White paper

Harnessing artificial intelligence and big data

A new wicked problem for the public sector?

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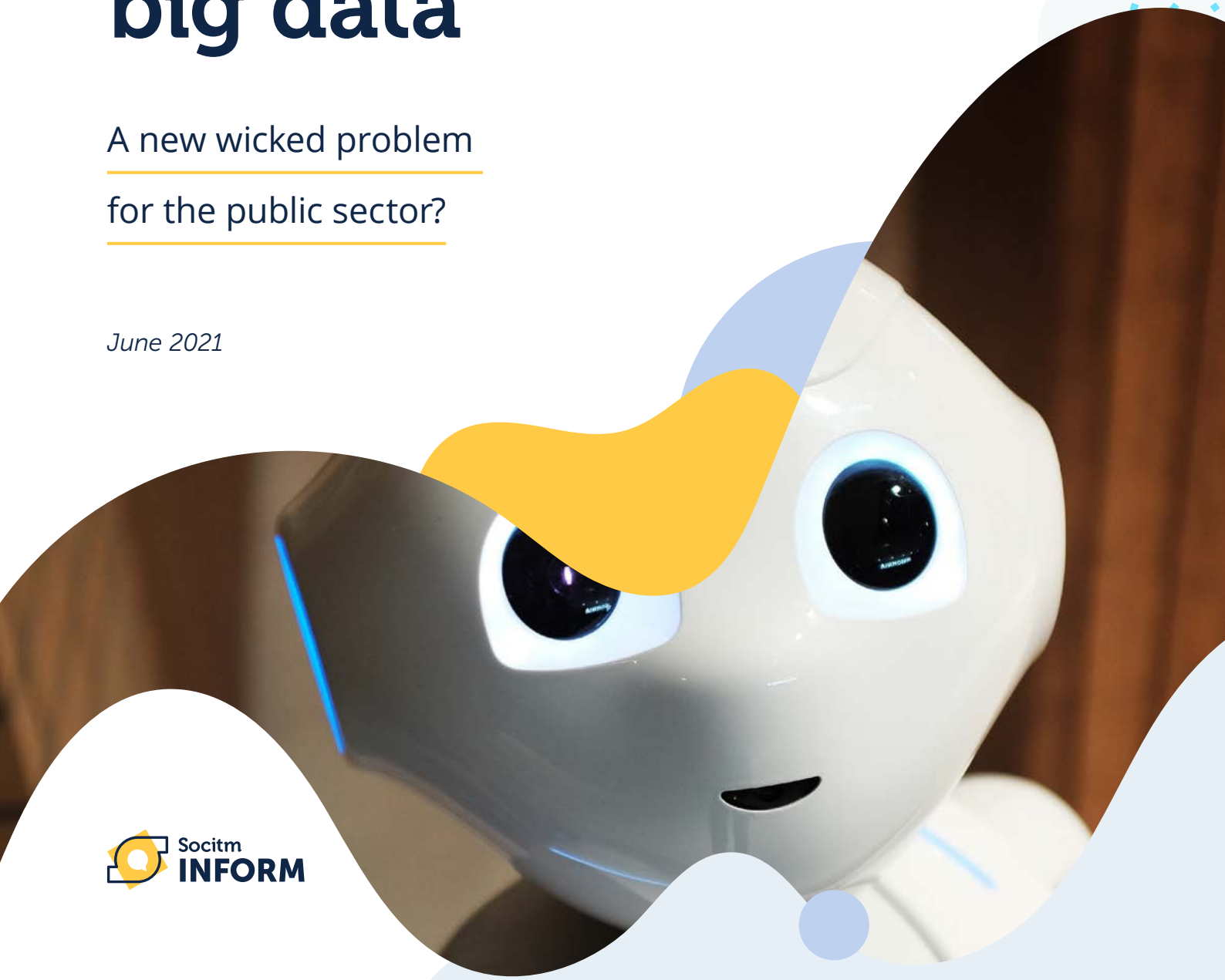

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Table of contents

Introduction

Key points

- Policy-makers need to be aware that deploying AI to resolve complex problems may bring a further set of wicked problems to resolve.
- Open-endedness makes it difficult for governments to keep up with the pace of development and to create the appropriate legal and ethical framework within which to harness AI and BD, while the regulator may never know when "he has done his job".
- In the public sector, we need to focus on the outcome of AI-based decisions – the good and bad - and not just the logic behind them.
- The test of solutions to wicked problems will never be fully conclusive as waves of repercussions continue to reverberate, with policy makers needing to be mindful that not all correlations are indicative of actual causal effects.
- AI can generate irreversible policy interventions that can have an adverse impact on human interests independent of their validity, particularly where these interventions may be based on spurious correlations.
- AI working with BD presents us with a unique wicked problem, evidencing a potential additional distinguishing property comprised of bias in the original code, bias in the data and subsequent changes to the algorithm as the rules of operation are changed by the machine itself.
- Policy and regulation for harnessing AI and BD will need to be built upon principles of upholding societal ethics and values.
- If AI instances become so complicated that decisions become unexplainable and unchallengeable, then a 'responsibility gap' will be opened-up as public trust is quickly eroded, heightening a sense of injustice if errors are made and an inability to attribute responsibility.

In this white paper, we explore the application of Artificial Intelligence (AI) and the related use of Big Data (BD) within the public sector. We seek to establish whether their application generates an intrinsic 'wicked problem' and the implications that this has for public policy and practice.

Definitions

Artificial Intelligence can be considered to be a computer system capable of showing human-like characteristics, in particular "perception, understanding, action and learning".[1]

Big Data can be defined as constituting "vast quantities of dynamic, varied digital data" analysed by systems calibrated to deal with "data abundance as opposed to data scarcity".[2]

In the public sector, where the state is a prime generator and user of data, Kitchin sets out the tensions that exist about the way in which data is harnessed to govern and manage services on behalf the population.[3] At one end of the spectrum, data can be exploited to advance efficient government and value for money as well as specific projects such as anti-crime, security and safety. Conversely, a libertarian viewpoint would espouse reduced oversight and regulation (via data) of economic and social systems, and a drive towards transparency via open data, whereby residents and activists are able to interrogate swathes of government data acting as a check and balance on the state through so-called 'armchair auditors'.[4]

The paper contributes to the debate surrounding 'digital ethics', a key consideration in the context of Socitm's policy theme: Ethical and secure use of emerging technologies and data.

Wicked problems

In order to assess whether harnessing AI and Big Data constitute a new 'wicked problem', I will use the lens of ten characteristics originally created by design theorists Horst Rittel and Melvin Webber[5] to draw attention to the complexities and challenges of addressing social policy problems.

Rittel and Webber's ten characteristics of wicked problems

1. There is no definitive formulation of a wicked problem.
2. Wicked problems have no stopping rule.
3. Solutions to wicked problems are not true or false, only good or bad.
4. There is no way to test the solution to a wicked problem.
5. Solutions to wicked problems are irreversible with no opportunity to learn by trial-and-error.
6. There is no end to the number of solutions or approaches to a wicked problem.
7. Every wicked problem is essentially unique.
8. Every wicked problem can be considered to be a symptom of another problem.
9. The way a wicked problem is explained determines its possible solution.
10. The planner has no right to be wrong.

There is no definitive formulation of a wicked problem

AI and BD present an evolving set of problems for policy makers to resolve. Chadwick recognises that "publicly available information may be inaccurate, partial or decontextualized."[6] Consequently, the data presented to an AI instance may change in terms of depth, breadth and quality of provenance. Further complications arise when the coding within an AI instance allows it to learn from patterns identified in the data.

AI instances can thus be problematic for policy makers in working towards understanding all conceivable solutions[7] and can direct them towards a preferred resolution that is less than optimal or ethical. The complex range of outcomes that AI can produce may lead to an inability to define underlying causes, resulting in humans becoming vulnerable, alienated, and automated masters.[8] For complex instances of AI this could lead to an intrinsic presentation as a wicked problem.

Data carries with it opportunity, but it can also be a liability.[9] In the instance of using AI to create knowledge from interrogation of large pools of BD, no one would argue that we would not wish for society to become more insightful, wise, productive, efficient, effective, sustainable.[10] However this activity can also drive negative civil liberties outcomes, such as dataveillance, social sorting, data security, control creep. The same intervention can be viewed as both insight or dataveillance, promoting differing response of either enhanced use or control and restriction.

Kitchin contends that data are both social and material, being both representative of the world but actively producing it.[11] With AI's ability to order and provide insight to ever larger and more disparate data sources, this effect is likely to become increasingly prevalent. Solutions generated by AI will vary in scale and complexity. Tracking them back to provide a definitive formulation of the core wicked problem may not be possible. Yet, problem understanding and problem resolution are concomitant to each other.[12]

With the increase in processing power and the accumulation of ever greater volumes of data – "the detritus of contemporary life"[13] – harnessing AI & BD will potentially further amplify wicked problems creating a shifting terrain for policy-makers to navigate. Policy-makers will need to be aware that deploying AI to resolve complex problems may bring a further set of wicked problems to resolve.

Wicked problems have no stopping rule

This characteristic suggests that wicked problems lack an inherent logic signalling when they are solved. In harnessing AI and BD, it is difficult to envisage a stopping rule to the problem. With 2.5 quintillion bytes of data created every day[14] and processing power following the trajectory laid out by Moore's Law, the reach and capability of AI and BD applications is set to increase exponentially.

The ability for AI systems to accrete code as they learn, exemplifies Rittel and Webber's claim of "no ends to the causal chains that link interacting open systems".[15] AI will generate a "feedback loop... augmenting existing processes",[16] with the requirement to digitise further data for AI manipulation. The 'machine learning' embedded in AI can result in more data being available for exploitation by as yet unwritten algorithmic code, creating new ways of solving a problem or an as yet unidentified problem.

In public sector settings, this open-endedness makes it difficult for governments to "keep up with the pace of development"[17] and to create the appropriate legal and ethical framework within which to harness AI and BD, while the regulator may never know when "he has done his job".[18]

Solutions to wicked problems are not true or false, only good or bad

Assessing against this characteristic, we could be drawn into concluding that it is the use setting that will delineate AI as intrinsically wicked in nature. However, the impact of AI delivering against a non-wicked problem might have the effect of hollowing out jobs and expertise from a particular professional skillset. Whilst not immediately problematic, in the future a loss of human expertise may prove bad. As Coeckelbergh suggests: "if something happens to the automation system we are lost".[19]

As the public sector is often focused on addressing wicked problems, the effect of AI on these interventions needs to be discussed. Is AI simply an unbiased tool or does it amplify the wicked nature of the problem? In traditional service delivery, Busch and Henrickson explain how 'street level bureaucrats' are able to apply nuance to policy implementation and emphasise the individual over generalised rules.[20] Policy makers often decide upon policies that are open-ended, allowing room for interpretation and reasonableness. However, with decision making becoming more data-driven, evidence informed and technocratic,[21] the use of AI & BD has the potential to reduce discretion at the sharp-end of policy implementation weakening professional and relational values.

Busch and Henrickson further state that removal of discretion can be a good thing enabling all clients to be treated equally. On the other hand, they recognise that loss of client level insight might generate sub-optimal delivery of difficult solutions.

In settings where many parties are equally equipped[22] to judge the quality of solutions, that is to say whether they are good or bad, the reduction of discretion that an AI solution may offer has the potential to amplify the nature of wicked problems being faced. In the public sector, we need to focus on the outcome of AI-based decisions – the good and bad – and not just the logic behind them.

There is no way to test the solution to a wicked problem

AI systems working with ever expanding 'data lakes' of uncertain provenance will result in governments and regulators never knowing if their laws and regulations are definitive in resolving the identified problems of these new technologies. With the world effectively stockpiling information,[23] the exploitative potential of AI can never be fully quantified. Rather, this data revolution will create new knowledge and practices[24] that will alter the way that states govern.

Two examples help to illustrate the potential transitory nature of solutions to deficiencies in AI & BD:

1. Subsequent generations of AI enhanced or originated algorithms may exacerbate or activate existing errors in the code that lead to unforeseen consequences.[25]

2. Increased processing power and data aggregation techniques will lead to further analytical opportunities, negating previous solutions.

Both the technology itself and its ever-expanding use-settings in the public sector will mean the test of solutions will never be fully conclusive as waves of repercussions continue to reverberate,[26] with policy makers needing to be mindful that not all correlations are indicative of actual causal effects.[27]

Solutions to wicked problems are irreversible with no opportunity to learn by trial-and-error

In considering this characteristic, Rittel & Webber use the example of large public works pointing to the fact that once built a highway is most unlikely to be unbuilt. Installations of AI may be analogous where large sums of public money are invested in developing technological solutions for service delivery and human capital is divested, with professions running the risk of being *hollowed-out*. After these AI instances have been embedded, they may become "effectively irreversible" so that "every trial counts" with repercussions playing out over a "long half-life".[28]

In the public sector, the 'one-shot nature' of AI solutions may be seen in their tendency to create and shift the public sector operational paradigm, triggering and motivating actions based on the insights generated.[29] This brings with it the danger that AI can generate irreversible policy interventions that can have an adverse impact on human interests independent of their validity, particularly where these interventions may be based on spurious correlations.

There is no end to the number of solutions or approaches to a wicked problem

AI has the capacity to learn from its setting and experience, reflecting on these as much, or more than its original programming.[30] This degree of self-direction not only affects how goals are achieved, but also allows AI to have potential autonomy in what goals it generates.[31] This could create ambiguity in the origin paths that lead to specific decisions. This capability to generate new outcomes may lead to ill-definable solutions[32] that confound human capacities for action and comprehension.[33]

In public sector settings, the shifting base of a decision-making algorithm could lead to outcomes that are not safe (e.g. medical or traffic management interventions) or unfair (e.g. pre-crime enforcement or resource allocation) with rationale behind them that cannot be explained[34] and with policy makers and enactors being a step away from the final outcome. In this space of multiple and shifting outcomes it is likely that policy makers will be presented with situations where uncertainty can inhibit the identification and redress of ethical challenges.[35]

Every wicked problem is essentially unique

An AI installation's ability to learn will render it unique. It will become shaped by its interaction with the operating environment, adopting new behavioural patterns as it looks to address the problem that is presented to it.[36] This uniqueness can be accentuated in the creation of the initial algorithm by the introduction of bias, leading to "unexpected behaviours".[37] This bias can occur due to the codifying of past behaviour of human beings within algorithms as they accrete AI generated code,[38] discriminating in ways that are not observable or comprehensible to humans.[39]

Data sources can also affect the way a problem presents. AI will encode the bias in your data[40] with new data assemblages being messy and sometimes contradictory.[41]

I would contend that AI working with BD presents us with a unique wicked problem, evidencing a potential additional distinguishing property[42] comprised of bias in the original code, bias in the data and subsequent changes to the algorithm as the rules of operation are changed by the machine itself.[43] This level of originality of outcome when applied to public sector settings has the ability to generate new wicked problems that will be difficult for policy makers to anticipate.

Every wicked problem can be considered to be a symptom of another problem

One of the roots of problems with AI applications is in the new ways that data is generated and handled. With social media and GPS tracking capabilities in many of our day-to-day devices, we routinely leave a trail of data in our wake.[44] This data can be repackaged, circulated and sold with the new custodian, via interpretation and correlation, becoming the controller of the narrative generated by transforming data into information.[45]

By reverse-engineering datasets through 'combing and combing',[46] individuals may be identified from purportedly anonymised sources. Consequently, AI applications in the public sector can lead to civil liberty concerns with anticipatory legal enforcement working on data of unknown provenance[47] or data which might contain bias and might have poor controls around it.[48]

AI may have the ability to improve the lives of citizens, but issues around the provenance of data and self-learning algorithms can make those interactions opaque and difficult.[49] As such policy and regulation for harnessing AI and BD will need to be built upon principles of upholding societal ethics and values.[50]

The way a wicked problem is explained determines its possible solution

AI instances have the capacity to create evidence from data that can be used to enact a particular decision. There are three 'Epistemic Concerns'[51] pertaining to this process:

1. "Inconclusive evidence" where the AI algorithms use statistical techniques to "produce probable yet inevitably uncertain knowledge".

2. "Inscrutable evidence" where the "connection between the data and the conclusion" is so complicated as to be unexplainable by humans.

3. "Misguided evidence" where conclusions are only as "reliable as the data they are based on".

Based on such evidence, actors will choose those explanations which are most plausible to them.[52] These three epistemic concerns give actors different ways of describing AI as problematic, including:

- AI uses statistical techniques that attribute actions for individuals based on the generalities of a group rather than reflecting specific circumstances.
- Inability to challenge an AI decision if the route of the decision path is indecipherable.
- Concerns around inherent bias in datasets.

In public sector settings, the above discrepancies can only enhance the wicked nature of decision-making, adding an additional layer (or multiplication perhaps) of interpretability to any discrepancy and leading to a greater reliance on the world view of the policy maker when proposing resolutions to the problem.[53]

The planner has no right to be wrong

Rittel and Webber make the point that "planners are liable for the consequences of the solutions they generate; the effects can matter a great deal to the people who are touched by those actions."[54]

In the public sector, there are numerous and growing numbers of settings where the ability to manipulate and derive insight from huge datasets will drive decision-making by policy makers. These decisions will have an impact on personal liberty and life chances. In applying AI to public service settings, policy makers will need to reflect that citizens are not just "objects to be manipulated, exploited, sifted and sorted".[55]

If we are to allow AI to learn during operation, it will also make mistakes as the machine "explores the "solution space... to arrive autonomously at new solutions".[56] This draws into play the concept of a 'Responsibility Gap'. Legislators will need to grapple with the change in landscape away from "traditional concepts of responsibility ascription".[57] When an AI instance generates a sub-optimal outcome, who is liable? The commissioner of the instance? The writer of the original algorithm? The human agent (if any) supervising the operation of the AI instance?

If AI instances become so complicated that decisions become unexplainable and unchallengeable, then a 'responsibility gap' will be opened-up as public trust is quickly eroded,[58] heightening a sense of injustice if errors are made and an inability to attribute responsibility.

Conclusions

Through analysing AI & BD through the lens of ten characteristics of wicked problems, I have demonstrated that AI conforms intrinsically to nine of the characteristics, with all ten being present when deployed in a public sector setting. In doing so, AI may serve to amplify the very nature of the wicked problems that is seeks to resolve.

In the public sector, where liberty, safety and wellbeing may be affected by harnessing AI and BD, policy makers will need to consider a responsibility gap, reflecting on how society can practically relocate the social and ethical duties displaced by automation.[59] This may lead to arguments for restraining areas of policy implementation where there is no clear human responsibility for technologies that have a powerful role in our lives.[60]

A public sector, fuelled by a constant need to find efficiencies, may find the lure of AI instances irresistible, necessitating a need to initiate and promote a social dialogue[61] to allay societal concerns. Ultimately however those citizens who are subject to data driven discriminatory treatment are unlikely to find it any more palatable than injustice derived from anecdotal evidence.[62]

Finally, if we are to reflect upon Rittel & Webber's over-riding message of the interaction between preferred solutions and problem definition, policy makers may need to resist over constrained problem definition that can lead to incremental achievements rather than innovation[63] in the use of AI & BD to deliver public service responses to society's wicked problems.

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