

Whose Future Is It Anyway?

Limits within Policy Modeling

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ABSTRACT

In the age of Big Open Linked Data (BOLD), we inhabit a landscape where future scenarios are imagined, modeled, planned for and embedded in policy. Between the euphoric techno-utopian rhetoric of the boundless potential of BOLD innovations and the dystopian view of the dangers of such innovations (e.g. ubiquitous surveillance etc.), this paper offers a critical understanding of the boundaries that are traversed by the implementation of BOLD within policy modeling. We examine BOLD as a tool for imagining futures, for reducing uncertainties, for providing legitimacy and for concentrating power. In doing so we further develop the LIMITS community's conceptualization of the *societal limitations on computing*, with specific reference to the assumptions, interpretations and trust that we place in these models when making socio-environmental policy decisions. We use an illustrative case of policy modeling, which provides a much-needed critical discussion of the inherent limitations and risks as well as the promises that are offered by BOLD.

CCS Concepts

• **Categories and Subject Descriptors:** K.4.m [Computers and Society]: Miscellaneous

Keywords

Societal limits; Big Open Linked Data; Agency, Legitimacy; Uncertainty; Simulation, Systemic Shifts, Trust, Political Power.

1. INTRODUCTION

Complexity is ever increasing with respect to the amount of data that becomes available to decision makers and citizens alike. Ranging from sensor data to text, from social media to expert repositories of knowledge, policy makers are grappling with how to discern signal from noise. With the seemingly limitless growth of data that is being generated, the challenge that emerges is how to make sense of and structure this resource. Citizens and policy

makers alike wrestle with how to intelligently filter information according to relevance, relationship and provenance. The endeavor becomes a question of *sense-making*, as well as one of *trust-building*. Within this context, policy-makers are increasingly coming under pressure to be more anticipatory and adaptive than reactive.

The role of Big, Open and Linked Data (BOLD) within the policy landscape has been met with enthusiasm as well as with critical concern [1, 21]. *Big Data* refers to large, diverse, complex, longitudinal, and distributed data sets that are generated from various instruments, sensors, Internet transactions, email, video, click streams, and other sources, whereas *Open Linked data* has the mandate of opening up and combining relationships within the (large but oftentimes compartmentalized) sets of existing data [10]. Bringing together both big data and open linked data within the context of policy modeling, we ask: what are the inherent limitations (if any) posed by societal attributes on computing? Specifically we look at assumptions, interpretations and the level of trust that we socially place on computational models and BOLD, when making decisions. We situate this discussion paper between the euphoric rhetoric about the boundless potential of BOLD innovations in imagining and preparing for a future of scarcity and the dystopian view that is built on the dangers (such as ubiquitous surveillance). Our aim is to offer a critical understanding of BOLD within policy modeling; as a tool for imagining futures, for reducing uncertainties, for providing legitimacy and for concentrating power.

We have structured this discussion paper as follows: first, we consider the limitations of policy modeling (using BOLD) as a “looking glass” or predictive crystal ball into our collective futures. We ask what legitimacy this brings and where trust as well as power comes into play. We draw on discussions from the LIMITS community to hypothesize about the *societal limits* of computing. More specifically, we address societal limits in regards to prediction within policymaking. We also challenge the paradigm of unlimited growth [9,6] that is enshrined in the assumptions and interpretations of computational models, and we consider the limits of computation with the metaphor of BOLD-as-a-magic-wand (that unleashes transformative change within the policy modeling landscape).

Having framed our arguments within related work, we then proceed to consider an illustrative case of a large-scale European experiment into policy modeling and simulation. Following our discussion and analysis we argue for new techniques and checks that need to be developed to expose inherent biases in models and big data analysis. Towards this end, the paper employs three lenses: uncertainty, legitimacy and agency. When considered

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LIMITS '16, June 08 - 10, 2016, Irvine, CA, USA
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ACM 978-1-4503-4260-5/16/06...\$15.00 DOI:
<http://dx.doi.org/10.1145/2926676.2926682>

together as an overlapping system, we find emerging concerns around power, truth and trust that needs to be considered within both the academic and the policy making community interested in the promise and the potential of BOLD.

2. RELATED WORK

Boyd and Crawford [2] see Big Data as a cultural, technological, and scholarly phenomenon that rests on the interplay of three factors: *technology* – where the trend is towards maximizing computational power and algorithmic accuracy to gather, analyze, link, and compare large data sets; *analysis* – drawing on large data sets to identify patterns in order to make economic, social, technical, and legal claims; and *mythology* – where they refer to the widespread belief that large data sets offer a higher form of intelligence and knowledge that can generate insights that were previously impossible and with an aura of truth, objectivity, and accuracy.

In this paper we are particularly interested in the myth of increased quality, objectivity and truth that emerges from the introduction of BOLD within policy modeling. In order to closely examine how this myth is created, we need to first consider pre-analytic assumptions about the future that are embedded in these tools and ways in which such tools are set up within the policy modeling and predictive processes. Pielke [22] walks us through this journey:

"...typically, policy makers recognize a problem and decide to provide resources to science to reduce uncertainty or produce predictions. Scientists then go away and do research to predict natural behavior associated with the problem, and predictions are finally delivered to decision makers with the expectation that they will be both useful and well used." Pielke [22] refers to the prediction enterprise, which he argues, *"is a complex process, one that includes all the interactions and feedbacks among participants, perspectives, institutions, values, interests, resources, decisions, and other factors."*

Thus right from the start of the process we see an inherent tension between the desire for *reduced uncertainty* as an expectation of scientific modeling and the complexity that comes with mapping social ecological processes within a policy context. If we further consider the ability to accurately measure, quantify, and provide provenance to data upon which such models are built, we run into additional limitations that are linked to *legitimacy*. Helbing [7] warns that while *"Big Data" has great potential, in particular for better, evidence-based decision-making... it is not a universal solution, as it is often suggested. In particular, data-driven approaches are notoriously bad at predicting systemic shifts, where the entire way of organizing or doing things change.*" These systemic shifts could range from climate models to political unrest and economic meltdowns. He goes on to say: *"The suggestion... that Big Data is the key to the future – can be misleading in pretty dangerous ways. Most obviously, it could precipitate a descent into an authoritarian surveillance state where there is very little personal liberty or autonomy... But even if that were not to happen, Big Data could create a false sense that we can control our own destiny, if only we have enough data. Information is potentially useful, but it can only release its potential if it is coupled to a sound understanding of how complex social systems work."*

We here observe a tension that arises between a need to understand the interactions between stakeholders in complex social systems and the opposite pull of eliminating uncertainty from data driven policy making. We also see the problem that

Knowles and Eriksson [11] address when they argue that without confronting the underlying psychology that perpetuates our limited understanding of the predicaments we are facing at a global level, *"there is little computing can hope to achieve [as] these psychological limits to computing do not only concern the users of our systems [...], but also ourselves, as researchers within computing"*.

In addition to the question of *uncertainty* and *legitimacy*, we identify another variable that brings limitations to the world of BOLD in policy modeling. This relates to human *agency*. This is best illustrated by the fact that BOLD along with increased computational capabilities today, is breathing life into the concept of "Natural Capital" [3]. The underpinning idea is of putting a monetary value on ecosystem services. This, in principle, is a straightforward way to frame policy arguments involving natural habitats. The influential journalist George Monbiot [16] however argues:

Say we decide that we're going to value nature in terms of pounds or dollars or euros and that this is going to be our primary metric for deciding what should be saved and what should not be saved. This, we are told, is an empowering tool to protect the natural world from destruction and degradation. Well you go to the public enquiry and you find that, miraculously, while the wood you are trying to save has been valued at £x, the road, which they want to build through the wood, has been valued at £x+1. And let me tell you, it will always be valued at £x+1 because cost benefit analyses for such issues are always rigged."

Thus *who* is building the models and using the outcomes will play a key role in determining how various variables are weighted and valued. Furthermore, valuation does not offer much unless it is somehow reflected in policy. Power in our opinion is the elephant in the room within the discourse of BOLD and policy modeling, because the question "whose future are we imagining and towards what purpose?" is seldom asked. From the LIMITS community, Bonnie Nardi [18] hit a key chord here, when she said: *"Rapidly accumulating changes to our environment and culture demand that we look ahead. Technology drives change, and we in human-computer interaction should attend to the future. But which future? The one we want? The one we think is coming?"*

Many of us take for granted that the future can be extrapolated from the present and the recent past, and, that the future is based on a narrative of expanding borders and scientific progress, growing economic prosperity and human wellbeing [19,18]. Some thinkers take this notion to the extreme and propose that we will soon (within a few decades) colonize the asteroids, create computers that are smarter than humans, be able to download our minds into silicon and live forever, or repair our bodies and have them last for a thousand years or longer [12, 5, 17]. While these ideas seem hyperbolic and strange to some, the less outlandish notion of scientific and economic progress in small incremental steps forever, or at least for a (very) long time into the foreseeable future, is on the other hand part of the fabric of the grandest of our modern narratives, and a part of the very operating system of modern societies.

In sum, the way BOLD within policy modeling falters at embracing systemic shifts; the way values are attributed within the limitations of our current metaphors (political and economic), and the belief that scientific progress will continue in incremental steps ad infinitum, present a set of assumptions at loggerheads with the foundational principle of the LIMITS community [15]. What we find of particular interest here is the tension between the

world of possibilities, most often based on implicit or explicit techno-utopian dreams, and a *world of limitations*, as discussed within Collapse Informatics [24], the LIMITS community [20] and elsewhere [8]. This tension provides us with a lens with which we can question the assumptions made in policy modeling – for example in the case of technological quick-fixes as offered by the newest, shiniest toy at our disposal - BOLD. It becomes crucial to ask: Which are the envisioned worlds that are embedded in these models? Whose futures are these models predicting? Who has access to the tools of modeling and future-making, based on the vast possibilities BOLD has to offer.

3. METHODOLOGY

As an illustrative case, we present insights from the participation (of two authors) in a three year European Research Initiative that developed tools for policy modeling and simulation. The data we consider within the paper pertains to the first half of the project, where exploratory exercises were conducted in end user engagement to ascertain expectations, fears and needs of the stakeholder community (in this case policy decision makers and their support staff). The insights presented here draw from a set of 23 qualitative interviews conducted between 2014 and 2015 at the UK, German and the European Parliament level of governance. We have used qualitative and interpretive analytical methods to unpack and critically examine this case, drawing on the two bodies of work discussed above.

3.1 Exploring Limits within Policy Modeling through a European case study

Within this paper we consider a large scale European research project (running from 2013-2016) that had an articulated desire of advancing policy modeling and simulation, data analytics and social network discussion dynamics in the hope of providing economic and social benefits to policy-makers at all governmental levels across Europe. Taking as its starting point the observation that once a policy has been formulated, it becomes difficult to make useful predictions about its likely impact and its effectiveness, the project embraced these tools as the logical fix to the problem. The argument put forward here, for the use of BOLD, was that policy specialists may lack the resources and the methodology to be able to access the most current data and may not be in a position to take into account the views of citizens on policy issues expressed in real time through social network discussions. As its main objective then, the project worked towards developing a tool set which would enable the extraction of information from big data and open data sources; the automatic annotation and linkage of homogeneous data; the lexical analysis of sources; the creation of policy models combining quantitative open data sources with qualitative data from social media; the likely impacts of a policy to be simulated, via understandable visualizations; and the tracking of discussion dynamics in social media.

We present this case as we believe it aptly reveals a number of assumptions that underpin the models from the perspective of those that build them, as well as the concerns and trepidations on the part of its users (policy decision makers) towards the promise and purpose of such technologies. Early on in the project, as we approached policy makers and their teams to gather their requirements and wish lists with regards to policy modeling and simulation, we witnessed a deep concern on their part about the perceived appropriation of data models to gain legitimacy. This concern was for example articulated by UK parliamentary officials, when they mentioned that members of the Parliament

(MPs) in particular were not sufficiently data literate to understand the limitations of the models put forward by such sense making technologies. They feared that they would not be able to fully question the data these models would be based on. This would, they argued, have direct bearing on their ability to participate in a meaningful way.

“You put a number on anything and it gives a certainty... as soon as you have numbers being bandied around there’s a risk that there might be too much certainty attached to anything that any model could come out with. Pitching it at a level that informs but doesn’t give more certainty than any model is ever going to be able to capture...”

The suggestion was made in a parliamentary focus groups that MPs would be likely to use a ‘killer fact’ to support a political point they were trying to make rather than using information they were sure was representative of the body of evidence around an issue. Providing context and guidance about how the tool should be used is therefore crucial if it is to be used by MPs or others with potentially low levels of data literacy. This raises the question of citizens rights and interests being protected rather than policy makers wielding such tools as the ones presented in our project, in order to entrench their already powerful positions and reinforce a status quo politically. While there is nothing new in politicians using available information to support their positions, what we are underscoring here is the *myth* of objectivity, truth and certitude that accompanies BOLD today.

Linked to the above notion of *legitimacy* and *certitude* (built on provenance and accessibility of the big open data), is the ability to follow the evolution of discourses within policy areas. In other words, not only is trust built along a dimension of transparency but it is also built chronologically as those entrusted with making decisions can track the dynamic flows over time. Within the project, we found that policy makers expressed that what they were most interested in was the ‘delta’ or the change (evolution) of their search term since they last monitored a given topic. So for instance, in the case of Germany, where policy makers were researching the term ‘inclusion’ and ‘migration’, what became of key relevance to them, was to be able to track the evolution of a discourse and the rate of change. By adding citizen discussions via social media as a variable, we found a unique form of participation taking place, where citizens acted as *social sensors*, contributed their views, sentiments, knowledge and preferences, and in doing so formed an additional layer (to the big, open data), shaping the final policy under discussion. This we understood to be a good illustration of both *agency* (where policy analysts and decision makers deliberately opened up the modeling process by allowing different voices to populate the landscape), and *legitimacy* (based on representativeness of the data when provided by citizens themselves).

Building further on the limitation of legitimacy, the separation of scientific and policy modeling and the incumbent tensions was illustrated by this quote from an assistant of a member of the European Parliament (MEP):

“At the time of considering the Kyoto protocol [i.e. referring to Greenhouse emissions], all policy makers saw a scientific simulation of what will happen in the future, if this policy is adopted. We had scientific data and worked on this data for years and years but in the end it went to a different direction. Scientific truth is put into doubt by a political instrumentalisation. We can’t anticipate decisions as it is all politicization.”

Two key points emerge from the above. The first relates to the lack of trust or legitimacy in “political artifacts” as opposed to

“scientific facts”. This is attributed to the question: *in whose interest* are such tools deployed? There is an explicit concern articulated by citizens and experts (scientists) that politicians will use analytical as well as simulation tools to put a “political spin” on opinions they give more weight to. The second point relates to agency – where the MEP assistant above talks of “instrumentalisation” – which is an interesting terms within this context. Here we are made to see modeling and simulation tools as well as the Big Open Linked Data they are built upon as instruments in the hands of those already in power. These instruments are then deployed in myriad ways to shape the course of our futures (in this case against the scientific consensus on climate change). While raising the cautionary note on the limitations of using BOLD within policy modeling, the above MEP assistant went on to pinpoint:

“Scientific evidence is very interesting and important for the European Parliament because that would lead to no game between the opposition and the ruling party and ensure less instrumentalisation.”

In other words he calls for a de-coupling of scientific fact or expert knowledge from political manipulation, within the decision making sphere. A similar de-coupling is called for by other policy makers in our sample, of citizen opinions emerging from social media and expert opinions emerging from emergency services (as in the flood risk management for example), in that the former are more subjective concerns of communities and hence open to greater manipulation. Pielke [22] explains the above phenomenon very well when he says that: *“the belief that modeling and prediction can simultaneously meet the needs of both science and decision is untenable as currently practiced. If no adequate decision environment exists for dealing with an event or situation, a scientifically successful prediction may be no more useful than an unsuccessful one.”*

This case in point again links to the issue of power and the current political discourse that to some extent discourages human action on global predicaments. For computer science researchers to have a chance to introduce change into the current course of our actions, we first need to acknowledge that political interests are driving our research and design agendas. It is thus crucial for us to devise concrete ways to oppose them.

4. DISCUSSION

In this paper we have teased out three limitations inherent in the use of BOLD within Policy Modeling. We started this paper by situating our investigation within the few critical voices (both in the LIMITS and Policy Modeling communities) that seek to question the euphoria surrounding BOLD. We then, via an illustrative case, grounded our arguments by revealing how these assumptions are embedded in the design and implementation of these models. We are now in a position to take a step back and review the key insights that emerge from this discussion.

Uncertainty: When considering the simulation of future policy scenarios and their impacts, a key limitation of using BOLD within decision-making is the lack of understanding of its predictive power, the reliability of its sources, and its potential reducibility. Weber [25] observes: *“In the real world, systems are open and there are fundamental limits to predictability.”*

We argue that there will always be assumptions that have to be taken axiomatically (i.e., due to lack of high quality information). Computational shortcuts appear in order to make the problem computationally tractable. Even if the methodology is sound, the devil always hides in the details and, given enough details, many

devils can hide, even without ulterior motives on the part of the model designer or model user. What is hence needed is greater transparency built into the models and built into their use context. This transparency should demonstrate the degrees of certainty represented, rather than an implicit assumption regarding the completeness of predictions in relation to the simulation of futures.

Legitimacy: Another key limitation that is inherent in the implementation of BOLD within policy modeling is the legitimacy that is implicitly coupled with the outputs of the modeling or prediction exercises. When exploratory modeling initiatives are packaged and presented as consolidated results, there is a great danger of political manipulation taking place. As was illustrated in our case study, this is a key concern amongst policy analysts, decision makers, governments as well as citizens. Models are extremely powerful tools and they can be harnessed to produce legitimacy as well as opaqueness or obfuscation within a policy context. We argue that this is a direct result of a lack of differentiation between exploratory and consolidative models within policy-making. Sarewitz et al. [23] reinforce this belief when they say that *“most presentations by scientists and the media of the results of national and international climate assessments have sought to imbue the imprimatur of consolidative knowledge upon what are inherently exploratory exercises. Those who conflate the science and policy roles of prediction and modeling trade short-term political or public gain with a substantial risk of a more lasting loss of legitimacy and political effectiveness.”*

An emergent thread from both certainty and legitimacy is the assertion of a singular, authoritative Truth. The idea that BOLD can lead us to an objective, omnipotent truth is a myth [4, 2]. This idea leads to false expectations both on the part of policy makers and citizens. In reality, issues of provenance of data, accuracy of assumptions, weighting of relationships between nodes all contribute to muddying the waters.

Agency: Linked to the above limitation of legitimacy (or the false perception thereof), is the notion of agency. What this relates to essentially is *who* is behind the questions being asked, *who* is embedding their assumptions and world views within models that are designed and lastly *who* is interpreting the outputs of such modeling exercises – taking into account that the resulting decisions shape our collective futures. Linked to these questions is also the question of access. Depending on who has access to model building and BOLD analysis tools, we see the emergence of new digital power divides, as well as futures imagined in line with party-aligned political interests.

Following from the discussion on agency, we arrive at the *emergent properties* of Power and Trust. These are seldom discussed within the discourse of BOLD or policy modeling and simulation in the field of computer science. While there is a great deal of discussion surrounding the power of big data itself in terms of the transformations it can bring about, there is hardly any critical commentary on how the power of those that own, store, wield and process this data shape the future of our societies. At present, the capacity to own, store, and make sense of such large data sets resides in the hand of select corporations and governments alone [13]. This is a non-trivial fact if we consider how policies today are founded on the power hierarchies of such elites to decide which futures to select. This privileged group is the third group Manovich [14] refers to when he speaks of those that have the expertise to analyze big data, and it is this group that will get to determine the rules of how Big Data will be used.

5. CONCLUSION

There is a compelling need for debate and discussion of the role of modeling and prediction in decision-making, not the least within the context of BOLD. While we presently see some promising trends of BOLD-driven modeling playing a key role in predicting epidemiological patterns and in natural disaster management, the purpose of this paper is to raise some critical and cautionary arguments around the limitations that are inherent in using these powerful tools. We have here presented three lenses through which this can be done. They are the lenses of uncertainty, legitimacy and agency.

In this paper we argue that while there is nothing inherently wrong with models or modeling or with big data, there are lots of problems with the ways models and modeling that is based on big data are being instrumentalised today. What we find to be problematic is the taken-for-granted assumptions of unlimited resources and infinite (economic) growth that are made as well as in how one implements the models, thereby reinforcing these assumptions. Inflated expectations in regards to the new, shiny toys (analytical, technological, computational) within the context of policy making is also problematic. We here again refer to the inflated expectations of BOLD, leading to the illusion of a removed, objective, accurate, birds-eye view of our social and material realities [2,4].

This paper provides an insight into what societal limits on computing can look like. It does so by tracing how various assumptions are built into the operating system of our socio-technical tools (i.e., assumptions regarding systemic shifts, infinite incremental scientific progress and the infallible reach of big data). Removing those involved in the design of models that rely on BOLD from the users of such tools (e.g. policy makers) leads to the creation of inflated and inaccurate understandings of the sensitivity and the (sometimes lack of) accuracy and power of these tools. We thus ask: How can limits-aware researchers develop new techniques to expose inherent biases and assumptions in the design and creation of models and in big data analysis? We would recommend more transparent expressions of assumptions, value attributions and sensitivity analysis to appear as tangible, visceral parts of the policy modeling, simulation and BOLD enterprise.

ACKNOWLEDGMENTS

Our thanks to the reviewers who have contributed to the articulation of ideas in this paper through their valuable comments

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