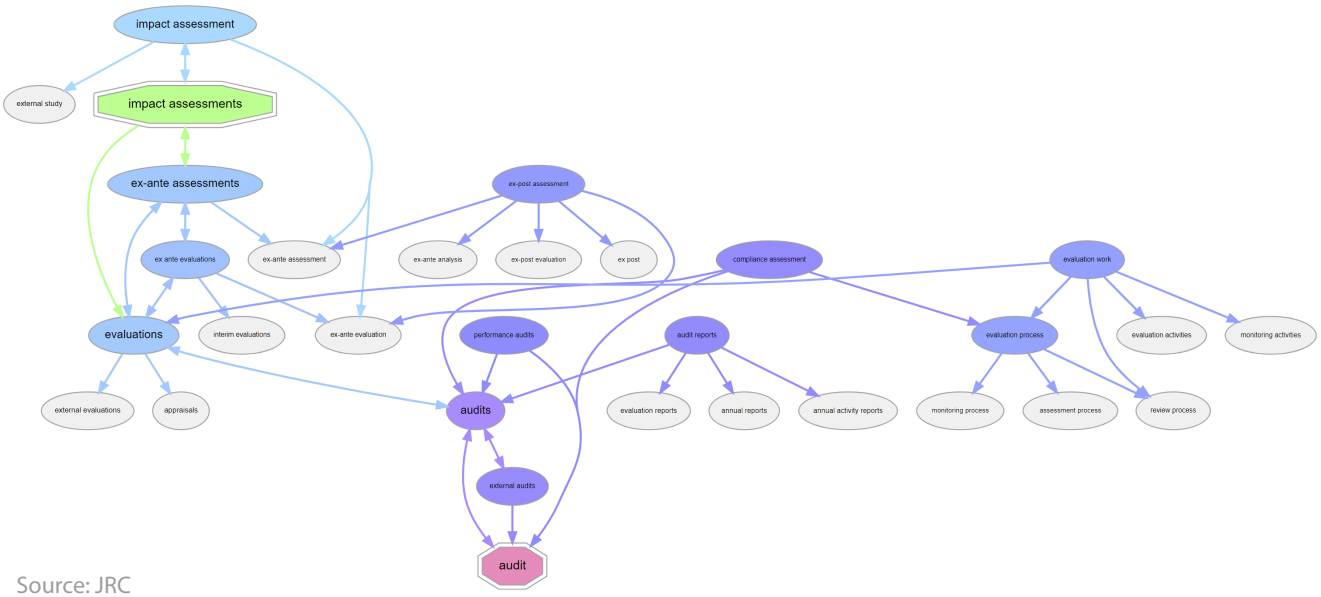
Source: JRC

SeTA's key users are Commission experts working in the field of policy impact assessments, where an ability to learn quickly about a new domain and all terms used within it (including slang[4]), plus fast access to relevant documents, are prerequisites for allowing experts to concentrate on generating added value, instead of performing mundane tasks. However, SeTA's potential user community is much broader: archivists, policy analysts, anyone responsible for checking a large document collection, or even the leader of a newly established cross-domain team trying to help people understand their interlocutors' slang would benefit from an instrument that explains the meaning behind Commission policy terms and their context.

One of the most significant side-effects of building SeTA was finding that a digital assistant can support domain experts by offering comprehensive coverage of their domains. Thus, SeTA provides on-the-fly ontology creation, where the expert's job is to say exactly where to stop. This approach also helps to explain and explore the relationships between different terms, as in Figure 3, which simply asks: *What do impact assessments have in common with audit?* In less than two seconds, SeTA finds similarities, components and variants directly from the vector space, with no need to search for anything in the texts. It also satisfies the frequently expressed desire for a more holistic viewpoint, as comparing terms from different domains will unearth relationships with which the reader may have been unfamiliar.

4 According to Wikipedia, 'slang exists because we must come up with ways to define new experiences that have surfaced with time and modernity'. The meanings of words develop in different ways, depending on whether they are used by politicians, scientists, engineers or policy makers. However, context and frequency remain the same, so SeTA can tell that *waste water treatment plant* is very similar to *municipal sewage treatment facility*. The worlds of the office and everyday reality are thus connected!

Figure 3 – Features common to impact assessments and audit



Source: JRC

But SeTA's best feature of all is that it actually works!

A different approach to summarising text

There are several methods for extracting meaningful information from a large text without having to read everything. For instance, we can combine word embedding with the *TextRank* algorithm to extract the most important words or sentences from a document. In theory, we can train a deep neural network on a large corpus of text/abstracts to obtain a solid model for generating summaries from a document. However, we have taken a different approach that is best suited to the needs of policy analysts: claim extraction and fact checking.

Imagine being tasked with checking a draft impact assessment about population exposure to PM2.5. The search 'PM2.5 exposure population in health risk' yields 220 results on the Publications Office website. About two weeks' reading time, you might think?

We have split our EU corpus into roughly 500 000 000 sentences, identifying all phrases (e.g. *audit trail*) and mentions of date, location or institution, etc. The neural network predicted whether the *2000* in the sentence is a year, a quantity or part of a phrase (e.g. *Natura 2000*).

This approach allowed database queries such as [*eurovoc: health risk AND sentence:PM2.5 AND sentence:exposure AND entities:(PERCENT)]* that yields 18 sentences in 10 documents. We can refine the query results further by adding *children*, which returns one sentence from the final report of the JRC project SINPHONIE on school indoor pollution. The whole procedure took less than 30 seconds. Why *search* for information when you can simply *find* it?

Such an approach therefore helps us to construct a knowledge graph as the key to yet another and more important advance: automated fact checking. Natural language-processing algorithms can easily parse the sentence *GDP growth in Belgium in 2007 was 3.3%* into GDP growth [phrase], Belgium [location], 2007 [date] and 3.4% [quantity, percentage]. However, sentences are usually written by real people and, as paraphrased in the very first sentences of this article, are often too complex and difficult for an algorithm to comprehend: 'The Federal Statistical Office released figures for GDP growth

and the general government deficit in 2005, at 0.9% and 3.3% of GDP, respectively'.[5] Where an analyst can get slightly confused for a second, the machine still fails miserably to understand how the numbers connect to the terms … so far. But we are working on it.

Stepping into the future

One of the main reasons we are working on knowledge extraction is automated fact checking. While the first sentence in the previous paragraph can easily be structured into a Eurostat database RESTful service query to obtain information that Belgian GDP growth in 2007 was actually 3.4%, the second sentence requires the attention of an expert.

Automating fact extraction and verification will help us in the very near future to build an AI assistant that will offer policy analysts the facts they need while they are actually writing their sentences. GDP growth in Ireland in 2015 was … And, *ping*, the computer automatically inserts the eye-watering figure of 25.6%.

However, more importantly, such information can be extracted to create a database of facts and claims. Computational models (e.g. for GDP forecasts) can benefit hugely from having comprehensive information for back-casting to improve models. Knowing what claims have previously been made about a topic would help avoid contradictions. Ex-post analysis will be a breeze if all facts and claims upon which policy formation is based are already available. New problems where information quality yields a totally different meaning will result from this process. There won't be much room for boredom and the comfort of the familiar in the future.

SeTA has been trained and continuously improved in order to support analysts exactly where we think it will help them the most. Finding all facts, citations and relevant documents will reveal fundamental truths. We may not yet have reached a situation of on-the-fly data extraction from published news and Member State reports, but we are working on it. We may still have a low fact-extraction ratio, but 80% is better than nothing. PDF is a print format and a lack of information on text/sentence/paragraph flow means that extracting text from PDFs is a real headache. To compensate, we have also written de-hyphenators, spellcheckers and phrase formatters.

SeTA's tools, even in their current state, either as a web application or a web service for information system integration, provide a major opportunity for alleviating the burden for the institution's *analysts/generalists*, who can understand the facts when they see them instead of reading reams of self-confirming text.

Seeing is indeed believing. Those of you who use the European Commission's networks, where SeTA is accessible, are invited to try the SeTA user interface[6] and its web services.[7] We are currently in discussions with the Publications Office to offer SeTA as one of the interfaces for facilitating access to the whole European public document corpus.

Real-life use-cases were behind the birth and growth of SeTA. Please let us know if you find the system useful so that we can continue to learn and build something together!

5 CELEX:32006D0344
6 https://seta.emm4u.eu/txtmining/
7 https://seta.emm4u.eu/seta-api/seta/doc

New ECA Member

As independent professionals, auditors can assess long-term benefits

Interview with Viorel Ştefan, ECA Member

By Derek Meijers and Gaston Moonen

Viorel Stefan, in liaison with the free world

Viorel Ștefan started his six year mandate, as the new ECA Member from Romania, on 1 July 2019, as. Before coming to Luxembourg, he was Minister of Public Finance and Deputy Prime Minister of Romania. He has also served for over twenty years as Member of Parliament in his home country. He believes that the ECA can add great value by providing assessments on how different areas interconnect, while providing practical recommendations for the near and distant future. In this interview, he shares some key aspects on his background, experiences and perspectives for his work at the ECA.

Facts of life experience

In his professional life, the new ECA Member has seen many sides of life: working under communist rule, in a state owned enterprise, then leading a private company, in politics as parliamentarian but also in the executive branch as Minister of Public Finance and Vice Prime Minister. Viorel Ștefan clearly becomes reflective when thinking about his early steps in his career. 'It is not easy to speak about this because it was a difficult period. The image, which describes best that period, is "A bird in a cage with its wings crushed, attempting to fly away."'

He considered himself luckier than many others at that time. In the nine years prior to the fall of communism, Viorel Ștefan worked as an economist and later head of service of a shipping company in Romania. 'I started to work in a shipping company, with international activities, which gave me a chance to have contact with the free economy and the free world. This allowed me to focus on my work and to distance myself from politics. I hoped that the regime would fail. Fortunately, this happened in 1989!'

Later, he became Chief Executive Officer, then Chairman of the Board of the shipping company. This first experience was valuable in other ways: 'If you work in such an environment, you can follow the economic evolutions. I believe you know the sentence: "When the ships are waiting for operations, it is a signal that the economy is thriving. But when the wind roars into the harbour, it is a strong portent that recession is looming."'

Even when the regime changed in 1989, Viorel Ștefan was not inclined in getting involved in politics and preferred to stay in what he calls 'micro-economic management.' 'At that time I wondered whether it was better to stay in a position at micro economic level, or involve myself into macro-economic issues. But after three years, I changed my mind because in the new context I realised that, with the knowledge I had accumulated, I could be useful for others, for the wider public interest'. In 1993, he joined a political party, and in 1996 became a member of the Romanian Parliament, as a senator.

From the 1990s, Romania started a difficult transition – privatisation, new governance model, new type of economy. 'I felt that I was ready to contribute to these processes. And I found a concrete role that I could play. So I did.' Looking back, he is happy with that decision: 'I feel that I contributed to many positive developments in the Romanian economy.'

> *"I feel that I contributed to many positive developments in the Romanian economy.*

Making practical experiences part of policy research

When he was in politics, Viorel Ștefan felt that he could further contribute to the development of the Romanian shipping infrastructure by sharing his experience. This resulted in a PhD thesis for his doctorate degree in economics. 'My research was based on my experiences when I was leading micro economic level processes in this sector, which experienced unprecedented changes. For the first time, many countries transitioned from communism to capitalism. Many great challenges!'

In his research, Viorel Ștefan focused on shipping transport in a European context: 'I based my PhD thesis, entitled *Ways to efficiently improve the river transport system in the European context*, on my experiences of leading a restructuration, a privatisation, and an 'Initial Public Offering' process'. He explains that the thesis related to infrastructure, reconfiguration of navigation systems, implementation of new management tools, and harmonisation with other European systems - all during a period that the Danube was practically paralysed. With a certain pride, he concludes: 'A few years after my thesis, the European Commission approved a special strategy for the Danube… which was the topic of my thesis.'

Success comes with a well-performing team

When speaking about his experiences in politics, Viorel Ștefan clearly distinguishes between his years in the legislative and executive branches. 'The two are rather different. In parliament, in the legislative field, you need knowledge and a certain experience to contribute to improving laws and regulations in specific fields. But when you become a minister, it is much more than experience and knowledge.' He underlines that, then and there, you have to be able to manage rather difficult problems, take decisions quickly and grasp the far-ranging economic and social consequences of decisions.

> *"... when you become a minister, it is much more than experience and knowledge.*

Consequently, for Viorel Ștefan, being the Minister of Finance was a lot more than minding the State Treasury or managing a budget. 'You cover of course fiscal policy, but also customs, public debts, state property, and relations with the international financial institutions. For example, the European Investment Bank's Board of Governors comprises

ministers designated by each of the 28 Member States, usually finance ministers. It lays down credit policy guidelines, approves annual accounts and balance sheet, and decides on the Bank's participation in financing operations outside the European Union and capital increases.'

For him, a crucial success factor in this period was a well-performing team. 'Without this, it will not work. Your success depends on a well-trained and qualified team that you lead with a vision that energizes, orients, and engages its members. Of course, I think your team needs to be inspired by the goals you set, so that they can come up with the best solutions.'

> *Your success depends on a well-trained and qualified team that you lead with a vision...*

While the effects of decisions as a minister might be more visible and direct, the new ECA Member believes that parliamentarian work also bring clear, but sometimes delayed, results. As Chair and member of the Committee for Budget, Finance and Banks, he contributed to institutional reforms of, for example, the central bank and the Romanian Court of Auditors: 'All these institutions developed a modern, European profile when all national legislation was harmonised with EU legislation, with the 'acquis communautaire.' 'A huge process and I am proud of my contribution to the result.'

From policy maker to auditor

For Viorel Ștefan, becoming ECA Member was a logical step in his career. Smiling, he explains: 'If I look at my career through an economic lens, I started at micro level, then continued at macro level – national level if you want. The next logical step is to work at European level!' He considers the ECA an appropriate institution for him to do so. 'The ECA is one of the most important institutions. Our reports are the strongest input used by the European Parliament to grasp the effectiveness of policies, and therefore to fulfil its democratic role in a pivotal moment for our Union. Through our contributions, we also have an influence on the trust citizens have in the European construct.'

When it comes to building trust, the new Romanian ECA Member refers to his extensive experience in the Romanian parliament. For him, the key starting point was good faith. 'If you are able to demonstrate good faith in your dialogue with political partners, you can gain their support throughout the process. Do not forget that in politics the objectives are often more or less the same. However, the means to meet them are different. If you are able to grasp your political partner's perspective, if you have the capability to understand, many things are possible.'

> *... in politics the objectives are often more or less the same. However, the means to meet them are different.*

Viorel Ștefan considers such an understanding also crucial in the audit process, for both the auditor and the auditee: 'I believe that we should present our audit findings to the auditee and show that we have enough convincing and irrefutable evidence.' We have to be convincing with arguments based on clear evidence and keep in mind that the citizen expects us to check if the EU is securing value for money.

At the ECA, Viorel Ștefan has become Member of the audit chamber Sustainable Use of Natural Resources, and Member of the Audit Quality Control Committee. 'In this audit chamber, I am the Reporting Member for three tasks, all related to agriculture, energy, environment and pollution. We need to assess the interconnections between these topics because they all influence the quality of our environment and address the most important subject of the day, climate change, which is transforming our society and our daily lives.' He adds that a report should propose, when appropriate, practical recommendations for improving the policy.

> *We need to assess the interconnections (...) and address the most important subject of the day, climate change...*

Contributing for future generations

Viorel Ștefan highlights three important issues, where the ECA could play an important role, for the future. First, digitalisation: 'It is a priority of the ECA strategy and, of course, an important goal for the new European Commission too. Digital systems can solve routine problems that consume many resources, and therefore free audit resources for other tasks. But we need to be aware that digital systems cannot judge, and their creativity is limited.'

> *... digital systems cannot judge, and their creativity is limited.*

Second, the ECA's role of auditing the performance of EU policies and programmes: 'The ECA must be able to assess the EU's performance and report in an accessible language, so that every EU citizen can understand our conclusions'. He thinks that ECA auditors have a clear advantage: 'Auditors, as independent professionals, can assess long-term benefits.'

Last but not least, he mentions climate change and environment as specific issues where he hopes the ECA can contribute. 'I sincerely hope that, after my mandate, I will be able to tell my 14-years old son that, as ECA Member, I contributed to improving the environment in which he and his generation will live. It is the most important thing in life and our duty towards the future generations.'

> *I sincerely hope that (...) I will be able to tell my 14-years old son that, as ECA Member, I contributed to improving the environment*

4th Young EUROSAI (YES) conference in London – a must for young ECA auditors too

By Grzegorz Grajdura, Sustainable Use of Natural Resources Directorate, and Marion Kilhoffer, Financing and Administering the Union Directorate

Young public auditors at the fourth YES conference in London in November 2019. Source: UK NAO

From 4 to 7 November 2019 the National Audit Office of the United Kingdom hosted the fourth 'Young EUROSAI,' or 'YES' conference. From all over Europe young staff gathered in London to discuss recent and future trends in the work of supreme audit institutions (SAIs). From the ECA two young auditors from different directorates participated: Grzegorz Grajdura and Marion Kilhoffer. They share their impressions and takeaways from a conference that focused on how SAIs can be relevant in an ever-changing world.

Elaborating with youthful enthusiasm on SAIs' work and outlook

Young EUROSAI (YES) is a biennial conference for representatives under 35 years of age from member institutions of the European Organisation of Supreme Audit Institutions (EUROSAI). The idea behind these conferences is to give younger staff the opportunity to share new ideas and innovative solutions to the challenges faced by supreme audit institutions (SAIs).

This year's theme was 'Relevance.' The discussion revolved around three main questions: how can SAIs remain relevant in an ever-changing world? How can we use new technologies to reach the public? Should our roles and mandates evolve to match this new environment? Though still under 35 years of age, both of us have been working at the ECA for quite some time now, so this conference was an opportunity to see how to best mix experience and 'youthful enthusiasm' in our daily work.

The organising committee from the UK National Audit Office (NAO) had done a wonderful job in putting the conference together, but also taking care of the participants' well-being. The best example would be how they made sure we would all find our way from the Westminster metro station to the statue of Emmeline Pankhurst, our rallying point

for the visit to the Parliament: although it is only a 350m walk, every 50m a group of young NAO staff was standing on the pavement with bright yellow YES umbrellas. Instead of following the yellow brick road, we followed the yellow umbrella road.

Main takeaways

The main thing we took from this conference was that we all have very similar challenges – trust, visibility, impact, independence – and we need more cooperation between institutions to solve them. It does not make much sense to try to come up with ideas in our own little corner if someone else has already thought about the same problem and found a solution.

Another surprising thing, for us at least, was how advanced the ECA was on some reflections compared to other SAIs. For example, 'investigation audits,' i.e. quick reports with no conclusions and no recommendations. The UK NAO and the Dutch Rekenkamer have introduced these new products in their portfolio. They look very much like our Rapid Case Reviews, which we have been piloting for a few years now. Similarly, we presented two examples of ECA performance audits (environmental audit and assessing the impact of projects on climate change, and performance audit of HR policies) in our workshops. The feedback we got from the participants was that they felt that their SAIs were not yet at the level of reflection and action on these topics that we had reached at the ECA.

On other points, though, our impression is that we are lagging behind. Some European SAIs have more sophisticated and diverse approaches to increasing their visibility and communicating about their reports: two minute videos for all reports where auditors present their findings, podcasts to present the audit reports, staff participation in community events to increase people's awareness of the existence of the SAI. Many also conduct regular feedback surveys with key stakeholders , similar to the ones we do here at the ECA.

Getting your message accross

Arno Visser, the President of the Netherlands Court of Audit, challenged the YES 2019 participants to present their conclusions in a way that would make them memorable. Drawing on all our discussions on visibility, impact and clear messages, the four groups working on the conclusions took up the challenge and came up with rather disruptive ways of presenting the results of our work. Two groups went for infographics and drawings, and two organised mock protests where our demands were set out on large placards, from 'give us back our independence' to 'enough meekness, time for assertiveness' through 'we want financial autonomy.' Apparently auditors make good protesters.

YES particpants trying to get their message across. Source: UK NAO

The conclusions of the conference were handled in a more traditional way. Our reflection revolved around four main points: being credible, being independent, being trusted and being valued. We identified actions to be put in place to rise to these challenges (see **Box 1**).

Creating a YES network

All participants agreed that we needed a way to stay in touch to continue sharing our work and our best practices. For the moment, we are still trying to find the best way to do it, but we will stay in contact and hope to keep this network alive.

Overall, we found this YES conference a very enriching experience. There are few networking opportunities for ECA auditors at international level, and even less so for junior staff. We realised that quite a few of the things we do at the ECA are not known among European SAIs. So there is clearly a need for the ECA to invest more in practice sharing with our counterparts.

Box 1 – Actions to be put in place to rise to key challenges for SAIs

How can SAIs continue to be perceived as credible?

- keep up with new technologies and develop new skills;
- share knowledge and best practice;
- present our findings in a credible way and discover new channels of communication.

How can SAIs ensure they maintain their independence?

- financial autonomy to assure the independence of the SAI;
- ensuring that the legal framework is designed in a way to guarantee effective criticism of other institutions without consequences, such as removal of the board;
- avoid being overwhelmed by outside influences. Strive to be an influencer rather than be influenced.

How can SAIs ensure their work continues to be trusted?

- presenting our findings appropriately;
- proximity to our stakeholders;
- recognisability and visibility.

How can SAIs ensure they are valued by all branches of government?

- SAIs should be bold and assertive to overcome the lack of clarity around their position in relation to parliament and governments;
- use the right communication channels to allow SAIs to directly communicate their message to society;
- be reactive and flexible in the timing of studies.

Prime Minister of the Czech Republic visits the ECA

By Werner Vlasselaer, private office of Jan Gregor, ECA Member

From left to right: Klaus-Heiner Lehne, ECA President, Andrej Babiš, Prime Minister of the Czech Republic, and Jan Gregor, ECA Member

Andrej Babiš, the Czech Prime Minister, visited the ECA on 8 November 2019. Werner Vlasselaer, head of the private office of ECA Member Jan Gregor, provides some insights on the visit and the topics discussed.

Discussing ECA's recent audit work

On 8 November, the Prime Minister of the Czech Republic visited the ECA as part of an official state visit to the Grand Duchy of Luxembourg. Prime Minister Babiš was accompanied by Petr Kubernát, Ambassador of the Czech Republic to the Grand Duchy of Luxembourg, Milena Hrdinková, State Secretary for European Affairs and Vít Olmer, Government Counsellor for the European Council. ECA President Klaus-Heiner Lehne and ECA Member Jan Gregor welcomed the Czech delegation.

The visitors exchanged views on recent developments and trends in the EU. They also discussed the possibility of the Council stepping up the way it takes the outcomes of the ECA's independent audit work into consideration.

ECA auditors were on hand to present some of the ECA's recent work, and there was an open discussion about this. The first topic was administrative expenditure, which represented 6.3 % of the 2018 EU budget, covering salaries and other staff expenditure (60 %), buildings (11 %), equipment and other expenditure. Since 2000, the ECA has delivered a positive opinion on the legality and regularity of this expenditure. In addition to recurrent audit work for the purpose of the Statement of Assurance, the ECA carries out performance audits and reviews. The exchange of views covered, for instance, the ECA reports on buildings (centralisation of Parliament buildings, European External Action Service buildings, office space in the EU institutions) and on staff expenditure

(5 % reduction in posts, 2014 staff reforms).The ECA is also planning special reports on the European Personnel Selection Office (EPSO) and the Commission's use of external consultants.

Another topic covered was revenue. Auditors presented the ECA opinion on the own resources legislative package for the next Multiannual Financial Framework. The general conclusion of the opinion is that the proposed system of EU financing remains complex. They also presented the results of an audit on the Commission's verification of GNI data. In this audit the ECA concluded that the Commission did not apply a consistent approach when carrying out its verifications in Member States. In the area of revenue, the ECA is currently carrying out an audit of financial risks in customs and has planned another on gross national income (GNI).

Input for debates on the future EU budget

Prime Minister Babiš indicated that he would like to see more account taken of the ECA's reports in decision-making on financial flows in the EU, and added that the Council should better use of information resulting from the ECA's work. For him, ECA publications show in which areas money can be saved. He found the meeting inspiring and a useful preparation for debates on the future EU budget.

Reaching out

European Parliament's new Committee on Budgetary Control: a first fact-finding visit to the ECA

By Helena Piron Mäki-Korvela, Directorate of the Presidency

Members of the CONT at the ECA in Luxembourg. From left to right: CONT Vice-Chair Isabel García Muñoz, Luke 'Ming' Flanagan, Claudiu Manda, Tomáš Zdechovský, Sándor Rónai

On 19 November 2019 a delegation from the European Parliament's Committee on Budgetary Control (CONT) visited the ECA to meet the ECA President and Members. This was the first visit by the new CONT following the EP elections in May 2019. During the meeting a variety of topics were discussed, ranging from the ECA's corporate strategy update, challenges of digital audit, the Statement of Assurance and the new annual report on performance, to providing technical support to the Member States and how the ECA can contribute to safeguarding EU values and respect for the rule of law. Helena Piron Mäki-Korvela, the ECA's senior institutional relations officer, reports.

Strategy, mandate, audit approach and follow-up

ECA President Klaus-Heiner Lehne welcomed the Committee on Budgetary Control (CONT) delegation, led by Vice-Chair Isabel García Muñoz, to an extraordinary meeting in Luxembourg. He emphasised the importance of nurturing close cooperation between the Parliament, and in particular the CONT, and our institution. He also gave an update on the state of play of the ongoing peer review on the implementation of our current corporate strategy and its forthcoming revision. ECA Member Eva Lindström reported on the efforts the ECA has been making to move towards digital audit in our future work, with the aim of handling data with smart IT tools.

Lazaros Lazarou, ECA Member, provided some background information about the ECA's new 'attestation audit' approach, which takes the work of other auditors into account and thus provides better insights into the functioning of internal control systems. Generally speaking, it also helps to reduce the audit burden for final beneficiaries. Lazaros Lazarou also emphasised that, to improve EU spending overall, it is important that both the Commission and the Member States further improve their reporting on the regularity of spending.

Several CONT MEPs expressed their concerns about the recent cases of serious mismanagement of EU funds in certain Member States, and called for action at EU level to put pressure on national authorities that are not using funds in a transparent and legal manner. Klaus-Heiner Lehne stressed that the role of the ECA as the external auditor of EU finances is to report on irregularities, and that dealing with suspected fraud falls within the remit of OLAF, the EU's anti-fraud agency. He pointed to the importance of clearly defining the respective responsibilities of OLAF and the European Public Prosecutor's Office (EPPO), which will start operating in the near future.

Considering that the spending rules for EU financial support can be overly complex, often also due to additional national or regional requirements, members of the CONT wanted to discuss in particular how the EU could provide additional technical support to Member State administrations. ECA Members Iliana Ivanova and Phil Wynn Owen gave some insights into the way the ECA provides guidance on the shared management of EU spending in the areas of cohesion and agriculture. They emphasised that the ECA's current approach for its Statement of Assurance audits does not allow for the ranking of Member State administrations by performance. Reference was also made to the ECA's close working relations with the EU SAIs, which was clearly valued by the MEPs present.

ECA Member Danièle Lamarque underlined the importance of issuing audit recommendations that are both clear and realistic. She explained how the ECA systematically follows up the Commission's action on our recommendations. Another topic discussed was that of the next multiannual financial framework and future EU budgets. Speakers from the ECA referred to our recent opinion on the common agricultural policy, which needs to address challenges ranging from climate concerns to accountability arrangements.

Annual performance report, Brexit, rule of law

ECA Member Jan Gregor informed the MEPs about the ECA's new annual report, which will focus on assessing the performance of EU spending programmes. He drew attention besides to the many performance audits on which the ECA reports each year. The MEPs generally expressed their appreciation for the new report's value-for-money assessments, but also urged the ECA to find further ways of reporting on financial and compliance issues so as to reduce spending errors and limit irregularity in the use of EU funds.

Jan Gregor also updated the MEPs on our institution's preparations for the UK's departure from the EU, in terms of guidance for auditors regarding their ongoing work and financial audits of the EU accounts that may follow after Brexit.

ECA Member Annemie Turtelboom spoke about the ECA's recommendations in reply to the Commission's proposal on safeguarding EU values and the rule of law. In the European Parliament, both the CONT and the Budget Committee have taken all five ECA recommendations on board, including the importance of setting clear legal provisions.

Future meetings

Representatives of both the ECA and the CONT stressed how useful they had found the meeting and how essential it was to continue the practice of regular exchanges. Having completed the 2018 discharge hearings in the autumn, the CONT will now have more time to consider performance audits at its regular meetings and, together with other EP committees, will be drafting a number of suggestions for the ECA's 2021 work programme. The ECA's presentations of performance audits will offer plenty of opportunities for further exchanges of views on different aspects of EU finances.

IMF Director Vitor Gaspar gives perspectives on the role of good governance in public finance

By Mirai Neumann, Directorate of the Presidency

The term 'good governance' is a key concept for governmental activities and the application of citizens' rights. For many people it is also a fundamental part of maintaining and strengthening the current world order. The European Union strives to be a role model in realising good governance. The ECA addresses the concept and its application throughout its work and welcomes discussion on it, as happened during a presentation by Vitor Gaspar, Director of the Fiscal Affairs Department of the International Monetary Fund (IMF) on 25 November 2019 at the ECA. Mirai Neumann, trainee in the Directorate of the Presidency, reports on some key issues Vitor Gaspar covered.

Good governance… as seen in a medieval fresco

Vitor Gaspar has held several senior policy positions, including Director-General of Research at the European Central Bank, a senior position at the European Commission and Portuguese Minister of State and Finance. Since 2014 he has been Director of the Fiscal Affairs Department of the IMF.

After an introduction by the ECA's Secretary-General Eduardo Ruiz García, Vitor Gaspar presented two key slides. The first displayed a quote from Michel Camdessus, economist and former Managing Director of the IMF (see box). Another key slide was a painting by Ambrogio Lorenzetti, which, in his view, showed the key actors in good governance and the delicate balance between them. He used the painting to highlight the concept of good governance, its key elements and the pitfalls that can arise if it is not properly safeguarded and applied. He underlined that good governance is important not only for countries, but also for international organisations, such as the IMF or the EU, which work closely with countries and their finances. That is why he found it so important to start by conveying a proper understanding of the concept.

> *Good governance is important for countries at all stages of development. . . . Our approach is to concentrate on those aspects of good governance that are most closely related to our surveillance over macroeconomic policies—namely, the transparency of government accounts, the effectiveness of public resource management, and the stability and transparency of the economic and regulatory environment for private sector activity.*
>
> Michel Camdessus, Address to the United Nations Economic and Social Council, 2 July 1997

IMF Director Vitor Gaspar gives perspectives on the role of good governance in public finance

Source: Vitor Gaspar

Ambrogio Lorenzetti, Allegory and Effects of Good and Bad Government, fresco, 1339, Sala dei Nove, Palazzo Pubblico, Siena, Italy.

The key ingredients: functioning state capacity and public accountability

According to Vitor Gaspar, good governance goes hand-in-hand with functioning state capacity. Shortcomings in governance will lead to corruption. Simply put: weak governance means a high chance of corruption. For him the close relationship between corruption, government effectiveness, the rule of law, and voice and accountability is undeniable. The key thing is to ensure that the components for a functioning state, such as tax capacity, public administration capacity and legal capacity, are working and in balance.

Vitor Gaspar explained that independent institutions, and above all supreme audit institutions such as the ECA or those of the EU Member States, have a mandate to be an agent of and for civil society. By exercising independent external oversight, audit institutions guarantee that citizens can obtain a transparent understanding of fiscal spending. Together, strong fiscal institutions and an engaged civil society can control and monitor the functioning of the state and at the same time spot signs of weak governance and corruption. But it is crucial to make sure that corruption is detected at an early stage. This is because, once signs of weak governance become entrenched, they are persistent and hard to reduce or keep within manageable limits.

For the IMF Director it is also crucial, and in his view inevitable, for EU Member States, and all the EU institutions and agencies, to act in concert to achieve the common goal of good governance. There cannot be leaks in the EU's revenue and expenditure, and budgets must be spent in a transparent and accountable manner, not only so that the EU can deliver its services efficiently but also as an inspiration for Member States' administrations and others. This becomes even more relevant in times of economic, climate, or security crisis, when society is susceptible to unrest and strong institutions are needed in Member States, the EU and the international community to continue earning citizens' trust and confidence. For Vitor Gaspar, further improvements to public accountability in the EU are essential to foster such trust – and the SAIs play a key role in this.

ECA leads 2019 peer review of the National Audit Office of Lithuania

By Stéphanie Girard, private office of François-Roger Cazala, ECA Member

From left to right: Helen Hodgson (NAO), Inga Tarakaviciute (NAOL), Tim Valentine (NAO), Rafal Czarnecki (ECA), Audrone Vaitkeviciute (NAOL), next to her another staff member of the NAOL, Stéphanie Girard (ECA), Alfonso De La Fuente Garrigosa (ECA), Eduardo Ruiz García (ECA), Arūnas Dulkys (NAOL), Mindaugas Macijauskas (NAOL) and Natalie Low (NAO).

Following a request from the Auditor General of the National Audit Office of Lithuania (NAOL), the ECA recently carried out a peer review of the NAOL in association with the National Audit Office of the United Kingdom (NAO) and the Supreme Audit Office of Poland (NIK). The peer review started in January 2019, and the final report was presented in December 2019 to the staff of the NAOL and the Lithuanian Parliament. Stéphanie Girard, Attaché in the private office of François-Roger Cazala, ECA Member, was a member of the peer review team. Here she highlights some of the key issues in the peer review process and report.

Focus on audit standards

The objective of the peer review was to provide the NAOL and its stakeholders with an assessment of whether its audit approach is in line with audit standards – in particular the International Standards of Supreme Audit Institutions (ISSAIs) – and to make recommendations for improving its activities. The review also sought to assess the extent to which the recommendations of the previous peer review (2014) had been implemented.

Joint peer review with the UK NAO and the Polish NIK

The team was composed of the ECA (lead reviewer), the UK National Audit Office (NAO) and the Supreme Audit Office of Poland (NIK). Work began in January 2019 and continued throughout the year. During on-the-spot visits, interviews were conducted with the Auditor General and his deputies, as well as directors, heads of department, team leaders, auditors and staff responsible for operational areas. The peer review team also interviewed members and staff of the Lithuanian Parliament (Seimas), representatives of the Chancellery of the Government and the Ministry of the Interior, the President of the Republic of Lithuania and the President and representatives of the Constitutional Court.

The review consisted of a detailed examination of selected performance, financial and compliance audits and a number of outcomes of the quality control and review procedures. The team also assessed the independence of the NAOL (legal framework, financial and organisational independence), its mandate, quality control arrangements, financial and human resources management, approach to professional development and training, strategic planning, overall audit planning and relations with its stakeholders.

Following a meeting in Luxembourg in mid-November 2019 to agree on the final text, the peer review report was presented in early December 2019 to NAOL staff and the Seimas.

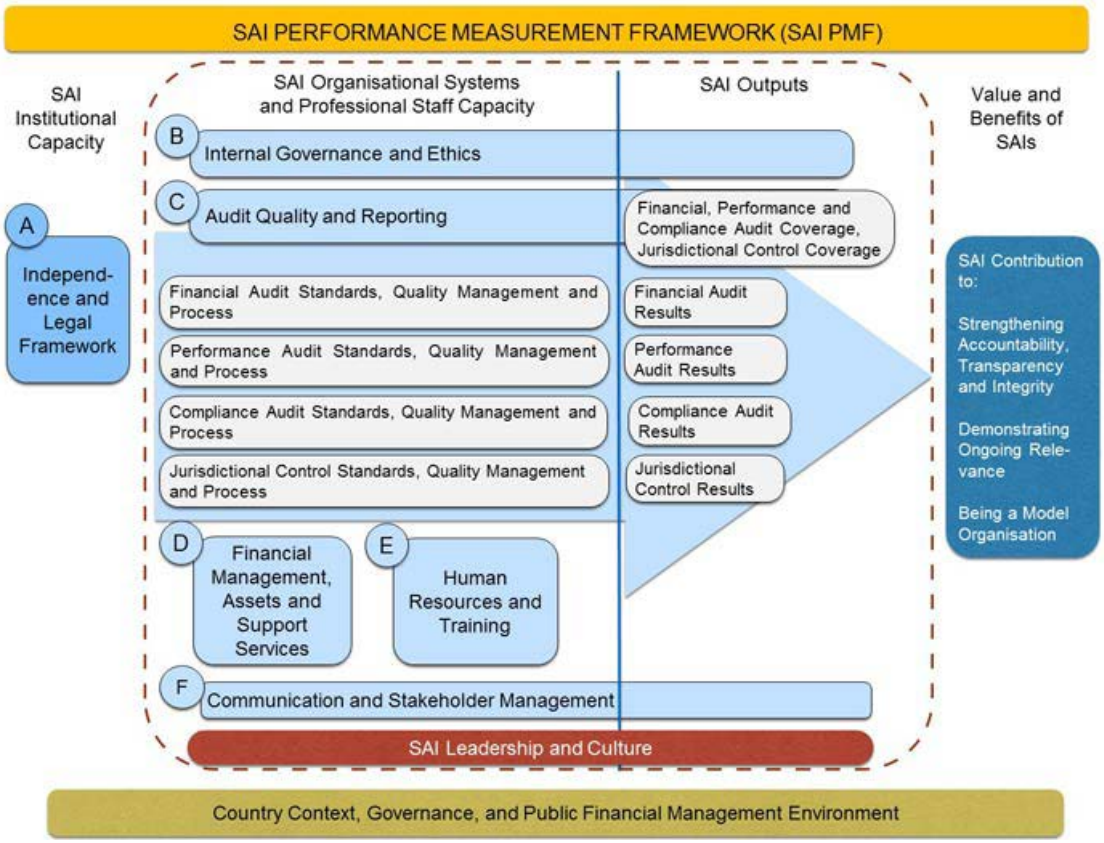
Methodology and process based on ISSAIs

The peer review was carried out in accordance with the INTOSAI guidance document GUID 1900 (previously ISSAI 5600). The peer review team also made extensive use of the SAI Performance Measurement Framework (PMF) produced by the INTOSAI Development Initiative and endorsed by INTOSAI in December 2016. The PMF mainly uses ISSAIs as the benchmark against which SAI performance is measured. Sometimes the tool also refers to other good practices established within INTOSAI.

As shown in **Figure 1**, the assessment covers *six main domains* which are measured by a set of *25 indicators*. The framework allows for a holistic assessment of an SAI's performance, since it covers areas as varied as audit work, independence and legal framework, internal governance and ethics, relations with stakeholders, financial management, assets and support services, and human resource management and training.

Five of the six domains are under the SAI's control. The exception is domain A (independence and legal framework), which, despite being outside the SAI's remit, is crucial to its performance, as has been emphasised in ISSAIs and stressed by the UN General Assembly[1]. Its importance is also recognised by the UN Agenda for Sustainable Development, Goal 16 of which focuses on building effective, accountable and inclusive institutions at all levels.

Figure 1 – Measuring SAI performance



Source: https://www.idi.no/en/idi-cpd/sai-pmf

1 Resolutions 66/209 and 69/22, which encourage states to apply the principles of SAI independence set out in the Lima and Mexico declarations.

Using the PMF helped us to organise, standardise and streamline our work, which was helpful given the varied backgrounds of the nine members of the peer review team from three different SAIs. It also removed the risk of duplicating our work and facilitated the reporting process and, prior to that, relations with our reviewee – since the NAOL and its staff were fully aware of our work set-up and what we would require from them. We were thus able to build a strong relationship of trust with our reviewee, which proved to be of utmost importance.

Outcome of our work

In the peer review report we concluded that the NAOL has improved its management and enhanced the quality of its audits. On following up the 2014 peer review, we concluded that nine of the 11 recommendations made at the time had been implemented, while the other two had been partly implemented. The report highlights several good practices and concludes that the NAOL is compliant in all material aspects with the applicable ISSAIs and that its business processes, procedures and auditing practices contribute to its goals and strategic objectives.

The report presents ten recommendations for improvement, some of which aim at further enhancing the NAOL's financial or performance audit policies and guidance, processes and/or practice. Others are linked to professional development and training, or to human resource management (mainly because the NAOL's recently revised HR strategy was not yet fully translated into concrete action plans at the time of the review).

Compared with the circumstances of the previous peer review, we noted recent changes in the legal environment in which the NAOL operates. These have an impact on the annual performance appraisal and recruitment procedures applicable to public sector staff. For instance, a recent law removed the Auditor General's authority to decide on the recruitment of NAOL staff. The process is centrally managed by a department within the Ministry of the Interior which has control over the recruitment of all public sector officials.

Some of these changes may have an impact on the NAOL's operational independence. Therefore, we make a number of recommendations to enhance that independence, and suggest that the NAOL refer them to the Seimas, the President of the Republic and the Government, as the matters concerned fall outside the NAOL's remit.

Peer review benefits are a two-way street

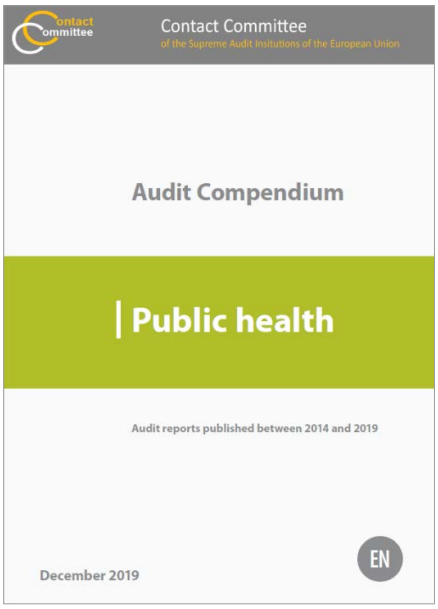
The whole experience was rewarding for all parties involved, both the reviewers and the reviewee. It enables the SAI reviewed to identify good practices, room for improvement and possible solutions. It gives a detailed picture of the SAI's performance which can serve as a strong basis for future self-assessments or peer reviews. And it gives the reviewers an opportunity to exchange experience and learn from the practices of all involved.

Reaching out

Audit Compendium on Public health

By Derek Meijers

On 19 December 2019, the Contact Committee of the Supreme Audit Institutions of the European Union published an Audit Compendium on the topic of public health, providing an overview of public health audit reports across the European Union. The Audit Compendium on public health is based on audit reports by the SAIs of 23 EU Member States and the ECA between 2014 and 2019. Derek Meijers, project manager for the Compendium, gives some background information.



The state of public health in the EU

Just before the Christmas break, we finalized and published the second Audit Compendium of the Contact Committee (CC) of the heads of supreme audit institutions (SAIs) of the European Union (EU) and its Member States. The Compendium provides some background information on public health, its legal bases, main objectives and related responsibilities at Member States' and EU levels. In addition, it illustrates the main challenges the EU and its Member States are facing in this field.

Public health is a complex area to audit. Nevertheless, the large number of audits carried out in recent years reflects the great significance of this domain for EU citizens. Drawing on recent results of audits carried out by the ECA and the SAIs of 23 EU Member States between 2014 and 2019, the Compendium shows how these address important performance aspects and scrutinise different issues of public health. Prevention and protection for example, or access to and quality of health services, the use of new technologies and eHealth, as well as the fiscal sustainability of public health services.

In addition to the ECA, the following EU Member States contributed to the Audit Compendium on public health: Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia and Spain.

Mainly national topic but common challenges

In 2018, CC published its first Audit Compendium. Led by the ECA, the first Compendium was intended to enhance the communication of relevant audit messages to its stakeholders and the broader public. Based on audit reports produced by 14 CC members between 2013 and 2017, the first edition was dedicated to the issue of youth unemployment and the integration of young people into the labour market.

Box 1 - Contact Committee

The Contact Committee is an autonomous, independent and non-political assembly of the heads of SAIs of the EU and its Member States.

It provides a forum to discuss and address matters of common interest relating to the EU. By strengthening dialogue and cooperation between its members, the Contact Committee contributes to an effective and independent external audit of EU policies and programmes.

The publication was welcomed at national and EU level as a valuable addition to the range of audit reports published throughout the EU, as well as a good way to communicate possible overlaps and differences between the audit findings in a representative number of Member States. As various Member State and EU stakeholders, such as the European Parliament, called upon the CC and the ECA to repeat the exercise, it was decided to publish a second Compendium, this time on the highly topical subject of public health.

As public health is mainly the responsibility of the Member States, the EU Member States have largely different health systems. The EU supports efforts at national level with a specific focus on complementing or coordinating the Member States' actions. Over the last few decades, national health systems have been facing numerous challenges, such as ever-rising costs, ageing populations, or patients as well as healthcare professionals becoming more and more mobile.

Great example of good cooperation

Just as the first edition, this second Audit Compendium is a product of the cooperation between the national SAIs and the ECA within the framework of the Contact Committee. It is designed as a source of information for everyone interested in this important policy field.

Box 2 - Audit Compendium

The Audit Compendium is available in English, French and German on the website of the Contact Committee. The other 20 EU language versions will be published as soon as they are available.

Naturally, such cooperation is rather complex, but the result shows it is also very valuable. Therefore, now that we have finished this edition, preparations have started for a third Audit Compendium, the topic of which will be decided by the Contact Committee in the coming weeks.

ECA publications in October/November/ December 2019/January 2020

Special report 17/2019

Published on 24/10/2019

EU venture capital for SMEs: significant funding in need of more direction

The European Commission is due to allocate more than €3.3 billion to support investments in innovative start-ups through venture capital funds between 2014 and 2022, according to a new report by the European Court of Auditors (ECA). So far, however, the Commission has not yet carried out a comprehensive assessment of market needs or absorption capacity. Moreover, it has provided only limited evidence of the impact achieved, say the auditors.

Click here for our report

Audit preview

Published on 29/10/2019

Auditors to look at the action taken by the Commission to foster an EU Capital Markets Union

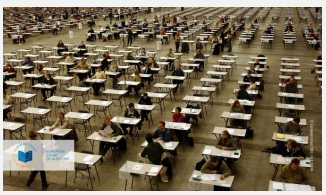
The European Court of Auditors is assessing how successful the Commission's action has been so far in building the Capital Markets Union, a major initiative launched in June 2015 as part of the "Juncker Plan"..

Click here for our report

Audit preview

Published on 05/11/2019

Recruiting for the EU: Auditors to check the cost-effectiveness of the European Personnel Selection Office's selection process



The European Court of Auditors is conducting an audit to establish whether the European Personnel Selection Office (EPSO) meets the EU institutions' recruitment needs in a cost-effective manner. In particular, the auditors will analyse whether EPSO's selection process yields enough successful candidates and whether the cost of EPSO's selection process is proportionate to the institutions' recruitment needs.

Click here for our report

ECA publications in November 2019

Special report 19/2019

Published on 07/11/2019

The EU's Innovation and Networks Executive Agency delivered many of the expected benefits but should improve implementation of the delegated spending programmes

Overall, the European Parliament, Council and Commission have put in place adequate ethical frameworks, according to a new report from the European Court of Auditors. But the auditors also identified certain areas where the coverage, specificity, clarity and level of guidance could be improved and harmonised, as well as examples of best practice. In addition, staff awareness and perception of the ethical framework and culture should be strengthened, say the auditors.

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Special report 20/2019

Published on 11/11/2019

Schengen border control IT systems are well designed but need timelier and more complete data

The border control authorities in Member States should focus more on entering complete data promptly in the EU's information systems that support surveillance of the Schengen area's external borders, according to a new report by the European Court of Auditors (ECA). The Schengen IT systems are a strong tool and increasingly used by border guards when performing border checks. However, some data is currently not included in the systems, while other data is either incomplete or not entered in a timely manner. This reduces the efficiency of some border checks, say the auditors.

Click here for our report

Special report 24/2019

Published on 13/11/2019

Migration management in Greece and Italy: time to step up action to address disparities

The EU should step up action on asylum, relocation and return of migrants to better meet the objectives of its support, according to a new report by the European Court of Auditors (ECA). Emergency relocation schemes did not reach their targets and only partially achieved their main objective of alleviating pressure on Greece and Italy. Despite increased asylum-processing capacities in both countries, long handling times and bottlenecks persist, while returns of irregular migrants remain low and problematic across the EU.

Click here for our report

2018 audit of EU Joint Undertakings in brief

Published on 14/11/2019

Auditors sign off 2018 accounts of all EU research Joint Undertakings

The European Court of Auditors (ECA) has given a clean bill of health for all the EU's Joint Undertakings, issuing clean opinions on their financial transactions and confirming the positive results reported in previous years.

Click here for our report

Special report 21/2019

Published on 15/11/2019

EU fight against antimicrobial resistance: little progress to date

The EU's fight against "superbugs", especially bacteria which have become resistant to antibiotics, has brought little progress to date, according to a new report from the European Court of Auditors. While EU action has led to some progress, especially on veterinary issues, there is little evidence that the health burden of antimicrobial resistance has been reduced, say the auditors.

Click here for our report

Special report 18/2019

Published on 20/11//2019

EU reports well on greenhouse gas emissions but needs better insight into future reductions

EU greenhouse gas emissions data is reported in line with international requirements and inventories of emissions have improved over time, according to a new report from the European Court of Auditors. However, better insight is needed into specific sectors such as agriculture and forestry, say the auditors. They also suggest further improvements to reporting on how EU and national mitigation policies contribute to meeting emission reduction targets for 2020, 2030 and 2050.

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ECA publications in November/ December 2019

Report (pursuant to Article 92(4) Regulation (EU) 806/2014)

Published on 27/11/2019

EU's potential liability in winding up failing banks assessed as "remote"

The Single Resolution Board (SRB) and the European Commission – in line with accounting rules – did not disclose any contingent liabilities potentially arising from ongoing judicial proceedings against their role in winding up failing euro area banks, according to a new report by the European Court of Auditors (ECA). At the same time, the SRB disclosed €90 million of contingent liabilities related to legal proceedings in EU and national courts, in which banks challenge their upfront ("ex-ante") contributions to the Single Resolution Fund (SRF).

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Special report 22/2019

Published on 04/12//2019

EU fiscal governance: requirements for Member States need to be strengthened further and better monitored

The EU needs to further strengthen its legal requirements for national budgetary frameworks and better monitor how Member States put them into practice, according to a new report from the European Court of Auditors (ECA). In several respects the requirements are softer than international standards and the European Commission has so far only limited knowledge about whether countries apply them properly. The auditors also warn against the risk of inconsistency between the Commission's and independent fiscal institutions' (IFIs) assessment of countries' compliance with EU fiscal rules, as well as of the limited effectiveness of the European Fiscal Board due to the fact that it is not fully independent from the Commission.

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Special report 23/2019

Published on 05/12//2019

EU measures to stabilise farmers' income: low uptake coupled with overcompensation

EU instruments helping farmers to insure their income against falling prices and production losses have only partially met their objectives, and their uptake remains low and uneven, according to a new report from the European Court of Auditors. In addition, some exceptional measures have not been properly targeted and can lead to disproportionate compensation payments, say the auditors.

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ECA publications in December 2019

Audit preview

Published on 9/12/2019

EU Auditors to examine cross-border cooperation programmes

Many EU internal border regions are under-developed and face socio-economic disparities. The European Court of Auditors is conducting an audit to assess whether the specific programmes financed under EU cohesion policy have tackled cross-border challenges effectively.

Click here for our report

Special report 09/2019

Published on 11/12/2019

EU funding for Morocco showing limited results so far

EU financial aid for Morocco, delivered through direct transfers to its treasury from 2014 to 2018, provided limited added value and ability to support reforms in the country, according to a new report from the European Court of Auditors (ECA). The European Commission addressed the needs identified in national and EU strategies, but it spread the funding across too many areas, which may have weakened its impact, say the auditors. They also found the Commission's management of budget support programmes for the country was hampered by weaknesses in the way they were designed, implemented and monitored, as well as in the assessment of results.

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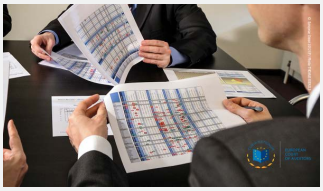
Special report 25/2019

Published on 12/12/2019

EU budget support to partner countries not always backed up by sufficiently relevant and robust performance data



The data the EU uses for granting budget support variable tranches to partner countries is not always solid enough to take informed decisions, according to a new report from the European Court of Auditors. Performance indicators and their targets are sometimes not relevant, which makes it difficult to assess whether partner countries have made progress in implementing reforms as agreed. Decisions to release the budget support payments may therefore not always have been sufficiently justified, say the auditors.

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ECA publications in December 2019/ January 2020

Audit Compendium

Published on 19/12/2019

Auditors across the EU scrutinise public health

An overview of how auditors across the European Union scrutinise public health has been published today by the European Court of Auditors (ECA) on behalf of the Contact Committee of EU supreme audit institutions (SAIs). Altogether 24 SAIs have contributed to this second Audit Compendium of the Contact Committee.

Click here for our report

Audit preview

Published on 09/01/2020

Use of the EU's space assets under scrutiny of Auditors

The European Court of Auditors is examining how effectively the European Commission has promoted the uptake of services provided by two of the EU's key space programmes, Copernicus and Galileo. Around €260 million were allocated to these activities from the EU budget for the period 2014-2020.

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Special Report 01/2020

Published on 15/01/2020

EU ecodesign and energy labels improving energy efficiency

EU action on ecodesign and energy labelling has contributed to greater energy efficiency, according to a new report from the European Court of Auditors. However, there were significant delays in the regulatory process and the impact of the policy risked being overestimated. In addition, non-compliance with the regulation by manufacturers and retailers remains a significant issue, say the auditors.

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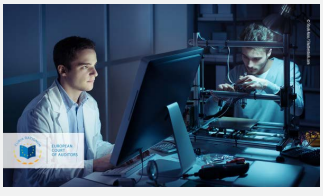
Special report 02/2020

Published on 22/01/2020

SME Instrument supporting innovation effectively



The SME Instrument provides effective support in developing innovation projects, according to a new report from the European Court of Auditors. More than 5 000 projects have been funded and EU branding has helped SMEs to attract additional investment. However, the auditors also identify areas of improvement with a view to setting up a European Innovation Council in 2021.

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NEXT EDITION

Can accountability safe our planet?

Source: Pixabay

Large fires in Australia, extreme weather events, changing habitats for animals due to changing temperatures, loss of biodiversity, rising sea levels, desertification, droughts, disrupted agriculture and subsequent famines… There is no doubt that adverse climate conditions could potentially disrupt our way of life, pose risks to the world's cultural and natural heritage sites, and lead to significant shifts in the world's balance of power, or even threaten global peace.

Climate change could be one of the greatest threats facing humanity. And even though there are also sceptics who do not think the threat is as imminent as the striking FridaysForFuture school children believe, it is a no-brainer that polluting and consuming less would be better for our environment, our own health and wellbeing, and especially for future generations. The big question is whether we can change our ways to save this planet and, if so, will our efforts pay off, or will they be too little, too late?

Today's audit institutions are expected to look at climate change action: was it done and even more importantly: did it help. Audit institutions of the future may be asked whether today's government action to counter climate change was appropriate to achieve goals set for decades ahead. More and more we are seeing public audit reports arriving with recommendations for the measures that are needed to reach climate goals agreed in the dozens of high-level climate conferences to date. In our next edition, we will dive into the role of the auditor in actions and plans in the fight against climate change. And present practices, perspectives and hopes concerning the ways auditors can contribute to a green and climate-proof future.

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EDITION
HIGHLIGHTS

COVER:
First *Electronic Numerical Integrator And Computer* was 45 meters wide with 20 banks of flashing light
Shutterstock/Everett Historical /Shutterstock/everything possible

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