Knowledge Assessment of Projects of the Danish National Artificial Intelligence Uptake Fund

Summary

April 2021

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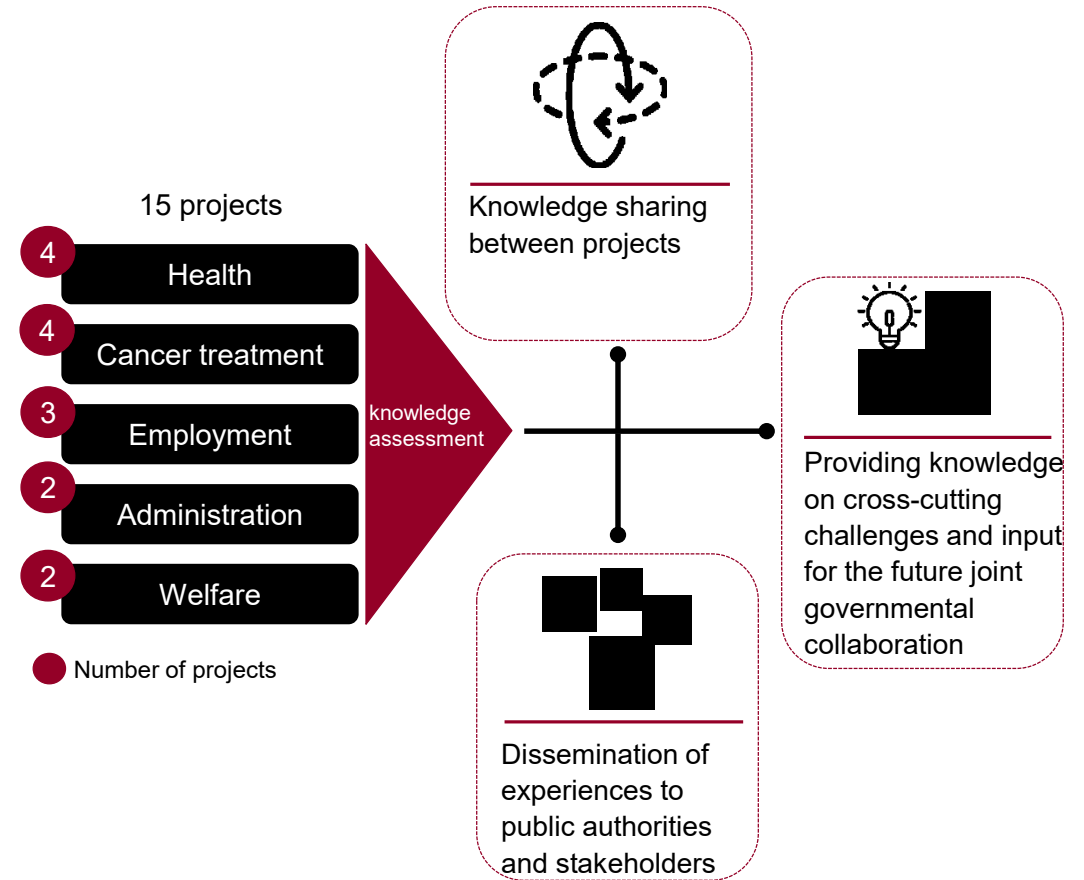MINISTRY OF FINANCE

Introduction

In the annual Budget Agreements for 2020 between the government, Local Government Denmark and Danish Regions, an investment fund for new technologies was established for the period 2019-2022. The Danish national AI Uptake Fund supports projects using artificial intelligence in order to increase the quality and efficiency of key tasks in the public sector. This knowledge assessment gathers preliminary key insights from the 15 projects.

At the beginning of 2020, the first 15 projects financed by the AI Uptake Fund were launched - seven municipal projects and eight regional projects. These projects serve as a test bed for the usage of artificial intelligence in the areas of healthcare, employment and in administrative case processing.

The purpose of the projects is to provide experience with the use of artificial intelligence in the public sector and knowledge of challenges when using the technology. Thus, the projects will show how we can overcome central challenges in relation to e.g. legal, data-related, and ethical issues.

The knowledge assessment is based on knowledge gathered through desk research, 15 interviews with the project managers of the signature projects, and subsequent written feedback from the project managers. The purpose of the knowledge assessment is to share experiences from the projects and to gather knowledge on challenges and experiences when using artificial intelligence, to serve as a base for the future joint governmental collaboration.

Purpose of the knowledge assessment

15 projects

- 4 — Health
- 4 — Cancer treatment
- 3 — Employment
- 2 — Administration
- 2 — Welfare

● Number of projects

knowledge assessment

Knowledge sharing between projects

Providing knowledge on cross-cutting challenges and input for the future joint governmental collaboration

Dissemination of experiences to public authorities and stakeholders

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Projects Initiated in 2020 within Healthcare

	Prediction of exacerbation of COPD and heart failure patients	**Artificial intelligence for faster and better diagnosis of emergency patients**	**Artificial intelligence in general practice**	**Real-time predictions and essential information for clinicians**
Budget	The project receives DKK 3.9 million and runs from the beginning of 2020 to the middle of 2023.	The project receives DKK 8.7 million and runs from the beginning of 2019 to the end of 2022.	The project receives DKK 8 million and runs from the end of 2019 to the middle of 2021.	The project receives DKK 1.6 million and runs from the end of 2019 to the end of 2020.
Aim	The aim is to prevent exacerbation in COPD patients as well as patients with heart failure by detecting at-risk patients and initiating early, preventive treatment. By intervening before exacerbation occurs, it is possible to reduce the number of admissions and prevent deterioration.	To assist healthcare professionals in deciding whether or not to admit an emergency patient a tool that can provide a quick diagnosis of the 15 most common acute illnesses will be developed. This provides better opportunities to differentiate between non-critical patients and critical patients who need hospital admission. Thus, resources can be used better for the benefit of the patients.	In general practice, physicians need to handle and process a lot of information, including patients' test results. However, not all test results require action from physicians. By automating the handling of these types of test results, physicians' attention can instead be allocated to patients and their treatment.	To manage the planning of staff resources and patient processes information about e.g. discharges and the current occupancy is required. The purpose is to provide health professionals with real-time predictions of the occupancy at the hospital wards. This allows for making better use of the hospital's capacity and organising patient pathways more efficiently.
Solution	Based on patient reported measurements of blood pressure, oxygen saturation, and heart rate, the algorithm identifies whether there is a risk of exacerbation or heart failure, even before the event occurs. A deterioration in the patient's condition warns the healthcare professionals and early preventive treatment can be initiated.	Based on analyses of blood and urine samples, the algorithm can detect the 15 most critical diagnoses and infections. The algorithm can also rank the probability of these within 60 minutes of the patient's arrival.	The algorithm will support physicians' work in general practice by, for example, automatically handling received test results or sorting blood test results and making physicians aware of results that require immediate response.	The algorithm provides predictions for the bed occupancy rate of the hospital wards, the number of discharges and the risk of patient readmission in order to provide a real-time picture of the capacity.

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Projects Initiated in 2020 within Cancer Treatment

	Better diagnosis of prostate cancer	**Artificial intelligence for better planning of cancer treatments**	**Artificial intelligence to prevent complications after bowel cancer surgery**	**Reduction of radiation dose in relation to scans used in cancer treatment**
Budget	The project receives DKK 5 million and runs from the end of 2019 to the beginning of 2023.	The project receives DKK 2.7 million and runs from the beginning of 2020 to the end of 2022.	The project receives DKK 7.7 million and runs from the end of 2019 to the beginning of 2023.	The project receives DKK 2.5 million and runs from the end of 2019 to the end of 2023.
Aim	Prostate cancer is often diagnosed at such an early stage that the cancer has not yet spread from the prostate. However, the vast majority of patients still have their prostate removed, which causes discomforts or complications. The project will develop a solution that can assess the risk of the cancer spreading, ensuring the patient does not undergo unnecessary surgery.	The purpose of the project is to be able to stratify cancer patients and identify high-risk and low-risk patients. This allows for better adaptation of patient treatment plans. It will be possible to optimize the use of resources and offer treatment for the benefit of the individual patient.	One in four bowel cancer patients develops complications after surgery, and one in three experiences relapse. The purpose is to identify patients at high risk of complications, death, or relapse after bowel cancer surgery. The treatment plan can thus be adapted in advance, reducing the risk after the operation.	In PET scans, a radioactive tracer is injected into the patient. Higher doses of tracer provide a clearer scan image. However, the radiation dose may increase the risk of cancer development later on. The purpose is to reduce the radiation dose without reducing the quality of the scan image. This can reduce the risk of cancer and the cost of the radioactive tracer.
Solution	Based on data from previous disease patterns, the algorithm will assess the risk of the cancer spreading from the prostate. The result will support the medical assessment of which patients need surgery to avoid the formation of metastases and which patients can be exempted from surgical treatment.	The project will use artificial intelligence to offer a more individualised and risk-based cancer treatment. The algorithm will, among other things, divide patients into high-risk and low-risk groups in order to be able to adapt the treatment to the individual's needs.	The algorithm is trained using health registry data on bowel cancer patients. The model is embedded in a software module, and is to be used with data from the individual patient to estimate risk of death, complications, readmission, re-operation, etc.	The algorithm processes scan images produced using a reduced radiation dose. Reducing the radiation dose increases the amount of noise in the image. The algorithm reduces this noise and the image can therefore still be used for diagnostics.

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Projects Initiated in 2020 within Welfare and Administration

	Aalborg Kommune **Intelligent rehabilitation and targeted healthcare services for citizens**	**Esbjerg Kommune** **Faster case processing when granting cleaning services using new technology**	**norddjurs kommune** **Intelligent sorting and filing of mail to provide citizens with faster case processing**	**KØBENHAVNS KOMMUNE** **Shorter response time to construction applications and help submitting correct documents**
Budget	The project receives DKK 4.1 million and runs from the beginning of 2020 to the end of 2021.	The project receives DKK 2.2 million and runs from the beginning of 2020 to the end of 2021.	The project receives DKK 1.9 million and runs from the beginning of 2020 to the end of 2021.	The project receives DKK 4 million and runs from the beginning of 2020 to the end of 2021.
Aim	Not all citizens who could potentially benefit from physical exercise treatment are offered this at the optimal time. The purpose of the project is to create knowledge about when and which citizens will most likely be able to complete a physical exercise treatment plan in order to be able to offer a more targeted rehabilitation.	When deciding whether to provide cleaning assistance for citizens, the caseworker must assess the individual citizen's needs. However, there is great variation in how demanding each case is to process. The purpose of the project is to increase the quality of the process for the citizen and to free up resources for complicated cases that require more attention.	Every day, Norddjurs Municipality receives large amounts of digital mail and emails into a main inbox. The mail must be sorted and sent out to relevant case-workers and filed. These are resource-intensive and routine tasks. By automating these tasks, the municipality can free up resources and shorten the case-processing time for citizens.	Construction applications often have long case-processing times. Additionally, many applications are filled in incorrectly, prolonging case-processing times. The purpose of the project is to reduce the case-processing time by screening the applications for errors and presenting the case workers with information on decisions in previous and similar cases.
Solution	The algorithm provides information on which citizens would benefit the most from participation in a exercise course. The algorithm will identify citizens with a high risk of falling. The algorithm compares, among other things, data on the granting of services to citizens and data on the success rate of actual exercise courses.	The algorithm will serve as a decision support tool for the caseworker in questions of whether a citizen should be granted cleaning services. The algorithm will base this on structured data regarding e.g. the citizen's condition, housing situation, and potential cohabitants.	The algorithm sorts incoming mail - both emails and digital mail. The algorithm then automatically distributes the mail to the right recipients. The algorithm will also be able to automatically file incoming mail.	The algorithm will be a decision support tool for caseworkers processing construction applications. The algorithm will present decisions from previous, comparable cases and thus support the case workers in their assessment and decision.

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Projects Initiated in 2020 within Employment

	FREDERIKSBERG KOMMUNE	**ODENSE KOMMUNE**	**KØBENHAVNS KOMMUNE**
	Correct and uniform case management when sanctioning unemployed citizens	**Targeted employment programmes for unemployed citizens**	**Better match between unemployed citizens and companies**
Budget	The project receives DKK 4.7 million and runs from the beginning of 2020 to the middle of 2022.	The project receives DKK 7.2 million and runs from the beginning of 2020 to the middle of 2022.	The project receives DKK 2.9 million and runs from the beginning of 2020 to the middle of 2021.
Aim	The decision to sanction unemployed citizens is a complicated task for the caseworkers. Practices for when citizens should be economically sanctioned are not always uniform. The purpose of the project is therefore to develop a tool that can support caseworkers' assessment of whether economic sanctions will have the desired effect or not.	To offer better and more targeted employment programmes to unemployed citizens, knowledge is needed about what creates the greatest effect and helps citizens the most. The purpose of the project is to reduce the period of unemployment and provide more beneficiary services to citizens.	Although companies demand labour, it can be difficult to match unemployed citizens with the right skills to the right jobs. The purpose of the project is to develop a tool that can help case workers offer a more targeted job search and thus increase the effect of the employment programme.
Solution	The algorithm will analyse which factors have a negative or positive impact on citizens' probability of becoming more or less available for employment. The algorithm will also provide support the assessment of whether adverse events (i.e. absences from activation offers or interviews) should trigger economic sanctions.	The algorithm provides a decision support tool for caseworkers to help them offer unemployed, job-ready citizens a targeted programme. The algorithm will make proposals for specific activities that can reduce the expected period of unemployment based on the individual citizen's information.	The algorithm matches the described professional and personal abilities from unemployed citizens' CVs with requirements in current job openings to propose alternative jobs in other industries or alternative job types. In this way, case workers can better help the unemployed towards a more targeted job search.

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The Experiences from the Projects of the AI Uptake Fund

The knowledge assessment provides select examples on experiences gained by the projects in the first year:

- Zealand University Hospital has established access to one of Denmark's most powerful supercomputers, showing the potential for using supercomputers to process large amounts of data within the healthcare sector.

- Telecare Nord will be testing their algorithm in a randomised trial with up to 300 citizens to provide insights into how citizens can help influence the development of solutions that use artificial intelligence.

- In Norddjurs Municipality, an algorithm that has already been implemented for mail sorting is to be tested in three other municipalities. The project provides experience with scaling up artificial intelligence solutions.

- Aalborg Municipality has established a collaboration with Aarhus University, which is an example of how synergy effects can arise between academic research and practice-oriented municipal citizen service centres.

- The City of Copenhagen is putting the finishing touches on a white paper which will include an 'artificial intelligence go-to guide'.

- At Rigshospitalet, the reduction of the radioactive tracer dose used in PET scans is close to being implemented. The project shows how artificial intelligence can improve the treatment of e.g. cancer patients.

Perspectives and preliminary results from 6 projects

Select preliminary results

norddjurs kommune — Upscaling solution on mail sorting to an additional three municipalities	Testing solution on early detection of deterioration in patients with COPD and heart conditions including 300 citizens	**KØBENHAVNS KOMMUNE** — Publishing white paper on the project's experiences and results
Aalborg Kommune — Collaboration between university, municipality, and supplier resulted in synergy effects	**Rigshospitalet** — Currently clinically validating the solution that reduces the dose of radioactive tracers used when scanning cancer patients	REGION SJÆLLAND SJÆLLANDS UNIVERSITETSHOSPITAL — Using supercomputers for data processing. Initial proofs of concept show promising results.

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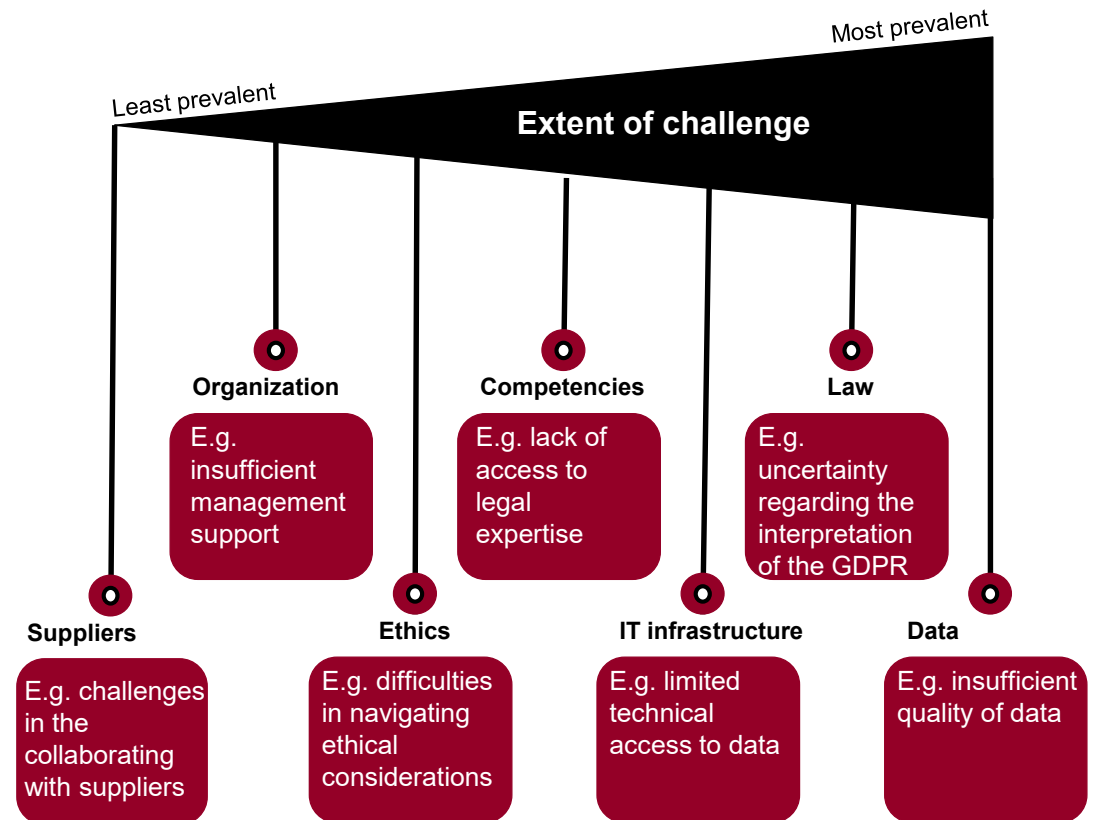# Examination of Challenges Experienced by the Projects

The knowledge assessment describes the cross-cutting challenges with concrete project cases

The knowledge assessment examines and describes the challenges across the 15 projects. Seven areas with perceived challenges have been identified. For each of the seven areas, cases are presented on the challenges that are perceived as the most significant across the projects. The seven challenge areas are:

- **Data**: this area covers challenges regarding the data underlying the technical solution, and includes the quality and quantity of the data as well as challenges with standards for e.g. data formats.

- **Law**: this area covers challenges with e.g. interpretation of the GDPR as well as challenges with legal documents and risk assessments.

- **IT infrastructure**: this area includes challenges with technical aspects of receiving access to the necessary data, secure data sharing, as well as systems and the technical solutions.

- **Skills:** this area covers challenges with lack of skills in the project group, including expertise in law and data science.

- **Ethics:** this area covers the ethical challenges and issues that may arise from the use of artificial intelligence and the use of data.

- **Organization**: this area covers challenges with project organisation, including management support and project anchoring.

- **Suppliers:** this area covers challenges in collaboration between authorities and suppliers who provide e.g. legal or technical services to the project.

The knowledge assessment examines the extent of the cross-cutting challenges and highlights the most significant cases

Most prevalent

Least prevalent

Extent of challenge

Organization
E.g. insufficient management support

Competencies
E.g. lack of access to legal expertise

Law
E.g. uncertainty regarding the interpretation of the GDPR

Suppliers
E.g. challenges in the collaborating with suppliers

Ethics
E.g. difficulties in navigating ethical considerations

IT infrastructure
E.g. limited technical access to data

Data
E.g. insufficient quality of data
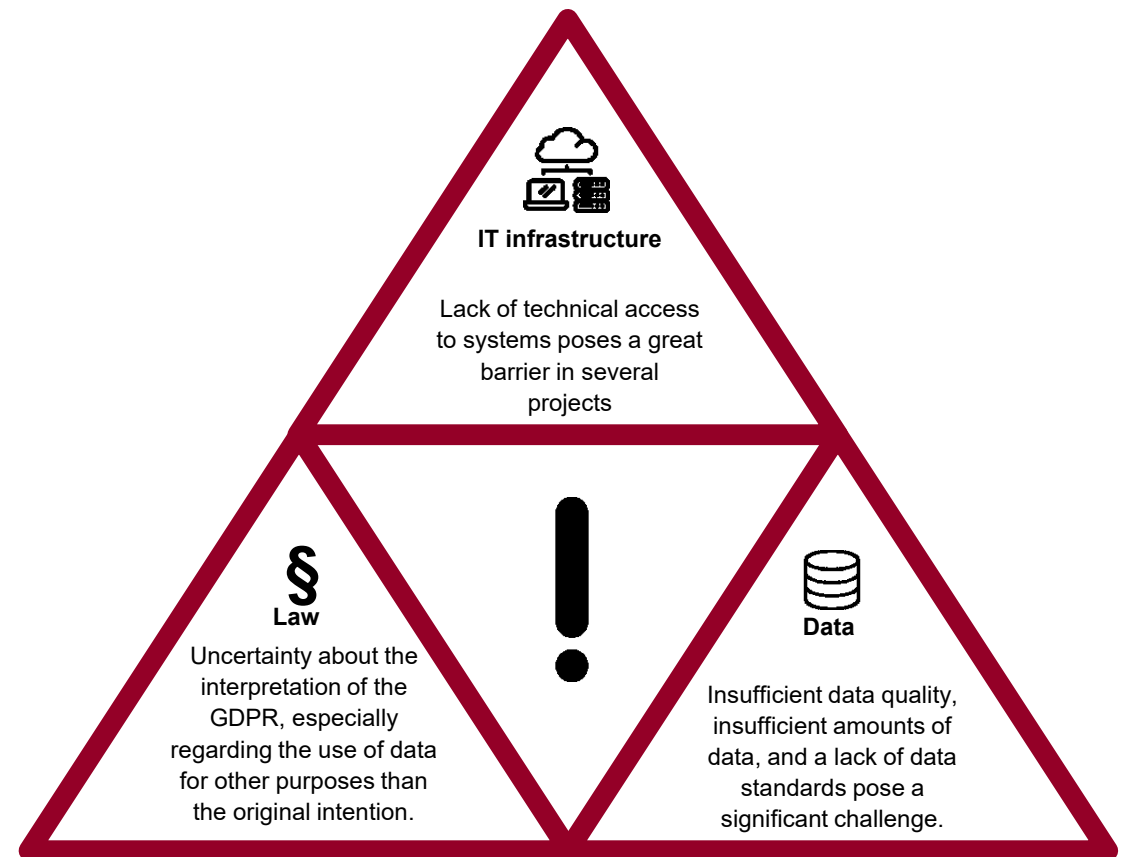
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Three Challenges Perceived as Most Significant

The knowledge assessment uncovers the most significant challenges, illustrated with cases from the uptake fund

Some challenges are perceived as significantly more extensive and difficult than others. In particular, access to and use of data stand out as the main challenge across three areas, which include **IT infrastructure**, **law**, and **data**.

- **IT infrastructure.** A significant challenge that just over half the projects have experienced concerns the lack of technical access to data in existing systems. The challenge may be due to the fact that a system is not built for data extraction, or that authorities have to pay a supplier for access to their own data. For example, University Hospital Zealand has experienced challenges in accessing data from the electronic health records system *Sundhedsplatformen*.

- **Law.** The biggest perceived challenge concerns uncertainty about the interpretation of the GDPR. Projects, for example, experience uncertainty in the interpretation regarding the use of data for other purposes than those for which the data was originally intended.

- **Data**. Several projects experience challenges with insufficient data quality, insufficient amounts of data, and lack of data standards. This may be due to the fact that the data is unstructured, or that the individual organization does not have sufficient amounts of data within the subject area. For example, Rigshospitalet has had challenges regarding the lack of protocols for the standardisation of data. Therefore, naming of data may vary from department to department, making compilation of data difficult.

The knowledge assessment highlights challenges relating to IT infrastructure, data, and law as the most significant

IT infrastructure

Lack of technical access to systems poses a great barrier in several projects

Law

Uncertainty about the interpretation of the GDPR, especially regarding the use of data for other purposes than the original intention.

Data

Insufficient data quality, insufficient amounts of data, and a lack of data standards pose a significant challenge.

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Recommendations for New Projects

After their first year, the current projects pass on their experiences and advice to new projects

Based on the experiences that the project managers have gained over the past year, the knowledge assessment gathers advice that the project managers themselves would have found helpful at the start of their project.

As part of the interview, all 15 project managers were asked for recommendations for new projects for the fund. The many insights have been condensed to 10 recommendations. Some advice is about organisation, such as the importance of good partners or spending enough time when assembling the project group to ensure the right skills.

One advice emphasises that projects using artificial intelligence must be regarded as core projects that are not limited to only e.g. the IT department. Instead, there is a need to establish a sense of broad ownership across the organisation, ensuring the necessary project anchoring in all departments that are affected or have an impact on the project.

Other recommendations focus on not underestimating the importance of certain tasks, such as the resources required to establish a legal basis or ensuring an overview of the organisations' own systems and data.

The data ethics perspective should also be considered, since data ethics can have a great impact on the type of solution pursued. Therefore, it is also important to uncover the perspectives of people who are affected by the solution and involve them in the development process, whether it is caseworkers, doctors, or citizens.

The project managers' recommendations for new projects

10 recommendations for new projects

- **Create an overview of the data and understand the data needs**
- **Do not underestimate the need for establishing a legal basis for the project**
- **Establish an overview of existing and potential IT systems**
- **Everyone who is affected by the project should be included**
- **Make time to assemble the right project group with the necessary skills**
- **Respect data and data ethics**
- **Ensure support from the management**
- **Avoid technology fixation**
- **View AI projects as core projects in the organisation**
- **Find good collaboration partners**

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Inspiration for Using Artificial Intelligence in the Public Sector

The knowledge assessment has identified a number of select cases and tools that can be used when working with artificial intelligence in the public sector.

Several organisations have developed tools for working with artificial intelligence. These tools can serve as inspiration when handling the cross-cutting challenges. This applies, for example, to the **Danish Council for Data Ethics' tool for assessing risks regarding collating data registries**.

Local Government Denmark has developed a toolbox that provides **guides for filling in legal documents**, e.g. a template for conducting an impact analysis on data protection for artificial intelligence solutions.

Additionally, cases from other public authorities are presented in the full knowledge assessment [in Danish], e.g. regarding data governance and IT infrastructure. A few cases from the uptake fund are also included.

In **Aalborg Municipality**, the **ethical considerations** affected the project in relation to the development of the algorithm. The algorithm is designed to include many citizens at the expense of a high precision in the algorithm, which is elaborated on in the full knowledge assessment [in Danish].

The **City of Copenhagen** has developed **a code of ethics for artificial intelligence** and established a **centre for artificial intelligence** to support the development and use of the technology.

Odense Municipality has established a **digital laboratory** to ensure testing and adoption of new technologies for continuous improvement of workflows.

Select tools and cases on the use of artificial intelligence

Category		Type	Organisation	Description
Data	🗄	Case	Miljø- og Fødevareministeriet Fødevarestyrelsen	Anchoring data ownership
Law	§	Tool	KL	Toolbox with legal guides
		Case	Region Rigshospitalet	Anonymising data
IT infrastructure		Case	ERHVERVSSTYRELSEN	Closed test environment for AI
		Case	ERHVERVSSTYRELSEN	Integration of AI solutions in operations
Skills		Case	KØBENHAVNS KOMMUNE	Centre for artificial intelligence
Ethics	⚖	Tool	Dataetisk Råd	Tool for data registry collation
		Case	KØBENHAVNS KOMMUNE	Codex for artificial intelligence
		Case	Aalborg Kommune	Ethic pathway for project
Organization		Case	ODENSE KOMMUNE	Digital laboratory

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