Attaining the Stable Movement of Knowledge Objects through the Swedish Criminal Justice System: Thinking with Infrastructure

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Abstract

This article thinks with infrastructure about the stable movement of knowledge objects such as crime scene reports, traces, and order forms through the Swedish criminal justice system. Infrastructures span different communities and borders; the criminal justice system is made up of necessarily disparate epistemic cultures. Thus, they share a central concern: Both aim for stable movement from one context to another. Thinking with infrastructure, the article argues, makes it possible to widen analytical focus and capture the structures and the continuous work that resolve the tension between different sites and thus enable the stable movement of knowledge objects. Using sensibilities from infrastructure studies– for the resolution of tensions, for continuous maintenance, and for inequalities – the article argues that the criminal justice system *enacts* the knowledge objects' stability across epistemic cultures. In other words, the stable movement of evidence-to-be through the Swedish criminal justice system is the result of infrastructur*ing*, that is, of its continuous creating of conditions that facilitate movement and create and re-create stability. This perspective may be useful for studying the movement of knowledge also in other contexts.

Keywords: epistemic cultures, infrastructure, stable movement of knowledge, knowledge objects, standards, alignment work, inequalities, forensic evidence, criminal justice

Introduction

This article brings sensibilities from infrastructure studies to analyzing the movement of knowledge objects related to forensic evidence through the Swedish criminal justice system. There, the stability of the evidence-to-be as it is moved through a collaboration of disparate epistemic cultures (Knorr Cetina, 1999; see also Kruse, 2016) is a central concern: forensic evidence is only understood as legally secure if it can be perceived as unaltered from the crime scene to the courtroom. However, the epistemic differences implicit in the collaboration of the different professions make it difficult for knowledge objects (such as expert statements or crime scene reports) to carry meanings stably. The epistemic differences between authors and recipients mean that knowledge objects are not always read in the way they were intended to. Thinking with infrastructure about the criminal

justice system's movement of knowledge objects makes it possible to see the continuous work which undergirds this movement and through which the criminal justice system enacts the stability of the knowledge objects being moved through its epistemic cultures.

In this way, this article aims for a new and deeper understanding of how the criminal justice system moves knowledge. Its framework and understanding may also be helpful in analyzing the movement of knowledge in other contexts; thus, the article in extension also aims to contribute to the development of STS theory.

Infrastructuring across epistemic cultures

This article's analytical point of departure is understanding the different professions in the Swedish criminal justice system as different epistemic cultures (Knorr Cetina, 1999) and paying attention to how epistemic differences between them make the stable movement of knowledge difficult.

Epistemic cultures produce and maintain specific understandings of what valid knowledge is and how it should be produced and understood. This also implies that knowledge produced in one context or epistemic culture is not necessarily understood in the same way in another. This makes it difficult to move knowledge stably between them. While *knowledge objects* travel, they may be understood quite differently by producers and recipients, and thus the *knowledge* they are meant to move does not remain stable. Such mutability is, of course, not necessarily problematic. Quite the opposite, mutability or flexibility – in de Laet and Mol's (2000) term, 'fluidity' – may be a prerequisite for mobility. In the criminal justice system, however, mutability *is* problematic. There, epistemic differences, while necessary in other ways, are an obstacle to the stable movement of knowledge.

In order to think about how the Swedish criminal justice system makes possible and enacts the stability of knowledge objects that travel through its different epistemic cultures, this article thinks in terms of infrastructure (e.g. Larkin, 2013; Star and Ruhleder, 1996) and infrastructuring (Karasti and Blomberg, 2018). STS-informed scholarship on infrastructures has underlined their relationality. As Star and Ruhleder put it, infrastructures resolve *"the tension between local and global"* (1996: 114; italics in original) – or, perhaps, rather the tension between different kinds of local. They famously propose asking "*when* – not *what* is an infrastructure" (Star and Ruhleder, 1996: 113; italics in original), pointing out that an infrastructure becomes one through being embedded in relationships and practices. As infrastructures facilitate the movement of things or people across distance, often spanning different communities and borders, they share the criminal justice system's central concern: Both aim for stable movement from one (local) context to another.

Infrastructure studies, then, offer sensibilities that can be fruitful for thinking about the mobility of knowledge, especially the work that the facilitation of movement requires: Infrastructures such as roads (Harvey and Knox, 2015) and canals (Carse, 2012), must be set up and maintained, which requires concerted efforts across several communities and thus necessitates relationships. Establishing a large sociotechnical system like an infrastructure means establishing a new set of relationships (Carse, 2012) between a number of human and non-human actants – for example through standards (Star, 2010). In addition, infrastructures are vulnerable to both tampering and decay (Öhman, 2016), thus requiring constant attention.

Linking infrastructures with knowledge is not a new concept. Implicitly, they figure in quite a few STS notions dealing with the movement of knowledge, for example the trading zone (Galison, 1997), the boundary object (Star and Griesemer, 1989), or the network that Actor Network Theory (ANT) describes as being co-constructed with the immutable mobiles that are moved through it (Latour, 1983: 155).

Other scholars have paid attention to the role of infrastructures in the production of knowledge – recently in a series of theme issues of *Science & Technology Studies*[1]. In the context of collaborations, scholars have also spoken of data or information infrastructures, especially when discussing the sharing of data (e.g. Borgman et al, 2013; Edwards, 2010; Edwards et al, 2007; Parmiggiani and Monteiro, 2016; Plantin et al, 2018), and often in terms of how such infrastructures

consist of more than physical structures. Monteiro et al (2013: 576), for example, have, drawing on Hanseth et al (1996), pointed out that technologies and artefacts in dispersed collaborations are embedded in and sustained by standards, norms, and practices – i.e. information infrastructures – that enable them to function as tools for collaboration. Thus, this work strongly resonates with Bowker's infrastructural inversion (Bowker et al, 2009: 99), underlining the importance of establishing and ordering relationships between different actants. One of the central points in this scholarship is that "our knowledge of nature is inextricably entangled with the infrastructure that we use to gather data about nature" (Parmiggiani and Monteiro, 2016: 32).

I will use the figure of the infrastructure to think about the structures and relationships and the work associated with them that support the (stable) movement of knowledge. Specifically, I want to bring three sensibilities from infrastructure studies to my analysis of the stable movement of knowledge objects through the criminal justice system.

The first sensibility is attention to the resolution of tension, that is, to how the relationships that are so crucial for an infrastructure's functioning are constituted and organized. As Star and Ruhleder (1996: 114) point out, infrastructures can successfully span different places and communities because they resolve the tension between them. In this resolution, standards play a central role. With Bowker and Star, standards are "a set of agreed-upon rules for the production of (textual and material) objects" that "spans more than one community of practice (or site of activity)"[2] and "persists over time" (Bowker and Star, 1999: 13). As such, standards are an organizing principle that can resolve at least some tensions between different sites, for example by establishing shared understandings; as I will discuss, they can also contribute to the stable movement of knowledge.

This sensibility enables analytically capturing and acknowledging different understandings, interests, and involvements in a shared endeavor and the bridging of such differences. In other words, it is a sensibility that can speak also to differences and tensions rooted in disparate epistemic cultures.

The second sensibility I will bring to the analysis is for the continuous – and often invisible – work that sustains the resolution of tension. Infrastructures are vulnerable and thus require continuous maintenance to remain functional. Dams for example are vulnerable in a number of ways: the intractability of large bodies of water, dangers like earthquakes and flooding, and the peril of sabotage all make them susceptible in different ways (Öhman, 2016). Thus, they are in constant need of supervision and stabilization; the tension between different kinds of local is not resolved once and for all but must be resolved continuously.

Similarly, I will maintain here, do the relations and standards that resolve tension between epistemic cultures require continuous work to remain functional. In addition, not only do standards need maintenance; standards also cannot be built to be applicable to every possible case and thus have limitations. As Star famously points out, "there are always misfits between *standardized* or *conventional* technological systems and the needs of individuals" (Star, 1990: 36; italics in original).

These inevitable misfits mean that the tensions between different kinds of local are not and cannot always be completely resolved through standards alone. Resolving them requires additional work. This does not necessarily need to be copious or conspicuous work; Star (1990: 36ff) for example discusses how scraping onions off one's hamburger in a fast food restaurant addresses the misfit of standards with individual needs – in her case, an allergy to onions. Fast food, she explains (Star, 1990: 36ff), is prepared according to standards that make it possible for the restaurant to serve guests quickly and for the chain's guests all over the world to know beforehand what their order will get them. But for someone who is allergic to onions – a standard ingredient in hamburgers – obtaining a hamburger without onions can be time-consuming and thus the opposite of fast food. Ordering a standard meal and scraping off the onions, then, is a comparably simple resolution of the clash – but it does involve work.

Such work, I argue, supports the standards, resolving the tension the standards alone

cannot resolve – and at the same time keeping the standards functional. In other words, like physical infrastructures require maintenance, so do standards require work to ensure that they can continue to resolve the tension between sites.

In paying attention to this kind of work, I will take inspiration from Strauss's 'articulation work' (Strauss et al., 1985: chapter 7; Star, 1991: 275) that highlights the often invisible or unnoticed work that makes the work perceived as the "real" work possible. An example are nurses preparing patients for examination by a doctor (Strauss et al, 1985: 156). I will combine his notion with Vertesi's work on producing "moments of alignment" (Vertesi, 2014: 268). She draws attention to the "seams" between infrastructures with different standards and "how actors skillfully produce moments of alignment between and across systems" (Vertesi, 2014: 268) to "produce a shared experience of seamlessness" (Vertesi, 2014: 277) in environments that rely on multiple, overlapping infrastructures. That is, she argues that seamlessness is a fleeting state that must be repeatedly produced.

Her "seams" are comparable to Star's misfits (Star, 1990: 36); in both, the resolution of tension causes new tensions and in both, this new tension must be dealt with for the "real" activity to be able to continue. Like articulation work, this is work that, I will show, is not always noticed or acknowledged as part of the primary work. I will call such work of supporting standards *alignment work*, since this work (temporarily) aligns different epistemic cultures, creating an experience of seamlessness between different sites in the criminal justice system.

With a sensibility for this work, I want to draw attention to the continuous work that is performed around interprofessional standards in the criminal justice system, supporting and complementing them. In other words, this is an analytic sensitivity to the constant and sometimes unnoticed work that nevertheless is essential for maintaining the resolution of tension between epistemic cultures and thus for the movement of knowledge between them.

Connected to these two sensibilities is a third one, one for power and power relationships. Infrastructure studies discuss how the relationships manifested in and through infrastructures need not be symmetric or equal – indeed, infrastructures can materialize existing inequalities (e.g. Hoag and Öhman, 2008; see also Larkin, 2013); in addition, infrastructures have often been a part of domination in colonial processes (e.g. Bear, 1994; Chikowero 2007; Öhman, 2016; von Schnitzler, 2018).

Infrastructures are intertwined with power and inequalities in other ways, as well: who has the power to draw together the resources and relationships required (Harvey and Knox, 2015), to whose benefit and at whose cost infrastructures are established (Öhman, 2016; Carse, 2012; see also Edwards et al, 2007), who is given access (Anand, 2012; Appel, 2012), and who does the maintenance work and to whom this work is (in)visible. Infrastructure studies have also drawn attention to how the "same" structure can do radically different things for and be understood radically differently by different people that (have to) engage with it (e.g. Harvey and Knox, 2015; Öhman, 2016).

Öhman discusses such inequalities on an existential level, showing how reservoirs can be a very useful part of the national electricity infrastructure at the same time as their weak ice covers in winter pose a lethal danger to the local (and indigenous) people (Öhman, 2016: 67ff). This resonates – albeit on a much larger scale – with Star's discussion of the "misfits" (Star, 1990: 36) between standardized systems and individuals: the same standards that are meant to make people's lives easier and more efficient make life considerably more complicated and difficult for those considered non-standard. In other words, standards exclude at the same time as they expedite, and whom they exclude (and benefit) is a political question.

As knowledge and power are intertwined (e.g. Foucault, 1977) – not least when it comes to what is accepted as valid knowledge (e.g. Harding, 1998; Shapin and Shaffer, 1985; Verran, 2001) – paying attention to inequalities associated with its movement seems only prudent. However, I certainly do not mean to say that there are inequalities of a level comparable to those discussed in connection with physical infrastructures between the different professions of the Swedish criminal justice system – to do so would be to trivialize suffering. What I want to do, instead, is to use this sensitivity for power to trace

how different professions engage with the resolution of tension between different sites.

Star's work is particularly helpful here: Maintaining standards despite inevitable misfits, she explains, "often involves the private suffering of those who are not standard" (Star, 1990: 43). With this, she draws attention to not only the marginalization implicit in standardization but also to the mainly invisible work that the engagement with standards requires of some people in case of misfits, for example the rather mundane scraping of onions off hamburgers or other ways of closely monitoring one's food when eating out. Similarly, co-operations that depend on standards often rest on the invisible work of only some people and not others (Star, 1990: 36-44).

Which work is visible and which is (made) invisible is also a question of power relationships. Invisible work, for example the articulation work discussed by Strauss et al (1985: 151ff), is typically performed by occupational groups lower down in the hierarchy, whereas visible work is typically performed by higher-status professions. In medicine, for example, coordination of work or giving patients emotional support (Bowker and Star, 1999: 229ff), both largely invisible yet essential for health care, are performed by nurses, whereas the visible work is performed by doctors. In other words, the issue of (in)visibility and, consequently, recognition is intertwined with status and power.

Thus, the sensibility for power and power relationships can draw attention to invisible versus visible (alignment) work and control over one's work. This is a sensibility that, I will argue, draws attention to inequalities embedded into the stable movement of knowledge across even relatively equal epistemic cultures.

These three sensibilities are of course not the only possible ones to take away from infrastructure studies. I have chosen to focus on them because they offer a way of thinking about facilitating movement across contexts – ideally, without losses or changes – and about work that is performed away from but still essential for this movement. This, I will show, is helpful in analyzing how stability is enacted in the movement of knowledge across the epistemic cultures of the criminal justice system.

Methods

My empirical material comes from two different but related ethnographic studies in the Swedish criminal justice system. Between 2008 and 2012, I have studied how the criminal justice system's different professions collaboratively produce and use forensic evidence (see Kruse, 2016), conducting ethnographic fieldwork at a public prosecution's office, a criminal investigation division, a crime scene division, and three units of the NFC (the National Forensics Centre, Sweden's state-run and only forensic laboratory; then called the Swedish National Laboratory of Forensic Science). I also observed a number of trials in district court and conducted formal interviews with forensic scientists, prosecutors, district court judges, defense lawyers, and a crime scene technician.

In my analysis, I took inspiration from Grounded Theory (Glaser and Strauss 1967), looking for patterns as well as for contradictions. My analytic focus was on understanding what was important to practitioners in the different parts of the criminal justice system and how their perspectives related to each other and their collaboration. This made it possible to trace the production of forensic evidence through the criminal justice system as a whole, from the crime scene to the verdict, and how the different professions with their different competences contribute in different ways to this production (Kruse, 2016). It also brought out the occasional frictions between professions in the collaboration – and made these frictions understandable.

The question that stayed with me was how the criminal justice system organizes for and makes possible this collaboration. Thus, the second study focused on crime scene technician training at the NFC, a site where two of the criminal justice system's professions – forensic scientists and crime scene technicians – meet for an extended period of time. The training prepares the crime scene technicians not only for examining crime scenes but also – and as importantly – for mediating between the police and prosecution on the one hand and the forensic science laboratory on the other: They will commission analyses from the laboratory (on the investigation leader's orders) and participate in formal meetings and informal

conversations with police investigators, prosecutors, and forensic scientists (in varying constellations) to help align different requirements and understandings into a working cooperation. In other words, the training, a course spread out over a year and alternated with the students' regular work, is one way of setting up and supporting cooperation across professions.[3]

My fieldwork there took place with the class of 2013, consisting of ten men and ten women. With few exceptions, I observed all of the lectures, exercises, and crime scene examinations, listened to and participated in discussions over coffee and lunch, and conducted informal interviews with both teachers and students.

In the analysis of this material, I have, again, looked for both patterns and contradictions. Elsewhere, I have written about the crime scene technicians' professionalization and role in the criminal justice system (Kruse, 2020a) and their professional socialization. For this article, I have analyzed the material with a focus on how the students were prepared for their mediating role and how different understandings and perspectives were (or were not) addressed and negotiated. I chose this focus in an attempt to understand the collaboration of different professions in the criminal justice system in spite of different understandings and perspectives.

Epistemic cultures in the Swedish criminal justice system

The different professions or epistemic cultures (Knorr Cetina, 1999) in the Swedish criminal justice system share a rhetoric of willing cooperation as well as the goal of solving crimes in a legally secure manner – i.e. of working towards that the right person is convicted for the right crime – but they contribute to that cooperation and goal in different ways and at different times. Crime scene technicians examine the crime scene; forensic scientists perform laboratory analyses on the traces the crime scene technicians have recovered; police investigators set the analysis results into a wider context through for example interviewing, suspects, and witnesses; prosecutors assemble the whole of the evidence into a court case; and judges and lay assessors evaluate the whole of the evidence put before them (see also Kruse, 2016).

They also have very different backgrounds and competences: Crime scene technicians with their police backgrounds and specialization in forensics have broad knowledge and skills in forensic technologies as applied to crime scenes. Their competence is in finding and recovering a wide range of traces and analyzing crime scenes; their concerns are about contributing to investigations as a whole and about protecting society. Forensic scientists with their science backgrounds are specialized in one or a few forensic laboratory analyses. Their competence is in analyzing single traces and evaluating the result; their main concern is the correctness of their expert statements. Police investigators with their policing backgrounds work predominantly with people, not crime scenes or traces. Their competence is in assembling evidence, especially through interrogation, thus providing a context to the forensic evidence; as they meet the people involved in investigations, their concern is with them as well as with society as a whole. Prosecutors are specialized in the law; their competence is in bringing together the specifics of a case with legal rules and requirements. Their concerns are about assessing and assembling all of the evidence into a convincing whole. Finally, judges are, like prosecutors, specialized in the law, but their competence is in assessing the evidence as a whole, and their concerns revolve around legal security (Kruse, 2016).

These epistemic differences are highlighted by occasional frictions. For example, crime scene technicians (and police investigators or prosecutors in their capacity as investigation leaders) may want traces analyzed at the NFC that forensic scientists deem unnecessary. Conversely, forensic scientists sometimes express dissatisfaction with the quality of the material they have been sent, when in at least some of these cases, the crime scene technician in question probably has done the best they could under the circumstances. In addition, where forensic scientists speak about traces and their analysis in terms of assessing hypotheses, police investigators and crime scene technicians also talk about the value of laboratory analysis turning up the unexpected – e.g. a cold hit – that may not be of immediate use but can lead to useful evidence or information (e.g. through

interrogating someone who may not otherwise have drawn the police's attention). That is, while both the forensic scientists' and the crime scene technicians' expertise is in forensics in a wider sense, not only is the forensic scientists' expertise deeply specialized whereas the crime scene technicians' is general, the different professions also have different experience – of the ordered laboratory versus the disorderly crime scene – and different roots. These differences manifest for example in different views on both crime scenes (see also Kruse, 2020a, 2020b) and specific traces and may lead to frictions.

Furthermore, prosecutors and police investigators are much more interested in how a laboratory result fits into the whole of a case than they are in the intricacies of the probabilistic reasoning with which the forensic scientists evaluate it – nor do they have the training that makes these intricacies easily accessible to them. Thus, there is sometimes friction between forensic scientists and prosecutors about what a piece of evidence means (Kruse, 2013).

Even though such frictions were not a regular part of everyday work, they were still common enough that everyone had stories of them. Thus, they may not paint a representative picture of the Swedish criminal justice system's cooperation, but they do illuminate the complexity of the collaboration of disparate epistemic cultures: their different contributions to the production of forensic evidence are all essential, but their epistemic differences also make for mis- and differing understandings. In other words, it is both necessary and difficult to move knowledge between the criminal justice system's different professions.

Knowledge objects

The criminal justice system's collaborative production of forensic evidence takes a form that could be likened to a relay – while all of its epistemic cultures contribute to the collaboration, they do so successively, not simultaneously. The 'batons' in this relay, then, are the knowledge objects that are moved from epistemic culture to epistemic culture and are expected to transport the evidence-to-be from the crime scene, through the forensic laboratory and the criminal investigation division to the prosecution and finally the court.

These knowledge objects are, for example, forensic expert statements,[4] crime scene reports, traces, and order forms. To my interlocutors, it was of utmost concern that recipients and producers understand them in exactly the same way – in other words, that the knowledge objects remain stable.

Consider the reports Swedish crime scene technicians write after their examination to convey their results to police investigators, prosecutors, defense lawyers, and judges. These reports contain a description of the crime scene, the traces the technicians have found and recovered, and, ideally, the results of the analyses the NFC has performed on the traces. The reports conclude with the technician's assessment of the crime scene as a whole, explaining the technician's conclusions (and on which traces and analyses these conclusions are based) to the reader.

When forensic scientists teach the writing of these reports, they emphasize the importance of readers' understanding why the crime scene technician made the assessment they made and how strong the conclusions are. Their concern is twofold: The first one is the reports' durability. If the technicians convey exactly what their conclusions are based on and how they arrived at them, new information – sometimes brought to the investigation long after the crime scene examination – will not render the report obsolete. Even if the conclusions should be refuted, the descriptions and explanations in the report will make it possible to reassess the technicians' findings in the light of the new information. Thus, the report will remain useful even if the case should turn into a cold case.

The second concern is with legal security. Misunderstanding the reports – including over- or underestimating the strength of the conclusions – may affect the outcome of the investigation and subsequently the verdict.

Accordingly, standardized expressions of "value", based on Bayesian reasoning, are meant to harmonize the writing and the reading of the text. The NFC has developed and teaches the technicians to use a scale of "value," that is, of how strong they consider their conclusions.[5] The expressions range from the results of the crime scene examination "showing" that something has happened

– the strongest expression – to giving "strong support", giving "support" and speaking "neither for nor against." The results can also show or give support to something not having happened. For example, a complete lack of pertinent traces at the scene of an alleged burglary might be concluded to give support or perhaps even strong support that the burglary did not happen.

The rationale behind such uniform expressions is to make it easier for readers – mainly conceptualized as prosecutors[6] – to understand the reports. Instead of technicians making up their individual systems of expressing their conclusions and readers having to figure out how strong the technician intended the conclusions to be, there is only one standardized set of expressions that always means the same. This reasoning resonates with the laboratory's own evaluation and communication practices; the NFC expresses the strength of their laboratory results on a graded numerical scale paired with similar expressions (cf. Nordgaard et al., 2012; Kruse, 2013). In other words, the knowledge object is templated in a way that is meant to transport meanings intact.

Another type of knowledge object in the criminal justice system are the traces that crime scene technicians recover from crime scenes, even though they might not appear as self-evident knowledge objects. Since they are tangible objects – for instance fingerprints captured with powder and tape, hairs in envelopes, glass fragments in plastic jars – their movement from the crime scene to the laboratory may seem like merely a practical matter.

However, as soon as a trace is being abstracted from the crime scene (cf. Latour, 1999: 48 ff; see also Kruse, 2016: chapter 5), it is the product of the technicians' work and understandings and thus decidedly material-semiotic (cf. M'charek, 2016: 16). And although traces are not documents (but they certainly are part of a bureaucracy) and are not expected to be as easily read by a wide range of recipients as a document, they still are expected to carry decipherable meaning from the crime scene to the laboratory, albeit decipherable only through (successful) analysis.

This decipherability depends on how the trace is recovered. For example, as crime scene technicians learn during training, bodily fluids decompose under certain conditions, which hampers DNA profiling; thus, they are taught to mop up such fluids with forensic cotton swabs and then seal the swabs into special paper bags. Fibre analysis requires care to avoid cross-contamination or loose fibres falling off and being lost; accordingly, crime scene technicians are taught how to turn a garment and brown paper into a "Swiss roll" that keeps the disturbance of fibres to a minimum, how to examine clothes from different persons in different rooms and by different technicians, and how not to cross-contaminate these rooms.

These methods aim to stabilize the traces across contexts and over time. Their application, albeit not always as straightforward as it seems in the classroom (see Kruse, 2020a: 72ff), is what makes the traces' movement from one epistemic culture to another seem "merely" a practical matter. In other words, even though traces are not written documents, they – and their decipherability – are still shaped by their "authors."

The last knowledge object I will discuss here are the electronic order forms that accompany each trace to the forensic laboratory. Like the crime scene reports, these forms are documents, but their projected lifespan is much shorter. Besides specifying which analyses (from a catalog) the trace is to be submitted to and giving contact information, order forms are meant to convey relevant parts of the larger investigation's context to the laboratory.

The latter has to do with the laboratory's evaluation practices: After the forensic scientists have established a match between a trace from a crime scene and a comparison sample, they evaluate how "strong" the conclusions are that can be drawn from it. To do that, they might, depending on the type of analysis, need quite a bit of information; a fibre analyst, for example, may need to know under which circumstances and when (in relation to the presumed crime) the clothes she is analyzing have been seized. In other evaluations, the forensic scientist may not need to know details.

When filling out the order forms, the crime scene technicians are to convey what they consider the relevant parts of the investigation to the forensic scientists: They convert the question

the investigation leader wants the trace to answer – for example whose fingerprint they found – into an analysis code from a catalog, and they organize and convey information from the investigation in a way that is relevant for the forensic scientists and their analysis (see also Kruse, 2020a: 72ff). In other words, these order forms contribute to making the traces decipherable in a way relevant to the investigation.

All of these knowledge objects are created in order to move decipherable evidence-to-be between the criminal justice system's epistemic cultures. My interlocutors talked about their concerns in realtion to this movement in terms of traces deteriorating or getting damaged, of vital information getting lost, and of readers misunderstanding – all of which, they explained, would affect legal security. From an STS perspective, my interlocutors' foremost concern thus is the *stability* or, to speak with Morgan, the *integrity* (Morgan, 2011: 12) of the knowledge they are moving. That is, they want the knowledge objects to travel as a "stable configuration" (Law and Mol, 2001: 611) that is understood in exactly the same way everywhere in the criminal justice system.

But it seems that such stability is elusive, and not only because of epistemic differences. Due to the relay character of the collaboration, my interlocutors also often did not know how their knowledge objects were received. Reception takes place in the producers' absence, and it is unusual for members of the criminal justice system to be able to track what happens to a case to which they have contributed. The frictions that sometimes occur around knowledge objects in the criminal justice system when producers and recipients do meet – for example in meetings, phone calls, informal conversations, or when witnessing in court, all of which are typically rooted in recipients' questions (cf. Kruse, 2016: 112ff) – contribute further to their uncertainty; they made them wonder how other knowledge objects were received. Forensic scientists repeatedly talked about wondering how often prosecutors close cases instead of taking them to court because they mistakenly think that the evidence is too weak. In other words, in the cases in which the producers of knowledge objects are not involved in the objects' further career – which is the majority – it can be very difficult to know for practitioners whether they have achieved stability or whether they only (and perhaps mistakenly) believe so.

Analytically, the stability of knowledge is equally elusive. How can one tell whether a knowledge object has traveled stably? And how stable is stable enough?

What is also difficult to capture analytically is how such elusive stability can be achieved. My interlocutors appeared to focus on the knowledge objects themselves, spending time and care on both designing templates and crafting individual knowledge objects. I argue, however, that these knowledge objects (and their templates), as important as they are, do not tell the whole story of how knowledge is moved stably. I will draw attention to the work that undergirds the movement of knowledge through the criminal justice system and that, like physical infrastructures, forms the substrate for this movement. The sensibilities from infrastructure studies will make it possible to trace and analyze how the stability of knowledge objects is enacted in the criminal justice system.

Resolving tensions: Interprofessional standards

A sensibility for standards and how they resolve tension between different sites makes it possible to think about how epistemic differences in the criminal justice system are bridged. Practices such as the templating of crime scene reports and the teaching of how to recover different traces can, with this sensibility, be seen as interprofessional standards that (aim to) resolve epistemic tensions and to facilitate the movement of knowledge objects.

Consider the traces – fingerprints, hairs, glass fragments, etc – that crime scene technicians recover at the crime scene and send to the laboratory: These traces must be recovered, packaged, and transported in a way that makes successful laboratory analysis possible; in other words, the crime scene must be harmonized with the laboratory. When crime scene technicians are taught how to recover traces so that the subsequent analyses do not suffer or become impossible,

the teachers in effect disseminate standards that are meant to resolve the tension between the laboratory and the crime scene. These interprofessional standards are exactly what *makes* their movement, and their stable movement at that, a merely practical matter. That is, just like plumbing standards are not at the forefront of thought for someone opening a faucet, interprofessional standards that are firmly in place may become virtually invisible.

The importance of interprofessional standards for resolving epistemic tensions becomes easier to see where they are not fully in place, as for example the expressions of value to be used in the crime scene reports. While the crime scene technicians seemed to welcome the standardization as a way of establishing shared practices within their profession, the prosecutor invited to give a guest lecture as part of the crime scene technician training was hesitant when students asked about these expressions. They might be understood quite differently by different people, she said, so it was chancy to rely on them alone. What was important, however, she went on, was that the crime scene technicians explained their process of thought.

Her concern that the expressions of value could be understood differently by different readers suggests that she did not perceive them to be as easily readable as they were intended. Of course, one prosecutor is not representative, but as this was a prosecutor who had been specifically invited to the course to talk about crime scene reports, her hesitation might still be indicative. It also ties into the hesitation I had heard in my earlier study from both prosecutors, judges, and defense lawyers about the NFC's scale (which then had been in place only a comparatively short time). Then, there was sometimes quite some uncertainty about what a particular grade meant or how many grades there were (see also Kruse, 2013).

Such hesitation and uncertainty indicate that, to function as an interprofessional standard, the scale and the expressions of value would have to be established across the criminal justice system's epistemic cultures as holding fixed and shared meaning. If they are not, the crime scene technicians' crime scene reports may not always travel stably – or "with integrity" (Morgan, 2011: 12) – to their recipients.

In other words, applying a sensibility for standards and how they can resolve tensions between sites to the movement of knowledge objects through the criminal justice system makes it possible to see the necessity of establishing shared understandings across epistemic cultures for the stable movement of knowledge objects: Without them, knowledge objects cannot travel stably or with integrity through the criminal justice system; like a boundary object (Star and Griesemer, 1989), their intended and received meanings might differ quite considerably. However, interprofessional standards alone do not guarantee the stability of the knowledge objects in the criminal justice system, nor do they make stability less elusive – if standards are not well-established or standardized expressions are misunderstood, this may pass unnoticed.

In addition, as the next section will discuss more closely, standards always and inevitably have limitations. Thus, in order for the tension between epistemic cultures to be resolved, standards must be supported and complemented.

Alignment work

With a sensibility for the – often invisible – work that is necessary to keep the undergirdings of movement in working order, I want to draw attention to the alignment work that supports and complements interprofessional standards and, at least temporarily, resolves the tension between sites or epistemic cultures in the criminal justice system. It aligns, for example, standards and specific circumstances or different understandings with each other.

The interprofessional standards involved in moving traces from the crime scene to the laboratory, for example, cannot be applied as effortlessly in every situation as it may seem at first glance or in the NFC's classroom. The stories students told each other about particular crime scenes they had encountered were an illustration that there are misfits (cf. Star, 1990: 36) between (general) standards and (individual) crime scenes and that quite some work may be required to stabilize both knowledge objects and standards in the face of these misfits.

One such story vividly described examining the site of a suspected rape on a beach, where a dog brought in to sniff out semen had duly marked a spot in the sand. Of course, the technicians were well aware of how to handle presumptive body fluids: by mopping them up with forensic swabs, sealing these into their sterile paper bags, and posting them to the NFC. However, the spot the dog had marked was several square meters large – certainly too large to swab – and nothing could entice the animal to be more precise. So, the technicians obtained pizza boxes from a local restaurant, carefully scooped up the sand in question with them, stacked them in the back seat of a car, and drove them across the country to the NFC.

This was evidently a highly entertaining story; when it was told in a corridor during a break, it was met with laughter and questions for details. The entertainment was neither at the expense of the technicians in the case, nor did it seem to be meant as more than mild criticism towards the (absent) teachers. It was easy, the students agreed, to say what one should *not* do – they were quite aware that pizza boxes were not an approach endorsed by the NFC. But what *should* one do, then? Swabbing several square meters of sand clearly would not have worked, nor is a portion of beach a movable object that can be put in the post, which is an option with objects suspected to carry relevant traces. That is, the students neither disputed the general validity of the standards they were being taught nor their necessity, but wrestled with their applicability.[7]

The story – reminiscent of the stories with which photocopier technicians share experiences and reflect about their work (Orr, 1996) – did not report the results of the laboratory analysis, and no one asked about them. Instead, the story and the subsequent discussion highlighted how the crime scene technicians, through inventiveness, professional skill, and dedication managed to save a possibility of forensic evidence: They did so by reconciling the interprofessional standards that make the traces' movements possible with the particular circumstances of a crime scene. In the story, circumstances were unusual and difficult, which made the technicians' work unusual and thus visible, but the principle applies to every crime scene – their work at the crime scene supports the interprofessional standards' resolving or at least decreasing the tension between the crime scene and the laboratory.

Their alignment work is also part of maintaining these standards and keeping them functional. By aligning the standards with each crime scene's particular circumstances, they minimize how much the misfits between standards and individual crime scenes affect the resolution of tension between crime scene and laboratory. Thus, their alignment work prevents the standards from failing to resolve tension and thus from becoming obsolete and perhaps discontinued.

Alignment work does not always maintain and support such standards in the criminal justice system, it may also complement them, for example technicians' witnessing in court. In her lecture on proceedings in court, a lawyer invited to the crime scene technicians' training talked at length about the importance of testimony complementing the written crime scene report. "Reading alone isn't always going to do it," she said, so even a well-written report – one that, in her words, "leads" the reader and "explains" what the crime scene technician has seen and done at the crime scene and concluded afterward and on which premises – might not be sufficient in itself.

If the technicians were summoned to court, she stressed, "that isn't because the report isn't good enough, but because the case is so complicated that the prosecutor thinks it's valuable that you come and explain [your work] and answer questions." She explained, "I don't see the connections you see;" in other words, as her competence was in the law, not in forensic or crime scene work, she did not expect to understand every crime scene report and its implications in exactly the same way as a crime scene technician would. What would be self-evident to a technician could be difficult or even obscure to her. Thus, she felt she – and by implicit association also other lawyers, prosecutors, and the courts – occasionally needed additional explanation and guidance. I have encountered similar reasoning in other voices from the criminal justice system, for example a judge who appreciated forensic scientists' testifying in court in addition to their expert statements, as "it [the evidence] would probably

have been harder to understand from just the written material."

In other words, stability in the form of more homogeneous understandings can be achieved by placing reports and stements in the company of their authors and their "explanations." The crime scene technicians' expert testimony thus constitutes a different kind of alignment work, one that keeps the crime scene reports stable by aligning how they are understood in court with their intended meanings. One could say that summoning crime scene technicians to court compensates for the insufficiency of the interprofessional standards that are meant to harmonize the writing and the reading of the reports. One could also say, however, that their expert testimony is a different way of resolving tensions between the crime scene and the court and of facilitating the reports' stable movement. With both perspectives, however, the reports' stability is achieved not (only) through the object itself, but (also) through work being done repeatedly and in an institutionalized way – namely through the well-established institution of summoning members of the criminal justice system to court as expert witnesses. This kind of alignment work also makes it possible for practitioners to capture the otherwise so elusive stability – the back and forth of questions and answers in court gives both authors and recipients a feeling for whether their understandings are in alignment.

Thinking about alignment work, I argue, also necessitates thinking about by whom and under which circumstances this work is performed – in other words, to bring a sensibility for power and inequalities to the infrastructuring that undergirds the movement of knowledge.

Inequalities

A sensibility for power makes it possible to think about the visibility and invisibility of alignment work in the criminal justice system as well as about practitioners' possibilities to shape their work and the larger collaboration.

The crime scene technicians' alignment work at the crime scene, for example, is quite invisible in the criminal justice system as a whole. Even though its sometimes less than perfect results may be very visible – it is reasonable to assume that the forensic scientist receiving the pizza boxes noticed that they were not forensic swabs in paper bags[8] – both the performance of and the necessity for alignment work are absent from official descriptions of crime scene technicians' work, as well as from the classroom sessions discussing and disseminating interprofessional standards (see also Kruse, 2020a). The technicians' stories about "difficult cases," as they called them, such as the beach case, were told predominantly outside of the classroom, that is, during breaks or transitions between classes.

In other words, like other invisible work – coordinating medical work (Strauss et al., 1985: 151ff) or giving patients emotional support (Bowker and Star, 1999: 229ff) – the work of aligning standards with crime scenes and vice versa is made invisible through not being marked as officially part of the production of forensic evidence. Unlike some other invisible work in other contexts – for example the monitoring required when people with uncommon allergies engage with standardized gastronomy (Star, 1990: 35) – this alignment work did not necessarily always seem to be only a burden to the crime scene technicians, however. Judging from how the story about the beach case and other, similar ones were told and received, the crime scene technicians performed alignment work willingly, with the common goal in sight, and took pride in their dedication and inventiveness. That is, the usefulness and durability of the standards may not come at the price of private suffering (cf Star, 1990: 43), but at the price of the crime scene technicians' skill, inventiveness, and dedication being unseen and unacknowledged outside of their own profession.

When it comes to control over one's (alignment) work, an example may be the electronic order form that crime scene technicians fill out when they send traces to the NFC. This form, designed by the NFC, is, of course, a kind of infrastructure in itself, resolving tension between the investigation and the laboratory by linking a trace with information such as which analysis is being ordered, who is ordering it, whether the case is prioritized (for example because there is a suspect in custody or the case involves minors), and relevant information about the case. As such, it is meant to facili-

tate the traces' smooth and stable movement to the laboratory and subsequently the analysis results' movement to the investigation.

However, the cost for at least a part of this resolution – albeit not a financial or material cost – remains, perhaps unwittingly, with one profession: While including case information appears an unproblematic part of laboratory procedure to the NFC, to the crime scene technicians, providing such information poses a problem. They see the investigation's integrity jeopardized: Both to prevent false confessions and to preserve the evidentiary value of a true revelation, it is crucial to know whether an interviewee talks about a detail because they have been involved in or witnessed the crime or because they have heard or read about it. The fewer people who know details of a case, the easier it is to keep track of who knows what. Thus, crime scene technicians – many of whom have been investigators earlier in their careers – may have been ordered to silence or be reluctant to give details even to forensic scientists. In the words of a crime scene technician student who commented the teachers' instructions for the forms, it was one thing to give details to a medical examiner she knew, but it was a different thing entirely to give these details to "someone at the [NFC] whom I've never even seen and who I don't know who they're married to."

That is, she apparently felt that she and her peers were being asked to trust strangers with classified information – something she was not comfortable with. In addition, the order form may, in accordance with the Swedish principle of public access to official records, eventually become a public document, which may make crime scene technicians even more reluctant to provide information there. This, in turn, affects the stability of the knowledge objects – the traces – being moved.

Refusal to provide information, however, may lead to friction between crime scene technicians and forensic scientists. The NFC's position as the forensic authority in the country, together with the forensic scientists' academic backgrounds as opposed to the police's and thus the crime scene technicians' blue-collar profession, may be a factor in how practitioners experience this friction.

That is, even though there are no tangible sanctions, crime scene technicians may feel that their refusal may lead to their being perceived as troublesome and uncooperative in a collaboration whose willingness is otherwise emphasized. In addition, they may also feel frustrated that their concerns about the quality of the evidence being produced are not being heeded – in other words, they may feel that control over the collaboration is distributed unequally.

Conclusion: Enacting stability

In this article, I have examined the movement of knowledge objects through the Swedish criminal justice system through the lens of infrastructure and infrastructuring. In particular, I have brought to this movement three sensibilities from infrastructure studies – for standards' resolution of tensions, for maintenance, and for inequalities.

This has made it possible to widen analytic focus from the knowledge objects themselves to structures and practices that undergird their movement. Through these structures and their associated practices, I argue, the criminal justice system *enacts* the knowledge objects' stability across epistemic cultures. In other words, the stable movement of evidence-to-be through the Swedish criminal justice system is the result of infrastructur*ing* (Karasti and Blomberg, 2018), of its continuous creating conditions that facilitate movement and create and re-create stability. Not only must standards be developed, they must also be disseminated to the relevant professions – professions who constantly lose and acquire members – and, perhaps most importantly, supported and complemented by alignment work.

Paradoxically, this continuously enacted stability has quite a lot in common with the fluidity de Laet and Mol (2000) underline as the characteristic that makes a particular bush pump mobile. Both the bush pump's mobility and knowledge objects in the criminal justice system are dependent on the involvement of different actors. The bush pump can only work in different places with their different conditions if there is a community around it that sets it up and maintains it, that is, adapts it to these different places and conditions. Likewise, the criminal justice system's

knowledge object's mobility often depends on alignment work that aligns different epistemic cultures.

Looking at the movement of knowledge in the criminal justice system through the lens of infrastructuring thus makes it possible to think about stability as not a quality (of for example a knowledge object) but as a rather fleeting state that requires the work of a community and can only be temporarily attained. That is, the stability that may, for example, be achieved when crime scene technicians, in the words of the lawyer, "explain" their crime scene work in court is part of the court interaction, not only of the crime scene report that is being explained. In other words, knowledge objects can be stabilized as long as there is infrastructuring – for example in the form of functioning standards or of alignment work – to resolve the tension between epistemic cultures. With this perspective, it is not surprising that stability is so elusive – it is momentary and fragile.

The infrastructuring that undergirds the stable movement of knowledge in the criminal justice system is not always visible or noticed. Some alignment work, for example, is very visible – such as acting as an expert witness in court – whereas other alignment work may only be visible within the profession performing it, e.g. a large part of the alignment work performed at the crime scene. Nor is the work of infrastructuring or control over it always distributed equally. Compared to other inequalities, for example those discussed in infrastructure studies (e.g. Öhman, 2016; Anand, 2012; Appel, 2012), these certainly are not grave – yet they affect the mobility of knowledge objects. If interprofessional standards clash with unseen or unheeded local needs – such as the investigation's need for information control – they add instead of resolve tension. Unnoticed or unacknowledged alignment work also means that practitioners may not receive relevant training (see also Kruse, 2020a), which, in turn, may affect the collaboration. Thus, a sensibility for power can be fruitful for thinking about the stable movement of knowledge even through the criminal justice system; in sites less characterized by common goals, this sensibility might be of even more importance.

Thinking with infrastructure and (some of the) sensibilities from infrastructure studies about the movement of knowledge objects through the Swedish criminal justice system has thus made it possible to think differently about how stability – however fleeting – can be attained when moving knowledge across epistemic cultures. It has also made it possible to draw attention to work that may be performed spatially or temporally away from the knowledge objects that are being moved but still is essential for this movement. This perspective, I suggest, may be useful for studying the movement of knowledge also in other contexts.

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Notes

1 Special Issue on knowledge infrastructures, see *Science & Technology Studies* issues 1-3, 2016 (vol. 29).

2 For an example of how convoluted standards in border-spanning large technical systems can be, see Hanseth et al. (1996) on information infrastructures.

3 See Kruse (2015) for more on becoming a crime scene technician in Sweden.

4 These I have discussed elsewhere (Kruse, 2013).

5 For a discussion of this scale, see Kruse (2020b).

6 In the Swedish criminal justice system, prosecutors lead pre-trial investigations of severe crimes or in which there is a suspect.

7 Such stories can, of course, still carry an element of resistance. It is conceivable that at least some crime scene technicians harboured resentment towards the teachers (most of whom, after all, are not crime scene technicians themselves) for telling them how to do their job.

8 In addition, the forensic scientist presumably performed alignment work of their own – that was not visible to the crime scene technicians – when (or if) preparing the trace for analysis.