FROST & SULLIVAN

TomTom

2022 NEW PRODUCT INNOVATION

Global Automotive Navigation Industry

Best Practices Criteria for World-Class Performance

Frost & Sullivan applies a rigorous analytical process to evaluate multiple nominees for each Award category before determining the final Award recipient. The process involves a detailed evaluation of best practices criteria across two dimensions for each nominated company. TomTom excels in many of the criteria in the automotive navigation space.

Technology Influence to Match Needs

Vehicle navigation tools have come a long way, from bulky paper maps to portable navigation devices (PNDs) and smartphone navigation solutions. However, each iteration comes with shortcomings, such as the use of slow and rugged systems like PNDs and the unsafe practice of using smartphones while driving. Consumers desired ease and convenience when using their favorite mobile apps in-vehicle, without the burden of handling a smartphone while driving.

The advent of digital technologies and satellite imagery resolved these issues with the first factory-fitted in-vehicle navigation system in the 1990s. Since then, the automotive navigation industry has flourished into a multi-billion dollar industry with leading mapping software and device manufacturers - namely TomTom.

> *"TomTom Navigation for Automotive brings the best of both worlds for automakers and end consumers in terms of cost efficiency, system reliability, and enhanced user experience."*
>
> ***– Ashwini Suvarna, Research Analyst***

Over the years, Frost & Sullivan analysts have tracked how advancements in disruptive technologies, GPS, and navigation features in-vehicle have accelerated the connected car industry. Apart from music and other convenience features, navigation has been a key contributor to the next-generation growth of the automotive industry. However, this progress came at the cost of navigation hardware, software, updates, and user experience (UX). In-vehicle systems relied on onboard

map integration depending on stored data. The system cost, based on the required storage of 64GB for an entire European continent map, for instance, necessary yearly map updates, data charges for the updates, and connected service usage all put a hole in customers' pockets. By the time the vehicle is launched, the integrated map software is also often outdated within a year, not providing customers with the latest details.

TomTom, a leading player in mapping and location services in the consumer domain since 1991, invented its first route-planning software for mobile devices in 1996, followed by the release of its first satellite navigation device in 2004 and further exploring the automotive industry by 2007. Recognizing the concerns and loss in customer experience, TomTom launched TomTom Navigation for Automotive in 2021, a cloud-native in-dash hybrid navigation system that relies on the "cloud-first, onboard next" technology leveraging cloud and onboard maps for constant navigation functionality. By integrating the latest advanced services through cloud computing, Frost & Sullivan notes that the solution brings about fast, up-to-date automotive routing with less need for onboard storage.

Reliability

Customers typically prefer the integrated functionality and experience that smartphone duplication offers over in-vehicle infotainment (IVI) devices, which can be both difficult to use and navigate. Despite OEMs spending years developing seamless in-vehicle factory-fitted navigation systems, consumers prefer to rely on smartphone mapping applications for their speed, latest maps, and interactive user interface (UI). However, automakers struggle to provide a well-connected speedy mapping service with the latest maps due to their traditional system architecture and way of working.

TomTom's powerful cloud-computing technology enables fast, up-to-date routing and fresh maps with smart usage of online services, OTA software, and continuous map updates to create a responsive user experience. The cloud-integrated online navigation structure integrates with a vehicle's IVI system to provide users with secure, connected, fast, and real-time navigation information and switches to using the cloud while connected and available onboard maps in case of loss of connectivity for non-stop, seamless navigation.

Standing by its safety and ease-of-use principle, TomTom's new intuitive user interface for its cloud-native hybrid navigation solution can be displayed on the center stack, cluster display, and head-up display (HUD) - irrespective of screen size and aspect ratio. This approach allows information such as turn-by-turn navigation, lane-level instruction, and traffic/hazard warnings to be displayed on the cluster and HUD, improving driver safety and comfort.

The technology can easily be integrated into any in-vehicle infotainment system as a pre-integrated stack delivered through easy-to-use SDKs and APIs that can run on the cloud. This adaptable solution is integrated with advancements made to the software engine remotely to provide users with the best-in-class experience. Map data is updated much more frequently over-the-air giving consumers an efficient and reliable in-vehicle hybrid navigation system.

"The system easily integrates with any vehicle type, whether EVs, trucks, or motorbikes, with a full-stack navigation portfolio comprising the navigation engine, navigation UI, EV routing and range, maps, traffic and travel data, and vehicle sensor information."

– Ashwini Suvarna, Research Analyst

Quality

TomTom's cloud-native hybrid navigation system developed for the automotive industry offers impressively strong competition against existing conventional onboard navigation systems or cloud-only navigation technologies in the market.

Traditional onboard navigation systems relied heavily on built-in map storage involving high hardware costs and data charges that were comparatively higher a few years ago. Similarly, cloud-only navigation options supplied by some competitors, although costing less on built-in storage, rely heavily on connectivity for continuous data usage, incurring high charges in addition to the drawback of unreliable connections. Compared with these solutions, Frost & Sullivan points out that Tomtom's flexible hybrid navigation approach allows automakers to consume significantly less data storage than the traditionally used built-in capability of 64 GB. Its system also does not rely on data connectivity as heavily as cloud-only navigation. Frost & Sullivan lauds TomTom Navigation for Automotive for bringing in a balance for automakers and consumers in terms of data cost efficiency, onboard storage and enhanced user experience.

The system easily integrates with any vehicle type, whether EVs, trucks, or motorbikes, with a full-stack navigation portfolio comprising the navigation engine, navigation UI, EV routing and range, maps, traffic and travel data, and vehicle sensor information. The dynamic range mapping helps drivers visualize the EV range, alerting users with charging location and cost comparisons and adding the charging destination as a waypoint, all based on the system's predicted range analysis. The TomTom technology also offers users voice-support integration via Amazon Alexa, Cerence, and Houndify to interact with the navigation system for additional safety.

In addition to its feature-rich technology and market strategy, the brand intends to reinforce its competitive edge around four pillars — uncompromisable UX with customizability, boosted safety and automation, a carefree EV journey, and built for easy integration — that nicely define TomTom's value proposition.

Customer Ownership and Customer Service Experience

The competitive environment in the automotive navigation space requires continuous innovation and new technology investments to update map databases and create innovative product integrations. With its goal to push boundaries and create versatile location-based services and software, TomTom is highly committed to automation and innovation. The company relies on consistent customer feedback to design better products and contribute to the map database, creating a flywheel effect.

TomTom's strategic priority to nurture user pride in customer ownership and satisfaction is through providing a comprehensive location platform and mobility technologies, emphasizing better maps at a lower cost for productivity and efficiency of the map-making platform; online acceleration to boost competence in the cloud-based platform for easy user access; enhancing product portfolio to develop innovative products for customer needs and satisfaction; and becoming an employer of choice to best attract, retain, and grow tech talent.

To excel in enhancing the product experience for customers, TomTom commits to a meticulous quality management process beforehand to avoid faulty launches. Its internal policies, governance teams, and code of conduct are designed to diminish the risk of incidents that could damage the brand's reputation and image. Compared with other competitors, TomTom adopts a unique practice, in which it reviews new opportunities and analyzes client satisfaction based on its excellence standards to ensure it can deliver per customer expectations.

The launch of TomTom's latest navigation platform has led to numerous opportunities and partnerships with multiple OEMs, the largest being a multi-year agreement with Volkswagen Group. While Volkswagen and TomTom have had a long-standing partnership since their traffic service integration, the new deal is with CARIAD, Volkswagen's automotive software and technology company. TomTom aims to integrate its latest navigation solution into Volkswagen's digital cockpit, delivering regular OTA updates, route guidance and accurate estimates, and onboard mapping in the absence of data connectivity. To enhance service experience, TomTom is also working with CARIAD to co-develop additional innovative services, such as pioneering lane-level navigation, lane-dependent traffic, and a personalized electric vehicle experience across the Volkswagen Group's entire line-up.

TomTom allows automotive brands to prioritize their customers first, giving them the freedom to innovate. Unlike its other competitors, the data gathered is solely used to improve in-house products and services, providing no support to alternative business models that could compete with TomTom customers. TomTom's customer service team strives to deliver quality, responsive services and proactively monitors its platforms for customer feedback and issues to address challenges and improve internal service integration.

Design

The design of TomTom's Navigation for Automotive gives an alternative to brought in-phone navigation.. Emphasizing on user experience, safety and customizability, the design of Navigation for automoitve is tightly integrated with vehicles to fit a huge variety of OEM system setups . Proactive flows minimize the required interaction to allow drivers to focus on the road.

Navigation for Automotive has made it easier to start your navigation in the from of a companion app, smart predictions or a simplified search flow. Live up-to-date maps and data ensure that TomTom gets drivers to their destination comfortably and confidently. A smooth, compelling 3D map visualization translates the driver's context in glanceable views.

TomTom's EV-first design principles incorporate charging needs in driver's natural interaction flows. For example, when planning long distance trips; the software is able to check a huge variety of options to ensure that the best charging stations are automatically added to the route. Details such as 'predicted destinations' including 'EV charge on arrival' provide new and seasoned EV drivers with confidence. TomTom combines vehicle data with the navigation context to give drivers a holistic view of the surrounding. TomTom's Virtual Horizon allows TomTom to anticipate the drivers' path and proactively avoid issues ahead. If there is a speed camera, traffic delay, or accident ahead; TomTom informs drivers even without having a planned route.Tight integration of navigation across the IVI system allows TomTom to achieve a holistic cockpit experience. The cluster provides a guidance focused view of required maneuvers, while the central and passenger displays give more planning capabilities. Even when navigation is now shown on any display, TomTom provides helpful notifications in appropriate locations.

TomTom recognises the challenges OEMs are facing in terms of product integration in the era of software-defined vehicles.. With a flexible product offering, they demonstrate a renewed focus on the level of integration to fit all OEMs. OEMs can choose from a reference UI to fit their primary display use cases or adopt a more customised integration effort. For OEMs who desire more control, the UI components and APIs allow a very deep level of integration into the system.

All of these integration types are supported by tools, examples and documentation to inspire and support OEM teams.TomTom's effort on improved OEM designer/developer experience, quick cycle time, iterative workflows, and continuous testing will allow OEMs to set more ambitious targets.

TomTom's Navigation for Automotive product suite gives OEMs the tools to provide driving experiences that were previously out of reach. In the generation of smartphone app dominance, Navigation for automotive is the key for drivers' seamless experience with hybrid embedded navigation systems. ***Brand Equity***

To keep pace with the fast-evolving automotive market, TomTom explores software-defined vehicles across three major areas — the EV line-up dominance, immersive cockpit experience, and increased automation — to future-proof its navigation technology. The release of its cloud-hybrid TomTom Navigation for Automotive solution powered by an advanced mapmaking platform strengthens the brand's position as a location technology specialist, utilizing a blend of artificial intelligence and cartographer skills to integrate data from various sources.

TomTom maintains its strong brand position and competitive edge across the automotive ecosystem by remaining independent, creating strong data governance, showcasing extensive market expertise in location data, providing strong user experience knowledge, and creating multiple collaborations in the existing ecosystem.

Through its comprehensive portfolio of navigation solutions, TomTom continues to reinforce its position across multiple domains in the connected car market. Apart from its TomTom Navigation for Automotive solution partnership with CARIAD and the Volkswagen Group, it has alliances on connected navigation, EV

and ADAS solutions with many other OEMs, like Stellantis, Hyundai-Kia-Genesis, Renault-Nissan-Mitsubishi Alliance, Subaru, BMW, and others. It has launched a digital cockpit software platform in partnership with automotive technology leaders such as Alexa, Amazon Music, Bosch, Cerence, Cinemo, Faurecia Aptoide, Harman, Microsoft, and Rightware is developing an augmented reality HUD with expertise from Apostera and Phiar, and driving advancements in the field of automated driving with Virtual Horizon and HD Maps, bolstering TomTom's brand value and company growth. By constantly updating map content based on changes in the environment and rigorously adding new geographies and features to its map database, Frost & Sullivan concludes that TomTom is able to clearly meet the needs of existing and new users, introduce new products, and expand its market footprint.

Conclusion

The in-vehicle navigation industry has seen dramatic changes over the past few decades, with users certain to experience even more innovative advancements in the years to come.

TomTom's new-generation, cloud-native hybrid navigation in-vehicle solution works in online and offline situations with cloud-computing capabilities, enhancing the user experience with state-of-the-art hyper-fast routing and responsive navigation technology. Frost & Sullivan appreciates how this solution enables TomTom to properly address customer challenges while cementing the brand's presence in an EV-dominant future fueled by immersive experiences and automation. With product innovation as its key growth strategy, TomTom is poised to strengthen its global market presence and extend its solution offerings in the electric and autonomous vehicle market.

With its strong overall performance, TomTom earns the 2022 Frost & Sullivan Global New Product Innovation Award in the automotive navigation industry.

© Frost & Sullivan 2022

What You Need to Know about the New Product Innovation Recognition

Frost & Sullivan's New Product Innovation Award recognizes the company that offers a new product or solution that uniquely addresses key customer challenges.

Best Practices Award Analysis

For the New Product Innovation Award, Frost & Sullivan analysts independently evaluated the criteria listed below.

New Product Attributes

Match to Needs: Customer needs directly influence and inspire product design and positioning

Reliability: Product consistently meets or exceeds customer performance expectations

Quality: Product offers best-in-class quality with a full complement of features and functionality

Positioning: Product serves a unique, unmet need that competitors cannot easily replicate

Design: Product features an innovative design that enhances both visual appeal and ease of use.

Customer Impact

Price/Performance Value: Products or services provide the best value for the price compared to similar market offerings

Customer Purchase Experience: Quality of the purchase experience assures customers that they are buying the optimal solution for addressing their unique needs and constraints

Customer Ownership Experience: Customers proudly own the company's product or service

and have a positive experience throughout the life of the product or service

Customer Service Experience: Customer service is accessible, fast, stress-free, and high quality

Brand Equity: Customers perceive the brand positively and exhibit high brand loyalty

© Frost & Sullivan 2022

About Frost & Sullivan

Frost & Sullivan is the Growth Pipeline Company™. We power our clients to a future shaped by growth. Our Growth Pipeline as a Service™ provides the CEO and the CEO's growth team with a continuous and rigorous platform of growth opportunities, ensuring long-term success. To achieve positive outcomes, our team leverages over 60 years of experience, coaching organizations of all types and sizes across 6 continents with our proven best practices. To power your Growth Pipeline future, visit Frost & Sullivan at http://www.frost.com.

The Growth Pipeline Engine™

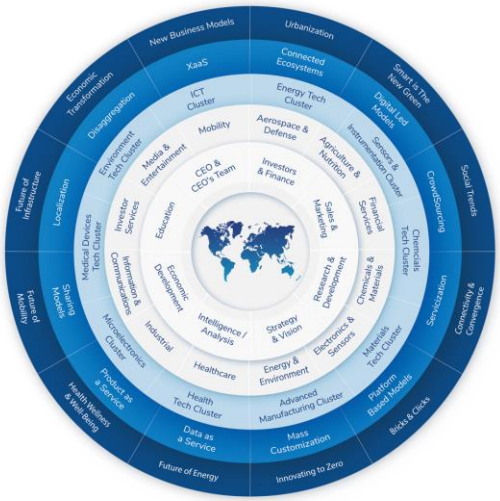
Frost & Sullivan's proprietary model to systematically create ongoing growth opportunities and strategies for our clients is fuelled by the Innovation Generator™.
Learn more.

Key Impacts:

- **Growth Pipeline:** *Continuous Flow of Growth Opportunities*
- **Growth Strategies:** *Proven Best Practices*
- **Innovation Culture:** *Optimized Customer Experience*
- **ROI & Margin:** *Implementation Excellence*
- **Transformational Growth:** *Industry Leadership*

The Innovation Generator™

Our 6 analytical perspectives are crucial in capturing the broadest range of innovative growth opportunities, most of which occur at the points of these perspectives.



Analytical Perspectives:

- Mega Trend (MT)
- Business Model (BM)
- Technology (TE)
- Industries (IN)
- Customer (CU)
- Geographies (GE)