Artificial intelligence and distributed ledger and blockchain technologies in public administration

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Summary

› The digitisation of public administration is associated with high expectations. This also applies to the innovation and technology fields of artificial intelligence (AI) and distributed ledger technology (DLT).

› The task areas for AI applications in public administration are manifold. So far, however, only little use has been made of the opportunities involved.

› In the context of public administrative action, DLT applications are particularly appropriate for the management of transaction and process data, such as those occurring in register administration.

› International practical examples show that AI and DLT projects have become a regular service of public administrations. These projects include both indi-vidual applications, such as automatic traffic control, and the introduction of complex digital infrastructures as a basis for administrative services.

› The introduction and use of AI and DLT in public administration is not merely a technical issue. Established processes as well as the organisational and service culture of public administration must be adapted. Moreover, specific knowledge must be built up and networked.

› The interdepartmental digital challenges require a clarification and simplification with regard to the responsibility for the targeted expansion of technology strategies focusing on AI and DLT.

What is involved

Digitisation is a central trend in the modernisation of public administration. The Online Access Act (»OZG«), the requirements for the digitisation of public administrative services resulting from the COVID 19 pandemic, as well as considerable financial resources invested in various measures have contributed to a certain momentum of digital development. The fields of technology that could boost the digitisation of public administration include both artificial intelligence (AI) and distributed ledger technology (DLT).

AI is primarily associated with autonomous and data-based decision-making processes that are intended to increase the effectiveness, efficiency, quality and security of administrative processes. Furthermore, technical systems in which modern methods of AI are integrated also promise individualised or scaled offers that can be adapted to the respective user or the respective application scenario. In a rough classification, two approaches can be distinguished: On the one hand, there are rule-based AI systems, which are based on the application of fixed rules and lexical knowledge. Currently, these systems are mainly used in order to automate procedures and processes within highly standardised environments (e. g. to control production processes), but they are also used within the framework of simple text-based dialogue systems (chatbots). On the other hand, there are machine learning techniques that recognise regular patterns, extrapolate data and develop rules based on training data and learning algorithms. Corresponding AI applications are particularly appropriate for processing dynamic and unstructured or partially structured source materials, such as image or audio data. Thus, e. g. pattern recognition of financial transactions can be used in order to combat money laundering or automatic facial or dialect recognition can be applied (Fig. 1). AI applications enable new forms of interaction between public administration and citizens, companies or other public institutions, but also prognostic assessments in connection with administration-related action for planning and other prospective administrative processes. In Germany, various AI applications can currently be found in public administration at the federal, Länder and municipal level. Nevertheless, it is obvious that the number of AI applications here is still low compared to that used in the private sector.

DLT describes a technological approach for the decentralised processing and storage of data on several computers connected to a network. With regard to their technical design,

Fig. 1 Rule-based systems and machine learning techniques
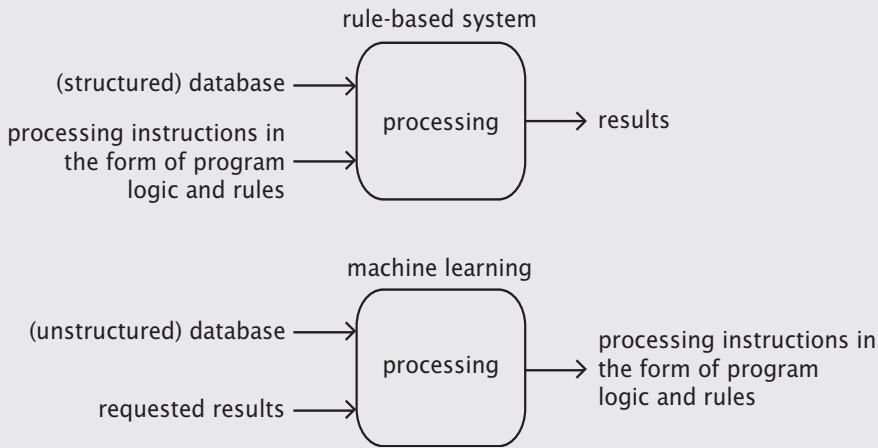
Own illustration based on Ajanki, A. (2018): Differences between machine learning and software engineering. 11.1.2018, https://futurice.com/blog/differences-between-machine-learning-and-software-engineering (28.4.2022)

DLT networks are divided into three types, with the granting of read and write permissions being the key differentiator: Which stakeholders are allowed to view the data stock (read permission) and who is authorised to carry out new transactions (write permission) (Fig. 2). For this reason, the decision on whether to make a data change is not made by a central instance. It is automated and made cooperatively within the DLT network based on various consensus mechanisms. In general, fields of application for DLT are those in which a large number of stakeholders – possibly unknown to each other – cooperate with each other and no confidence-building intermediary instance is available or even desired. Hence, the decentralised structure of DLT offers a certain potential for being used in register modernisation, since very often many institutions at different administrative levels are involved, using and changing register data within the framework of standardised processes, but not exchanging it. Digital citizen identities and the verification of documents are also considered to be promising fields of application for DLT networks. Last but not least, the use of DLT in public administration is generally considered to be beneficial where work is carried out following an interdepartmental approach and high demands on the integrity of the information status exist, e. g. regarding interorganisational cooperation in public administration. So far, DLT applications are not very widespread in public administration at the federal, Länder and municipal level. Many projects are still in a planning phase or at an early testing stage.

International practical examples of AI and DLT

An international comparison shows a broad spectrum of application fields for AI and DLT in public administration. In many countries, a number of digitisation projects have already become a regular service of administration. This includes individual applications, such as for AI the automatic traffic control in the city of Pittsburgh (USA) or for DLT the verification of documents and certificates by the Maltese administration. Moreover, some international projects (Estonia, Finland) are focusing on the introduction of digital infrastructures as a basis for various administrative services. In this context, Estonia is taking a pioneering role: Under the term »e-Estonia«, the Estonian government has been implementing a far-reaching digitisation of public administrative services for several years already. Based on a DLT-like, state-operated technology as well as an electronic »e-identity« for the legally binding signing of contracts and documents, citizens are offered comprehensive administrative services in digital form (electronic voting, car registration, application for child benefit). In this way, the Estonian government provides citizens with access to a central digital state portal and how it enables the use of digital administrative services based on one single input of data.

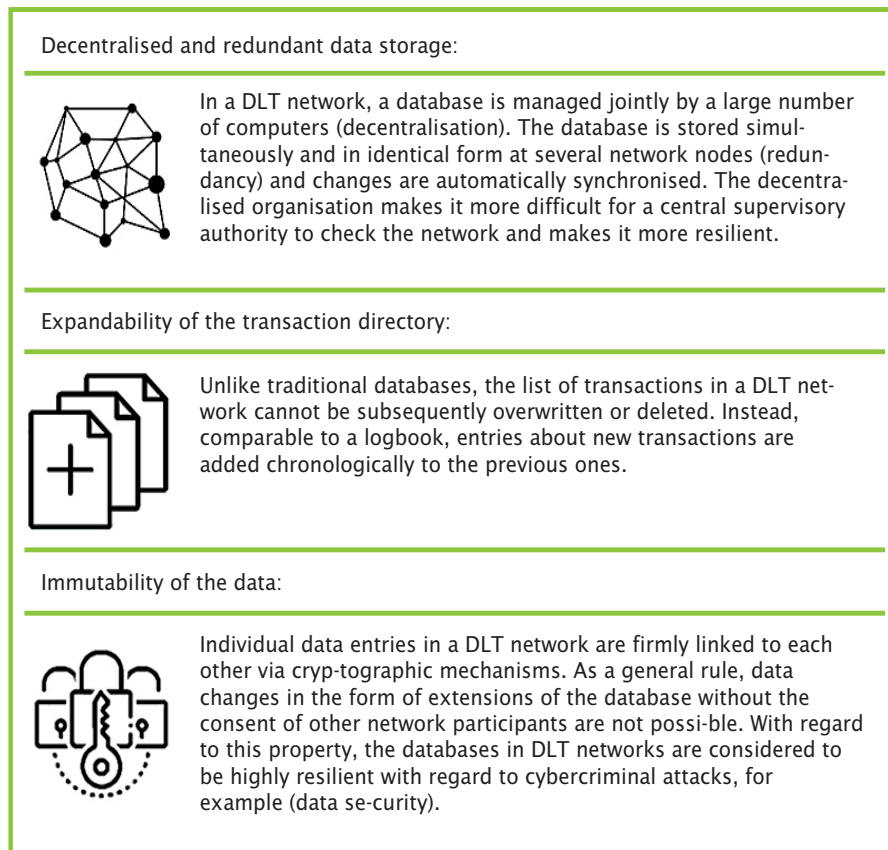## Challenges regarding the use of AI and DLT in public administration

Public administration faces a wide range of challenges with regard to implementing AI and DLT applications. In terms of AI-based applications, these arise in particular with regard to ensuring a suitable database, complying with transparency requirements and making human resources available. With regard to the database, for example, there is a risk that any structural biases in the underlying database will be perpetuated within the classification, forecasting or recommendation

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Digression: Impact of the COVID-19 pandemic on the digitisation of public ad-ministration in Germany

The outbreak of the COVID-19 infectious disease and the development into a global pandemic caused significant changes in the framework conditions and tasks for public administrations. In order to protect the population, associated regulations were set up (Home Office, curfews and contact restrictions) and numerous digital measures with the aim of maintaining essential public services were implemented in German authorities on a federal basis. Following a prioritisation of crisis- and health-relevant administrative services, mainly applications for digital infection surveillance and outbreak management (»SORMAS ÖGD-COVID 19«), for supporting the contact person management of the health authorities (digital symptom diary »Climedo«) or chatbots (chatbot »COREY«) for informati-

Fig. 2 Technical core properties of DLT

Decentralised and redundant data storage:

In a DLT network, a database is managed jointly by a large number of computers (decentralisation). The database is stored simultaneously and in identical form at several network nodes (redundancy) and changes are automatically synchronised. The decentralised organisation makes it more difficult for a central supervisory authority to check the network and makes it more resilient.

Expandability of the transaction directory:

Unlike traditional databases, the list of transactions in a DLT network cannot be subsequently overwritten or deleted. Instead, comparable to a logbook, entries about new transactions are added chronologically to the previous ones.

Immutability of the data:

Individual data entries in a DLT network are firmly linked to each other via cryp-tographic mechanisms. As a general rule, data changes in the form of extensions of the database without the consent of other network participants are not possi-ble. With regard to this property, the databases in DLT networks are considered to be highly resilient with regard to cybercriminal attacks, for example (data se-curity).

Own compilation

decisions of the AI. Especially AI applications that integrate artificial neural networks have recently been accused of discrimination and the associated intransparency, i. e. the lack of reproducibility of decision patterns. Another challenge in developing the innovation potential of AI by public administration is the provision of sufficient personnel capacities as well as corresponding technical expertise. However, both explicit expertise and implicit empiric knowledge are among the areas that have so far been difficult to build up within public administration itself. In order to realise the potential of AI applications, changes in organisational structures and processes are also necessary.

The main challenges with regard to the introduction of DLT applications in public administration are the complexity of this technology, increasing and distributed data volumes and thus also growing requirements regarding data storage. An essential technical task is to raise the procedures currently often designed for pilot projects to a quality level that is suitable for regular operation. Moreover, DLT applications must be integrated into existing administrative processes and IT systems – taking into account procedural security concepts. Setting up and operating DLT applications requires specialists from data science, cryptology and computer science. Another challenge with regard to realising the innovation potential of DLT is the current lack of technological know-how in administrative institutions. In addition, there are regulatory aspects with regard to statutory provisions and obligations to provide evidence.

Options for action

The use of AI and DLT in public administration in Germany and abroad shows not only diverse innovation potentials but also central challenges with regard to tapping these potentials. The following options for action are focused on:

› Awarding of mandates for the expansion and coordinated implementation of technology strategies focusing on AI and DLT: In view of the interdepartmental digital challenges to be tackled, the responsibilities for the targeted expansion of technology strategies focusing on AI and DLT as well as their coordinated implementation should be clarified and simplified. The digitisation of public administration could be driven forward by awarding clear mandates with a binding call to act.

› Target-based management of using AI- and DLT-based strategic administrative innovations: The development and establishment of a system of defined performance targets – including the provision of the resources required for this – could support the strategic management of using AI- and DLT-based administrative innovations and ensure transparency with regard to their implementation.

on on the region-specific corona infection occurrence at federal, Länder and municipal level were introduced. The majority of these projects – which were initiated in the wake of the COVID-19 pandemic – involved the digitisation and automation of existing administrative processes (as of March 2021). The question of the extent to which the COVID-19 pandemic has been a driver for the digitisation of public administration is subject to controversial debates, although the data on this is currently limited. It currently remains to be seen what impetus the pandemic will emerge with regard to the digitisation of public administration in Germany and specifically regarding the spread of AI- or DLT-based administrative innovations.

> Strengthening knowledge, knowledge management and knowledge transfer: The build-up and networking of specific knowledge bases for AI and DLT applications in public administrations as well as the promotion of necessary skills and competences for employees are pre-requisites for digitisation. In this context, interdisciplinary knowledge management systems should integrate technology-specific technical, methodological, empiric and process knowledge.

> Promotion of research and development cooperations for the implementation of digitisation measures: Close co-operation between administrations, research institutions and private providers can advance the development of digital applications and processes. Intraorganisational teams with an interdisciplinary structure should be deployed in early phases of the development of digital applications in order to support acceptance in the later application context by means of customised development.

> Designing cross-authority applications as part of a responsible data strategy: In view of rapid changes and heterogeneous structures in the databases used as well as new possibilities for automated data linking and aggregation of data sources, the public administration has a special responsibility when using AI and DLT applications. This responsibility is caught between the conflicting priorities of data protection and economy on the one hand and the acquisition and use of the data required for the applications on the other hand. The focus is on developing and implementing a responsible and sustainable data strategy.

> Creating a regulatory framework that promotes innovation: The promotion of an innovation-friendly and confidence-building regulatory framework for AI and DLT applications should be implemented by means of ethical and legal advice for AI and DLT applications in order to offer administrations application-specific guidance.

> User-friendly design of digital public authority services: In order to ensure that digital administrative services are also widely accepted and used among the population, aspects of accessibility and user-friendliness of digital services should be given high priority already in the conception phase.

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