
Paul M. Leonardi
University of California

Keywords: artificial intelligence, digitization, digital exhaust, organization change, remote work

Companies have flirted with remote work since the 1970s. Estimates from late 2019 suggested that slightly more than 5 per cent of employees worked remotely with regularity. But as COVID-19 has spread across the globe over the past few months, and shelter-in-place orders were issued by governments, many companies have initiated a rapid and wholesale shift to remote work arrangements, at least for knowledge-intensive work.

This shift is enabled by digital technologies that allow workers to communicate via text, audio, and video and to share and edit data and documents in real-time. As examples of the dramatic and swift increase in remote work enabled by digital technologies, Zoom’s daily active user base grew by 67 per cent in March 2020, the number of daily active users of Microsoft Teams grew from 20 million in November 2019 to 44 million in March 2020, and Slack added 7,000 new paid customers in February and March, 2020 – roughly 40 per cent more than in each of its previous two quarters. Google announced it will continue remote work until at least summer 2021 and Twitter extended the opportunity for all employees to work remotely indefinitely.

Most discussions around this shift to remote work have focused on exploring first-order effects – areas of organizational behaviour that are likely to change directly following a transition to working exclusively through digital technologies. Although first-order effects are important, it is the second-order effects of remote working that have the potential to be the most profound, but are the most understudied. In this paper, I explore three of the most important second-order effects likely to shape the trajectory of work for several decades: (1) Remote work creates vast amounts of digital exhaust, (2) Digital exhaust is used to turn employees into data representations, and (3) Artificial intelligence (AI) uses those data representations to predict (and shape) employee behaviour.

Address for reprints: Paul M. Leonardi, Technology Management Program, 1319 Phelps Hall, University of California, Santa Barbara, CA 93106 (leonardi@ucsb.edu).

© 2020 Society for the Advancement of Management Studies and John Wiley & Sons, Ltd.
Digital Exhaust: What We Leave Behind When We Work Remotely

Increases in the use of digital technologies produces corresponding increases in the amount of work that is recorded and stored. Every time employees send each other emails via Outlook, message each other on Slack, initiate a video conference in Zoom, like someone’s post on Jive, form a team in Microsoft Teams, or assign someone to project milestones in Trello, these digital technologies record that action as meta-data. Whereas most office-based employees conduct slightly more than 50 per cent of their communications through digital channels, record roughly 25 per cent of their meetings, or document how they approached a particular work task some 10 per cent of the time (all figures according to my own research), remote workers in the age of COVID-19 are conducting nearly ALL of these activities through digital technologies that create time-stamped logs of their behaviour.

These meta-data are digital exhaust. Logs of employee behaviour are called digital exhaust because they are by-products of other activities, like setting up a meeting or running calculations. Although the term ‘exhaust’ may signal the inadvertent nature of such digital records and connote worthlessness, nothing could be further from the truth. In my own research, I have documented how digital exhaust can be used to help employees reduce work duplication and increase innovation (Leonardi, 2014), develop more accurate organizational metaknowledge – knowledge of ‘who knows what’ and ‘who knows who’ (Leonardi, 2015), and apportion work tasks more effectively (Leonardi, 2018). Organizational leaders who collect and analyse digital exhaust created by employees can develop efficient systems for knowledge transfer (Leonardi and Meyer, 2015) more effectively implement strategy (Neeley and Leonardi, 2018), and identify individuals whose networks are optimized for certain roles (Leonardi and Contractor, 2018).

To more thoroughly explore the kinds of digital exhaust produced by remote work, researchers might ask questions such as: How do workers/managers interpret signals from one’s digital exhaust? How does access to colleagues’ digital exhaust shape an organization’s knowledge economy or power structure? What are the ethics of granting access to other people’s digital exhaust and what implications does it have for organizational justice and equity?

Digital Footprints: How Our Exhaust Turns Us into Data Representations

By themselves, individual particles of digital exhaust contain very little meaning. For example, if an employee starts work late one day (as recorded by VPN login times), spends an unusually short amount of time working with information in a portal (as recorded by server-side time-stamps), and is unusually quiet in a meeting (as recorded by total seconds of talk-time in a Zoom session), none of these pieces of digital exhaust by themselves tells us much. But when those pieces are combined, examined over time to qualify a pattern of behaviour, and compared to other employees’ patterns, they can start to create inferences that an employee is, for example, disconnecting from the organization.

Putting these pieces of digital exhaust together allows companies to construct digital footprints of employees, teams, and sub-units. Digital footprints are collections of data that represent an entity. They are the mathematical representation of everything a company knows about that entity and they are used to make predictions about its behaviour.
Digital footprints are constantly updated as the entity produces more digital exhaust. In my research, I have documented how employees who recognize that their mediated activities allow companies to create digital footprints of them sometimes feel as though they are being surveilled by peers and leaders, causing them to act in ways that leave purposeful patterns of exhaust that effectively game the system (Leonardi and Treem, 2012). I’ve also shown how the creation of digital footprints can create a vicious cycle in which employees feel that everyone else’s actions are more visible than theirs, thus compelling them to work more so as to enable the company to produce a digital footprint of them suggesting they are exceptionally hard workers: These employees experience high levels of burnout (Cristea and Leonardi, 2019).

Because the volume of digital exhaust produced in the era of COVID-19 is prodigious, organizations increasingly use algorithms that code digital exhaust into particular categories of action, sort those categories, and perform complex computations that link them together. The result is that algorithms are increasingly central in turning employees’ digital exhaust into digital footprints that serve as data representations of them. To explore this process, scholars might ask: Under what conditions do managers and leaders become confident that digital footprints are accurate representation of employee behaviour? What changes arise when employees become aware that management is observing their work by attending to their digital footprints? In what ways can digital footprints aid in mentoring and coaching and in what ways will they serve as warrants for disciplinary action or censure?

Artificial Intelligence: When Our Data Representations Predict and Shape Our Behaviour

It is only in the past several years that the computational power and development of mathematics undergirding AI have progressed far enough to make meaningful predictions based on people’s digital footprints. Although many companies were ready to analyse data at scale, they didn’t have enough of it to analyse because most employees’ actions were not recorded and stored. COVID-19 solved that problem. Today, companies are beginning to use algorithms to sift through the digital footprints assembled as remote workers create digital exhaust. The most advanced companies are using AI to combine these patterns with new datasets (like employee turnover or performance data) to test assumptions about certain relationships, learn autonomously from these tests, and, make predictions about future employee behaviour. These predictions can set the stage for managerial and organizational policy decisions.

As organizations increasingly make use of algorithms to sort through the glut of digital exhaust they collect and store, employees are sometimes unfairly advantaged or disadvantaged by the way those data are turned into predictions by AI (Leonardi and Treem, in press). It is clear that the vast amounts of digital exhaust produced through remote work arrangements can improve organizational behaviour in many ways, but they also threaten to undermine some of the very systems, processes and institutions that make workplaces fair and equitable.

Most of the digital tools organizations implement to help with remote work are cloud-based applications hosted by vendors whose contract rights give them access to some
or all of the digital exhaust produced through them. Those vendors are able to use al-
gorithmic modelling to create macro-level digital footprints of the behaviour of people
and organizations and use AI to make predictions. They sell those predictions to other
companies that market to us and bid to consult with our organizations, and they use
those digital footprints to improve their own technologies in ways that allow them to col-
lect even more digital exhaust. Zuboff (2019) has written eloquently about how vendors
monetize digital exhaust and use it to construct digital footprints that predict and shape
our behaviour.

To explore how AI is used to turn digital footprints into predictions, researchers might
begin to ask questions like: How will leaders incorporate AI-based predictions into their
decision-making processes? Should organizations be required to let employees see pre-
dictions of their own behaviour and what are the consequences of this choice? Under
what conditions do predictions of employee behaviour instigate a set of compensatory
activities that turn them into self-fulfilling prophecies?

CONCLUSION

Some observers argue that we are entering an era in which remote work will be the ‘new
normal’. If that prediction comes true, it means that people, teams, and organizations
will be quantified, modelled, and shaped in heretofore unknown ways. Others argue
that remote work will not become mainstream soon and that most workers will return
to offices when the pandemic subsides, will resume activities in which they work outside
of digital technologies, and will produce much less digital exhaust. If that vision of the
future comes true, it is unlikely to portend any less of a dramatic shift in the way orga-
nizations operate than if people remain working remotely. That is because the scale and
duration of remote work that COVID-19 has enabled has already produced so much
digital exhaust that companies will build models from this unique window of time for
decades to come. Regardless of whether remote work remains common or whether it be-
comes another brief spike in the long history of starts and stops since the 1970s, it is very
likely that the digital footprints produced during COVID-19 will serve the basis for many
organizational practices, policies, and ideologies in the future. It is these second-order
effects of remote work that need to be understood, discussed, and debated today so that
organizational scholars can provide the insights that will allow us to thoughtfully build
and manage the organizations of tomorrow.

REFERENCES

of face time in distributed work’. Organization Science, 30, 552–72.
Leonardi, P. M. (2014). ‘Social media, knowledge sharing, and innovation: Toward a theory of communication
visibility’. Information Systems Research, 25, 796–816.
Leonardi, P. M. (2015). ‘Ambient awareness and knowledge acquisition: Using social media to learn “who
knows what” and “who knows whom”’. MIS Quarterly, 39, 747–62.
Leonardi, P. M. (2018). ‘Social media and the development of shared cognition: The roles of network expan-
sion, content integration, and triggered recalling’. Organization Science, 29, 547–68.

© 2020 Society for the Advancement of Management Studies and John Wiley & Sons, Ltd.


