Mapping the Automated Decision-Making Landscape in the Danish Welfare State


Bagger, Christoffer; Schwarz, Benjamin; Jørgensen, Rikke Frank; Lomborg, Stine; Søe, Sille Obelitz; Neumayer, Christina

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Authors

Christoffer Bagger, Postdoc, University of Copenhagen.
Benjamin Schwarz, Postdoc, Danish Institute for Human Rights.
Rikke Frank Jørgensen, Senior Researcher, Danish Institute for Human Rights.
Stine Lomborg, Associate professor, University of Copenhagen.
Sille Obelitz Søe, Assistant Professor, University of Copenhagen.
Christina Neumayer, Associate professor, University of Copenhagen.

About:

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Executive Summary

Overview of the Landscape

- Of the 98 Danish Municipalities (Kommuner), 37 have either ADM projects, smart city projects or both. The majority of these existing municipal projects (n=24) were launched from 2019 onwards.
- A Total of 103 public ADM projects were located across Denmark. The domain of health or healthcare has the largest number of projects (n=40).
- Ten (10) biosensing initiatives are anchored in Denmark.

Key Insights

- Many ADM projects focus on healthcare (n=40).
- Finished pilot projects as well as abandoned or possibly decommissioned projects are usually not evident via municipal or regional websites, and the existence of many projects was only indicated by finding mention of them via external sources (e.g. news sites).
- This indicates that projects of public automation might go “below the radar”.
- The majority of communal welfare projects were concerned with themes of energy efficiency, environmental surveillance, or agriculture.
Introduction

This report provides a overview of the public sector’s uses of automated decision-making (ADM), biosensing and smart city landscape in Denmark in 2022. The report will focus on three central areas: smart city projects in municipalities, public ADM projects at municipal, regional or state level, and to a lesser extent on public biosensing projects.

Denmark has long been known for its high degree of digitalisation and use of digital technologies. This process of digitalisation is evident in most areas of the public sector (Hjelholt & Schou, 2019). Within the broader context of digitalisation, this report focuses specifically on the datafied welfare state (Andreassen, Kaun & Nikunen, 2021; Jørgensen, 2021; Kaun, Lomborg, Pentzold, Alhutter & Sztandar-Sztanderska, 2023) and ADM projects which relate to this overall theme. Denmark serves as both a critical and extreme case (Flyvbjerg, 2006) for mapping the extent to which the automation of welfare is diffused. The report presents the first comprehensive overview of ADM in public welfare in Denmark.

Following this introduction, a brief background section will outline the areas of concern (automated decision-making systems in the public sector, smart cities and biosensing) as well as some of the conceptual foundations (including the distinction between communal and core welfare) that have guided the mapping. A method section will outline the search protocol used to establish a database of ADM projects. The analysis section will outline the findings and provide an overview of the landscape of automated decision-making as it pertains to (core and communal) welfare in Denmark. A brief graveyard section will compare the present mapping of the landscape in 2022 with a similar mapping in 2020, emphasizing which projects are and are not present in both databases. A discussion and conclusion section will outline some of the limitations of this report and its contributions to the state of knowledge on ADM in the Danish welfare state.
Background

Definitions and Delineations

As terms like “automated decision-making”, “smart cities”, and “biosensing” are not clearly delineated, we briefly outline the operationalizations we have used for this report.

Automated decision-making systems are broadly understood as any digital system which uses data-intensive algorithmic techniques to make decisions or aid human actors in making decisions. While there are ongoing discussions about the exact delineation between these two categories (Lomborg, Kaun & Scott Hansen, 2023), this report adopts a capacious conception of ADM. As such, any digital systems which were described as “automated” in the search below were included.

Smart cities are an equally contested term, and perhaps more akin to a “fuzzy concept” (Clark, 2020, p. 2) than a strict categorization. What exactly counts as the minimum threshold for a “smart city” remains a topic of debate, not least due to a research focus on paradigmatic or exceptional cases (Shelton, Zook & Wiig, 2014). Here, we similarly take an inclusive perspective in our research. In practice, our search on “smart cities” usually uncovers very limited implementations of technical systems, such as sensors in bins or other inanimate objects which were able to communicate via the internet of things.

Biosensing was specifically included in this search to survey any public data-gathering tools (sensing devices and concomitant decision-making systems) which were not caught by municipal-specific or official state-sponsored lists of automation projects. Moreover, this search uncovers the state of developments in biosensing in border control and migration, and whether the logics applied there had extended into other domains. “Biosensing” here is understood as sensors (and attached computing systems) aimed at sensing biological entities – including, but not limited to – human beings.
**Core and Communal Welfare**

Central to the contribution of this report is the distinction between “*core*” and “*communal*” welfare as laid out by the AUTO-WELF project. This distinction allows us to both analyze and distinguish between a broad range of systems, although we concede that there is room for further clarification of the provisional definitions as phrased below.

<table>
<thead>
<tr>
<th>Term</th>
<th>Core Welfare Automation</th>
<th>Communal Welfare</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition for the AUTO-WELF project</strong></td>
<td>Digital systems which use data-intensive algorithmic techniques to make or aid human actors in making decisions in social services, including in relation to employment services, healthcare, and social benefits provisions?</td>
<td>Automation of communal welfare infrastructures and services including smart city and smart village initiatives that aim at providing automated social infrastructures for community building and urban development, some of which might involve participatory engagement of citizens.</td>
</tr>
<tr>
<td><strong>Key feature of automation</strong></td>
<td>Operates from an individual level of data collection and profiling.</td>
<td>Operates from an aggregate level of data.</td>
</tr>
</tbody>
</table>
Method

Search Protocol

The general search protocol was adapted from a previous unpublished mapping of the ADM landscape in Denmark in 2020 by Sne Scott Hansen as part of the ADM Nordic Perspectives research network. The findings of the present report will mainly relate to the mapping in 2022, but the previous mapping of 2020 will become relevant again in the comparative discussion of which projects that in the meantime have either been abandoned or concluded.

This report approaches governance of Danish public welfare provision at three distinct levels in decreasing order of scope: (1) The national government or state, (2) the five regions and regional governments, and (3) the 98 municipalities. This is a rough approximation of the internal organization of the Danish public sector since the Structural Reform (Strukturreformen) of 2007.

Search Protocol for Municipal Projects

Based on a list of Danish municipalities and their websites all Danish municipal websites were searched using each municipal website’s own search engines with three purposive keywords: “algorithm”, “artificial intelligence”, and “smart”. Of these three keywords “algorithm” generally produced the fewest hits. This approach has two main challenges: that most of the municipal search databases did not allow searching for keywords in combination (e.g. “artificial + intelligence”); and that the use of the term “smart” did not consistently relate to automation or digitalisation.

This search indicates that at least some municipalities do not make public announcements on failed or decommissioned projects. This includes the “Gladsaxe solution” in the municipality bearing the same name, controversial for its focus on early intervention in potentially harmful or problematic family situations and subject of much public debate and criticism (Alfter, 2020). The section on the “Graveyard of ADM projects” will further elaborate on this.

This portion of the search located 37 municipalities which either had smart city projects, public sector ADM projects or both.
**Search Protocol for the General ADM Database**

A list of the so-called “signature projects” (da: signaturprojekter) – an official list of projects which were intended to implement “artificial intelligence” at municipal or regional level – was sourced and cross-checked between the website of the Agency for Digitalisation (Digitaliseringsstyrelsen) and The National Association of Danish Municipalities (Kommunernes Landsforening or KL). 40 of the ADM projects in our database are signature projects, equally distributed between the municipalities and regions (Digitaliseringsstyrelsen, 2023). These projects were used as the basis for a web-based search intended to find more information on ADM-projects in Denmark. This uncovered a considerable number of additional projects. However, much of the relevant information was hidden behind paywalled websites (either of official Danish news organizations or of niche media), meaning that the search mainly served to confirm the existence of these projects. In total, this search identified 103 ADM projects at municipal, regional, or state level.

**Search protocol for biosensing projects in Denmark**

The bio-sensing projects included in the database on which this report builds were first identified by a web search of the keywords “biosensing” or “bio-sensing” in combination with “Denmark”. This mainly returned projects by university students (on BA / BSc level) typically from technical programs at Danish universities (e.g., Aalborg University). As a result, we consulted the news database of the Bioengineering Department of the Technical University of Denmark (DTU) using the keywords “biosensor environment” (biosensor miljø), “biosensor medicine” (biosensor medicin) and “electrochemical biosensor” (elektrokemisk biosensor). While this returned a number of results, projects which were not organizationally anchored within Denmark (i.e. directed by Danish project owners) were excluded from the database. In total, 10 biosensing projects were included.
Analysis

Overview of the Analysis

The analysis part of this mapping includes the following:

- A discussion of the ADM projects in relation to their welfare sectoral locations and whether they primarily contribute to “communal” or “core” welfare automation.
- An analysis of the primary functions of the core welfare service ADM systems inspired by Alston’s (2019) typology of digital systems.
- An overview of Danish municipalities with smart city projects aimed at communal welfare.
- A discussion of the aims of the public smart city projects in Denmark.

Biosensing Projects

The mapping included 10 biosensing systems anchored in Denmark. These include projects relating to what we might call “core” welfare services such as health and citizenship (e.g., tracking of diabetes-related health data and biometric information for immigration control) as well as more “communal” welfare projects, such as tracking fish populations and water quality.
### ADM Projects by Welfare Sector

<table>
<thead>
<tr>
<th>Welfare Sector</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other</td>
<td>5</td>
</tr>
<tr>
<td>与其他相关的公共行政 (non-sector specific)</td>
<td>12</td>
</tr>
<tr>
<td>通勤福利 (Communal welfare)</td>
<td></td>
</tr>
<tr>
<td>环境、能源与农业 (Environment, Energy, and Agriculture)</td>
<td>14</td>
</tr>
<tr>
<td>交通 (Transportation)</td>
<td>8</td>
</tr>
<tr>
<td>安全 [1] (Security)</td>
<td>2</td>
</tr>
<tr>
<td>核心福利 (Core welfare)</td>
<td></td>
</tr>
<tr>
<td>工作、劳动与就业 (Work, Labour, and Employment)</td>
<td>9</td>
</tr>
<tr>
<td>健康 (Health)</td>
<td>42</td>
</tr>
<tr>
<td>儿童、教育 (Children, Education)</td>
<td>6</td>
</tr>
<tr>
<td>护理 (Care)</td>
<td>3</td>
</tr>
<tr>
<td>其他 (Other)</td>
<td>5</td>
</tr>
<tr>
<td>补贴与税支付 (Benefit and Tax Payments)</td>
<td>2</td>
</tr>
</tbody>
</table>

In total, 103 ADM-projects were identified in a variety of sectors including public administration, security (policing), construction, transportation, and most prominently, health.

The largest group of ADM projects (n=40) are centered around the healthcare sector, including a variety of specific illnesses and health issues (cancer, depression, pregnancy) as well as general improvements in the health sector. The emphasis is likely a reflection of various factors such as: the political emphasis on the healthcare sector, the relatively uncontroversial political nature of focusing on healthcare, the large portion of public funds allocated to the health sector, as well as the quality of health-related data available (Akademiet for Tekniske Videnskaber, 2019; Digitaliseringsstyrelsen, 2023, Høyer, 2019).
A small number of the ADM projects in our mapping did not fit neatly into our preconceived categories of either “core” or “communal” welfare. These include projects centered on non-specific public administration (e.g. chatbots to engage with citizen requests of various kinds or systems to automatically handle emails for public employees), and projects focused on the digitization or discovery of cultural heritage, and in one instance of the anticipation of refugee activity (which arguably fall outside the remit of core and communal welfare).

The core welfare ADM systems were coded in accordance with Alston’s (2019) typology of digital welfare systems, highlighting here the ADM system’s primary purpose. As Alston’s (2019) typology is implicitly about the benefits (or risks) of the individual citizen, the communal or unclassifiable welfare initiatives (e.g. those listed under “administration” above) were not subject to coding and categorization. To our best knowledge, there is no comparable typology available for the classification of communal welfare automation systems, and hence none have been used to code the communal (smart city) projects.

As visible in the table below, most of the ADM projects fall under the remit of “risk scoring and needs classification”. Again, the focus on the healthcare sector accounts for a considerable share of these systems. The emphasis is usually on the early detection and triage of specific illnesses.

In contrast, Alston’s (2019) category of “identity verification” is entirely absent from the present dataset. This is possibly due to the state-owned monopoly of such systems in the forms of MitID and the Danish social security number (CPR-numre) - a mandatory marker of citizenship.
The category of communication (f) mostly consists of chatbots which are accessible through municipal websites. While only two systems are primarily concerned with “fraud prevention and detection”, we may assume that fraud prevention is a secondary function of other systems, even if it is less outrightly stated.

<table>
<thead>
<tr>
<th>Core Welfare Services by Alston’s (2019) Typology</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Eligibility assessment</td>
<td>5</td>
</tr>
<tr>
<td>c) Risk scoring and need classification</td>
<td>40</td>
</tr>
<tr>
<td>c) Welfare benefit calculation and payments</td>
<td>9</td>
</tr>
<tr>
<td>d) Fraud prevention and detection</td>
<td>2</td>
</tr>
<tr>
<td>f) Communication between welfare authorities and beneficiaries</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADM Project by level of Governance</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal</td>
<td>41</td>
</tr>
<tr>
<td>Region</td>
<td>41</td>
</tr>
<tr>
<td>State</td>
<td>18</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
</tr>
</tbody>
</table>

The table above shows the ADM projects and their level of governance. The municipal level includes projects specifically tied to the workings of a specific municipality, or owned or managed collectively by a number of municipalities. The regional level describes projects located at the level of regional governance (primarily healthcare-based as discussed below), while state projects include matters of national administration (including policing, taxation, and benefit payments) as well as projects particularly tied to self-owning institutions directly answerable to the state (i.e. Danish universities). The “Other” category is comprised of projects governed by NGOs such as the Danish Refugee Council or Børns Vilkår with no intrinsic ties to the Danish government.
Municipalities with ADM and/or Smart City Projects

Of the 98 municipalities in Denmark, 37 have either an ADM project, a smart city project, or both, as outlined in the table below. This indicates that such projects have a significant degree of diffusion at the level of municipalities.

<table>
<thead>
<tr>
<th>Municipality</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not have projects</td>
<td>60</td>
</tr>
<tr>
<td>Have smart city projects</td>
<td>15</td>
</tr>
<tr>
<td>Have ADM projects</td>
<td>12</td>
</tr>
<tr>
<td>Have ADM projects, have smart city projects</td>
<td>10</td>
</tr>
</tbody>
</table>

By way of geographic distribution – the table below approximates the division of these smart city municipalities among the regions. Notably, there were no smart city projects located in the entirety of the North Jutland Region, and only one smart city municipality in the entire Zealand region.
<table>
<thead>
<tr>
<th>Regions</th>
<th>Municipalities with Smart City projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Region</td>
<td>Københavns Kommune&lt;br&gt;Gladsaxe Kommune&lt;br&gt;Bornholms Regionskommune&lt;br&gt;Gribskov Kommune&lt;br&gt;Frederikssund Kommune&lt;br&gt;Brøndby Kommune&lt;br&gt;Frederiksberg Kommune&lt;br&gt;Glostrup Kommune&lt;br&gt;Høje-Taastrup Kommune&lt;br&gt;Vallensbæk Kommune&lt;br&gt;Furesø Kommune</td>
</tr>
<tr>
<td>Zealand Region</td>
<td>Faxe Kommune</td>
</tr>
<tr>
<td>Region South Denmark</td>
<td>Kolding Kommune&lt;br&gt;Odense Kommune&lt;br&gt;Vejle Kommune&lt;br&gt;Nordfyns Kommune&lt;br&gt;Fredericia Kommune&lt;br&gt;Nybørg Kommune</td>
</tr>
<tr>
<td>Region Middle Jutland</td>
<td>Syddjurs Kommune&lt;br&gt;Silkeborg Kommune&lt;br&gt;Viborg Kommune&lt;br&gt;Aarhus Kommune&lt;br&gt;Randers Kommune&lt;br&gt;Horsens Kommune&lt;br&gt;Samsø Kommune</td>
</tr>
<tr>
<td>Region Northern Jutland</td>
<td>[No smart city projects found]</td>
</tr>
</tbody>
</table>
As might be expected we find many examples of smart city initiatives within the largest cities of Denmark, such as Copenhagen (pop c. 600,000) and Aarhus (pop c. 330,000). Aarhus has branded itself extensively as a smart city in many aspects, including both technical infrastructures and citizen participation.

However, city or municipality size itself does not explain the initiation of smart city projects. Smaller cities (such as Silkeborg with a population of 50,000) extensively brand themselves as smart cities in all three of the major regards discussed in the next section (silkeborg.dk, not dated), while the sparsely populated island municipality of Bornholm is involved with a network of “smart island” initiatives (brk.dk, not dated).

**What is “Smart” about Danish Smart Cities**

The smart city aspect of the municipalities presents a highly varied degree of approaches to the concept of the smart city. Even so, prominent themes in general smart city discussions such as the fostering of entrepreneurial communities (Clark, 2020) are given little emphasis. Some of the most prominent trends are outlined in the following three categories:

(a) matters of transportation (e.g. ”smart” bicycle infrastructure, “smart” stops for buses, ”smart” parking or charging stations for electric cars). In the area of transportation, there is little emphasis on service provision through the platform or gig economy in Danish municipalities, in contrast to many ongoing discussions about smart cities (cf. Clark, 2020; Robak, 2016). Instead the emphasis across the smart city initiatives seems to be on optimizing existing public transport infrastructures and creating the technical infrastructure for electricity-driven private passenger cars.

(b) focus on daily maintenance and waste management. Several municipalities highlight their ”smart” bins, or internet-connected vermin traps. What these tasks share is an emphasis on the automation of managing undesirable (filthy) elements of city life.

(c) smarter focus on energy and resource usage and tracking of environmental factors such as temperatures in buildings or water levels in the city. In terms of datafication, the unit of tracking is thus the non-human environment, even though it is clearly tracked with the safety and wellbeing of humans in mind.
Although we have not coded the smart city projects within Alston’s (2019) typology, his categories are partly analogous to certain subsets of the smart city projects. For instance, there is some affinity between the climate and weather predictions projects and Alston’s discussions of *risk assessment* systems.
Graveyard of Projects

The 2020 mapping found a total of 80 existing or finished ADM-based projects in Denmark. Of these, only 55 are still present in the 2022 mapping. This suggests that documenting completed, abandoned, or decommissioned projects is not a priority within public administration.

A number of the Signature projects (n=7) were recently wrapped up and evaluated, although this does not account for the large number of projects which have disappeared from the search (Digitaliseringsstyrelsen, 2023).

For researchers, this leaves searching news reports or other popular coverage as the most reliable source for documenting such projects (e.g. Bernsen, 2019). Both methodologically, ethically, and empirically, this lack of access to defunct projects leads to challenges in the study of datafication and automation in the welfare state and in cognate fields studying digital or ephemeral phenomena (Corry 2021; McCammon & Lingel, 2022). Not only does the inaccessibility of terminated projects, including notably “failures”, present researchers with a lack of opportunity to produce new knowledge, it may also inadvertently preclude public administration from iterating and learning from failed projects (Flyvbjerg & Gardner, 2023). We may critically interject that even in the context of a digital welfare state in which information is assumed to be both abundant and adequately captured (Dencik & Kaun, 2020), systems of decision-making and their capturing are not themselves subject to such scrutiny.
Limitations and further work

The present report has focused on automation, artificial intelligence, and automated decision-making within specific public institutions broadly related to welfare, but many sectors we know employ or that we expect to employ automation are not included. This includes news media, the implementation of ADM systems and artificial intelligence in private organizations more broadly, or ADM systems among institutions such as Udbetaling Danmark (Payout Denmark) and the Danish court systems. We are aware of a number of systems not included in this report despite their potential for elucidating and discussing key dimensions of the automatization of welfare.

As indicated in the description of the search protocols, this is thus far the first national mapping of automated decision-making projects within the Danish public sector, but the results and overview is not exhaustive. This is due to limitations in both the search protocol and limitations in what is publicly chronicled by the relevant organizations. We can summarize that there are a number of projects impossible to trace if one observes the present search protocol. This, either because they are (a) not officially attached to any of the public institutions (e.g., municipalities) queried, (b) not framed in a manner that flags them as "automated-decision making", (c) they are to some degree confidential, or (d) a combination of the above.

While methods exist to further broaden the scope of this search (e.g. document requests from public institutions) this report gives an indicative picture of how ADM and smart projects are publicly presented. Conversely, this report can serve as the starting point for more in-depth examinations of both particular cases of welfare automation (included in the present database or not) and/or for a more sweeping commentary on and critique of the welfare automation landscape in Denmark.
References


This category covers two systems implemented by the Danish police. Although these are technically concerned with individual data first and foremost (profiling of persons or tracking of vehicles), in the present analysis we have elected to sort them under communal welfare.