WA RUC

Appendix B-2: Simulation Analytics Results

December 2023

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PREFACE

Forward Drive was a research, development, demonstration, and public engagement effort of the Washington State Transportation Commission. The project sought to advance understanding of and implementation pathways for per-mile road usage charging (RUC) as an alternative to motor fuel taxes and alternative fuel vehicle registration surcharges. The project aimed to address several key issues for RUC including principally equity, user experience, and cost of collection. As reported in Volume 1, the project unfolded in several stages. A series of appendices contain more detailed results. These appendices are organized as explained and illustrated below.

Appendix A. Forward Drive began with research spanning several activities including financial analysis, equity outreach and analysis, user experience research, and cost of collection reduction workshops (Appendices A-1 through A-4, respectively). The purpose of the research was to explore the financial, equity, user experience, and cost impacts of RUC under a variety of deployment scenarios. This research informed the design of experience-based simulations and pilots of various elements of a RUC program.

Appendix B. The research stage led directly to the design and development of simulations and pilots of RUC program elements spanning several areas to reflect the multiple objectives and research findings. The centerpiece of the simulation and pilot testing stage was an interactive simulation of RUC enrollment, reporting, and payment. As described in Volume 1, the simulation offered over 1,100 Washingtonians an opportunity to experience RUC in as little as a few minutes, followed by a survey about their preferences and opinions. The detailed results of the simulation survey and the measurements of the simulation itself are presented as separate reports (B-1 and B-2, respectively).
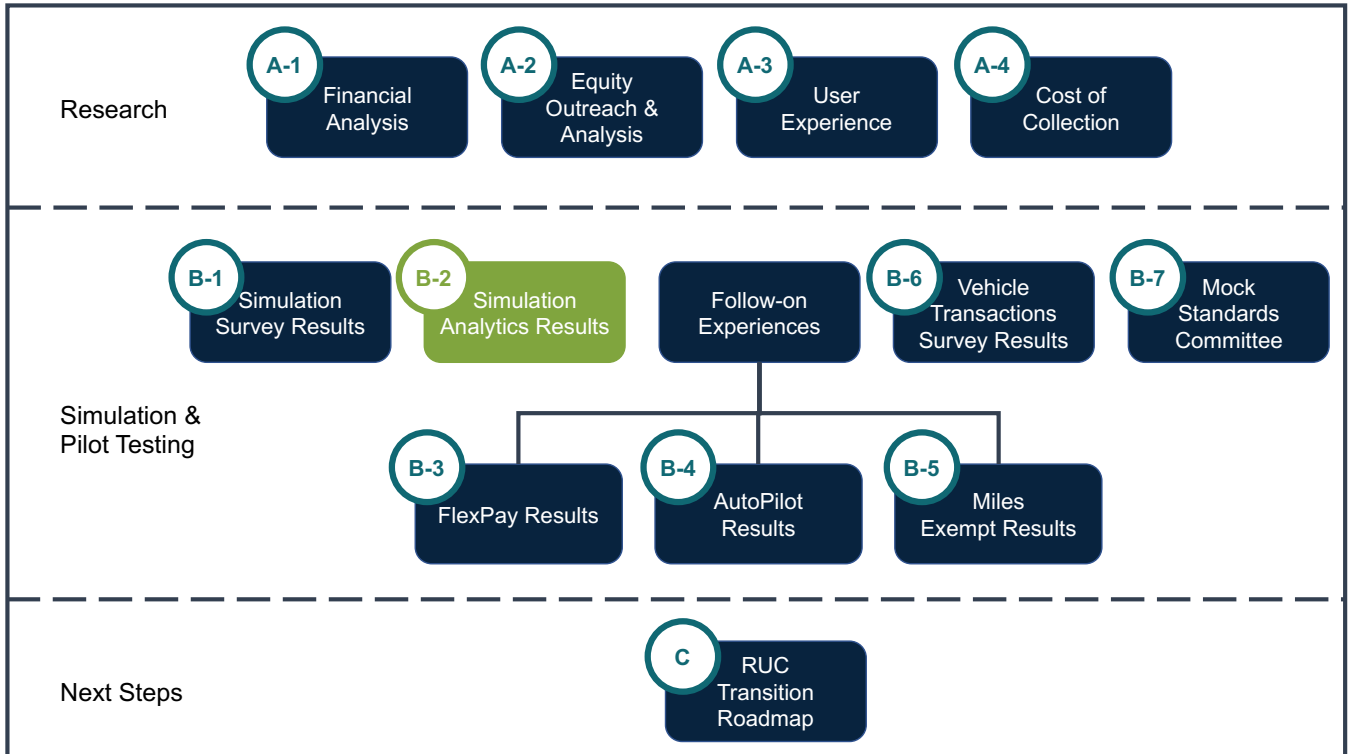
Within the simulation, participants could opt into one of three follow-on experiences, each designed to further test a specific feature of RUC of interest to Washington stakeholders and policymakers:

- FlexPay tested installment payments, allowing participants to pay their RUC over four payments instead of all at once (B-3).

- AutoPilot tested using native automaker telematics to report road usage as an alternative to self-reporting or other technology-based approaches to reporting (B-4).

- MilesExempt tested a self-reporting approach for claiming miles exempt from charges, such as off-road and out-of-state driving (B-5).

The simulation and pilot testing stage also included a statewide survey of Washingtonians' vehicle transactions designed to understand existing transactions and preferences and possibilities for how RUC reporting and payment could potentially be bundled with such transactions (B-6).

Lastly, the simulation and pilot testing stage included a mock standards committee of RUC experts from jurisdictions and industry. The committee simulated the process of creating standards for RUC to support cost reduction, enhanced user experiences, and multi-jurisdictional interoperability (B-7).

Appendix C. Appendix C details a transition roadmap for RUC in Washington drawing on the results of the research and simulation and pilot testing, as well as the updated recommendations regarding RUC implementation from the Commission to the Washington Legislature in 2022.

Research

A-1 Financial Analysis

A-2 Equity Outreach & Analysis

A-3 User Experience

A-4 Cost of Collection

Simulation & Pilot Testing

B-1 Simulation Survey Results

B-2 Simulation Analytics Results

Follow-on Experiences

B-6 Vehicle Transactions Survey Results

B-7 Mock Standards Committee

B-3 FlexPay Results

B-4 AutoPilot Results

B-5 Miles Exempt Results

Next Steps

C RUC Transition Roadmap

Appendix B-2 covers results of performance analysis of the Simulation itself, including time to complete and methods of access.

1.0 INTRODUCTION

During the course of the Washington road usage charge (RUC) simulation, Azure Analysis Services was used to monitor participant behavior. Data collected were used to quantitatively assess participant experiences and behaviors. Findings from this analysis can inform future system design to understand and optimize the user experience for a web-based RUC transaction.

The primary objective of analytics is to better understand how respondents interacted with the simulation. This analysis focused on the following metrics:

- Completion time
- Browsing patterns (e.g., continuous from beginning to end versus navigating back and forth)
- Perception of the time spent (comparing actual time with the survey answer)
- Type of device used

Data collection occurred during the live operations of simulation from December 2022 to January 2023.

2.0 SIMULATION OPERATIONS

The RUC simulation began with an email invitation to participate, containing a unique code for accessing the simulation.

By clicking the link in the email, the participant was taken to the simulation website, which began with a welcome screen. The welcome screen provided an explanation as to the purpose of the simulation and asked the participant to provide their unique access code. It also explained the purpose of the simulation: to experience reporting and paying a RUC. It also explained that pages with dark text on light background represent the simulation of a RUC system; meanwhile, pop-up messages with light text on dark backgrounds and yellow accents represented interventions that would not exist in a real RUC system. These pop-ups, like the narration of a story, aimed to guide the participant by providing context and explanations about certain features of the simulation that differ from reality. Pop-ups were also used to invite participation to enroll in follow-on experiences, depending on the choices they made inside the simulation.

Following the welcome screen, the participant was prompted to enter information about the vehicle they most often use in their household.[1]

Once the participant selected their vehicle information (make, model, year, and trim), average combined fuel economy was automatically calculated and displayed.

Next, the participant entered the portion of the simulation with dark text on light background. The simulation began with a welcome screen explaining what RUC is in several sentences along with frequently asked questions (FAQ). The participant could explore the FAQ, if they wished, or proceed directly to the next step by clicking "Get Started."

WA RUC
WASHINGTON ROAD USAGE CHARGE

Washington Road Usage Charge Program

As vehicles become less dependent on gas, Washington is transitioning from funding roads through the state gas tax and gallons purchased, to a road usage charge based upon the number of miles driven.

The objective of this program is for drivers to pay based on their use of Washington's roads, regardless of what type of vehicle they drive.

Get Started

Frequently Asked Questions

What is a road usage charge?	>
What is the per-mile rate of the Road Usage Charge?	>
Why is Washington state studying a road usage charge system?	>
Will this be an additional tax?	>
What is this simulation exploring?	>
What happens if I drive out of state or in private roads?	>
Can miles be reported without using GPS data?	>
Do participants have to pay with their own (real) money?	>
How would out-of-state drivers be handled in a road usage charge system in Washington state?	>
Have other states adopted a road usage charge?	>

Next, the participant was asked to provide their current odometer mileage as a numerical entry. As they typed, an estimate of the number of miles they drove in the past year automatically appeared. In the background, the simulation calculated this number by dividing the odometer reading by the age of the vehicle in years. For example, a vehicle with model year 2013 with an odometer entry of 100,000 was estimated to be ten years old and have driven 10,000 miles in the past year. The estimate was meant as an approximate guide for the participant, who could also choose to customize the number of miles driven over the past year by editing it directly. At the same time, the participant could see a running total of their RUC charges in the upper right corner of the screen. This total could be expanded on any page of the simulation to see the calculations, including such details as gas tax credits, discounts, exemptions, and transaction fees.

WA **RUC**
WASHINGTON ROAD USAGE CHARGE

$ **87.07**
Last Year's Estimated Total
Show Details

What is the current mileage on your vehicle's odometer?

Learn how to find your odometer

Odometer Mileage

50,000

Estimated Miles Driven Over Previous 12 Months

12,500 mi.

Estimated miles driven look off? Enter it manually here.

Previous   Next

Participants entered an average of 86,363 for their odometer mileage and an average of 7,594 miles driven in the preceding year. The average vehicle age was 11 years with an MPG of 24.9 among internal combustion engine vehicles. Five percent of vehicles entered for the simulation were zero-emission vehicles (ZEVs). Based on these entries, the average participant owed $176.04 in RUC but had paid an estimated $146.40 in state gas taxes, leaving a net average RUC due of $29.64.

The average miles driven and gas tax paid were smaller than the statewide average of about 10,000 and $250, respectively. This difference is likely attributable to the fact that the number of high-mileage vehicles and high consumption fuel users (HCFUs) captured in the sample for the simulation is smaller

than the actual proportion of such vehicles statewide. According to a Washington Joint Transportation Committee (JTC) study published in 2023, approximately 8% of Washington vehicles are driven more than 20,000 miles per year, and 0.7% are HCFUs (defined as consuming more than 1,500 gallons of fuel per year).2 Among simulation participants, only 1% reported driving more than 20,000 miles in the past year, and only one (representing about 0.1% of the sample) qualified as a HCFU. Since the sample was weighted based on demographics, not road usage characteristics, weighting cannot correct for this difference.

After entering the odometer reading and clicking "Next," the participant was asked to provide a photo of their odometer for verification of the number they entered on the previous screen. Choices included uploading an image immediately from their device, two options for uploading an image later, and one option to refuse to submit an odometer image. A link with more information was available if the participant wanted to learn more about odometer verification prior to making a selection. The two options for uploading later included providing their mobile number or scanning a QR code to open a link. Both of these options would open a web application for capturing and submitting an odometer photo The participant did not actually have to follow through with either of these options; the simulation merely captured their preference.

Although an odometer image was not actually required, this information was not shared with the participant until *after* they made their selection.
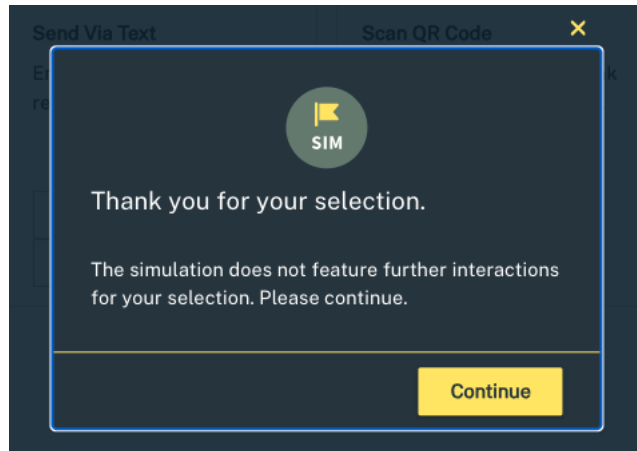
The majority of participants selected that they declined to submit an odometer image, possibly since they had no prior knowledge of the photo need prior to the simulation and were not prepared to provide such an image. In survey comments, some respondents offered that they did not want to provide an odometer photo, while others selected the "decline submission" option because of the inconvenience of accessing their vehicle in the moment. Overcoming this convenience hurdle for customers may benefit from proactive communication. Among those that made a selection, over 70% selected the "upload now" option.

Next, the participant was prompted to choose a method of exempting non-chargeable miles from their total RUC bill. They had three choices: (1) they could claim no exemptions, (2) they could claim a standard exemption of 200 miles (no evidence or documentation required), or (3) they could claim an exemption of greater than 200 miles (evidence required). Participants who select "greater than 200 miles" were invited to enter exactly how many exempt miles they would like to claim. A link with more

information was available if the participant wanted to learn more about exemptions prior to making a selection.

Among participants in the simulation, 36% claimed no exemption, 44% opted for the standard exemption, and 20% claimed more than 200 miles, and. Among the 20% claiming more than 200, the average amount claimed was 2,540 miles.

After making their selection and clicking next, the participant who selected "greater than 200 miles" was invited to participate in the "MilesExempt" follow-on experience. As indicated by the light text on dark background of the popup, this invitation was not part of the RUC simulation, meaning it would not form part of a real RUC reporting and payment experience.

Next, the participant was prompted to declare whether they are eligible for an income-qualified discount based on their existing enrollment with any of three state programs that require income qualifications. A

link with more information was available if the participant wants to learn more about discounts prior to making a selection.

Among participants in the simulation, 12% claimed some form of income-qualified discount, which entitled them to a discount equal to 20% discount of their gross RUC owed.

Next, the participant was presented with four choices for how to report miles driven next year: self-reporting (similar to what they just did), vehicle telematics, installed device, or mobile application. High-level information and indicative pricing for each option was presented to the participant, and a link with

more information was available should they want to learn more about mileage reporting methods prior to making a selection.

Participants who selected "vehicle telematics" were invited to participate in the AutoPilot follow-on experience. The vast majority (88%) of participants selected self-reporting in the simulation.

Next, the participant was asked to choose between making one payment or four equal payments for their net RUC owed, the amount of which remained visible in the upper right corner. A link with more information was available if the participant wants to learn more about payment plans prior to making a

selection. Among participants, 85% selected the "pay today" option, while 15% opted for paying in four equal installments over time.

Participants who selected "four equal payments" were invited to participate in the FlexPay follow-on experience.

Finally, the participant was asked how they wished to pay: via credit/debit card, bank account, or payment app. Additional fees of 3% were added for the credit/debit option. A link with more information was available if the participant wanted to learn more about payment options prior to making a selection. The most popular choice, with 54% of participants, was the debit/credit card option, despite the 3%

additional fee. 22% chose bank transfer, while 13% chose payment app (such as Venmo) and 11% chose cash or check.

After making their selection, for avoidance of doubt, a popup window appeared reminding the participant that no payment was due for purposes of the RUC simulation.
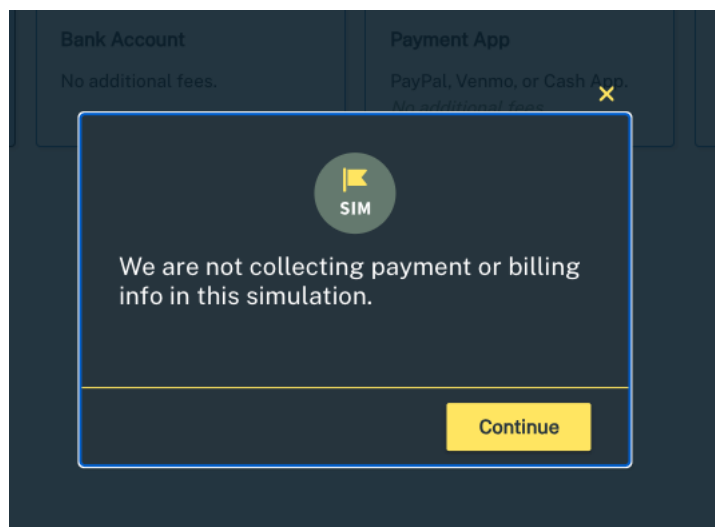
Next, the participant was presented a summary of all charges in a single screen and given one final opportunity to go back and revise any choices they made.

WA **RUC**
WASHINGTON ROAD USAGE CHARGE

How would you like to pay for your road usage charge?

Credit/Debit	Bank Account	Payment App	Cash/Check
Card transaction fees may apply.	No additional fees.	PayPal, Venmo, or Cash App. *No additional fees.*	No additional fees.

$**88.25**

Last Year's Estimated Total
Show Details

Previous   Next

Once they confirmed their selections, the participant received a confirmation of "payment" and a link to download a PDF version of their statement of charges. Lastly, the participant was invited to complete a survey about their experience.

WA **RUC**
WASHINGTON ROAD USAGE CHARGE

Does everything look correct?

Your Vehicle	
Make	Subaru
Model	Outback AWD
Year	2020
License	WADRIVER
Average MPG	29 mi.

Road Use Plan	
Current Odometer	50000 mi.
Odometer Photo	Uploaded
Exemptions	200 mi.
Reporting	Vehicle Telematics
Income-Based Discounts	None
Payment Plan	Pay Today
Payment Type	Credit/Debit

Road Use Charge	
Chargeable Miles	12300 mi.
Charge-Per-Mile	$0.024
Income-Based Discount	$0.00
Subtotal	**$295.20**
Estimated Gas Taxes Paid	$209.52
Transaction Fee (3%)	$2.57
Total	**$88.25**
Today's Charge	**$ 88.25**

Previous   Confirm

3.0 RESULTS

Simulation analytics focused on the 653 participants that constituted a statewide representative sample Unfortunately, Azure failed to store unique identification data for 11% of participants, so these are excluded from the results. The reasons for this missing data set are unclear but likely include an Azure outage during the simulation time frame, user ad blockers and firewall settings, and enabling of Azure's own "sampling" setting (designed to reduce analytics data collected for large-volume sites). In addition, in instances where the simulation data were believed to have problems, certain adjustments, as presented in Table 1, were implemented to clean the data prior to analysis. The analysis was ultimately based on 584 complete observations, after accounting for these factors.

Table 1: Simulation analytics data adjustment

Issue	Weight	%	Fix
No issue	476	73%	
Missing ID	69	11%	Removed
Missing Pages - Keep	4	1%	Aggregate time for multiple pages
Completion Time > 1 day	83	13%	If time spent on a page is greater than
Completion Time > 1 hour	16	2%	5 mins, replace with 85th percentile
Completion Time > 30 minutes	5	1%	
Total	**653**		
Kept	**584**		

To make the participant sample representative of the statewide population, each participant was assigned a weight based on various demographic and socio-economic factors. These weights were used to adjust the survey results, ensuring they accurately reflect the characteristics of the Washington population. This approach helps to provide a more accurate representation of the overall population.

The median time required to complete the simulation was approximately five minutes and twenty seconds, with over 85% completing in less than 12 minutes (see Figure 1).
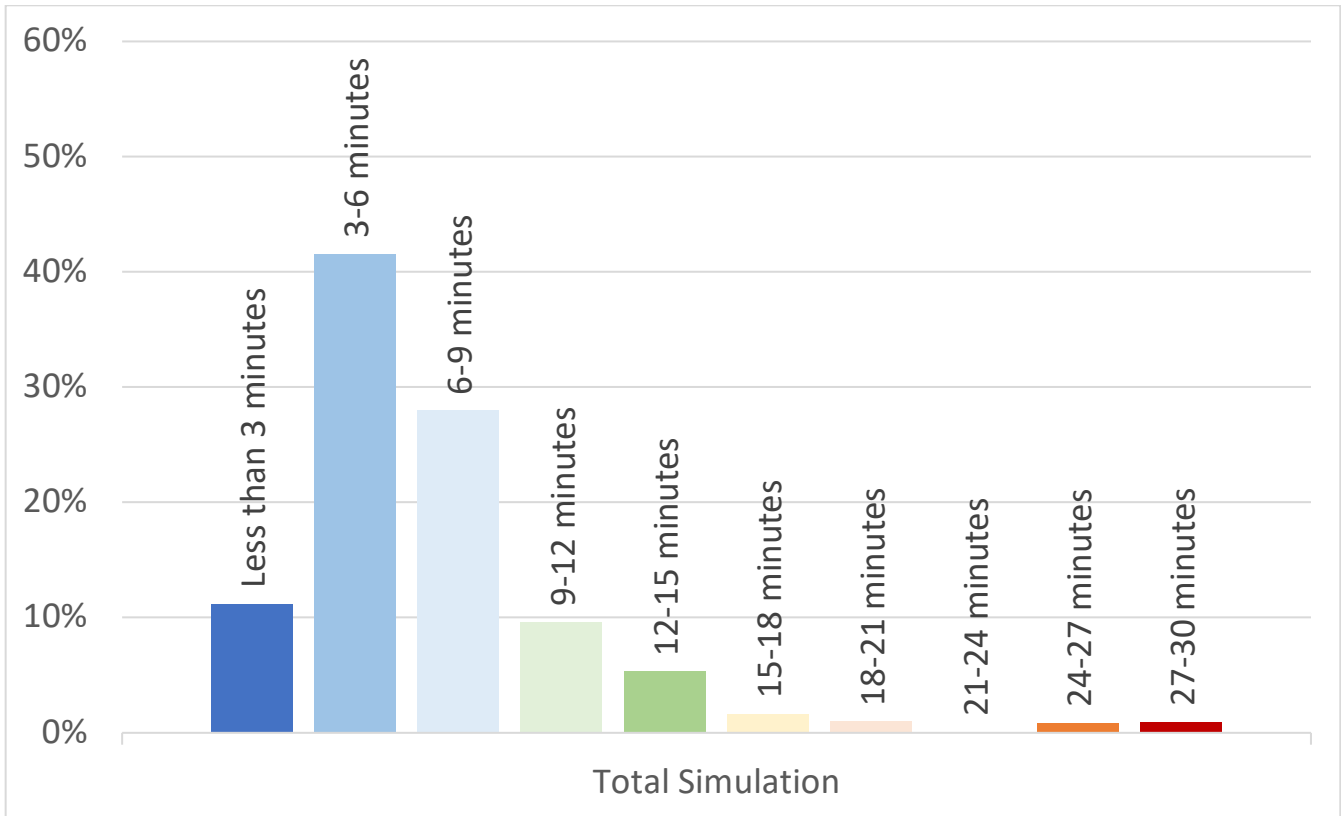

Figure 1: Time spent by respondents on the entire simulation

Looking at the disaggregated data, certain pages stand out in terms of completion time (see Figure 2). Particularly, the page prompting respondents to report their odometer mileage consistently had the highest average completion time, with a median of 38 seconds. This finding suggests that gathering accurate mileage information might require more time and attention from the participants. For example, this may reflect participants leaving their device to document their actual vehicle odometer reading. Thus, it is crucial to optimize the design and user experience during this step to ensure a successful simulation—for example, making it straightforward to resume the process of entering vehicle data after a period of inactivity.

Selecting a method to verify odometer mileage and a method of mileage reporting for future years tied for the second highest median completion length, at 25 seconds each.
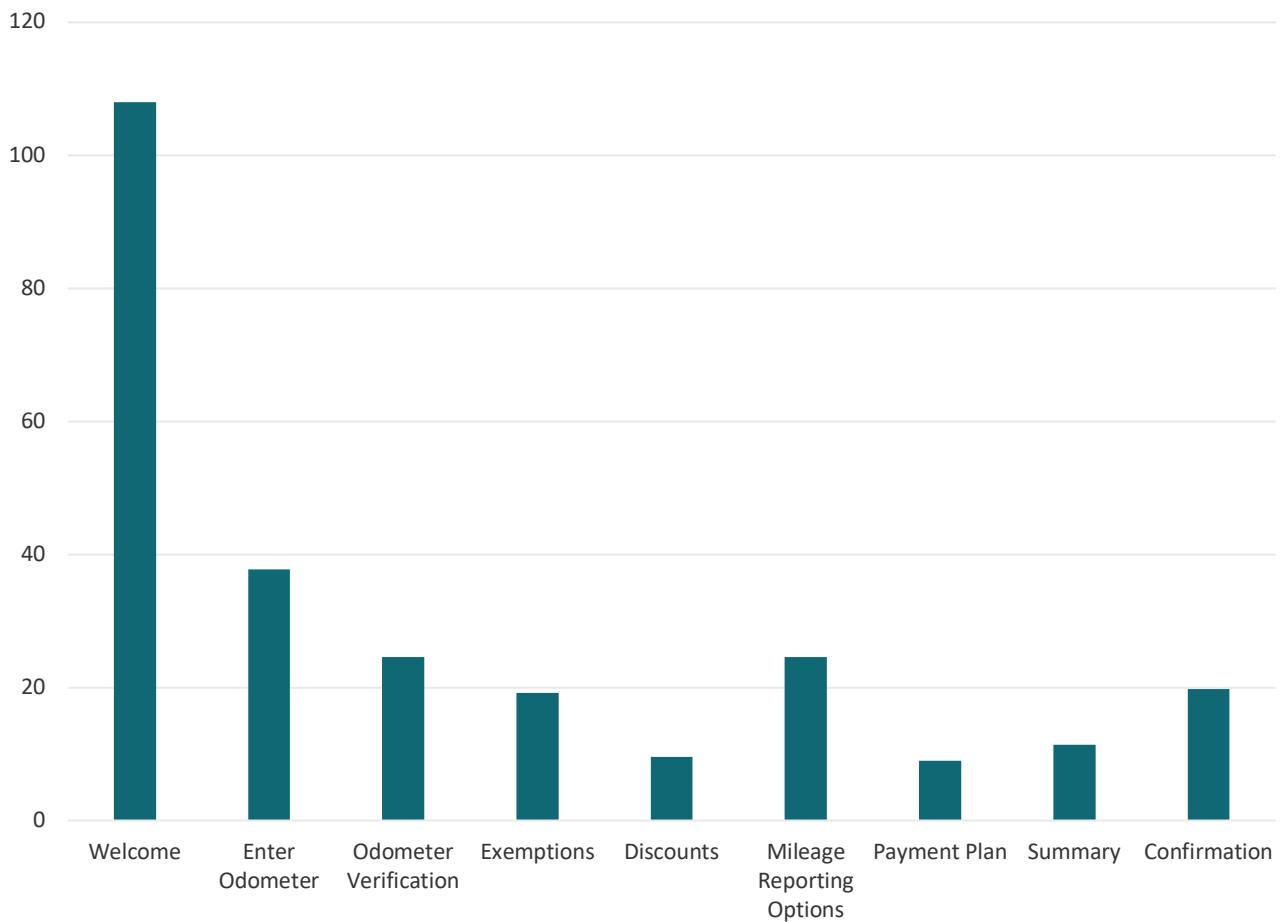

Figure 2: Median Time Spent Per Page in Simulation (Seconds)

Following the completion of the simulation, users were surveyed to provide an estimate of the time they felt they spent in it. The survey results indicate that users' perceptions of the time spent generally align with the actual time elapsed, with over 40% providing an accurate assessment, and another 30% saying the Simulation felt faster than it actually was (see Figure 3).
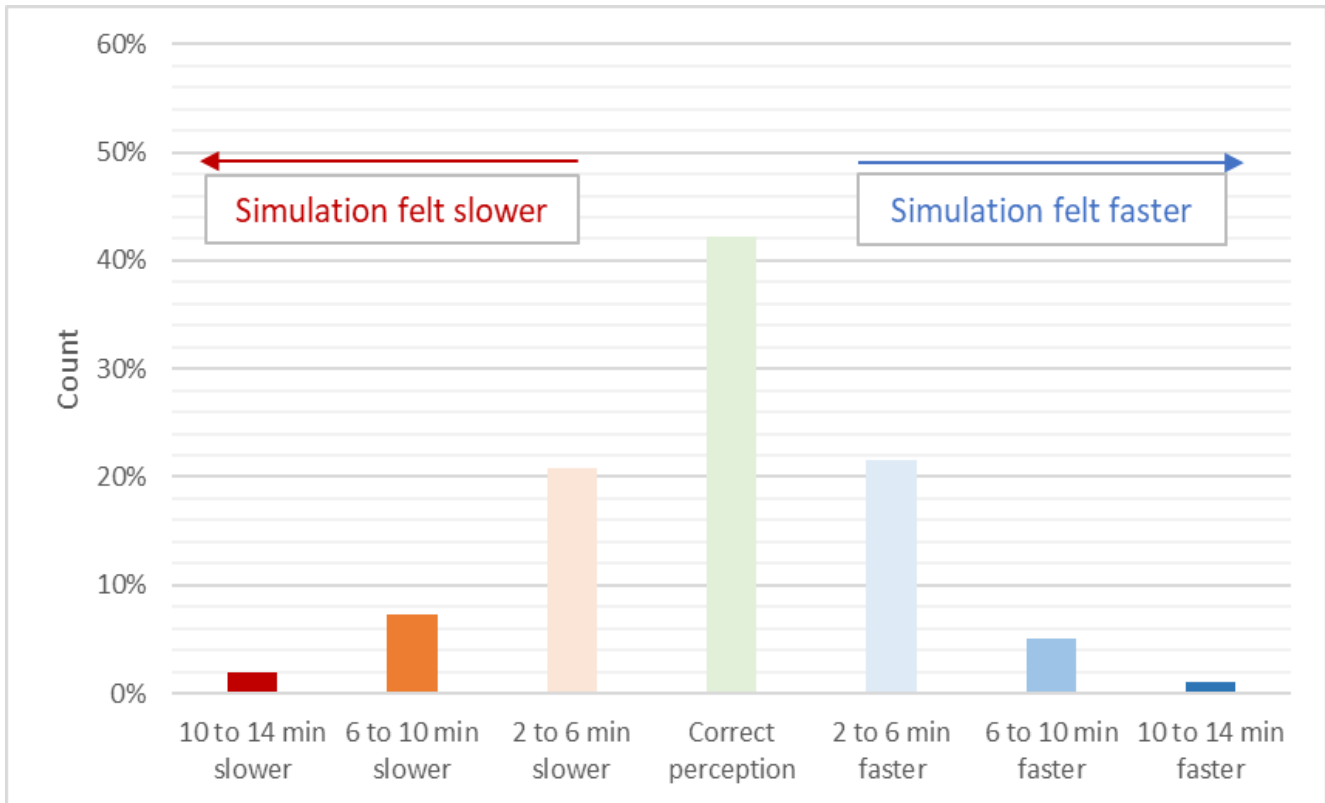

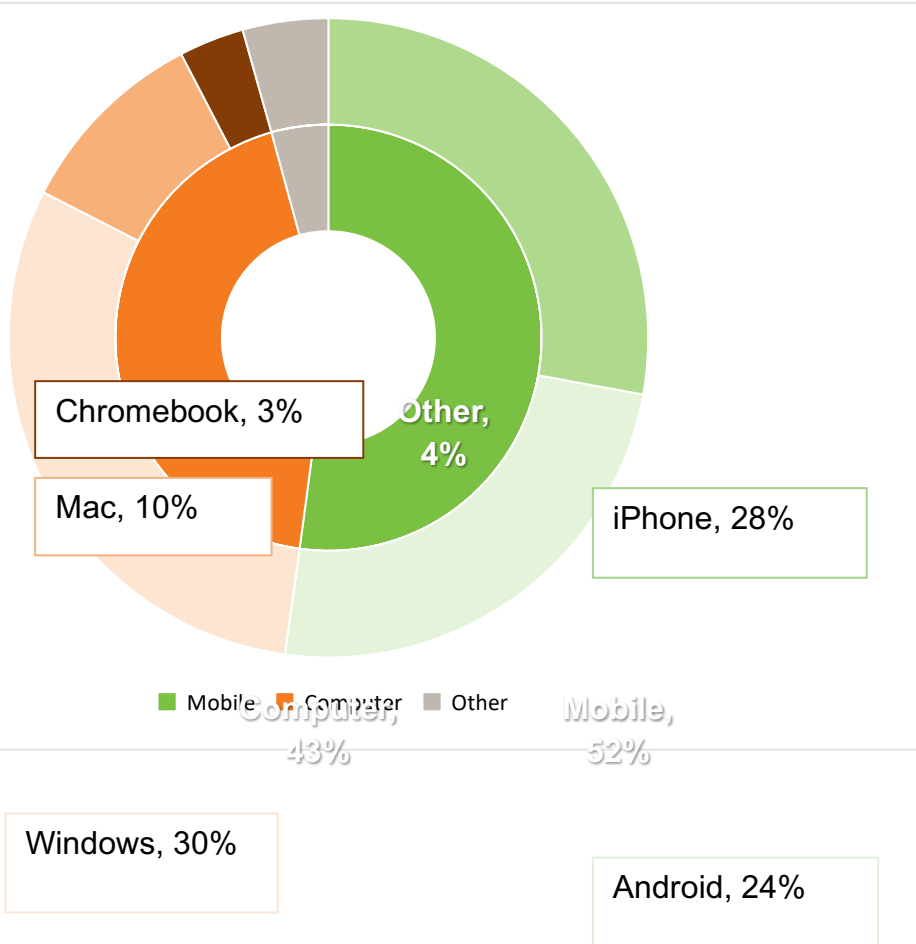**Figure 3: Time spent on simulation compared to survey answers**

Figure 4: Respondents by type of device (note: other includes Kindle, iPad, and multiple devices)

Findings revealed that 82 percent of respondents completed the entire simulation process without returning to previous pages, which indicates a relatively seamless and user-friendly experience. In addition, a greater number of participants reported spending less than eight minutes on the simulation compared to the actual count of individuals who completed within this timeframe. This suggests that the simulation design was perceived by users as easy to use.

4.0 LESSONS LEARNED

Participant survey responses do not tell the entire story of their experience. Behaviors revealed through web analytics form an important additional observation point to compare to opinions, beliefs, and preferences. In the case of the RUC simulation, analytics data allowed confirmation of the perceived time to complete, the most lengthy pages visited, and devices used for accessing the site.

For future research involving measurement of web-based behaviors with a somewhat limited flow of users, implementing an in-simulation analytics tool instead of relying on Azure (or any other external monitoring) would represent an improvement. With the number of site users measured in the hundreds or thousands, the volume of data generated is relatively small. This makes it more feasible to handle web analytics within the simulation itself. This approach could offer cost savings, simplify the analytics process by removing the reliance on external services, and allow for greater customization of behaviors measured.

Although no data were lost during this study due to retention losses, this was recognized as a potential limitation. The RUC simulation was designed to use the free functionality of Azure Analysis Services which includes data retention for only three months. For future analytics efforts that may last longer, research teams may prefer to create a paid account to save and retrieve data so that no data are lost.