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DOMESTICATING HOMECARE SERVICES

Vehicle Route Problem Solver Displaced

by Jenny M. Bergschöld

This article presents a case study of a vehicle route problem solver in the context of homecare work. Vehicle route problem solvers are technologies that calculate geographically rational driving routes. Primarily framed as tools for financial control, they have been tested in homecare services with good results under controlled circumstances. However, they have not been studied as part of users' everyday work after implementation. The case study shows how, through processes of domestication, the vehicle route problem solver becomes unable to provide homecare workers with 'optimal' driving routes. Additionally, it shows how this 'malfunction' renders it understood as inconsequential to the very activities it was designed to support which ultimately leads to its removal from driving route production processes. The results highlight the importance of carefully studying how vehicle route problem solvers and other technologies interact with the everyday lives of those who are meant to benefit from them.

Keywords: Domestication, Vehicle route problem solver, Homecare services, Posthumanism, Welfare technologies

Author: Jenny M. Bergschöld
Department of Interdisciplinary Studies of Culture,
Norwegian University of Science and Technology, 7491 Trondheim, Norway.
jenny.bergschold@ntnu.no

Introduction

The Norwegian population is aging and Norwegian welfare services for the elderly are extensive. As a result, Norwegian municipalities are anticipating escalating costs and searching for ways to manage this. Vehicle route problem solvers (VRP-solvers) are implemented in the belief that they will save on resource expenditure, thus lessening the financial burden (Ministry of Health and Care Service 2012[r]). As such, VRP-solvers are part of the increasing trend of adopting New Public Management (NPM) inspired means (Szebehely 2005[r]; Trydegård 2012[r]; Vabø 2005[r]; 2007[r]; 2009[r]) to govern the welfare state.

VRP-solvers are technologies that are capable of calculating 'optimal' driving routes by drawing on geographical data. Additionally, it renders the driving routes available to homecare workers in the form of schedules. Often by way of a handheld unit. Tests have shown that VRP-solvers are able to reduce time spent planning driving routes and traveling between care recipients' homes by at least 7% and at least 20% respectively (Eveborn, Flisberg, & Rönnqvist 2006[r]). The question that remains, however, is what happens after implementation?

Homecare workers were found to spend considerable time and effort correcting the driving routes incurred by, what seemed to be a 'malfunctioning' VRP-solver. To study the use of the VRP-solver and its implications, this study draws on domestication theory (Berker, Hartmann, Punie, & Ward 2006[r]; Lie & Sørensen 1996[r]; Sørensen, Aune & Hatling 2000[r]). Domestication theory argues that implementation of technologies can never be assumed to be rational, linear, or monocausal, as user-technology relationships are always sites of innovation where reality is produced through mutual adaption.

The next section elaborates on Norwegian homecare services and VRP-solvers. Subsequently, domestication theory and research methods are described. Then, concepts from this theoretical framework are applied in the study of a VRP-solver in a homecare service unit in Norway. Finally, the last section discusses the findings.

Vehicle route problem solvers in homecare services

In Norway, homecare services are part of the municipal health and social services. Homecare services include medical assistance, as well as other types of services. They are provided to people whom, due to illness, disabilities, or other issues, are unable to manage daily activities on their own. Help provided by homecare services includes, but is not limited to: wound care, administration of medicines, personal care, assistance with preparing and eating meals, medical observation, personal hygiene, laundry, food preparation, and dishwashing.

A considerable amount of homecare work is performed outside of immediate interactions with care recipients. Part of this work is the transportation to and from care recipients' homes. Planning driving routes is a complex and time-consuming task. It requires that the persons responsible consider the tasks to be performed for each client, the level of professional knowledge required for those tasks, and the distance between each residence. In addition, some tasks are particularly time-sensitive, such as the administration of medication at set times, or the providence of basic everyday tasks including getting out of bed, performing personal hygiene, or getting dressed. However, workers may not always be on time and care recipients must often adjust to the temporal rhythm of the organization regarding when such assistance can be delivered (Leppänen 2005[r]).

Homecare work simultaneously comprises 'caring for' and 'caring about' (Ungerson 1983[r]). While formally concerned with practicalities, homecare work involves other aspects too. Many studies in the field of homecare service studies have demonstrated that homecare work also involves and depends on emotional labour. Such emotional labour may include provision of comfort, empathy, and shared joy and sometimes occurs at the expense of homecare workers well-being[1].

Homecare work is much like any frontline human service work, where 'street-level bureaucrats' (Lipsky 1980[r]) provide services to dependent recipients. It is a form of work that implies the application of some form of moral judgement (Hasenfeld 1983[r]; 1992[r]). Ultimately, these practices form the final policy product which is delivered to the public (Lipsky 1980[r]). This means that homecare work, including travelling between care recipients' homes, is not merely a matter of logistics, but also a matter of care and ethical concern. Similarly, the issue impacts workers' conditions of labour. Consequently, to frame any aspect of homecare work in purely quantifiable terms is inevitably reductionist.

The Norwegian government places critical importance on managing the tensions between its limited sources and its increasing ageing population. As lifespans increase and medical technology allows for better diagnoses, the clientele to whom welfare organizations must cater is growing rapidly (Ministry of Health and Care Service 2012[r]) and the population is encouraged to remain in their own homes throughout the ageing process as opposed to moving into institutional homes. Thus, in Norway, ageing entails becoming increasingly reliant on homecare services to manage everyday life and a well-functioning homecare service is of vital importance.

As municipalities seek to cut costs, many homecare service organizations have implemented VRP–solvers. In the field of management and operations research, the issue of creating optimal service routes is known as the 'vehicle route problem(s)', or 'VRP' (Dantzig & Ramser 1959[r]). The following section demonstrates

1 See e.g. Astvik 2000[r]; 2002[r]; 2003[r]; Barer 1992[r]; Davies 2001[r]; Eliasson 2000[r]; Fahlström 1999[r]; James 1992[r]; Petersson, Leppänen & Jönsson 2006[r]; Szebehely 1995[r]; Wærness 1984[r].

how VRP is described in the field in general and in relation to homecare services.

The basic model of VRP is the Capacitated VRP (CVRP). The CVRP describes fleets of identical vehicles located at a central depot that need to be optimally-routed to supply a set of customers with known demands. Each vehicle can only perform one route and the total number of customer deliveries cannot exceed the fleet capacity. A variety of the CVRP is the 'VRP with Time Windows' (VRPTW) which expands the basic CVRP by imposing the condition that each customer is visited within a specific time interval (Baldacci, Mingozzi, & Roberti 2012[r]). Toth & Vigo (2001[r]) describe how the VRP can be understood as composed of five basic components: road network, point of service delivery, depot, vehicles, and drivers. All of these components are subject to constraints that can influence the calculation of the optimal route. In the context of homecare services, these constraints includes visits to care recipients being scheduled at precise times, this may be due to medical issues but may also include other reasons. Such time windows place constrains on the system because they influence the order of visits. Medical deliveries to care recipients may involve going to another location before travelling to the client recipients' home, which will also influence the order of visits. The vehicular and driver capacity of the depot may differ each day, and staff working hours may impose a constraint on the fleet capacity. Such constraints and many others create different problems which must be solved as part of the driving route planning process.

The VRP problem and its varieties are well researched[2], in terms of the mathematical complexities involved scheduling operations in home health care services[3]. However, only a few studies describe VRP-solvers after implementation in the practices of delivering homecare services to care recipients, and those that do have only tested the technology under controlled circumstances.

Eveborn et al. (2006[r]) describe the development and testing of a VRP-solver which they refer to as 'Laps Care'. They demonstrate a 7% decrease in total working time for the unit, a 20% decrease in travelling time, and that gathering staff members for 30 to 45-minute long morning meetings can be reduced to a fraction. Similarly, Angelsen (2013[r]) reports successful results of a project that developed and demonstrated a VRP-solver in the form of a web-based geographical information system specifically developed for Norwegian homecare services. Design and development processes were based on dialogue with representatives from the Development Center for Homecare Services Nordland.

Both VRP-solvers described in these studies draw on geographical data in order to provide homecare workers with a schedule that is constructed around the geographically-optimal driving route, while considering that visits to care recipients' homes must occur at particular times. In addition, the above described studies have demonstrated substantial time saving on driving routes when calculations adopt precise geographical data rather than estimates.

However, studies of VRP-solvers consistently scope results in a reductionist manner, merely relating them to financial gain. Moreover, the results are embedded in the implicit assumption that the implementation and use of technologies is linear, rational, and monocausal. In other words, they imply that technologies are impervious to their social context and user-technology interactions, and are merely carriers of reliably predictable outcomes. While there is no denial that technologies are forceful actors, domestication theory entails a protest against the notion that this forcefulness can be assumed to be inherent in the technology itself (Sørensen 2006[r]).

Domestication

In the field of social studies of technology, domestication theory is part of a sociotechnical approach that perceives technology and society as mutually shaping one another (Bijker, Pinch, & Hughes 1987[r]). Domestication theory suggests that we study user-technology relationships as sites of innovation and productions of everyday life. Originally developed in a collection of empirical studies in the field of media and communication studies (Silverstone & Hirsch 1992[r]) more contemporary accounts of this theoretical framework has inspired empirical research in variations of mutual adaption between technologies and social contexts for a wide variety of technologies[4].

Domestication studies in the field of social studies of technology focus on three main features of the co-production of the social and the technical: 1) Sets of practices related to an artefact, 2) the construction of meanings, including the role the technology may play in relationship to actors' identity production and 3 processes related to learning (Sørensen et al. 2000[r]). This particular 'flavour' of domestication studies engages with ideas from Actor-Network Theory (ANT) and semiotic approaches to understanding technologies (Akrich & Latour 1992[r]; Latour 1988[r]; 1992[r]). In this version, domestication studies emphasise the construction of everyday life and are less concerned with the household or consumption (Sørensen 2006[r]).

The concept of a 'script' (Akrich 1992[r]; Akrich & Latour 1992[r]) may be used to describe the sociality/agency of technologies in user-technology practices. When objects are designed, the manner in which they are meant to interact with users and vice versa is inscribed in their physical form and function. In this manner, the

2 See Toth & Vigo (2001[r]) for a comprehensive overview of the field, or Baldacci, Mingozzi and Roberti (2012[r]) for a more recent account
3 See e.g. Nickel, Schröder and Steeg (2012[r]); Cheng and Rich (1998[r]); or Bertels and Fahle (2006[r])
4 Berker et al. (2006[r]), Levold & Spilker (2007[r]) and Lie & Sørensen (1996[r]) are three useful anthologies for those interested in overviews

design of an artefact defines actors with 'specific tastes, competences, motives, aspirations, political prejudices [...] thus like a film script technical objects define a framework of action together with the actors and the space in which they are supposed to act' (Akrich 1992[r], 208).

Scripts are based on designers' understandings of users and their needs. Such understandings may come from informal inquiries, or more formal procedures such as market surveys and user trials (Akrich 1995[r]). When technologies are used, they are interpreted by their users. An important influence from ANT is the idea that scripts can be contested by users who consciously seek to override inscriptions (Sørensen 2006[r]). While designers' scripts and users' interpretations may coincide, it is common for the original script to become the subject of negotiations (Berker 2011[r]). For example, users may avoid using certain functions, or develop methods of 'tricking' or ignoring the script to produce desired results. Such actions may be understood in terms of a process where the technology is re-engineered (Sørensen 2006[r]). In theoretical terms such 'tinkering' with the original script is here understood as *anti-programs* (Latour 1991[r]).

Another important contribution from ANT is the understanding that 'mutual adaption' is the complex movement of objects into and within existing sociotechnical configurations. Domestication of a technology may be understood as the phenomenon where a script is re-engineered in user-technology relationships, and becomes associated with practices, meanings, people, and other artefacts to form unpredictable heterogeneous networks of humans-devices-knowledges-institutions (Sørensen 2006[r]; Sørensen et al. 2000[r]). Networks are performed as users draw on symbolic, practical, and cognitive resources, and are rendered empirically visible as observable patterns of use (Sørensen et al., 2000[r]). Such heterogeneous outcomes may also be understood as *cyborgs* (Haraway 1987[r]) or monsters (Law 1991[r]). At this point, the technology has gone beyond the boundaries of a single device to become a different entity (Haddon 2006[r]). As actors move into, out of, or within networks, they change. Thus, actors are 'fluid' although they may become stabilized in networks (De Laet & Mol 2000[r]; Mol & Law 1994[r]). From this perspective, sociality or agency does not designate a domain of reality or individual traits of actors, but 'a movement, a displacement, a transformation, a translation, an enrolment' (Latour 2005[r], 64). Crucially then, the enactment of technology is equally dependent on the script and what the user does with this inscription (Latour 1991[r]). For example, studies of television sets in domestic settings show how the placement of the TV contributed to its uses and meanings, as well as the production of everyday life (Sconce 2000[r]; Spigel 1992[r]).

Jelsma (2003[r]) shows how scripts can be understood as revealing of the morality of devices. A 'strong' script may offer few alternative actions, while a 'weaker' script may be understood as less normative of user actions (Latour 1992[r]). Nevertheless, even strong scripts are mediating but not determining of user practices (Jelsma 2003[r]). Domestication studies understand user-technology relationships as unpredictable sites of innovation. However, 'unpredictability' here does not merely refer to the configuration of networks also but to their outcomes which may have *trickster* qualities (Haraway 1991[r]), meaning that implications may be unpredictable even to users themselves (Berker 2011[r]).

Method and case description

Theory application in studies of domestication is a methodological issue (Hartmann 2006[r]). Users are experts on the implicit conditions of using their technologies in the course of their everyday lives. However, when technologies have become domesticated, users' knowledge of what or why something is done when engaging with the technology may have become tacit. Arguably then, domestication studies require repeated engagement with the participants, preferably in the course of on-going practices as this accommodates questions which may elicit such tacit knowledge. For this reason, I employed a research strategy that combined participant observations of regularly reoccurring practices of use with questions regarding users' on-going activities and choices.

The empirical material was collected during the autumn of 2015 and focuses on two different types of use and users in a homecare service unit in a Norwegian municipality. The analysis is explorative and based on abductive inferencing (Reichertz 2007[r]). The material was coded using emic as well as etic codes. Emic coding served to identify practitioners' perspectives on the domestication of the VRP, while etic coding served to integrate the same with the theoretical framework. During fieldwork the emerging material was continuously subjected to open coding using emic codes. Etic codes derived from domestication theory served in the checking process. This type of analytical procedure may be described in terms of social constructionist grounded theory (Bryant & Charmaz 2010[r]; Charmaz 2014[r]). The material was constructed using a combination of participant observation and qualitative interviews. Participant observations enabled a focus on procedures of scheduling as processes of using technologies in practice. Additionally, questions, which sought to encourage homecare workers on-going reflections regarding their actions and choices, were asked throughout those observations. Due to privacy concerns, identifying features such as the names of participants and the geographical location of the unit in question have been anonymized.

As part of a larger project concerned with the delegation of work to technologies in the Norwegian welfare state, the fieldwork for this study started out as an exploration of sociotechnical processes in homecare work with and without clients. No specific technology or process was selected for study prior to commencing fieldwork. I contacted several homecare service units, described my interest in studying technologies in homecare service work with and without clients, and asked if it would be possible for me to accompany one or several homecare service workers in the course of their work to 'observe and ask questions'. I was able to gain access to a homecare service unit after only a few attempts. I also negotiated the conditions and terms of my participation in procedures with the individual research participants. I would then ask if I may accompany them to study 'the role of technologies in their work with and without clients', and when doing so 'take notes of everything that happens in the course of the day, ask questions, and make audio recordings of our conversations'. All homecare service workers who were approached agreed to participate.

A participant observation covered the entire working day. This means that observations started at the point when workers arrived at the offices at the start of their shift and ended at the point when they left for the day. The size of the sample included in this article may be described in at least two ways. One way would to be to say that this is a study where observations were conducted and questions asked during an 8 hour long working day for one planner and seven meetings where 20-25 homecare workers simultaneously corrected driving routes. Some of those homecare workers were the same from time to time, some were not. In total the sample comprised the planning activities of 57 individuals. Another way of describing the size of this study would be to describe it in terms of its possible implications for care recipients. During each of the 7 meetings that were observed, 20-25 homecare workers rearranged the driving routes for 7-12 care recipients per homecare worker.

After completing an observation, I would immediately seek out an isolated place to complete my field notes, expanding on the shorthand notes I had collected throughout the day. I would add initial analytical reflections to my field notes and take note of future questions to be asked. Typically, this treatment took three to four hours and resulted in eight to nine pages of typed text. All audio recordings were transcribed *ad verbatim* by myself or by an assistant.

While the focus of the initial observations and questions regarding procedures was 'the role of technologies in homecare work with and without clients', it soon became apparent that a subsection of this field was of great importance to the participants. It turned out that all homecare workers spent considerable time every day correcting mistakes in their driving routes. Despite the fact that the organization had implemented a VRP-solver. On noticing this, I focused my observations on how these problems were handled and made the effort to explore how and why the VRP-solver 'malfunctioned', by observing how the planner used the technology to make schedules. During these observations, I paid particular attention to any understandings related to why the VRP-solver had to be used in this particular manner, even though it clearly meant that resultant driving routes would be problematic.

The VRP-solver studied here is a software with two sets of user interfaces split over two types of hardware. One in the form of a software installed on a PC while the other is in the form of a handheld extension of the same software but installed as a smartphone app. In the PC version, the software consists of a planning interface which allows 'planners' (i.e. employees) tasked with the production of schedules for homecare workers to plan visits to care recipients and draw on geographical data to ensure that schedules constitute geographically-rational driving routes. When the system is first installed, the user registers the data of employees (i.e. form of employment, availability, etc.) and care recipients (i.e. tasks to be performed by the homecare workers during the visits, medical information, address, phone numbers, etc.). In addition to the data entered by the user, the system contains geographical information in the form of maps with detailed information of the road network. As users enter care recipient data, the system matches addresses with positions on the map and calculates the travel time between them.

Homecare workers work with the handheld extension of the software. The handheld device provides the user with the opportunity to view the schedule as a list and as a driving route which is displayed on a map. Together, these two features comprise the VRP-solver. However, the handheld device also includes several other functions, such as the opportunity to view and write information relevant to the tasks performed with care recipients. In addition, the handheld unit holds specific material properties. Such complexity is typical for many modern ICTs and may be understood in terms of two main observations: Firstly, it has the capacity to house much information in a 'small package'; Secondly, it is mobile and easy for homecare workers to carry around in the course of their work.

Domesticating the vehicle route problem solver

I'm attending a routine 30-minute meeting which marks the start of every shift. I'm sitting at the table with a homecare worker and her handheld device, both of whom I'll be accompanying today. We are in a room with four tables and every seat is equipped with a printed schedule with the employees' name at the top, a pen, and a bunch of keys. While relatively quiet, the room is brimming with activity. Everybody is busily writing in the margins of their schedules.

The schedule that this homecare worker is working today adds up to 3 hours and 40 minutes' worth of tasks to be performed at 10 different addresses in the 4 hours before her lunch break. At lunch, she will receive a new schedule for her afternoon. Her first client visit is scheduled at 0800hrs, which is also when the morning meeting ends.

The homecare worker is writing the new order of client visits [2,6,8…] in the margin of the printed schedule. 'I'll talk to you in a moment, I just have to figure this mess out first', she says. She is familiar with the addresses and so knows how much time the drive will take – 'well, approximately at least!' – and how she can save time. Some re-orderings move clients from the end of the list to the beginning, some are only moved slightly, *but all are rearranged. Around us the other members of the shift-team are working on their own schedules while drinking their morning coffee. All work is performed on paper. The handheld devices remain untouched.*

The travel time between care recipients' homes is not accounted for within the time frame designated in each shift. The 'mess' to which the homecare worker is referring, is that as a result the schedule does not reflect the reality of homecare workers. They are thus tasked with finding a manner of physically transporting themselves between care recipients' homes, within the timeframe at their disposal. To 'figure out' the mess means to find a way of enabling oneself to do so. When homecare workers were asked to reflect on the necessity of performing such manual corrections of the driving routes, they often responded by explaining why it was important to them that the driving routes were functional, as well as how a functional driving route is ideally configured.

> *'Well it [the schedule] is our main tool when we work so it is important that there is a flow, you know… [So] that there is not, well, not one stop there and then we have to go all the way in the other direction, and then back again. So we need to put it together in an 'okay' manner, otherwise we won't be able to make it in time'.*

In the course of this explanation, the homecare worker points to the three first names on her schedule, implying that the geographical distance between them is not only far, but also arranged in a manner which disrupts 'flow'. From this illustration, corroborated by many similar explanations from other homecare workers, it is possible to infer three main observations of the homecare workers' situation. Firstly, homecare workers require a driving route with 'flow' for them to be able to perform all visits to care recipients' houses within the time frame at their disposal; Secondly, a driving route that 'flows' arranges visits to care recipients in an order which privileges geographical location; Thirdly, the schedules handed to homecare workers at the start of their shift usually do not 'flow'.

To the homecare workers, the functionality of driving routes seemed limited to this notion of 'flow'. Notably, the reorganization of the driving route privileged geographical rationality and finishing on time over care-related issues, such as the timeliness of visits. This is potentially problematic as the timeliness of visits to care recipients is, amongst other things, tied to the administration of medicines, the changing of diapers and catheters, the help to get out of bed and start one's day, the provision of meals, and clients' rights to be able to live and plan life autonomously. Moreover, that homecare workers experience a need to geographically optimize driving routes manually is a somewhat surprising find in a homecare service unit where a VRP-solver that draws on geographical data to perform this very task has been implemented. Nevertheless, the observation made on that first day turned out not to be a unique case. At the start of every shift, all homecare workers in this unit routinely spent approximately 30 minutes correcting the mistakes of what was clearly a malfunctioning VRP-solver in order to construct 'flow'.

Unravelling the 'malfunctioning' Vehicle Route Problem Solver

The homecare workers' explanations were often practically oriented towards the nature of their problem and their understanding of what their activities needed to achieve. However, the planners' answer to questions concerning the time estimates allotted for travelling offers a somewhat different perspective on the social circumstances in which the VRP-solver has been implemented.

The interface is similar to a Gantt chart. All schedules are visible on the screen. Each schedule is a horizontal bar that represents the timeline of the relevant shift, e.g. 0800hrs to 1200hrs. Planning starts by importing all of the relevant visits to care recipients' homes to the interface. They pool at the bottom of the interface, which is also organized like a bar along a timeline. To make the schedules, the planner drags care recipients' names from the pool at the bottom of the screen and drops them the individual schedules. This means that if a name is dragged from the 0800hrs mark in the pool, it also dropped at the 0800hrs mark in one of the schedules. Every time a name is added to one of the schedules, the program sums up the total amount of time in terms of tasks to be performed during the visits, and does this for each individual schedule. She keeps adding visits to the schedules until the sum of each schedule is approximately 3.5 hours. This makes for a blanket estimate of 30 minutes of travelling time per schedule. When all the schedules are complete, they are printed, labelled with each homecare workers' names in handwriting, and neatly stacked in preparation for distribution to homecare workers at the start of the next shift.

> **J.:** *Is 30 minutes enough time to visit all of the care recipients?*
> **Planner:** *No, not really but it has been decided by the municipality [the municipal administration].*
> **J.:** *Oh?*
> **Planner:** *We are not allowed to [include driving time when making the schedules]. We are only supposed to include direct time [spent in direct interactions with care recipients] […] about 3.5 hours per schedule […]. Of course, it [the driving route] gets all wrong, but that is how it has been decided and then there is nothing we can do.*

While the VRP-solver is theoretically capable of producing schedules that are calibrated around the most efficient driving route by drawing on geographical data, the planner describes how she is unable to reproduce that script (Akrich 1992[r]; Akrich & Latour 1992[r]) because she has been instructed to not include driving time on the schedules. Instead, all schedules are planned on a blanket assumption that driving time will take 30 minutes. However, while the planner conveyed her acceptance of this rule, the issue is still perceived as problematic:

> **Planner:** *But then we say 'and how are we supposed to manage then?', but they don't care about that. It's just how it is going to be. So the issue with the time spent on travelling has been raised many times, but yeah. That's how it is. I mean the [municipal] politicians, right? They instruct those who are responsible for us [the homecare services]. And then our administrative manager, she has [name of*

municipal director of Health and Welfare services] who sits down in City Hall, that is her boss. So he tells her, and then she tells our operative manager, and she tells us. And that is how it goes.
J.: *So this is a long-standing struggle?*
Planner: *Yeah, it's a reoccurring discussion but we [planners in the municipality] are not allowed [to calculate the travelling time], so there isn't much we can do.*

The question of calculating as opposed to estimating driving routes is a long-standing struggle. The instruction is understood by the planner in terms of a problematic and political intervention in daily homecare service operations where the homecare workers, the planner and their manager is on one side and the municipal politicians is on the other. While relevant decision-makers have been informed that the blanket estimates are disruptive to the point where homecare workers question their ability to manage their work, the attempts to change the directive have so far been unsuccessful. It would not be unreasonable to presume that such a refusal may be related to an interest in resource savings.

Since the planner is prohibited from using the technology to calculate the driving routes, she uses other methods to approximate a geographically-optimal route as best as she can. When she drags and drops care recipients' names from the pool at the bottom of the interface, she tries to keep the clients that live in the same direction on the same schedules. In this way, routes are roughly kept within the same geographical area of the district that the unit must cater to. While we cannot assume that the instructions are made from a position of knowledge in relationship to the exact mechanics of the software, these instructions nevertheless shape the relationship between the planner and the VRP-solver in a specific manner. It produces a constraint that renders the planner unable to draw on geographical data whilst making schedules. However, they do not prohibit her from using the software altogether.

Using a Vehicle route problem solver without drawing on geographical data

As described in the excerpt from field notes included above, the planner at this particular homecare service unit has a method for using the VRP-solver to make schedules without drawing on geographical data. To accomplish this, she uses a feature in the software that allows her to 'switch off' map data, thus removing geographical data from the configuration. By doing so, it is possible for her to input a set value of 'direct time' – that is, time spent in interaction with clients. When this feature is used, the system does not include calculations of travelling time in the schedules. Instead, the system merely calculates the total amount of direct time added to each schedule. When names of care recipients are dragged from the pool and dropped into individual schedules, the system adds the time estimate of the tasks that are to be performed during that particular visit, to all of the previously added visits to care recipients along that particular route. This calculation is displayed in the form of a number that goes up every time a visit is added. If the total amount of time adds up to more than 3,5 hours the numbers turn red as an indication that no more visits may be added to this particular driving route.

As each schedule covers only four hours, this means that the system is effectively set to construct schedules around the parameter of traveling time using a blanket estimate of 30 minutes, and to disregard the geographical distance between the care recipients' homes. After all of the schedules have been finished, they are printed, labelled with each homecare workers' name in handwriting and neatly stacked in preparation of the routine of manual geographical optimization at the start of the next shift.

The planners' ability to draw on a feature to exclude geographical optimizing from the process of crafting driving routes may be understood in terms of a weak script (Latour 1992[r]) in the sense that it allows for a larger degree of flexibility in the relationship between the user and the technology. This weak script (Latour 1992[r]) allows the user to re-engineer (Sørensen 2006[r]) the technology from VRP-solver, to a device which merely counts the total amount of hours and minutes in client interactions. In this case, the planner uses this flexibility to disable the VRP-solver, thus effectively displacing (Latour 2005[r]) the part of the software that is concerned with VRP-solving. It is this displacement that enables her to simultaneously follow instructions and use the software, even when she is prohibited from basing the driving routes on calculations. Angelsen (2013[r]) describes a similarly weak script (Latour 1992[r]) in the form of a feature which allows the planner to override VRP-solving by entering set parameters. It may thus be presumed that such weak scripts are possibly common and/or not coincidental.

Anti-programming the handheld unit

In this section, attention is turned from the planner and the PC-based user interface and to the homecare workers and the handheld user interface. As previously described, manual driving route optimization has become a part of everyday operations and is routinely performed at the start of every shift by the homecare workers. Every day, as the homecare workers arrive to work, they sit down at tables where every seat has been supplied with a set of tools: A handheld unit (which contains the schedules made by the planner, as well as details on the tasks to be performed during visits to care recipients), a set of keys, and a printed version of the schedule contained in the handheld unit and a pen. In order to correct the 'mistakes' in the driving routes, the homecare service workers reorder the client visits so that the order is set in a manner where client visits reflect the most rational geographical driving route, to the homecare workers' knowledge. By doing this, they enable themselves to 'make it in time'. This method of reordering the visits may be understood as a way for the homecare workers to empower themselves, not only in relationship to the 'faulty' schedule, but also in relationship to the hand held device itself.

The handheld device is, in essence, an extension of the VRP-solver in the form of a windows phone were an app is installed. Materialized in this manner, the VRP-solver is rendered mobile. In comparison with the planners' PC-based VRP-solver interface, the handheld device only allows for a very limited set of actions in relationship to driving routes. Users of the handheld device may access and look at their own schedule. They may also look at other users' schedules. Users of the handheld device are however *not* able to change the order of visits, and they may not draw on geographical data to match the addresses on their list to their geographical positions in relationship to each other. These restrictions may be understood in terms of a script that contains rules about the manner in which users are meant to interact with the technology (Akrich 1992[r]), in this care which role homecare workers should have in relationship to driving routes. Relying on the implicit assumption that planners are able to produce optimal driving routes by drawing on geographical data when making schedules, these rules dictate that homecare workers should not make but only receive driving routes. From the perspective of the homecare workers, the logic embedded in the device, to order client visits by when they should occur and prohibit any alternative ordering, becomes a problem. A 'flaw' in the designers' script that must somehow be solved if they are to be able to perform all of the visits to care recipients on their route.

By renumbering the order in which they will visit clients in the margin of the printed list, homecare workers draw on their individual knowledge of the geographical area as a way of getting around these restrictions. This thus provides an antiprogram (Latour 1991[r]) to the LMP's script (Akrich 1992[r]; Akrich & Latour 1992[r]), which stops them from interfering with the driving route through the handheld device. By deploying the antiprogram (Latour 1991[r]), the homecare workers are able to render the handheld unit incapable of stopping them from interfering with the driving route. Thus the antiprogram (Latour 1991[r]) provides a means for the homecare workers to re-engineer (Sørensen 2006[r]) the technology and empower themselves in relationship to the script (Akrich 1992[r]; Akrich & Latour 1992[r]) by displacing (Latour 2005[r]) the handheld device from activities concerned with driving route problem solving.

The meetings during which the homecare workers optimize driving routes take approximately 30 to 35 minutes every shift. The routine of starting every shift with a meeting existed before the VRP-solver was implemented into the organization. Originally, these meetings provided an efficient manner of spreading information concerning any developments in care recipients' needs during the night or the shift before. After the implementation of the VRP-solver, this information is now available to the homecare workers in the handheld devices they carry. However, the implementation of the VRP-solver has not rendered the meetings superfluous to the operation of the homecare service unit. Instead, the time is used for the manual optimization of the problematic driving routes and so these meetings are still performed at the start of both shifts.

Understanding and attributing meaning to the technologies

However, aspects of the handheld device has nevertheless managed to enter into networks of practices. In some situations, the homecare workers unanimously praise the handheld device for its usefulness and the convenience it provides. More importantly, however, such accounts did not concern the part of the technology which is the VRP-solver. Users who were initially opponents to its implementation typically expressed how the handheld device was so useful to them that they would not be able to do their job without it. Sometimes, they would even express that they love it:

> **Homecare worker (HCSW)**: *It is super easy and really good to use, and I have to say that I was one of the biggest opponents.*
> **J.:** *You were? What did you picture as problematic?*
> **HCSW:** *That it was going to be too hard. I would have to learn a lot of new things, IT and stuff... Start to find where everything is on this thing, right, on [the LMP my note] this... thing! And then I thought to myself – shit, I'm supposed to have to fiddle with this and look for things? But then one evening shift I sat and just fidgeted a bit with it and then suddenly – 'damn! I can write a report on this!' And then I realized you know... and now I love it. I can't work without it*

The ability to write reports on the handheld unit was a highly appreciated feature, because it meant that workers no longer had to wait for one of the computers at the offices to become available, and thus saved them time. The ability to write reports immediately after visits, rather than having to wait until one came back to the office, decreased the risk of forgetting information. In this case, it was the material script (Akrich 1992[r]; Akrich & Latour 1992[r]), the mobility of the device, as well as the software itself that facilitated domestication.

Another important feature on handheld devices that was often mentioned by users was that it relieved them of the burden of carrying instructions and information in paper form:

> *'We were going to start using this and read the assignments on it... and... we used to have these paper lists. Really thick ones, like ten pages where everything we were supposed to do for care recipients was written, and I thought 'oh my god and now we have to learn this as well?' But now I love it, now I can't work without it! Nowadays, I can't stand the papers, I only carry this one where I've noted the order of visits'*

In this and other similar accounts, the technology's ability to enter into the network of practices (Latour 2005[r]; Sørensen et al. 2000[r]) is made dependent on how its mobility works together with the software's capacity to house much information in a 'small package' to relieve the homecare worker of the 'really thick' stacks of paper, rendering her work paperless. The homecare workers unanimously praised these two specific features. In these accounts, the handheld device is described as more than a technology. It has transformed into something beyond the technology itself (Haddon 2006[r]). It has become something with which one can have an emotional relationship. Using it has become a natural part of being a homecare worker, to the point where homecare workers feel it would not be possible to perform homecare work without it.

These descriptions of the handheld unit reveal how end-users could keep using it to fulfil desired results by translating (Latour 2005[r]) it to their own needs. This occurs implicitly by 'fidgeting' with the unit (i.e. to learn how its functions may be advantageous), and explicitly by using it as a time saving resource (i.e. when writing reports) and a source of knowledge (i.e. when using it as a replacement to the paper reports which they used to have to carry). Typically, when homecare workers account for how scripts contributed to the fulfilment of their needs and desires, they draw from personal instead of collective experiences. Without such personal revelations of how the technology fits with their needs and desires, the practical, symbolic, and cognitive adaptions that are necessary for domestication to embed the technology into the daily routines might be less likely to occur. More crucially, however, signs that of the technology had entered into networks of practices never occurred in relationship to the handheld device in its capacity of a VRP-solver.

The planner too, while using less affectionate terms, expressed an appreciation for the system when I questioned the value of the technology when she was not able to use it for calculating driving routes:

> **J.:** *But is the technology not essentially useless to you now? [after the capacity to calculate routes has been disabled]*
> **Planner:** *But it does help me, it helps me with all of the information on the clients and on the employees. Of course, doing it in this way takes a lot longer both for me and for the others [the homecare workers] but I would not say that it is completely useless.*

Even though the software does not function as a VRP-solver, the planner is still able to appreciate it. Her appreciation is due to its usefulness in storing all the relevant information needed to fulfil the task of making driving routes. In this case, the technology's ability to enter into networks of practices (Latour 2005[r]; Sørensen et al. 2000[r]) is facilitated by the software's capacity to store a great deal of information in one place and the possibility to draw on that information, such as how much time a specific visit is estimated to take when constructing schedules. It is this weak script (Latour 1991[r]) that allows the planner to disable this function. Effectively displacing (Latour 2005[r]) the VRP-solver component from the software by using a feature of the program itself, as opposed to having to construct an antiprogram. It is this weak script that enables her to use the software even without the VRP-solver component. Consequently, it is possible to observe that in this case, the weak script is constitutive of the faulty driving routes rendered through use of the PC based version of the VRP-solver. A second observation is that this domestication is somewhat ironically constitutive of the removal of the very aspect that makes it a VRP-solver i.e. the capacity to calculate optimal driving routes by drawing on geographical data. A removal which in turn, occasions the need for homecare workers to displace (Latour 2005[r]) the handheld VRP.

Similarly, in its capacity of a VRP-solver, the handheld device was treated as inconsequential. It was not mentioned in discussions between colleagues when routes were planned, nor touched during route planning activities. In fact, it was only referenced when I asked direct questions concerning its use, whereupon workers would typically dismiss it as something that had nothing to do with driving routes. While the homecare workers were not able to draw on a weak script (Latour 1992[r]) to re-engineer the handheld device. They were nevertheless able to re-engineer it by deploying an antiprogram (Latour 1991[r]) which effectively displaced it from operations related to driving routes. In relationship to the handheld device as well, at this point domestication has meant displacing (Latour 2005[r]) the handheld device.

In processes of domestication, the technology becomes part of users' everyday lives. This implies that end-users are pivotal to the design of new technologies (Berker 2011[r]). As the case of the handheld unit demonstrates, technologies may or may not alter existing routines depending on whether or not end-users have been able to make personal experiences of the technology as capable of fulfilling their needs. When end-users understand scripts as inconsequential or even hindering to necessary activities, the technology may lose the normative capacities envisaged by designers or implementers (Berker 2011[r]). However, when scripts align with end-users' interests, the technology's capacity to deliver predictable results may be less challenged.

Vehicle Route Problem Solver Displaced

This study has shown that the PC-based VRP-solver is rendered 'malfunctioning'. Through processes of domestication it becomes unable to provide homecare service workers with driving routes which they deem functional. Additionally, it has showed how this 'malfunction' renders the VRP-solver in its handheld form understood as inconsequential to the very decisions it was designed to support. Together, these processes of domestication result in the displacement of the VRP-solver from all practices related to driving route planning. For this reason, it is likely that a performance evaluation of the technology would find that the implementation of the VRP-solver fails to live up to expectations, such as the capacity to decrease travelling time by 20% as described in Eveborn et al. (2006[r]). In such a scenario, it is likely that decision-makers may question the quality of the product and seek alternate options.

Studies of technologies in domestic households have shown how the placement of a technology was found to be an important aspect of domestication. Where the TV was placed shaped its uses, meanings, and functions (Sconce 2000[r]; Spigel 1992[r]). In the case of the VRP-solver, domestication has entailed its displacement from networks of activities where route planning is performed. As a result, end-users experience a need to geographically re-configure the driving routes. The displacement the handheld unit is partly dependent on the script in the handheld unit. This script presupposes that end-users are passive consumers of geographically optimal driving routes, as opposed to interested in and capable of constructing them. Antiprograms may involve displacing the VRP software from operations concerned with vehicle route problem solving. Implicitly, by issuing an instruction that, whether intentionally or unintentionally, prohibits planners from drawing on geographical data when making driving routes; or explicitly, by deploying an antiprogram which effectively renders the handheld unit inconsequential to homecare service workers' decisions in relationship to driving routes.

The script of the handheld device is also a question of presupposing certain patterns of presence and absence in planning activities. In the case of the handheld VRP-solver, this script is 'strong' there is not much scripted flexibility, and thus, not much mutuality in the adaption between users and the technology. Users' activities are restricted to adhering to the script or finding ways around it. As Jelsma (2003[r]) argues, scripts that allow or disallow user actions may also be understood as more or less normative in relationship to moral actions. As previously discussed, homecare work, much like any frontline human service work where street-level bureaucrats (Lipsky 1980[r]) provide services to dependent recipients a form of work that implies the application of some form of moral judgement (Hasenfeld 1983[r]; 1992[r]). Ultimately, these practices form the policy product which is ultimately delivered to the public (Lipsky 1980[r]). In this case, it is likely that the homecare workers practices of reordering the driving routes in order to achieve functionality, results in untimely visits to the care recipients.

In the case of the VRP-solver, the weak script that allows the planner to turn off geographical data may, somewhat ironically be understood as a strong script with a high dose of moral normativity that gains trickster qualities (Haraway 1991[r]) through processes of domestication after implementation. The planner is able to switch off geographical data, but she is unable to switch off the feature that lists the order of client. In other words, the script normatively privileges the timeliness of visits to care recipients over geographical rationality. Similarly, the scripting of the handheld unit prohibits homecare workers to interfere with the timeliness of visits by disallowing the digital reordering of visits. However, homecare workers have had to find ways to enable themselves to 'make it in time', they aim to achieve 'flow' by deploying an antiprogram that displaces the handheld unit from the social network, and thus by implication, also displaces the moral normativity of the script (Jelsma 2003[r]). In terms of domestication theory, we are reminded of how actors change as they enter into, move within, and transit out of networks, sometimes gaining trickster qualities in the process.

In the case of the 'malfunctioning' VRP-solver it is reasonable to assume that homecare workers activities of spending 30 minutes correcting the driving routes, and the very real possibility of untimely visits to care recipients, are both unintended implications or trickster qualities of these networks. In relationship to techno determinist understandings of the implementation of technologies as rational, linear and monocausal, the study of the VRP-solver is a case in point. Scripts do not determine users' behaviour.

In a study of Norway's domestication of the mobile phones, Sørensen and Nordli (2005[r]) found that perceived convenience led initially resistant users to be surprised at their need of their devices. This seems to be the case in relationship to the handheld device as well. Initial resistance is overcome by the notion that the technology greatly facilitates everyday practices. While new technological devices can be understood as separate entities, their entrance into everyday life means they not only enter into networks, but also that existing networks change and that technologies change with them. In the case of the handheld device in relationship to information on the care recipients, domestication has meant that the network has transformed in a specific manner. The 'piles of papers' that had to be carried around previously have exited the network, and so has the need to write reports on stationary PCs at the homecare service office.

The handheld unit was recognized as a facilitator of familiar and important practices, such as carrying around information on care recipients. Features perceived as useful by end-users were not only added to networks of actors, practices, and knowledge of transporting and carry and documenting information on care recipients; they also changed the network by displacing previous actors (i.e. papers and stationary computers) and changed aspects of everyday life (i.e. carrying papers, waiting time). By contrast, the single papers' ability to allow homecare service workers to reconfigure the order of visits to care recipients displaces the VRP component of the handheld unit from networks concerned with driving route planning. While delimitation of homecare workers control over workload in relationship to timeframe led to displacement. The same device manages not only to enrol homecare workers in a network, but also become an emotional object. In other words, it is loved in its capacity of facilitating the performance of homecare work. These findings strengthen the argument that the capacity of technologies to enter into networks of practices seems intricately tied to the ability of being perceived as supportive of end-users' interests and motives.

From a sociotechnical perspective, creative antiprograms deployed by end-users is not unexpected, and may be understood to serve as compensatory functions (Berker et al. 2006[r]). In this case the homecare workers understand the original configuration of the driving routes in their schedules as faulty to the point where they will not be able to perform all client visits within the timeframe available to them. It might be added that this is not a unique case. Their experience is supported by the findings of Holm and Angelsen (2014[r]), who found that driving time in the homecare services was routinely underestimated by at least 22 % when estimated by planners who were not able to draw on geographical data. Moreover, the homecare workers perceive handheld units to be useless in the venture of optimizing routes. In this scenario, it must be acknowledged that the homecare workers have the option of failing to perform their routes and simply go home at the end of the day, regardless of whether they have been able to visit all care recipients. Acting in this manner may even be a strategic choice in terms of rendering the problem visible to the larger society, as it is likely that a failing homecare service would put pressure on crucial decision-makers to disallow rough blanket time estimates. Instead, the homecare service workers make use of the antiprogram (Latour 1991[r]) and draw on their tacit knowledge of the geographical area to construct routes that are as geographically optimal as possible under their circumstances. While this compensatory work solves the immediate problem on a day-to-day basis in part, it may also be understood as problematic in terms of addressing the larger issue as it serves to obscure how and why the VRP-solver 'malfunctions'.

The case of the 'malfunctioning' VRP-solver could be understood as the result of a misunderstanding of how the technology works. There can be no assumption that the instruction to exclude calculations of driving routes comes from a position of knowledge with regards to how the technology works. However, the technology includes features for turning the VRP-solving feature off in the planning interface, effectively setting the system to privilege blanket estimates over calculations. As I have previously argued there are also other indicators that such script may be commonly occurring. This might indicate that designers foresee situations where the software is bought but not used to its full capacity. It might also be observed that being seen to implement a technology which calculates 'true' distances while ensuring that using that software will never result in driving routes that exceed a predetermined time-frame might hold political value. Nevertheless, the same instruction also results in driving routes that are disruptive to the point that every homecare worker spends 30 minutes at the start of every shift to correct them. While this study has not been concerned with understanding the motives and understandings of managers regarding the use of the device(s), it is not unreasonable to assume that this problem-solving routine may be an unforeseen implication of the instruction to base all driving routes on a blanket estimate of 30 minutes.

Domestication studies teach us the importance of considering the relationships between technologies and users. The implications of technologies are hard to predict, perhaps particularly so in the case of complex technologies like ICT's. In its capacity of being a VRP-solver the handheld device becomes an obstacle that must be overcome. In such situations, it is the user's capacity to displace the VRP-solver that is perceived as necessary to perform homecare work. On the other hand, certain features of the technology are boasted as necessary if homecare work is to be performed at all.

In a time where technologies are increasingly implemented in welfare institutions, cases like this may serve as important reminders. Because user-technology relationships are sites where innovation occurs reliance on tests under controlled circumstances is not sufficient. Understanding the work technologies do, requires the careful study of how technologies interact with the everyday life of those meant to benefit from them.

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