Travels and Trials of Climate Knowledge in Finnish Municipalities

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Abstract

We examine why implementing climate aims has proven challenging for municipalities. Recognising that climate policy research identifies 'barriers' to the forward motion of environmental knowledge, we use STS tools to dismantle 'barrier thinking' and analyse the dynamics of climate knowledge in municipal organisations. The primary data are 21 interviews with climate change and risk management experts in Finnish municipalities. We employ the idea of 'trials of strength' to analyse not mere barriers but gatherings, translations, and implementations of environmental knowledge. We argue that four kinds of trials are crucial in transforming climate knowledge so it can cohere with ongoing processes: it is gathered and condensed at the organisation's borders; climate experts embody and transmit the knowledge; meeting tables form obligatory passage points for its implementation; and road maps draw actors together to circulate knowledge. While traveling around municipal organisations, climate knowledge is often sidetracked but can sometimes become unexpectedly effective.

Keywords: climate change, environment, knowledge, trials of strength, road maps, organisations

Introduction

Why are the globally recognised initiatives of climate change adaptation and mitigation difficult to implement in local practices? Knowledge of climate change and its acuteness is hardly lacking; indeed, climate information that can be used across various scales and institutions abounds. Yet much of local climate governance and sustainability centres on how different indicators and 'best

practices' are followed, how this affects performance, which policy instruments are effective, and how climate goals are implemented locally (Hsu et al., 2020; Terama et al., 2019). Knowledge is seen to travel from top to bottom, from abstract to concrete, and from scientific research to international organisations, states, and finally municipalities. Such a technocratic, top-down process alone does not suffice: it is not enough to come up with the right kind of policies and indicators (e.g. Knox, 2020; Terama et al., 2019). A particularly pressing problem of taking on climate change adaptation and mitigation lies rather in 'the transfer, receipt and integration of knowledge across participants' (Weber and Khademian, 2008: 334).

We approach the problem from an STS point of view to contribute to the topical field of climate governance and sustainability studies. By putting forward classical STS concepts to the study of climate knowledge in municipal governance organisations, we draw up an approach for STS research to reassemble the organisational formation and momentum of knowledge in a new way. Our line of inquiry has practical pertinence to the field of climate policy and its study as well, as municipalities arguably have incentives to produce and circulate knowledge about climate and environmental change and to maintain such expert practices. They seem to falter in two key aspects, however: in in the 'interessement' and 'enrolment' (Callon, 1986: 221) of other actors in efforts to find adequate 'coherence' (Law, 2002) with other practices in the organisations. Instead, established core practices seem to truncate and filter down climate knowledge.

We inquire into these processes in detail by tracing the travels of climate knowledge through municipal organisations in Finland and by analysing transformations of the knowledge during these travels. As research questions we ask: what kind of knowledge is gathered, condensed, and implemented in the Finnish municipal organisations; how does this knowledge become tested and transformed in organisational practices; and what kinds of frictions emerge in these processes? To answer these questions, we employ the idea of 'trials of strength' (Callon, 1986; Latour, 1987). Four key trials are identified by focusing on environmental experts' daily work on climate issues:

organisational borders, the experts themselves, meeting tables, and road maps.

In the following, we first elaborate on previous research and present our theoretical outlook. This section is followed by a description of the research process, data, and methods. We then present our results and analysis in four subsections. The conclusion discusses our findings vis-à-vis previous research.

Respecifying transfers of climate knowledge as trials of strength

Climate work requires both integrating and mainstreaming knowledges and strategies (Keskitalo and Andersson, 2017). Accordingly, the role of intermediary organisations has received attention as a prospective solution (Kivimaa et al., 2019). For example, the HINKU network of aspiring 'carbon-neutral' Finnish municipalities is thought to be crucial for local mitigation efforts as it both acts as a "vertical intermediary" and facilitates "peer support" (Karhinen et al., 2021).

Yet both the transfer of knowledge and the intermediary work it requires encounter obstacles in the governance of climate change adaptation (e.g. Eisenack et al., 2014; Intergovernmental Panel on Climate Change, 2014). Between the input of abundant knowledge on climate and environment and the output of effective policy measures and emission reductions are 'barriers', extensively diagnosed clogs in the flow of knowledge (e.g. Amundsen et al., 2010; Biesbroek et al., 2013; Lehmann et al., 2015). What constitutes a barrier to climate knowledge is a lack or a deficiency of optimal conditions: communication breaches, organisational stovepipes and silos, dysfunctional leadership, or flawed institutional arrangements (Clar et al., 2013; Eisenack and Stecker, 2012; Moser and Ekstrom, 2010). In this line of thought, knowledge is treated as an enabling resource that actors transport from one policy phase to another. Barriers, then, are disruptions of what would otherwise be an optimal flow of knowledge across governance organisations.

Since intermediary 'knowledge-brokerage' between research and policy practitioners (Clar et al., 2013) and successful interventions into climate governance both remain wanting, the

kind of 'barrier thinking' described above has been called into question (Biesbroek et al., 2015). At issue in climate adaptation should be not so much the diagnoses of removable blockages in otherwise smoothly running pipelines but a fine-grained understanding of these very governance processes, particularly the complexities of decision-making (Biesbroek et al., 2015), or the practices of coordinating climate strategies and actions in governance organisations (e.g. Clar, 2019). What remains uncomplicated even in this problematisation is, however, the knowledge itself.

We aim to sidestep the gridlocks of both barrier thinking and the constant need for more and better intermediary coordination of levels and processes of governance. For this, we respecify the transfer of knowledge in governance organisations by using the science and technology studies (STS) framework. In the spirit of classic works by Michel Callon (1986) and Bruno Latour (1987), who built on Michel Serres (1974), and contemporary STS-inclined approaches to policy organisations and knowledge (e.g. Freeman, 2009; Voß and Freeman, 2016; Lehtonen, 2003, 2017), we approach knowledge as a practical achievement that requires *translation*, an operation in which both the issue at hand and the relations between the translator, the translated, and other actants involved are transformed (Callon, 1986; Latour, 1984, 1999). The travel and translation of knowledge across organisational practices is thus not only a matter of transfer but also of transformation (Gherardi and Nicolini, 2000).

With these classic STS ideas, we respecify the notion of transferring knowledge in three ways. First, knowledge becomes translated and transformed in the process of being taken up in different kinds of organisational practices. Second, the same object or mode of knowledge can be taken as data, information, or knowledge, depending on context (Latour, 1999: 24–79). Third, knowledge can be treated as tacit and personified, documented and inscribed, or put into practice in different ways as it moves across policy processes (Freeman and Sturdy, 2014). In sum, we approach climate knowledge not as discrete resource objects at the mercy of extraneous, dysfunctional conditions but as situational: contingent on the practices of its uptake and interwoven with material arrangements.

To become established in municipal organisations, such local arrangements of knowledge must be made stable enough to fit the bill. To capture these crucial waypoints, we operationalise our respecification through the concept of *trials of strength*, developed in Latour's (1987) and Callon's (1986) early works on science and knowledge. According to Latour (1999: 311), trials are "experiments of various sorts in which new performances are elicited." Practical elicitations of knowledge are not neutral but require strength. We use the idea of trials to focus on the tests in which climate knowledge is put as it travels through municipal organisations.

The trials appear at junctures where the knowledge and expertise of climate specialists meet with those of other organisational branches (technical management, zoning, forestry, etc.) and policymaking. We therefore follow the efforts of environmental and climate experts in Finnish municipalities to make environmental and climate knowledge travel through their organisations and become effective. During these travels and trials, modes of knowledge on climate adaptation and mitigation tend to gain and lose traction and often become sidetracked. Our approach thus stands in substantial contrast to the problematisation of ineffective climate measures of much policy research and practice. Put bluntly, a trial is not a barrier. The cause of a lack of sufficient knowledge or its coordination and communication cannot be extraneously identified and remedied. Rather, a trial is the locus at which the course and mode of climate knowledge become transformed. How this happens is an empirical question that lends itself to inquiry only in particular situational practices. Whether a trial serves to block or accommodate certain kinds of expertise and knowledge is not a question of yes or no but of degrees and forms of their transformation.

Research process, materials, and methods

We began our research work at the beginning of 2018 by mapping resilience gaps and blind spots in the governance of and preparedness for climate change-related risks in Finland. The work was car-

ried out as part of a multi-disciplinary research consortium focusing on wicked socio-environmental disruptions and comprehensive resilience in Finland. The body of Finnish national-level documents taking account of these issues and their impacts was both wide and scattered, but we detected that this corpus of literature – including policy documents, directives, and grey literature – addresses climate change predominantly within an established national administrative discourse, especially regarding issues of security strategy, risk assessment, and crisis management. Recently, there have also been attempts to broaden these framings in terms of comprehensive security, resilience, and preparedness and a consequent emphasis on the role of non-governmental organisations and citizens in tackling these challenges. Nonetheless, national security and risk management framings predominate the discourse on resilience, while successful efforts to include long-term climate change and sustainable development issues have thus far remained sparse (Hakala et al., 2019a, 2019b; Ministry of Interior of Finland, 2019; Reinekoski et al., under review; Räisänen et al., 2021).

This initial finding led us to expand our understanding of the barriers to mitigating and adapting to climate change. Instead of nationally established security and risk-driven policies, we targeted a rather patchy corpus of policy documents, such as public environmental and municipal climate strategies, guidelines, and road maps, to pinpoint gaps in the seams between municipal organisations and national scales of governance. This second stage of our mapping work further directed our selection of informants.

Access to the interviewees was gained by contacting municipal administrations and asking who was responsible for climate change mitigation and adaptation. In the five municipalities we approached, few people had been formally recruited for these tasks. Instead, we found experts who had a wide variety of responsibilities that often had to do with not only climate change but also environmental issues more broadly, public enlightenment, and the administration of natural resources in the municipal area. We ended up recruiting interviewees to represent various branches around environmental climate issues

and working on both fixed-term and permanent contracts in municipalities of different sizes and administrative structures.

Eventually, a data corpus consisting of transcriptions of 21 expert interviews of 52–90 minutes with people working in five Finnish municipalities was gathered. Nine informants worked as environmental or climate specialists and twelve as experts of risk management and preparation. The smallest municipality employed only one climate expert, while the large cities had several. The semi-structured interviews were carried out during a seven-month period in 2018 at the informants' offices. The themes touched upon in all interviews included environmental and climate threats and the preparations to respond to them, responsibilities, knowledge, and technology and communication. All informants were also asked to reflect on their own expertise, tasks, and responsibilities and describe an ordinary day at work. The 21 environmental and climate experts offered rich reflections on and characterisations of how they gather and process data, frictions in the implementation of climate knowledge, and the tools and devices at play in everyday organisational realities.

We conducted the analysis in two interconnected phases: data-driven coding work conducted by the corresponding author, Virtanen, was followed by a theoretical interpretation carried out by the whole research team. In the first phase, the raw data from the interview transcriptions were coded using the Atlas.ti software. In the coding work, particular attention was paid to epistemic issues and knowledge tools and objects, such as emission calculations, numerical indicators, maps, and air quality measurements, and to the software and devices used in making these calculations. Challenges related to these issues were also highlighted at this stage. Then, grounded on cross-coding and merging the codes and by conducting a constant comparison between different codes, four general themes were identified to classify and summarise the data: *tools, devices, and instruments* (280 coding occurrences in the data); *data and knowledge* (277); *goals and efficiency* (265); and *expertise and resources* (250). These themes are not mutually exclusive, as each utterance could contain several

codes. During the analysis, quotations pertaining to each theme were also compiled.

In the second phase, the entire research team read the interview transcripts, gathered remarks, and made notes about issues relevant to the research task at hand. We then brought our findings together and interpreted the thematised data jointly by using the conceptual idea of trials of strength. Interviewing a diverse group of experts working on environmental and climate issues in their everyday contexts allowed us to trace multi-directional paths that climate knowledge appeared to travel in municipal organisations. These traces led us to discover situations of trial in which different practices met each other with friction. We identified four key trials through which environmental and climate knowledge must pass during its travels in municipal organisations to be able to cohere with ongoing processes:

1. gathering and condensing knowledge at the borders of the organisation;
2. the expert as the embodied transmitter of knowledge;
3. meeting tables as obligatory passage points for implementing knowledge; and
4. road maps for drawing actors together and circulating knowledge.

We trace the travels of environmental and climate knowledge through these trials to answer our research questions.

Analysis and results

Context: Expertise not yet established

The daily work of our interviewees emerges as both multifaceted and organisationally unestablished. The environmental specialists in Finnish municipalities are "working a field that does not exist," as a planner in sustainability issues evocatively puts it. She positions herself implicitly outside the core of the municipal organisation where she works. She also considers the issues on which she is working to be novel and not yet comprehensively recognised outside her daily tasks in the wider organisational practice. Another interviewee, an environmental planner, summarises this view:

It's been a completely new thing for the waterworks, when they drag pipelines [on their screen], that they must consider where the pipelines are dragged. Based on natural values, I mean, and not only where they are easiest to pull based on engineering science.

The interviews reveal that the specialists' everyday work appears to be a bricolage of multiple tasks; their responsibilities stretch horizontally and vertically across sectors and units and from the grassroots to the highest levels. The interviewees connect environmental and climate issues with what the organisation is "already doing," as one climate specialist puts it. Two consequences are immediately notable: first, as environmental and climate expertise is yet to be established as a stable field in Finnish municipal organisations, it appears to be intertwined with various sectors and other issues; second, the interviewees are not passively fulfilling tasks assigned to them but make themselves and their knowledge actively heard. At the same time, they constitute their own expertocracy. In this context, the category of knowledge is not internally homogeneous but heterogeneous, traveling through diverse paths and crossing various thresholds – in our term, trials of strength – to become embedded in organisational practice and decision-making.

The first trial: Gathering and condensing heterogeneous information and climate knowledge at organisational borders

The first trial of strength centres on the way in which heterogeneous information and the types of climate knowledge that are relevant for municipal organisations can cross the borders around and within them. We highlight the ways in which relevant information is filtered and tried out before it is assumed by the organisation and, especially, by the person in charge of gathering and disseminating the information within the organisation. Various gatekeeping practices in which experts welcome and develop information that could become useful knowledge to the organisation emerge in our analysis.

The experts gather, condense, and transmit heterogeneous information in their everyday work while opening paths for it to become

meaningful as knowledge in terms of organisational conditions. To bring knowledge inside an organisation requires multiple skills. Even though the educational backgrounds of the interviewees varied from a degree in natural sciences to engineering education, all had duties that required technical skills and knowledge, such as emissions accounting. In addition to technical data gathering and processing, they also attend workshops and seminars and follow academic and organisational discussions around environmental themes, seeking to gain new information by reading research articles and grey literature. The interviewees also discuss these issues with their peers, and municipal residents often reach out to them.

Even though there are multiple sources of environmental and climate information, condensing it into knowledge is predominantly limited to numerical and software-assisted forms. Finnish municipalities measure, quantify, monitor, and chart their environmental and climate progress in multiple ways. Numerical indicators are pivotal in this data gathering and condensing. For example, one environmental specialist describes the development work of indicators, which are connected to a data service based on the goals of the United Nations 2030 agenda for sustainable development and piloted in some municipalities in Finland, Sweden, and Great Britain:

> Under these 17 sustainable development goals, around 50 indicators have been gathered. Now the service is to be developed further to double the amount of the indicators, so during the next year there will be about one hundred indicators.

Another interviewee, an environmental planner, says there are "a good 30 indicators of ecological sustainability" currently in use in her municipality…

> … from greenhouse gas emissions to the amount of green areas and protected areas, to the increase in private car use, amount of public transport and the city's own procurements and environmental perspectives on them.

These kinds of indicators are important as numerical formulae of data handling; they enable standardisations over changes in time and place. Thus, they not only make it possible to compare one municipality with others but also allow environmental and climate information to pass the trial at the border of the organisation without friction, to begin to travel inside the organisation, and to be implemented in its practices.

Mere data gathering fails to pass the trial, however. Standardised indicators are crucial not only for condensing environmental and climate information but also for linking it smoothly outside the experts' own fields and expertise. In this regard, indicators are further scrutinised, combined, and merged to enable comparing them both within and between municipal organisations. For these purposes, the interviewed experts draft reports based on the technical information that they gather and possess. A yearly carbon dioxide report is based on systematic greenhouse gas emission calculations, for instance, and "at intervals of four years, a comparison is made" between similar municipalities, an environmental planner says. Various indicators gathered and reports drafted based on them connect environmental and climate work both inside and between municipal organisations and, at the same time, integrate it over space and time.

Work on indicators and other forms of data processing is coupled to the use of knowledge tools and devices. Environmental and climate experts both gather and handle data with various applications and computer devices; they further manipulate and shape the data to fit into other apparatuses and process it to create numerical indicators and visualisations. A sustainable development coordinator, for instance, manipulates cartographic and location data on her desktop with a practiced hand:

> I'm able to overlap the carbon sink map, the biodiversity map and the demographic map. So, there are already many kinds of possibilities available, and we try to come up with the ones that are the most informative and important for the adaptation plan, for example.

Combining different kinds of environmental maps is a technical issue and a relatively easy one for this interviewee. Moreover, cartographic data are amply available in the organisation or, as the

interviewee puts it, "on tap in the cartographic system" and ready to be used anytime on a desktop. Software tools also come in handy both when "updating the data" and in gathering and drafting reports:

> The [reporting] system generates different kinds of diagrams and graphs which can be used by the municipality. We then update the data and make sure that the newest information is at hand there. (Environmental and climate specialist)

Thus, the tools help knowledge to travel, as another interviewee says:

> A reporting tool [is used], so a municipality can choose which indicators it would like to report, based on which year, and whether it would like to juxtapose its indicators to the ones of other cities and to generate a report like that. (Environmental specialist)

By applying tools and devices, the experts condense the environmental and climatic data into numerical and visual information. They also draft reports based on this tool-mediated condensation. Reports are stabilised knowledge-objects: their standardised form allows them to smoothly connect beyond the experts' desktops, both within and outside the municipal organisation. Therefore, reports are crucial in the trial of becoming part of the organisations' activities.

Despite the prevalence of tools and standardised indicators, not all environmental and climatic data are gathered technically or compressed into numerical or visual forms. An interviewed environmental planner, for instance, describes her daily ecological data gathering by contrasting it to desktop work on software tools and computer devices. She goes into the wild to chart …

> … which natural values are prevalent now, and after that take[s] part in the land use planning to get the natural values safeguarded as the land use planning proceeds. And then, [she conducts] different evaluations of natural effects related to the city's plans. And then, planning the municipality's protected areas and choosing new ones, and kind of overseeing plans and activity … to plan how diversity values can be considered.

As a trained biologist employed by a relatively small municipality, she works "in the field a lot," especially during the summer months. Her work is primarily "nature conservation in practice" conducted as an "all-terrain biologist." Moreover, she implements fieldwork findings into organisational practice on her own. Consequently, her work is attuned to both the "goings-on" in nature and the practices of different stakeholders in the municipality.

An inventory of natural values in certain areas that the environment planner has compiled, for instance, has recently been taken up in land use planning. Instead of drafting reports based on indicators and other standardised forms of information to link the environmental and climate information with organisational practice, she makes sure that the information becomes adapted at face value, without ancillary arrangements. In so doing, she not only collects and condenses knowledge but also roots it in the organisation through her own initiative. The first trial of strength of environmental and climate knowledge, which takes place at the organisation's external borders, is passed because of her individual effort. This kind of transmitting work is at the core of the second trial.

The second trial: The expert as the embodied transmitter of knowledge

The second trial of strength in the travels of environmental and climate knowledge turns the experts themselves into the embodied representatives of knowledge. We go through the connections and situations in which experts hope to mediate environmental and climate knowledge with and in the organisation. The mediation takes place either in direct encounters with other individuals or by gradually establishing ways in which the information generated would habitually be taken into consideration by the appropriate individuals and departments of the organisation. Both forms of these mediations test the environmental expert's capability, first, to make others in the organisation understand that they need new information and, second, to translate and provide the relevant information to those who need it in a form that is both intelligible to and operable for them. These translations mould the expert, the recipient, and the mediated information.

All the interviewed experts describe the processes of data gathering and handling at length and point to them as important part of their daily work. They also use software-based data tools with a practiced hand and routinely draft reports based on measurements, indicators, and visualisations. Consequently, the difficulties in taking account of environmental and climate issues lie deeper than a general lack of knowledge; rather, as one climate specialist puts it, what surfaces as more important is friction in the "connections between things."

A development coordinator explains: "We have the carbon sink and carbon stock map available as cartographic data, but in a way, we don't have any kind of instructions or measures related to them." In other words, for her it is not clear how to use these data, and how others could put them to use. Similarly, an environmental planner indicates that there are ample data available on environmental and climate issues, much of which are processed into indicators and reports, but she is dubious about their actual impact:

> As we gather indicators, there are of course loads of data, [but] to make them effective in terms of decision-making has been quite challenging. The data we gather, I don't know whether they serve the purpose. The city always has an enormous amount of information [but] does it have impact on anything? Is it all just unconnected reports? Can someone really make use of them in projects and decision-making?

Moreover, even though indicators and reports stabilise the understanding of the environmental and climate data relevant for the municipalities and enable juxtapositions between different time spans and organisations, the indicators' relevance can be short-lived. One informant describes how environmental reports are connected to more wide-ranging strategies and evaluations and how the reports change accordingly:

> We have been doing our own report for some five years now and connected it to our environmental policy evaluation, but all this is changing now because we have a new strategy, new outlines for environmental policy, which were just today processed at the city council, in fact.

She then continues by saying that, for example…

> … the comparison of social sustainability indicators was dropped a couple of years ago, as every municipality has these welfare reports that say similar things. Then there are some [indicators] which might be nothing more than gathered only for one particular purpose.

Her reflection is eventually rounded off with a rhetorical question followed by an immediate answer: "And have they been brought up when making decisions? Maybe not."

There are thus abundant data and tools to process that data, but there is no overarching awareness of how to use, combine, and transmit different forms of data and make environmental and climate knowledge effective in the organisation. First, even though data are gathered, condensed, and made available, their actual implementation is not guaranteed.

> It's up to the awareness of the planners whether they take out the [forest biodiversity] map when they're drawing the planning map,

as one development coordinator puts before continuing with scepticism:

> So, recently I have been saying to land use people that the baseline is not to mess up these carbon sinks. But it hasn't really affected the practice.

The interviewee tries her best to use visual cartographic data to concretise the issue at hand and tackle the frictions in its implementation: "The red spots [on the forest biodiversity map] could point out that it would be possible to protect that spot." However, the red spots do not affect the ongoing organisational processes unless she takes on an active role. Consequently, she thinks her tasks make up "a kind of multi-professional job."

In practice, she cannot stick to her own area of expertise but is obliged to understand what everybody else in the organisation is doing and to intervene – if she wants to achieve any results: "I have made jokes that my work is to meddle in everyone else's jobs."

Second, environmental and climatic issues are also wide-ranging, long-term, and complex, and

the measures used do not capture them in their entirety. A sustainable development coordinator highlights such a discrepancy between traffic and air quality measurements. The current calculation tool captures only a part of emission issues: "There is some legwork to be done here as some activities […] are not visible in the calculation, and it has to be told somehow that this has an impact indeed." The tool at hand enacts and stabilises emissions as particular kinds of objects and, at the same time, steers attention away from other possibilities of object-making. Consequently, other types of measuring are needed to shed light on important aspects of the issue – and at scales that are currently neglected. She goes on to describe how, besides current calculations, it is also indispensable to "make visible somehow, for instance, that other factors of air quality have been improved. Nitric oxides, particles, and the like dwindle at street level."

Both examples highlight the frictions of environmental and climate knowledge implementation and the ensuing need for the experts to transport, transmit, and translate the knowledge into the organisational practice themselves. The data will not do the work automatically; they must be translated, and the experts take care of these translations in person. The interviewees mediate between as yet unestablished environmental and climate knowledge and already established organisational practices. These translations are not specific tasks to be taken care of occasionally but the core work of the interviewed experts. An environmental specialist, for instance, describes her work as mediating "natural values and the city's ventures."

As these ventures follow their own logic and pace, they can often appear incommensurate with climate aims. The interviewees refer to, for example, slowness of change in policies and attitudes and a general complacency in local politics and municipal bureaucracies. An environmental specialist describes her frustration in terms of not being heard. She represents the highest level of knowledge of climate change and extinction mitigation in her organisation, but she feels that she is made to languish on the outer circle of her organisation, "detached from strategic management":

Looking at the organisation, there in the box [where the strategy managers work, concretely and metaphorically], inside which we are not, but where strategic development, budgetary planning, human resources development, information management and then risk management and the ownership steering of our big companies are. There they have apparently good conversations, but you are not with them.

She and her colleagues do not have direct access to the inner core of the organisation, so the climate issues in which they specialise are not sufficiently considered in organisational practice. This interviewee tries her best to tackle this by being active, which means that her efforts to be heard take up a large part of the working day:

I meet people from other parts of the organisation a lot. We try to get to the right meetings and to the right discussions and discussion threads. Yes, we are curious, and we read the agendas and we are all ears because our presence is not remembered, even though we would have something to say and provide. This is also kind of detective work.

Another interviewee, a sustainable development planner, describes similar frictions by illustrating how she tries "to muscle into all kinds of work groups and bring forth these issues."

In this kind of mediation work, experts become human embodiments of climate change knowledge. This mediation is a two-way process between the experts and the organisation. The interviewees are not only active mediators themselves but are also called upon when environmental questions are to be discussed in the organisation:

A lot of my time goes into answering questions from other branches of the city bureaucracy. A town planner will call to ask whether there is a question of conserving a path for a flying squirrel [an endangered and protected species in Finland] and what that would mean in practice. And then I look at the map and tell them that in areas like these, suburban areas with small houses, you should always leave enough green spaces. And then they either will or will not make changes in their zoning plans. And then I will get an email from forestry, someone telling me that they're planning

some clearings there and wanting to know if there are some environmental values they ought to think about. Consultations like these take a lot of time. (Environmental specialist)

Besides mediating branches inside the municipal organisations, the interviewees also work as links "between civil society and the city organisation" on environment and climate issues, as another environmental specialist phrases it. In encounters inside and outside the organisation, the expert is tested. For environmental and climate information to become embedded in the organisation, she must transport, transmit, and translate it, which requires both socio-communicative skills and awareness of organisational processes and practices. In the words of a climate specialist, "you have to be able to speak, be brave enough to go out there and talk to people" and, ultimately, learn "how the city works." Knowing the organisation thoroughly enables these experts to be with the right people at the right time, sitting at what the informants call "the right tables."

The third trial: Meeting tables

To succeed in making environmental and climate knowledge effective, it is of utmost importance to be at the right tables at the right time and with the right people. It is at the meeting tables where decisions are made and where all the heterogeneous things of which a municipality takes care are brought together, amalgamated, and incorporated into – or dropped from – the city's agenda; these tables are 'obligatory passage points' (Callon, 1986; Latour, 1984) for getting any climate knowledge implemented. The best tables are those that are permanently occupied because the stability of positions enables moving agenda items along. However, it takes a lot of effort to be allowed to be present as the embodied climate knowledge representative. The meeting tables make thus up the third trial of strength. Environmental and climate expertise is put into practice in municipal organisations by successfully undergoing these trials.

At the meeting tables, there is in principle no incommensurability, as everything is negotiable; in practice, the structures and path dependencies of the city become readily apparent to the

environmental experts. To begin with, it is difficult to get a place at the right table; this is the effort required to become the embodied climate change knowledge representative in a group of people who present and represent many other concerns and interests in the municipality. Moreover, seats at these tables are not permanent; environmental and climate issues can be swept away, and the tables themselves can be dismantled altogether. This is because environmental and climate work in Finnish municipalities is largely externally funded and operates as projects. When an individual project is finished, the tables where these concerns are made to matter most are folded up and put away.

When asked about the structure of her daily life at the office, one energy and climate specialist responds by saying that, "well, very much meetings, it's like that; discussion is maybe the most typical work task I do." These meetings are frequent and important. To affect the choices made in cases where environmental and climate issues are introduced to the organisation's "traditional" way of making decisions, active discursive mediation is needed: "We now implement [the climate plan] in the organisation by just discussing what it means with different units' management groups." Knowledge is mediated by social encounters in a discursive fashion and shaped around meeting tables. Therefore, the experts dare not risk not being at the tables; they are constantly seeking "to be in the right place at the right time," as the interviewee describes it.

Keeping track of all the proper times and places becomes frustrating at times, and insuperable frictions surface as a result of that effort. These are evident in the descriptions of facing barriers blocking the possibility for active mediation work and, at the same time, the translation of environmental and climate issues into organisational practice. Being socially active and having "big ears" are not always enough, as important decisions are often prepared in chains of preliminary meetings in which a preselection takes place in choosing who "gets a seat at the table," as a climate specialist put it. Another interviewee, an environmental expert with a fixed-term contract, recounts a chain of frustrating events of trying to

insert a climate mitigation perspective into the city's procurement plans:

> I went to see the head of procurement and asked whether I could join the committee, since, anyway people in the executive council had said that I should see the plans and bring some environmental perspective into it. But I never got to see the plans. So, I went and asked what the situation is. And he says, oh yeah there's this committee. Can I join the committee? Complete silence. Then I asked my friend who's got a permanent post whether she could play dumb and ask about the situation, so she does. And gets one reply. And then nothing. So the next step is I go to see our branch director [Environment and Sustainability] and tell him, "Here's the thing and I think we need to be on this committee, but we're not getting any answers, and it's like maybe some people just don't want too many people in so things don't get too complicated and messy and too time consuming so they can't get the plan ready for the city council." So, the branch director must go and play dumb and say, "Hey I just heard there's this committee and could we possibly get on it?" Finally, I get on the committee, but of course at that point it's June and they've been working on the plan since January. In the end I got to give them the comments I had, but I'm not sure whether they can do anything about them because there's big pressure to get the plan finalised. It's all a bit problematic.

A project worker like this informant might have crucial expertise for incorporating environmental and climate plans and actions into the procurement plan. However, she cannot appoint herself a permanent member of a committee and can only get onto the committee through social footwork and being on good terms with the people capable of having impact on procurement.

No matter how active and skilful the experts are, the doors of the boardrooms close the moment whatever project they are working on ends. Environmental experts are often project workers, so their points of view are only temporarily present in the organisation. By contrast, the best tables are those that are permanently occupied:

> The people that get invited into meetings, they usually have permanent positions, which of course makes sense in terms of continuity, because projects end, and project people come and go. (Environmental specialist)

This precariousness has concrete effects on the organisation's everyday work, as environmental and climate knowledge is porous and not thoroughly established. Even when the experts' points of view appear to have been established during a longer tenure, they can be suddenly bypassed. Another interviewee, working as a project-based environmental expert, provides an example:

> I've been working with the city planning people for years now on many projects and then, out of nowhere, someone there may say, "Yeah, we talked about this, but we can't really help with any emission reductions, you know, because there will always be some emissions when there's new zoning". And I'm like, "What just happened?"

Stringing discrete projects together does not help if the translations fail in stabilising environmental and climate knowledge and rooting it into the organisational structure. The knowledge remains tied to each project and to the employees recruited to work on it. To put this another way, the experts' precarious working conditions block the establishment of environment and climate knowledge and tie the implementation of that knowledge to social contacts and personal activity. Fortunately for the environmental experts, some of the things they are able to present at the meeting tables do move forward and are stabilised into new forms and new objects that can have more staying power than the project workers' employment contracts. We round off our analysis by concentrating on one such object, the road map.

The final trial: Climate knowledge on the road (map)

Environmental and climate knowledge does not easily reach the most important table, budget negotiations, but all is not lost. As the fourth and final trial of strength, we examine the tables that environmental and climate knowledge does reach easily; among these, the road map table is central. It is in fact made based on climate knowledge and for climate knowledge. The aim of translat-

ing climate knowledge is to make an intervention, but interventions are not tied to contributing to established, straightforward processes like budgeting. Other channels are available or can be created instead and perform different kinds of interventions.

When asked about how environmental and climate knowledge is implemented in the everyday operations of the municipalities in which they work, the interviewees highlight diverse communication processes like meetings, workshops, informal discussions, and 'road maps.' These maps of environmental and climate issues make up one part of the motley patchwork of future-oriented policy forms, short-term campaigns, medium-term plans, and long-term development programmes, strategies, and scenarios.

The environmental and climate road maps are loosely coordinating positionings and near-future plans, typically gathered in an ad hoc manner by a multi-stakeholder network. Once a road map is created, it is not used in a straightforward fashion as an implementation tool for a set of initiatives and goals. Instead, the status and function of road maps appear to be impermanent and diffuse. They chart initiatives and outline plans and serve the municipality as compilations of activities, measures, and aims: "The idea [of the road map] has been to put together everything we do to see what kind of things are currently going on", a climate and energy specialist describes the purpose of road maps. Thus, they are also used as a means for an organisation to monitor itself. The maps function as framing devices and checkpoints for ongoing processes: "We can observe [with road maps] whether we are on the right development path." But because they are diffuse, road maps also spread out easily to various branches within the organisation. In so doing, they affect organisational practice in uncoordinated and unpredictable ways. Besides coordinating organisational activities for the near future, the road maps mentioned in the interviews share other features. First, they are guidelines drafted through a multi-stakeholder effort and are accordingly connected to a wide web of plans and future policies. Second, their role is ultimately ambiguous in organisational practice, and they are depicted predomi-

nantly as loose, fragmented, and unbinding by the interviewees. However, third, the road maps are not insignificant in establishing environmental and climate issues.

In general, road maps figure as stabilised points of reference for coordination of future-orientated environmental and climate initiatives. Diverse road maps on themes such as resource wisdom, carbon neutrality, economic development, and transport and the environment were pointed out in this vein during the interviews. For example, a Carbon Neutrality Road Map has the ambitious yet broad aim of comprehensive carbon neutrality of the municipalities at issue. It is created not only to steer but also to compare climate actions in many Finnish municipalities of similar size. However, the map is not implemented into organisational practice in a straightforward fashion, but rather it provides a general framework for a decade-long process.

The experts discussed road maps at length in the interviews, but their actual role in implementing environmental and climate knowledge and in managing the ensuing activities remains unresolved. The porous status of the maps becomes evident even in their inception phase. Even though the road maps were used by the municipal organisations, they were "not created inside the city hall," as one head of development puts it. Instead, their creation processes are connected to wide networks spanning outside municipalities and involving various partners, both public and private. For example, the Resource Wisdom Road Map used in one of the studied municipalities was created by a network of diverse stakeholders, "including the consultants of The Finnish Innovation Fund Sitra." Besides this fund …

> … there were some fifty quarters involved, roughly half of them enterprises and the rest public administration and the university and the like. And in a similar vein, the city has an urban strategy, and there is a separate programme that contains a section focusing on the environmental side of things. Also, the city's own strategy was drawn up in cooperation with enterprises and the university. (Head of development)

Another interviewee sheds light on the multiphase creation process:

> It was workshopping where these steps
> were outlined. There were experts and
> non-governmental organisations and others
> talking, so [they were] that kind of facilitated
> workshops. (Environmental specialist)

A sustainable development coordinator refers similarly to "stakeholder workshops," and a climate and energy specialist describes a recent process of road map drafting as "stakeholder work" with "many participants outside the city to reflect on these measures."

When asked about the methods used in creating road maps, the interviewees report that "there are no standard procedures," in the words of a head of development. Although the networks are wide and the creation processes multistage and time-consuming, the maps are drawn up anew every time, "depending on the situation." The interviewed manager speaks of an "orienteering map" which is created in multi-stakeholder work, "and when everyone is brought up to speed […] the map is discarded, and everyone clears off." These kinds of processes of creation were also pointed out as challenging, and the implementation of the maps as frictional:

> It was planned to be carried out in a certain way
> and then, when I was not at work when it was
> created, things maybe didn't go as they were
> supposed to. So, the idea was kind of to think up
> actions which would fit [the city], and as there
> were these groups taking part, there would be the
> people ready to really carry out the actions. But
> the thinking kind of stayed on the upper level, so
> details and specifics always remain a bit loose.

These challenges, highlighted by a climate and energy specialist, are further connected to the general ambiguity of road maps. They do not appear to have a binding coordinating role in getting environmental and climate activities across in the municipalities, as an environmental planner describes: "the plan has to be made, and then no one says who's going to implement it." A climate specialist laments the looseness of the maps with similarly frustrated overtones:

> It's not enough that we have these road maps
> and plans; these actions must take place. And the
> process is usually such that you must go through
> the same things over and over again.

When the interviewees discuss the actual effectiveness of different measures it becomes evident that roadmaps lack binding strength in environmental and climate action. Instead of loose road maps, suggestive plans, and numerous chains of workshops and brainstorming sessions, they call for binding procedures that would "really implement responsibilities to different actors," as an environmental planner puts it. According to her, the implementation of the contents of the road maps would be completely different if appropriate responsibilities were written into regulations of the Centre for Economic Development, Transport and the Environment that in Finland manages regional planning issues, or simply enacted into law.

The interviewees depict the road maps as too loose and porous to be able to guide and implement environmental and climate knowledge and activities inside Finnish municipal organisations. Yet from the point of view of travels and trials of knowledge, their role appears central. First, the road maps channel environmental and climate knowledge into routes leading outside the core processes of municipal organisations. Instead of budget and planning tables, environmental and climate knowledge is *steered to* the road map tables; alternatively, these multi-stakeholder and ambiguous tables are *made for* environmental and climate knowledge and *based on* that knowledge. Thus, second, tying these modes of knowledge to road-mapping does not push them entirely outside organisational practice. The pivotal aim of translating knowledge is to achieve change in organisational practice. Even though this aim is hard to reach directly – by translating the knowledge into the budget, for instance – there are still multiple channels available for this, each of which performs different kinds of interventions.

For instance, climate road maps can be taken up at the tables where the marketing of a city is planned. In the efforts to draw in new taxpayers, both individual and corporate, environmental and

climate knowledge is translated into a marketing strategy through which the municipality can make itself known as a successful green city. Once the road map for a green, sustainable, and clean brand for the municipality is created, it is also connected to essential organisational processes. Carbon neutrality, for instance, does not drift unattached but is mentioned everywhere from municipal websites to agendas for global city networks.

The travels of climate knowledge thus can take surprising turns and become effective in unexpected ways. The bids for the European Cultural Capital for 2026 (ECOC) by Oulu and Tampere, two of the three Finnish cities that have advanced to the second round of competition, provide an example. Both bids attempt to connect climate awareness and action to a transformative programme for making the cities flourish as places of cultural production, social and environmental justice, and sustainability (Oulu, 2020; Tampere, 2020). While climate knowledge is often shunted off to the periphery in municipal decision-making processes, the evaluation processes in ECOC bids connect the knowledge to the centre in completely new ways. At the same time, research-based measures behind the sustainability aims are pointed out and made visible, which, in turn, keeps these activities going in the everyday worlds of the interviewed experts.

It is also significant that the Tampere bid is regional and involves numerous smaller municipalities in the surrounding region, which facilitates the travels of climate knowledge between them. Furthermore, if either city wins the ECOC nomination, this could have far-reaching consequences by opening up new input slots for climate knowledge in different departments of the city organisation, in other Finnish and European cities, in cities involved in climate action networks such as C40 and the Covenant of Mayors, and in the Finnish state itself. During the bidding process, the travels of environmental and climate knowledge reached a new and completely unforeseen venue.

Despite the experts' scepticism, environmental and climate knowledge can make a difference in the municipal organisations, but that difference is not achieved with the most important target – the budget – in sight. Differences develop through detours instead (Latour, 1999). Detours are not

dead ends, and the knowledge is not lost during detouring; rather, it is translated into municipal processes in unpredictable ways. We return here to the beginning of the story: drawing up the road map, no matter how porous or unbinding it may be, is able to translate new knowledge in and for the municipal organisation. The road-mapping process has enrolled actors to seek and produce information consisting of new kinds of indicators and new kinds of comparisons and to draft future visions. Environmental and climate knowledge is at the core of the road map and thus at the core of the organisation's future, when visualised and imagined this way. Moreover, when the road map is drawn, more information becomes available and condensed into a form that is easily circulated. During its travels, the new information is translated into the municipal organisation, not in a forthright manner but in roundabout ways.

Conclusion and discussion

We have made an intervention into the field of climate governance and sustainability studies by respecifying the transfer of knowledge in governance organisations with STS tools. This new outlook provided us an opportunity to answer two different calls. First, in climate policy research, a need to understand the provenance and dynamics of barriers, instead of diagnosing where to remove the clogs from the policy pipeline, has been pointed out (e.g. Moser and Ekstrom, 2010; see also Biesbroek et al., 2013; Eisenack et al., 2014). We shifted the focus on the appearances of frictions and hindrances that climate knowledge encounters in the everyday work of climate experts. By following the travels of environmental and climate knowledge in Finnish municipalities, we explored, first, what kind of knowledge is gathered, condensed, and implemented, and, second, how these modes of knowledge are transported, transmitted, and translated in organisational practices.

Second, to advance STS's own techniques of knowledge production, we have presented a research design to both unpack current understandings of frictions of climate knowledge adoption and to reassemble the organisational formation of climate knowledge and its routes

of impact in a novel manner. To make sense of what happens during the travels, we employed the classical STS idea of trials of strength. Instead of stopping and checking a box at the sight of a possible barrier in our interviewees' accounts, we interrogated further. As frictions emerged in the unsettled "connections between things," we focused on what enables climate knowledge and experts to proceed and what comes of them once a trial is surpassed.

We identified four key trials through which knowledge must pass: (1) the practices of both gathering heterogeneous information about environmental and climate issues and instilling it in municipal organisations; (2) the experts themselves as personified reservoirs of knowledge; (3) the various meeting tables where knowledge is both condensed and made to travel farther; and (4) climate road maps, which work not only to curtail environmental knowledge but also allow it to be circulated and implemented in unpredictable ways.

We encourage future studies focusing on modes and movements of knowledge to put these four trials to test. In our own analysis, they show how fully functional organisational practices work to regulate, compartmentalise, and filter climate knowledge in several interwoven ways. To understand what is at stake in these dynamics of administering climate change actions in municipal governance, we conclude by discussing our results together with STS-inclined approaches to knowledge translations in policy organisations.

Climate and environmental knowledge must first find its way into the organisation and its practices: it must cross the outer borders of the organisation and further negotiate internal boundaries. The experts do this kind of boundary crossing, intermediary work in at least two respects. Their discursive efforts connect sectors and make complex climate issues meaningful to the municipal organisation. With their tools and devices, the specialists condense environmental information into translatable forms; the organisation recognises and takes in especially numerical information and reports in duly drafted forms. Devices like air quality measurements and carbon dioxide reports frame and tame manifold climate issues into technical and numerical forms by

mimicking the organisational input slots already in place.

Together, the intermediary functions of discursive work and knowledge devices reveal how climate knowledge is kept in check by deeply ingrained organisational structures in the municipalities. Once the trialling frictions between established, and precarious practices become manifest, climate knowledge meets organisational boundaries. On the one hand, knowledge devices appear as boundary objects that can ease in the 'local' knowledge of the climate specialists into the municipal organisation (Bechky, 2003; Star and Griesemer, 1989); on the other, the trials demarcate the organisational core from the periphery (cf. Yanow, 2004). While allowed to enter the organisation's practices through certain devices and strenuous communicative effort, climate knowledge remains on the outskirts, failing to enrol other sectors and actors.

The specialists themselves, indeed, personify and embody a trial for environmental knowledge. Instead of being institutionalised in and distributed across organisational practices, the knowledge is cultivated and sustained in and through the experts (cf. Freeman and Sturdy, 2014). While our informants represent the peak of environmental expertise in their organisations, they remain dispensable or auxiliary at best. The organisation will keep on operating without climate knowledge, which, however, needs the organisation to sustain itself.

The trials that determine whether climate knowledge is allowed to diffuse in the organisation also put climate experts and their knowledge in their precarious place. Meetings materialise as 'tables' around which crucial decisions are made. The right meeting tables, or just knowing how to get a seat at them, prove to be a decisive testing ground. It is there that the tasks of including and excluding relevant actors and parties in the organisation are performed and where sense is made of what the organisation knows and does (Freeman, 2019; Schwartzman, 1989). Trials at meeting tables filter climate knowledge, and what passes the sieve transforms into new kinds of devices: climate and sustainability road maps.

Drafted as multi-stakeholder efforts, road maps figure as stabilised points of reference for future-

oriented processes related to environmental and climate issues. Road maps provide the means for a municipality to make sense of "where we are going" as an organisation that wishes to project effective climate actions. Road maps work as mediators in Hennion's (1993) and Latour's (1999) sense, and drafting the maps translate existing knowledge in different sectors into the organisation's prospects. Road maps mediate between things that the organisation is "already doing" and its future aims.

But road maps have had to go through a trialling transformation (cf. Gherardi and Nicolini, 2000) before they can be "distributed differentially" (Freeman and Sturdy, 2014: 16) in the organisation. Direct translations of climate knowledge into the organisation's core knowledge practices, especially those involving budgeting, fail. These modes of knowledge are thus steered onto sidings and the peripheries of the organisation, from where they can assume new unpredictable forms.

Road maps reappear, for example, in the marketing and branding in cities' efforts to promote themselves sustainable and ecologically progressive. Green marketing is more tightly coupled to the organisational core, especially to budgeting, than climate knowledge in its initial forms. But as these modes of knowledge are trans-lated into marketing road maps, they also eventually become attached to organisation processes. Climate knowledge is not translated into the municipal organisation in a forthright manner but in roundabout ways such as marketing detours.

Our travels and trials approach reveal conflicts in knowing how to do climate governance: by translating climate knowledge so that it conforms to their established practices, municipalities can defer a transformation of their purpose. Still, it is through these very trials that municipal governance organisations come to know how and what they ought to know in order to function – and with what kind of knowledge they "make do" (Voß and Freeman, 2016: 22). The pressing practical implication for municipalities is to recognise and reassemble the structural, path-dependent practices that steer climate knowledge onto organisational peripheries.

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