FINAL REPORT
D2X DEVICE TO DEVICE COMMUNICATION

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EXECUTIVE SUMMARY

Imagine hitting a pothole while commuting to work. Now imagine hitting that same pothole the next day, and the following and the next. Many drivers encounter a version of this problem, promising themselves to avoid the obstacle next time, only to forget it by the time they encounter it again. Our recommendation of creating an accelerometer module will make this a problem of the past. By creating an accelerometer, or G-sensor, module, Cedar can combine the real-time data provided by the accelerometer with its radar detectors and Drive Smarter App to provide a hands-free solution to tracking potholes.

An accelerometer can go beyond simply detecting road conditions. In fact, we recommend Cedar to leverage their device-to-device capabilities to provide two additional features to their radar detectors:

- ***First Contact alerts*** would allow users to set an emergency contact on the Drive Smarter App who would automatically be alerted in case of a collision
- ***Parking Collision alerts*** would automatically alert the car owner of any collisions that occur to the car while the car is parked.

The goal of this report is to communicate the state of the radar detector market and link our customer and research insights to our recommendation of including an accelerometer module.

PROBLEM SUMMARY

Radar detectors are a powerful tool for providing consumers with alerts to threats on the road. This can include alerts a driver's speed relative to the posted speed limits in addition to advanced alerts to radar and laser threats. Cedar Electronics is the leader in radar detectors. Their product line of radar detectors via Cobra® and Escort® brands takes a significant portion of the roughly $125 million radar detector industry [3]. Although the radar detector market is growing, radar detectors themselves are saturated with similar features and pricing, providing little scope for differentiation. Entry into the market by new competitors emphasizes the need for continuous improvement and innovation from Cedar.

Cedar aims to combat these encroachments by:

- Developing new, exciting product innovations/combinations of features to better address driver needs—our solution of utilizing accelerometers aids with this and we explain in depth throughout the report.
- Align innovations with marketing strategies that will appeal to customers outside of the current customer base–we explain why a Safety Assist Package comprised of a radar detector and an accelerometer has immense growth potential.

Making products that address safety on the road is valued, totaling over $6B in just 2018 [1], while also solving a genuine lack of speed limit and radar awareness, which companies like Waze® are failing to address [2] completely. Cedar Electronics' product line of radar detectors via Cobra® and Escort® brands takes a significant portion of the roughly $125 million radar detector industry [3]. Both brands' primary offerings include devices: dash cameras, radar detectors, and mobile applications that allow drivers to alert each other to the location of red lights, speed cameras, and other hazards.

One primary directive is to find devices that have synergies with Cedar's radar detectors, articulate benefits, and provide paths to execution. In this report, we have utilized several tools like SWOT, customer & market research (sourced from Fortune Business Insights), and competitive analysis to help us identify consumer pain points, quick wins, and several exciting growth opportunities. This report contains diverse user stories, needs, and statistics representing the state of the market. This report will serve as the guiding document for further analysis and technical feature development efforts.

Once Cedar rolls out the product with the minimum initial investment, they will be able to gather valuable market insight and further partner with companies and incorporate the accelerometer within the production of all the radar devices. Our solution will help Cedar test the waters before going into these long-term commitments and bulk-producing products, and these insights will also help Cedar formulate further product strategies.

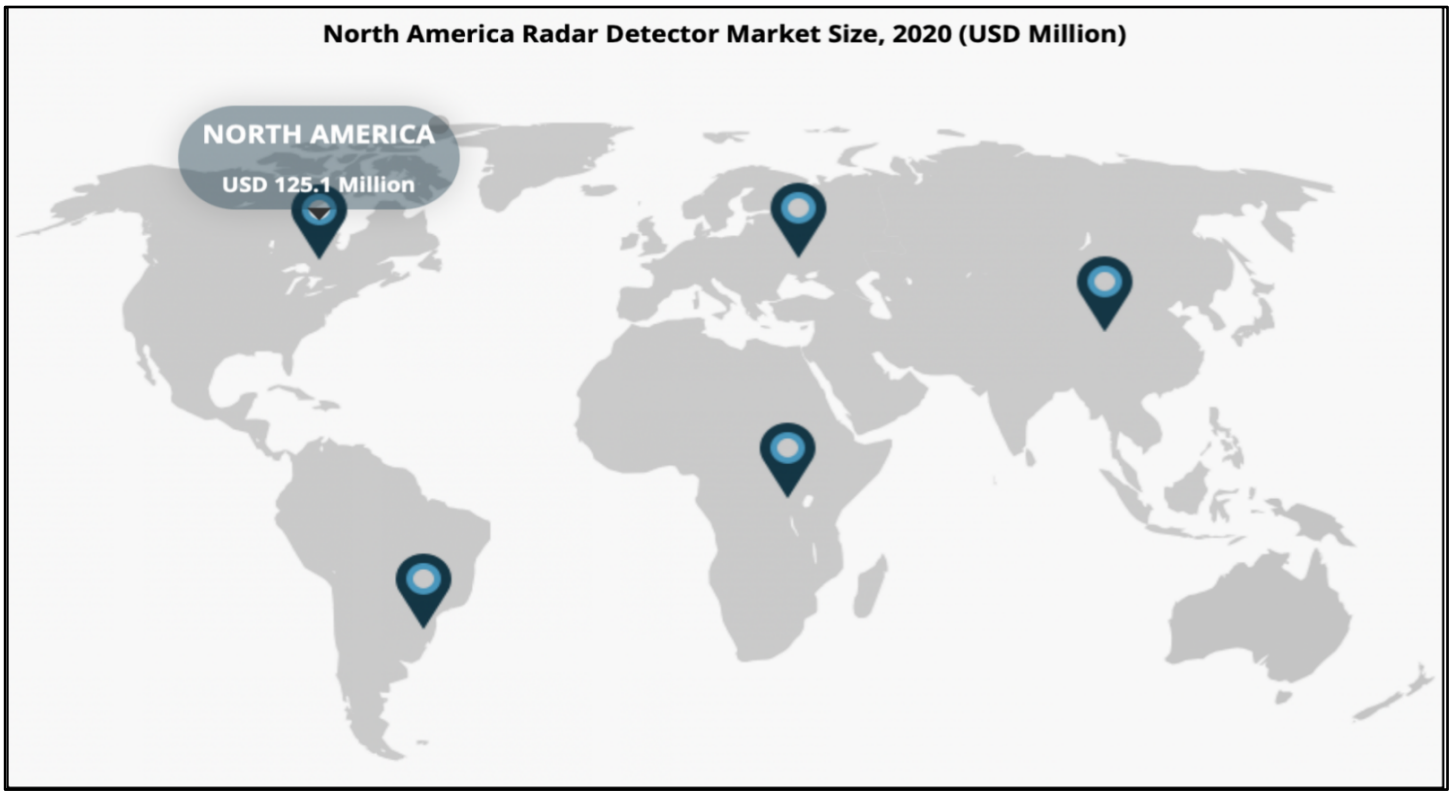
MARKET SUMMARY

The global automotive radar market is expected to reach USD 3.95 billion by 2028 and exhibit a CAGR of 9.7% between 2021 and 2028. The market size stands at USD 2.01 billion in 2020.

Reasons for Market Growth:

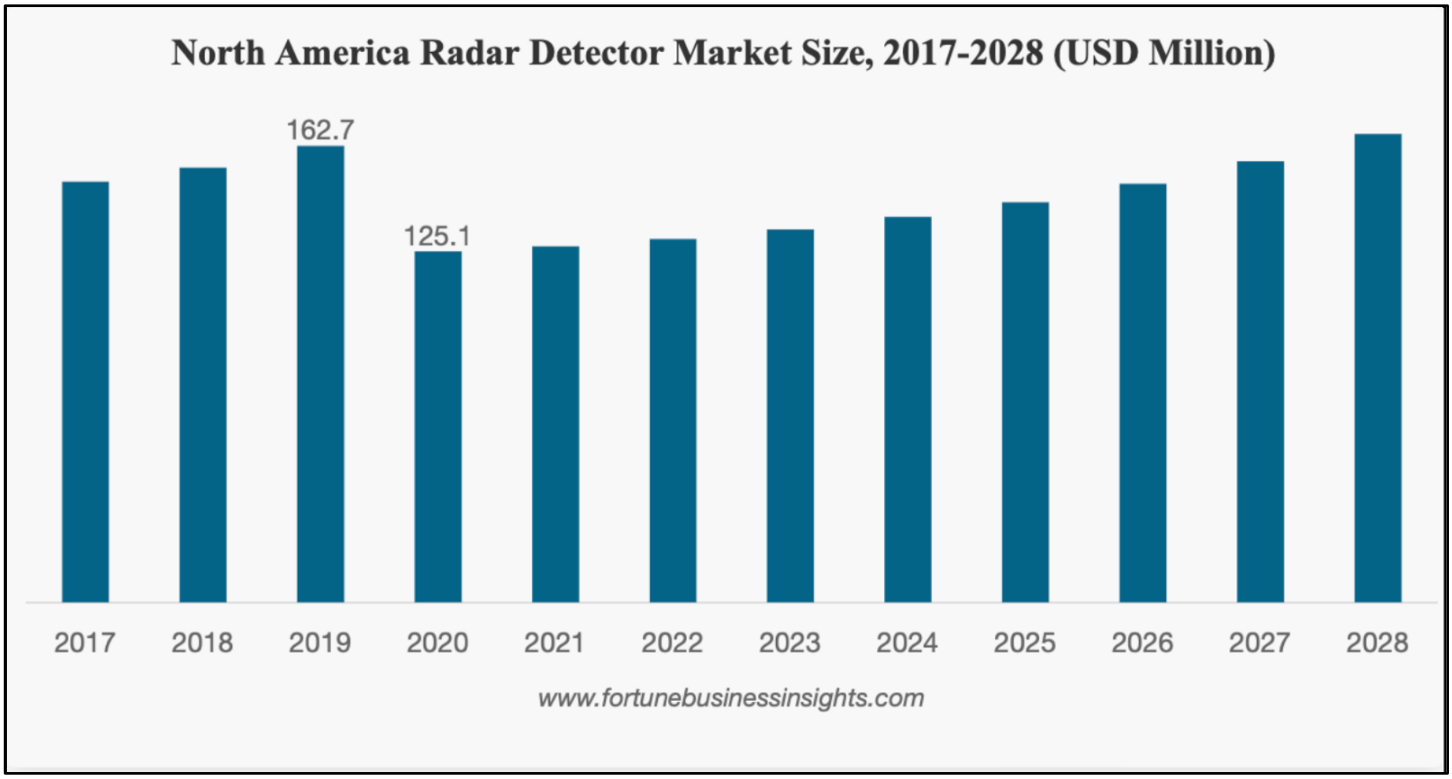
- Customers that are the most enthusiastic about advanced tech features are younger, high-income, urban-driving males with newer cars.
- New car sales went up by 1.0% (this number is way lower than usual because of the pandemic) compared to January 2019 and Automobile sales stats show that a total of 1,144,279 new cars were sold in January 2020. [1] Over 60 percent of new car buyers in the United States between mid-March and September 2020 identified as men. [2]
- Hence, according to our market research, observations, and interviews, as long as people continue to invest in automobiles and new technology, the radar market is expected to keep growing.
- Other than that, increasing company participation, investment, and globalization push market development
- A semi-Autonomous segment to increase due to innovation and development from key operating players.
- Acquisitions from industry leaders are expected to improve the product's market prospects.
- Low-weight and technologically advanced devices have the potential to generate a positive market growth trend.

North America is predicted to have the most significant RADAR market share throughout the forecast period based on region.



Effects of Covid-19 on the industry:

The market growth graph takes a hockey curve taking a dip in 2020 due to a decrease in demand and government and socio-economic restrictions. However, the market is expected to grow from 2020 onwards as the demand and expansion of this market grows, which will revert to pre-pandemic levels once the pandemic is gone.

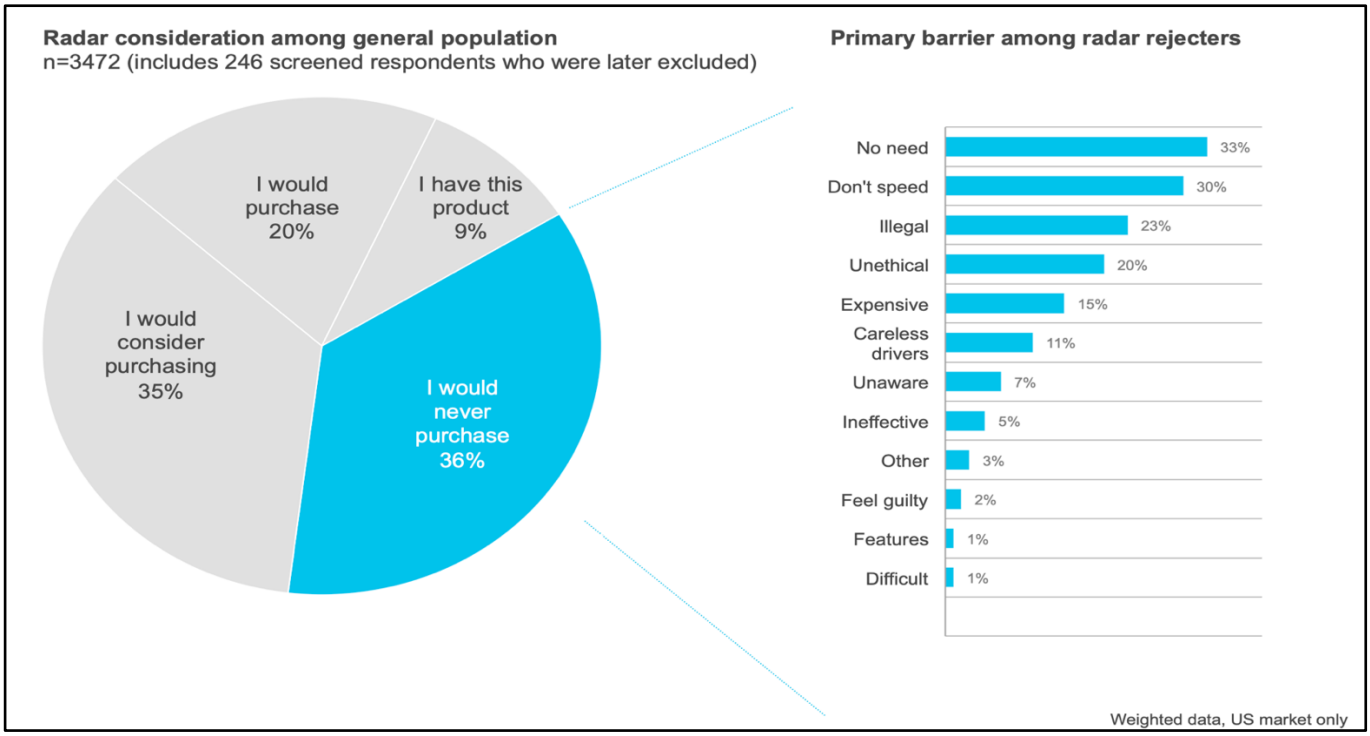


If pre-COVID was any indication, drivers will soon be back on the road several times a week

- Most drivers are behind the wheel daily, if not several times per week
- Longer haul driving is split – about half of drivers make a two-hour trip at least once a month
- Emptier roads are not necessarily safer; the NHTSA report found that decrease in traffic during the pandemic correlated with riskier behaviors (DUI, speeding, failing to wear seatbelts)
- Another research suggests that drivers feel freer and less inhibited with less traffic on the roads.
- NHTSA data found that fewer phones are on ears, but distractions are still fatal; 2800+ were killed and 400,000 were injured in distracted driver crashes in 2018
- TL and iAM RoadSmart study also suggest that Android Auto and Apple CarPlay distracted drivers and made them less reactive, especially when using the touch screen
- Hence, it is safe to say that there is a growing demand for safety features incorporated in the car ecosystem.

STRATEGIC FIT & IMPORTANCE

We recognize that strategic product development necessitates a learning mindset. It's not about having all the answers before you begin; it's about optimizing and learning along the way, changing course and responding to user needs, focusing on incremental delivery, and prioritizing the work that will provide the most significant value first. We laid our initial groundwork for our project by identifying new user needs and determining the best solution to those needs. We agreed on outcomes and clarified our understanding of the most critical user pain points to address in this process. This report validates potential product solutions and establishes priorities for iterative development. Through strategic document review, customer interviews, market consideration, brand perception, and variation in emotional and functional priorities we understood that the potential demand for Radar Detectors is greater than anticipated.



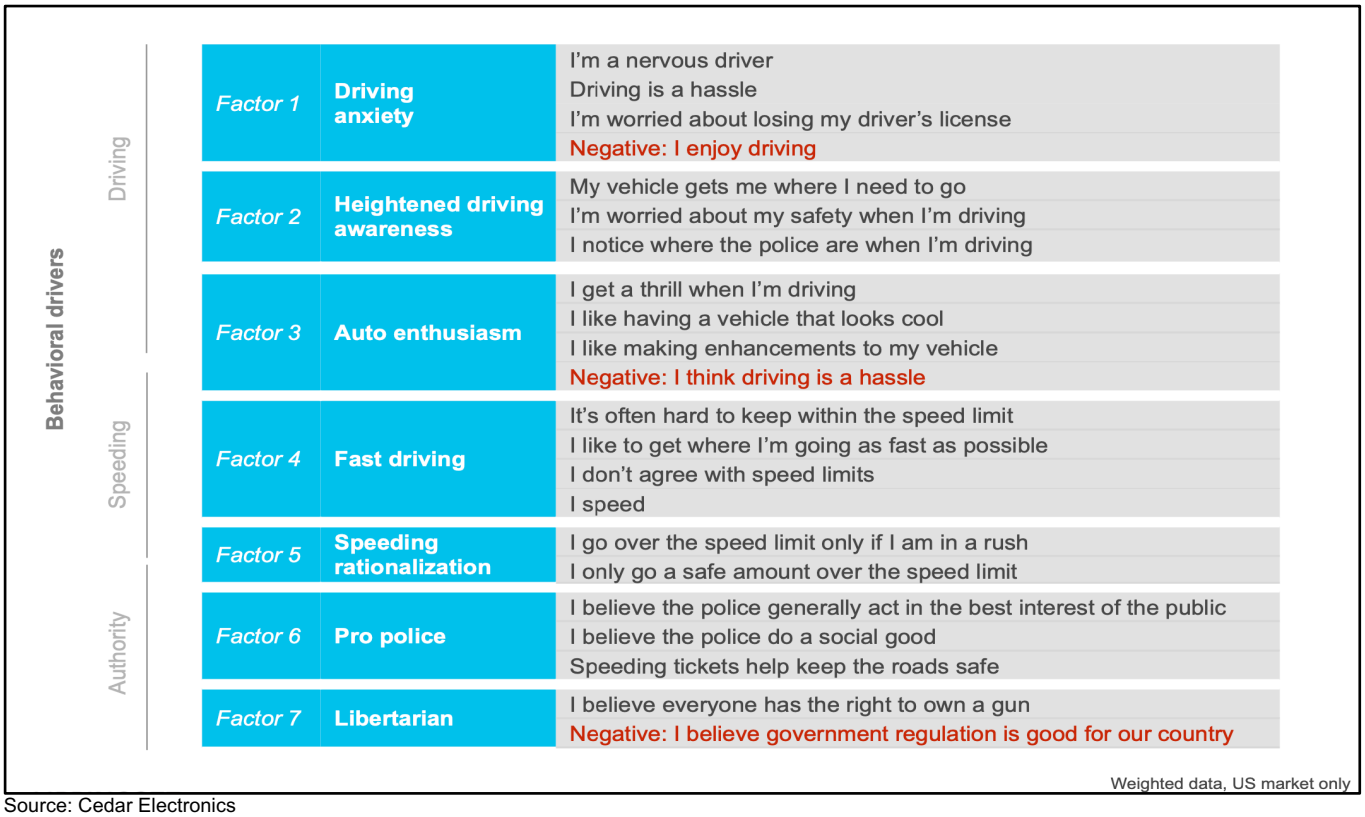
Source: Cedar Electronics

Choosing and Advancing Ideas

Based on market research by Cedar Electronics, the stated consideration of radar detectors among the general population is high (35%), creating a significant opportunity for Cedar to grow the radar market by articulating a clear brand benefit and appealing to customer behaviors and sentiment.

- Growth begins with clearly communicating and demonstrating the brand's differentiation, as even radar-savvy consumers struggle to understand Cedar's differentiated "quality" and "performance."

To further explore customer sentiment, we considered behavioral factors to segment the U.S. driver population. Since numerous and complex emotions beset consumers, factor analysis uncovers the fundamental dimensions underlying these emotions. Below are the factors and customer segmentation based on drivers' common attitudes towards each aspect.



Source: Cedar Electronics

Cedar research points to eight robust and psychographically distinct driving segments, each with unique views on driving, speeding, and authority.

- Among these, the Escort brand resonates most today with a small (8% of drivers) but highly radar-penetrated segmented – the **Anxious auto lover**
- Among the remaining segments, two meaningful opportunities emerge – one set of segments defined by their driving enthusiasm and another that views the driving experience as a source of anxiety

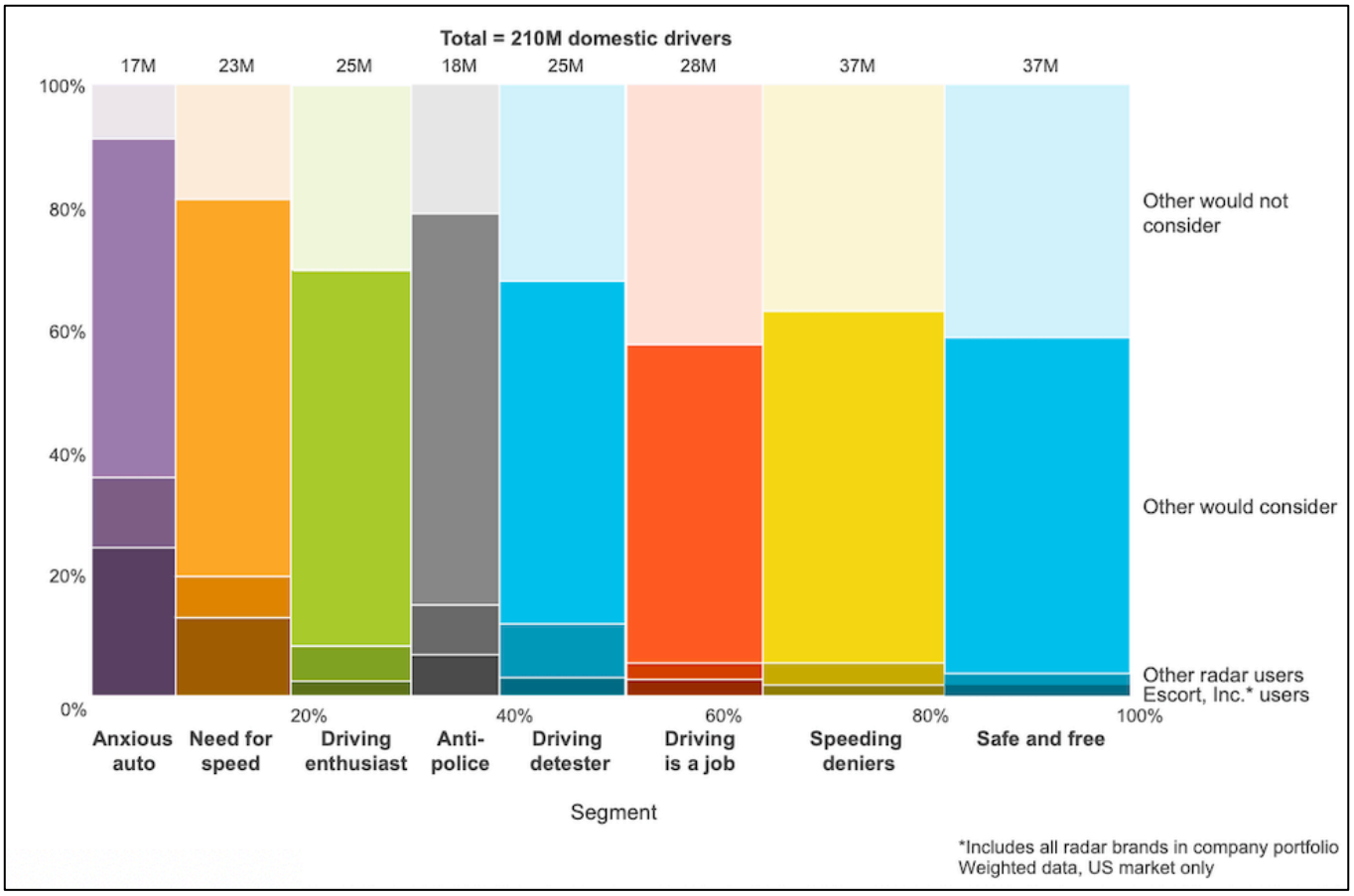
Today, radar and Escort both resonate most amongst Anxious auto lovers, although opportunities exist to broaden relevance to other segments

	Anxious auto lovers (17M)	Need for speed (23M)	Driving enthusiast (25M)	Anti-police (18M)	Driving detester (25M)	Driving is a job (28M)	Speeding deniers (37M)	Safe and free (37M)
								
Description	I love my car, but there's a lot to worry about on the road	I like getting the most out of my car—and that means speeding	I relish the thrill of the open road	The police don't do anything good for people	Driving is a hassle, and I'm a very nervous driver	I've got things to do, and I need to get them done as fast as possible	Laws exist for a reason—I only speed if I'm in a rush	Government regulation is a bad thing—I'm in control of my own actions
Gender breakdown	61% men	69% men	43% men	64% men	54% men	36% men	46% men	50% men
Average income	HIGHER	HIGHER	LOWER	MID	MID	MID	MID	LOWER
Ticket frequency	HIGHER	HIGHER	LOWER	HIGHER	MID	MID	MID	LOWER
Tech expectation	Intuitive, with settings to personalize use							
	+ Specialized & cutting-edge	+ Visually appealing & worth sharing	+ Worth sharing & expresses personal style	+ Customizable & effortless to operate				
Price threshold[1]	$$$	$$	$$	$	$	$	$	$
Escort brand users[2]	18% (3.2M)	8% (1.7M)	2% (0.4M)	5% (0.9M)	3% (0.7M)	2% (0.7M)	1% (0.5M)	1% (0.4M)
Beltronics users[2]	19% (3.3M)	6% (1.3M)	1% (0.2M)	2% (0.4M)	1% (0.2M)	1% (0.2M)	1% (0.3M)	1% (0.3M)
Escort Inc. users[3]	**24% (4.1M)**	**12% (2.9M)**	**2% (0.6M)**	**7% (1.2M)**	**3% (0.8M)**	**3% (0.8M)**	**2% (0.7M)**	**2% (0.7M)**
Other radar user[4]	11% (1.9M)	6% (1.5M)	6% (1.4M)	8% (1.4M)	9% (2.2M)	3% (0.7M)	3% (1.3M)	2% (0.7M)
Radar considerer[5]	54% (9.2M)	59% (13.8M)	60% (14.7M)	62% (11.1M)	56% (14M)	50% (14.0M)	56% (20.5M)	54% (20.0M)
Opportunity for Escort	**65% (11.1M)**	**65% (15.3M)**	**66% (16.1M)**	**70% (12.5M)**	**65% (16.2M)**	**53% (14.7M)**	**59% (21.8M)**	**56% (20.7M)**

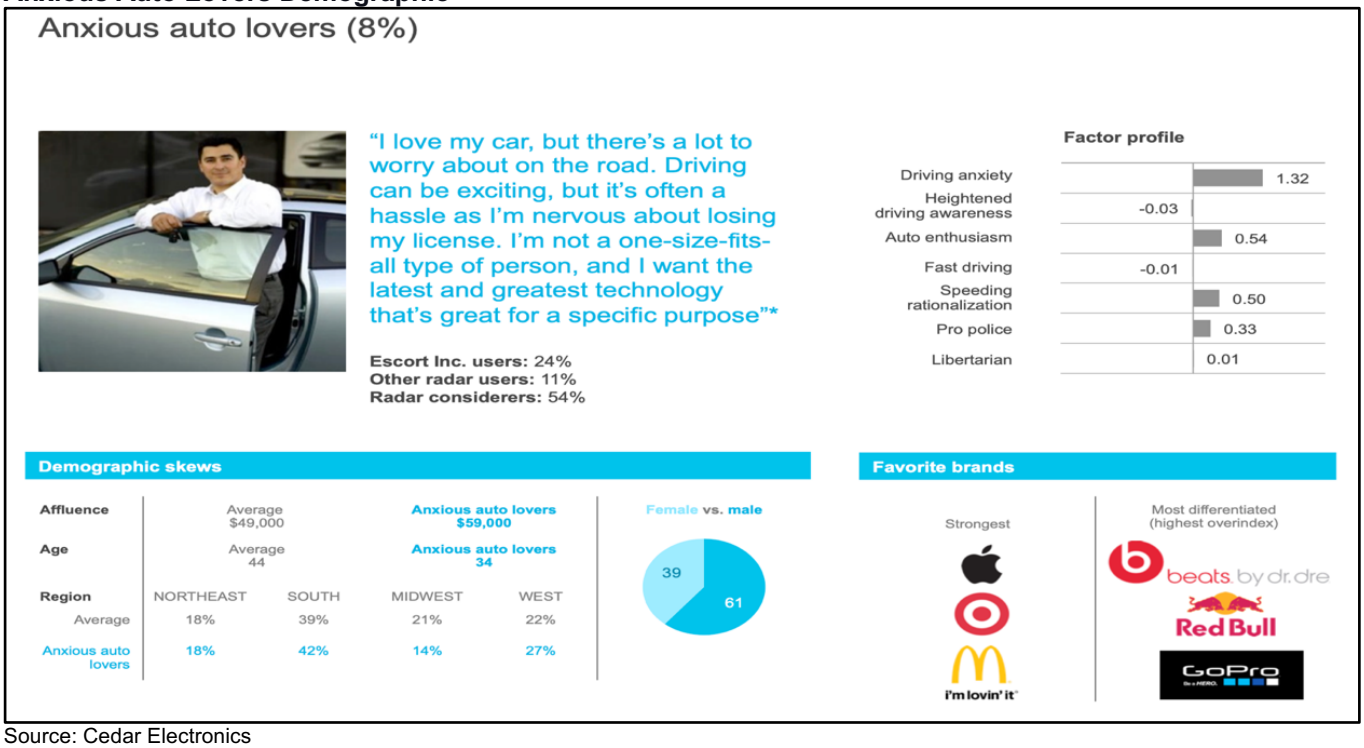
Source: Cedar Electronics, US market only. Population estimates 210M US drivers.

The anxious auto lover is characterized by a higher average income, speeding ticket frequency, and price threshold compared to the rest of the adult U.S. driving population. Additionally, when each asked about radar detectors and their interest in them, anxious auto lovers are estimated to have a larger percentage of drivers consider purchasing radar detectors than the other segments, as shown below. Furthermore, radar and Escort both resonate most amongst anxious auto lovers.

Given the characteristics of the anxious auto lover, we determined our solution should resonate with this segment. Given the high awareness of radar and Escort, compared to other driver segments, combined with their high sensitivity to safety, any new Cedar product would best be adopted by this segment.

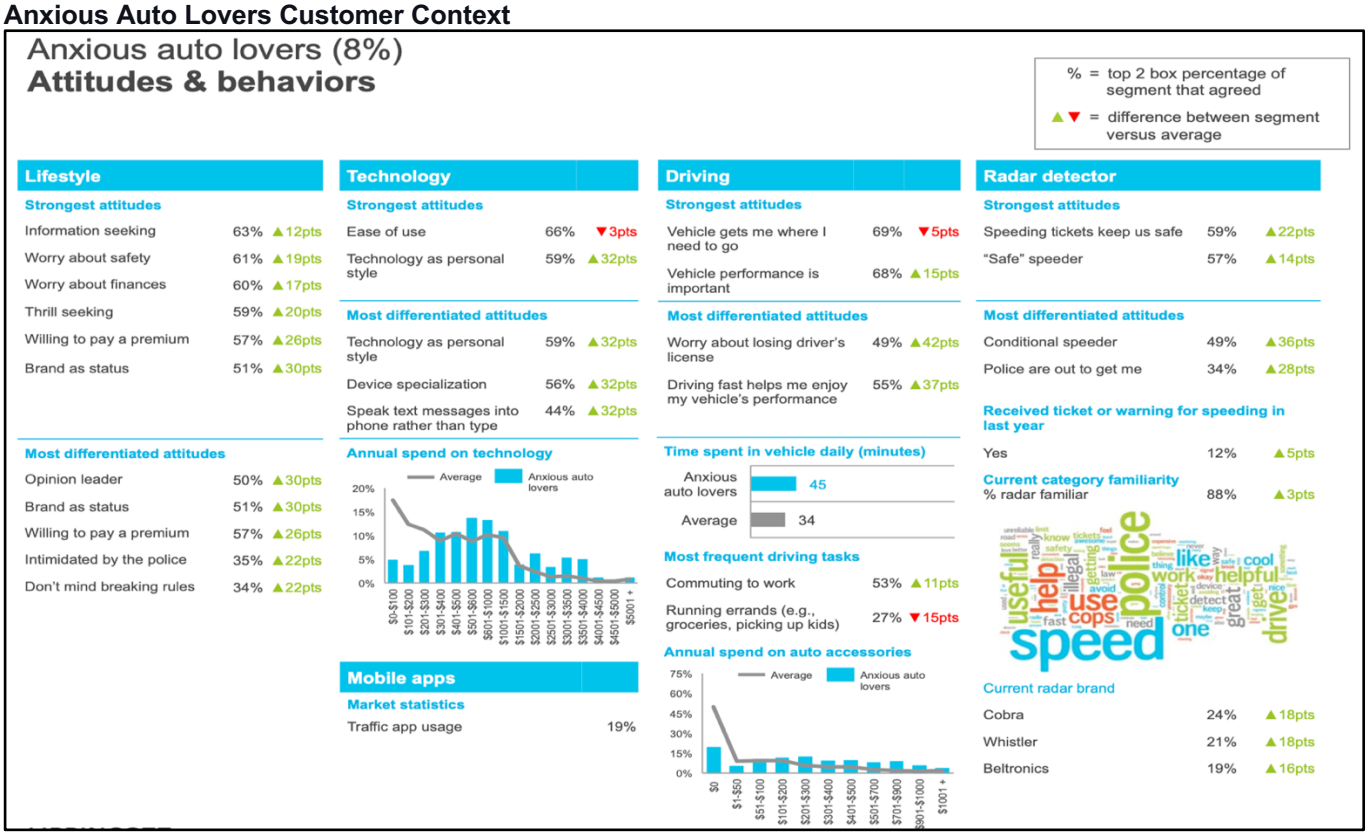


Anxious Auto Lovers Demographic



Source: Cedar Electronics

Anxious Auto Lovers Customer Context



Source: Cedar Electronics

Summary of Findings

Why Anxious Auto Lovers as a target segment?

Through our research we believe that Anxious Auto Lovers will make the best target segment due to the following characteristics:

- Anxious auto lovers worry about safety.
- Vehicle performance is important to them.
- Are willing to pay a premium on services
- Consider brand as a status symbol
- Intimidated by the authorities
- Prefer technology for its ease of use, some consider it as a personal style
- They appreciate device specializations
- Are conditional speeders

CUSTOMER INTERVIEWS

As vehicles become more sophisticated and technologically advanced, customer behavior towards purchasing a new car and purchasing accessories changes rapidly. The team has conducted over 70 interviews to understand the customer context around Baltimore better.

1. The summary of our findings is below:
2. Technology features such as blind-spot monitoring, apple carplay, android auto, and 360-degree cameras are on many driver's wishlists.
3. Radar detectors are not a priority for customers looking to purchase used cars.
4. The most popular car accessories sold at big retail stores and chain stores are inexpensive items costing below $100. This gave us an insight into what segment of drivers (Anxious Auto Lovers) should be a target for Radar Detectors.

Methodology and Data Analysis

The team interviewed adult drivers and car buyers interested in using some form of driving technology. Interviews and observations were conducted to understand their behaviors and needs. Interviews were conducted in Baltimore, both via zoom and in person. The interviews were conducted at the following locations in Baltimore:

- CarMax - A popular second-hand car chain
- AutoZone - The largest automotive accessories chain in the US
- Walmart - An American retail chain that also carries automotive parts
- Social events around Homewood campus

Additionally, we also conducted an interview with Vortex Radar, a popular YouTuber focusing on radar detectors. Furthermore, automotive industry data and studies conducted by Deloitte [3] and Mckinsey [4] have been factored in alongside the data we collected from interviews.
The goal of the interviews and data analysis was to find answers to the following questions:

1. What factors trigger customers to purchase accessories for a vehicle?
2. What factors trigger customers to buy a vehicle?
3. Understanding the customer's behavior/needs towards radar detectors?

Interview Findings

Below are the detailed results for some of the key findings from the team's interviews over the past two weeks. A summary of the critical findings validated with industry data is also provided.

CarMax
19 customers interviewed
Age Range - 24-55 years
Inferences:

- Customers do not consider radar detectors or any accessories while purchasing a car.
- People wish to have features like blind-spot detection, lane departure warning, 360-degree cameras, and Apple CarPlay in their car accessories.
- Heated seats are features people wish to have in their cars.
- Price, Fuel efficiency, and the need for a larger space are usually considered when buying a car from CarMax.

AutoZone
24 customers interviewed
Age Range - 21-38 years
Inferences:

- There were no radar detectors on display in the showroom.
- The most popular accessory they sell is seat covers and stereos.
- Customers did not consider radar detectors a necessity, and they did not find the need to have a radar detector as a part of their vehicles.

Walmart
15 customers interviewed
Age range - 19-57 years
Inferences:

- Like AutoZone, radar detectors were not being sold.
- Inexpensive accessories like repair kits, motor oil, replacement parts, and tires were sold.
- Customers did not find the necessity to have a radar detector as a part of their vehicles.

Homewood Campus (Students and Working professionals)
12 Customers interviewed
Age Range - 16-35 years
Inferences:

- Most of the people interviewed were unaware of the technology.
- Most consumers preferred driving 'safe' in the first place.
- When asked about their priorities with regards to this technology, they seemed interested in the prospect of early detection of speed cameras

- Most people were interested in features involving car maneuvering (e.g. rearview cameras)
- Parking assistance was also perceived as an essential feature for less experienced drivers.

Interview with Vortex Radar (Ariel)

Ariel runs a popular YouTube channel called Vortex Radar that focuses primarily on radar detectors, and he maintains rdforums.com, which is the largest radar detector forum globally. The team interviewed him on Feb 16, 2022, and these were our findings:

1. According to Ariel, most radar detector buyers would buy radar detectors only for one purpose: radar detection and not much else.
2. Radar detectors with additional functionality built-in are neither excellent at radar detection nor with other features because of space constraints.
3. Accuracy of filtering out false positives (i.e., car passing by with radar built-in for collision avoidance and the radar thinks it is a speed camera) is highly correlated with the price of the radar detector, meaning a more expensive radar detector will be more accurate.
4. It is possible to transfer data from the phones to the radar detector from a technical standpoint. However, patents and regulations from the phone brands have come into play.

Customer Segment

Geographic	Demographic	Behavioral
Baltimore, MD Laurel, MD Arlington, TX San Francisco, CA	Age Range: 19-57 % Male: 63% % Female: 37%	• Benefits Sought: Convenience, Fuel efficiency, larger space, and safety • Occasion: No specific occasion, only when the customers felt the need to buy a vehicle or accessorize the vehicle. • Loyalty: As such, no loyalty was observed towards accessorizing their vehicles. Customers treat their cars like appliances. • Buyer Readiness: Only when the need arises • Actions taken: Online shopping or In-person shopping

Summary of Findings

Based on our interviews conducted since February, these are the following workable insights:

- Drivers want safety features like EMS services built into radar detectors, where the device sends a notification to an emergency contact in the event of an accident (EMS Services).
- Drivers desired a method to detect bad road conditions on the road so that they could drive more safely at higher speeds (Road Condition Detection).
- Drivers want to know where the road accidents are (Accident Map).

We considered a few additional questions when deciding which ideas to develop for Radar D2X Communication.

- How many ideas will Cedar be able to implement realistically?
- What is the business impact (for example, how often can Cedar involve the technology teams within a given timeframe?)
- How does this concept fit into Cedar's tactical vs. strategic objectives? (i.e., working on the projects that need to be done, rather than acting on opportunistic revenue grabs)
- What are the competitors offering?
- Any potential for tie-ups with other brands and their products?

What steps did we take to improve our internal product idea generation process?

- Collaborate closely with our host to provide feedback on ideas, progress, and development milestones in order to enable as much of the organization as possible.
- Determine Cedar's key performance indicators (KPIs), and educate ourselves with Cedar's strategic and tactical plans, ahead of time. Make sure that all new ideas are sized and classified in accordance with those structures, and that we choose our priorities wisely.

Recommendation

Why Accelerometers?

The scope of the project was to find devices that have synergies with Cedar's Radar Detector and Drive Smarter App. Cedar's competitive edge is their emphasis on and capabilities with device-to-device communication. By introducing an accelerometer module, Cedar can have the module and radar detector connect seamlessly through Bluetooth to the Drive Smarter App. Additionally, the inclusion of an accelerometer would allow for the introduction of new features: EMS/First Contact and Parking Collision alerts along with automated pothole detection. The consumer profile we're targeting combined with technical and business feasibility led us to this solution. In terms of targeting consumer sentiment, we realized many drivers we interviewed focused on safety and their desire to improve safety while driving. Some interviewees emphasized their joy of driving while others made clear their driving was simply a necessity. When combined with our research on U.S. driver segments, we believe the anxious auto lover, with high awareness of radar detectors and higher anxiety related to driving than the average driver, will find the inclusion of an accelerometer appealing. With regards to technical and business feasibility, many of the radar detectors Cedar currently produces include Bluetooth and WiFi, allowing for the technical connection between devices and with the Drive Smarter App. Additionally, the two alert features proposed, EMS/First Contact and Parking Collision alerts, are extensions of the current parking collision alert feature currently implemented in Cedar's M2 dash cameras.

RISKS & ASSUMPTIONS

Product Assumptions

Our approach to building assumptions was to capture all our assumptions during team meetings and keep a record of whether those assumptions were validated or not. The validation for each assumption was done through user and market research. Below are the top 3 assumptions:

Assumption	Questions about the Assumption	Action Items
Drivers want EMS services built into the radar detector where in case of an accident the device sends a notification to an emergency contact (EMS Services)	- Are there any EMS products/services we can incorporate into the radar detector? - How many drivers are using a similar product? - Are there any technical components that we can add to the radar detector that will allow us to incorporate EMS services?	Technical and financial feasibility research to incorporate EMS into the radar detector
Drivers wanted a way to detect bad road conditions on the road so they can drive safer at higher speeds (Road Condition Detection)	- Are there any existing devices that can detect road conditions such as potholes and patches? - How often do drivers hit potholes and it damages their car?	Study technical aspects of incorporating accelerometers into radar detectors to detect road conditions while driving.
Drivers want to know where accidents on the road are (Accident Map)	- Are there existing databases where we can collect the data from? - Does knowing that there is an accident ahead improve decision-making for the driver?	None. Cedar is already working with HAAS alert for accident data

Risks
Now that we know what our key assumptions are, we can start looking at the risks involved with some of these assumptions. We categorized the risks into the following categories:

- Value Risk: Whether our idea brings any value to the users
- Usability Risk: Whether users can easily figure out how to use the device
- Feasibility Risk: Whether Cedar's engineering team can incorporate this idea into the product
- Business Viability Risk: Whether this idea works along with various aspects of Cedar's business strategy.

Below is a table of the risks associated with the implementation of the new features. Risk factors are given below between 0.0 to 1.0. Where numbers closer to 0 are considered low risk, and numbers closer to 1 are considered high risk.

EMS Services

Risk Type	Risks Involved	Risk Factor (Consequences of Failure) – See next section for Calculations
Value Risk	Many radar detector users purchase it only for the sole purpose of speed camera/radar detection.	0.23
Usability Risk	Adding EMS services may make the Drive Smarter app even more bloated and accelerometer pairing may be complex	0.35
Feasibility Risk	Cedar's devices may not be compatible with the accelerometers and may not be compatible with Drive Smarter's ecosystem	0.5
Business Viability Risk	Adding EMS services along with accelerometers may be expensive and can drive up the cost of the product. There could be additional R&D needed to incorporate the accelerometer into the radar detector's systems and drive smarter. Development time for a project like this is something to be concerned about as well because many technical development aspects are outsourced.	0.35

Road Condition Detection

Risk Type	Risks Involved	Risk Factor (Consequences of Failure) – See next section for Calculations
Value Risk	The cost of incorporating a road condition detection system into the radar detector may be quite expensive and may not attract many customers.	0.35
Usability Risk	Radar detectors themselves give a lot of audible warnings, adding pothole detection may increase the number of audible warnings even more, thus being a burden for the user	0.35
Feasibility Risk	Accelerometers may have technical limitations in detecting road conditions and potholes. The system also has to work in unison with the GPS, and there are various technical factors that may risk the feasibility of this concept.	0.63

Business Viability Risk	In terms of business, incorporating pothole detection will increase the cost of each detector significantly to an estimated $1000 dollars. There could also be an additional cost of R&D where pothole detection may need to be done at high acceleration/speeds. Development time for a project like this is something to be concerned about as well because many technical development aspects are outsourced.	0.50

Risks Factor Calculation

The risk factor is ranked between 0-1. We created a benchmark to estimate the consequences of failure and based on that, the risk factors were calculated:

C_f (Consequences of Failure) = $(C_t + C_c + C_s)/$, where:

Magnitude (Cf)	**Technical Factor (Ct)**	**Cost Factor (Cc)**	**Schedule Factor (Cs)**
0.1 (low)	Minimal to no consequences	Budget Estimations Not Exceeded	Negligible impact on schedule
0.5 (medium)	Some limitation in technical performance	Cost Estimates increased by 5% - 20%	Small slip in schedule
0.9 (high)	Technical goals not achieved	Cost Estimates increased by 50%	Large slip in schedule

EMS Services

Risk Type	Cf
Value Risk	Ct (0.1) + Cc (0.5) + Cs (0.1) /3 = 0.23
Usability Risk	Ct (0.5) + Cc (0.5) + Cs (0.1) /3 = 0.35
Feasibility Risk	Ct (0.5) + Cc (0.5) + Cs (0.5) /3 = 0.50
Business Viability Risk	Ct (0.1) + Cc (0.5) + Cs (0.5) /3 = 0.35

Road Condition Detection

Risk Type	Cf
Value Risk	Ct (0.1) + Cc (0.9) + Cs (0.1) /3 = 0.35
Usability Risk	Ct (0.9) + Cc (0.1) + Cs (0.1) /3 = 0.35
Feasibility Risk	Ct (0.9) + Cc (0.5) + Cs (0.5) /3 = 0.63
Business Viability Risk	Ct (0.1) + Cc (0.9) + Cs (0.5) /3 = 0.50

Mitigation Plan

Risk mitigation efforts can be made to control the risks mentioned above. The mitigation plan is given below:

EMS Services

Risk Type	Risk Control	Description
Value Risk	Extensive market research	Monitor user purchase patterns.
Usability Risk	Usability Testing	Come up with prototypes and conduct usability tests with at least 100 users
Feasibility Risk	Prototyping	Develop multiple software and hardware prototypes to test and monitor compatibility with the Drive Smarter's ecosystem
Business Viability Risk	Supply Chain Re-evaluation	Re-evaluate suppliers and find cheaper alternatives, also form an internal development team instead of outsourcing all of the development of Drive Smarter's software to ensure better compatibility.

Road Condition Detection

Risk Type	**Risk Control**	**Description**
Value Risk	Extensive market research	Monitor user purchase patterns.
Usability Risk	Usability Testing	Come up with prototypes and conduct usability tests with at least 100 users
Feasibility Risk	Prototyping	Develop multiple software and hardware prototypes to test and monitor the compatibility between Accelerometers and the GPS in the radar detector
Business Viability Risk	Supply Chain Re-evaluation	Re-evaluate suppliers and find cheaper alternatives to lower the price.

OPPORTUNITY

We brainstormed several themes and ideas to identify opportunities for Cedar via Device- Device communication. The future of the automotive industry is rich in technology. According to the Consumer Technology Association, the demand for advanced driver-assistance systems and automated features will be strong during the next decade.

We conducted a modified SWOT analysis to better understand Cedar's capabilities and improvement areas, keeping in mind the potential for automated and improved driving features.

ATTRIBUTE	**WHY?**
S: Cedar has multiple product lines enhancing ADAS (RD, Dashcam and Harman Spark)	#1 search hit on amazon.com for "radar detector" Well known among enthusiasts and the radar community
S: Cloud Connectivity and Database	No other radar detector competitor has this feature
S: Connectivity with car stats	Ability to connect to customers
W: Niche market	Heavily associated with people wanting to speed and not necessarily a safety enhancing device
W: Drive Smarter app performance and usability	The app onboarding and UX is not intuitive. This will further repel non-enthusiasts.

T: Smartphone apps integrating similar features	Jeopardizes a consumer's willingness to purchase a radar detector system when a free or low-cost alternative is available through their phone. It was recently announced that a hazard alert system (HAAS Alerts) was integrated into Apple Maps
T: Relying on 3rd parties for this data/features	Cedar cannot control quality of data or how it is implemented outside of third-party API.
O: Using 3rd party accelerometer/ data from user's device to create crash/ Road Condition awareness	Using Cedar's strength of connectivity to car stats/ accelerometer data can be used to detect crash by looking for a sudden drop in vehicle acceleration.
O: Consumer can have the benefit of other devices capabilities due to connected cloud	Customer purchasing just radar detector can also have pothole detection feature because some other car has cedar dashcam in it and saw a pothole and now its stored in the database
O: Create and integrate a database containing obstacles and potholes	This is an easily implementable opportunity because Cedar already has cloud storage connectivity, this will require creating a data pipeline in the existing infrastructure

S- Strength, W - Weakness, O - Opportunity, T - Threat

Based on the above assessment, Cedar currently caters to a specific group of car drivers (aka enthusiasts) and their customer segment can be exponentially increased by catering to safety needs of the customer as found in internal Cedar documents, where 61% of the Anxious Auto lovers' segment have stated that safety is their top concern [Lippincott Research] [19]. We have brainstormed several ideas and zeroed down to one feature which enhances the safety of the driver and can also be implemented using device to device communication. We recommend implementing EMS alerts along with the Mayday Feature. This can be implemented by a combination of first detecting that a crash has occurred and then using 3rd party APIs like OnStar to alert local EMS to dispatch an ambulance. But since Cedar wants to create an independent database of potholes and mechanism for accident detection instead of partnering with OnStar and Haas, we explored hardware sensors capable of achieving this task. We recommend Cedar to bundle/ integrate Accelerometers with the Radar Detector and the Drive Smarter app.

Accelerometers are hardware sensor devices capable of measuring the change in velocity (i.e. acceleration) in 3-dimensions (x, y and z). We recommend Cedar. Since these devices are capable of tracking acceleration in x and y-axis, we can create use-cases to detect Accident/ sudden change in acceleration via x-axis tracking and detect potholes via y-axis. This device can help Cedar expand the Pothole Database in conjunction with Dash-camera.

EMS Services:
What?
We want to enable the driver to be able to interact with emergency services, ambulance proximity, crash alerts, accident locations and be sure that in case of an accident, local EMS authorities are notified automatically. Cedar already has a large network of devices (dashcams, rd's) continuously updating Cedar's Database, this creates a plethora of use cases, to enable a customer buying one particular product of cedar to still have some of the advantages of other products. For example, a customer purchasing Radar detector can benefit from the data stored in the cloud pushed from the dash camera. 3rd party services like HAAS Alert's safety cloud further amplify the safety enhancing use cases.

Why?
From our market research and customer interviews, drivers have a strong desire to improve safety. In addition, research suggests drivers are easily distracted. As features such as Apple CarPlay and Android Auto become more widespread, driver distractions will increase and there will be a greater need for EMS and hazard alerts. It has been found that notifications for obstacles on the road drastically decrease the risk of car crashes and over 90% of car crashes occur due to human error (Smith, Stanford Cyber Law) [20]. This clearly indicates the impact our recommendation will have and can be used to increase the value of the product to current users as well as help to expand the market to non-enthusiasts.

How?
There are several other methods to estimate if a crash has occurred (driver biometrics/ car stats). One way to accomplish this is, if the driver is wearing a fitness tracking device, this data can be analyzed and a sudden change in vitals can indicate a car crash. This requires integration with 3rd party fitness tracking applications and due to the wide range of brands, this approach might be tedious and time taking. So, we explored solutions to this problem, which do not involve driver biometrics. To be able to understand when an accident/crash occurred without taking into consideration driver vitals, the simplest way to analyze the drop in acceleration of the vehicle. Since getting car statistics is not standardized and requires manufacturer level partnerships, we suggest using a G-sensor/ accelerometer to track the accelerations and program alerts based on spike/ drop in the values. Since the accelerometer can send raw velocity data via Bluetooth, with programming it is possible to create accident and pothole detection use-cases. This is how a sample accelerometer output looks like.

Typical accelerometer data:

time	type	code	value
8163 49da 6d62 000d	0000	0000	0000 0000
8163 49da 91d8 000d	0002	0000	0048 0000
8163 49da 9231 000d	0002	0001	0012 0000
8163 49da 9251 000d	0002	0002	03ba 0000
8163 49da 9270 000d	0000	0000	0000 0000
8163 49da b6cf 000d	0002	0000	0036 0000

For our specific recommendation, we need to concentrate on code and value columns where the code 0 means x-axis, 1 means y-axis, and the values mean the relative change of velocity over small bursts of time.

We recommend partnering with either of the two accelerometers [21][22] below as they are standalone products without any wires involved and can transmit acceleration data via Bluetooth over a decent range to allow for accelerometer placement anywhere in the car. We recommend choosing the accelerometer with a faster data transmission rate as it is critical for the quality of the use-cases built upon them.

PROJECT FINANCIALS

To understand the product pricing in greater depth we performed a customer perception vs product pricing analysis of Cedar products against its top competitor products.

Methodology

We first listed down all the features of every radar product under Cedar Electronics.

1. Based on our customer interviews and market research we filtered the 8 most desirable features which are listed as follows:

360 Detection
Directional Alert Arrows
Defender Database
Bluetooth-Equipment and Drive Smarter App
Update over built in WiFi
IVT filter
DSP
Stickycup Mount

Fig. Most Desired features

2. We then assigned scores to each device and graphically represented them using the value vs price framework.

DEVICE	SCORE ASSIGNED	PRICE
REDLINE EX	8	$749.95
MAX 360C	8	$649.95
MAX 360	7	$499.95
MAX 3	5	$399.95
ESCORT X80	2	$299.95

**Discontinued*

Fig. Scores assigned to each device

Fig. Value vs Product Perception Framework

The products highlighted in red are competitor products

To begin with, we recommend adding the Accelerometer to REDLINE 360C, MAX 360C, and MAX 360. Since these products are placed in the high-high quadrant, it makes sense for cedar to begin the conjunction with them. After gaining valuable market insights, we recommend cedar to add the accelerometer piece to the rest of the radar detectors.

Product Cost if Accelerometer is incorporated

To exemplify product costing we have chosen ESCORT MAX 360 based on its placement in the value vs product perception framework. Below are some of our considerations and projections.

- Number of units compatible with the Radar Detector - 30,000
  Cost of buying the accelerometers in bulk - 80% of MSRP ($36/$45)
- Attach rate of accelerometers – 10%
- Lift in radar unit sales as part of bundle - 5%
- Shipping is borne by the customer

We consider two cases below:

Here, we consider the cost of the accelerometer, the cost of radar, and the margin. In this case, we assume the radar detector is being sold as an assist package along with the accelerometer.

CASE 1 - Radar Detector + Accelerometer + Margin

Avg Radar cogs		$266.00					
Accelerometer cogs		$36.00					
						Total cogs	$302.00
Total SP		$685.00					
Standard Margin		$383.00					
Standard Margin rate		55.91%					
		Units		Sales			
Base sales		30,000	$	18,600,000			
Lift	5%	31,500	$	19,530,000		Sensitivity around yellow cells	
Attach rate	10%	3,150	$	204,750		lift 3% - 7%	
			$	1,134,750	Lift in revenue	Attach rate 5%, 10% 15%	
Std Mgn lift	1500	$ 574,500					
Std Mgn Acc	3150	$ 91,350					
		$ 665,850					

Sensitivity Analysis - Case 1

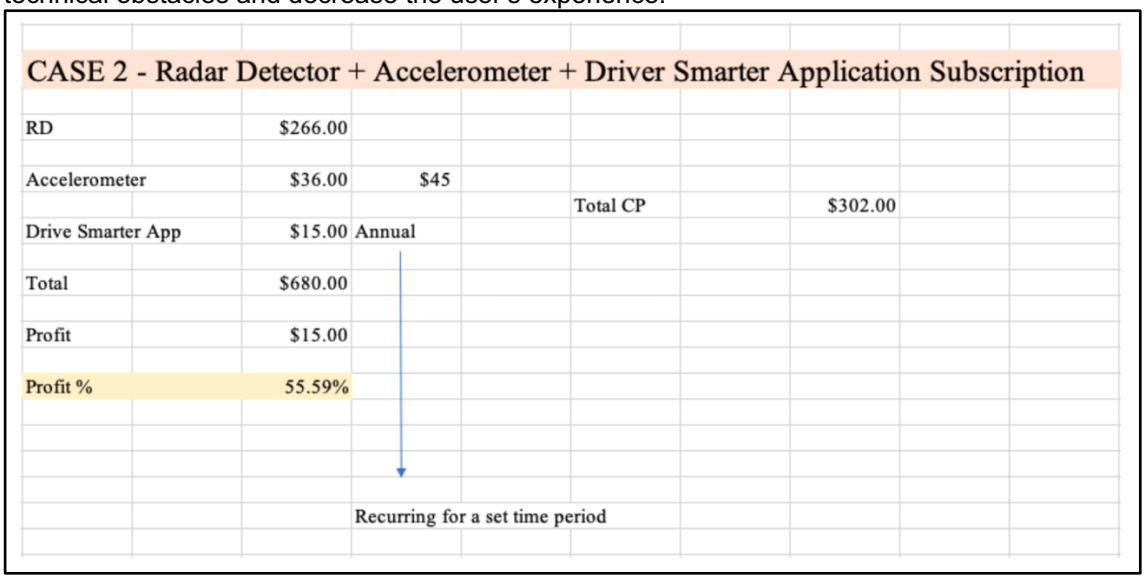
When SP Changes by $10

			SP			
	55.91%	665	675	685	695	705
	282	57.59%	58.22%	58.83%	59.42%	60.00%
	292	56.09%	56.74%	57.37%	57.99%	58.58%
CP	302	54.59%	55.26%	55.91%	56.55%	57.16%
	312	53.08%	53.78%	54.45%	55.11%	55.74%
	322	51.58%	52.30%	52.99%	53.67%	54.33%

When SP Changes by $20

			SP			
	55.91%	645	665	$685.00	705	725
	282	56.28%	57.59%	58.83%	60.00%	61.10%
	292	54.73%	56.09%	57.37%	58.58%	59.72%
CP	302	53.18%	54.59%	55.91%	57.16%	58.34%
	312	51.63%	53.08%	54.45%	55.74%	56.97%
	322	50.08%	51.58%	52.99%	54.33%	55.59%

Here, we consider the cost of the accelerometer, the radar, and an annual subscription fee for the drive smarter application. In this case, we assume the customer already has an accelerometer and buys a radar detector from cedar with an annual subscription to drive smarter app.
This case needs a deeper investigation with the compound cost of annually paid fees for the drive smarter application. We do not recommend this case because the margins are lower and from a marketing standpoint, the assist package of radar is no longer a package but is divided into two components. This case could also incur technical obstacles and decrease the user's experience.



CASE 2 - Radar Detector + Accelerometer + Driver Smarter Application Subscription

RD	$266.00			
Accelerometer	$36.00	$45	Total CP	$302.00
Drive Smarter App	$15.00	Annual		
Total	$680.00			
Profit	$15.00			
Profit %	55.59%			

Recurring for a set time period

Sensitivity Analysis of Case 2

When SP Changes by $10

		SP				
	55.59%	660	670	680	690	700
	282	57.27%	57.91%	58.53%	59.13%	59.71%
	292	55.76%	56.42%	57.06%	57.68%	58.29%
CP	302	54.24%	54.93%	55.59%	56.23%	56.86%
	312	52.73%	53.43%	54.12%	54.78%	55.43%
	322	51.21%	51.94%	52.65%	53.33%	54.00%

When SP Changes by $20

		SP				
	55.59%	640	660	680	700	720
	282	55.94%	57.27%	58.53%	59.71%	60.83%
	292	54.38%	55.76%	57.06%	58.29%	59.44%
CP	302	52.81%	54.24%	55.59%	56.86%	58.06%
	312	51.25%	52.73%	54.12%	55.43%	56.67%
	322	49.69%	51.21%	52.65%	54.00%	55.28%

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