

Hierarchical Needs in U.S. Automotive Customer Feedback and the Sentiment–Function Nexus

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Abstract: This paper analyzes a non-experimental declarative framework for interpreting changes in the U.S. automotive market, including chip shortages, accelerated car adoption, and the continued dominance of SUVs and trucks. It proposes an in-depth analysis of a four-layered demand hierarchy, focusing on the following layers: basic needs, functional/performance needs, experience/service needs, and identity/value needs. Furthermore, through a complementary emotional-functional ontology, it covers factors related to safety/ADAS, powertrain, and charging, and infotainment/human-machine interaction. It outlines measurement blueprints (co-occurrence enhancement, conditional share, journey slicing) and management tools (importance matrix, demand hierarchy scorecard), and verifies that electric vehicle anxiety is more strongly influenced by charging reliability than by rated range; trust depends on service transparency and OTA stability. Finally, it prioritizes related services and user experience, while establishing a clear path for future empirical verification.

Keywords: Customer Needs Hierarchy, Sentiment–Function Mapping, U.S. Automotive Market, Voice of Customer (VoC).

Disciplines: Information Science.

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1 INTRODUCTION

The U.S. auto market, a bellwether of the economy, is undergoing significant shifts, driven by several emerging auto trends. From the ongoing chip shortage to the rising popularity of electric vehicles (EVs), and the dominance of SUVs and trucks, these trends are shaping the future of the automotive industry and influencing consumer choices [1,2,3]. This article examines these developments in depth, highlighting key facts, figures, and market dynamics. One of the most significant auto trends in recent years has been the global semiconductor chip shortage, which has severely disrupted the automotive supply chain. This shortage has led to reduced production and limited inventory at dealerships, pushing up prices for both new and used cars.

According to Cox Automotive, new-vehicle inventory in the U.S. was at just 1.7 million units in early 2023, significantly lower than pre-pandemic levels. As of August 2024, total inventory stood at 2.91 million units, translating to roughly 68 days of supply. While this represents an improvement, the situation remains challenging, affecting consumers' ability to find and purchase vehicles at affordable prices. The growing adoption of electric vehicles is another major auto trend transforming the U.S. market. With growing concerns about climate change and advances in EV technology, consumers are increasingly considering electric options. In 2023, EV sales in the U.S. surged by 65%,

reaching nearly 800,000 units. The momentum behind this trend is expected to accelerate, with projections suggesting that EVs could account for more than 50% of new-car sales in the U.S. by 2030 [4,5]. Automakers such as Tesla, Ford, and General Motors are increasing EV production to meet anticipated demand. Additionally, the federal government has set ambitious targets to reduce carbon emissions, offering financial incentives to boost EV sales further.

Against this backdrop, understanding what customers value—and why—becomes essential, this article advances a declarative framework that links a hierarchy of customer needs to the sentiment–function relationships embedded in U.S. automotive feedback. We organize needs into four tiers—Foundational (safety, reliability, total cost of ownership), Functional/Performance (range/fuel economy, drivability, ADAS quality, build), Experience/Service (purchase transparency, financing, service/parts, OTA updates, connectivity), and Identity/Values (design pride, sustainability, data privacy). We then map emotions such as trust, pride, anxiety, confusion, disappointment, and anger to concrete vehicle functions (e.g., charging, infotainment/HMI, safety/ADAS, subscriptions), clarifying how emotional responses arise from specific product and service touchpoints across the shopping-to-ownership journey.

The contribution is twofold: (1) a domain ontology that standardizes how feedback is categorized by need tier, function, and emotion; and (2) a set of testable propositions

for future empirical research (e.g., trust jointly depends on service transparency and OTA stability; EV anxiety is driven more by charging reliability than rated range)[9]. Methodologically, we outline a blueprint suitable for surveys, interviews, and secondary VoC sources (reviews, forums, complaint databases, app-store feedback), while staying non-empirical in this paper. For managers, the framework prioritizes interventions where negative emotions concentrate (e.g., ADAS inconsistency → anger; subscription friction → fairness concerns) and encourages emotion-weighted satisfaction metrics. For scholars, it provides a clear framework for validating associations across powertrains, personas, and lifecycle stages in subsequent studies[10].

2 CONCEPTUAL FRAMEWORK: NEEDS HIERARCHY & SENTIMENT-FUNCTION ONTOLOGY

2.1 NEEDS HIERARCHY (U.S. CONTEXT)

Maslow's hierarchy of needs is a motivational theory in psychology that comprises a five-tier model of human needs, often depicted as a pyramid with hierarchical levels. From the bottom of the hierarchy upward, the needs are physiological (food and clothing), safety (job security), love and belonging (friendship), esteem, and self-actualization [11-12]. Key Takeaways

Needs Hierarchy: The original hierarchy includes physiological, safety, love/belonging, esteem, and self-actualization needs. Later expansions add cognitive, aesthetic, and transcendence needs.

Not Strictly Linear: While Maslow initially proposed that lower needs must be relatively satisfied before higher ones, modern research suggests people often pursue multiple needs simultaneously.

Cultural Variations: Different societies may prioritize needs differently. Individualistic vs. collectivist cultures, for example, can shape which needs take precedence[13].

Practical Applications: In fields such as education, healthcare, and workplace management, Maslow's framework helps identify barriers to motivation and guides strategies to address various needs.

Criticisms: Maslow's biographical approach, cultural biases, and the debate over rigid vs. flexible ordering highlight the importance of viewing his theory as a starting point rather than an absolute rule[14].



FIGURE 1. HIERARCHICAL DIAGRAM

Level 1: Physiological needs

According to Maslow, the most essential human needs are those that keep us alive, such as food, water, shelter, and air. Without this basic level of survival, a person can't be expected to engage in much higher-order thinking or achievement [15]. "A person who is lacking food, safety, love, and esteem would most probably hunger for food more strongly than for anything else," Maslow explained in his paper. Everything else, he posited, has to come after.

Level 2: Safety needs

With basic needs fulfilled, the next level of needs moves to safety. These include financial security, freedom from fear, stable health, and anything that can lend predictability and stability to our day-to-day lives. Maslow argued that it's this level of safety-seeking that leads humans to prize systems that bring order to their existence, perhaps in the form of law or religion. Some challenges to this level, he suggested, could be "wild animals, extremes of temperature, criminals, assault and murder, (and) tyranny."

Level 3: Needs of belonging

Once basic survival and a modicum of security are established, human needs change slightly. The third level of the hierarchy encompasses concepts such as friendship, community, love, shared experiences, and any factor that provides humans with a sense of belonging [16,17]. In this model, Maslow assumed that the fulfillment of one level generally leads to a desire to attain the next.

"Now the person will feel keenly, as never before, the absence of friends, or a sweetheart, or a wife, or children," Maslow wrote. "He will hunger for affectionate relations with people in general, namely, for a place in his group, and he will strive with great intensity to achieve this goal. He will want to attain such a place more than anything else in the world and may even forget that once, when he was hungry, he sneered at love."

Level 4: Esteem needs

The top of Maslow's Hierarchy — the ultimate condition of human opportunity — has to do with self-actualization [18]. But first, humans must fulfill the needs of

esteem. Esteem, in this sense, refers to a person's sense of self and their sense of self in relation to others. This level includes factors such as dignity, personal achievement, and perhaps a sense of prestige in a particular area. "Satisfaction of the self-esteem need leads to feelings of self-confidence, worth, strength, capability, and adequacy of being useful and necessary in the world," Maslow wrote.

Level 5: Self-actualization needs

Finally, once a person has all they need to survive, function, and understand their position in the world and their community, they can enter the final portion of the hierarchy. Self-actualization can mean many things, but many examples center on a desire to explore, create, or expand one's skills [19,20]. Concepts such as beauty, aesthetics, and discovery translate into real-world examples, including art, learning a new language, refining one's talents, and becoming the best one can be. "A musician must make music, an artist must paint, a poet must write, if he is to be ultimately happy," Maslow wrote. "What a man can be, he must be. This needs we may call self-actualization." (Despite the pronouns, one assumes the process of self-actualization is also applicable to humans who are not men.)

The hierarchy of needs is traditionally represented as a pyramid. Over time, other thinkers have revised and revisualized Maslow's hierarchy in various ways, elaborating on or splitting the levels, or proposing models in which needs are ordered differently. The general idea remains the same, however: humans have different sets of needs that depend on one another, and one must have basic needs fulfilled before they can reach their potential[21].

2.2 EXAMPLES OF MASLOW'S HIERARCHY OF NEEDS

Beyond its psychological applications, numerous disciplines have found Maslow's model to be a helpful teaching tool [22]. Some educational professionals refer to the hierarchy when assessing educational or behavioral challenges among students, seeking to identify where their needs aren't being met. Similarly, the hierarchy is used in some business leadership theories as a guide to support employees and build a healthy organization. Race and social justice advocates have used this hierarchy as a model to explain how fundamental inequalities significantly hinder underserved people's upward mobility.

"Experiencing food insecurity, having inadequate housing, or being overworked does not inherently make us unable to experience moments of genuine happiness, contentment, and ease," the YWCA, a women's rights organization, states in an article about race, poverty, and well-being.

"However, experiences such as food insecurity, inadequate housing, or being overworked disadvantage us in our quest to live well. They present barriers that must be overcome, challenges that must be faced, and equate us with

worry for the possibility of our most basic needs not being met, jeopardizing our first desire, to live." Some scholars in this field reframe Maslow's hierarchy as a hierarchy of rights or inequities to clarify where and how phenomena such as discrimination lead to the denial of these needs[23].

2.3 WHY THE HIERARCHY OF NEEDS IS IMPORTANT

While many people find Maslow's hierarchy of needs useful, it's important to remember that the model is just one way of thinking about human psychology and was not, and is not, considered a scientific absolute [24]. Common criticisms of Maslow's model argue that it is too arbitrary or that humans should be understood as existing along a continuous spectrum. Still, many experts consider the concept a valuable way to approach personal well-being and broader questions about potential. "It really takes into account both our deepest deficiencies and challenges, as well as our highest strengths," psychologist Scott Barry Kaufman told mindbodygreen.

"Maslow saw his hierarchy as falling within a theory of motivation," Charlie Huntington wrote for the Berkeley Well-Being Institute. "By looking at the ways your own behaviors follow – and deviate from – the hierarchy, you may gain insight into what motivates you."

3 METHODOLOGY

3.1 DATA UNIVERSE & ONTOLOGY CONSTRUCTION

This article adopts a multi-source Voice-of-Customer (VoC) universe designed for conceptual completeness rather than empirical execution. Sources include public reviews (dealer/OEM sites), owner forums, app-store feedback for connected-car apps, National Highway Traffic Safety Administration narratives, JD Power-style survey question banks, and internal dealer service notes. We harmonize these heterogeneous texts through a three-layer ontology[25]:

(a) Need tier (Foundational; Functional/Performance; Experience/Service; Identity/Values),

(b) Function/aspect (safety/ADAS, powertrain & charging, infotainment/HMI, connectivity/apps, build/fit-finish, cost/financing, aftersales/service, OTA/subscriptions, design/brand), and

(c) Emotion (trust, pride/excitement, satisfaction, anxiety, confusion, disappointment, anger/fairness).

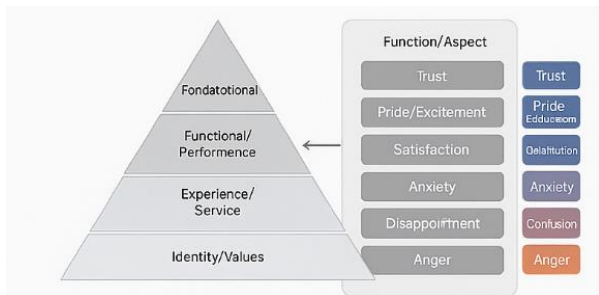


FIGURE 2. NEEDS HIERARCHY, FUNCTION/ASPECT, AND EMOTION

This layered structure ensures every feedback unit can be consistently tagged along the ownership journey. Conceptually, annotation proceeds in two passes. Pass-A assigns aspect and need-tier using a controlled vocabulary plus disambiguation rules (e.g., “lane keep drift” → safety/ADAS; tier = Foundational). Pass-B applies an emotion label with calibrated intensity (routine annoyance vs. severe complaint). Ambiguities (e.g., OTA failures that are both performance and service issues) are resolved by a “primary aspect” rule and a secondary cross-reference to preserve multi-causality. We recommend a governance appendix that defines examples, boundary cases, and escalation rules, so that future studies can reproduce the mapping without rederiving the category definitions.

3.2 SENTIMENT-FUNCTION ASSOCIATION LOGIC

After ontology alignment, the framework models how emotions connect to functions within each need tier. Core measures are (i) co-occurrence lift (emotion↔aspect pairs relative to baseline frequencies), (ii) conditional share of each emotion within an aspect, and (iii) journey slice differentials (shopping vs. post-purchase vs. service). Conceptually, we compute a Trust Index as a composite of service transparency, safety/ADAS consistency, and OTA stability flags, and an Anxiety Index that emphasizes charging access reliability (for EVs) over catalog range [26,27]. These indices are declarative constructs here; later empirical work can tune weights via confirmatory analysis.

To surface practical priorities, we propose a Materiality Matrix in which the x-axis represents issue volume (the frequency with which an aspect appears) and the y-axis represents negative-emotion intensity (anger/anxiety, weighted by severity). Quadrant-I items (high volume, high intensity) become first-line managerial actions (e.g., ADAS inconsistencies; subscription lockouts); Quadrant-II (high intensity, low volume) suggests targeted “fix fast” campaigns; Quadrant-III (high volume, low intensity) calls for UX polish; Quadrant-IV signals monitoring-only. The matrix also supports segmentation by powertrain (EV/HEV/ICE), persona (family/commuter/enthusiast/fleet), and region [28].

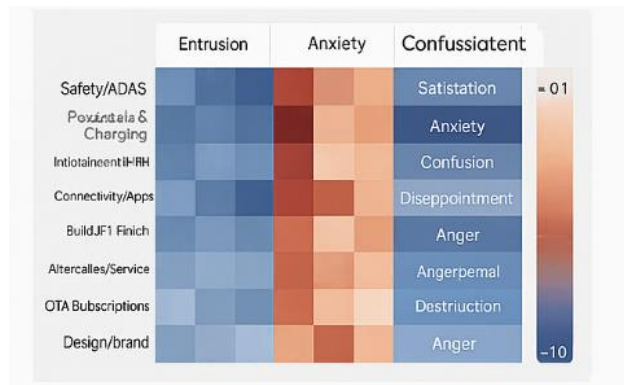


FIGURE 3. SENTIMENT-FUNCTION HEATMAP

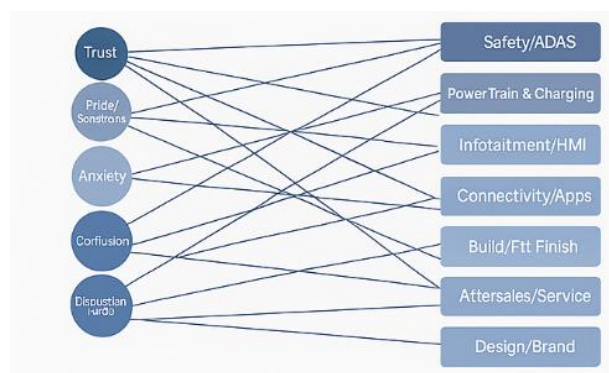


FIGURE 4. BIPARTITE SENTIMENT-FUNCTION GRAPH

3.3 MANAGERIAL DASHBOARDS, PROPOSITIONS & VISUAL NARRATIVES

For decision-makers, we outline a Needs-Tier Scorecard that aggregates sentiment by tier, then drills down to the underlying aspects. Each card displays (a) tier satisfaction proxy (emotion-weighted), (b) top negative drivers, (c) top positive “advocacy” drivers (pride/excitement), and (d) “fast path” levers (e.g., service transparency scripts, OTA cadence stabilization, charging-reliability messaging). A companion Journey Sankey visual traces the origins of negative emotions (shopping vs. ownership) and their resolution (dealer, OTA, roadside assistance), helping teams strengthen weak handoffs.



FIGURE 5. NEEDS-TIER SCORECARD AND MATERIALITY MATRIX DASHBOARD

The conceptual framework yields clear, testable

propositions for future work: *P1*—Safety/ADAS inconsistency evokes stronger anger than equivalent cosmetic defects; *P2*—Among EV owners, charging access reliability dominates rated range in explaining anxiety; *P3*—Trust is co-determined by service transparency and OTA stability; *P4*—Pride mediates the effect of design/performance on advocacy. A Roadmap Table can map each proposition to a recommended evidence source (e.g., survey module, forum mining, app-store reviews) and to an executive action (e.g., ADAS recalibration notice, transparent parts delay ETA)[29]. This closes the loop from conceptual insights to operational playbooks without executing empirical analyses in this article.

TABLE 1. PROPOSITION ROADMAP

Proposition	Primary Data Source	Suggested KPI	Managerial Action	Caveats
P1. Safety/ADAS inconsistency evokes stronger anger than cosmetic defects of equal frequency.	NHTSA complaint narratives; owner forums; dealer service notes	Anger rate within ADAS vs. cosmetic mentions; Severity index	ADAS validation & recalibration program; clearer lane-keep/ACC limitations in HMI	Platform skew; sarcasm detection; incident vs. perception mismatch
P2. For EV owners, charging access reliability explains anxiety more than catalog range.	EV forums; charging -app reviews; JD Power-style survey items	Anxiety Index (charging reliability weighted); Failed session rate	Partnerships for charger uptime; real-time routing & availability messaging	Regional infrastructure variance; trip profile confounders
P3. Trust is jointly determined by service transparency and OTA stability, not reliability alone.	Service CSAT verbatims; app-store reviews; dealer notes	Trust Index; On-time ETA disclosure rate; OTA rollback incidence	Standardized transparency scripts (parts ETA, costs); OTA release gates & staged rollouts	Attribution ambiguity; mixed responsibility (OEM vs. dealer)
P4. Pride/excitement mediates the effect of design/performance on advocacy (WOM/Referrals).	Brand community posts; survey modules (design, performance, advocacy)	Advocacy intent (WOM/NPS top-box); Pride score	Launch narratives & owner showcase; test-drive/performance events	Social desirability bias; short-lived novelty effects
P5. Subscription/feature-locking complaints map primarily to fairness/anger, depressing infotainment satisfaction.	App-store reviews; forums; support tickets	Fairness-anger density; Infotainment CSAT; Cancellation rate	Simplify tiers; clearer trial→paid transitions; offline fallbacks for core functions	Pricing/contract complexity; cohort heterogeneity
P6. Family personas overweight safety/space;	Segmented surveys; forum	Tier contribution weights	Persona-specific trims and messaging;	Persona misclassification; small cell sizes

enthusiasts overweight drivability/performance in satisfaction formation.	personas tags	to overall satisfaction by persona	dealer fit-to-need checklists	
P7. Purchase transparency reduces post-delivery regret more than price incentives alone.	Purchase journey surveys; dealer CRM notes	Post-delivery regret rate; Transparency metric (itemized OTD clarity)	Mandate itemized OTD quotes; cooling-off education; finance explainer	Regulatory variability; finance product confounders
P8. HMI complexity increases confusion and perceived ADAS risk even when features meet spec.	Usability studies (verbatims only); app/HMI reviews	Confusion density; Misuse flags; Help-seek rate	Simplify HMI flows; context help; safe-defaults for ADAS toggles	Lab vs. field gap; multi-language localization limits

4 CONCLUSION

Set against the U.S. market’s structural shifts—chip-scarcity aftershocks, accelerated EV adoption, and the continued strength of SUVs and trucks—this paper articulates a declarative framework that links a hierarchical model of automotive customer needs to a sentiment–function ontology. The four-tier hierarchy (Foundational; Functional/Performance[30]; Experience/Service; Identity/Values) provides scaffolding for interpreting Voice-of-Customer narratives with greater precision than star ratings or generic CSAT. By routing each feedback unit through the tiers → function/aspect → emotion, the framework clarifies why the same event (e.g., an OTA failure) can elicit distinct emotions depending on its perceived tier (performance vs. service) and journey stage (shopping, delivery, ownership). This synthesis positions needs hierarchy as the organizing principle and sentiment–function links as the explanatory mechanism.

Operationalized as dashboards and materiality maps, the framework directs managerial attention to issues that are both frequent and emotionally costly. Conceptually defined indices—Trust (service transparency × safety/ADAS consistency × OTA stability) and Anxiety (charging access reliability weighted above catalog range for EVs)—translate qualitative feedback into actionable priorities. The proposition roadmap (P1–P8) offers testable claims that can anchor pilots: stabilize ADAS behavior to blunt anger; improve charger uptime visibility to reduce EV anxiety; standardize parts-ETA transparency to lift trust; simplify HMI and subscription flows to curb confusion and fairness complaints; and tailor trims/messages to persona-specific weights (safety/space for families; drivability/performance for enthusiasts). In practice, these moves shift measurement from undifferentiated satisfaction to tiered need fulfillment and emotion-weighted outcomes, enabling faster, more

targeted product, service, and UX interventions.

As a non-empirical blueprint, our contribution is conceptual: it harmonizes categories and proposes association logic without executing data collection or modeling. This choice avoids premature overfitting but introduces limitations—platform skew in secondary sources, ambiguity in emotion labeling (e.g., sarcasm), and attribution gaps across OEM–dealer–infrastructure boundaries [10-11]. Future work should (i) validate the ontology with inter-annotator protocols, (ii) estimate proposition effect sizes via aspect-level sentiment modeling and causal designs where feasible, (iii) extend to multimodal signals (telematics, voice, in-car HMI logs) and longitudinal OTA policies, and (iv) examine equity impacts across regions and customer cohorts. With these steps, the field can convert the present framework into a replicable measurement system that reliably links engineering and service decisions to the emotions that ultimately drive loyalty, advocacy, and lifetime value.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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