

Mediatiation of Work. A History of Control Room Practice

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In order to be a capable control room operator¹ two things are essential: to have a direct view on the water and to once have been a skipper. During my ethnographic fieldwork in Dutch inland navigation control rooms² many, often older and more experienced, operators told me this. A former skipper knows what it is like on water, what information a skipper needs, and how a ship behaves. The ideal would be for operators to have regular shifts on the patrol vessels to keep their knowledge of ever-changing rivers up-to-date, but most have accepted that as a thing of the past. Contact with water historically, practically and optically is deemed important. However, an operator in the control room of the Antwerp port disagreed when we came to the necessity of shipping experience: »air traffic control is not being done by ex-pilots either« (Fieldnote 07.04.17).

In fact, none of the German, Dutch or Belgian state-run organisations that operate control rooms for the coordination of traffic between Duisburg, Rotterdam and Antwerp – the busiest inland waterways in the world, actors regularly claim – require their operators to have shipping experience. The operators were once inland navigation skippers, constantly on the move in this transnational infrastructure, although most of the canals and rivers connecting the main nodes run through the Netherlands. Of the four »infrastructuring« (Star/Bowker 2006) organisations involved, the main Dutch infrastructure and engineering agency runs the inland navigation control rooms along these waterways, coordinating traffic at intersections. It is these control rooms that I will focus on in this article. Here operators have trouble taking anyone seriously who are not former-skippers. Almost any work-related utterance, usually from one of their superiors, can be legitimately repudiated, at least in the eyes of operators, with: »s/he never sailed«.

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- 1 Operator can be translated to German as »Bediener«. The exact title differs between control rooms: in train and emergency contexts the Anglicism »Dispatcher« is used in German. In the Dutch practice central to this paper the operators are titled »verkeersbegeleider«, which they translate to German as »Schiffsbegleiter« or »Verkehrsleiter«. For port and sea coordination of ships »Nautiker« is used in Germany.
 - 2 VTS, which stands for Vessel Traffic Services, is the international prefix commonly used for this type of control rooms and operators.

A direct view of the water is also no longer guaranteed. Many operators have no sight of the territory they monitor other than CCTV and radar layered with nautical maps and a geo-locative system called AIS (Automatic Identification System). This is because often different intersections, called ›sectors‹, are centralised under one roof and operators rotate every few hours between them, switching consoles. All control rooms still have a direct view of the water, as a rule grand panoramic ones, and are situated at the heart of the bustling ports or crowded intersections, but only for one sector this view actually corresponds with its interfaces. Practically, the view of the water is still used: binoculars are abundant, operators use them every shift, often huddle, peer over the water and discuss the event that has drawn their attention. Operators say the view allows them to factor in many variables at once (draft, visibility, wind, cargo) in order to assess the ability of a ship to manoeuvre. However, when I followed a cohort of future operators during the course of their formal training, neither binoculars nor direct sight of the waterway were ever a topic as training is done on simulators.

These experiences in the field drew me into historiography to address the question of what the genealogy of this contestation between organisation and profession is? How did skippers become operators, what changed for them when they did, why did the organisation recruit skippers initially and, most importantly, how did this experience become irrelevant? It is remarkable for such a fundamentally different understanding of the operator work – what an operator should know and be able to observe in order to do the job – to exist between those who do the work and their superiors.

This article covers the *longue durée* of lived infrastructure, detailing the emergence of control rooms and operator work. Both the operators and the agency set out to improve competence and serve publics, yet professional and organisational motives for formalisation and modes of accountability diverged. This materialised in practices of learning. It is argued that through the mediatisation of work, which here is shifting the observational scope from the waterscape to screens, a configuration of interfaces, learning could be relocated, which made the work ›simulatable‹. Therefore, what constitutes legitimate access to an ongoing community of practice was no longer controlled by operators, and no longer rooted in shipping. Thus, it is shown how *Homo faber's* move from mobile life to settled work transformed the intimacy of expertise. All of this is told through recorded (archives), retold (interviews) and observed (ethnography) practice, which cannot be equated – though every story asks for a little suspension of disbelief – and that are at times actively deployed to sound out the other, yet are also welcomed for how they resonate with each other, if one only listens.

Profession

Despite the overwhelming visuality of the control room, listening is a key part of the work, as communication between the control room and ships is done through marine VHF radio. Upon entering a sector, skippers tune to its frequency and notify the control room of their intentions. From my ethnographic research both on ships and in control rooms it is clear that nowadays skippers and operators talk quite differently. Operators are drilled in what is called ›conversation discipline‹. The »affordance« (Gibson 1977) of

VHF radio is such that sending and receiving simultaneously is impossible. When many ships are involved, passing arrangements have to be communicated quickly, so that the frequency is open for 1) alternative proposals, or 2) confirmation of arrangements by all actors involved and then 3) a new wave of traffic. Skippers tend to be chattier than operators, and more informal, often needing more words.³ Given the current contrast between the use of VHF radio between operators and skippers, records of communication between operators with skippers, their former colleagues, in more informal times would have been highly valuable historical sources.

Yet, the control room history that can be told with the official archives scarcely covers the operators' perspective, I found no records of anything that looked like daily control room work, and thus no transcripts of operator-skipper communication either. What these formal documents do provide are traces of the formalisation of operator work from an employer's perspective. In my research I focused on the first inland navigation control room that the Dutch agency built in Dordrecht, just east of Rotterdam, situated at the confluence of four rivers. It was in this control room that the transition from skipper to operator must have been most fundamentally arranged, I presumed. Luckily, some of the now retired operators that worked there for decades kept private archives, mainly covering from the late 1970s until the late 1990s (the latter decade is not yet available in official archives).⁴

One of these archives contained a report on an incident in 1983, which included a transcript of a conversation between a control room and a sea ship (cf. Zwijnenburg/Zanten 1983). Due to its size this sea ship was required to let a pilot (*Lotse*) board before it entered port or ventured further inland up the river, as was the case here. A pilot advises the captain on all matters of navigation and communicates with local authorities. What was transcribed was a heated interaction between a Dutch pilot and a Dordrecht control room operator. The pilot had asked to use the middle of the shipping lane in order to turn the corner at one of the two Dordrecht intersections, one where the current and riptides (at a confluence they vary) are considerable, ultimately receiving permission. The operator had afterwards carefully plotted the movement of the ship on a prefabricated paper map, using radar recordings, which makes the spatial aspect of the manoeuvre still intelligible now. When the ship went all the way to port-side, it was on course for a collision with two inland navigation push boats sailing downstream in the opposite direction, who were keeping starboard (as is the rule). The operator tried to convince the pilot to alter course. Due to their size and draft seafaring ships have right of way as they are tied to the shipping lane, inland navigation ships can often still pass a buoy on the wrong side, but not in this case. The two The two pushers each had four barges lashed in front of them, making them a 180-meters-long, more than twice as long as the sea vessel. To avoid a collision both had to put their ships in reverse, ships cannot brake, as they went downstream a

3 When passing familiar ships, skippers regularly chat (on a separate frequency) until they are beyond each other's reach, discussing politics, family, and the latest cargo prices alike.

4 I speak of archives as these collections are ordered, have an archivist, and are carefully maintained. They are nothing fancy, a few shelves of files, but in proportion to what is left of the archive of their entire district – about 6 percent an archivist of the state archive reckoned – still significant.

standstill would take forever. The intervention by the operator would have consequences for the pilot's liability had it actually gone wrong – had the operator done nothing and things went wrong, the operator would have been accused of negligence.

At the time the pilot and the operator still had the same employer, which meant that his formal report for reckless navigation ensured a reprimand for the pilot, so the operator who had compiled it told me (cf. Interview 05.01.18). The report is a manifestation of the operator-pilot rivalry. A historical study, translated *The Past as Building Block of the Present*, written by Goffe Halma, a former operator in the Rotterdam port, describes how pilots had trouble recognising the authority of the control rooms (cf. Halma 2004).⁵ This illustrates how professions function in a system, as Andrew Abbott understood it, a system in which »jurisdiction is the defining relation in professional life« (Abbott 1988: 3). This is because »[p]rofessions develop when jurisdictions become vacant, which may happen because they are newly created or because an earlier tenant has left them altogether or lost its firm grip on them« (ibid.: 3). The rivalry mainly played out in ports, where pilots had enjoyed a monopoly on navigation as a service, but occasionally spilled over into Dordrecht territory. The operator explained that the incident was illustrative of the inferior position that inland navigation skippers held (who were always expected to accommodate sea traffic, never the other way around), and thus the operator felt compelled to defend his former colleagues (cf. Interview 05.01.18).

To be a professional has come to stand for competence and authority, getting paid for work generally suffices to be able to claim the label. However, from a sociological point of view a profession is a particular social arrangement of expertise. Expert knowledge is controlled and curated by one group, who's exclusive right to perform the work is granted by law. It enables one to work autonomously, with authority and within the safe space of a shared set of values, excluding rivals, making clients depend exclusively on the expert knowledge of one group, which makes for a relatively secure way to generate a comfortable income. Admission depends on credentials: on completing formal training, often also an apprenticeship, and both are traditionally extensive, as in medicine for instance (cf. Susskind/Susskind 2015: 16). Shared values bind the profession, often including the aspiration to work in service of the public (ibid.: 17-18). Susskind and Susskind stress the role of this public, calling it a »grand bargain«, which can also be understood as a social contract between the public and the profession, one in which exclusivity is granted in return for »affordable, accessible, up-to-date, reassuring and reliable services« based on »expertise, experience, and judgement« (ibid.: 22-23).

Professionalisation has long been a public notion and to attain the status of profession has been a goal (often never attained) for occupational groups. Harold Wilensky, the author of one of the most cited texts on professionalisation, written in 1964 and called *The Professionalization of Everyone?*, was asked to look back on the article in 1980. He wrote: »I was astonished by the number of professional association leaders who read it and asked me to solve their problem of achieving professional status – an invitation I have

5 The book is, as the title suggests, an attempt to explain in which »überlieferten Ordnungen« operators work nowadays (Schmidt cit. in Wietschorke 2010). Moreover, it is about which struggle they went through in their attempt to hand it down on their terms.

resisted« (Wilensky 1980: 9). Operators knew that there was a difference between seeing themselves as professionals and receiving public recognition for it (cf. Halma 2004: 59).

Organisation

During fieldwork I have repeatedly felt the expectation of operators towards me to make their struggles public, which might then improve their situation – I have always tried to deflate those expectations, promising nothing more than a truthful report on what I experienced in the field, but one that would be published for a scholarly audience, in a language that is not overly accessible and thus would not carry their story very far. Inversely, their supervisors often seemed concerned about me making my experience public, again with the general public in mind, assuming I was looking to reveal something controversial about their organisation like an investigative journalist would. Preemptively, either in phone calls or emails, they tried to neutralise the complaints of the operators about budget cuts and reorganisations. They know, that once I am in they have lost control. When operators actually conduct their work, they are isolated from the agency that employs them, whose offices are elsewhere. The very reason I found this field was through an item aired by the Dutch public broadcaster NOS in 2015 on their primetime newscast in which operators sounded the alarm as they believed that cutbacks had led to dangerously understaffed control rooms (cf. Van der Parre/Hofs 2015). I understand making these worries public as a desperate attempt to keep their part of the bargain. Wilensky already pointed out that due to hierarchical structures it is hard to maintain professional autonomy in complex bureaucratic organisations (cf. Wilensky 1964: 146). Just as important is that the organisation in focus has its own social contract, as Dutch citizens have granted them money and power through their political representatives. Let us briefly focus on the organisation the operators are part of to understand both its hierarchy and social contract.

The agency, called Rijkswaterstaat, a subsidiary of the Dutch Ministry of Infrastructure and Environment, employs about 9000 people, who work on what they call ›dry‹ and ›wet‹ infrastructure. It was founded in 1789, when the Netherlands was under French rule, fashioned after the French engineering corps, adapting a military-like structure. The goal then was to break regional power structures, that impeded a more sustainable water defense and management, and to centralize and foster engineering expertise (cf. Bosch 1998). From 1848 onwards the agency, now dominated by civil-engineers, gained the power (and funds) to actively contribute to a goal it had always set itself: to create conditions that would enable the Netherlands to develop economically (cf. Bosch/Ham 1998: 79). Aided by technological advancements, primary in hydro-construction, a practice of social engineering was developed (cf. Van Den Brink 2010; Willems et al. 2015). What remained of the military like structure was a ›strong esprit the corps‹, with which the agency took on mammoth projects in the twentieth century, creating vast interior lakes, reclaiming land, rebuilding infrastructure after the Second World War and radically redesigning the delta after the devastating floods of 1953 (Van Den Brink 2010: 76-77). Thus, their planning and oversight of the construction and maintenance of waterways, bridges, sluices, tunnels, highways, barrages, storm surge barriers, aqueducts, and dams

developed the Netherlands from a hard to navigate bogland to a densely populated metropole that simultaneously has a highly productive and economically significant agricultural sector (cf. Lintsen 2002).

The rise of control rooms

Control rooms are sociomaterial »agencements« (Gherardi 2018) in which, through centralisation, a continued comparison of current state to future goals takes place – if necessary the current state is manipulated in order to achieve these future goals. In practice both the comparison and the manipulation comes about through sequences of action that are distributed among human and non-human actors and thus require mutual orientation and close cooperation between them (cf. Suchman 1993; Hutchins 1995; Heath/Luff 2004). This practice originated in the late 19th and early 20th century and was an answer to increased scale and speed but also facilitated the desire for centralised control and allowed for an increase in scale and speed within this model. Infrastructure, railways for instance (cf. Beniger 1989), large corporations (cf. Yates 1989), and armed forces, especially navy (cf. Lambert 2005) were all thought to be monitored and managed better through a centralisation of communication and information. Organisations were restructured to accommodate the need for information to travel upwards, the information itself was shaped by new accounting techniques and record keeping principles. Based on new representational strategies, analyses were translated into orders that were communicated downwards in novel ways. During the 20th century the control room became a popular management principle and trope, and the particular dispersal of infrastructural control rooms were answers to mobility and safety demands. The frequency, volume and speed of movement in airports, railway stations, metro lines and ports required oversight, also to allow for these factors to increase. As a result, infrastructural control rooms operated much more locally and in a more detailed way (cf. Silvast/Virtanen 2014), and were less dramatically centralised than, for instance, the British war room that Lambert chronicles, or the map room of a large corporation that Yates discusses.⁶

The first nautical control rooms emerged in Western Europe in the 1950s and were oriented towards the sea, assisting ships and pilots reaching ports safely, especially during fog or storm. These control rooms were, at least in the Netherlands, as a rule manned by former navy personnel that had already grown accustomed to marine VHF radio and radar (cf. Halma 2004: 18). Rotterdam built the first land radar chain that moved further inland to cover the entire port. From the outset it was, as the planning commission at the time said, also intended »as advertisement for this world class port« (ibid.: 13). When ready, Prince Bernhard, husband of the Queen and keen on (military-related) technology, inaugurated the control room network in 1956. This brought extra press coverage and emphasised the prestige of control rooms. Today, those photos of the Prince behind the radar console hang, enlarged, in the corridor of that same, recently renovated, control room. Inaugurations, Leo Coleman writes, show us the »fundamental relation between

6 That is not to say that highly centralized control rooms, especially in the military domain, did not try to manage local circumstances minutely (cf. DeLanda 1991; Edwards 1996).

social, collective consciousness and political symbols, on the one hand, and the material organization of society on the other« (Coleman 2014: 459). Control rooms are pivotal nodes in the material organisation of society that also, beyond such inaugurations, are employed symbolically to solicit public trust, to honour their social contract, and legitimise in this case the state agency and therewith the state itself.⁷ It was also this publicity, think of NASA's Mission Control, that fuelled the embrace of popular culture of the control room from the 1950s onwards (cf. Deane 2015). Nowadays many metropolises are run and monitored through control rooms (cf. Mattern 2015), where along the double logic of the control room its very existence is eagerly made public. The transparency and invisibility that Star identifies as a fundamental feature of infrastructure (cf. Star 1999: 381), pertain to the actual work done in control rooms.

Plans for inland navigation control rooms in the Netherlands date from the early 1970s (cf. Engel 1970; Arrondissementsingenieur 1972), and in 1982 the first control room was fully functioning in Dordrecht. Precursors to the Dordrecht control room – warning towers along the hard to navigate parts of the German Rhine, which were established during the second half of the 19th century, and a 1955 Dutch sign post situated at the intersection of a major river and canal – depended respectively on media like flags and initially on signal lamps, for inland navigation control rooms VHF radio and radar were pivotal. Through VHF the superior overview that a radar network afforded, aided by CCTV cameras, could be communicated with passing ships, which enabled the step towards active coordination. This does not explain why the agency wanted to take upon the role of traffic coordination.

The dynamic in which inland navigation the Dordrecht control room emerged is intricate – different actors highlight different aspects. The agency argued that the control room was necessitated by the growth, both in absolute numbers and average size, of commercial inland shipping, including the rise of tankers, expanding seaport and industrial activity in the South-Holland area, and the explosion of recreation on the water during summers (cf. Benedenrivieren 1976: 34-37). The efforts that were underway for layering instead of intersecting infrastructures – railway bridges were heightened, auto tunnels were dug – would lead to hindrance for traffic for several years, which needed extra coordination, especially in an area with strong current and riptides (cf. Dordrecht 1972). The patrol vessels used for this could then be directed centrally too. This centralisation resulted in a significant reduction of patrol boats and crew, with reduced cost as a consequence (cf. Interview 07.01.18). During the 1970s mayors of towns situated near busy intersections lobbied for the control rooms as the public notion was that chemical tankers were sailing bombs (cf. Interview 07.01.18). It was thought that the control room could supervise the transport of dangerous substances and in case of calamities its technological setup could help manage them (cf. Report 1972).

This recognition of publics and focus on the use of the waterway ties into larger developments within the agency and Dutch society. An actor who was a policy maker at the agency in the Dordrecht region in the 1970s, said that the agency »saw that the civil engineering solution was no longer working« (Interview 07.01.18). The agency was used

7 An important non-Western example is Allende's Cybersyn project (Medina 2011).

to provide a solution to a dangerous part of the waterway by rigorously redesigning it, but the people who were affected by these plans no longer readily accepted them, also motivated by environmental concerns (cf. Filarski 2014: 320-323). The agency's authority, them being the sovereign experts, had started to crumble and thus other ways had to be found to legitimize action. In 1975 the Dutch parliament told them as much when it recognized the need of »a better alignment and consideration, both within waterway policies and in relation with other societal sectors« (cited in Willems et al. 2015). What has been built by the agency since the 1970s has primarily been ›dry‹ infrastructure, like highways. Sluices are ageing, most of them built in the 1960s, smaller channels have been determined off limits for the larger barges instead of widening them. Focus has shifted from mid-term to short term and budgets and attention for waterways have gradually diminished (ibid.). With the rise of neo-liberalism the direction of policy took a behavioural turn, which is still regularly advocated by policy advisers I speak to. Instead of building, the focus shifted to the users of infrastructure, which were no longer exclusively the shipping industry. The goal now became to use the infrastructure that was there more efficiently – efficiency and budget cuts function in circular causality, both can be cause and effect. Since the mid 1970s the control rooms and the nautical division of the agency operates according to the service-oriented motto »safe and swift« (Benedenrivieren 1976: 1).

Formalisation of work

The formalisation of control room work occurred in four entangled stages: (1) the regulation of inland navigation and the formulation of control room tasks, (2) the formalisation of knowledge, (3) the relocation of teaching, and (4) the mediatisation of work. The first is the very foundation, the mandate of control rooms, the second and third are closely related: knowledge that spread orally now ended up in textbooks, but another sense of relocation here pertains to skill. It was first primarily attainable for the newcomer through mimesis, through working next to someone who put it into practice. Then a control room simulator was developed, which brought the transfer of knowledge and the training of skill outside the confines of the control room. This, in turn, was entangled with the mediatisation of work, which made the co-presence with the waterway and the observational ability that came with the experience of shipping less important as the interface gained prominence. All of this occurs in cycles, thus stages occur more than once, in more than one direction: new laws have prompted further formalisation of knowledge, but also initiatives to further mediatise work needed regulatory backing and solidified the relocation of teaching too.

Remarkably, the regulation of inland shipping happened internationally before national regulation came about: since 1815 there has been the Central Commission for the Navigation of Rhine (CCNR), and the treaty of Mainz (1831) required skippers to attain a patent attainable through proven shipping experience per section of the river. Other Dutch waterways were first regulated in 1897, and ambiguities were only eliminated in 1965 (cf. Filarski 2014: 310). As late as 1984 a new regulatory code formalised the use of regulatory media, i.e. traffic signs (ibid.: 310).

A 1979 communiqué by the agency informed shipping that the »post is at service to shipping on the waterways around Dordrecht« (Hoofdingenieur-Direkteur 1979). It would

concern itself – not yet around the clock and without radar – with the compliance with shipping regulations and act as a »control post from where, in order to enhance safety, shipping will be assisted with information and advice, possibly with sailing instructions« (Hoofdingenieur-Direkteur 1979). A 1983 report defines work: »[w]ith help of radar [...] and TV [...] traffic information is supplied to the waterway user and permanent surveillance of the traffic development takes place within the coverage area« (Zanten 1983: 1). The goals are »guarding and accommodating a swift and safe traffic development, in cooperation with the patrol boat« and »to contribute to preventing shipping accidents and reducing the harmful consequences for passengers and ships« (ibid.). Tasks are categorized and defined, but in such a way that there was room left for them to be carried out in various different ways.

Thus, the early days of the control room were more informal, improvised: »when you knew a period of high water was coming due to rain or meltwater the local wool shop was warned that they had to clear their basement, farmers were warned to move their cattle« from riparian land (Interview 05.01.18). Operators were not inclined to interfere with other people's work (cf. Interview 04.01.18). They appreciated being left alone – management hardly set foot in the control room – and operators still don't enjoy telling a skipper what to do. Although they had the authority to intervene they were disinclined to do so when it concerned professional skippers. They could resort to giving an order, called »traffic instruction« (Directoraat-Generaal Scheepvaart en Maritieme Zaken (D.G.S.M.) 1983: 4). There are operators who have never issued a traffic instruction their entire career, others gave one or two – operators pride themselves in this, as a skilled operator should be able to get skippers to do what they want while skippers think it was their own idea (cf. Interviews 04.01.18 and 05.01.18; Fieldnote 14.11.16; Fieldnote 03.04.17; Halma 2004: 25).

Reading Marcus Popplow's synthesis of technology and knowledge in early modern Europe (2015), it occurred to me that formalisation of work already happened before formal education and the disembodiment of knowledge took place. Before the sedimentation through formal training – which guarantees the spatial and temporal separation of work, teaching and learning – the skippers who became operators were already shaped by formal arrangements. Aside from the occasional course they took, most prominently one to obtain a radar certificate, their (working) biographies show how the formal arrangement of actual work on board formed a curriculum in itself. Before they could become skipper, they went through at least three different positions on board, each of which had to be mastered before progression to the next job was possible – mastery was determined by the length the job was performed and by the approval of colleagues who had progressed further in this system. So the history of the formalisation of control room work has roots in the inland navigation shipping practices of the 1960s and 1970s in the Netherlands, but often learning started even earlier.

When asked about his education a retired operator (born 1952) replied: »Well, I am born on a steam tugboat« (Interview 19.02.18). Many skippers-turned-operators started learning as part of what Jean Lave calls a »community of practice« (Lave 1991), in which both skill and identity are developed, before they went to school. Central here is the notion of »legitimate peripheral participation«, as participation in family life coincided with presence in the steering hut and thus peripherally participating in navigation

practices (ibid.: 64). The operator explained that he had lived onboard until his sister had to go to school, then his mother left the ship with them, while his father kept on sailing: »That is when I had a land life [...], well, whenever I saw a chance I went onboard, so I actually joined all holidays, working onboard, so that is how I rolled into the tugboat life« (Interview 19.02.18). When he was sixteen he joined his father full-time, eventually took over and together with his wife and later their children lived on board until 1982. They decided it was better for their children to grow up on land, and at the time inland navigation took a downturn.

During a four-day journey on a 135 meters barge across German, Dutch and Belgian waters I got to observe and participate in a snippet of learning as an ongoing loose practice. The ship was owned by Rebecca and Rob, a married couple in their late fifties, early sixties, of whom the husband spend most hours at the helm. They employed a Czech sailor called Leo, with whom they spoke German.⁸

»Leo [...] is now at the helm, »eben festhalten« Rob had said and instructed him about the course. Leo doesn't sit down, stands behind the skipper's chair, doesn't have to change speed, just hold course. After a few minutes Rob is back« (Fieldnote 27.11.16 till 30.11.16).

Rebecca is also qualified as a skipper and spent time at the helm too. When she had to use the bathroom and Rob was asleep, she asked me to take over. The first time I had to do very little. The second time was different:

»We were on the Hollandsch Diep [a wide waterway in the south-west of the Netherlands] when Rebecca asked me to take over the helm again. This time I really had to steer, but had less clear instructions and now it was dark. Got a better sense of the helm by trying and seeing how the ship reacted. She invited me to sit this time, but felt more comfortable standing like Leo did« (Fieldnote 27.11.16 till 30.11.16).

Learning comes with being on board and starts before anyone declares the lesson to have commenced, or with the idea to teach in the first place. Before holding the helm – an almost horizontal steel stick of about ten centimetres long with a black synthetic knob at the end – I already developed a sense of its kinetic and tactile dimensions through observation, which I only realised once I was using it. However formalised elements are discernible too: I saw that for Leo the captain's seat was off limits, which then certainly would be the case for me. This would have been a normal situation for those born into the shipping community of practice, like both Rob and Rebecca did.

The first to leave the ships were the children. Skippers' children had been exempted from compulsory education until 1966 – after the war specialised boarding schools came up. From the 1980s mainly mothers made long transnational drives at the weekends to pick up their children – it was the main reason for having a car said Rebecca, the introduction

8 Upon their request these actors were given fictive names and the name of their barge was left out.

of special cranes made it possible to drop it off wherever you were (cf. Interview 01.08.18). Now most parents have followed their children and floating houses have been substituted with brick ones. Boarding schools are being closed. Skippers work in shifts, about a week on board and a week off. A transnational family life, a permanent state of mobility within an otherwise settled society – like Rob and Rebecca have always lived – has given way to single members partaking in scheduled mobility and networked sociality. On board fathers ›skype‹ with their children at bed time, while women at the helm are becoming a rarer sight. It has become increasingly unlikely for skippers' children to share the steering hut (long enough) for them to master the work through mimesis. Shipping is still primarily learned by starting out as sailor, taking over the helm occasionally. Currently there is a shortage in the inland navigation labor market – no wonder, given that there is no one else in the steering hut anymore besides the skipper.

Skippers who had been their own bosses did not have any diplomas, which meant they had to start within the lower ranks of the agency. The former tugboat skipper started on board of a patrol vessel as a deckhand motorman. Another skipper-turned-operator (born 1956), who had been a captain on a 180-meter-long push barge combination since he was 21, started out on a sluice, planning the order of ships in the lock. His other options, once he started looking for less mobile and more predictable jobs after his wife had set him an ultimatum to settle, were the water police and customs, both would have meant studying at their academies. He wanted to work and the agency preferred skippers ›as they had of course practical insight‹ (Interview 04.01.18).

When recruiting the first operators, experience with both radar and VHF radar was sought (cf. Interview 05.01.18), and newer inland navigation ships had both, so it was their skippers who applied. The advantage they had over navy radar operators seeking a job on land was their knowledge of the waterways and their lived experience with the much slimmer spatial margins typical of inland navigation. All of this they had learned at the helm (cf. Halma 2004: 279).

Family life and work became separated where the skippers-turned-operators now went to work, work no longer was at home. The latter changed first with the ship becoming a working environment when the other family members disembarked for a settled life, then a mobile life was abandoned altogether.

Seeking authority

Many skippers-turned-operators encountered their first computer in the control room. In 1984, perhaps 1985, the first was introduced, named *Birgitte* by the operators, which ›nobody understood‹ how to use (Interview 04.01.18). Another operator thought that especially ›those of the old school‹ had issues with it, around 1982 he had bought a *Commodore 64*, when he and his family moved to land, and had programmed games with it (Interview 19.02.18). He remembered that one operator in his first report written with the computer instead of a typewriter actually ›proudly‹ mentioned in the report with which medium it was made (ibid.). There was resistance against the introduction of computers too – eventually not only new operators, but also the more experienced had to take a course so that they could compose logs of their shift on the computer (cf.

Interview 19.02.18). Eventually standards were developed to bring uniformity to these reports (cf. Zanten 1989). With this computer they started to store their knowledge of different aspects of waterway infrastructure externally, every shipping company, wharf or pier was given an entry, and heights of bridges were documented (cf. Interview 05.01.18).

The margin that could be interpreted as professional autonomy in control room work was also an affordance of the media they worked with. The logs made in *Birgitte* could be adjusted later when an operator discovered his error, without anyone ever noticing it (cf. Interview 05.01.18). Radar was not automatically recorded yet, recording was started manually when a dangerous situation seemed to arise, as was the case in the altercation with the pilot discussed above. In the beginning operators were working with almost the same equipment as they had done on board. Contrary to the development of many other media, the first radar use was mobile (cf. Bauer 2005), only to become stationary later. The Dekaradars stood one floor below, with cameras above them, which were connected to the screens in the consoles in the control room above. One of these machines is now located in the corridor of the Dordrecht control room with the layout of the Dordrecht intersection clearly burned into the screen as a testimony to its not entirely afforded immobile use. These radars did not have concentric circles indicating distance yet and were so rudimentary that »you were looking at nothing but dots, the actual picture you made in your head« (Interview 05.01.18). This embodied practice clearly positioned operators within the agency as masters of traffic coordination, but the difference with Leave's model is that newcomers could not attain the operator identity solely through apprenticeship, as this partly had to be attained beforehand while sailing. Furthermore, the limited view that radar provided meant that the exclusivity of their knowledge derived from their shipping days, because 1) local waterway knowledge had to make up for the abstraction and 2) scoping the waterscape as they had done in the steering hut – recognising ship type, draft and manoeuvre – complemented what they had already assessed from the given traffic situation through radar and VHF radio.

The operators' uniforms, indicating their authority, once situated them at the higher echelons of the outdoor division hierarchy. One retired operator remembered that upon entering the control room for the first time in the early 1980s »all that gold leaf really made an impression«, referring to operators' shoulders straps (Interview 04.01.18). The division consisted of repair and maintenance crews including their own layers of supervision. The all but disappearance of the layers below the operators constituted a significant shift (cf. Interview 05.01.18). When visiting a control room I asked an operator what the gold stripes on his shoulders indicated, he explained it and added that »when you have enough stripes you can take off your uniform« (Fieldnotes 04.11.16). Referring to a senior policy adviser that same operator said: »you can see he is high up the ladder exactly because he dresses so scruffily« (ibid.).

The organisational isolation of the control room went hand in hand with a specific rationale for the formalisation of work. Filarski writes that in the »mid 1980s the state apparatus started to shrink, which continues until this day« (Filarski 2014: 332). If that ambition has actually led to the reduction of the net amount of civil servants is doubtful, as bureaucracies in Western Europe have survived largely untamed despite (or even as a result of) numerous efforts to achieve the contrary (cf. Graeber 2015a). The answer to

the question »how service could be maintained with less personnel?« was mainly felt by those with little education at the bottom of the hierarchy. It was believed that the market was more capable of working cost effectively, thus contractors were found for most of the physical work. As the bottom fell away a managerial layer above the operators grew and changed. Generally, in the 1980s »managerial trends« were biased »in favour of financial management« (Duménil/Lévy 2011: 84), both managers and professionals were encouraged »to see the world from the perspective of investors« (Graeber 2015b: 75). Some operators felt a general loss of autonomy, as increasingly »everything had to be answered for and arranged long beforehand« (Interview 05.01.18). Another operator mentioned – when asked what his general impression was of the agency where he worked for almost three decades – that the degree in which the operators were allowed to give input depended on the economic tide: during downturns you had to do as you were told by management and policy advisers (cf. Interview 04.01.18). Similarly, one operator, who started in the late 1980s and still works in the control room deduced that when access to the control room is more restricted, and only agency hotshots visit, budget cuts are imminent (cf. Interview 20.02.18). A person in a senior position in the field of inland navigation, himself a former skipper, told me that there are hardly managers at the agency with practical knowledge of shipping and control room work. On the condition of anonymity, he told me that he fairly recently confronted the head of the nautical division of the agency with this deficiency. The reply he got was that this was done quite deliberately, as expert knowledge only impedes organizational change. From the mid 1980s onwards under the banner of New Public Management market logic was applied to the public sector. A senior policy adviser of the agency's nautical division I interviewed casually spoke of »business cases« when he meant policy proposals (cf. Interview 29.04.16).

When trying to professionalise it helps to have an association. In 1975 operators of Rotterdam and other sea traffic oriented control rooms formed a »guild« called *Racon* (cf. Halma 2004: 49-65). Until 1990 *Racon* worked closely with a labor union, and it at times sounded like one itself. Through the years the guild focussed on four goals: improving working conditions, standardising nautical communication, establishing central training, recognition of the profession internally and publicly. Many Dordrecht operators joined the guild, which laboured for early retirement possibilities as recognition of the intensity of the work. In the early years operators worked twelve hour shifts, with frequently hardly any time to go to the toilet, let alone eat (cf. Interview 05.01.18). Due to efforts of operators to measure the intensity of the work the agency hired a consultancy firm whose report in the late 1980s lead to shorter shifts (cf. Verschoor/Giessen 1990), now eight hours, as the intensity of traffic sectors varies between sectors, operators started rotating every two hours between them (cf. Interview 05.01.18). Only in 2002 an early retirement deal came into effect – a very costly arrangement for the agency, which it managed to overturn in 2015.

From the beginning *Racon* had lobbied for central training in order to (1) diminish the dependency on the local control room chief, who controlled training and examination, (2) increase the standing of the profession through the introduction of official degrees, (3) raise the competency of the workforce through the introduction of foreign languages in

the curriculum, and (4) uniform and discipline VHF communication. This meant a first step in the relocation of learning and work, at least for the first part – the second part of training was still done locally.

Compared to the operators in inland navigation control rooms the operators in port control rooms, who founded *Racon*, struggled with a reverse problem: their knowledgeable skill was rooted in their navy days and was deeply connected to and afforded by their nautical media. The pilots on board of the sea vessels in the port structurally questioned their legitimacy. When in 1987 a *Racon* report was criticised in a maritime trade journal for operators’ dependency on »advanced equipment« instead of »more severe training and experience« like the pilots, it were these former navy-men who were targeted. *Racon* countered that this type of criticism lacked an acceptance of »normal developments in this modern technological world« in the interest of »HUMANS, ENVIRONMENT and above all Economy« (Halma 2004: 60-61). Pilot eligibility means one has to climb the maritime ranks first until becoming a captain on a sea ship, directly responsible for and knowledgeable in the way a ship moved, like the skippers-turned-operators had done.

The transcript of the 1983 altercation between a pilot and the Dordrecht control room, as discussed above in the section titled »profession«, ends with a conversation on a separate frequency, so not to occupy the frequency used for coordinating traffic. Here, the highest ranking control room officer has taken over, talking to the pilot who had forced two larger inland navigation ships to an emergency break:

»Operator: To me it appears richly overdone to have ships of over 200 meters go in reverse, because you with your 4 meter draft can’t in an orderly fashion enter [the Dordrecht port]
 Pilot: You have no idea how this ship steers! You know nothing about the draft dimensions of this ship! You know nothing of this ship!
 Operator: No sir. We know that. You only know that. But I tell you, we have made a video recording of it [...]. That is clear enough.
 Pilot: But you judge things you have no knowledge of« (Zwijenburg/Zanten 1983: 5-6).

The authority of the operator as a professional, and therefore the authority of the control room depends on the exclusivity of the knowledge of the operator and therewith the dependency of the client on that knowledge. Here the pilot has his own knowledge, and thus thinks he doesn’t have to listen, or at least can judge the information of the operator on merit.⁹

Simulatable

Inland navigation skippers are deemed to be stubborn but when it gets foggy, operators often explain, everyone gets very obedient all of a sudden. Onboard of well-equipped ships I have seen the nervousness that thick fog brings out. As fog cannot be ordered, operators being trained on the control room had to wait for this most critical weather

9 The report to which this transcript belongs mentions all the details of the ships involved. As mentioned before, the two ships that have to go in reverse were 180-meters-long, not »over 200 meters«.

condition to occur (cf. Halma 2004: 77). »Newcomers become old-timers through a social process of increasingly centripetal participation«, states Lave, »which depends on legitimate access to ongoing community practice« (Lave 1991: 68). However, compared to a girl born as a daughter or granddaughter of a Yucatec Mayan midwife, a case that Lave cites (ibid.: 70), or compared to someone born on a ship, operators have little time to master their work. A way to manipulate the events that contribute to centripetal participation, a way to manipulate what is ongoing, is the Vessel Traffic Services Simulator that the agency had built.

The earliest ideas for the vessel traffic simulator date from 1975, in 1983 the contract with Dutch developer Marin was signed, in 1986 it was ready (reportedly the first one worldwide) and inaugurated by Neelie Kroes, the Minister of Transport, Public Works and Water Management – it cost a small fortune (Halma 2004: 88-90). The simulator seemed to be modeled after the setup of the port of Rotterdam control rooms, no wonder since mainly operators with a naval history and working background in sea traffic-oriented control rooms had been involved. They had co-developed the simulator, headed the training program, written the training scenarios, set the learning goals (ibid.: 89-91; Interview 20.07.18; Interview 21.07.18).

In the simulator old-timers and newcomers would sit in separate rooms behind a console, with each a radar screen, a monitor connected to a shipping database, and radio connection between them. The simulation existed of what can best be described as contingent events played out in a stable map (cf. Gekker 2016) of a port and its peripheral area with a river and a tributary – a situation that mostly resembled the Rotterdam layout. A scenario, or ›run‹, would take about thirty minutes, in which ships on the radar screen would move, the old-timer would impersonate all the different ships calling in, or the newcomers could call ships, which they could identify by touching them with the pen on the radar screen, which then made their names, dimensions, and cargo appear on the second screen. There were enough consoles to run four simulations simultaneously – each their own run or all together in one, each controlling their sector and also communicating between sectors (cf. Halma 2004: 89-91; Interview 04.01.18; Interview 21.07.18).

An operator remembered the simulator as an experience »indistinguishable from reality«, also because the old-timers could impersonate different skippers (»a fisherman or East-European skipper in broken German«) so well (Interview 21.07.18). He had been a skipper on a push boat before he had switched to an agency patrol vessel. His transfer to the control room in 1987 coincided with the start of training at the simulator. It is hard to say where his legitimate peripheral participation started, from his patrol vessel his participation was mediated over VHF radio, and his visits to the control room were certainly legitimated. Yet there is a stark contrast between how he appraised the simulator and how another operator did, someone who had already become a Dordrecht old-timer through presence in a control room. The former felt, looking back, that Rotterdam had always set the bar higher and considers them the benchmark. The latter felt the simulator – the radar type, the training scenarios and norms – diverted too much from the standard they had established locally, in Dordrecht. Because they »did take inland navigation ships equally seriously« their VHF frequency use was more intense, which meant that the way the Rotterdam operators understood conversation discipline was not concise enough for

the amount of calls Dordrecht operators made in roughly the same timeframe (Interview 20.07.17). The translation of the dominant socio-material *agencement* of the control room into centralised training made it, for some Dordrecht old-timers, a dislocation of teaching, while it was also a relocation of learning: simulation enabled legitimate peripheral participation of sorts in the Rotterdam control rooms.

In the simulator the fog became permanent, as a direct view of the waterscape disappeared. The weather conditions became whatever the scenario said they were. The old-timers now acted out the nervous skipper. Newcomers learned to rely on their interfaces, the windowpane was no longer part of their observational scope from the outset, like it had been for the first skippers-turned-operators. Backed by a research report written by a consultancy firm Dordrecht operators succeeded in adding a stable map of one of the Dordrecht sectors for simulation (Verschoor/Giessen 1990; Interview 23.07.18). However, the fictive, Rotterdam-inspired map remained dominant. When following a cohort of newcomers in spring 2017, all the runs I witnessed were done in the fictive port (simulating the typical traffic of such a territory), also by those training for inland navigation intersections, which have distinct traffic patterns.

Over the years the control room has been supplied with: (1) AIS (through radio signals name, GPS location, departure and destination of a ship are exchanged) layered with radar onto the digital nautical map, (2) automatic radar plotting aid (ARPA) was added as a function in this layered interface (with which potential collisions, but also time and distance between current ship position and for instance an intersection can be plotted), (3) more accurate gauges (such as wind speed, current, visibility, water level), increased resolution and light sensitivity of CCTV camera's, (4) internationally linked databases with detailed cargo information and (5) ergonomic gains in screens and consoles grouping all these interfaces etc. This continued mediatisation moved the action towards ever larger and more numerous screens, and subsequently made control room work increasingly simulatable.

Profession, mediatisation, organisation

In understanding how shipping experience became irrelevant for operator work three levels need to be distinguished: profession, mediatisation and organisation. Firstly, skippers-turned-operators failed to attain professional status on their own terms. They got caught in the systems of profession, more particularly in the rivalry between pilots and port operators. Where the former had claimed ships and the water as domain of their mastery, the latter had taken the interface as synthesis of theirs. Skippers-turned-operators were more akin to the pilots, having grasped the many variables that play a role in the sustained manoeuvrability of a ship after living on it for years and climbing the ranks, but were grouped with the port operators, predominantly former navy radar personnel, who had already been active as operators for twenty-five years when the inland navigation control rooms emerged. The operators also did not manage to gain the authority that comes with the exclusive control over professional knowledge. Their shipping experienced always remained intangible, non-formalized, which made it easy for the managerial class to make operators sound irrational, a classic move (cf. Noble 1977). The existential

approach to work, and work as a domain of masculinity (remember *Birgitte*), was transferred to the control room. Men at the helm became men behind the console and stayed put for decades. Nowadays old-timers see that new operators seek upward mobility and pursue careers beyond the control room, which requires pragmatism instead of idealism in order to overcome the control room isolation. The guild *Racon* was dissolved in 2016 after it failed to find new members for the board – it had been hibernating for a few years. »Operators are no longer crazy about the job« (Interview 05.01.18).

Secondly, mediatisation (itself to a large extent afforded by digitization) allowed for the locus of observation to change. One might expect that when technology is used to control the way work is done, automation would be a key concept in this article. However, in the work itself not that much is automated yet: mainly administrative tasks and, most prominently, the identification of ships. Mediatisation changed the social conditions of learning, the intimacy of expertise gave way to a training that is repeatable, measurable and as a result accountable. Thus, the operator in the Antwerp control room quoted in the introduction could make the comparison with air traffic control and point out that former airplane pilots do not become operators – in his understanding knowledge of software and protocols matters more than understanding of airplanes.

Practices and norms of the port control room operators materialised in the simulator training. As a consequence, admission to local control room training, to legitimate peripheral participation, which is now the second stage of training, was no longer skipping experience, or naval experience for that matter, but simulator experience. Formalisation of work led to more clearly and narrowly defined tasks, with nautical media as their focal point. An intricate understanding of the needs of the users of the waterway, the waterway itself and those other living beings around it was no longer required. Improved accuracy, new affordances layered in interfaces, and centralisation of information moved the action to the screen and gradually reduced the relevance of the access to the waterscape through the windowpane.

This promotes a socially atomised understanding of work. Heath and Luff have shown that the specificity of local control room working practices, despite formalisation of tasks and standardisation of procedures, is persistent and difficult to learn for newcomers (2004: 116-117). The inland navigation practices the former skippers knew intimately, were similarly dependent on collectively performed tasks. Thus, the prominence of the simulator highlights individual responsibility and is a step towards the isolation of skill and competence away from collective practices.

At the third and final level we find the organisation capitalising on mediatisation. It provides the agency access to an accountability that sounds rational compared to the emotional operators. As shortly mentioned above, the operators blew the whistle on their agency in 2015, saying that austerity had left the control room exposed. National and regional media and trade journals reported on operators breaking the ranks. There were questions asked in parliament, the responsible minister denied any danger and reassured the public that work could be done more efficiently and thus with less people due to »technological innovation« in the form of AIS (Schultz van Haegen 2015: 2). The agency had subsidised this technology, and later made it mandatory for skippers. With AIS skippers are able to see around a corner, beyond an island, or sluice. AIS is not meant

for navigation as radar is, in the sense that the position updates of ships are not frequent enough, yet it shows ship names so that a skipper knows far in advance who to call over the VHF radio, information which before was exclusively available to operators. What was once an exclusive control room perspective, initially through its elevated perspective on the water, moved ever more onto the screen and had now travelled to the ships the operators once left. Mediatisation has made the operator perspective mobile.

Some of the operators have returned to shipping after their early retirement as their skills are in demand now that the inland navigation communities of practices are hollowed out. One explained that he tried it for a while, but couldn't cope. In the 1970s he found out he always struggled during night shifts between three and four o'clock – then his body seemed to give up on him. Back then he had company in the steering hut, a game of chess was played, stories were told. Needs be, another would take over the helm and he could get some fresh air on the deck. Now he completed twelve hour shifts alone (cf. Interview 17.04.18). Steering hut dashboards have come to resemble control rooms consoles, all relevant information is centralised. With action moving to the screen the skipper can work on his own, *Homo faber* having to pee out of the window if push comes to shove.

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