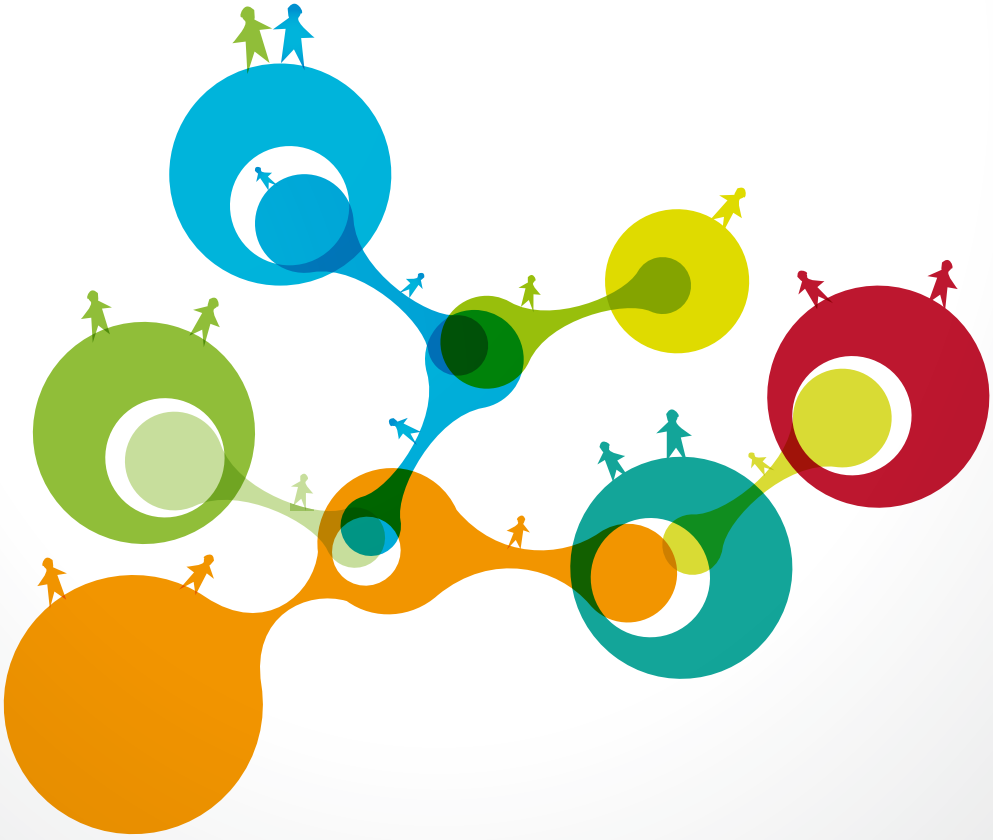
European Commission

THEMATIC PAPER

DIGITAL TECHNOLOGIES AND ADVANCED ANALYTICS IN PES



MARCH 2019

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The European Network of Public Employment Services was created following a Decision of the European Parliament and Council in June 2014[1] (DECISION Nº 573/2014/EU). Its objective is to reinforce PES capacity, effectiveness and efficiency. This activity has been developed within the work programme of the European PES Network. For further information: http://ec.europa.eu/social/PESNetwork

This activity has received financial support from the European Union Programme for Employment and Social Innovation 'EaSI' (2014-2020). For further information please consult: http://ec.europa.eu/social/easi

[1] DECISION No 573/2014/EU

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Written by Willem Pieterson, in conjunction with ICF

MARCH 2019

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1. INTRODUCTION

As often mentioned in recent PES Network publications, the world in which PES are operating is evolving more rapidly than ever, and much of those changes come from the combination of 'digital' and 'data'. More and more services are delivered through digital (or electronic) service channels and more and more processes are powered by technology and handle files which are completely digital.

Concepts: Digital and Data

By digital, we refer to the impact of information and communication technologies (ICT) on PES processes and services.

By data we refer to data both as the 'product' being processed by PES, as well as data that is the 'by-product' created by technology (such as server logs and usage statistics).

PES have long recognised the value of information and communication technology. As far back as the 1960s many PES started digitising their information and storing records in mainframe computers. This initial step was followed by the introduction of personal computers, computer networks, the internet and so forth. Not only have generations of new technologies started to appear faster and faster, but it has also created a state of constant change in which PES need to develop flexible strategies and create more adaptable organisations.

A key ingredient to achieve this is using available data to the PES' benefit. Real-time collection and processing of information could allow PES to spot challenges and opportunities in a more timely manner. In addition, advanced types of data analytics allow a PES to constantly improve processes and services and develop new service offerings. This could give PES more control over organisational efficiency and effectiveness as well as improving customer satisfaction. Therefore, one could argue that *advanced data analytics* should be a key ingredient of any strategic initiative developed by a PES.

The role and importance of data and analytics already features in many PES Network activities and publications (see overview below), and it will in all likelihood continue to do so in the future. The purpose of this paper, within this context, is twofold:

a. To bring together all the relevant insights generated by the PES Network on this important topic. This paper could serve as the *umbrella* or starting point for any PES manager or employee interested in the topic. Within this paper, references can be found to PES Network documents produced in recent years, with these documents fully referenced in Appendix 2.

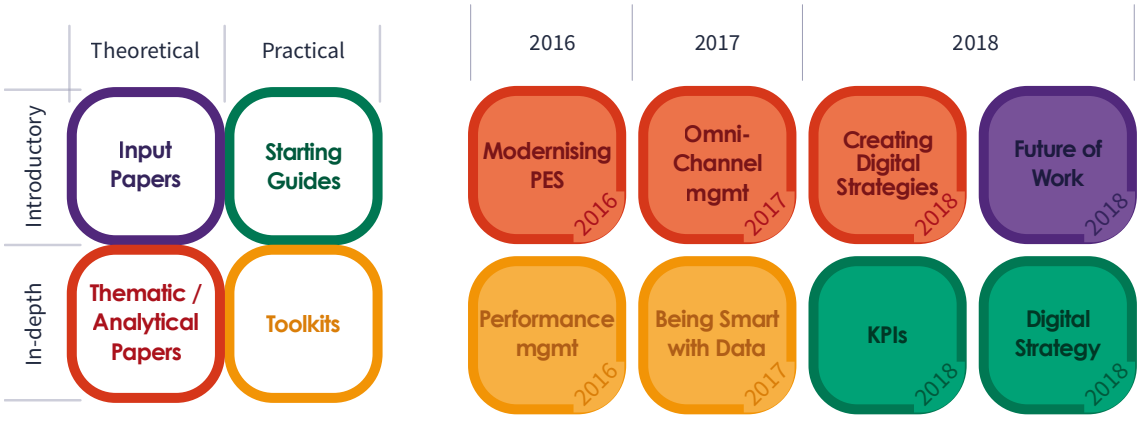
b. To provide an update on the latest trends and developments both within PES and the outside world. This serves as a refresher for many of the other documents and insights. More importantly, it can help PES in planning their strategic (data and digital) initiatives for the coming years.

A PES Network Seminar, 'Trends and developments in digitalisation and data analytics' took place in Brussels on 15 January 2019. Representatives from 25 PES in the PES Network attended the seminar and engaged in fruitful discussions about data and digital. This Thematic Paper builds on the information provided in the input paper for the seminar, incorporating the themes and issues raised by PES during the discussions.

1.1 Data and digital in the PES Network

In recognising the importance of digital and data for PES, these topics have featured prominently in the PES Network in recent years. Various types of PES Network publications have been produced in the past number of years focusing entirely on data or digital, or having a very strong connection to these topics (such as the publications on omni-channel management and the future of work).

The overview below shows the types and titles of the key PES Network documents and links to these (with a synopsis) can be found in Appendix 2.



1.2 Overview of this paper

The remainder of this paper is organised in three sections. Chapter 2 provides a brief introduction to the topic (2.1). This chapter also provides a short overview of the role of technology and digital strategy (2.2) and a longer overview on the topic of data and analytics (2.3). Chapter 3 focuses on trends and developments within PES and in general. Chapter 4 provides a number of concluding remarks and points for PES and the PES Network to discuss in 2019 and beyond.

2. SETTING THE SCENE; DIGITALISATION & ANALYTICS

This chapter provides an overview of the topic as well as a number of definitions and descriptions of relevant terms and topics.

2.1 Data and digital

While the focus of this paper is on data and advanced data analytics, it is virtually impossible to discuss this topic without reference to the digital technologies that enable, facilitate and allow data analytics. On the one hand digital technologies generate data and allow data to be analysed. At the same time data and insights generated from stand-alone (or initial) or continuous data analysis lead to new technological opportunities. We call this interaction, the IT/Data feedback loop.

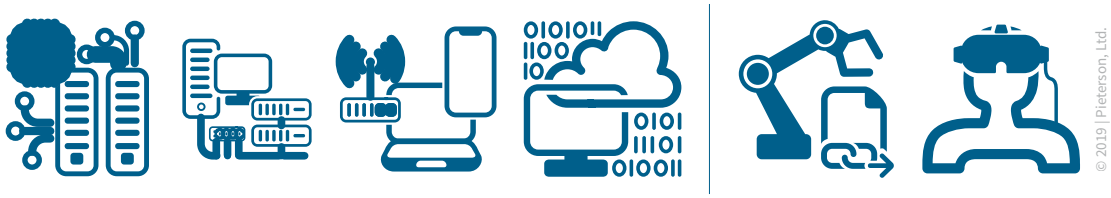
The topic of the relationship between data and technology has been discussed in detail in the PES Network's analytical paper on *Modernising PES through supportive Data and IT strategies* (2016) (see Appendix 2). Two points are crucial for understanding the context.

The first is that the number of technologies within PES has increased dramatically since the 1960s with a succession of different generations of technological innovations. The figure below gives an overview.

The second point is that technological innovation appears to be moving increasingly fast. In part this is due to the exponential nature of chip development (see below), but factors such as *globalisation* and *mobility* stimulate an increasingly fast adoption and improvement of technologies. With the (anticipated) further increase of technology within PES the amount of data generated will only increase more, generating new possibilities to use these data in analytics activities. For example, the Internet of Things (IoT) is a development that relies on two fundamental principles:

- Connecting devices (things) to the internet
- Equipping these devices with sensors and other technology so that they become 'smart'.

For example, smart doors could measure the number of people entering a PES office and smart signs could gather information on how many people view vacancies posted in windows of placement offices. Data from these IoT devices could be used to better tailor vacancies or better forecast and plan caseworker capacity. In a (potential) future world where large numbers of objects are connected to the internet and gather information, the amount of



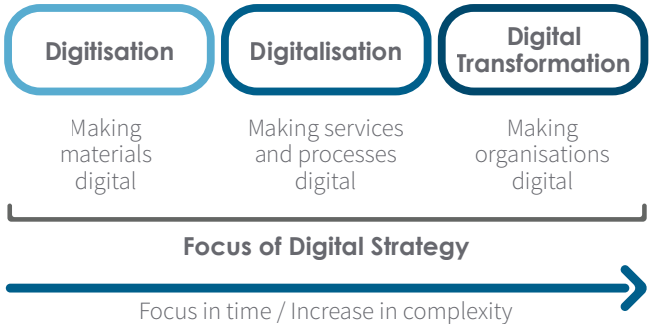
1960s-1970s
Computer Chips
Mainframes

1980s-1990s
PCs
Networks
Internet

2000s
Wireless
Mobile

2010s
Data Revolution
Cloud Computing
IoT

>2010s
Artificial Intelligence
Automation/Robotization
Blockchain
AR/VR



data available to PES could increase dramatically. At the very least this leads to the consideration for PES, when planning digital strategies, of how data could feature within these strategies. The thematic paper on *Creating Digital Strategies* (2018), and starting guide *Getting Started with Digital Strategies* (2019), could be of use for PES wanting to explore this topic further.

In addition, the increase of technology in society leads to changes in the labour market. As explored by the PES Network in 2018, automation and robotisation are expected to change the nature of many jobs and potentially make jobs redundant[1]. PES could benefit from analytics to better understand these changes and prepare for this future.

Lastly, it is important to note that technological innovation does not only lead to more data available for PES to work with but also leads to massive increases in computational power. Since the 1960s the processing power of computer chips doubles roughly every 18-24 months[2]. The increases in computational power in recent years have made it possible to analyse vast amounts of data and extract value from the sheer vastness of data.

The increase in the use of technology in organisations raises the strategic profile of the topic. Therefore, it is no surprise that many organisations (PES or not) are developing 'digital strategies' that focus on the integration and expansion of technology across the entire organisation. These strategies evolve over time, with earlier strategies simply focusing on digitisation of information, followed by a focus on digitalisation of processes and services, and lastly a digital transformation in which the entire organisation is being re-aligned with the technology used. While more PES are developing digital strategies (also see next chapter), few are considering a complete re-organisation at this point.

The thematic paper on Creating Digital Strategies (2018), and starting guide *Getting Started with Digital Strategies* (2019), could be of use for PES interested in learning more on the types and development of digital strategies.

2.2 Big or 'Smart' Data

An important side-effect of the increase in technology and digitalisation of products and services is the generation of and access to large amounts of data. This is largely due to four phenomena:

a. Digitisation of information and storage of records in data systems[3] has made access to information much easier and turns data into a resource that can be used to create or improve offerings.

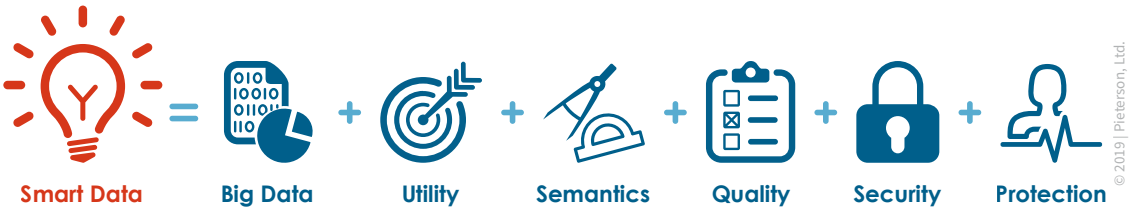
b. Connection of data systems through networking technologies (both intranets and the internet) has greatly increased the amounts of data available.

c. Information and communication technologies themselves create data (for example server logs) that can be used to optimise processes or other purposes.

1 PES Network Working Paper 'The future of work: implications and responses by the PES network'. Available at:https://ec.europa.eu/social/BlobServlet?docId=20520&langId=en

2 This phenomenon is referred to as Moore's law.

3 By data system we refer to any type of database infrastructure, including data bases, data warehouses, data marts, and data lakes.



d. The increase in the number of digital devices connected to the internet (e.g. IoT sensors) allows for the creation of additional information that can be used to tailor or refine offerings.

As a result, and as mentioned above, the amount of data available to PES is increasing drastically, leading to the label of 'big data'. In its simplest form, big data simply refers to very large data sets, but there is no unified idea of what 'big' entails (which arguably is also a moving target). More commonly, big data are being described by the three Vs.

- Volume (referring to the quantity of information)
- Variety (referring to the multitude of information types)
- Velocity (referring to the speed with which data is stored, analysed and/or changed).

However, we believe that too narrow a focus on the quantity element of data ignores various other aspects of data that are equally important. Therefore, we prefer to use the term 'smart data'.

Smart data[4] is the combination of:

- Big Data – refers to large quantities of data.
- Utility – points to the potential value of data (e.g. how it can help solve a PES business problem).
- Semantics – refers to the way in which data are described and organised.
- Data quality – refers to aspects of quality of the data, such as completeness, reliability, and degree to which the data is error free.
- Security – refers to the degree to which data are stored and used in a secure way.
- Data protection – refers to the protection of privacy and issues of confidentiality (also see section 3.4).

All these aspects need to be in order before the data can be used in a valuable and meaningful way. Whilst the hype around big data has waned in recent years, this does not imply the phenomenon has withered. Rather, it has fairly quickly turned into a given for many organisations that have now turned to deriving value from this data.

Although, value is often expressed in terms of cost savings. We can define several areas where (big) data analytics are believed to aid a PES:

> Improving the effectiveness of the PES

The PES have several objectives that need to be achieved. The unemployed need to be re-employed, vacancies have to be filled, etc. Data can help improve the primary processes by focusing on the effectiveness of the systems and processes in place. Increasing the number of positive matches in a system or improving the number of people correctly profiled is another example, that can be achieved by increasing the number of variables included in a profiling application. A final example is the use of performance management systems[5] to monitor performance and make adjustments when needed.

> Improving the efficiency of the PES

Working smarter, doing more with less, are keywords which apply to methods to make the PES more efficient. In general a PES can work more efficiently if it saves time and/or money performing the same duties. Increasing the number of matches a system can make or enhancing the productivity of case-workers using data driven tools are examples of how a PES can work more efficiently.

4 See the Analytical Paper Modernising PES Through Supportive Data and IT Strategies (2016) for a longer discussion.

5 Performance Management was a topic in another Peer Review in 2012. See: ec.europa.eu/social/BlobServlet?docId=7957&langId=en

> Improving customer satisfaction

It is important to deliver services that satisfy the clients of the PES (the obvious clients are jobseekers, those at risk of unemployment[6], and employers, but we can also think of clients such as other governments (e.g. those a PES supplies Labour Market Information (LMI) to) or third parties (that pull data from a PES using Application Programming Interfaces (APIs)). Part of this, is the increasing need to also be transparent to the public.

2.3 Open data

Another topic of importance to PES arising from the seminar is that of open data. In line with the Thematic Paper on Modernising PES (2016), we define open data as those types of data that PES make available for re-use for free and for any purpose. A presentation by the Dutch PES (during the seminar) illustrates four reasons as to why PES could make certain types of data public:

1. Creating business opportunities

Private sector companies can exercise their right to re-use public sector information (PSI) to make data (e.g. about vacancies) public so that business can develop and create new business opportunities. Important arguments for open data are the creation of jobs and improving the function of labour markets.

2. Demands from governmental stakeholders

In the Dutch situation, municipalities in particular were asking for (national) data about the labour market as a source of LMI and to create Active Labour Market Policies (ALMPs). While this applied in this case specifically, it is likely that similar situations exist in other countries. Open data generated by the PES could help other governments create a better understanding of the labour market, compare regions or localities and create policies (e.g. in the areas of education or finance).

3. Requests from other employment agencies

Other types of employment agencies, whether public or private, could also request data from the PES. This could be used for benchmarking or benchlearning purposes or to create business intelligence related insights.

4. Political pressures

Lastly, political pressures either from local, regional, or national governments can request PES to open up data sources (some exceptions are mentioned in the Directive like those related to personal data protection). This could stem from desires to create transparency in the public service, improve accountability of government, help governments innovate, or create business opportunities (see point 1 above).

The recast of the PSI Directive provides with a description of the term 'open data' "Open data as a concept is generally understood to denote data in open formats that can be freely used, re-used and shared by anyone for any purpose. (...)". While not that many EU PES have open data, or plans to work on open data, some do. Nevertheless, any data held by a public sector body falls within the scope of the PSI Directive and as such, becomes re-usable.

The French PES is possibly the most advanced in this regard. It has created an API store[7] from which open data can be retrieved for research, innovation, benchmarking, or business development purposes.

6 See also Analytical Paper 'How do PES act to prevent unemployment in a changing world of work' (2019).

7 See https://www.emploi-store-dev.fr/portail-developpeur-cms/home.html

Open data is also an important part of the European Commission's Digital Single Market agenda. Here PES open data would fall under what the EC labels Open Public Sector Information or Open PSI. The European Commission's policies focus on generating value for the economy and society through the re-use of this type of data[8]. This is linked to the EC's policy opening up scientific data for everyone[9].

Related to the concept of Open Data is the concept of Re-use of PSI. After all, opening up PES data sets is one way to stimulate the availability and re-use of PSI. The European Commission recognises that PSI could be a valuable resource for the digital economy. It could not only be used as resource for the production of data-driven services and applications, but also to improve efficiency of service delivery and decision making. Last year, the European Commission launched their latest proposal[10] for an update to the Directive on the re-use of PSI (originally from 2003 and updated in 2013)[11]. The co-legislators have reached an agreement on the new Directive[12], which is set to be finally adopted in the spring 2019.The overall objective of the upcoming Directive on Open Data and the PSI re-use is to contribute to the strengthening of the EU's data-economy by increasing the amount of public sector data available for re-use, ensuring fair competition and easy access to market for players that re-use public sector information, and enhancing cross-border innovation based on data. Besides stimulating governments in the EU to make public sector information available for re-use preferably as Open Data, one important new provision is the requirement (in certain situations) on public sector bodies to make dynamic ("real-time") data available through APIs.

The Directive, if adopted, could have two main implications for PES. The first is an increased pressure to start releasing Open Data preferably through APIs. The second is an increase in possibilities for PES to innovate or drive innovation by benefiting from Open Data from other government bodies.

In any case, it seems likely that Open Data is 'here to stay' and PES not developing initiatives in this area could benefit from doing so and learn from their PES Network colleagues.

2.4 Advanced analytics

Analysing and using data is, of course, nothing new. For a number of years various approaches and types of analytics have been developed to generate insights from data. Examples include qualitative and quantitative statistical approaches, knowledge discovery in databases (KDD) and data-mining (see Appendix 1 for an overview).

However, what is new is the combination of the two main developments described above (big data & advances in computational power) with a third component: learning algorithms. These are mathematical models embedded in software that can recognise and learn from patterns, and based on this information extrapolate to the future. We call this new class of analytics, *advanced analytics,* to distinguish them from older types of data analysis and analytics that tended to focus more on simply computing, transforming and condensing information.

Within this group of advanced analytics we find three types of analytics, each embedded in each other. These are artificial intelligences (the main type and therefore shown in the triangle above), machine learning, and deep learning.

Artificial Intelligence

Artificial intelligence (AI) is used to create smarter technologies that can make decisions or support decision making. The main goal of AI is to create technologies that are so smart that they can think and act like humans. Artificial Intelligence is a broad concept that encompasses machine learning, deep learning and intersects with other types of analytics, such as data mining and statistics.

8 See https://ec.europa.eu/digital-single-market/en/open-data

9 See https://ec.europa.eu/research/openscience/index.cfm?pg=openaccess

10 See https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:0234:FIN

11 See https://ec.europa.eu/digital-single-market/en/proposal-revision-public-sector-information-psi-directive

12 See http://www.europarl.europa.eu/RegData/commissions/itre/inag/2019/02-06/ITRE_AG(2019)634786_EN.pdf

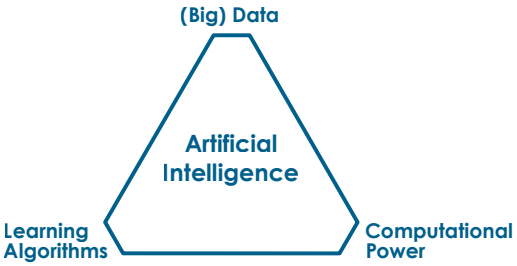
Most well-known examples of AI applications are smart assistants as developed by companies such as Google (the Google Assistant), Amazon (Alexa), Apple (Siri) and Microsoft (Cortana). More recent trends in AI, as mentioned during the seminar, focus on such areas as:

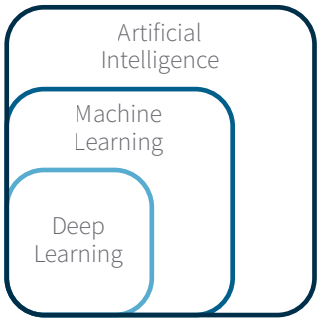
- Creation of autonomous vehicles and robots. In the context of PES, this could help in the creation of case worker robots that move autonomously across offices.
- Applications using data from devices connected to the Internet of Things (IoT) that combine data to create new applications. In the context of PES, a triangulation of data collected by various sensors could help tailor, or personalise, the service experience for jobseekers.
- Data is being used to increasingly improve the understanding of individuals' emotions and the public's sentiments e.g. through the analysis of social media and/or facial (expression) recognition. This could be used by PES to help generate better LMI data. develop real-time ALMPs or improve services to jobseekers by incorporating emotions in AI-Human service interaction[13].
- Improvements in models and analytics' capabilities allow for increasingly accurate real-time analysis. This could aid PES in real-time fraud detection or instant personalisation of services to clients.

AI is also high on the agenda of the European Commission, which became clear during the seminar. The European Commission puts forward a European approach to artificial intelligence and robotics. It deals with technological, ethical, legal and socio-economic aspects to boost EU's research and industrial capacity and to put AI at the service of European citizens and economy[14].

Machine learning

Machine learning is used to create better functioning algorithms and models by learning from ongoing analysis. Machine learning is a subset of artificial intelligence and there is disagreement about





the exact difference between the two concepts. We see the difference where machine learning is mostly used to analyse large volumes of data, discover patterns in these data and subsequently learn from the data; artificial intelligence goes one step further and includes systems that can make decisions, combine elements, reason and thus show behaviour comparable to human thinking. Herein also lies a key difference between machine learning and data-mining/KDD; in machine learning there is a clear emphasis in learning from the data and the applied analysis for future iterations.

A well-known example of machine learning is predictive texting (either in e-mail or sms) where the system has learned that certain words are often used together so it can 'predict' which words could follow after a certain word has been typed (such as Thank + You or Happy + Birthday). Another example is formed by recommender systems such as used by Netflix or Spotify that recommend certain media for you based on your behaviours and the behaviours of customers similar to you.

13 As showcased by the following example - see https://www.youtube.com/watch?v=mKZ8401666g

14 See https://ec.europa.eu/digital-single-market/en/artificial-intelligence

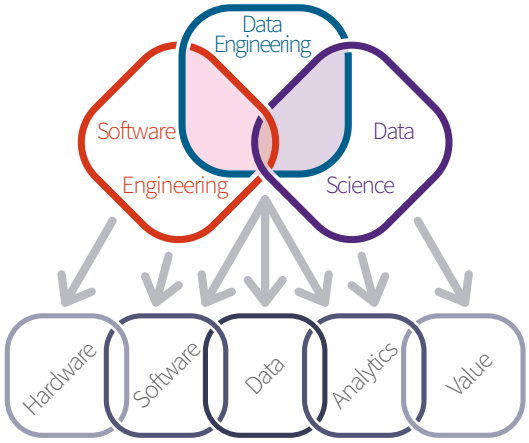
Deep learning

Deep learning is a subset of machine learning (which, as explained above) is a subset of artificial intelligence. In our view[15], the key difference between machine learning and deep learning is that deep learning focuses heavily on unstructured and abstract data as well as the combination of many layers of data. Machine learning tends to focus on structured data and discovering patterns in data that are well organised.

An example of deep learning is found in tagging systems for photos on smart-phones or social media that recognise faces (or places or any other category) and then provide categorisations. For example, the phone can recognise the Eiffel Tower in your pictures, based on the fact that it has seen millions of pictures of the structure before and has been told ('trained') this structure is the Eiffel Tower.

The implementation of advanced analytics in the organisation is more complicated than one might think. It requires considerable resources that include the set-up of an analytics infrastructure and creation of a data team. These issues and required investments are discussed in more detail in the toolkit on *Being Smart with Data and Using Innovative Solutions* (2016). PES also need to consider how to manage anticipated shortages in talented data professionals (see section 3.5) Furthermore, as the relationship between 'digital' and 'data' is tight, there is overlap in different business functions dealing with IT and data. For example:

- Software engineers focus on the development and maintenance of software running on the various IT systems (hardware) of the PES.
- Data engineers' main role is making sure data is organised in such a way it can be used by the organisation. Very often a big part of their work involves ETL[16] of data and in order to do this, they often collaborate with software engineers, to make sure IT systems store the right data and it can be extracted easily.



- Data scientists' main role is to use data to provide value for the organisation. This could be in terms of a) solving business problems, b) improving processes and services and/or innovation. In organisations with large analytics functions, data scientists often have data analysts working for them to create algorithms and run analytics. Data scientists work closely with engineers to make sure they have the right data to provide value.

One challenge for PES will be to develop these capabilities internally and/or hire new staff to fullfil these roles. With anticipated talent shortages (also see 3.5, point 5) in the future in these areas, PES should start investing sooner rather than later in plans to develop and/or acquire future skill sets and talent capabilities.

15 Once again, many different interpretations exist, so the reader may have come across different definitions. We have tried to create an easy-to-understand common definition.

16 Extraction of data from systems, Transformation (or cleaning, sanitising and organisation of data) and Loading (putting it into analytics data systems).

3. WHAT IS HAPPENING? PES DEVELOPMENTS AND FUTURE TRENDS

3.1 General PES developments

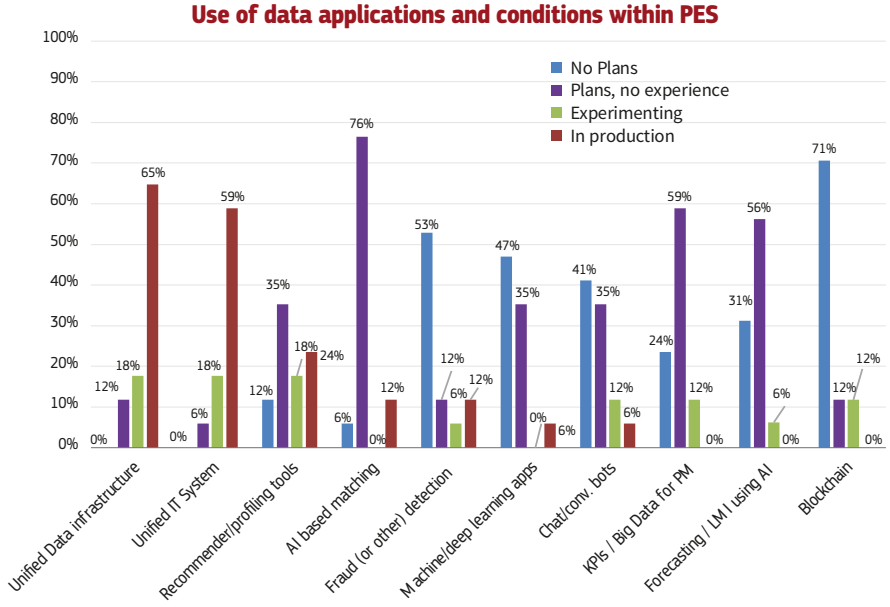
As is the case with the world in general, the PES are constantly changing and evolving. This becomes clear when we analyse the changes within PES in recent years in the areas of focus here (data and digital).

Using data is clearly a 'work in progress' for PES, but PES are moving in the right direction. For example, when we asked PES in 2016 (as part of the Thematic Review Workshop on Modernising PES) whether data was linked and unified across the PES, this only applied to a minority of the PES. At present, in late 2018, 65 % of PES have unified their data infrastructure.

Similarly, we see an increase in the use of data. PES are increasingly using data to measure and manage performance: for example, several PES have a system of Key Performance Indicators (KPIs) under development (e.g. Estonia or Slovenia) or already in place (e.g. the Netherlands), whereas several years ago, the use of data to measure parts of the organisation was considerably less well spread. The PES Network's *Toolkit on Performance Management* (2016), as well as the PES Network's *Getting Started with Key Performance Indicators* (2019) can be helpful resources for those PES considering activities in the areas of performance measurement and/or management.

The increase in use of data does not extend solely to the back-office part of integrating data sources. While few PES (see figure above) are actually using AI or other types of advanced analytics, more and more PES are planning to do so. For example, 76 % of PES are now considering the adoption of AI based matching and little over half of PES are planning to use AI for labour market forecasting and other types of LMI. Similarly, there is interest in developing chat and/or conversational robots. Some PES are already experimenting with these. For example: the German PES is developing plans to implement a chat bot, the French PES is already working on a chat bot (called Ludo). The Slovenian PES is developing an interactive assistant (IZA) which, while not being very advanced yet in terms

Use of data applications and conditions within PES



Note: Numbers do not always add up to 100% as "don't know" answers were omitted from the figure.

of underlying AI, bears great promise for the future. The role of bots as service channels and their position in the 'mix' of service channels offered by PES is further discussed in the PES Network's analytical paper on *Multi-Channel Management in PES: from blending to omni-channelling* (2017).

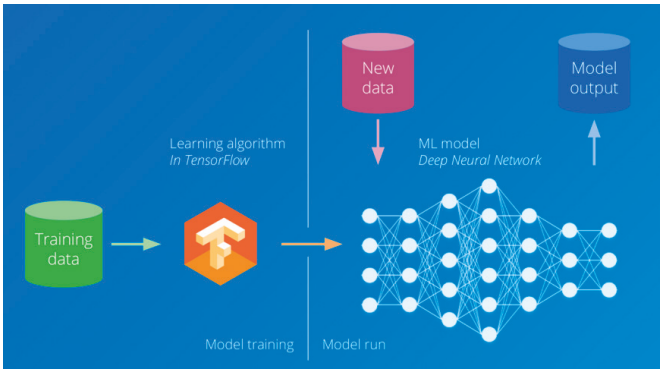
There are more examples of how PES are using AI (and/or its sub types) to innovate:

- The French PES developed a deep learning based recommender system helping jobseekers find relevant applications and tools based on their personal situation in the 'Employment App Store' (emploi-store.fr).
- The Dutch PES has developed an application that detects potential fraudulent behaviour based on click data.
- The Belgian-Flemish PES (BE-VDAB) has developed a profiling tool (based on various machine learning models) to predict the time jobseekers are unemployed.
- Similarly, VDAB is using machine learning based predictive models to support caseworkers. The model segments customers based on (un)employment risks and helps caseworks give recommendations.
- Lastly, VDAB is using deep learning to create new approaches towards vacancy matching. In this approach, the Neural Network[17] model tries to discover patterns in vacancy texts and jobseekers resumés and tries to match those based on similarities.

3.2 Data collection, integration, storage and organisation

With the increase in the use of data, also come challenges related to storage and organisation of data (a topic discussed in the PES Network's *Toolkit on 'Being Smart with Data'*). As became clear during the seminar, this is a topic high on the agenda of many PES.

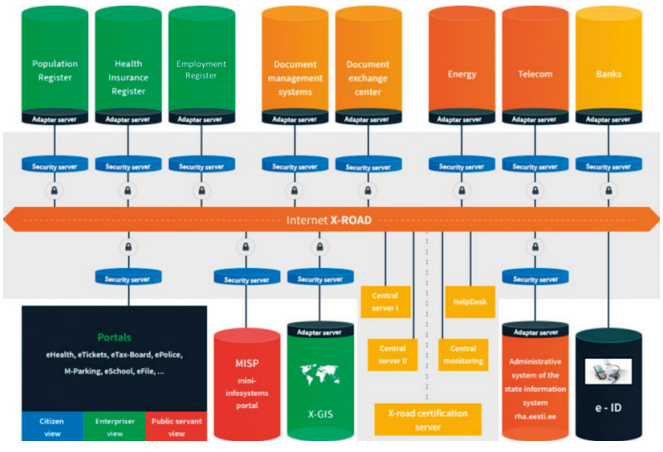
The first issue currently on the agenda is that of data collection and integration. Many PES are focused on collecting data internally and externally and integrating data sources into their own storage solution. Fortunately, there are some good examples from PES and/or EU countries.



Nationwide, Estonia's X-Road (see graphic below) is still regarded as a leading example on how, on a national level, organisations (both public and private) can connect and integrate their data sources. Finland has adopted the same model and is creating its own version of this X-Road.

Other countries are taking other initiatives to facilitate data sharing and integration. France, for example, has created an API store (also see 2.3 above) where developers can use these APIs to develop applications (among others for the Employment App Store). Austria is working to integrate data sources from other governments as well. The German PES has also invested heavily in its data infrastructure and now has, as part of the BI2020 strategy, a unified data warehouse upon which analytics can be performed. Other PES are embedding data firmly in their organisational structure, such as in Cyprus where a new data processing officer was appointed recently.

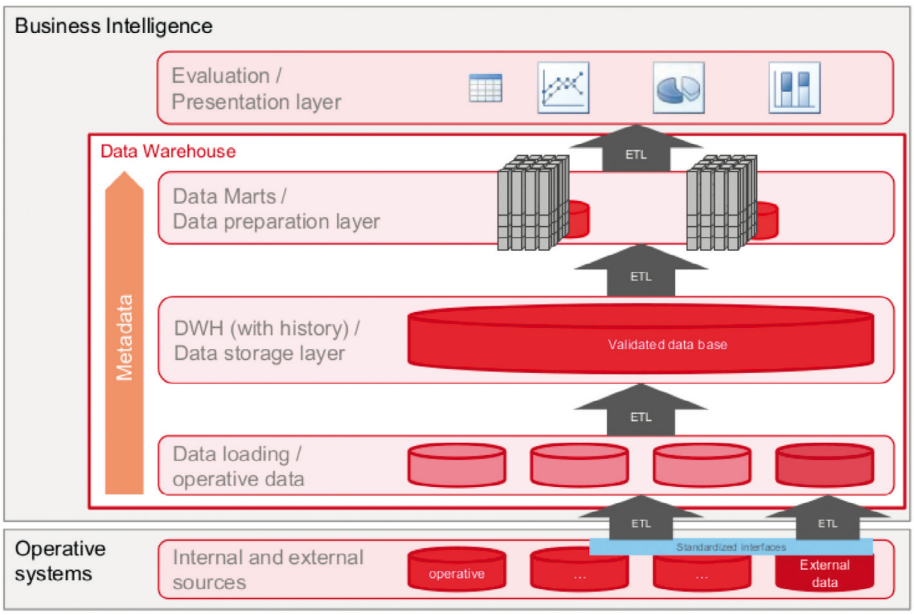
Schematic overview X-Road Estonia



For an explanatory video, see here:
https://vimeo.com/94158435

17 See here for a basic introduction: http://pages.cs.wisc.edu/~bolo/shipyard/neural/local.html

German Data Warehouse architecture



This example is interesting as it combines two approaches towards storing (and organising) data; a data warehouse and a data mart. These two, together with data lakes, are three common approaches towards storing data. The figure below provides an overview of the three concepts.

Data warehouse (DWH)

A data warehouse is a storage facility of structured and organised data. Often it contains collections of (large) data sets and different data bases. Data warehouses often contain (historical) data from processes and system that either need to be archived and or kept for re-use.

Data mart

A data mart is typically built on top of a data warehouse and is used to serve specific functions in the organisation. Therefore, they often contain smaller (restricted) data sets. This creates an extra security layer, and makes it easier for users to access specific types of data that they need.

Data lake

A data lake, in its simplest form is a place where all data, structured or unstructured, can be stored. There is no, or very little, organisation in the data. Data lakes can be used as a 'reservoir' to hold data before it is organised, or a place where unstructured data oriented analytics can work from.

However, cleaning and organising data remain challenges, especially as organisations start collecting and storing vast amounts of (un)structured data. This is why more and more organisations have started to invest recently in dedicated data curation functions. Activities of these functions include capturing, cleaning, organising, defining, and aligning disjointed data. An important question for these functions is how the data needs to be classified or clustered. Automated machine learning techniques can find structures (using approaches based on pattern recognition[18]) in data and while these are very useful to discover 'hidden' structures they can suffer from ambiguity as to where the classification comes from. This could limit their practical application. Another approach is trained or hybrid pattern recognition in which either the algorithm is trained by a human that can distinguish between categories (and thus guide the subsequent learning) or where an existing schema is fed into the

18 See https://www.techopedia.com/definition/8802/pattern-recognition-computer-science

Danish Presentation Dashboards

machine as the basis for the training. A key example of such as scheme in this context is the European Skills, Competences, Qualifications and Occupations (ESCO) classification framework.

Classification Example: ESCO

ESCO (European Skills, Competences, Qualifications and Occupations) is the European multilingual classification of Skills, Competences, Qualifications and Occupations. It provides structured descriptions of around 3,000 different occupations and roughly 14,000 types of skills that are linked to these occupations. In addition, around 8,000 different qualifications are available. As it is translated in many languages (27 languages; all official EU languages plus Icelandic, Norwegian and Arabic) it can be used to classify a wealth of international labour market information.

The primary aim of ESCO is to support job mobility across Europe and therefore a more integrated and efficient labour market, by offering a "common language" on occupations and skills that can be used by different stakeholders on employment and education and training topics. However, it could also be used to classify and organise existing databases by mapping (un) structured information about skills, qualifications and jobs to the classification framework.

The scheme itself can be downloaded here: https://ec.europa.eu/esco/portal/download

There is an ESCO API available as well: https://ec.europa.eu/esco/portal/api

Learn more: https://ec.europa.eu/esco/portal

We are also seeing progress in terms of digital strategy development in which both 'Digital' and 'Data' play a prominent role. For example, Belgium-Wallonia (BE-Le Forem) launched a new digital strategy in 2017 that focuses heavily on the use of data. Similarly, Slovenia is working on a digital strategy with ample focus on analytics. In this case, analytics focuses primarily on the development of a Key Performance Indicator system in which the performance of the PES is being measured and analysed. KPIs and performance management in general are analytics topics that are featuring high on PES agendas. Countries such as the Netherlands have KPI systems in place and others, such as Estonia, have them under development. While KPIs themselves are not necessarily advanced analytics applications, thinking about measurement and using data to measure performance tend to be good gateways into advanced analytics applications.

Similarly, we are seeing an increased interest in the presentation of analytics results. The topic of *dashboards* as a means to display information, often to different audiences is gaining traction within the PES Network. PES such as the Danish PES have been making good progress in this area with the development of tailored dashboards with different types of information for jobseekers, employers, and case-workers.

So, if anything, the broader topic of 'Data' (including the presentation of results) is definitely on PES agendas and more and more, data is being discussed in the context of digital. If anything, PES in recent years have mostly invested in data infrastructure and the integration of systems and processes. This lays the foundation for further digitalisation or digital transformation as well as the use of advanced analytics. While the use of advanced analytics is on the rise within PES and most are interested in AI applications, most applications are either experimental or small scale at this point in time.

French PES' Digital services marketplace

See http://www.emploi-store.fr

3.3 Innovation Labs

With the increase in the relevance and potential of data comes the opportunity to use data as a means to innovate and fuel new applications. Several PES (e.g. Belgium-Flanders, France) now have innovation labs where PES are experimenting with new applications, often driven by AI. The French PES has created an environment in which it tries to stimulate innovation (in which the lab plays a central role). In this environment:

a. Any PES employee can pitch an innovative idea to the PES' *Le Lab*.[19] If the idea is accepted, the employee can become an "Intrapreneur".

b. The Intrapreneur can develop his/her idea within or with help from Le Lab to develop and test it.

c. If the idea is viable, the idea can be developed further within an internal 'start-up' and made market ready within the PES' incubator "La Fabrique[20]".

d. Successful ideas can be implemented organisation wide. For example, applications can be adopted within the organisations' own Digital services marketplace for employment and training (or application store - emploi-store.fr) where customers can find applications and tools that can help with job search or career development.

The Swedish PES, as became clear during the seminar, is going one step further with the idea of innovation labs and is now in the process of creating a lab specifically dedicated to the development of applications.

3.4 Privacy and data protection

Critical issues for PES that emerged during the seminar relate to the protection of data as well as privacy concerns. The implementation of the EU General Data Protection Regulation (GDPR)[21] seems to be a big concern for many PES attending the seminar. While the regulation is complex, various resources are available to help PES (as well as other businesses and organisations) implement the EU data protection rules. For example, the European Commission offers information on different topics, such as:

- Application of the regulation
- Principles of the GDPR
- Public administrations (including PES) and data protection
- Legal grounds for processing data
- Obligations
- Dealing with citizens

Other practical resources are available online[22] that could help PES increase their understanding of the regulation as well as support its implementation. The activities of the PES Network in 2019 will also include a focus on big data and ethics.

19 Le LAB provides a dedicated, physical space for French PES employees and stakeholders to come together and think through problems and solutions related to employment services in a creative and innovative way. See the PES Practice for more information at: https://ec.europa.eu/social/main.jsp?catId=1206&langId=en

20 La Fabrique also hosts external start-ups, for more information see the PES Practice at https://ec.europa.eu/social/main.jsp?catId=1206&langId=en

21 See https://ec.europa.eu/info/law/law-topic/data-protection_en

22 For example, see https://www.infosecurityeurope.com/__novadocuments/355669?v=636289786574700000 & http://f.datasrvr.com/fr1/416/76165/IAPP_GDPR_and_Privacy_Shield_Survey_Report.pdf & http://content.linklaters.com/pdfs/mkt/london/TMT_DATA_Protection_Survival_Guide_Singles.pdf

3.5 Broader trends and developments

The broader world of data and digital, of course, is also changing. Large technology firms in particular, are pushing the boundaries of technology and AI forward at a fast pace. However, it does appear that in most areas the motto is 'evolution', rather than 'revolution'. In terms of digital strategies most organisations seem to continue planning for further digitalisation or digital transformation. If anything, it seems the 'human' or 'soft' aspects of digital are getting more attention, mostly driven by the realisation that it is often not technical factors that challenge the success of digital, but human related factors such as:

- The organisational culture
- Role of leadership
- Resistance and willingness to adopt changes by employees and customers
- Communication and collaboration

Similarly, in advanced analytics, the focus will also be on evolution. For example, intelligent assistants (such as Apple's Siri) when they arrived (in the 2010s) were considered a revolution in the development of AI. Currently, the focus is on improving these assistants rather that radically changing them. The same could be said for most areas of analytics and AI. While it is impossible to provide an overview of all trends in the space, we see the following as key developments[23] for the near future that could be of importance for PES:

1. AI integration across services and processes.

As AI becomes sophisticated, it gains skills that allows it to do more than just relatively simple tasks (for example turning switches on/of, predicting text while writing). In the coming years AI is likely to become more sophisticated and a big part of that sophistication is derived from the integration of functions across services and processes.

One example of AI integration across services and processes are developments in AI Powered recruiting tools. For example, Mya[24], which stands for "My Recruiting Assistant," is a chatbot recruiting assistant. It can communicate with candidates via Skype, email or text. It can pre-qualify candidates and even reject a candidate if the employer decides to pass on his or her application.

Such integration could be interesting for PES in terms of making the 'customer journey' more efficient and effective. For example, unemployment registration could automatically feed into profiling/segmentation, Active Labour Market Policies (ALMPs) and job-matching.

2. Advances in checking and fraud detection

A big area of development and interest is that of checking data and detection. Advances in computational power and sensor capability are now making it easier to check records and, for example, detect fraud. Investments of the banking and insurance industries, government intelligence and border security are big drivers of progress in this area and in coming years applications in this area are likely to trickle down to other organisations.

One example is the development of advanced neural networks (such as Convolutional Neural Networks[25]) that are much better at detecting anomalies in patterns that previous generations of algorithms could not spot as easily. Another area where such applications can be applied is that of monitoring computer network traffic and user behaviours to discover hacks, attacks, and so forth. Several companies are working on solutions to constantly monitor the networking infrastructure of organisations and detect potential dangers[26]. Another example is the use of AI to classify records and check them against rules, for example, to see if information is GDPR compliant[27].

While applications such as fraud detection are not yet high on many PES agendas (see section 3.1), this is likely to change in the future as these applications become more commonplace. With the increased focus on security (also see below) it is an area in general that will grow in importance.

3. More attention on security and privacy

With a lot of mainstream media attention occurring concerning data leaks, theft, security and privacy (not the least because of GDPR), security and pri-

23 Based among others on the following - see https://www.entrepreneur.com/article/323761

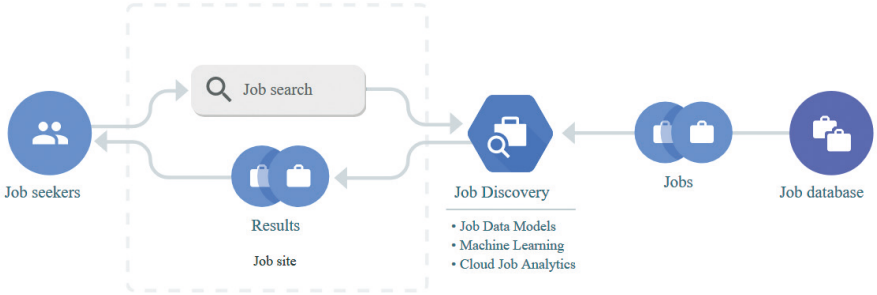
24 Hiremaya.com

25 See http://ufldl.stanford.edu/tutorial/supervised/ConvolutionalNeuralNetwork/

26 See for example Darktrace. Available at: https://www.darktrace.com/en/technology/

27 See for example applications such as Checkr. Available at: https://checkr.com/product/

Google Job Discovery



See https://cloud.google.com/job-discovery/

vacy are likely to be high on the agenda for the near future. The importance of security and privacy is augmented because advances in AI will create new security challenges. One example of this is recent developments in machine created content, for example, where technologies are used to alter video and audio[28] and create fake news. Cyber attacks, fighting spam and identity abuse are other security areas that will require ongoing attention.

Similarly, privacy remains on the agenda with many organisations still working to meet GDPR requirements.

4. Better data processing and organising

As we noted in the Toolkit from 2017, 90 % of all data collected is unstructured and data teams in organisations spend as much as 90 % of their time cleaning and organising data. With the challenges this poses, it is no wonder that better (and automated) organisation of data is high on the list of important future developments.

For example, AI tools such as Chorus.Ai can automatically record, transcribe and store conversations as well as determine how salespeople perform, which can help make the sales process and conversations more effective. Somewhat related is the rise of automated machine learning applications (AutoML) which aims to make it much easier to select machine learning algorithms, parameter settings, and the pre-processing methods that improve their ability to discover patterns in data.

PES who are still in early stages of data organisation and processing could benefit strongly from developments in this area, by saving considerable time and resources.

5. Talent shortages

A fifth development for the future is the expected shortage of talent in the data space. IBM, for example, estimates that by 2020[29], the number of jobs for U.S. data professionals will increase to around 2.7 million. As the supply of highly trained professionals is much lower, salaries in this area are expected to increase and this could, in general, hurt the public sector where salaries in general are lower (and/or capped).

This could become a serious problem for PES looking for talent in the near future. One solution is to work more closely with external providers of data solutions, another is the re-skilling or upskilling of existing employees. As mentioned above (2.4), given these expected talent shortages, PES wanted to invest in advanced analytics should develop an HR strategy sooner rather than later.

6. More advanced assistants and bots

In terms of front-office (channel) developments, noteworthy is the improvement and evolution of 'bots' (whether they are chat bots, conversational bots or intelligent assistants). While bots have been a promising application of technology to increase efficiency for quite some time now, the actual success has been far from universal. It is, however, widely expected to improve in the near future.

28 For a well known example see here: https://www.youtube.com/watch?v=cQ54GDm1eL0

29 See https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=IML14576USEN&

In part this is due to such developments as improvements in (AI Powered) search and speech/text recognition. Another factor that plays a role is the increased integration of data-sources and functionalities (also see point 1 above). An interesting example is the Autodesk Virtual Agent (AVA)[30] that also responds to emotional signals from the customer to learn and understand whether a customer understands a response and is happy with the answer.

With the interest of PES in bots still being high, this is definitely a development worth monitoring, assessing when bots become mature enough to provide sufficient value.

7. UX/UI design becomes more important

As technology becomes more prevalent and intelligent, the higher the risk of increases in complexity. Furthermore, the success of any technological innovation is determined by the degree to which people are able to interact with it. While the focus of software development used to be predominantly on development of functionality, this focus has begun to shift (with the rise of smart-phones) towards a focus on the user-interface (UI) and user-experience (UX) for users of tools.

As a result, expectations of users regarding UI/UX are shifting and increasing. Therefore, many organisations – and PES should also consider this – are increasing their investments in UI/UX design, involving the end-users in design and development processes.

8. Better and more specialised hardware

Hardware is expected to become more specialised in the near future. Companies such as Facebook and Google started building dedicated systems for machine and deep learning several years ago. Now that the first dedicated AI chips have appeared in smart-phones, dedicated chips and appliances are expected to trickle down into the market.

For PES, this means that dedicated hardware for certain applications is likely to become more accessible and affordable in the near future. This could provide benefits for in-house solutions and/or lower the cost for cloud-based applications.

9. Evolution, rather than revolution

It is likely that we will see further developments in existing (model based) analytical methods like (Bayesian)[31] inference, decision trees, simulation platforms, and graph-based approaches. While deep learning continues to be an area of major (scientific) research and development, most actual applications on the market will remain hybrid approaches with elements of deep learning and these are likely to be evolutions of existing approaches.

We are expected to see improvements in domains in which PES operate. This includes private sector labour mediation services and even cloud-based newcomers to the market. For example, Google recently launched their 'job discovery' service, which is basically a matching engine that can be used by any interested party.

As such, it is an opportune time for PES who have little or no experience in this space to catch up on the basics of advanced analytics and AI, at least in terms of basic knowledge.

10. Blockchain will be put to the test

Blockchain is one the latest technological developments in recent years to experience great hype. The de-centralised ledger underpinning crypto currencies such as bitcoin has been hailed to transform anything from the diamond trade[32] and shipping insurance[33], to areas more closely related to PES work, such as the application by job.com where blockchain will be used to record contracts between jobseekers and hiring organisations.

Despite the attention blockchain attracted and its success in the world of crypto currencies, a critical question remains what the actual value and benefits of the blockchain are over more conventional solutions to record transactions. A recent study found virtually no benefit of the blockchain[34], raising the question whether it is an appropriate area of investment for PES. At this point in time it seems wise to just to monitor developments in blockchain in 2019 and beyond.

30 See https://www.youtube.com/watch?v=mKZ8401666g

31 See https://www.datascience.com/blog/introduction-to-bayesian-inference-learn-data-science-tutorials

32 See http://fortune.com/2017/09/12/diamond-blockchain-everledger/

33 See http://fortune.com/2017/09/05/maersk-blockchain-insurance/

34 See https://www.theregister.co.uk/2018/11/30/blockchain_study_finds_0_per_cent_success_rate/

4. CONCLUSIONS AND CONSIDERATIONS

Data and *Digital* are no longer foreign concepts to PES, and as both concepts have increased in importance for society as a whole, so have their importance within PES. In recent years we have seen a flurry of activities in the PES Network reflected in the progress made by PES to embrace technologies in front-offices and back-offices and adopt more data-driven mindsets.

PES have, in general, worked on the unification of IT and data systems, often resulting in platforms and systems that contain all (historic) data from a PES. Progress has been made in the areas of profiling and matching and other process-related elements. In the front-office, PES have improved their digital offerings. There is both growing interest and application of data to measure and manage performance. Furthermore, in recognising the importance of *digital,* PES have increasingly elevated *digital* to the strategic level and started to develop digital strategies often with an important focus on data and analytics too.

Lastly, PES in general have started to look at innovating. Innovation labs are sprouting up across the EU and there is a keen interest to learn about new digital technologies and explore the opportunities of advanced analytics (most notably artificial intelligence) to improve PES services and processes.

With technological innovation currently focusing more on evolution of analytics and technology, the time is looking good for PES to keep pushing forward and start reaping the potential benefits in terms of *effectiveness, efficiency,* and *customer satisfaction*.

However, there are also threats and challenges:

A challenge for PES is to move the entire organisation in the right direction. While many good things are happening, the good examples and 'best practices' are exceptions rather than rules. Also, while one PES may be operating an excellent data system, another is leading the way in digital strategy development. The level of involvement in technological use, development and/or innovation varies widely among PES across the EU.

A threat for PES and their effectiveness is whether they are sufficiently prepared to face a world of constant change and evolution.While PES are moving forward, the world is changing too. Not only is technology and data related innovation occurring rapidly, it is accelerating. This means that PES is likely to face a future of constant change in which the need to be flexible and have strategies that evolve over time becomes increasingly important. While PES are moving in the right direction the question remains whether a) they move fast enough and b) are adaptive enough to keep changing in the future.

Another challenge for PES and the PES Network is to start collaborating with each other and engaging in mutual learning at an earlier stage in the innovation process so that resources can be pooled.

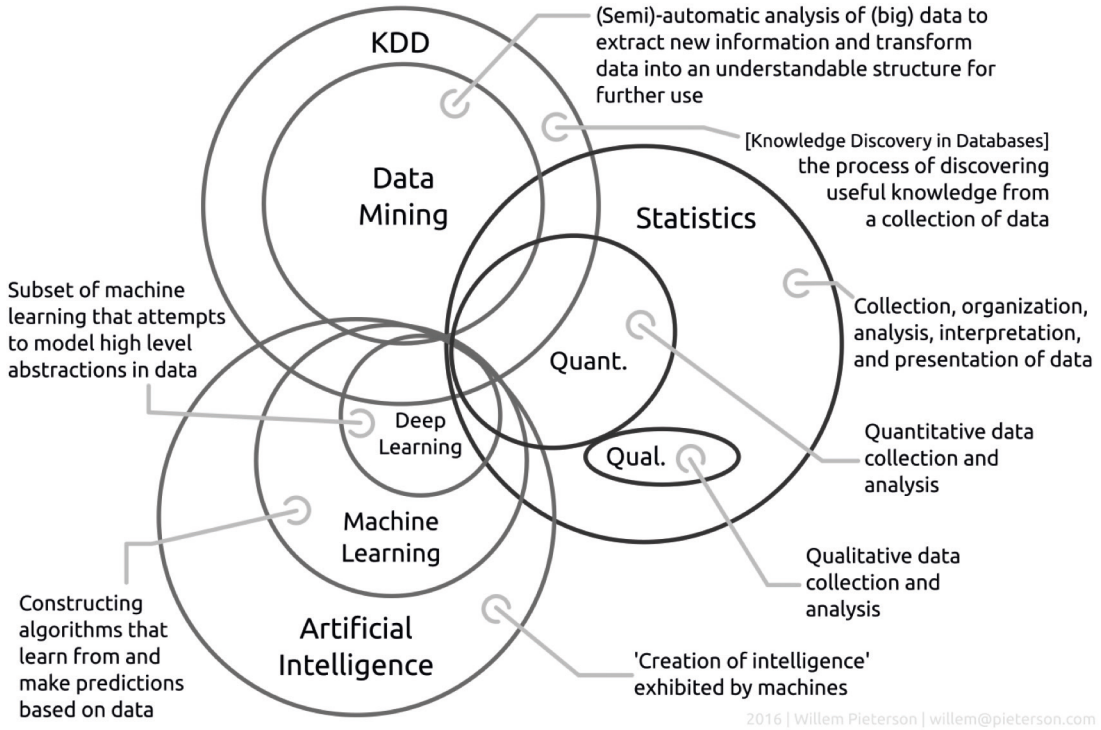
While innovation is happening and PES are experimenting as well as sharing knowledge with each other, most innovation happens at a single PES and is only shared with the Network post hoc. The question is whether PES have the capacity, knowledge and scale to tackle all future challenges alone. And while all countries, cultures and contexts are very different, many of the challenges remain the same.

In addition, we have to recognise that there are large disparities between the different PES across Europe. While some are mostly digital and heavily focused on advanced analytics, others are still working on creating the basic unified IT systems underpinning the organisation. Hopefully the PES Network can help in bridging this divide and bring the different PES closer together.

APPENDICES

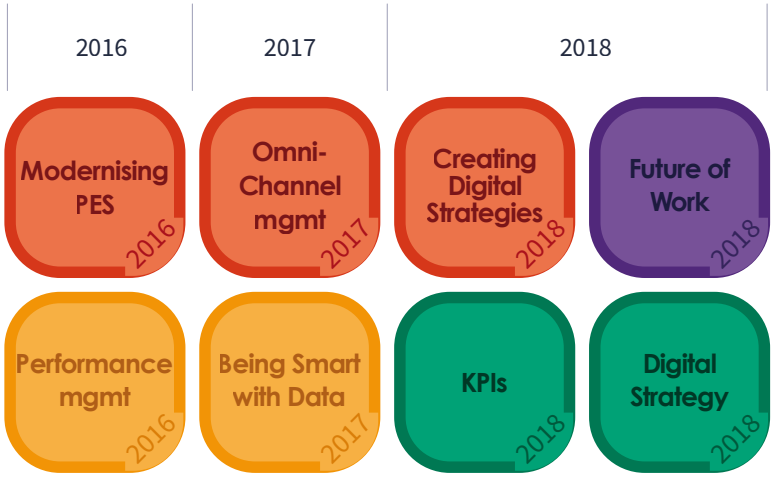
Appendix 1: Analytics Concepts

Key Data Analytics Concepts



Appendix 2. PES Network publications

Key publications on data and digital



Modernising PES

This Analytical Paper focused on modernising PES. It acknowledges that PES operate in an increasingly volatile environment and helps PES understand and plan for continuous change, with an emphasis on IT and Data.

Analytical Paper: Modernising PES through supportive data and IT strategies
https://ec.europa.eu/social/BlobServlet?docId=16602&langId=en

Performance management

Due to the financial crises of the late 2000s, PES have faced an environment of austerity and even as the economy has recovered, there is an ongoing focus on PES' efficiency. As a consequence, measuring and managing performance has increased in importance. The Analytical Paper helps PES understand the topic of performance management, whereas the toolkit helps PES create robust systems of performance management.

Analytical Paper: Performance management
https://ec.europa.eu/social/BlobServlet?docId=18866&langId=en

Practitioner's Toolkit: Performance management in PES
https://ec.europa.eu/social/BlobServlet?docId=16572&langId=en

Omni-channel management

With the increasing importance of technology in society, so too does the importance of technology in the PES front-offices. This leads to new channels, as well as existing channels being increasingly powered by technology. The Analytical Paper discussed different types of channel strategies, including the relatively new approach of omni-channel management in which channels in the front-office are managed holistically.

Analytical Paper: Multi-Channel Management in PES: from blending to omni-channelling
https://ec.europa.eu/social/main.jsp?catId=1163&langId=en

Being smart with data

Following the Analytical Paper on Modernising PES, a Toolkit was produced to support PES seeking to begin working with data and advanced analytics. The Toolkit explored the entire process from collecting and integrating to data engineering, analytics and implementation of analytics' results.

Practitioner's Toolkit: Being smart with data, using innovative solutions
https://ec.europa.eu/social/BlobServlet?docId=17367&langId=en

Creating digital strategies

As technology becomes more important, 'digital' becomes an increasingly strategic topic for PES. The Thematic Paper discusses current issues in digitalisation and digital strategies. It discusses approaches towards digitalisation and strategic as well as management issues towards strategies.

Thematic Paper: Creating digital strategies
https://ec.europa.eu/social/BlobServlet?docId=20126&langId=en

Future of work

Technologies are not only impacting PES operations but are also one of the factors shaping the labour markets of the future. The PES Network Working Paper and Analytical Paper explore the future of work and how PES should respond to future labour markets that are increasingly driven by digital technologies.

PES Network Working Paper: The future of work: implications and responses by the PES Network
https://ec.europa.eu/social/BlobServlet?docId=20520&langId=en

Analytical Paper: How do PES act to prevent unemployment in a changing world of work?
https://ec.europa.eu/social/BlobServlet?docId=20600&langId=en

Getting started with KPIs

As management of performance (see above) becomes more important, so does the measurement of performance. Key performance indicators are the most important measures of performance of a PES and thus are a vital instrument in measuring how well the PES is doing. This Starting Guide helps PES to get started with the implementation of KPIs and systems to measure them.

Starting Guide - Getting started with key performance indicators
https://ec.europa.eu/social/BlobServlet?docId=20673&langId=en

Getting started with Digital Strategies

The Thematic Paper on creating digital strategies discusses how digital technologies are impacting PES and trends and developments in digitalisation. A next step for PES, especially those not very advanced yet, is to start planning a digital strategy. This Starting Guide helps PES to create a digital strategy and understand the key factors to keep in mind when doing so.

Starting Guide - Getting started with digital strategies
https://ec.europa.eu/social/BlobServlet?docId=20684&langId=en

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