WORK ZONE DATA EXCHANGE

WORK ZONE DATA SURVEY REPORT

Work Zone Data Working Group
WORKER PRESENCE SUBGROUP

March 2021

About the Survey

The Work Zone Data Working Group (WZDWG) Worker Presence Subgroup conducted a survey of work zone stakeholders to assess the current state of practice of tracking and publishing real-time information about the presence of workers in work zones. The aim of the Worker Presence Subgroup is to advance the availability of worker presence information in work zone activity data and eventually to require the inclusion of real-time information about the presence of work zone workers in all Work Zone Data Exchange (WZDx) feeds.

The WZDWG is chartered under the Federal Geographic Data Committee Transportation Subcommittee. The WZDWG is supported by the U.S. Department of Transportation (U.S. DOT) Intelligent Transportation Systems Joint Program Office (ITS JPO) and the Bureau of Transportation Statistics. The chairs of the Worker Presence Subgroup are:

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Methods

This survey was conducted online via SurveyMonkey. Responses were collected starting on July 13, 2020 and ending on September 2, 2020. The survey was distributed during conferences, and via email and social media to WZDWG contacts, ITS JPO contacts, state DOT contacts provided by the Federal Highway Administration, and trade association mailing lists. Participants were also encouraged to forward the survey to their peers.

The WZDWG Worker Presence Subgroup developed four separate survey tracks to elicit data from multiple perspectives on the topic of tracking, recording, reporting, consuming, and using data about the presence of workers in work zones. The survey opened with demographic questions to help identify the organization and job role of the respondent in order to direct them to the appropriate survey track. Each survey track included a unique set of questions tailored to the respondents' position in the process of capturing, creating, reporting, or consuming worker presence data.

The four survey tracks were:

- Track A: Infrastructure Owner / Operator (IOO)
- Track B: Work Zone Equipment Providers
- Track C: Work Zone Workers
- Track D: Work Zone Data Consumers

Results and Analysis

After removing duplicative and incomplete responses, the number of survey responses totaled 537.

Some users did not answer any questions beyond the opening demographic questions. These responses were removed from the survey response database. Duplicate responses from an individual via self-identification were also removed. Respondents who did not clearly identify the organization they are associated with are not counted in organization counts, but the response was still recorded and retained in the results database.

Track A – Infrastructure Owner/Operator (IOO)

Two hundred twenty responses were received for Track A survey. The majority were from state DOTs, followed by city/local DOTs.

It is important to note that, within the 220 total responses to Track A, **97** responses were received from representatives of the Washington State Department of Transportation (WSDOT). To avoid over-representation of WSDOT in the results and analysis, the Working Group separated WSDOT Track A responses from all other validated responses into two separate bins. The Track A analysis that follows focuses on the data set with WSDOT removed. However, both data sets are included in this paper for reference.

It is interesting to note that responses from individuals within WSDOT varied significantly, reflecting differences in understanding among agency personnel about how, why, and what the Department is tracking and reporting with regard to worker presence. This may also be reflective of the broader industry, suggesting that education and campaigning around the reasons to advance the state of WP tracking practices among IOOs may be effective.

Tracking Planned Work Zones

Track A first sought to discover whether respondents believed their agency tracked *planned* work zones. This question is distinct from whether agencies track *active* work zones or real-time *worker presence.* Tracking work zones is challenging because a planned work zone or work zone permit for a particular date range does not necessarily turn into an active work zone on the day of. Weather, contractor preference, incidents, and other factors can affect whether planned, authorized work zones are actually taking place on a given day.

In the Track A group, the majority of respondents (70%) reported that their agency **does** have a system for tracking planned work zones—22% did not, 8% were unsure.

This result suggests that a basic system for tracking planned work zones has been established for many or most IOOs. However, a lack of such systems may still be somewhat widespread. The absence of a system for tracking planned work zones may create the perception within an agency that tracking worker presence is not achievable.

Tracking Active Work Zones

Next, Track A asked respondents whether they believed their organizations had systems for tracking *active* work zones. This is distinct from tracking *planned* work zones, in that such a system would report work zones that are *active right now*.

Fifty percent of Track A respondents reported that their organization **does** have such a system. Thirty-eight percent stated that they did not have such a system; 11% did not know.

A significantly lower proportion of IOOs track *active* as opposed to planned work zones. This may be due to the complicating factors discussed above.

This may be a topic worthy of further exploration, as it suggests it may be possible to make advancements in tracking active work zones without first establishing a system for tracking planned ones. This question would ideally be explored with data consumers, as well. What is the value of knowing about planned versus active work zones? If active work zone data is of a much higher value, it might make sense to focus development efforts there, rather than being slowed down or stuck by the complexities of tracking planned work zones, at least for the purposes of WZDx.

Defining Worker Presence

The WZDx Worker Presence subcommittee hypothesized that a lack of a common definition of worker presence may inhibit the development of worker presence reporting in some or many states. Two Track A survey questions sought to explore this question.

Thirty-seven percent of the respondents reported that their state/region has a clear definition of worker presence. Twenty-nine percent stated that their state/region did not, while 33% did not know.

The survey also asked each respondent to indicate who they believed was responsible for defining worker presence. Forty-three percent understood the state DOT to be responsible, while 36% were unsure. Four percent said law enforcement, 5% said nobody, and 11% said "Other."

Some respondents stated that the manager or contractor responsible for the work zone project itself would define it.

Several respondents mentioned the *state legislature* in their free-text response to the question. Not including this as a pre-defined answer option was, in hindsight, a shortcoming in the survey design. This is an important issue in states that have enacted legislation that further penalizes traffic infractions within a work zone where workers are present—sometimes doubling the fines, or more. As such, data about whether workers were present or not at a particular work site could become key evidence in a courtroom.

What is unclear from the survey results is whether the existence of legislation with extra work zone penalties for traffic tickets issued within work zones *inhibits* or *encourages* the advancement of worker presence reporting systems in those states. The subcommittee hypothesized that the presence of legislation around traffic fines when workers are present would result in organizational reticence to track the data, perhaps due to concerns about the ensuing legal requests and/or the potential for inaccurate data. However, the data did not support this hypothesis.

The survey asked respondents to indicate whether they believed workers should be considered present in various work zone scenarios. The top-ranking scenarios were:

- Humans physically working within the work zone
- Humans physically within the work zone but not working (e.g. on break)
- Mobile equipment moving in the work zone.

Less than 50% of respondents thought that the following scenarios qualified as having workers present:

- A barrier wall in place within the clear zone
- A barrier wall in place within the edge lines
- A barrier wall in place within the right of way
- Fixed equipment in the work zone
- Mobile equipment in the work zone but not moving.

Interestingly, only 70% of respondents stated that workers are considered present when "humans are physically working within the work zone." Given the straightforwardness of this definition, one would expect a higher number of affirmative responses. However, three free-text responses to this question expressed confusion about what was being asked, which may help explain the result.

Interestingly, if we look specifically at responses from the Washington State Department of Transportation only, we find that 51% of respondents believed that a definition of worker presence existed in their state. Five percent said no, while 44% said that they don't know.

Tracking Worker Presence

The survey asked questions about whether the respondent believed their organization had operational systems for tracking worker presence. Only 5% of respondents confirmed that their organization does. Seventy-six percent answered no, while 18% did not know.

For those who answered “no,” the top three reasons cited for the lack of a system were:

- Not a priority
- Technology gaps
- Budget constraints.

As to the relevance of worker presence definitions, 33% affirmed that worker presence being “vaguely defined” was a mitigating factor. Only 5% indicated that “legal reasons” were a cause.

Why Track Worker Presence?

Survey respondents who indicated that their organization tracked or might track worker presence were asked what they believed were the reasons for tracking worker presence. It is worth noting that only a small number of distinct agencies (n=15) were represented in this response. Within this limited data set, top-ranking answers were:

- Contract management and/or enforcement
- Field activity tracking
- Share with the public through 511 or similar.

Speed enforcement was identified as a reason by 29% of respondents.

The lowest-ranking reasons among this limited data set were:

- Connected vehicle (CV)/Automated vehicle (AV) projects
- In-vehicle display (driver alert)
- Share with companies (Google, Waze, TomTom etc.)
- Internal statistics.

It is noteworthy that respondents’ answers are somewhat out of step with the mission of the WZDx initiative, which emphasizes the importance of third-party data-sharing, particularly in the context of ADS (Automated Driving Systems). Tracking field activities, managing contracts more effectively, and sharing work zone information over regional real-time traveler info systems (such as 511) are typically more closely aligned with IOOs’ more pressing goals and objectives. The lower-ranking reasons may have been rated as such because they have either indirect, or longer-term, hypothetical benefits. It is understandable that IOOs would focus resources on solving current issues first.

Efforts to gain worker presence reporting buy-in from IOOs might seek to better align the goals of data producers and data consumers to incentivize sustainable, widely adopted solutions.

Existing Worker Presence Tracking Technologies

For the small number of respondents (n=14) whose organizations do track worker presence, the following were identified as the top technologies or approaches currently in use:

- Worker check in/out via phone or radio call
- Camera-based monitoring
- Smart equipment.

Seventy-one percent of respondents answered “other,” with many of the free-text comments suggesting that paper tracking or daily reports were the primary methods used.

When respondents were asked to characterize their *existing* worker presence tracking technologies, top-ranking answers were:

- Simple
- Useful
- Accurate
- Feasible
- Practical
- Sustainable

The survey also asked respondents to estimate what percentage of worker presence activity in their state/region actually gets tracked. Answers spread across the spectrum, though the highest number of respondents were in the 80-100% range.

Respondents were asked to identify reasons why coverage was not at 100%, and the top reasons were: **technology gaps, worker compliance**, and **vaguely defined**.

If most respondents are using paper tracking systems for worker presence, there may be major gaps in achieving real-time worker presence reports in WZDx data feeds. While paper-based solutions may be simple, useful, and accurate, they cannot support the real-time data desired by the WZDx program.

Legal/Regulatory Concerns

Only a small subset (n=14) of Track A survey-takers responded to this question but most (9) stated concerns.

For those who did have concerns, the following were cited:

- Speed limit changes
- Increased traffic fines
- Accountability of personnel in the event of disasters, incidents or accidents.

Privacy Concerns

All respondents to Track A were asked the final three questions, which received 92 responses. The majority (77) stated that privacy concerns are not an issue.

Some themes mentioned among those with concerns include:

- Privacy laws
- Union agreements
- Public concerns about photo enforcement in work zones.

Ethical Concerns

Of the 92 respondents who answered this question, the majority (76) stated that ethical concerns are not an issue in reporting worker presence.

Few specific concerns were stated in the free-text portion of the question, except that unions were again mentioned.

Liability Concerns

Of the 92 respondents who answered this question, the majority (68) stated that liability concerns are not an issue in reporting worker presence.

Specific liability-related concerns expressed were:

- Liability for an accident or injury (in whole or in part) if the agency is aware of a work zone
- False positives may result in financial risk
- Diminishment of agency credibility if information is inaccurate
- Responsibility for injuries in the event of a system failure.

Track B – Work Zone Equipment Providers

The objective of Track B was to discover what solutions work zone equipment manufacturers are currently offering to detect and report worker presence in real-time.

A total of 25 responses were received. The majority (44%) were from equipment vendors, followed by others who identified as maintenance and construction companies (24%) or “other” (32%). The “Other” category included consultants, mobility service providers, and industry standards developers.

Existing Solutions for Tracking Workers Presence

The market for tracking worker presence is relatively new. Survey Track A results revealed that only 5% of the overall IOO responders (Q11) said that they track worker presence, indicating we are likely in the early adoption phase of the typical technology adoption lifecycle.

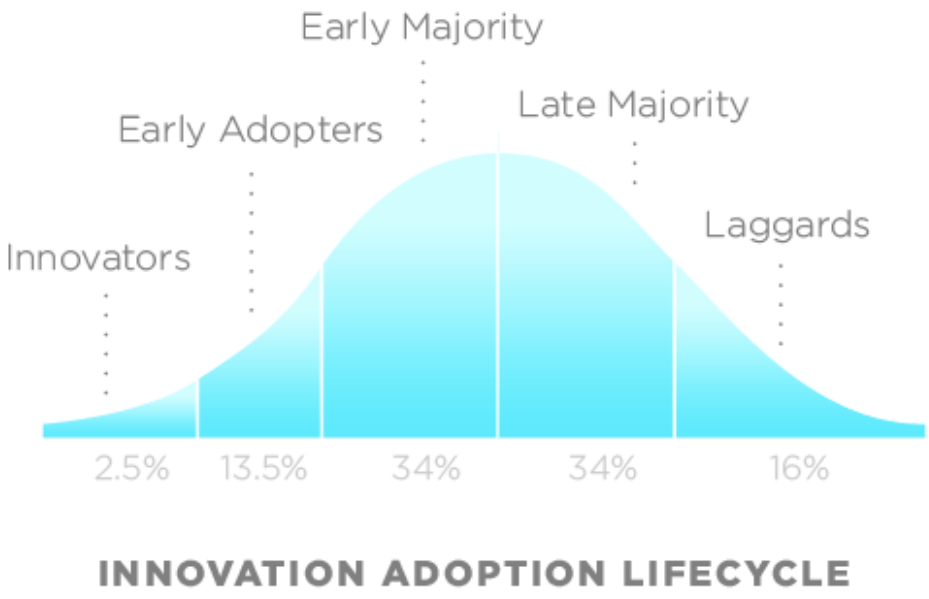

Figure 1. Stages of the innovation adoption lifecycle.

Reference: https://en.wikipedia.org/w/index.php?curid=11484459

This was also reflected in the Track B survey results. Six (6) companies reported offering systems to track the presence of workers in work zones. Four (4) are manufacturers:

- HAAS Alert
- Hill and Smith
- Icone
- Ver-Mac

Two (2) companies are solutions integrators that sell/rent solutions from the above manufacturers.

- Iowa Plain Signing
- Street Smart Rental

Due to the inherent limitations of surveys as a data-collection mechanism, it is possible or even likely that other vendors may also be offering solutions but did not respond to or were not aware of the survey. Given the reach of the WZDx initiative and increasing awareness of and interest in reporting worker presence, there may be an acceleration of products coming to market from a growing number of vendors in the near to medium-term future.

Technologies Deployed

All vendor survey respondents offer smart GPS (Global Positioning System)-enabled equipment to track workers' presence. This technology is commonly available and has been in use for decades. It is well adapted to this need, as it requires line-of-sight to properly receive the orbital satellite signal and derive local position.

Smart GPS-enabled equipment usually automatically reports the location of the workers or equipment with minimal or no human action. For example, a worker might need only to turn a power switch to enable data transmission.

Two (2) vendors are offering worker check-in/check out systems which allow workers to report their presence. The workers need to manually report the information, which creates the potential for delay or missed data. Examples of such systems include smart-phone mobile apps and manual radio/phone check-ins to a central dispatcher, where attendees enter the data into a central system.

One (1) vendor is currently offering camera monitoring to detect worker presence.

One (1) is using variable speed limit (VSL) signs to report worker presence. When workers are on site, the speed limit is decreased using the dynamic VSL. The action of decreasing to a lower speed limit and returning the speed to the regulatory one is used as a proxy for the presence of workers in the work zone. This presumably requires an operator in a Traffic Management Center to reduce the speed because they are aware of the presence of workers in the zone.

One (1) vendor developed a flagging baton to report the location of workers in an active flagging operation.

Worker Presence Tracking System Performance

Survey respondents provided their impressions of the performance of their offered solutions. All vendors responded that they somewhat or strongly agree that their solution is:

- Accurate
- Clear
- Feasible
- Practical
- Simple
- Sustainable
- Timely
- Useful

No respondents indicated that their solution was “sporadic.”

Only one (1) “somewhat agreed” that their current system is expensive. Two (2) “somewhat” or “strongly disagreed” and 3 neither agreed nor disagreed. The range of responses showed that pricing may be correlated to the value the end user will get. A solution may be perceived as expensive for a stakeholder that sees no benefits, and inexpensive for one that sees value.

Comparing Track A and Track B responses to this question (which was posed to both groups), results are similar but not identical. Vendors typically “strongly agreed” on many points, while the IOOs “somewhat agreed” on the *accuracy, clarity, practicality, simplicity, sustainability,* and *usefulness* of current market solutions.

The timeliness of data is the one quality with the greatest difference in respondents between IOOs and vendors. Vendors “strongly agreed” with the timeliness of data, while IOOs reported a mix between

strongly agree and disagree. However, most IOOs are not using real-time, automated worker presence reporting systems and may be commenting on their current, legacy systems. “Timely” is also subjective, as we will see in the Track D responses.

Why Equipment Providers Are Not Offering Solutions

Most (N=19) of the respondents to Track B, Question 26 are not offering a solution to track worker presence today. The most popular reasons are related to the definition of such systems, which they feel is currently vaguely defined, making it difficult to develop a product that will address the real user needs. Internal company prioritization of project, management support, and budget allocation were also identified as reasons. Also mentioned were:

- Had a solution in the past that customers were not using
- Outside their work scope
- Currently in development
- No workers in the work zone
- Offering big machinery, workers are inside the machine.

As mentioned earlier, this is normal for a technology that is in the early adoption phase. This phase usually helps to better define the users’ needs, which in turn leads to more products addressing those needs, thus growing the market with more requests and more solutions.

We would expect that many of them will offer solutions in the upcoming years.

Privacy Concerns

Most of the responders—92% (N=23)—stated that privacy concerns were not an issue.

The following were mentioned in free-text comments:

- It is not a vendor responsibility but an end-user one
- The developed solution should not keep any personal information on file.

Ethical Concerns

Almost all respondents—96% (N-24)—stated that ethical concerns are not an issue in reporting worker presence.

The remaining respondent mentioned that they care about an ethical approach in their solution.

Liability Concerns

All respondents stated that liability concerns are not an issue in reporting worker presence.

Track C – Work Zone Workers

The workers' acceptance of such tracking technology is a key factor for its global adoption going forward. This track provides more details on workers' roles, where and when they work, and what they think about tracking their presence.

A total of 70 responses were received. The majority came from state DOTs, with 47 of 51 DOT answers from WSDOT.

To avoid a WSDOT over-representation in the results and analysis, the Working Group separated out WSDOT Track C and all other validated responses into separate bins, both of which are presented in this paper.

This analysis showed that for most elements the WSDOT responses are very similar in percentage to the non WSDOT responses. Only one sub-element displayed a noticeable difference between the two groups.

Workers' Demography and Field Activities

Ninety-six percent (N=67) of responses to Track C came from DOTs and maintenance and construction companies. Equipment vendors and city/local DOT workers represented 4% of the sample.

Overall, there was a good mix of managers/supervisors and workers. Among non-WSDOT responses, mostly managers/supervisors responded. From WSDOT, 25% of responses came from managers/supervisors and 75% from field workers.

Respondents represented a wide range of work zone locations. The majority of the respondents are working on highway work zones. Surface streets, urban, and rural were also well represented. We did not get a lot of responses from utility workers (6% [N=4]) or first responders (10% [N=7]).

Work Zone Duration

The duration of the work zone varies, ranging from less than 1 hour to more than 1 week. The majority of the responses were in the 3 days or less category and in that sub-group, work zones that last between 1 hour and 1 day were the most popular pick. Work zone duration is an important element for a solution. It shall be installed rapidly, with minimal effort, and report the worker position in or as close to real-time to make it valuable.

Technology Used to Track Worker Presence

Fifty-two percent (N=11) of the non WSDOT workers and 62% of the WSDOT workers responded to this question about their level of comfort in regards to using various technologies to track their presence.

The most appealing/comfortable technology is a phone or radio where a worker reports their presence status to another human. Eighty percent of the workers are very comfortable using such technology. However, this technology is prone to delay and requires human processing. It is worth mentioning that 8% of respondents are very uncomfortable using this technology, regardless of the device used.

The second most comfortable technology is a mobile app. Fifty percent of the workers are either very or somewhat comfortable using a mobile app. If we add the workers that were neither comfortable or uncomfortable, 63% are comfortable using such technology. This technology is more efficient than calling as some steps could be fully automated by software.

The technologies above have in common that the worker has 100% control as to when he reports his presence. The next technologies are more automated and remove the worker's ability to report his presence himself.

Vehicle-based GPS tracking: 53% of the workers are very comfortable/somewhat comfortable or neither, versus 18% that are not comfortable using such technology. The WSDOT workers were more comfortable (64%) using this technology versus the non-WSDOT respondents.

Wearable GPS is the least appealing technology for the workers surveyed. Only 20% are very comfortable or somewhat comfortable using it, and 38% including the neither category. Thirty percent are uncomfortable with this technology. The WSDOT respondents reported being even less comfortable using such technology, with 50% answering as somewhat or strongly uncomfortable.

One respondent mentions that reporting is done using the inspector daily report.

The reasons mentioned for being uncomfortable using any of those technologies are:

- Lack of trust (reported multiple times)
- Feels like big brother (reported multiple times)
- Privacy (reported multiple times)
- Don't like the idea
- Not a robot.

This demonstrates that workers are more willing to report their position if they have the control to report their presence, and are reluctant at using an automated device that will track them all the time. That control is a critical element for such system adoption.

The fully automated, timely reporting of worker presence will never be achievable if full automation is not in place. On the flip side, if workers are not comfortable using or being in contact with an automated technology, the objectives of reporting workers presence will be difficult to achieve.

Track D – Work Zone Data Consumers

Track D of the survey provided answers to foundational questions regarding the collection, processing, and use of WZDx feeds among users. There were a total of 51 responses from the following data-consumer groups and the majority of respondents came from data mapping providers (42%), CV/AV developers/manufacturers (20%), followed by universities (14%) and consultants (12%). The remaining survey respondent agencies were tracked from city/local DOTs, equipment providers, and planning organizations (12%).

Track D survey questions were geared toward defining the ways that data is processed while gauging consumers' preferences for accuracy, timeliness and false-reporting tolerances. Each factor in this part of the survey plays a critical part in the effectiveness of real-time data reporting, therefore the survey

respondents' answers shed light on current and future expectations for WZDx data feeds. Most survey respondents were interested in real-time information about whether workers are present at work zones.

Before dissecting the survey answers further, it is important to note that there were three sections out of fourteen (21%) of Track D survey questions to which 38%-40% of respondents did not complete, providing fewer data to report on.

Uses of Work Zone Data

Once the type of data users were established, the survey asked respondents to list the ways they use data. Work Zone data consumers use work zone data for the following purposes, in order of popularity:

- Real-time maps
- Tracking active work zones
- Tracking planned work zones
- Automated driving systems
- Turn-by-turn navigation.

Additionally, work zone data consumers use the data for the distribution of real-time data to customers and the motoring public, performance monitoring, safety research, tracking road construction changes, and traffic alerts and notifications.

How data is processed was consistent across the board (35%) with preferred interest in real-time data at construction zones via vehicle-to-infrastructure (V2I) and WZDx feed from back-office to local vehicles. Thirty-two percent of survey respondents preferred data processed in construction zones at real-time with use of signage, back-office data to local vehicles via V2I communications, and WZDx download to vehicle maps. Additionally, consumers were interested in cloud to cloud integration and published feeds.

Data Quality and Timeliness

The majority of data mapping providers and equipment vendors would like to see more precise accuracy data feeds compared to researchers and consultants, whereas researchers and consultants responded that they would be more interested in workers present or within the vicinity of the work zone. However, a similar amount of survey respondents reported that they don't know their preferred level of precision or accuracy for worker presence data. Additionally, there was a response that more accurate data is preferred, but they had no defined minimum level of accuracy determined.

Frequency of data feed updates every one second are unrealistic due to the amount of data that would need to be stored, and are therefore preferred at one minute intervals. However, survey respondents would be satisfied with updates made within a 5-15 minute time frame. Based on the percentage of survey respondents, nearly 50% of respondents will be satisfied with a 5-15 minute update, 88% with a 1 minute update, and 100% within 1 second.

It is a fact that there will be a measure of false reporting of workers' presence within work zones, therefore an accepted frequency of this will need to be established within testing metrics. The most common responses for tolerance of false data reporting were 0.1% and 1%. There may be a significant amount of uncertainty among data consumers about what level of false reporting is acceptable.

Additional perspectives from survey respondents about what their organizations would like to receive were signals if the work zones were active, the presence of first responders, warning from connected vehicles, and worker presence privacy and guidance. How will workers utilize data and in what ways can the data be analyzed to predict trends/patterns to better assist construction workers? If the data can be set up as a feed that one can subscribe to, it'll improve the efficiency and usefulness of the data significantly. The feed format should be consistent between different DOTs at different levels (i.e., states, counties, cities).

Work zones are sometimes left "dormant" during off hours, perhaps with or without roadway restrictions in place. The assumption is that when no workers are present, the data (including restrictions) may be considered "planned." Once a worker is present, then the work zone is "active," confirming the planned data and adding further detail (e.g. more restrictions to roadway, speed, etc.) may begin. When standards are developed that anonymize data to address privacy concerns and highlight personal health and safety, then workers' presence may be more than willing to share presence data within the construction workforce.

Worker presence data can be very essential to connected automated vehicles (CAV), especially when they are traveling through work zones. Understanding the road geometry is particularly difficult for CAVs inside the work zone and this can pose safety concerns for workers present in the area. Real-time data exchange of worker presence data to CAV along with the MAP data messages would be highly required.

Future Considerations

The intent of the 2020 WZDx Worker Presence survey was to reach out to the industry to gain a deeper understanding of current definitions of worker presence in state and local regulations; current methods for collecting worker presence data; their strengths and weaknesses; needs and requirements around worker presence data; and any privacy, ethical, and legal considerations. The 2020 survey helped paint a clearer picture of where the industry now stands in collecting, reporting, and consuming worker presence data. It also raised more questions and opportunities for future investigation.

The 2020 Worker Presence survey engaged four stakeholder types: IOOs, equipment providers, data consumers, and work zone workers. In the future, engaging Public Information Officers (PIOs) employed by IOOs could be beneficial. As the survey revealed a range of understandings of the purpose, challenge, and goals of tracking worker presence among respondents, educational campaigns both within organizations and at the national level were identified as potentially useful follow-up actions for progressing the inclusion of WP data in agencies' WZDx data feeds. Engaging PIOs could be an effective way to better understand the communication side of reporting worker presence data, while also potentially making progress toward raising awareness of and achieving a shared understanding of the end goals of tracking worker presence.

Regarding the needs and challenges around worker presence definitions, future activities could include publishing a suggested "baseline" definition of worker presence that states or localities could adopt as part of developing their WZDx feeds, in the absence of other advice or clarity in their jurisdiction. The results of the 2020 survey could be used to craft such a definition. Another potentially helpful activity could be to assemble an inventory of states' and localities' worker presence definitions—and any associated regulations in a single document or database for further review and analysis.

It was also expressed that a clearer definition of work zones themselves could be valuable, specifically for contractors who have concerns around liability and automated systems. For example—“first sign to last sign” may be important to add to such a definition. This is not a question specifically for the Worker Presence Subgroup, however.

Another recommended follow-up effort is to engage in more detailed follow-up interviews with specific agencies and data consumers to better understand the context of some of the survey results. For example, a more detailed conversation with WSDOT could be beneficial to understand the variety of results received from within that single agency.

Survey Responses

1. What type of organization do you work for? (n=537)

Organization Type	Number of Responses	Percent of Responses
State DOT	314	58%
City/Local DOT	45	8%
Metropolitan Planning Organization	7	1%
Consultant	27	5%
Mobility Service Provider	4	1%
Equipment Vendor	13	2%
Maintenance or Construction Company	23	4%
Connected/Automated Vehicle Developer or Manufacturer	13	2%
Data and Mapping Provider	20	4%
Standards Development Organization	4	1%
University or Other Academic Institution	13	2%
Other	54	10%

2. Please write in the name of the organization for which you work.

Responses to this question are not being disclosed.

3. What best describes the field you work in? (n=536)

Field of Work	Number of Responses	Percent of Responses
Transportation Planning	23	4%
Traffic Engineering	78	15%
Intelligent Transportation Systems	24	4%
Operations	57	11%
Connected/Automated Vehicles	17	3%
Transportation Policy	6	1%
Public Transportation	7	1%
Freight or Port	1	<1%
Construction and Maintenance	21	4%
Transportation Data and Data Science	14	3%
Mapping/GIS	21	4%
Mobility Services	1	<1%
Standards Development	11	2%
Software Development	7	1%
Research	9	2%
Other	52	10%

4. What best describes your job?

Job Type	Number of Responses	Number of Unique Organizations (Q2)
I plan, coordinate, or manage work zones for a roadway operator or other public agency—*e.g., DOT, City, Public Works, Utility Coordinator, etc.*	220	86
I work for an organization that manufactures, rents, or provides equipment that is used in work zones.	23	18
I do on-site work within work zones—operate equipment, flagging, etc.	68	17
I work for an organization that uses or might use real-time work zone data in its products or services (e.g., real time maps, navigation, road closure management etc.).	78	21
Other	148	

Track A: Infrastructure Owner/Operators (n=220)

Organization Type	Number of Responses	Percent of Responses
State DOT	167	76%
City/Local DOT	27	12%
Metropolitan Planning Organization	2	1%
Consultant	8	4%
Mobility Service Provider	1	0%
Maintenance or Construction Company	2	1%
Other	13	6%

5. Is your organization responsible for activities involving work zones?

Responsible for work zone activities	# Responses excluding WSDOT (n=123)		# Responses from WSDOT (n=97)	
No	5	4%	0	0%
Yes	117	95%	95	98%
Don't Know	1	1%	2	2%

6. Does your organization have a system for keeping track of where work zones are planned on its roads or rights-of-way (ROW)?

Has work zone tracking system	# Responses excluding WSDOT (n=123)		# Responses from WSDOT (n=97)	
No	27	22%	1	1%
Yes	86	70%	83	86%
Don't Know	10	8%	13	13%

7. Does your organization have a system for tracking active work zones (Work Zone Tracking System)? (n=220)

Has a system for tracking active work zones	# Responses excluding WSDOT (n=123)		# Responses from WSDOT (n=97)	
No	47	38%	5	5%
Yes	62	50%	69	71%
Don't Know	14	11%	23	24%

8. Does your state/region have a definition of when workers are present in a work zone? (n=220)

Has worker presence definition	**# Responses excluding WSDOT (n=123)**		**# Responses from WSDOT (n=97)**	
No	36	29%	5	5%
Yes	46	37%	49	51%
Don't Know	41	33%	43	44%

9. In your state/region, who is responsible for defining Worker Presence? (n=157)

Answered "Yes" or "Don't Know" to Q8.

Responsible for defining worker presence	# Responses excluding WSDOT (n=74)		# Responses from WSDOT (n=83)	
State Department of Transportation	32	43%	41	49%
State Law Enforcement Agency	3	4%	1	1%
Nobody	4	5%	1	1%
Not Sure	27	36%	35	42%
Other	8	11%	5	6%

Other responses

- Defined in state law (5)
- On-site personnel: contractors, supervisors, techs, inspectors (7)

10. For each of the following scenarios, please check whether workers would be considered present in your jurisdiction. (n=198)

(Please check all that apply)

Scenario	# Responses excluding WSDOT (n=110)		# Responses from WSDOT (n=88)	
A barrier wall in place within the clear zone	26	24%	20	23%
A barrier wall in place within the edge lines	17	15%	21	24%
A barrier wall in place within the right of way	23	21%	13	15%
Fixed equipment in the work zone	25	23%	44	50%
Humans physically working within the work zone	77	70%	69	78%
Humans physically within the work zone but not working (e.g. on break)	72	65%	56	64%
Mobile equipment moving in the work zone	63	57%	64	73%
Mobile equipment in the work zone but not moving	40	36%	50	57%
Don’t know	30	27%	19	22%
Other:	4	4%	3	3%

Other responses

- Colorado does not differentiate between WZ with workers present and not present, or in active WZ or behind a barrier.
- Wisconsin DOT doesn't have a specific definition for workers present.

11. Does your organization have a system for tracking the presence of workers in work zones (Worker Presence Tracking System)? (n=198)

Organization has worker presence tracking system	# Responses excluding WSDOT (n=110)		# Responses from WSDOT (n=88)	
No	84	76%	29	33%
Yes	6	5%	13	15%
Don't Know	20	18%	46	52%

12. Why hasn't your agency implemented a Worker Presence Tracking System? (n=113)

Answered "No" to Q11.

(Please check all that apply.)

Reasons for not implementing	# Responses excluding WSDOT (n=84)		# Responses from WSDOT (n=29)	
Budget constraints	31	37%	5	17%
Legal reasons	5	6%	1	3%
Management support	8	10%	1	3%
Not a priority	34	40%	7	24%
Technology gaps	34	40%	4	14%
Vaguely defined	28	33%	4	14%
Other	28	33%	15	52%

Other responses

- Don't know (20)
- It has not been a priority (6)
- Tracking requires coordination with contractors or other agencies (3)
- We are not responsible for managing work zones (3)
- Unfamiliar or concerned with the technology (6)
- Workers are assumed to be present in work zones in my jurisdiction
- We are considering/have developed work zone tracking system (2)

13. Why does your agency track worker presence in work zones? (n=60)

Answered “Yes” or “Maybe” to Q11. (n=85; 25 non-response)

Reasons for tracking worker presence	# Responses excluding WSDOT (n=14)		# Responses from WSDOT (n=46)	
Contract management and/or enforcement	7	50%	23	50%
Connected and Automated Vehicle (CAV) projects	1	7%	0	0%
Field activity tracking	6	43%	24	52%
In-vehicle display (i.e. driver alert)	0	0%	2	4%
Internal statistics	1	7%	3	7%
Legal reasons	2	14%	12	26%
Publication of a Work Zone Data Exchange feed	3	21%	8	17%
Share with companies (e.g. Google, Waze, TomTom)	3	21%	1	2%
Share with the public (e.g. 511 or similar traveler info system)	5	36%	20	43%
Speed enforcement	4	29%	5	11%
Other:	4	29%	11	24%

Other responses

- Don’t know why we track worker presence (1)
- Don’t know if we track worker presence (7)
- Safety (3)
- Speed limit changes

14. What technologies does your organization employ for tracking worker presence? (n=60)

Answered “Yes” or “Maybe” to Q11.

(Please check all that apply.)

Technologies	# Responses excluding WSDOT (n=14)		# Responses from WSDOT (n=46)	
Camera-based monitoring	4	29%	11	24%
Smart equipment (e.g. GPS-enabled arrow boards, cones, trucks, etc.)	3	21%	4	9%
Smart wearables (e.g. GPS-enabled bands, watches, boots, vests, etc.)	1	7%	0	0%
Worker check in/out via mobile app	1	7%	7	15%
Worker check in/out via phone or radio call	4	29%	28	61%
Other	10	71%	15	33%

Other responses:

- Digital system (3)
- Daily reports (5)
- Inspector or crew manager keeps track (2)
- None (2)
- Don’t know (8)

15. Please indicate the degree to which you agree or disagree with each of the following statements. My agency's Worker Presence Tracking System is: (n=60)

Excluding WSDOT (n=14)

Quality	Strongly Agree		Somewhat Agree		Neither		Somewhat Disagree		Strongly Disagree		N/A	
Accurate	3	21%	7	50%	2	14%	1	7%	0	0%	1	7%
Clear	2	14%	8	57%	2	14%	0	0%	0	0%	1	7%
Expensive	1	7%	2	14%	4	29%	4	29%	0	0%	3	21%
Feasible	3	21%	8	57%	2	14%	0	0%	0	0%	1	7%
Practical	3	21%	8	57%	1	7%	1	7%	0	0%	1	7%
Simple	5	36%	6	43%	1	7%	0	0%	1	7%	1	7%
Sporadic	2	14%	2	14%	4	29%	3	21%	1	7%	2	14%
Sustainable	3	21%	6	43%	2	14%	1	7%	1	7%	1	7%
Timely	2	14%	5	36%	2	14%	4	29%	0	0%	1	7%
Useful	5	36%	5	36%	2	14%	1	7%	0	0%	1	7%

WSDOT Only (n=46)

Quality	Strongly Agree		Somewhat Agree		Neither		Somewhat Disagree		Strongly Disagree		N/A	
Accurate	5	11%	18	39%	9	20%	6	13%	0	0%	8	17%
Clear	4	9%	16	35%	14	30%	3	7%	0	0%	9	20%
Expensive	1	2%	10	22%	21	46%	1	2%	4	9%	9	20%
Feasible	5	11%	14	30%	17	37%	2	4%	0	0%	8	17%
Practical	6	13%	17	37%	11	24%	4	9%	0	0%	8	17%
Simple	3	7%	16	35%	14	30%	4	9%	1	2%	8	17%
Sporadic	2	4%	15	33%	12	26%	4	9%	4	9%	9	20%
Sustainable	3	7%	19	41%	14	30%	2	4%	0	0%	8	17%
Timely	3	7%	19	41%	9	20%	5	11%	2	4%	8	17%
Useful	6	13%	17	37%	9	20%	5	11%	1	2%	8	17%

16. Approximately what percent of Worker Activity is captured by your agency's Worker Presence Tracking System?

Excluding WSDOT (n=14)

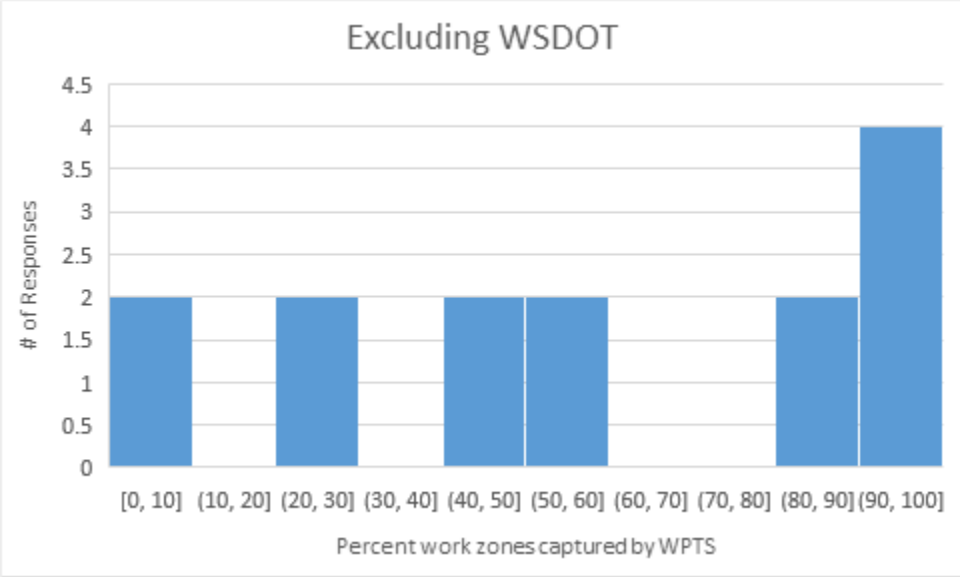

Figure 2. Respondents' estimates of the percentage of worker activity covered by their agency's worker presence tracking system, excluding WSDOT.

WSDOT (n=46)

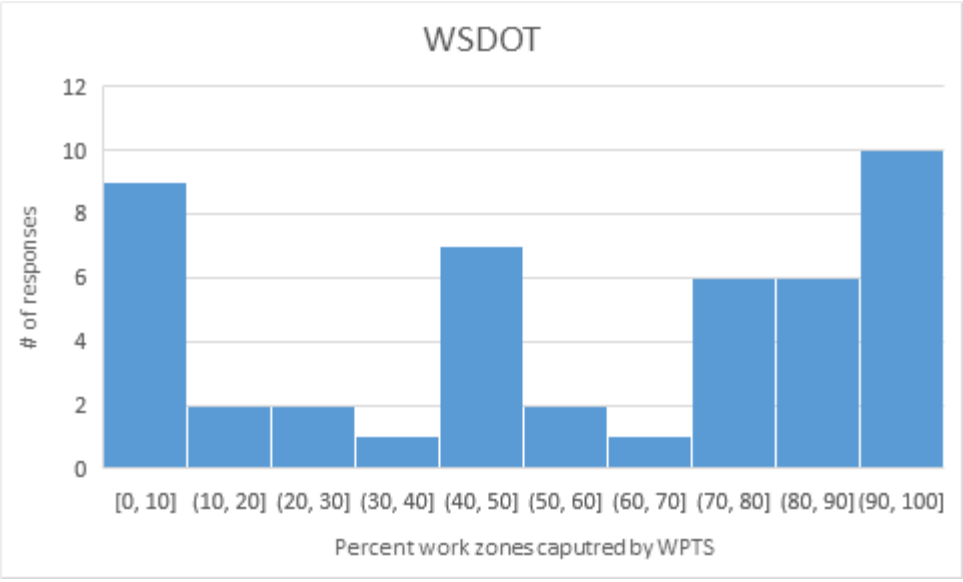

Figure 3. Respondents' estimates of the percentage of worker activity covered by WSDOT's worker presence tracking system.

17. If less than 100%, please indicate why Worker Activity is not being tracked. (n=60)

Reasons for not tracking worker activity	# Responses excluding WSDOT (n=14)		# Responses from WSDOT (n=46)	
Budget constraints	2	14%	8	17%
Management support	3	21%	2	4%
Not a priority	1	7%	6	13%
Technology gaps	4	29%	5	11%
Vaguely defined	3	21%	11	24%
Worker compliance	3	21%	13	28%
N/A (100% is tracked)	4	29%	10	22%
Other	2	14%	14	30%

Other responses:

- Don’t know (11)
- Don't believe we have a tracking system (2)
- Periodic checks to ensure the same people are on site

18. In your state/region, is Worker Presence a legal and/or regulatory issue? (n=60)

Is legal/regulatory issue	# Responses excluding WSDOT (n=14)		# Responses from WSDOT (n=46)	
No	5	36%	34	74%
Yes	9	64%	12	26%

If Yes, please explain:

- Don’t know (12)
- Speed limit and/or fines change when workers are present (4)
- Accountability purposes (3)

19. Does your organization have privacy concerns about Worker Presence Tracking? (n=164)

Has privacy concerns	# Responses excluding WSDOT (n=92)		# Responses from WSDOT (n=72)	
No	77	84%	58	81%
Yes	15	16%	14	19%

If Yes, please explain:

- Don't know/unsure (21)
- Concerns related to the union (2)
- Collect limited information due to privacy concerns (3)

20. Does your organization have ethical concerns about real-time Worker Presence Tracking? (n=164)

Has ethical concerns	# Responses excluding WSDOT (n=92)		# Responses from WSDOT (n=72)	
No	76	83%	61	85%
Yes	16	17%	11	15%

If Yes, please explain:

- Don't know/not sure (19)
- Concerns related to the union (3)

21. Does your organization have liability concerns about real-time Worker Presence Tracking? (n=164) (All answers skip to Q47)

Has liability concerns	# Responses excluding WSDOT (n=92)		# Responses from WSDOT (n=72)	
No	68	74%	56	78%
Yes	24	26%	16	22%

If Yes, please explain:

- Don't know/not sure (24)
- Concerned about liability in the case of an incident (1)
- Concerned about liability in the case of system malfunction (2)
- Concerned about liability in the case of inaccurate data (3)
- Concern related to union (2)

Track B: Work Zone Equipment Providers (n=25)

Organization Type	Number of Responses	Percent of Responses
Equipment Vendor	11	44%
Maintenance or Construction Company	6	24%
Other (please specify)	5	20%
Consultant	1	4%
Mobility Service Provider	1	4%
Standards Development Organization	1	4%

22. Does your company offer a system for tracking the presence of workers in a work zone (Worker Presence Tracking System)?

Only six are offering a system to track worker presence. Some of those are a distributor of the same solution. They are:

- HAAS Alert
- Hill and Smith
- Icone
- Iowa Plain Signing
- Street Smart Rental
- Ver-Mac

23. How many U.S.-based organizations have deployed your Worker Presence Tracking System?

HAAS alerts claimed more than 10 deployments while the others claimed more than 1.

24. Please indicate which technologies your Worker Presence Tracking System employs. (n=6)

The technologies used for worker presence tracking are the following, in order of most to least popular:

1) Smart (GPS-enabled) equipment: All vendors

2) Worker check in-out: 2 vendors

3) Camera based monitoring used by one vendor

4) Others: 2 vendors

a. Variable speed limit trailer

b. Flagging baton

25. Please indicate the degree to which you agree or disagree with each of the following statements. (n=6)

My company's worker presence tracking system is:

	Strongly Agree	Somewhat Agree	Neither	Somewhat Disagree	Strongly Disagree	N/A
Accurate	4	2				
Clear	5	1				
Expensive		1	3	1	1	
Feasible	2	4				
Practical	4	2				
Simple	5	1				
Sporadic			3		2	1
Sustainable	4	1				1
Timely	5	1				
Useful	4	2				

26. Please indicate why your company does not offer a Worker Presence Tracking System (n=19)

Reason	Number of Responses	Percent of Responses
Vaguely defined	4	21%
Budget constraints	2	11%
Management support	2	11%
Not a priority	1	5%
Technology gaps	1	5%
Other	5	26%

Other responses:

- Had a solution in the past that customers were not using
- Outside their work scope
- Currently in development
- No workers in the work zone
- Offering big machinery, workers are inside the machine.

27. Does your company have any privacy concerns about Worker Presence Tracking? (n=25)

Most (23) respondents have no Privacy concerns, the 2 that have privacy issues are for the following reasons:

a) One said that they addressed it by not keeping any personal information on file.

b) One said that the owner of the equipment shall tell if they have privacy concerns and not the vendor.

28. Does your company have ethical concerns about real-time Worker Presence Tracking? (n=25)

Almost all respondents (24) answered as not having ethical concerns. One respondent answered that they do have ethical concerns, adding that their solution is addressing that aspect.

29. Does your company have liability concerns about real-time worker tracking?

All respondents indicated that they have no liability concerns; one also questioned why liability issues may exist.

Track C: Work Zone Workers (n=68)

For Track C, there were 70 responses from organizations of the following types.

Organization type	Responses excluding WSDOT (n=21)	Responses from WSDOT (n=47)
City/Local DOT	1	0
Equipment Vendor	1	0
Maintenance or Construction Company	16	0
State DOT	3	47

*Forty-seven responses from WSDOT were filtered out and will be analysed separately to not influence the analysis.

30. What type of position do you hold?

Position	Responses excluding WSDOT (n=20)	Responses from WSDOT (n=44)
Manager	11	11
Non-manager	2	33
Other	7	

Other responses:

- Traffic control supervisor (6)
- Owner (1)

31. For what type of Work Zones is your agency/company responsible? (Multiple answers possible.)

Type of work zone	Responses excluding WSDOT (n=20)	Responses from WSDOT (n=44)
Highways	20	All
Surface Streets	10	13
Urban	10	16
Rural	11	18
Utility	2	2
First Responder (i.e., ambulance, police, towing, roadside assistance, spills, etc.)	3	4
Other (Please specify):	1 all type of roads	0

32. For which lengths of time are the Work Zones you work in active? (Multiple answers possible.)

Length of work zone	Responses excluding WSDOT (n=20)	Responses from WSDOT (n=44)
Less than 1 hour	5	7
Between 1 hour and 1 day	15	31
Between 1 and 3 days	6	5
Between 3 days and 1 week	7	10
More than 1 week	13	16

33. Does your agency/company require you to report when you arrive and/or leave a Work Zone?

Eleven organizations (52%) required the workers to report when present on site. Almost all (10) are using verbal communication over phone, cell, or radio system to report back. One was done by the inspector's daily report.

WSDOT: 29 reported (62%) requiring the workers to report when present on site. Most of the time (21) this is by phone or radio to various parties. The second method is face-to-face exchange with a supervisor, contractor, or inspector, and some (4) are using a daily log.

34. How do you report when you arrive and/or leave a Work Zone?

Responses excluding WSDOT (n=10)	Very Comfortable	Somewhat Comfortable	Neither	Somewhat Uncomfortable	Very Uncomfortable	N/A
Mobile app	4	1	1	1	1	2
Phone / radio	9		1		1	
Vehicle GPS	2	1	2		3	2
Wearable GPS	2	1	1	1	3	2

Most respondents are not concerned about being tracked, but those that are indicated the following reasons:

a) Lack of trust

b) Feels like big brother

c) Privacy

d) Don't like the idea

e) Not a robot

Responses from WSDOT	Very Comfortable	Somewhat Comfortable	Neither	Somewhat Uncomfortable	Very Uncomfortable	N/A
Mobile app	10	5	4	1	1	5
Phone / radio	23	1	1	1	2	1
Vehicle GPS	5	4	7	1	3	5
Wearable GPS	3	2	6	3	5	6

Twenty-one percent of WSDOT respondents are uncomfortable being tracked, giving the following reasons:

a) Feels like big brother

b) Lack of trust

c) Privacy concerns, personal information being stored

Track D: Work Zone Data Consumers (n=76)

It is important to note that, within the 76 total responses to Track D results, 25 entities identified as non-data consumers. These groups will not remain on the list of data consumers moving forward with Track D, resulting in a net 51 total responses.

All respondents to this set of questions selected “I work for a company that uses or might use real-time work zone data in its products or services (e.g., real-time maps, navigation, road closure management, etc.).”

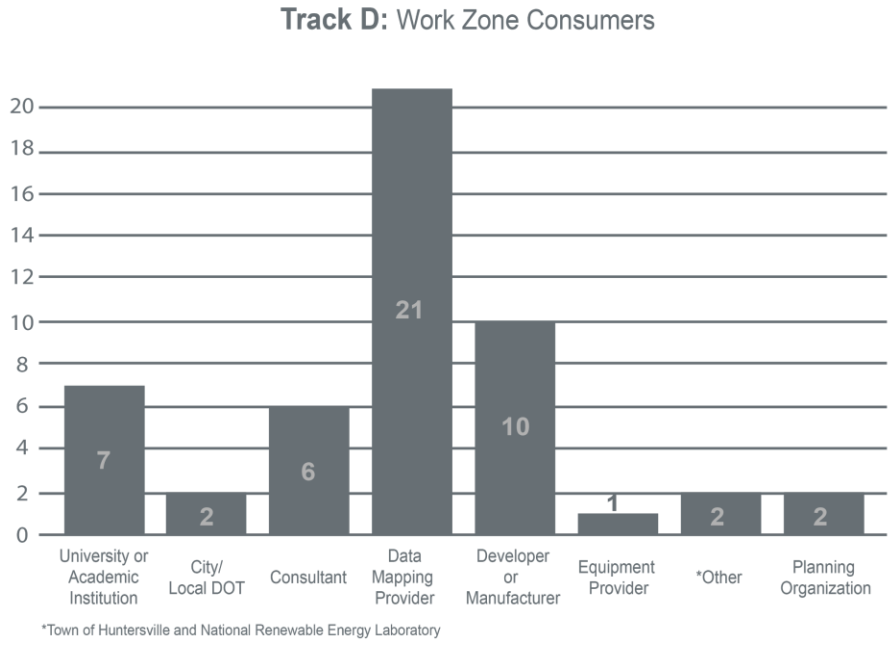

Figure 4. Responses to Track D by organization type.

37. Does your organization use real-time Work Zone data?

Most respondents were interested in real-time information about whether workers are present at work zones.

- Thirty-eight percent of data consumers said they “use real-time Work Zone data.”
- Fifty-one percent of data consumers said they “don’t use real-time Work Zone data, but would like to.”
- Eleven percent of organizations said that they don’t know if they do or don’t use real-time Work Zone data.

38. How does/would your organization use work zone data?

1. Real-time maps
2. Tracking active work zones
3. Tracking planned work zones
4. Automated Driving Systems
5. Turn-by-turn navigation.

Additionally, Work Zone data consumers use Work Zone data for:

- Distributing real-time data to customers and motoring public
- Performance monitoring
- Safety research
- Tracking Road Construction Changes
- Traffic alerts and notifications.

40. What type of Worker Presence data is your organization interested in receiving?

Multiple answers possible.

Type of worker presence data	Responses
Highways	27
First Responder (i.e., ambulance, police, towing, roadside assistance, spills, etc.	23
Urban	23
Surface Streets	23
Rural	22
Utility	15

Other responses:

- All areas that restrict speeds when workers are present
- Partnering with tolling.

41. For which work zone durations is your organization interested in receiving Worker Presence Data?

Multiple answers possible.

Work zone duration	Responses
Less than 1 hour	23
Between 1 and 3 days	20
More than 1 week	20
Between 1 hour and 1 day	19
Between 3 days and 1 week	18

Note: multiple answers possibly alleviates percentage.

42. How would your organization prefer to receive Worker Presence data?

Multiple answers possible.

Transmission method	Responses
Real-time at construction zones via V2I communications	18
WZDx feed from back office to local vehicle	18
Real-time at construction zones via signage	16
Back office data to local vehicle via V2I (vehicle-to-infrastructure) communications	16
WZDx download to vehicle maps	16

Other responses:

- Cloud to cloud integration
- Published feed.

43. How accurate does your organization need Worker Presence data to be?

The majority of data mapping providers and equipment vendors would like to see more precise worker presence data versus research/consultants.

Cumulative Accuracy Aspect	# of Responses	Cumulative Total on Overall	# of Responses that Don't Know
Within 1 foot of a worker	4	100%	100%
Within 3 feet of a worker	7	94%	92%
Within 10 feet of a worker	2	82%	78%
Within 100 feet of a worker	2	79%	73%
Within the vicinity of the work zone	16	76%	69%
Yes/no that workers are present	18	50%	37%
Don't know	13	21%	
Total that know	49		
Total	62		

Other responses:

- Depends on level of SAE automation that we are dealing with for a project
- The more accurate the better, no defined minimum level of accuracy as of now.

44. How timely does your organization need Worker Presence data to be updated?

Based on a percentage of replies, nearly 50% of respondents will be satisfied with a 5 minute to 15 minute update, 88% with a 1 minute update, and 100% within 1 second.

Cumulative Timely Aspect	# of Responses	Cumulative Total on Overall	# of Responses that Don't Know
Within 1 second	7	100%	100%
Within 1 minute	18	88%	87%
Within 5 minutes	9	58%	53%
Within 15 minutes	9	43%	36%
Within 1 hour	3	28%	19%
Within 24 hours	7	23%	18%
Don't know	7	12%	
Total that know	53		
Total	60		

Other responses:

- Depends on level of SAE automation that we are dealing with for a project
- Within 30 minutes
- 45 minutes
- Historical data.

45. What percentage of falsely reported Worker Presence data would be tolerable for your organization?

Cumulative Falsely Reported/Error Aspect	# of Responses	Cumulative Total on Overall	# of Responses that Don't Know
0.01 percent (1 out of 10,000 is wrong)	7	100%	100%
0.1 percent (1 out of 1,000 is wrong)	13	88%	84%
1 percent (1 out of 100 is wrong)	13	67%	55%
10 percent (1 out of 10 is wrong)	7	45%	25%
20 percent (1 out of 5 is wrong)	4	33%	9%
Don't Know	16	27%	
Total that Know	44		
Total	60		

Other responses:

- Depends on level of SAE automation that we are dealing with for a project
- Depends on whether false negative or false positive. False reporting of no workers present when there are workers is much more problematic.
- Please choose the maximum tolerable level.

46. What additional Worker Presence data, if any, would your organization like to receive?

- Additional signal of whether the work zone is active / valid. (E.g., we'd have a lower confidence in a work zone with no worker presence data over many weeks.
- Presence of first responders would warrant an additional hazard warning in the vehicle
- Construction changes that permanently affect driving rules (new road/exit/lanes, paint line changes, speed, lane rules, and availability).
- It could be important to know if workers are present on the drivable surface (no barrier between works and vehicles), or off of the drivable surface (a barrier is between the workers and the vehicles).
- Location of equipment that would be present on roads and their "safety" zones.
- Worker presence indicates active work zone. So any further restrictions or roadway changes (e.g. lane closures) when workers are present should be updated accordingly.

47. Please share any additional thoughts about Worker Presence data, if any:

- It is important to know at real time the location of work zones, especially in special APPS from the state or third-party vendor.
- Very important topic. We have recently added a "workers present" element to the police crash report and are looking at ways to incorporate this information into our lane closure management and reporting systems.
- We would like to notify drivers approaching a work zone if it is active and if they should be alert to workers for safety reasons.
- Worker presence data can be very essential to connected automated vehicles (CAV) when they are travelling through work zones. Understanding the road geometry is particularly difficult for CAV inside the work zone and this can pose safety concerns for workers present in the area. Real-time data exchange of worker presence data to CAV along with the MAP data messages would be very much necessary.