

# The Politics of Method: Taming the New, Making Data Official

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Statisticians are under pressure to innovate, partly due to shrinking budgets and the call to do more with less, but also due to technological advances and the emergence of new actors promising to produce more accurate and timely statistics with what has come to be known as “big data.” This raises the question, how do new forms of data and methods become legitimate and official? We approach this question by conceiving of official statistics as part of a transnational field in which different factions of actors compete and struggle over the authority to innovate the data and methods that are legitimated to produce official statistics. We consider these struggles as a politics of method that is not reducible to a competition between ideas and words. They are also material insofar as they feature competing digital devices mobilized to demonstrate the validity of new data and methods. Through two empirical examples, we identify the strategy of re-assembling methods to capture how statisticians tame and contain innovations based on big data, especially those introduced by data scientists, by integrating and simultaneously subordinating them to existing methods. By doing so, we suggest that reassembling is an innovation strategy that secures the relative position of national and international statisticians within the transnational field of statistics.

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Sociologist Mike Savage (2010) begins his book on the politics of method with an account of a study on the changing lifestyles of the British working class that was conducted in Manchester in 1962. Drawing from fieldwork diaries, Savage (2010, 1) highlights that interviewees cleaned the house, dressed up, and even prepared food for the interviewer, as they regarded it as “a badge of honour to be specially chosen for the interview.” This attitude is also reflected in the high response rates during this period: in a survey that had been conducted in nearby Glossop in the mid-1950s, “less than 2 percent of those approached by researchers refused to be interviewed” (Savage 2010, 1). Those days are certainly gone. A national statistician has noted that even for web surveys conducted by her office, “the response rate is less than 10 percent at the moment.”<sup>1</sup> This is also reflected in European Commission policy documents that invoke the “need to reduce the burden on respondents” (European Commission 2009, 6) as one of the main arguments for innovations in the production of official statistics. One cornerstone of the “Vision 2020” of the European Statistical System (ESS) is to replace or supplement questionnaire- and

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<sup>1</sup>Interview at Statistics Estonia, October 2015.

survey-based methods with different methods and sources of data, most notably administrative government register data and various sources of big data (Eurostat 2015, 13). While there are many definitions, statisticians usually adopt what is commonly referred to as the “3Vs” of big data: huge in volume, high in velocity, and diverse in variety of types and formats of structured and unstructured data (Kitchin 2015). The specific data that fit this definition are diverse and, according to one international organization, include that “from digital pictures, videos, posts to social media sites, intelligent sensors, purchase transaction records, and cell phones, GPS signals” (UNECE 2016, 2). However, beyond questions of definition, our research at national statistical institutes (NSIs) and international statistical organizations (IOs) suggests that using big data to innovate methods for the production of official statistics is difficult to implement as they are highly disputed among various stakeholders, including statisticians, policy-makers, end-users, and others.<sup>2</sup>

We locate these questions about big data and official statistics in the context of the genealogy of statistical reasoning (Porter 1986; Desrosières 1998) and its rise in relation to the “avalanche” of “gigantic quantities of data” (Hacking 1982, 280) and numbers (Porter 1995) in the nineteenth and twentieth centuries. From the amassing of centralized administrative data to that of censuses, modern methods for collecting, processing, managing, and analyzing large quantities of data have been central practices of governing (Hansen and Porter 2012; Hansen 2015). As Porter (1995, 15) has aptly argued, this has involved political disputes and contestations and required the development of “technologies of trust” such as statistical standards to be accepted as “objective” and “truthful” within and between scientific and bureaucratic communities. It is within this genealogy that we approach the current “deluge” (Hey and Trefethen 2003) of big data to question contemporary disputes over what it means for the making of what are deemed legitimate statistics.

Current disputes and calls to innovate methods that use big data began in earnest in 2013 at international meetings of statisticians. It is at such meetings that guidelines and regulations for existing and innovative methods of producing official statistics are debated and become recognized amongst statisticians. One of the earliest reports advocated that “the private sector may take advantage of the big data era and produce more and more statistics that attempt to beat official statistics on timeliness and relevance. It is unlikely that NSOs [National Statistical Offices] will lose the ‘official statistics’ trademark but they could slowly lose their reputation and relevance unless they get on board” (UNECE 2013, 3). The report went on to argue that the private sector was leading the development of big data analytics such as visualization methods, text mining, and high-performance computing. Not long after, another report similarly argued that “these new statistical figures may be seen as competitors of traditional official statistics” (Eurostat 2014, 2). The reports reflected not a consensus but the claims of a growing faction of statisticians, who advocated and sought to convince others that resources and investments in experiments with big data and demonstrations of “use cases” were necessary to innovate methods and keep pace with a growing competitor, that of data scientists.

In this article, we understand these struggles as a politics of method. What is at stake is the authority to innovate the data and methods (expertise, truth claims, practices) that are legitimate to produce official statistics. We focus on the case of population statistics to show that one of the challenges of the promoters of innovation is “unlocking” the settlements and commitments that make up existing data and methods. Drawing on the notion of a “triple lock” (Law, Ruppert, and Savage 2011), we argue that methods require and are secured by “method assemblages”

<sup>2</sup>The article is the outcome of collaborative analysis and writing between the two authors. The research leading to the writing of this article draws on collaborative ethnographic fieldwork conducted as part of an ERC funded project, Peopling Europe: How Data Make a People, and involved a team of researchers: Evelyn Ruppert (PI), Baki Cakici, Francisca Grommé, Stephan Scheel, Ville Takala, and Funda Ustek-Spilda. This article has benefited from the insights of all team members and is the result of ongoing collaborative work, conversations, and analysis.

that include advocates and their claims, conceptions of populations, and investments in material practices and digital devices for generating data and, in turn, enacting populations. That is, method assemblages include myriad actors, concepts, and techniques that make up practices that not only represent but enact realities by making some things absent or present (Law 2004). And, as Hansen and Porter (2012, 410) have argued in relation to transnational governance through numbers, method assemblages not only enact realities such as populations but “also produce actors, objects and relationships, including relationships of power.” We argue that struggles over legitimate methods for producing official statistics are situated in, and simultaneously help to shape the contours of, what we call a transnational field of statistics. This field comprises differently positioned stakeholders such as statisticians, demographers, domain specialists, academics, policy makers, and other users of statistics (cf. Scheel et al. 2016). While statisticians have long occupied a dominant position within the field, as noted in the quotes above, data scientists are an emerging profession challenging this dominance. As conceived by Bourdieu (1989), it is through specific practices that actors from competing professions struggle to advance or defend their relative positions within a field. For data scientists, at stake is recognition of their data and methods as legitimate and authoritative and, in turn, the cultural and symbolic capital that this will confer. For statisticians, their stakes are to protect and advance their authority and position in relation to each other and this emerging faction. We take up Bourdieu’s concept of fields to understand these stakes as a politics of method, as it captures “struggle and change” involved in innovating methods, recognizes that “continuities [are] fragile moments,” and provides a way to analyze “the emergence of new kinds of practices” (Bigo 2011, 240–41). In a nutshell, the transnational field of statistics is a veritable arena for the politics of method, which surface in struggles over methodological innovations and authority performed through practices in the production of official statistics. With Savage, we understand this politics of method not as a realm of pure science but “a messy, competitive context [in which] the roles of different kinds of intellectuals, technical experts and social groups are at stake” (Savage 2010, 237). But, in contrast to Savage, we highlight the important role that material-semiotic practices and digital devices, most notably demonstrations and visualizations, play in the politics of method, which are not reducible to argumentative struggles over ideas.

What then are the strategies through which methodological innovations are promoted and accomplished? In response to this question we develop two arguments. First, we outline four innovation strategies from industry studies that account for how innovation is accomplished: reproduce, recombine, invent, and transfer. We then introduce *reassembling* as a fifth innovation strategy. This strategy seeks to “tame” new methods that use big data, by integrating and simultaneously subordinating them to existing methods, to secure the relevance and authority of existing stakeholders, who dominate the production of official statistics within the field. Secondly, we depart from Savage’s conception of the politics of method to argue that these strategies involve not only competition between ideas. They also feature material-semiotic practices like demonstrations that seek to legitimize innovations in methods and data as official. In this way, we underscore that the politics of method are not reducible to a competition between human actors who can put forward the best argument in the most compelling manner. Rather, the politics of method requires a symmetrical analysis<sup>3</sup> that accounts for how different kinds of

<sup>3</sup>The principle of generalized symmetry is central to ANT-inspired, material-semiotic approaches in STS. David Bloor (1991) and the Edinburgh school had argued that the sociology of scientific knowledge should not only study false theories and failed experiments but also those accepted as true and successful, using the same concepts and methods. Following the principal of epistemological symmetry, STS-scholars should treat and study false and truth claims symmetrically. Following Michel Callon (1986, 200), who introduced the principle of generalized symmetry, STS scholars extend the principle of symmetry to human and nonhuman actors, which should receive equal attention in the analysis and be studied and described with the same terms.

digital devices are mobilized in struggles over methodological innovations in the production and legitimation of official statistics. With this material-semiotic understanding of the politics of method, we seek to contribute to recent discussions in critical IR on how data and numbers shape problematizations, ways of knowing, and interventions in transnational governance (Hansen and Porter 2012; Hansen 2015; Aradau and Blanke 2017; Rocha de Siqueira 2017).

We develop these arguments in two moves. In the first two sections, we elaborate our conceptual framework, specifically our understanding of the politics of method, the transnational field of statistics, and the role of innovation strategies, demonstrations, and visualizations in struggles over the legitimation of methods for producing official population statistics. In the third and fourth sections, we empirically engage this framework in two examples from our fieldwork. The first concerns how a map visualizing mobility patterns is crafted to promote the use of mobile positioning data as a new data source for official statistics in Estonia. The second attends to how visualizations are mobilized at international meetings of statisticians to promote new methods that use mobile positioning data and web-scraped data on job vacancies as potential new sources.

### The Politics of Method: Doing Things with Words and Words with Things

The difficulty of innovating methods is due to what Law et al. (2011) call the “triple lock” of methods. Methods have specific *advocates* (methodologists, sociologists), conceptions of a *reality* or what is to be measured (e.g., definition of a resident or base population), and then a *technique* for knowing that reality (e.g., survey or census and everything that makes them up). This “triple lock at work here . . . makes it very, very, difficult to know differently, to shape new realities, or to imagine different ‘method assemblages’ or modes of knowing” (Law et al. 2011, 13) because to innovate methods requires unlocking all. The term “lock-in” comes from industry studies that identify a major barrier to innovation as the dominance of a specific design—or in our case, method—in comparison to alternatives. Designs can become inflexible once dominant and then progressively become more “locked in” (Arthur 1989), in part due to their complexity and hierarchically nested elements (Murmans and Frenken 2006). More generally, a dominant design is the result of the creation of standards, institutions, economies of scale, and routines, all the investments that Latour (1990) has identified that constitute a setup.

Due to their extensivity and relative rigidity, particular designs get locked in and give rise to four innovation strategies or choices that van der Vooren, Alkemade, and Hekkert (2012) define as follows: (1) *reproduce* the dominant design with incremental improvements (e.g., improve a survey design in terms of the format); (2) *recombine* existing dimensions to create a new design (e.g., a large scale modular survey instead of multiple smaller ones); (3) *invent* new dimensions based on the existing design (e.g., introduce new technology such as web-based questionnaires); or (4) *transfer* a dimension from outside (e.g., replace or incorporate administrative data registers or big data). What drives the choice of strategy is often a combination of social and technical factors and forces, including barriers or incentives such as existing standards and routines or reduced costs, but also sociopolitical factors such as user demands or the institutional agendas of stakeholders, as we will illustrate in our examples.

Unlocking methods thus requires strategies that gather together new assemblages of advocates, conceptions of realities, and techniques for generating knowledge, that is, all the things and people that make up methods. In the case of official statistics, this involves struggles over the valuation of innovations in methods that challenge existing and established ones. How then are these struggles fought? For Savage, struggles around social science methods in postwar Britain involved disputes between proponents of different methods and how they aligned with larger

political projects such as practices of statecraft and nation-building. He provides, for instance, a convincing analysis of how the method of the sample survey helped to stabilize an imagined “British” community in an era of decolonialization and loss of empire, by providing scientific accounts of the “state of the nation” in which the truth of the whole nation was derived from observations of some of its parts (Savage 2010, 187–212). With this analytic focus, the politics of method emerge primarily as a struggle of ideas between different social scientists.

Savage’s understanding has affinities with Jean Francois Lyotard’s account of social struggles over the production, dissemination, and legitimation of knowledge as principally involving language (Lyotard 1984). He calls these struggles “language games” and argues they are played through different classes of utterances. Bourdieu (1989) also argues that truth becomes legitimized when recognized professional groups exercise symbolic violence over the production, consecration, and institutionalization of forms of knowledge. Following Bourdieu (1992, 152; authors’ translation), “this symbolic power is based, like any form of performative discourse, on the accumulation of symbolic capital,” which actors have acquired, as a sort of social authority, in previous struggles over legitimate knowledge. Hence, both Lyotard and Bourdieu understand language as strategic moves that bring things into being rather than simply reflect preexisting referents (for Bourdieu see also Bourdieu 1991). Their understanding thus has affinities with John Austin’s theory of language as “doing things with words,” where language can have performative force and make something happen (cf. Isin and Ruppert 2015).

However, language or discourse are just one of the practices that actors mobilize in their struggles over the legitimacy and authority of knowledge claims. To develop this point, we draw on Bourdieu’s concept of fields to situate these struggles in a transnational field of statistics. In brief, Bourdieu understands a field as a dynamic, relatively autonomous, relational social space in which various actors compete with one another over power and influence by mobilizing and trying to accumulate different forms of capital in order to improve their relative positions within the field. Importantly, Bourdieu has emphasized that to map the relational positions of actors, or agents, of a given field requires analyzing their habitus and the forms of capital they have at their disposal, as well as their “stances or position-takings,” which we can infer from “the practices and expressions of agents” (Bourdieu and Wacquant 1992, 105). Regarding the latter, actors occupying a given position within a field struggle to influence and improve their relative position through both what they say and what they do in practices. That is, beyond language games, they also engage in material-semiotic practices such as demonstrations and visualizations, as we elaborate in the next section.

The second reason we draw on Bourdieu’s work is that it permits us to underscore the conflictual nature of the politics of method which emerge as a series of struggles over legitimate methods for producing official statistics. In these struggles, statisticians and other stakeholders (demographers, data scientists, domain specialists, etc.) compete over budgets, agendas, and influence as they mobilize and try to accumulate different forms of capital, including cultural capital (expertise and skills in new methods and related digital devices), economic capital (funding for demonstrations of use cases, pilot studies), social capital (through alliances and professional networks with other proponents), as well as symbolic capital (recognition as innovators and leaders), to advance their relative position in the transnational field of statistics. The field emerges as a veritable arena of the politics of method, whose struggles shape, in turn, the contours and boundaries of the field (cf. Scheel et al 2016; Grommé, Ruppert, and Cakici 2018). With the work of IPS scholars Didier Bigo (2006) and Mikael Madsen (2014), we understand this as a transnational field. In this conception, the force of the national is not simply replaced by the transnational. Rather, the transnational exists only through the national, as professionals, like statisticians, “play simultaneously in domestic and transnational



fields” (Bigo 2011, 251), for instance when they participate as representatives of particular nation-states at international forums. For it is through their participation in international task forces, meetings, and conferences of organizations such as the United Nations and Eurostat, that they propose and exchange methods for the production of official statistics and seek international recognition and legitimation of innovations. They do so not only through words but, as expressed in the quotes calling for innovation noted in the introduction, through “use cases” developed by both national and international organizations that demonstrate and visualize methodological innovations and experiments with big data. At the same time, through the recognition of demonstrations at international forums, statisticians seek and acquire social, symbolic, and cultural capital to advance their relative positions in the field.

Language is thus only one way through which the politics of method are played. Another involves working with things to say something. This is an argument that Bruno Latour developed when he reversed Austin’s *How to Do Things with Words* into “How to Do Words with Things” (Latour 2000). What Latour does is move beyond Austin’s focus on language to understand how we speak through, and in relation to, things such as materials and technologies. Through this reverse formulation we suggest that political struggles over methodological innovations are also performed through material semiotic practices that say and bring something into being.

Following Latour (1990), investments in things and their mobilization are stakes in the politics of method and involve a competition between what we refer to as digital devices. Digital devices are elements of method assemblages made up of social and technical relations between multiplicities of things and people (Ruppert, Law, and Savage 2013, 24). These arrangements include technical infrastructures such as computer networks, scanners, algorithms, software applications, and so forth, as well as various actors including institutions and individuals such as users of statistics, data scientists, representatives of IT-companies, and so forth. The crucial point is that digital devices underscore the irreducible material character of knowledge production in general and the politics of method in particular. For instance, visualizations of digital data that are mobilized to demonstrate the claimed accuracy and veracity of a method assemble myriad elements to produce inscriptions such as charts, networks, and graphs. They not only represent but selectively bring into being and make present a matter of concern to convince others of their legitimacy.

To be clear, our point is that discursive struggles often work together with digital devices such that the politics of method cannot be reduced to language games. As we will show later, verbal claims and arguments promoting the adoption of new sources of data and innovative methods are supported by demonstrations and visualizations. Moreover, it is through the recitation, repetition, and reiteration of claims about the promises and values of innovations that truth is performed. This is what Judith Butler (1993) argues in her theorizing of gender as an effect of performative practices and utterances. What determines whether recitations have a performative force is whether there is an uptake; that is, in our case, the adoption and legitimation of new methods. Innovation of course is not a linear process but emergent, interactive, and involving multiple contestations, controversies, and feedback loops featuring many actors who cooperate or oppose each other (Callon 2007). It is through repetitions of claims in both words and material-semiotic practices that innovation strategies can be traced and analyzed.

### Demonstrations and Visualizations in Unlocking Methods

One historical means of making and substantiating truth claims by doing words with things are demonstrations, which become stakes in struggles over regimes of truth. Rather than thinking of demonstrations as a competition in search of

objective and verifiable truth as advanced in classical science, we adopt a position that has followed, especially since the time of the “science wars”:<sup>4</sup> the recognition that different truths and modes of world making coexist simultaneously, albeit in often conflictual and competitive ways. This does not, however, imply adopting a relativist understanding of truth but rather a pragmatist one.

Isabelle Stengers is a prominent advocate of the pragmatist position. She challenges the proposition that a political ontology involves accepting and tolerating different versions of worlds, which essentially amounts to a form of epistemological relativism. For Stengers (2005, 2010), the matter is not knowledge and a commitment to an ideal of objectivity but to scientific facts as crafted achievements and always made up of specific and partial connections. That is, to accept that there are different versions is not to advocate that there is a free for all competition over truth but that facts must be crafted and produced and constitute specific situated (not universal) achievements. Following this argument, demonstrations are not simply representations but involve engagements with and arrangements of reality—of things, devices, and setups as in a laboratory—and involve learning from what those setups tell us.

A prominent example of how truth was demonstrated and verified as relevant and legitimate in classical science is Robert Boyle’s seventeenth century experiments to produce “authentic knowledge” about matters of scientific fact about the workings of an air-pump to achieve a vacuum. As Shapin (1984) argues, to do this required collectivizing and multiplying witnessing. This was achieved through demonstrations that could be repeated and travel beyond the physical confines of a laboratory. This depended in turn on three interrelated technologies: the material technology required for the operation of the air-pump; the social technology of scientific rules and conventions for considering knowledge claims; and the literary technology of detailed experimental reports that could multiply witnessing beyond the laboratory. Shapin argues that detailed experimental reports more easily enabled others to imagine experiments without directly witnessing or replicating them. He makes three further observations that are of interest to us.

The first concerns the conditions that made it possible to be “morally certain” about “matters of fact” as reliable knowledge (Shapin 1984, 483). In Boyle’s time it was the credentials of multiple witnesses of demonstrations, principally scientific and credentialed men. The second observation he makes is that demonstrations were diffused not only through words but through literary technologies and especially visualizations. How might we then consider Boyle’s experiment in terms of a politics of method through the pragmatist lens offered by Stengers?

One is that Boyles’ practice involved a situated, crafted demonstration that was a fragile accomplishment involving not only the experimental setup but also social conventions and literary technologies for their circulation (Shapin 1984). A second is that the authority and legitimacy of the demonstration required affirmation by legitimate witnesses with recognized forms of capital. That is, the production, consecration, and institutionalization of knowledge was a matter of struggle and competition between different accounts and to be legitimized required recognition within a field of scientific practice. Like a public protest analyzed by Andrew Barry (1999, 77) as a “way of showing what can or might be done,” scientific demonstrations seeking to substantiate truth claims involve a politics of who can and who should be trusted to be a witness and under what conditions and in what ways. As such, a demonstration is always political because it involves the telling of a truth that is “intended to have effects on, or challenge the minds, or affect the

<sup>4</sup>The “science wars” of the 1990s involved sociological and philosophical conflicts over scientific realism versus constructivism, when scientists reacted against the thesis that science is a practice like any other (Stengers 2010). Scientists argued that scientific knowledge is real, while postmodern social scientists rejected scientific objectivity and interpreted Kuhn’s scientific paradigms to mean that science is socially constructed.

conduct of others” (Barry 1999, 77). A third, which we elaborate below, is the role of visualizations.

As in Boyle’s time, legitimizing new forms of data and methods requires demonstrations that can convince recognized witnesses of their validity. In this regard, Burri and Dumit (2007) highlight the role of images and visualizations in the production and legitimation of scientific knowledge. They note how ethnographic studies of scientific representational practices show that visualizations are also part of (and not separate from) evidence expressed in texts, words, data sets, files, and conversations (Lynch and Woolgar 1990). However, while visualization has long been part of such scientific practices and a concern in STS, it has now perhaps become even more so as excessive or big data demands new forms of analysis that can make data meaningful (Ruppert et al. 2013). In this regard, visualization has become a summarizing inscription for stabilizing and representing patterns so that they can be analyzed and interpreted as trends, circulations, and flows. This is an understanding famously advanced by Tufte (1983, 9) who argues that visualizations are not simply descriptions but also analytics: “graphics are instruments for reasoning about statistical information” that “*reveal* data. Indeed, graphics can be more precise and revealing than conventional statistical computations” (Tufte 1983, 13).

Building on these insights, we understand visualizations as crafted setups that involve situated enactments of realities. Rather than “unquestioned representations of ‘what is,’” visualizations are constructed and interpretative forms of knowledge making (Drucker 2011, 1). However, to return to our earlier point, this implies that visualizations bring realities performatively into being. What interests us here is, however, that visualizations are also mobilized to convince others and build allies. Put simply, visualizations are used to establish sociotechnical networks through which knowledge can be legitimized and stabilized (Latour 1990).

This function of visualizations is particularly pronounced in a transnational field that requires “virtual” witnessing through “literary” technologies that can easily travel across sites. Hence, just like Boyle’s classic demonstrations, the literary technology of visualizations is not only a key means of analysis but also of communication and building allies. Because they can be easily transported and communicated, visualizations can more readily operate as a “technology of distance,” as Porter (1995, ix) has argued in relation to the history of quantification and numbers. Willis (2016, 4) also suggests that “pictorial visualizations” of science in action are “imagined performances” that enable the dissemination and circulation of new knowledge and are key to their promotion and recognition. Adrian Mackenzie (2015, 437) similarly argues that data visualizations often tell a story, visualized “plots,” which are invoked in order to “persuade people to do things or help them decide what to do.”

Within this conceptual framework we now consider demonstrations encountered within our study of methodological changes within the transnational field of statistics. We focus particularly on proponents of new methods who seek to build allies as well as their opponents and their truth claims about new data sources and methods (benefits, relevance, problems, promises, speculations) and how these are accomplished through repetitions of both verbal arguments and demonstrations, most notably visualizations.

#### *Demonstration 1: Enacting Mobile Populations as Self-Evident Realities*

The atmosphere is tense at a meeting of the scientific council (SC) at the offices of Statistics Estonia (SE). The SC is supposed to provide the government with recommendations on methodological questions for the next population and housing census (PHC) in 2020. A demographer has just slammed her hand on the table, declaring the usage of a mixed method approach in the next census as a question of national survival: “but this info can only be obtained from a person directly. If we



want Estonia to survive, then there is no other way! There is the need to pressure the government, not the other way around.”<sup>5</sup>

The information the demographer is referring to concerns people’s place of residence. What is contested is the method that will be used to obtain data on this important census topic in the next PHC in 2020. While SE is under immense pressure by the government to move to a full register-based census,<sup>6</sup> which is regarded as a means to promote the country as a hub of innovation under the banner of “E-Estonia,” demographers push for a “mixed approach” that combines data from administrative registers with online and door-to-door enumeration for selected census topics.<sup>7</sup> The central concern of demographers is the low quality of data in the population register (RR), in particular that on people’s places of residence. One central outcome of the last census, which was based on traditional questionnaire-based methods, was that about twenty percent of the addresses recorded in the RR did not correspond to the place of residence that was eventually established through online and door-to-door enumeration (Puur, Sakkeus, and Aben 2013, 25–26). The problem is that inaccurate data on people’s place of residence will “have a serious distorting effect on more than a half of census characteristics” (Puur, Sakkeus, and Aben 2013, 130). The share of single parent households would, for example, nearly double, from twenty four percent in the 2011 census to forty two percent if families and households were formed based on RR data.<sup>8</sup> Hence, a feasibility study describes the inaccuracy of data on people’s place of residence in the RR as “the main hurdle on the way to a register-based census” (Puur, Sakkeus, and Aben 2013, 130).

The surprise guest at the meeting is, however, one of the founders of MOBDATA, a company that specializes in the production of statistics with mobile positioning data (MPD).<sup>9</sup> Hence, much of the following discussion revolves around the possibility of using MPD to determine people’s actual place of residence in the next census. This would require the use of MPD on the individual level, instead of aggregated data that has been analyzed by MOBDATA so far. In his input, MOBDATA’s representative focuses thus on legal and data protection issues.<sup>10</sup> The technical feasibility and methodological veracity of MPD seem to be minor issues. What interests us here, however, is how a visualization is mobilized to demonstrate the veracity of MPD as a method to track and follow the whereabouts of increasingly mobile populations.

The visualization is a map that constitutes an essential element of MOBDATA’s marketing strategy.<sup>11</sup> The map has been shown on so many occasions and events both nationally and internationally that all attendees of the SC meeting are familiar with it, thus showing that visualizations have become a key literary technology through which truth claims travel and are demonstrated across sites. The map itself is rather unspectacular. It shows a conventional map of Estonia. The unconventional aspect is that the map features animated elements: red dots that move along the country’s most important transport axes. In the example of the screenshot

<sup>5</sup> Field-notes of SC meeting, December 7, 2015. Field-notes were taken by an Estonian-speaking research assistant, who subsequently provided a transcription in English. One author was also present and conducted interviews with some SC members before and after the meeting.

<sup>6</sup> Within the EU and beyond there is currently a move from traditional census methods, based on field enumeration and questionnaires, to register-based censuses that draw primarily on data from administrative registers (UNECE 2006, 14).

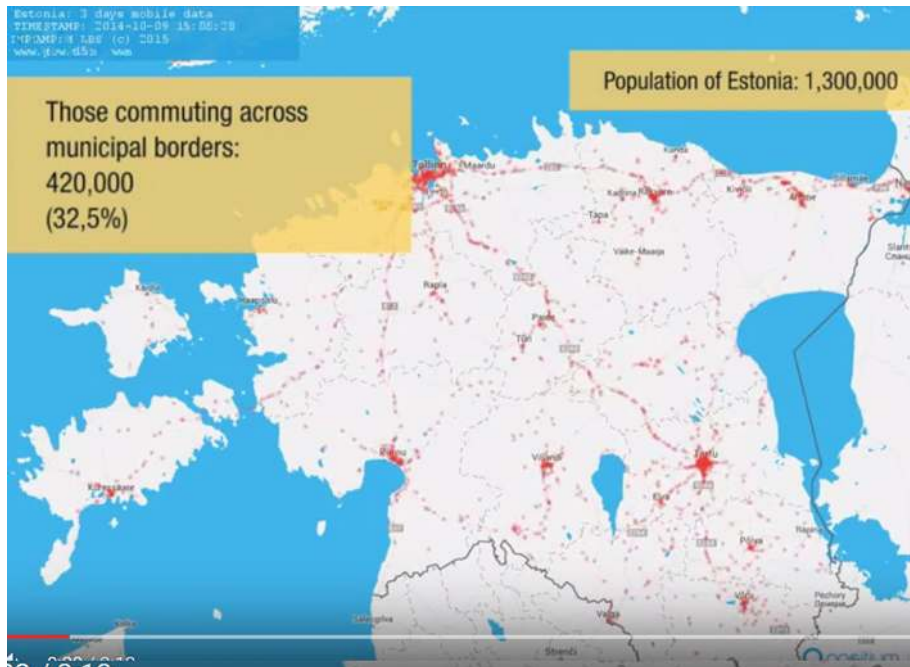
<sup>7</sup> Interview with statistician, December 2015.

<sup>8</sup> Interview with statistician, September 2015. The formation of families and households with register data would be based on an algorithm that SE has adopted (in slightly modified form) from Statistics Finland. The algorithm determines, based on address data and other biographical data from the RR, such as age, sex, children registered at the address, and whether cohabiting couples form a household or not (cf. Kätt 2015).

<sup>9</sup> The name of the company has been anonymized.

<sup>10</sup> Field-notes SC meeting, December 7, 2015.

<sup>11</sup> Interview with MOBDATA staff, February 2016.



**Figure 1.** Screenshot of the MOBDATA map (May 23, 2017)

in [figure 1](#), the dots visualize commuting patterns across municipal boundaries in Estonia. The number of moving dots increases and decreases during the animation, which shows commuting patterns over three days in a time-lapse of two minutes. Despite its simplicity, the map succeeds in generating astonishment, as a MOBDATA staff member responsible for sales in Estonia stresses: “Oh yes, people are impressed . . . it’s catchy, and it’s nice . . . people like to see things like this.”<sup>12</sup>

This astonishment is caused by what the moving dots enact and make intelligible: commuting patterns in Estonia. In contrast to other statistical accounts of mobility, such as static charts and tables, MPD seems to speak for itself precisely because it moves. The moving red dots become a vehicle not only for the data but first and foremost for its claimed self-evidence.<sup>13</sup> The red dots moving along Estonia’s main transport routes suggest that they correspond to the commuters they are meant to represent. Through this “realist trick” ([Law 2012](#)), mobility is enacted as a reality that exists independently of the methods that are used to describe it. There appears to be a seamless correspondence between the visualization (the moving dots) and the reality (commuting patterns in Estonia) it represents; it renders “the phenomenal world (as if it) were self-evident and the apprehension of it a mere mechanical task” ([Drucker 2011](#), 2). In this way, MPD is constituted as *the* perfect method for tracing the movements and locations of increasingly mobile populations, a method that offers an unrestricted vision from above, a vision that allows, in the tradition of the “god trick” described by Donna [Haraway \(1988, 581\)](#), to see “everything from nowhere.”

<sup>12</sup> Interview with MOBDATA staff, February 2016.

<sup>13</sup> When we talk about MPD in this case, we are talking about the data used for the billing of mobile phone users by mobile network providers. This data contains logs on the position and time of a mobile phone when in use. The location data is based on the connection of the phone to a particular antenna within the mobile phone network. The precision of location data thus depends on the size of the mobile phone cell covered by an antenna. The size of a mobile phone cell can vary significantly, especially between cities and the countryside ([Ahas et al. 2010](#)).

We understand the MOBDATA map as part of a method assemblage that makes things absent and present (Law 2004). What is rendered absent by the map are the working procedures of data acquisition, storage, cleaning, checking, adjustment, interpolation and so forth on which the apparently seamless visualization of commuting patterns in Estonia is based. These working procedures include, for example, the extrapolation of a population from MPD, in the case of figure 1, derived from mobile phones that are moving from one telecommunications antenna to another one. This work cannot be fully automated due to unforeseen events whose evaluation requires human judgment and interpretation.<sup>14</sup> Hence, only fifty percent of this work, which data scientists of MOBDATA call “quality management” (QM), has been automated so far.

Crucially, the map’s capacity to build allies derives precisely from making absent all the work that goes into the map’s crafting as a coherent account of mobility. This crafting includes, for instance, an automated algorithm that, starting from the observation that there are about 2 million active mobile phones in Estonia, but only about 1.3 million permanent residents, decreases the number of people that are inferred from MPD by a factor varying from one municipality to the next. The value of this “regionally varying adjustment coefficient” is based on calculations that have been conducted since the last census in 2011, using census results as a reference point.<sup>15</sup> This adjustment of MPD illustrates one of the key differences between established statistical and big data methods. While the former are based on data designed for the very purpose of generating statistical variables, big data methods reuse and repurpose data that, while often being more detailed and timely, have been produced for different purposes (Kitchin 2015). By rendering absent the adjustment procedures that are required to make MPD usable for population statistics, the MOBDATA map also renders absent these differences and that “big data are . . . are generally not representative of an entire population as they only relate to whoever uses a service” (Kitchin 2014, 475; Struijs, Braaksma, and Daas 2014).

What is also made absent by the MPD demonstration is the manual QM work. Every three months a member of staff (who we refer to as Wanda) conducts quality checks on MPD stored in MOBDATA’s database. Wanda checks the graphs showing the number of residents, visitors, and commuters, as calculated by MPD, for any irregularities. These irregularities could be the result of unforeseen events like road closures (in the case of a dip in commuter data) or rock festivals in the countryside (in the case of a peak of several days in the data). They could, however, also be the effect of a power cut or a broken antenna. In this case, the mobile phone might be connected to an antenna in a neighboring municipality, which would result in the allocation of the mobile phone user as a resident in, or commuter to, that municipality. To assess the source of irregularities in the data, Wanda engages in veritable detective work, which involves Google searches but also local knowledge of colleagues and friends. If Wanda cannot explain irregularities in the data through events like road closures or festivals, she manually corrects the data, assuming the source of the irregular increase or decrease is a power cut or broken antenna. Wanda checks the data for each of Estonia’s 213 municipalities, coloring the respective field on a print-out of a map of the country in either blue (correct data), yellow (needs to be double-checked after manual correction), or red (requires correction).<sup>16</sup> This cumbersome work can take up to two weeks, as it involves a “ping pong” between Wanda and a data scientist, who runs a “police algorithm” on the data, which verifies that the population size has not been inflated or

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<sup>14</sup> Interview with a senior MOBDATA staff member, April 2016.

<sup>15</sup> Ibid.

<sup>16</sup> Observation of, and interview with, a MOBDATA staff member, February 2016.

deflated due to her manual adjustments.<sup>17</sup> What this account of QM work shows is that the MOBDATA map is, indeed, a carefully crafted accomplishment. Moreover, it illustrates that the map's capacity to prompt astonishment and "sell" MPD as a viable method for statistical outputs hinges precisely on making all the work that goes into this crafting invisible.

What also explains the persuasive power of the MOBDATA map is that it renders absent the role that established methods play in this QM work. In her work, Wanda draws on data from SE's 2011 census results as well as register-based statistics as "orientation points" to assess the quality of MPD-based statistics and to adjust the population size, if needed. Hence, the quality assessment and adjustment of MPD draws on the very methods for which MPD-based statistics are supposed to offer an improvement.<sup>18</sup> For her detective work Wanda frequently uses, for instance, the SE website, where she looks up the official number of residents of the municipality in question to assess the scope of an identified irregularity. The use of the outputs of established statistical methods as yardsticks and orientation points for the quality assessment and adjustment of MPD based calculations implicitly renders the delegation of MPD to an inferior status as auxiliary, which we explain in detail below.

Yet, all this work is necessary to accomplish the apparently self-evident flows of moving red dots. For MOBDATA's data scientists do not know if a mobile phone user has been driving along a particular road. They just know that the same mobile phone has been connected to antennas in two neighboring municipalities and assume, based on "logical guessing," that the mobile phone user has been driving their car on the main road connecting the two neighboring municipalities.<sup>19</sup> In sum, these examples illustrate what MOBDATA's map accomplishes: it demonstrates the veracity of MPD as a data source for tracing the movements and whereabouts of increasingly mobile populations by rendering absent the irregularities in the data, the ethnographic and anecdotal local knowledge that data scientists mobilize to smooth out these irregularities, and the moments of interpretation and "logical guessing" that this work of extrapolating a population from MPD involves.

We would like to suggest that it is precisely because of the map's persuasive power, which derives as much from what the map makes absent as from what it visualizes, that MPD has become a serious contender in the politics of method of the transnational field of statistics. This is illustrated in plans of SE's methodology department to use MPD as "auxiliary data" in the production of official population statistics.<sup>20</sup> In brief, statisticians are planning a pilot study in collaboration with MOBDATA to assess whether MPD can be used to determine people's actual place of residence. One identified potential is to deal with the issue of an increased number of single-parent households due to incorrect addresses in the RR. The plan is to form two test groups that both feature couples with common children who live (according to RR data) separately. One group will consist of couples of which it is known from recent survey data that the address recorded in the RR is incorrect. The second group—the so-called control group—features couples who do live separately, according to survey-data based on face-to-face enumeration. With the help of MOBDATA's data scientists, SE's statisticians hope to establish, based on personalized MPD, where a person "actually" lives. To allocate a person, whose officially registered address has been revealed as incorrect, to another address, statisticians will collect all officially

<sup>17</sup> Though the role of this "police algorithm" is indeed to control the work of Wanda, this algorithm has inherited its informal internal name from the most important customer of MOBDATA.

<sup>18</sup> Interview with MOBDATA staff member, April 2016.

<sup>19</sup> Interview with MOBDATA staff member, April 2016. The reliability of this so-called "downscaling" of MPD to movement trajectories on particular transport routes is, from a methodological viewpoint, particularly problematic in densely populated areas with good transportation infrastructure where several routes are possible (Saluveer and Ahas 2014).

<sup>20</sup> The following account is based on an interview with a senior statistician of SE (December 2015) and field-notes of a methodology working group meeting, November 3, 2015.

registered addresses of the person concerned from various government databases. Based on their whereabouts according to MPD, the person will then be allocated to one of these addresses.

The plan of SE's methodologists to use MPD for official population statistics involves two of the four innovation strategies that we have outlined previously, namely that of the *transfer* of new dimensions from the outside as well as *recombining* innovations with existing methods. This latter is well evidenced in statisticians seeking to delegate MPD to the status of "complementary data"<sup>21</sup> by using it in conjunction with data from various administrative registers to determine people's place of residence. We interpret this as a strategy through which statisticians satisfy the government's imperative to innovate while at the same time retaining their dominant position as the authoritative producers of official statistics.<sup>22</sup> In other words, the looming threat of big data as a challenge to the dominant position of NSIs (Struijs et al. 2014) is tamed and contained by integrating and simultaneously subordinating MPD to this status. However, rather than simply a matter of addition, the introduction of new dimensions requires adjustments to all parts of the method assemblage.<sup>23</sup> It calls for investments in technologies and materials, the introduction of new conceptions of mobile populations, as well as reconfigurations in alliances and advocates. We thus suggest that the adoption of MPD constitutes a fifth innovation strategy, which we call *reassembling*.

The main achievement of reassembling resides thus in taming the new by delegating it to the inferior position of "complementary data" in the production of official statistics, thereby ultimately reinforcing the legitimacy and value of existing sources. From the perspective of MOBDATA, this nevertheless amounts to a major step forward, since MPD will eventually—thanks to the persuasive visualization of mobile populations by the map—become "official." Hence, MOBDATA will acquire recognition as "official," while its producers will acquire the cultural and symbolic capital and authority that comes with such recognition. Nevertheless, we suggest that reassembling also serves as a strategy that secures the relative position of statisticians in struggles over the legitimation of new sources of data and methods in the transnational field of statistics, a point we further explore in the next example.

#### *Demonstration 2: Comparing Methods to Secure the Status Quo*

Since 2001, the European Conference on Quality in Official Statistics has been an important biannual event organized by Eurostat.<sup>24</sup> The local host of its 2016 edition, the director general (DG) of the Spanish NSI, uses his opening address to suggest that this year is particularly significant in the context of demands to innovate methods that can better track the movements and whereabouts of increasingly mobile populations. To do so calls for experimenting with new data sources such as administrative and big data, which together require modernizing statistical systems. For him, this is "our data revolution," which involves not only working with new sources of data but adopting analytics such as new model-based statistics. The relevance of this conference for him is how to ensure quality within this new data environment.

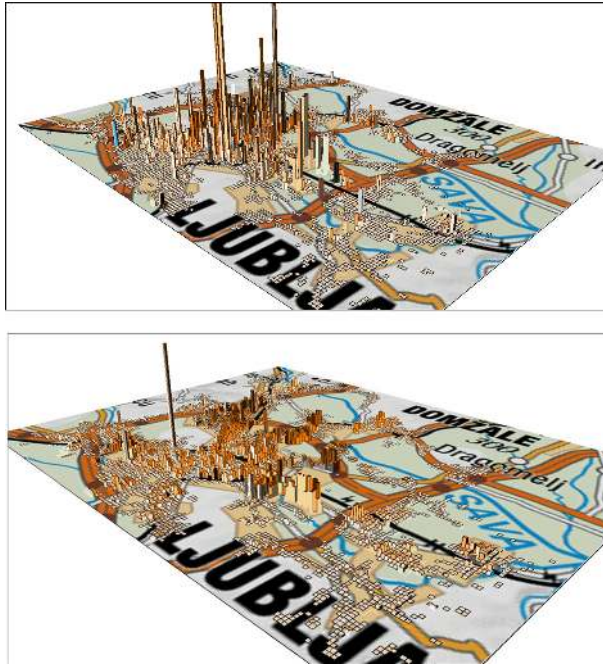
<sup>21</sup> This term was repeatedly used interchangeably with the notion of "auxiliary data" by a senior statistician in interviews conducted in October and December 2015. It is also more generally referred to by numerous NSIs.

<sup>22</sup> This argument is elaborated in relation to many other NSI experiments with big data in Grommé, Ruppert, and Cakici 2018.

<sup>23</sup> This is similar to the argument made about the introduction of digital devices in relation to social science methods: that the introduction of new devices requires that all of the elements (concepts, technologies, people, etc.) that make up methods need to be reassembled (Ruppert, Law, and Savage 2013) or redistributed (Marres 2012).

<sup>24</sup> The conference was held in Madrid, June 1–2, 2016. Narratives and observations are summarized from field notes taken during the event.





**Figure 2.** Comparison of day and night population densities for Ljubljana generated from mobile phone data.

Source: Statistical Office of the Republic of Slovenia (2016).

What the Spanish DG says in words, the Slovenian DG demonstrates with visualizations in her keynote address. She begins by setting up the visualizations that follow by summarizing a set of arguments about the opportunities and challenges of big data that are repeated throughout this event and others: improving the timeliness, reliability, and relevance of statistics; lowering the response burden and costs; addressing challenges such as access to data, privacy, ethics, and methodology; developing necessary skills and competencies; and adapting quality frameworks.

Subsequently, the DG switches to visualizations innovated by professions such as data science to demonstrate the opportunities of a mobile phone pilot investigating day and night population densities in Ljubljana (figure 2). Rather than charts, numbers, or line graphs, the DG displays a three-dimensional heat map that has become a popular visual form and which shows a rather obvious pattern—the density of population in the inner city differs during the day versus night. The data, analysis, and work that went into producing the visualization are not discussed. But the deployment of a visualization is not to settle technical questions. Rather, the visualization is a strategy to convince others that working with big data requires a “mental shift,” including new knowledge and competencies of data scientists, and that this in turn requires a change in “paradigm,” which the visualization performs. Like the visualizations of MOBDATA, the demonstration is a strategy to convince other statisticians and build allies for an innovation being advanced by her NSI. In other words, the heat map demonstrates a paradigm shift that statisticians sometimes refer to as a change from statistics to modeling. In this way, the demonstration shows how innovations need their diagrams not only to represent but also as “collective way-finding” (Verran and Winthereik 2016) or, as we have noted, as a means to build allies and to persuade others. It is a paradigm that Mackenzie (2015) has captured in his comparison of big data analytics and statistical tabulations from surveys, polls, or random sampling to measure variables based on stable and pre-given categories

such as migration. In contrast, big data analytics identify “associative patterns,” often rendered in visualizations that break up data into describable and measurable “features” or attributes of interest (Aradau and Blanke 2017, 379–80). It is a mode of analysis that does not begin with categories to then draw statistical inferences but with patterns to make predictions (Mackenzie 2015).

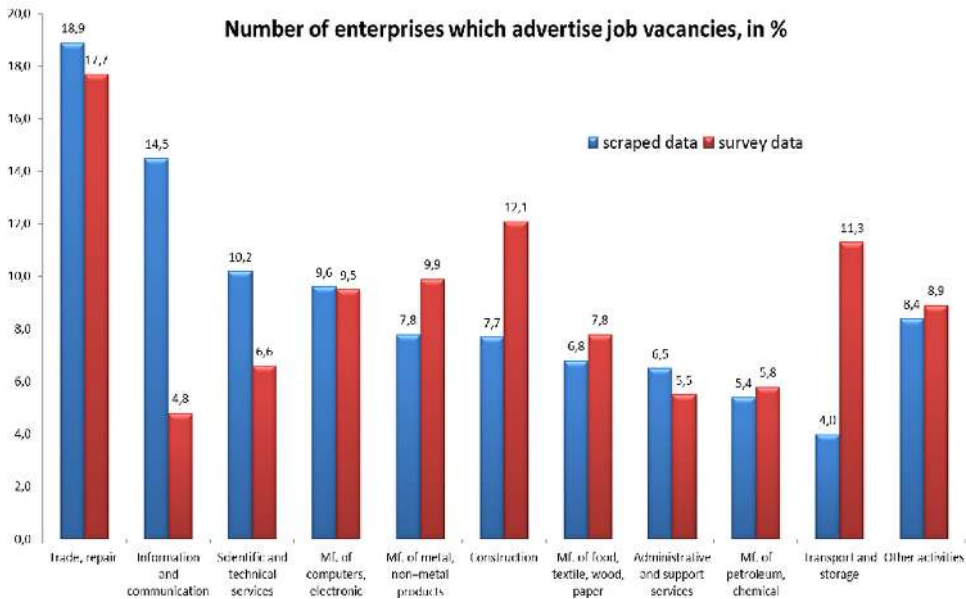
This demonstration is appealed to as “learning by doing” because talk about big data and innovating methods are, as the DG states, “insufficient”; it is by working with big data and experimenting with visual forms that are novel (for statisticians) that the potential for innovating statistics can be demonstrated. As she notes, many statisticians remain skeptical about this potential, and it is only through use cases and demonstrations that international support and recognition can be accomplished. But there is a further argument at work related to the call for a “culture change.” At stake in struggles over the innovation of methods are not simply new techniques or visualizations but how they challenge existing paradigms and conceptions of populations. Furthermore, appeals to “learning by doing” recognize another stake in the form of a competitor: the skills, expertise, and mindset of the emerging profession of data scientist, which is challenging the role of NSIs in the legitimate production of official statistics (Grommé et al. 2018). Through this demonstration, the DG visualizes what a paradigm shift looks like and who is the competitor. However, in the face of this challenge she argues that statisticians can compete in transnational struggles by acquiring the skills, expertise, and mindset required by this new method. In this regard, the strategy again is to *reassemble* not only the techniques of statistical methods but what makes up the very profession of statisticians. That is, by transferring in new skills, statisticians can become more like data scientists. At the same time, they in turn ascribe cultural capital to those skills and advance the relative position of data scientists. However, through this strategy, statisticians also assert their relative authority by validating and upholding their existing claimed skills and competencies, such as standards of data quality and privacy, and public trust and democratic accountability.<sup>25</sup> Reassembling again retains the relevance of statisticians’ existing skills and expertise while supplementing them with, and thus taming, new ones.

That the existing skills and capabilities of national statisticians are claimed to be superior is further illustrated in the next example in relation to quality, which statisticians assert as the province of their profession. Toward the end of her presentation, the DG evaluates the quality of big data through a comparison of survey and web-scraped data on job vacancies and implies that quality can be measured by the closeness of fit between the two (figure 3). In this instance, she deploys the familiar visualization of a histogram that reveals large differences between the two methods.

But the familiar visualization has further force. Demonstrating a new source of data and method against that which has already been legitimated is to secure the latter as the ontological truth. Replicating the truth is thus the test where the verdict is visualized in a pattern of differences. While there is some debate about the source of the differences, the conclusion she draws revolves around quality: web-scraped data do not meet agreed tests of statistical quality. Quality thus becomes the crux of the evaluation and source of the legitimate authority that only statisticians can provide. But rather than abandoning the paradigm shift, the DG notes that other data sources and analyses can be *complementary* to existing and official statistical sources. In other words, an innovation from the outside can be brought into the existing regime and incorporated but only insofar as its status can be rationalized in relation to the claimed superiority of existing methods. The form of innovation is again one of *resembling*, a defensive move to reinforce the validity and

<sup>25</sup> Fieldwork Notes. From the opening address of Walter Radermacher, then director general of Eurostat, at the “New Techniques and Technologies for Statistics (NTTS)” 2015 conference in Brussels, Belgium, an international biennial scientific gathering organized by Eurostat.

## Output – job vacancies pilot



**Figure 3.** Comparison of data on job vacancies scraped from web advertisements compared with survey data.

Source: Statistical Office of the Republic of Slovenia (2016).

legitimacy of existing data and methods and to bestow the profession of statisticians with the dominant role of “quality controller” in the transnational field of statistics.

In sum, reassembling emerges as a key strategy in the politics of method, a strategy which is called for and performed through both words and things. For their part, visualizations also play a key role as demonstrations and accomplish this in two ways. First, they perform new paradigms while mobilizing a strategy of reassembling that subordinates innovations to existing methods by framing them as supplementary to the skills of the statistician. Second, they perform comparisons that reinforce the validity and legitimacy of existing data and methods, thus elevating the profession of statisticians to the position of the quality controller. The former leverage the capacity of statisticians to acquire and appropriate the skills and expertise of data scientists, and the latter deploy known and recognized conventions to reinforce the status and authority of the existing dominant faction in the transnational field of statistics. In this way, the innovation strategy of reassembling suggests that the old and new can coexist, but eventually it is the old that is established as the legitimate “gold standard” in the politics of method.

### Conclusion

The near monopoly that NSIs once held over data and methods for knowing whole populations is being challenged by the proliferation of big data, digital technologies, and advanced computational analytics, especially in the private sector (see discussions, for example, in: Thrift 2005; Savage and Burrows 2007). How do these outside dimensions compete with, threaten, and get interpreted and incorporated in the transnational field of statistics? We have argued that this occurs through

material-semiotic practices that involve demonstrations through which new and existing factions engage in a politics of method. Data scientists seek to advance their position in the field through the recognition of their data and methods as legitimate and authoritative and, in turn, the cultural and symbolic capital that this will confer. For statisticians, they seek to retain their relative dominance through the strategy of reassembling, whereby new data, methods, and skills are tamed by making them supplementary and thereby subordinate to those that currently dominate the field. That data scientists are introducing innovative methods and statisticians are reassembling their methods and skills in response is evidence of how struggles are fought through practices.

Significantly, we have exemplified how methodological innovations not only enact new realities such as populations but are entwined with the making of professions and their relative power and authority within a field. In particular, visualizations promote and transport innovation strategies and serve as important tactics in struggles over influence, agendas, budgets, and different forms of capital in the transnational field of statistics. Reassembling is a strategy that is most successful as it tames the new by embracing and assimilating it, confirms and reifies existing methods as the gold standard and baseline against which to evaluate new methods, and reinforces the relative authority and position of their guardian profession. In this way, reassembling establishes the ontological and claimed epistemological superiority of established and legitimated statistical methods. The strategy also suggests that the lock-in of methods is so powerful that the possibility of radical innovations is rare given the alliances and investments in their maintenance. Contrary to claims about a “[big] data revolution” (e.g., [Cukier and Mayer-Schonberger 2013](#); [Kitchin 2014](#)), the legacies and alliances of established method assemblages have weight and force in the politics of method. What we have captured is that innovations within a field involve struggles that do not occur in one fell swoop but through iterative contestations and incremental adaptations.

We suggest that the framework we have developed and its material-semiotic understanding of a politics of method offers IR scholars a conceptual starting point for investigating innovation strategies and related struggles in other transnational fields. It provides a way to analyze how actors compete and cooperate through their practices and in relation to the imperative to innovate, such as in international development ([Nogueira 2017](#)), (in-)security ([Bigo 2006](#)), or border and migration management ([Frowd 2017](#)).

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#### **References**

- AHAS, REIN, SIIRI SILM, OLLE JÄRV, ERKI SALUVEER, AND MARGUS TIRU. 2010. “Using Mobile Positioning Data to Model Locations Meaningful to Users of Mobile Phones.” *Journal of Urban Technology* 17 (1): 3–27.

- ARADAU, CLAUDIA, AND TOBIAS BLANKE. 2017. "Politics of Prediction: Security and the Time/Space of Governmentality in the Age of Big Data." *European Journal of Social Theory* 20 (3): 373–91.
- ARTHUR, W. BRIAN. 1989. "Competing Technologies, Increasing Returns, and Lock-In by Historical Events." *The Economic Journal* 99 (394): 116–31.
- BARRY, ANDREW. 1999. "Demonstrations: Sites and Sights of Direct Action." *Economy and Society* 28 (1): 75–94.
- BIGO, DIDIER. 2006. "Globalized (In)Security: The Field and the Ban-Opticum." In *Illiberal Practices of Liberal Regimes: The (In)Security Games*, edited by Didier Bigo and Anastassia Tsoukala, 5–49. Paris: L'Harmattan.
- . 2011. "Pierre Bourdieu and International Relations: Power of Practices, Practices of Power." *International Political Sociology* 5 (3): 225–58.
- BLOOR, DAVID. 1991. *Knowledge and Social Imagery*. Chicago: University of Chicago Press.
- BOURDIEU, PIERRE. 1989. "Social Space and Symbolic Power." *Sociological Theory* 7: 14–25.
- . 1991. *Language and Symbolic Power*. Cambridge: Polity Press.
- . 1992. *Rede und Antwort*. Frankfurt am Main: Suhrkamp.
- BOURDIEU, PIERRE, AND LOIC WACQUANT. 1992. *An Invitation to Reflexive Sociology*. Cambridge: Polity Press.
- BURRI, REGULA VALÉRIE, AND JOSEPH DUMIT. 2007. "Social Studies of Scientific Imaging and Visualization." In *The Handbook of Science and Technology Studies, Third Edition*, edited by Edward J. Hackett, Olga Amsterdamska, Michael Lynch, and Judy Wajcman, 297–318. Cambridge, MA: MIT Press.
- BUTLER, JUDITH. 1993. *Bodies That Matter: On the Discursive Limits of Sex*. London: Routledge.
- CALLON, MICHEL. 1986. "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay." In *Power, Action and Belief: A New Sociology of Knowledge*, edited by John Law, 196–233. London: Routledge & Kegan Paul.
- . 2007. "What Does It Mean to Say That Economics Is Performative?" In *Do Economists Make Markets? On the Performativity of Economics*, edited by Donald MacKenzie, Lucia Siu, and Fabian Muniesa. Princeton, NJ: Princeton University Press.
- CUKIER, KENNETH NEIL, AND VIKTOR MAYER-SCHONBERGER. 2013. *Big Data: A Revolution That Will Transform How We Live, Work and Think*. London: John Murray.
- DESROSIÈRES, ALAIN. 1998. *The Politics of Large Numbers: A History of Statistical Reasoning*, edited by R. D. Whitley. Cambridge, MA: Harvard University Press.
- DRUCKER, JOHANNA. 2011. "Humanities Approaches to Graphical Display." *Digital Humanities Quarterly* 5 (1). Accessed March 26, 2019. <http://www.digitalhumanities.org/dhq/vol/5/1/000091/000091.html>.
- European Commission. 2009. "GDP and Beyond: Measuring Progress in a Changing World." Communication from the Commission to the European Parliament and the Council. August 20, 2008. <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0433:FIN:EN:PDF>.
- Eurostat. 2014. "Big Data—An Opportunity or a Threat to Official Statistics?" Presentation to the Economic Commission for Europe Conference of European Statisticians. Sixty-second plenary session. Paris.
- . 2015. "ESS Vision 2020. Building the Future of European Statistics." Brussels: Eurostat. Accessed June 15, 2017. <http://ec.europa.eu/eurostat/web/ess/about-us/ess-vision-2020>.
- FROWD, PHILIPPE. 2017. "The Promises and Pitfalls of Biometric Security Practices in Senegal." *International Political Sociology* 11 (4): 343–59.
- GROMMÉ, FRANCISCA, EVELYN RUPPERT, AND BAKI ÇAKICI. 2018. "Data Scientists: A New Faction of the Transnational Field of Statistics." In *Ethnography for a Data Saturated World*, edited by Hannah Knox and Dawn Nafus. Manchester, UK: Manchester University Press.
- HACKING, IAN. 1982. "Biopower and the Avalanche of Printed Numbers." *Humanities in Society* 5: 279–95.
- HANSEN, HANS KRAUSE. 2015. "Numerical Operations, Transparency Illusions and the Datafication of Governance." *European Journal of Social Theory* 18 (2): 203–20.
- HANSEN, HANS KRAUSE, AND TONY PORTER. 2012. "What Do Numbers Do in Transnational Governance?" *International Political Sociology* 6 (4): 409–26.
- HARAWAY, DONNA J. 1988. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14 (3): 575–99.
- HEY, TONY, AND ANNE TREFETHEN. 2003. *The Data Deluge: An e-Science Perspective*. Hoboken, NJ: Wiley.
- ISIN, ENGIN, AND EVELYN RUPPERT. 2015. *Being Digital Citizens*. London: Rowman & Littlefield International.
- KITCHIN, ROB. 2014. *The Data Revolution: Big Data, Open Data, Data Infrastructures and Their Consequences*. London: SAGE.
- . 2015. "The Opportunities, Challenges and Risks of Big Data for Official Statistics." *Statistical Journal of the IAOS* 31 (3): 471–81.



- KÜTT, KAIRIN. 2015. "Households and Families in the Register-Based Census." *Quarterly Bulletin of Statistics Estonia* 1: 148–57.
- LATOUR, BRUNO. 1990. "Drawing Things Together." In *Representation in Scientific Practice*, edited by Michael Lynch and Steve Woolgar, 19–68. Cambridge, MA: MIT Press.
- . 2000. "The Berlin Key or How to Do Words with Things." In *Matter, Materiality and Modern Culture*, edited by Paul Graves-Brown, 10–21. London: Routledge.
- LAW, JOHN. 2004. *After Method: Mess in Social Science Research*. London: Routledge.
- . 2012. "Collateral Realities." In *The Politics of Knowledge*, edited by Fernando Dominguez Rubio and Patrick Baert, 156–78. New York: Routledge.
- LAW, JOHN, EVELYN RUPPERT, AND MIKE SAVAGE. 2011. "The Double Social Life of Methods." CRESC Working Paper Series, Paper No. 95.
- LYNCH, MICHAEL, AND STEVE WOOLGAR, eds. 1990. *Representation in Scientific Practice*. Cambridge, MA: MIT Press.
- LYOTARD, JEAN-FRANCOIS. 1984. *The Postmodern Condition: A Report on Knowledge*. Manchester, UK: Manchester University Press.
- MACKENZIE, ADRIAN. 2015. "The Production of Prediction: What Does Machine Learning Want?" *European Journal of Cultural Studies* 18 (4–5): 429–45.
- MADSEN, MIKAEL RASK. 2014. "The International Judiciary as Transnational Power Elite." *International Political Sociology* 8 (3): 332–4.
- MARRES, NOORTJE. 2012. "The Redistribution of Methods: On Intervention in Digital Social Research, Broadly Conceived." *Live Methods: Sociological Review Monographs*, 139–65.
- MURMANN, JOHANN PETER, AND KOEN FRENKEN. 2006. "Toward a Systematic Framework for Research on Dominant Designs, Technological Innovations, and Industrial Change." *Research Policy* 35: 925–52.
- NOGUEIRA, JOAO. 2017. "Global Governance and the Politics of Inequality: Problematising Controversies in the Field of International Development." In *International Political Sociology: Transversal Lines*, edited by Tugba Basaran, Didier Bigo, Emmanuel-Pierre Guittet, and R. B. J. Walker. London: Routledge.
- PORTER, THEODORE M. 1986. *The Rise of Statistical Thinking, 1820–1900*. Princeton, NJ: Princeton University Press.
- . 1995. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.
- PUUR, ALLAN, LUULE SAKKEUS, AND SHIM ABEN. 2013. "Projekti Lõpparuanne. Aruande Versioon v 1.04 18.09.2013 [Methodology Study. Final Version]." Tallinn: Institute of Population Studies. University of Tallinn.
- ROCHA DE SIQUEIRA, ISABEL. 2017. "Development by Trial and Error: The Authority of Good Enough Numbers." *International Political Sociology* 11 (2): 166–84.
- RUPPERT, EVELYN, JOHN LAW, AND MIKE SAVAGE. 2013. "Reassembling Social Science Methods: The Challenge of Digital Devices." In "The Social Life of Methods." Special issue, *Theory, Culture & Society* 30 (4): 22–46.
- SALUVEER, ERIC, AND REIN AHAS. 2014. "Using Call Detail Records of Mobile Network Operators for Transportation Studies." In *Mobile Technologies for Activity-Travel Data Collection and Analysis*, edited by Harry Timmermans and Soora Rasouli. Hershey, PA: IGI-Global.
- SAVAGE, MIKE. 2010. *Identities and Social Change in Britain since 1940: The Politics of Method*. Oxford: Oxford University Press.
- SAVAGE, MIKE, AND ROGER BURROWS. 2007. "The Coming Crisis of Empirical Sociology." *Sociology* 41 (5): 885–99.
- SCHEEL, STEPHAN, BAKI CAKICI, FRANCISCA GROMMÉ, EVELYN RUPPERT, VILLE TARALA, AND FUNDA USTER-SPILDA. 2016. "Transcending Methodological Nationalism through Transversal Methods? On the Stakes and Challenges of Collaboration." ARITHMUS Working Paper No. 1. Accessed June 15, 2017, <http://bit.ly/2qR1aM>.
- SHAPIN, STEVEN. 1984. "Pump and Circumstance: Robert Boyle's Literary Technology." *Social Studies of Science* 14 (4): 481–520.
- Statistical Office of the Republic of Slovenia. 2016. "Challenges of Quality Assurance for Statistics Based on Big Data." Keynote Presentation to the European Conference on Quality in Official Statistics. Madrid, ES.
- STENGERS, ISABELLE. 2005. "Introductory Notes on an Ecology of Practices." *Cultural Studies Review* 11 (1): 183–96.
- . 2010. *Cosmopolitics*. 2 vols. Posthumanities 9–10. Minneapolis: University of Minnesota Press.
- STRUJIS, PETER, BARTELD BRAAKSMA, AND PIET J. H. DAAS. 2014. "Official Statistics and Big Data." *Big Data & Society* (April–June): 1–6.
- THRIFT, NIGEL. 2005. *Knowing Capitalism*. London: SAGE.
- TUFTE, EDWARD R. 1983. *The Visual Display of Quantitative Information*. Cheshire, CT: Graphics Press.

- UNECE. 2006. "Conference of European Statisticians Recommendations for the 2010 Censuses of Population and Housing." UNECE and Eurostat: New York and Geneva.
- . 2013. "What Does 'Big Data' Mean for Official Statistics?" In *Translated by High-level Group on the Modernization of Statistical Production and Services*. Geneva: United Nations.
- . 2016. "Interim Report of the Task Force on the Value of Official Statistics." Paris: Conference of European Statisticians. Sixty-fourth plenary session.
- VERRAN, HELEN, AND BRIT ROSS WINTHEREIK. 2016. "Innovation with Words and Visuals: A Baroque Sensibility." In *Modes of Knowing: Resources from the Baroque*, edited by John Law and Evelyn Ruppert. Manchester, UK: Mattering Press.
- VAN DER VOOREN, ALEXANDER, FLOORTJE ALKEMADE, AND MARKO P. HEKKERT. 2012. "Effective Public Resource Allocation to Escape Lock-In: The Case of Infrastructure-Dependent Vehicle Technologies." *Environmental Innovation and Societal Transitions* 2: 98–117.
- WILLIS, MARTIN. 2016. "Introduction: Imaginative Mobilities." In *Staging Science: Scientific Performance on Stage, Street and Screen*, edited by Martin Willis, 1–9. London: Palgrave MacMillan.