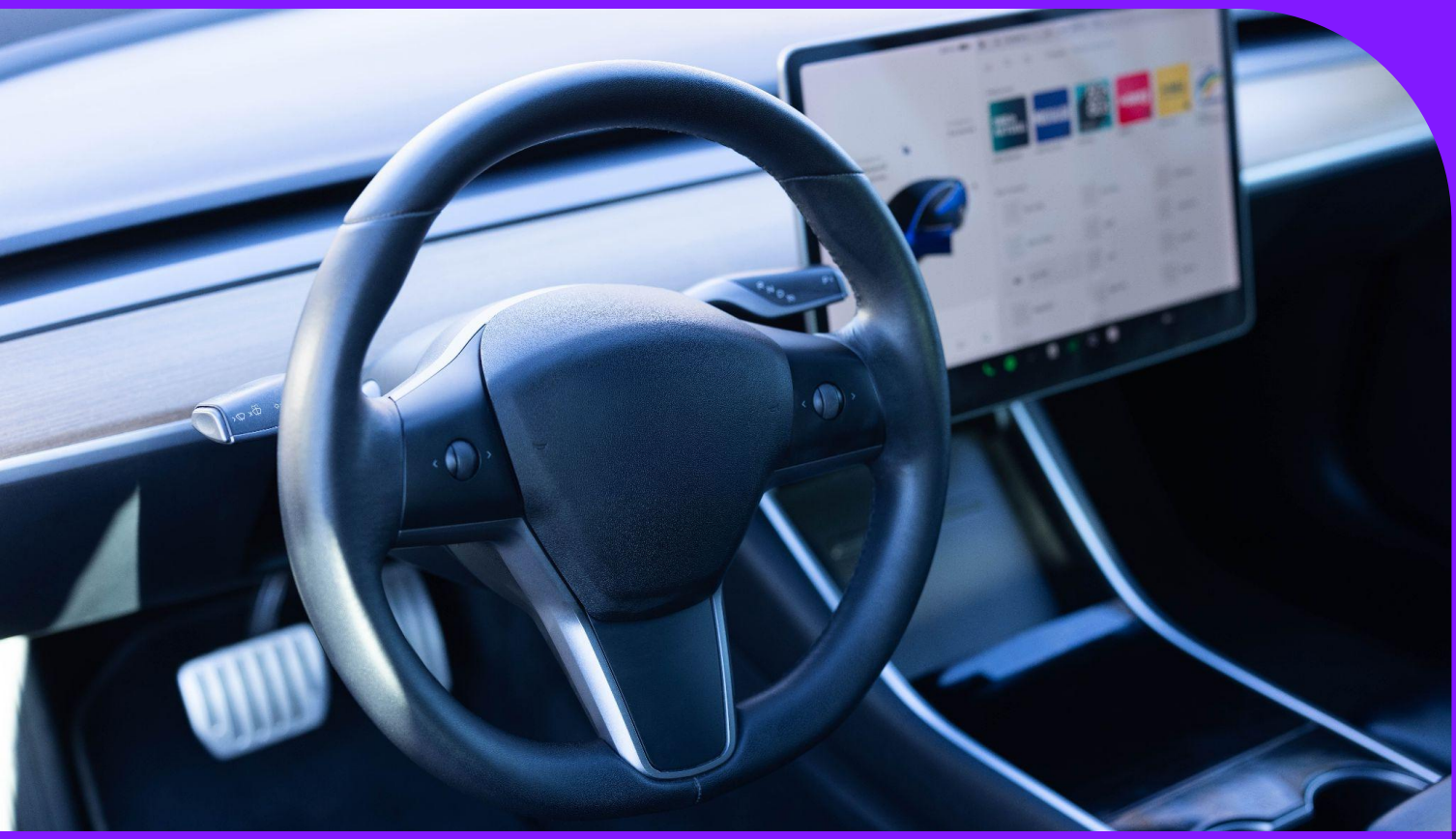


WHITE PAPER

Empowering the People Powering Autonomous Vehicles

A UX and wellness framework for safety operators

TaskUs™

Autonomous vehicles (AVs) are redefining transportation as we know it. Powered by machine learning, precision mapping and advanced sensor technologies, AVs promise safer roads, seamless mobility and new possibilities for how people and goods move.

The momentum is undeniable. Valued at $50.63 billion in 2023, the global AV market is projected to surpass $250 billion by 2032.[1] That's a 5x increase in less than a decade. McKinsey estimates that by 2030, autonomous systems could represent 12% of all new vehicle sales. [2]

But behind every self-driving system is a critical human layer. Specialized safety operators and AV workforce teams ensure that AVs function as designed and protect both humans (customers inside AVs and pedestrians) and the vehicles as well.

As investment increases and deployment scales, empowering this workforce is just as essential as advancing the technology itself.

Humans in the AV loop

Upon hearing the term "autonomous vehicle," one might think of cars driving entirely on their own. However, full autonomy remains out of reach. Technical, legal and ethical realities still require a crucial human presence behind the systems.

Research and real-world incidents demonstrate that human operators are essential for bridging technological limitations and real-world driving complexity. Arguably, humans will stay "in the loop" for years to come.[3,4]

In the AV field, there are different types of oversight work roles (see Table 1). The focus of this white paper is on **in-field AV operators**, who typically navigate hybrid workflows that demand both real-time alertness and technical fluency. We aim to describe how their day-to-day work proceeds, and to propose ways to support them, drawing from qualitative research interviews conducted with AV operators (see Appendix).

[1] Zion Market Research. (2023). *Autonomous vehicle market size, share & trends 2023–2032*. Retrieved from https://www.zionmarketresearch.com/report/autonomous-vehicle-market#:~:text=The%20global%20Autonomous%20Vehicle%20market,19.5%25%20between%202024%20and%202032.

[2] McKinsey & Company. (2023). *Autonomous driving's future: Convenient and connected*. Retrieved from https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/autonomous-drivings-future-convenient-and-connected

[3] Kalra, N., & Paddock, S. M. (2016). *Driving to safety: How many miles of driving would it take to demonstrate autonomous vehicle reliability?* RAND Corporation. https://www.rand.org/pubs/research_reports/RR1478.html

[4] Cummings, M. L. (2017). *Artificial intelligence and the future of warfare*. Chatham House Report. Retrieved from https://www.chathamhouse.org/sites/default/files/publications/research/2017-01-26-artificial-intelligence-future-warfare-cummings-final.pdf

Table 1
Types of roles in AV safety operations

Role	Location	Responsibilities
AV Operators (Safety Drivers/ Roadside Assistance)	On the road, stationed in a regular vehicle	• Supervise & manually intervene by reaching the spot when AVs encounter issues (e.g., software malfunctions), are stranded or misparked • Provide passenger assistance (including accessibility support)
Remote Operators (Remote Assistance)	Control center	• Monitor AV status and routes from control center • Remotely assist vehicles (e.g., rerouting, assist with remotely moving AVs from afar in case they are stuck) • Communicate with AV Operators during incidents • Escalate unresolved incidents
Fleet Monitors	Operations hub	• Oversee operational performance and compliance at a fleet level • Track policy adherence and incident trends

Traditionally, trust & safety in the context of autonomous systems has focused on safeguarding pedestrians or other drivers from risks associated with malfunctions or system failures.[5,6] As AVs mature, safety must also extend inward. Being frontline risk mitigators, AV operators' ability to stay effective under pressure directly impacts public safety and AV credibility.[7] Yet, their role remains underrepresented in infrastructure design discussions.

This white paper proposes a model anchored in Total Worker Health[8] (TWH), while also incorporating user experience (UX) design principles. Unlike existing studies that focus largely on user safety or system reliability, this analysis zooms in on the lived experiences of AV field operators to surface hidden human strains and unmet wellness needs. Our goal in combining TWH and UX design is to build a supportive ecosystem that protects AV operators and empowers them to do their best work.

[5] Bonnefon, J. F., & Rahwan, I. (2020). *Machine thinking, fast and slow. Trends in Cognitive Sciences, 24*(12), 1019–1027. https://doi.org/10.1016/j.tics.2020.09.007
[6] Rahwan, I., Cebrian, M., Obradovich, N., Bongard, J., Bonnefon, J. F., Breazeal, C., ... & Wellman, M. (2019). *Machine behaviour. Nature, 568*(7753), 477–486. https://doi.org/10.1038/s41586-019-1138-y
[7] MIT Technology Review. (2023). *Driving the future: The state of autonomous vehicles.* Retrieved from https://www.infosys.com/iki/videos/driving-future-autonomous-vehicles.html?utm_source=infosys_hub&utm_medium=main
[8] NIOSH. (2011). *Essential elements of effective workplace programs and policies for improving worker health and well-being.* National Institute for Occupational Safety and Health. Retrieved from https://www.cdc.gov/niosh/twh/

Why AV operators choose this work

The majority of operators in our study appreciated the autonomy of this profession alongside the capability to work outdoors rather than in a conventional office setting.

One AV operator expressed, “You have the freedom to relax. You are not under the microscope.” Another shared, “This job gives me the freedom to do my own thing while being situationally aware.”

Some of the operators also expressed a sense of pride in being part of a cutting-edge industry that’s still in its formative stages. Professional drivers or security personnel are able to upskill and build technological literacy by taking this new-age driving role. Operators value the trust placed in them to help ensure real-world safety while learning and supporting the growth of this rapidly evolving field.

“I enjoy learning about technology, going to the learning center. The knowledge we gather is good,” according to an AV operator.

Operators value the trust placed in them to help ensure real-world safety while learning and supporting the growth of this rapidly evolving field.

The unseen strains and toll in AV operations

AV safety work presents significant challenges that are not fully addressed by current operational models.

01 Physical demands

AV operators spend long hours in static positions inside vehicles. These vehicles and the equipment operators use (vests, phones, tablets, etc.) undergo heavy use and require frequent upkeep.

The in-field nature of the job exposes operators to environmental factors beyond their control (e.g., heat, snow, etc.). Additionally, issues such as not finding proximal or proper parking spots and restrooms facilities potentiate frustrations.

One interviewee shared, “I am not a fan of this side of town. It is harder to park and there aren’t many accessible bathrooms.”

These factors, while seemingly minor, can accumulate into significant daily stressors.

02 Cognitive challenges

Prolonged passive monitoring, inherent to this role, has been associated with cognitive drift and reduced vigilance over time.[9] AV operators similarly described struggling to stay alert during long periods of inactivity, "95% of the time I sit in my car and have to pay attention to the phone screen and wait. It's hard to stay alert, to stay awake."

The low stimulation, however, may be abruptly interrupted by startling emergencies, as an interviewee highlighted, "When you get a request, your heart races, and you get a rush of adrenaline."

The contrast between extended inactivity and sudden, high-pressure events creates a cycle of mental fatigue, which requires targeted engagement and grounding strategies.

03 Mismatch with traditional support models & workflows

"Transportation safety business model and call center business model clash. We are out in the field. In a call center, if you don't have the means or access to resolve an incident you can pass it onto an escalation queue, but here we can't do that. We have to resolve it in the field, and there's no one to pass it on to."

Unlike conventional customer support models used in call centers or centralized logistics, AV operators work independently in the field. Although they have immediate access to a supervisor by phone and can request assistance from other in-field operators, physical distance and travel time mean that support may not arrive instantly when an incident occurs.

"Transportation safety business model and call center business model clash. We are out in the field. In a call center, if you don't have the means or access to resolve an incident you can pass it onto an escalation queue, **but here we can't do that. We have to resolve it in the field, and there's no one to pass it on to."**

As a result, AV operators frequently need to make critical decisions and resolve situations in real time, relying on their own judgment until help arrives.

Given that AV operators often address issues directly on-site, their ability to think clearly and act fast also depends on the systems around them. Without integrating operator feedback into design decisions, we risk creating workflows that are not only inefficient but also potentially unsafe. These are natural growing pains of an industry on the cutting edge.

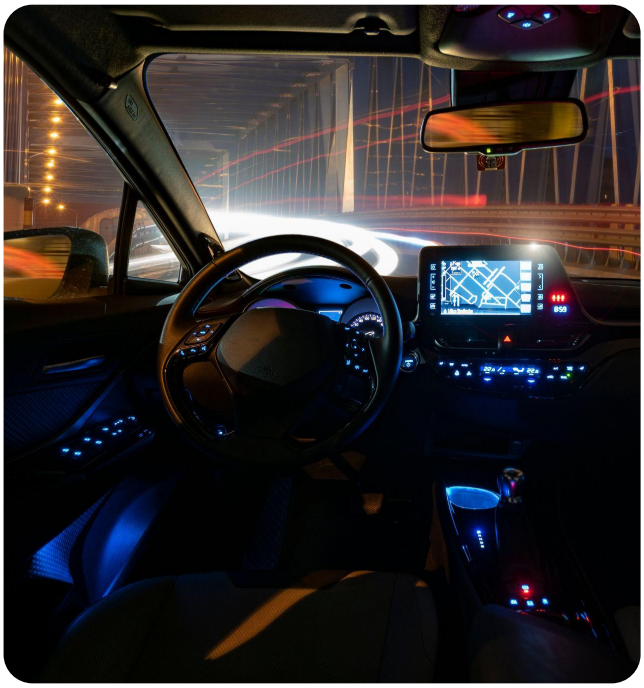
The goal must be to work alongside AV pioneers to co-create solutions that ensure their safety and well-being while facilitating productivity.

[9] Greenlee, E. T., DeLucia, P. R., Newton, D. C. (2018). *Driver Vigilance in Automated Vehicles: Hazard Detection Failures Are a Matter of Time. Human Factors: The Journal of the Human Factors and Ergonomics Society, 60*(1), 62–73. https://doi.org/10.1177/0018720818761711

Designing a holistic ecosystem for AV operators

In reviewing potential frameworks to guide our recommendations, we evaluated several established models, including: the Job Demands–Resources (JD-R) Model, Human Factors Analysis and Classification System (HFACS) and the Total Worker Health Framework (NIOSH).

We ultimately selected TWH as it integrates both traditional safety controls and proactive well-being strategies, aligning with the complex demands of AV operations. Unlike models that focus narrowly on one aspect of the job (e.g., hazard prevention, workload management, incident analysis, etc.), TWH addresses the full spectrum from system-level design changes to personal capacity building. This holistic scope makes it particularly well-suited to the hybrid (physical, cognitive and emotional) demands placed on AV operators, ensuring our interventions are both preventative and sustainable.



The National Institute for Occupational Safety and Health (NIOSH) initiated the TWH framework in 2011 to advocate for a comprehensive strategy that goes beyond hazard control to actively promoting workforce health and well-being as a core operational priority.[10]

TWH integrates physical, emotional and cognitive dimensions of health, thereby framing overall well-being as a systemic concern. It has been previously applied successfully in other working settings. For example, in manufacturing environments, TWH has led to the redesign of assembly line workstations to include adjustable seating and anti-fatigue mats, effectively reducing musculoskeletal injuries by 25%.[11] Such results underscore that prioritizing worker well-being makes for a core operational investment in safety and performance.

Traditionally visualized as a pyramid, the TWH hierarchy emphasizes upstream interventions, such as mitigation and environmental redesign before turning to individual behavior change or coping strategies. This mirrors the principle of primary prevention — promoting well-being and resilience by reducing risks and increasing protective factors, rather than treating stress or exhaustion.[12]

[10] Tamers, S. L., Chosewood, L. C., Childress, A., Hudson, H., Nigam, J., & Chang, C.-C. (2019). *Total Worker Health 2014–2018: The Novel Approach to Worker Safety, Health, and Well-Being Evolves*. *International Journal of Environmental Research and Public Health, 16*(3), 321. https://doi.org/10.3390/ijerph16030321

[11] Hudson, H. L., Nigam, J. A. S., Sauter, S. L., Chosewood, L. C., Schill, A. L., & Howard, J. (Eds.). (2019). *Total worker health*. American Psychological Association. https://doi.org/10.1037/0000149-000

[12] Sauter, S. L., & Murphy, L. R. (1995). *Organizational risk factors for job stress*. American Psychological Association. https://doi.org/10.1037/10173-000

Applying TWH to AV operations implies the need to shift from viewing the AV operator as an interchangeable system part to recognizing them as a whole person, whose mental and physical health directly affect, and are affected by, their work conditions.

In parallel, when we bring user experience (UX) design into the mix, we complement TWH by ensuring that technology and tools are tailored to AV operators' needs, concerns and experiences. Using the TWH hierarchy as a scaffold, we propose the following multi-level framework of interventions, adapted for AV operator safety and well-being, incorporating TaskUs wellness practices and research insights.

Building a safer, healthier AV operator ecosystem

The framework is structured into five levels: Mitigate Hazards & Stressors, Default to Safety, Optimize Operator Experience, Build Inner Capacity and Sustain through Culture.

01 Mitigate hazards & stressors

The first priority is to minimize risks to the safety or well-being of the worker, meaning tackling the root causes of physical and mental fatigue before they impact the operator and potentially lead to errors. This includes addressing prolonged sitting and vigilance through scheduled movement breaks integrated at intervals within shifts.

Brief physical exercises like periodically stepping out of the car for a walk or stretching enable mobility, recharge the mind and prevent postural and musculoskeletal strain or stiffness.

Blink-monitoring or alertness detection can act as a supportive safety net by triggering gentle alerts for momentary attention lapses, not as a punitive measure. Real-time biofeedback can also help adjust workflows to sustain situational awareness during long operations.

To tackle challenges of limited biobreak facilities, companies may deploy routing software to steer vehicles toward locations that have accessible bathrooms, rest areas and healthy food options.

02 Default to safety

If a hazard/stressor is unavoidable, the next best approach is defaulting to safety, meaning replacing an unsafe or unhealthy condition with a safer alternative. For instance, waiting for hours at a stretch is a given in AV operations, but that does not necessarily imply that phone scrolling is the only means left to be cognitively engaged. In fact, this may impair vigilance during critical moments.

A viable mitigation is for employers to allow pre-approved, low-cognitive-load stimuli such as podcasts or instrumental music that keep the person alert enough to not feel drowsy, without undermining vigilance.

Another example of defaulting to safety involves subtle systemic changes to be more practical for AV operators. For example, if a running AV encounters a problem while on the road, its system can resort to a minimal risk condition ("pull over" or "come to a safe stop") before requiring remote human AV operator assistance.

By programming the AV to yield a safe fallback on its own, the likelihood that an operator must execute a last-second, high-stakes save reduces. In essence, the AV "takes the first hit" of the problem, leaving the human with a more stabilized situation to handle.

Such strategies, aligned with fail-safe design, dramatically lower danger and the psychological pressure on the AV operator.

03 Optimize operator experience

The next level of intervention is to redesign the work environment and tools so that the job fits the human, not the other way around. The interviewees highlighted the impact of their physical environment, noting that challenges with regular vehicle maintenance from daily use for prolonged periods and ergonomic discomforts add to the everyday strain of the role.

Comfortable seating suitable for long duration sitting, optimal ventilation and sun protection are critical to improve operators' experience and alertness. These small upgrades help prevent physical discomfort from compounding mental fatigue, thus supporting both comfort and control.

Since the human working memory typically stores 4–7 items at a time,[13] interfaces should minimize cognitive load through clear visual cues, minimal text in critical alerts and layouts that match user expectations. Well-designed tools serve as external cognitive aids while poor ones can add to mental strain.

The guiding principle here is stress optimization. We acknowledge some stress and fatigue are inevitable in this job, but it is possible to purposefully redesign the context to keep these within healthy limits. Minor tweaks can markedly improve an operator's day-to-day experience and long-term well-being.

[13] Cowan, N. (2010). *The magical mystery four: How is working memory capacity limited, and why? Current Directions in Psychological Science, 19*(1), 51–57. https://doi.org/10.1177/0963721409359277

04 Build inner capacity

Psychoeducation represents the fourth level of the hierarchy. Moving focus from the system to the person, this step builds self-efficacy and resilience: when operators are well-trained and prepared mentally, they feel more in control and less stressed by unpredictable events. Further, when faced with such events, they are better equipped to self-regulate and bounce back. Interviewees repeatedly emphasized that "hands-on practice is what sticks," and recommended that training can be more connected with the realities in the field.

This reinforces a core principle of adult learning and behavior change: experiential learning and repeated practice build competence far better than one-off, theoretical lessons. To meet this need, continuous micro-learning may be integrated into the operators' daily regime. Breaking down information into smaller, digestible chunks over a large period of time mitigates cognitive overload.

User-friendly mobile platforms and applications may help deliver modules on the road (while not in action), as operators spend most of their shifts in vehicles and rely on their phones as primary work tools. These apps or platforms can provide refreshers and real-world scenario walkthroughs. Over time, these exercises strengthen operators' mental models and decision-making skills. Through mastery experiences, their self-confidence is boosted, and anxiety about "what-if" scenarios is reduced.

Capacity building for stress management and emotional regulation is a vital complement to technical training. TaskUs wellness programs mentor employees with evidence-based techniques to handle emotionally charged and cognitively taxing situations.

Capacity building for stress management and emotional regulation is a vital complement to technical training. TaskUs wellness programs mentor employees with evidence-based techniques to handle emotionally charged and cognitively taxing situations.

In the AV context, for example, instead of catastrophizing ("I almost caused an accident, I'm terrible at this"), operators learn to adopt a constructive internal dialogue ("That was a tough situation, but I handled it and I'll use it to improve").

Training designed by experienced clinicians and psychologists strengthens operators' mental fortitude and provides healthy outlets for stress. One interviewee articulated, "[Wellness] teaches us steps on how to relieve stress. I had a very stressful day once, and because of wellness I was able to calm down. We look forward to the wellness session every other week, because they are not just helpful for work but for our life too." Ultimately, this tier empowers operators to prioritize and safeguard their own well-being.

05 sustain through culture

A strong safety and wellness culture ensures that all the intervention tiers discussed until this point take root and become embedded in the work routine. For instance, an AV operator may return from handling a high-pressure emergency or encountering a distressing incident on the road.

One of the interviewees highlighted the need for quick debriefs with a trained wellness professional to process their experience, "Wellness (sessions) are a sounding board for things that I find challenging with the job."

Such support therefore acts as a psychological safety valve by preventing acute stress from becoming chronic. Furthermore, having regular, scheduled wellness check-ins normalizes the idea that seeking help is healthy, reducing stigma.

Based on our past research with other frontline staff, namely **content moderators** and **CX employees,** we encourage routinary psychological health support. Over time, this builds a climate of support as employees feel that their well-being is truly valued and is not merely lip service.

Team camaraderie and peer support are also important support elements needed in solitary jobs such as AV operations. Research has shown that social support buffers stress: having colleagues to share knowledge or vent frustrations can potentially mitigate the physiological stress response.[14]

[14] Cohen, S., & Wills, T. A. (1985). Stress, social support, and the buffering hypothesis. *Psychological Bulletin, 98*(2), 310–357. https://doi.org/10.1037/0033-2909.98.2.310

Half of the operators in our study mentioned that they highly value being members of their team.

One of the interviewees described the unifying energy of regular wellness sessions, "I have one colleague who felt kind of stand-offish. We rode in the car for 8 hours with no conversation. Through wellness sessions, I was able to get to know them outside of work. Understand who they are. Wellness bridged that gap."

Finally, recognition and open communication are key to building safe working environments. Organizations should actively acknowledge when operators exemplify safe and healthy behaviors through formal safety awards, or regular positive feedback and reinforcement. This also includes time-out instances. For example, if an operator decides to call a timeout because they felt fatigued, that decision should be acknowledged, not dismissed.

Positive reinforcement is a powerful shaper of behavior. Peers observe and learn the same healthy behaviors, and that eventually becomes the norm. Furthermore, leaders should facilitate regular forums (e.g., town halls, surveys) to help operators raise concerns without fear and with visible follow-through to build trust. If an operator can say, "The new interface layout is hard to use" without fear, and then sees that feedback acted on, it creates a virtuous cycle of engagement.

In summary, the "sustain through culture" tier targets weaving psychological safety and well-being into the fabric of daily work life.

Conclusion

So why invest so much in human-centered design for AV operations? The answer lies in the fundamental recognition that human welfare and long-term technological success are inseparable.

Autonomous vehicles are touted as a high-tech solution to human error in road navigation, yet ironically, their progress relies on humans more than ever. If operators are tired, stressed or poorly supported, the safety advantages of AVs can swiftly erode.

A human-centered approach is vital because it acknowledges the reality that automation does not eliminate human work, but changes it.

Investing in the wellness and user experience of AV operators is a strategic imperative for any autonomous vehicle program that values safety and success. By systematically applying TWH and UX design principles, an environment where operators are not just "adequately surviving" their work, but are truly thriving is born. AV operators in these ecosystems will be better equipped to keep the public safe and help the technology reach its full potential.

The ultimate reward is a virtuous circle: healthy, empowered operators lead safer AV operations, which in turn actualizes autonomous vehicles that enhance safer human mobility on roads.

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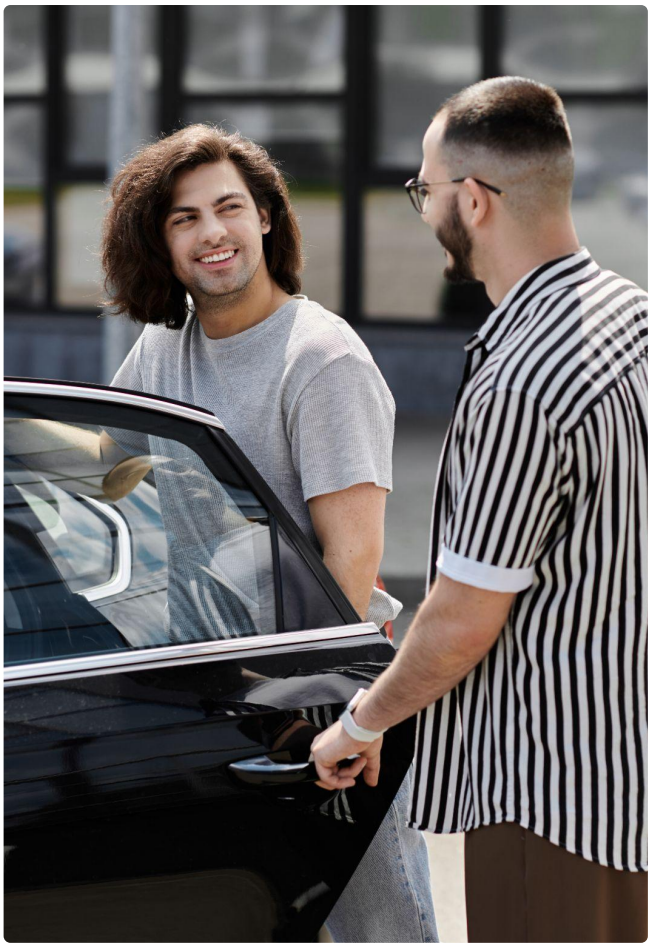

Appendix

Design

In November 2024, TaskUs conducted a qualitative research study to explore the lived experiences of autonomous vehicles operators. The study involved contextual inquiry and individual interviews with AV operators who work in the field.

Sample

Five US-based TaskUs employees provided informed consent and participated in one-on-one interviews. We recruited them to represent a range of tenure, shift patterns, and operational contexts in overseeing AVs, handling system malfunctions, and responding to emergency incidents (e.g., stranding). The average tenure of participants was 6 months at the time of the interviews.

Procedure

The study used a semi-structured interview guide with open-ended questions that explored AV operators' daily experiences, opportunities and challenges, coping strategies and perspectives on wellness. Each interview lasted approximately 40 minutes.

We transcribed interview data and performed thematic analysis to identify common themes in experiences related to operational challenges, wellness needs and workflow pain points, without neglecting individual differences. Researchers supplemented this with their insights from interacting with the interviewees.

About TaskUs

TaskUs is a leading provider of outsourced digital services and next-generation customer experience to the world's most innovative companies, helping its clients represent, protect, and grow their brands. Leveraging a cloud-based infrastructure, TaskUs serves clients in fast-growing sectors, including social media, e-commerce, gaming, streaming media, food delivery and ride-sharing, technology, financial services, and healthcare. As of March 31, 2025, TaskUs had a worldwide headcount of approximately 61,400 people across 28 locations in 12 countries, including the United States, the Philippines and India.

For more information, please visit:
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