



Automotive, Enterprise, IoT, and the Mobility Sector to Drive Future Location Sector Growth

Wireless Media Strategies (WMS)



Report Snapshot

Demand for location services will continue to grow as the value of location is realized across a number of sectors, including automotive, enterprise, IoT and mobility services, among others. This report provides Strategy Analytics' status update and outlook for location-based services growth in these areas. This report also updates our assessment of global location companies, which benchmarks Google, HERE, Mapbox and TomTom across characteristics such as map making capabilities, strength in automotive, map visualization, and ability to appeal to developers, in addition to others. Google and HERE continue to demonstrate leadership and strong capability across most of the benchmark attributes, while Mapbox and TomTom demonstrate strengths in others.



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Nitesh Patel

Tel: +44 (0)1908 423621

Email: npatel@strategyanalytics.com



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1. Executive Summary

Demand for location services will both evolve and expand across a number of sectors including automotive, enterprise and IoT, mobility services, mobile apps and digital advertising.

- Strategy Analytics' [Infotainment and Telematics service](#) estimates annual sales of navigation enabled cars (excluding HD Maps) will rise at a 6.9% CAGR, exceeding 60 Million by 2025, with above average increases across BRIC. This will provide continued growth opportunities for digital map and location service suppliers.
- In IoT Strategy Analytics expects a [12% CAGR in the number of cellular connections](#) to drive demand for location services. Enterprises will aim to [monitor the location and movement of connected devices](#) for the purpose of greater accountability, and improved management and decision making.
- Granular location data and detailed maps will underpin the growth of the [\\$330 Billion global digital advertising](#) opportunity by supporting anonymized user profiling, ad attribution and real-time location-based ad-delivery.
- Rising numbers of consumers with GPS equipped handsets combined with a growing base of mobile data users and an increasing number of users downloading apps from app-stores will boost the total addressable market of mobile LBS services over the next 5 years.

In this iteration of Strategy Analytics' location-platform benchmarking report Google and HERE both run out as leaders across the many of our eight categories. Mapbox and TomTom score strongly across several categories as competition across the location sector intensifies and customer demands evolve.

- Google demonstrates leadership in map-making, map-freshness, local search and its developer community. However, its areas of weakness include a lack of openness, and in the automotive sector - although the popularity of Android Auto and Android OS wins with car makers Volvo, Renault, Mitsubishi and Nissan, are positive signs.
- HERE demonstrates leadership in map-making, automotive, industry vision and openness. HERE scores highly on map freshness, particularly in terms of the depth and detail of its updates and meeting validation requirements. HERE is aggressively improving on areas like POI search, developer community and visualization.
- Mapbox is a leader in visualization. Mapbox also scores highly in map-freshness, innovation and openness. In map-making its reliance on OpenStreetMap (OSM) and probe data enables it to provide map coverage at scale with low cost. However, community mapping lacks scale, consistency, quality assurance and provenance to satisfy all needs. Mapbox is making progress in automotive though it remains early days.
- TomTom scores highly across map-making, map-freshness, automotive and openness. TomTom is focused on automotive and developing its offerings for enterprise and developers. Visualization tools remain a weakness for TomTom.



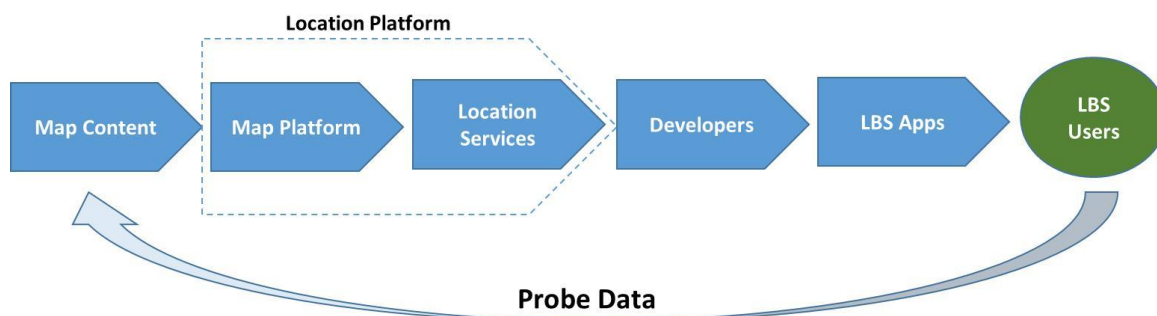
2. Transformation of the Location Sector

2.1 What Is A Location Platform?

Strategy Analytics defines a location platform as a company which provides customers with access to a range of location services which includes digital map tiles, geocoding (converting street names into coordinates and vice-versa), optimized routing, local businesses or points of interest (POIs) search, traffic information, and more. Location platforms enable enterprises and long-tail developers to integrate these horizontal location services into their own apps and services so developers don't need to build their own maps or common location service capabilities, Exhibit 1. Location-based applications and location services are usually underpinned by a map and supported by geolocation information provided either automatically via positioning technology like GPS or manually (e.g. address input).

Location platforms also provide tools for customers and developers to customize these location services. For example, to modify the style of the map tiles, or emphasizing specific details such as railway lines or public transport routes. Increasingly, location platforms enable enterprises and developers to integrate their own data (or third-party data) with map content and location services to create their own custom maps, visualizations and unique location services.

Exhibit 1 The Location Based Services Value-Chain & Live Data Loop



Source: Strategy Analytics

2.2 The Evolution of Map Making & Maintenance

Over time, map making techniques have become increasingly sophisticated, automated and cost effective. Modern map making and maintenance relies upon a variety of data sources, including satellite and aerial imagery, statistical analysis of GPS probe data gleaned from GPS enabled smartphones and vehicles, cameras on-board cars and smartphones, and LIDAR equipped mapping vehicles. Community efforts like Open Street Map (OSM), which relies on the contributions of individuals and organizations, have helped to democratise map making. Consequently, basic and crude 2D maps have largely become commoditized.



GPS probe data from cars and smartphones are analysed to detect changes to the current road network and also to measure traffic conditions in near real-time. For example, GPS data can provide early clues when a turn restriction has been recently implemented, or when new streets have been added. More recently, cameras on cars and smartphones are being used in conjunction with visual recognition and machine learning to detect and report on changes in real time back to the platform e.g. Mapbox's Vision SDK. Live cameras feeds can be analysed in real-time to segment and capture map content, such as road signs, and other detectable road features. Any changes which are detected can be used to update the map over-the-air.

2.3 Business Model Evolution

The business model for location services continues to shift. Both HERE and TomTom license their map content on a custom basis, and at high margins, to vehicle OEMs and other enterprises. However, in order to deliver location services to support a growing variety of use-cases at scale, HERE and TomTom are moving towards a platform approach, where location services are available via the cloud on a transactional basis. For example, developers can use software development kits (SDKs) or application programming interfaces (APIs) that request map tiles, geocoding, reverse geocoding or directions on-demand within apps or web services. Each request for these services is a billable event, and therefore the success of the platform business model (and Google, HERE, Mapbox and TomTom) will be linked to strong demand for location services from across key sectors. For enterprises with a need for location services on a large scale, or for customized needs, the licensing model is typically negotiated on a custom basis.



3. Future Location Growth Opportunities

Although basic location services (e.g. 2D roadmaps) are becoming commoditized, there is continued demand for services and solutions to be tailored to meet the needs of different sectors and use-cases, for example autonomous driving, electrical vehicles, IoT, and mobility, among others.

For autonomous driving, machine readable maps which provide centimetre level accuracy and high levels of detail are essential. For location-based advertising and attribution, accurately identifying the location of consumers with precision in different retail stores and buildings not only requires highly accurate positioning technology, but also accurate building level maps and place information. Similarly, for drones to safely navigate to their destination 3D building and airspace maps are essential. The rest of this section provides examples of the growth opportunities in each of these areas being targeted by companies in the location-sector.

- The automotive industry
- Enterprise – asset management , IoT, and business intelligence (BI)
- Mobile apps
- The mobility market
- Digital advertising and marketing

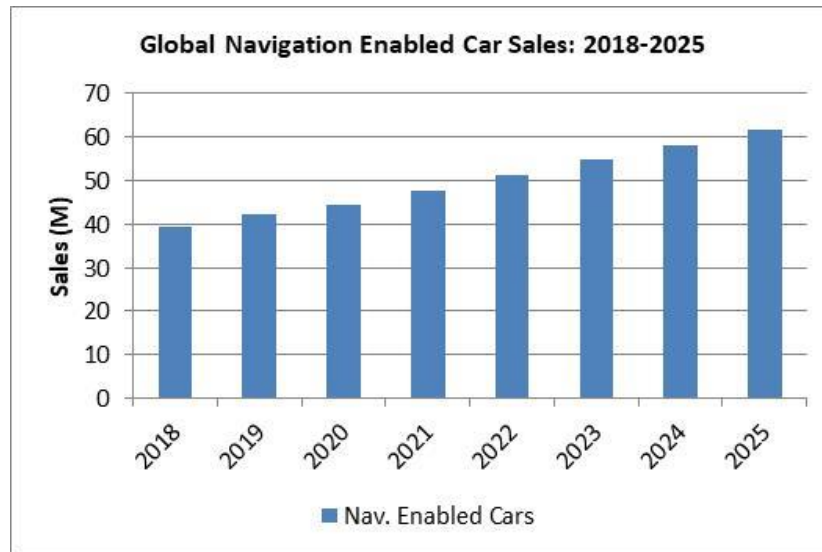
3.1 The Automotive Opportunity

The automotive industry remains a key market for location companies HERE and TomTom. For example, in 2017 TomTom derived 21% of its total sales (€190.6 Million) from its automotive business unit. HERE claims to provide location services for 4 out of 5 cars in Europe. For carmakers, location services such as turn-by-turn (TBT) navigation, traffic information, search, parking and fuel prices, will remain important capabilities delivered through vehicle infotainment units over the next five-years.

Strategy Analytics' [Infotainment and Telematics service](#) estimates annual sales of navigation enabled cars will continue to rise at a 6.9% CAGR, exceeding 60 Million by 2025, with above average increases across BRIC, Exhibit 2. This will provide a continued opportunity for growth for digital map and location service suppliers. The total excludes HD maps that will be required to safely guide autonomous cars, but includes connected cars which will have the ability to deliver live map-based services to users as part of the connected in-vehicle infotainment (IVI) experience. In depth analysis and forecasts of the infotainment services and telematics opportunity is available through Strategy Analytics' [Infotainment and Telematics service](#).



Exhibit 2 Annual Sales of Navigation Enabled Cars: 2018-2025



[Source: Strategy Analytics, Infotainment & Telematics](#)

Demand for different types of location services will evolve as the automotive industry does. For example, finding the location of electric charging points along routes, and their availability, will be essential for a [growing number of electric vehicle owners](#). Real-time information relating to the availability of charging points will also be important. Furthermore, the automotive industry is moving towards the higher levels of autonomous driving.

Over the next five-years the share of cars with HD maps will account for a negligible fraction of cars sold. However, in the long term Strategy Analytics expects the requirement for embedded navigation to increase as assisted and autonomous driving relies on high-definition (HD) maps.

High definition maps are fundamental to enable autonomous vehicles to accurately calculate their position on the road. Both HERE and TomTom are vying to take a leadership position in supporting autonomous driving with their HD Maps through partnerships with key stakeholders in the future value-chain for autonomous vehicles. Google is also taking a shot at the autonomous vehicle opportunity through Waymo, its self-driving project, while Mapbox is also building HD maps based on a crowd-sourced approach.

- TomTom claims its HD Map covers more than 380,000 KM of roads across Europe, the United States and Japan.
- HERE claims it is on target to have over 1 M KM of roads mapped in HD by the end of 2018.
- Waymo claims its autonomous cars have clocked a total of 10 Million miles by the end of October 2018, and in December 2018 launched the first commercial self-driving ride-sharing service, called Waymo One.



- Mapbox has not announced the extent of its HD Map coverage. However, it states that it has the ability to deliver lane level precision required to support Level 2 and Level 3 semi-autonomous driving using current probe GPS data, and in future the deployment of its Vision SDK on sensors deployed on vehicles and via partnerships with companies such as Intel's Mobile Eye, among others.

3.2 Enterprise

Different industry verticals have a need for both off-the-shelf and customized location services to support horizontal functions, including asset tracking, fleet management, business intelligence, and IoT among others.

3.2.1 Asset Tracking & Fleet Management

Improving risk management and providing greater accountability are driving the need for enterprises across industry verticals to track assets across the supply chain, including fleets of vehicles, parts and employees. Maps, geo-location and locations services are needed for tracking and managing assets.

Survey work conducted by [Strategy Analytics' Enterprise IoT service](#) during 2018 indicates that 48% of companies have implemented asset tracking (or asset monitoring) services, up from 40% in 2017. Additionally, a further 34% of companies surveyed indicated plans to deploy asset tracking in the next 12 month, up from 30% in 2017. Notably, the survey results indicated above average of adoption of asset tracking and monitoring across companies in the finance, insurance and real estate (FIRE) sector, telecoms, media and technology (TMT), Energy and Utilities and finally, and Healthcare and Pharmaceuticals.

The declining cost of connectivity via cellular (due to a combination of lower priced cellular enabled RFID tags and falling mobile data prices) is increasing the viability of cellular enabled asset management tags. The battery performance (and therefore lifecycle) of cellular-enabled tags has improved significantly, which is making them more viable.

Maps and location services such as geolocation, geocoding, routing, and navigation are useful for tracking products across the supply-chain, from within factories through to delivery to the customer. For example, as parts or assets move from inside to outside the factory, dispatchers are able to track the position of their vehicles in real time to provide improved guidance to internal and external customers relating to estimated arrival time. Dispatchers can also use information about potential delays due to traffic incidents to provide drivers with alternative routing information.

TomTom announced plans to sell its fleet management solutions unit, TomTom Fleet, for a value which has been estimated by financial analysts at around €1 Billion. Google claims Google Maps is used to support a number of fleet companies, including fleet minder, ABAX, TELETRAC NAVMAN, Vagabond, and Apod. Mapbox cites Transfix and Pole Star as customers. HERE's fleet customers include Fleetboard, Calamp, and EPAM (tracking).



3.2.2 Internet of Things (IoT)

Strategy Analytics expects a 12% CAGR in the number of cellular connections to drive demand for location services. Enterprises will aim to monitor the location and movement of connected devices for the purpose of greater accountability, and improved management and decision making.

Increasing numbers of IoT providers are offering location and tracking out of the box, not just around cellular, but also around unlicensed LPWA technology like LoRaWAN. Customers will increasingly have a choice beyond assisted GPS, depending on power consumption and the level of accuracy required for their particular solution. For example, some companies may just need to know where an asset is with basic geofencing. For example, warehouse assets like cable drums or the basic position of enterprise fleets to track those assets to a specific depot or location, which may not require a high level of accuracy. In those cases, even unlicensed LPWA technologies like LoRa may be sufficient, as long as the network knows what time a signal is picked up by any number of gateways, so that it is possible to triangulate that to a location with an accuracy of 40-50 meters, perhaps slightly less in dense urban environments.

For greater levels of accuracy, integrated AGPS/cellular/Wi-Fi sniffing will work very effectively, such as specific pallet locations or where in a storage rack an item is located. Some companies are also integrating these capabilities into unlicensed LPWA solutions, such as Actility, which has some patented IP around low power GPS (through its acquisition of Abeeway), which is a LoRaWAN equivalent of AGPS (Assisted GPS). The network provides key information to the device preparing to make a fix, which means that the GPS can be active for a shorter period of time, and acquire fewer satellite signals. The position calculations are then processed in the cloud, which reduces the battery impact, while still providing GPS levels of accuracy (in many cases sub-10 meters). If a standard GPS offering has a 1 year battery life and pure LoRaWAN has a 10 year battery life, this solution could give up to 9 years¹

Location services will also be used to enhance augmented reality which will create a more immersive experience. AR and real-time location services (RTLS) will be combined on a much bigger scale in order to provide value to the businesses and customers. In fact, the trend has already begun with airports and hospitals leveraging the use of BLE Beacons, combined RTLS and Wi-Fi to help find way through their large and difficult to navigate spaces.

IoT presents a future growth opportunity for location platforms as the number of devices connected to the internet increases. Strategy Analytics' [Enterprise IoT Strategies](#) service estimates the number of devices connected over the cellular network is set to grow by 12% CAGR between 2018 and 2025 across a variety of industry verticals. IoT in Healthcare, Primary Processing and Automotive is set to show the strongest growth. Cellular connectivity will enable these devices to be tracked or monitored, although clearly not all these connected devices will need support from location services e.g. geolocation, directions or routing.

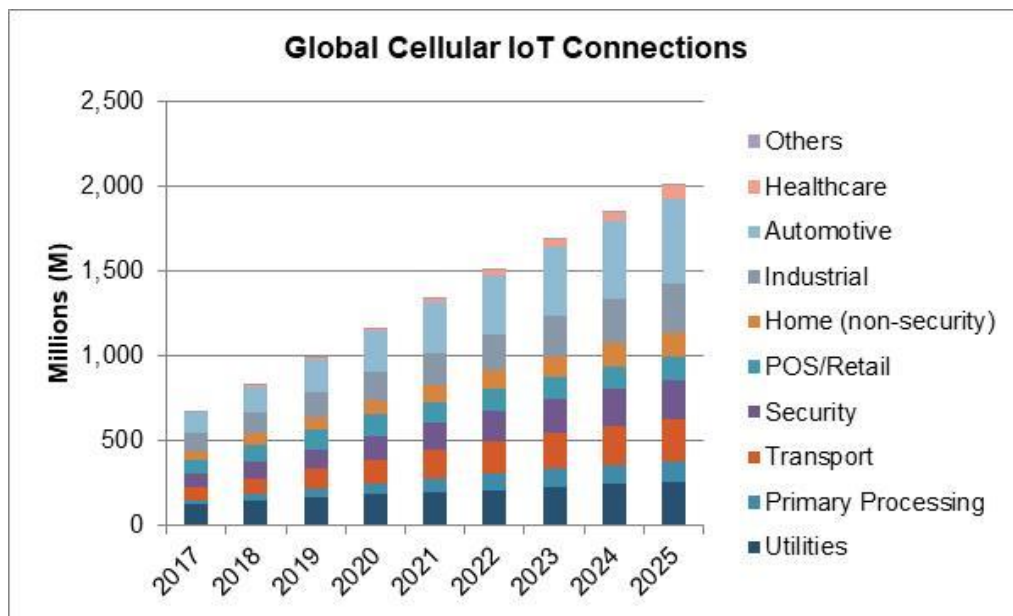
Fundamentally, where mobility is a core requirement e.g. Automotive, or Fleet or where assets need to be tracked e.g. in a factory, or across a supply chain, the greater the need for geolocation services. Traceability in the supply chain is becoming a very important element of compliance in many industries to guarantee the source of origin, as

¹ <https://www.actility.com/customer-stories/die-mobilier/>

well as the integrity of any component. Examples include car parts shipped globally to different suppliers, where location tracking and identification of the origin is vital, especially in terms of liability should there be a safety recall on a particular vehicle component. The same is also true in terms of food processing, where traceability is vital in guaranteeing the integrity of a finished product, for example, if a fast food chain guarantees customers that chicken nuggets contain 100% chicken breast meat, then suppliers need to ensure they can prove that the chicken nuggets they produce are sourced from chicken breast, or risk a serious breach of an SLA (service level agreement) with a customer.

Data recorded by these connected objects will be able to provide contextual information via alerts and can be visualized. For example, a vending machine which is low on a certain product item, or which has become faulty is able to communicate its status to head office and can be restocked or fixed.

[Exhibit 3 Global Cellular IoT Connections: 2017-2025](#)



[Source: Strategy Analytics, Enterprise IoT Strategies](#)

3.2.3 Business Intelligence (BI)

The use of BI tools by enterprises to make data driven decisions is on the rise and represents an area of growth for location platforms. Location services help businesses to visualize and analyse relevant business related data on maps to identify location-based insights.

Enterprises and businesses are increasingly using data to drive decision making. Big data and data analytics tools, which including BI software, is being used to help enterprises make sense of internal and external data. Strategy Analytics' [Mobile Work Force Strategies service](#) predicts SaaS (Software-as-a-Service) based business intelligence



solutions across small and medium businesses (SMBs) and corporates will grow almost [54% from \\$2.6 Billion worldwide at the end of 2018 to \\$4 Billion by 2022](#). The major providers of BI tools include Alteryx, IBM Cognos, Microsoft Power BI, Microstrategy, and Tableau. Both Alteryx and Tableau report strong growth in revenue during 2018, reflecting growing demand for BI tools in the sector.

- **Alteryx:** posted a 55% increase in sales during the first three quarters of 2018 to reach \$143.8 Million.
- **Tableau:** revenue for the first three quarters of 2018 is up 45% on the same period in 2017, putting it on track to exceed \$1.27 Billion during 2018. Tableau reports it has 70,000 customer accounts.

Maps and location relevant information helps to support a broad number of businesses intelligence use-cases. Examples of this include location analytics where location data can be used by venue owners to track footfall within stores and identify areas of high or low footfall, as well as to determine the ideal location of in-store displays and higher-value products. At a broader level location heat maps based on cell-tower traces can (and is) being used to determine the best location for businesses, such as supermarkets.

3.3 Mobile Apps & Services

Rising number of consumers with GPS equipped handsets combined with a growing base of mobile data users and an increasing number of users downloading apps from app-stores will boost the total addressable market of mobile LBS services over the next 5 years.

- **GPS handsets:** Annual sales of GPS enabled handsets, which support accurate geolocation, is set to rise from just above [1.58 Billion at the end of 2018 to just over 2 Billion by the end of 2023](#), according to Strategy Analytics' Emerging Device Technologies service.
- **App-store users:** Strategy Analytics estimates the population of users accessing app-stores to download apps and games will rise from just below [2.9 Billion at the end of 2018 to over 3.6 Billion at the end of 2023](#), thus increasing the addressable market of users able to download location-based applications.
- **Mobile data users:** Apps and services which rely on location based services served in real-time are dependent on mobile data connectivity when they are out and about. The number of mobile data users is set to approach 4.53 Billion by 2023. Furthermore, a number of mobile operators are offering zero-rated tariffs specifically targeted at users that depend on navigation and location-based services.
 - For example, in December 2018 Russian operator Megafon launched a tariff option called “On The Way” which provides unlimited traffic for specific apps travel apps.

3.4 The Mobility Industry

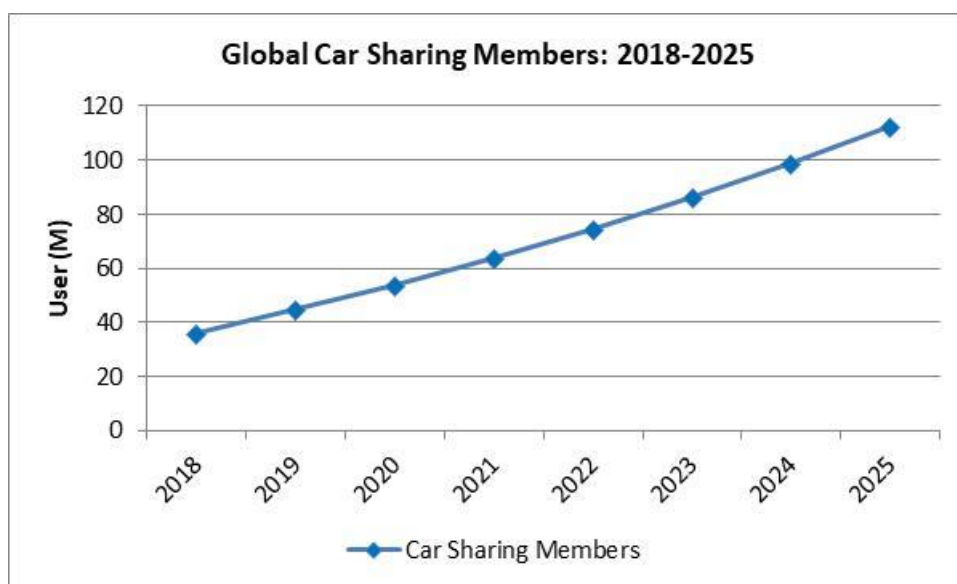
The mobility sector is amorphous, and covers a large number of on-demand use cases, including ride hailing, car sharing, micro-mobility, autonomous shuttles, and more. Location services delivered via smartphone apps often lie at the heart of many of these services, whether that is in the form of a digital map to enable passengers to locate



the nearest car sharing vehicle, or routing and navigation to assist drivers of taxi-hailing services, or a dispatch solution for taxi fleets.

Research from Strategy Analytics' [Connected Mobility](#) service highlights growth in the numbers of car sharing members over the next 7 years, Exhibit 4. Strategy Analytics' [Connected Mobility](#) research provides a deep dive into the market for mobility services. As discussed in [section 3.3](#) the growing use of smartphone centric mobility applications is being enabled by the rising adoption of smartphones and increasing access to large bundles of 3G and 4G mobile data, particularly in emerging mobile data markets.

[Exhibit 4 Global Car Sharing Member Growth: 2018-2025](#)



[Source: Strategy Analytics, Connected Mobility](#)

Strong consumer demand for on-demand ride hailing apps, such as Uber and Lyft, has created a need for traditional taxis-fleets to close the technology gap and offer similar consumer experiences. This includes providing apps to consumers for tracking taxis and ETA among others. Both Google and HERE have created specific solutions to address demand for location services from companies operating in the mobility-sector.

- **May 2018:** Google announced tailored solutions for ridesharing companies to enable them to embed Google Maps navigation into their applications.
- **Jan 2018:** HERE launched a new business unit called HERE Mobility to focus on providing solutions for the mobility sector. It also launched Open Mobility Marketplace to connect supply and demand for mobility services, in addition to Mobility Dispatch, a solution providing real-time fleet management.



- **March 2017:** HERE launched a set of location tools to enable developers of on-demand applications (e.g. ride-hailing, carpooling, food and package delivery, etc.) to embed location capabilities into their apps. Ride hailing platform, Grab, peer-to-peer ride sharing app, Volt, and Localift, an Australian friend-to-friend ride-sharing application, use a variety of HERE's location services.

Food delivery app DoorDash leverages Mapbox's directions API, optimization API (to handle multi-destination routing), and its real-time traffic capability. Lyft and Scoot are also Mapbox customers. Ride-hailing firm Lyft selected Google Maps to support its app (Lyft Navigation) for drivers.

3.5 Location-Based Advertising & Marketing

The use of geolocation data in advertising was covered in [section 4.3 of our previous report on location platforms](#). Location continues to underpin growth of the [\\$330 Billion global digital advertising](#) opportunity in three main ways:

- **Audience segmentation:** Correlating the geolocation of mobile device IDs (anonymously) against a database of places (and their boundaries) provides audience insights that underpin ad targeting. The places that people visit, along with other contextual information such as time of day (and inferred home and work locations) can assist digital marketers to build anonymised profiles and personas to support targeted advertising.
- **Digital advertising attribution:** Accurate user location information allows advertisers to measure the extent to which digital advertising drives in-store visits. Google has been measuring store visits (anonymously) since 2014 and is using this information to demonstrate the uplift in store traffic as a consequence of digital advertising campaigns.
- **Location and proximity ad-targeting:** The direct use of location to target users with messages based on their location or proximity to specific physical locations using geo-fencing. For example, Google AdWords enables advertisers to program their bids for searches on keyword searches conducted within advertiser defined locations. Equally, local business can leverage user location to prevent them from advertising to potential customers located in different towns or cities.

The combination of Google's leadership in keyword search advertising and the popularity of Google Maps and Android have translated strongly into location-based advertising and marketing. Google's primary business is auctioning prime advertising space displayed next to keyword searches conducted by consumers. The highest bidding advertiser is able to show their advert directly above organic search results. As Google has become an important consumer channel the more successful it has become at attracting advertising spend and encouraging business owners to supply Google with verified information about their businesses. E.g. store location, opening and closing hours and parking information among other information.

In July 2018 HERE announced a partnership with Locomizer, which builds audience profiles and segments based on an understanding of the places users visit regularly. Locomizer is using HERE's Places and 2D Footprints in order to identify buildings and locations. As highlighted by "audience segmentation" above, the ability to accurately identify buildings which consumers frequent lies at the very heart of Locomizer's audience segmentation strategy. Likewise, adsquare, a mobile data exchange for advertisers, uses HERE's Places Extract for similar purposes.



4. Location Platform Benchmarking

4.1 Benchmarking Update & Result Summary

In this iteration of the annual location report Strategy Analytics has revised its benchmark criteria to highlight the relative strengths and weaknesses of Google, HERE, Mapbox and TomTom across eight critical categories that are relevant for users of location services.

Strategy Analytics' has revised the categories being used to evaluate the location platforms to include map making, map freshness, POI search, developer community, automotive, map and data visualization, openness and flexibility, and growth and leadership:

- **Map making:** For use-cases and companies where it is essential for close to zero vulnerability from erroneous third-party map data, companies which are involved end-to-end with the map-making process are considered more reliable and safe. In the automotive industry where driver safety is paramount location platforms that build and validate maps by applying a combination of tools including industrial capture, satellite imagery, probe data and trusted third-parties have provided high levels of assurance. Companies deploying a broad range of map making techniques, with large country coverage and detail will score highly in this section.
- **Map freshness:** Providing fresh and up-to-date maps and map content is increasingly critical in this era of “on-demand” services. Furthermore, as the automotive industry evolves towards semi and fully autonomous vehicles the need to deliver machine maps with centimetre precision in real-time becomes critical for safety. Location platforms which have the capability to deliver updated and live maps to customers in as close to real-time as possible will score highly in this category.
- **Search and Point-of-Interest:** One of the key location services is the ability to search for local businesses, buildings and attractions with high levels of real-time accuracy. Therefore, the size, freshness and accuracy of the database of places provided by location platforms are key metrics. Higher scores in this section are awarded based on a combination of the size of place database, how frequently it is updated, its granularity and ability to customize results for specific use-cases.
- **Developer community:** The location-sector is in the process of evolving from a model where historically enterprises and businesses licensed the map content and services, to a model where they can access map tiles and other location capabilities (geocoding, routing, place search, traffic data and more) through application programming interfaces (APIs). A high score in this section is awarded to platforms that have captured a large share of developers of all types, and that provide a broad range of tools for developers.
- **Automotive:** The automotive sector remains a critical source of revenue and demand for the location sector, and therefore the ability to service both current and emerging needs of vehicle makers cannot be ignored. In this category we award higher scores to companies which have announced deals and partnerships to supply key players in the automotive space with location solutions.



- **Map and data visualization:** The need to provide customized map views and visualization of location data is likely to vary significantly according to both use-case and company. Some companies may want to provide a highly customized type of map to suit a specific use-case, or to toggle between different visualization options for a specific dataset. In contrast, for other companies it will be less important to customize either map or data visualization. Companies offering the broadest and most customizable set of data visualization solutions will score highly in this segment.
- **Openness and flexibility:** Providing an open and flexible location platform means enabling companies to layer in their own location data onto the map, or to pick and choose which location services to use from different providers. Also, some companies may want to customize certain features and capabilities, e.g. a retailer filtering the location of its own stores in the results of a search query, or customizing some code or an open API request.
- **Industry growth and leadership:** As highlighted in [section 3](#) of the report the opportunities for growth in the location sector will come from supporting [autonomous vehicles](#), the [on-demand mobility sector](#), and a rising demand for location intelligence with respect to [asset tracking, fleet management, and IoT as businesses embrace big data](#). Companies which communicate strong growth ambitions across some of these key location sectors, either directly or through partnerships will score the highest marks.

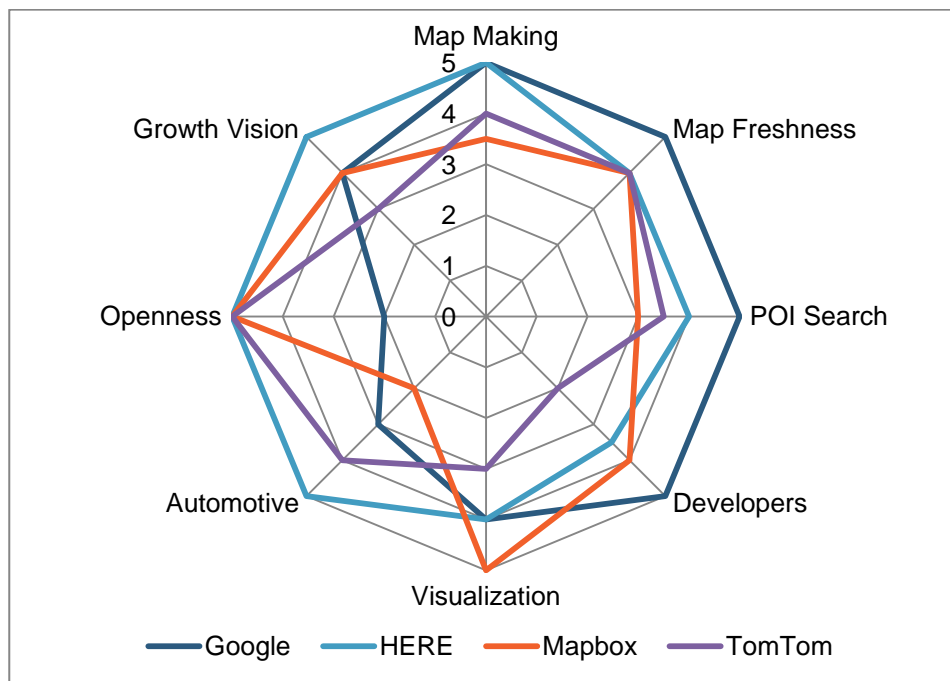
4.2 Benchmarking Category Results

Competition across each category remains fierce between platforms Google, HERE, Mapbox and TomTom. The importance of different capabilities and strengths varies based on use-case, sector and individual company requirements with both Google and HERE standing out.

- Google is a leader in POI search, map freshness, and developer community, and a joint leader in map making. It is making progress in automotive, but its closed approach to competition in listings, directories, advertising, navigation, and sharing user data remains a weakness for businesses and developers seeking openness and flexibility. Google's recent change in location service pricing will leave it vulnerable as HERE, Mapbox and TomTom aim to attract disaffected Google Map developers looking for alternatives.
- HERE is a leader in map making and automotive, has an aggressive and leading vision for the growth of the location sector, and is both independent and open. HERE has strong roots in supplying location content and tools to automotive companies and large enterprises, and continues to close the gap in POI search, visualization and the long tail portion of the developer community. HERE's efforts in aggregating vehicle sensor data across car makers, its new products OLP and mobility marketplace, and the launch of location data platform, XYZ Studio, are examples of HERE's vision for leadership in future growth areas.
- Mapbox is a leader in visualization and comes in joint second place in map freshness and openness. Mapbox's location services are being used by some large consumer app providers. Mapbox is developer friendly, coming second to Google based on the size of its developer community, but is also open, independent and flexible. Mapbox's reliance on OSM is perceived a weakness for enterprises and industries where the consistency and provenance of map data is considered essential, though this has not prevented Mapbox from gaining traction with businesses across a broad range of sectors.

- TomTom’s is almost on par with Google and HERE for its map making. TomTom has achieved a high score for openness and flexibility, enabling developers to mix and match location and data sources. TomTom is playing catch-up in its attempts to target developers, though its location services are directly available to Azure developers using Azure’s locations services. TomTom has also scored some recent wins with providers of consumer services such as Trivago and Zenly as it focuses growth in enterprise.

Exhibit 5 Summary of Location Platform Benchmark Scores



| | Google | HERE | Mapbox | TomTom |
|---------------|--------|------|--------|--------|
| Map Making | 5 | 5 | 3.5 | 4 |
| Map Freshness | 5 | 4 | 4 | 4 |
| POI Search | 5 | 4 | 3 | 3.5 |
| Developers | 5 | 3.5 | 4 | 2 |
| Automotive | 3 | 5 | 2 | 4 |
| Visualization | 4 | 4 | 5 | 3 |
| Openness | 2 | 5 | 5 | 5 |
| Growth Vision | 4 | 5 | 4 | 3 |

Source: Strategy Analytics

4.2.1 Map Making

Strategy Analytics believes map making leadership requires a combination of complimentary approaches which deliver maps that are accurate, detailed, offer high levels of coverage, and are validated, particularly as digital map requirements evolve towards high-definition and real-time updates at scale.



Each approach to map making has its strengths and weaknesses, as highlighted in Exhibit 6. For example, surveys conducted by mapping vans are able to capture detailed and granular information, but are resource intensive and do not provide a practical or efficient approach to keeping maps fresh and up-to-date. GPS probe data is excellent at detecting changes in the real-world on a near real-time basis, e.g. speed limit changes, turn restrictions, etc. However, probe data is unable to detect new street names or changes to names of places. Crowdsourced map edits provide a very low cost approach to keeping a map updated at scale, but the quality of the edits and consistency of coverage can both vary, while malicious edits remain an inherent risk.

Exhibit 6 Advantages and Disadvantages of Mapping Techniques

| Method | Advantages | Disadvantages |
|--------------------------------|---|--|
| Field Surveys/ mapping vans | <ul style="list-style-type: none"> Highly detailed Reliable | <ul style="list-style-type: none"> Resource intensive/ expensive Inefficient to update frequently |
| Imagery (satellite and aerial) | <ul style="list-style-type: none"> Effective | <ul style="list-style-type: none"> Expensive to update frequently Less detailed than surveys |
| GPS probe data | <ul style="list-style-type: none"> Continuous change detection Scalable | <ul style="list-style-type: none"> Lacks detail (on its own) |
| Crowdsourced | <ul style="list-style-type: none"> Low cost Scalable | <ul style="list-style-type: none"> Lacks consistency Variable quality Open to malicious edits |
| Expert community | <ul style="list-style-type: none"> Reliable and trusted map edits | <ul style="list-style-type: none"> Not as low cost as crowd sourcing Limited coverage |
| Third-party data | <ul style="list-style-type: none"> Leverage authoritative sources Fill obvious gaps | <ul style="list-style-type: none"> Variable levels of quality available Updates reliant on partner |

We have awarded Google and HERE top marks in this category. Both companies deploy a combination of industrial capture, expert community, and probe data techniques to build high quality, validated maps to support a large range of consumer and industrial use-cases, including autonomous driving, at scale.

| | Google | HERE | Mapbox | TomTom |
|-------------------|--------|------|--------|--------|
| Map Making | 5 | 5 | 3.5 | 4 |

Location platforms Google, HERE, and TomTom invest significantly in a variety of techniques, including industrial map capture, satellite imagery, authoritative data sources, and probe data, to maintain and improve map quality. Google does not publicly disclose details of its map making and maintenance process but does deploy mapping vehicles and leverages probe data from its community of Google Map and Waze users. Furthermore, Google’s base map partner program is designed to enable organizations (governments, local authorities, educational institutions, etc.) which have access to authoritative data sources to license their map content to Google. Google states it typically does not pay organizations for this content. HERE claims it deploys over 400 data collection vehicles on the roads, leans on over 50 expert GIS teams, and uses over 80,000 data sources and suppliers e.g. governments, local authorities, etc. to update its maps. TomTom has around 100 of its own mapping vehicles and in some countries uses partner vans for field collection. Like Google and HERE it licenses data from authoritative sources, and also relies on probe data from Apple iPhones to assist with change detection.



Mapbox uses OpenStreetMap (OSM) as its foundation, as part of 130 separate data sources, including data from satellite and street level imagery, authoritative sources e.g. governments and expert communities, and community inputs. With this approach Mapbox uses what it calls a “double validation monitoring system” to ensure malicious or erroneous edits are prevented from appearing on its maps. Mapbox claims an artificial intelligence (AI) system flags up over 70,000 map changes daily for human review, and that many of its core map layers are not easily edited. To maintain the map Mapbox relies heavily on anonymous GPS probe data collected via partner apps to detect map changes on a near live-basis e.g. where new turn restrictions have been implemented or when a new road has been added to a street network.

Strategy Analytics believes that Mapbox’s reliance on OpenStreetMap (OSM) is considered a relative weakness for enterprises and use-cases that demand consistent quality control, provenance, security and high levels of assurance that map data has not been compromised. With 1 Million monthly contributors OSM’s map detail can be very accurate and granular in certain geographies, but at the same time, lacking in others. Although Mapbox (along with other organizations) contribute to OSM, edits to OSM by the long tail of contributors are not always reviewed for errors. This inevitably introduces inconsistency in the quality of edits. The vandalism of digital maps is a clear risk for location platforms which depend on community input, as highlighted when Mapbox’s map of New York was defaced in August 2018. Mapbox claims this malicious edit was flagged up by its checking system (described above), but that it was published because of human error. Mapbox has placed further safeguards to mitigate the risk caused by malicious edits. It’s worth noting that Google decided to close down Google Map Maker (its community map editing platform) following a lengthy review which was initiated by several similar abuses of Google Maps.

It should be noted that well-known consumer apps with large active user bases in the hundreds of millions, including Snapchat, Tinder, Weather Channel, DoorDash, and others are embracing Mapbox’s location services. Therefore, it’s clear that Mapbox’s OSM foundation is not a barrier for a range of businesses and use-cases reliant on 2D maps. As a consequence of Mapbox’s approach it does not directly invest in industrial map making, and consequently operates on a lower cost base to competitors.

HD Mapping

For high definition (HD) maps that provide centimetre level precision and granular details, including the position and details of road markings, lanes, sign-posts, and traffic lights, probe and community approaches are insufficient on their own. Mapbox Drive has been created to support semi-autonomous driving (Level 2 and Level 3) and offers lane guidance. Mapbox launched its Vision SDK, to enable cameras (on smartphones or vehicles) to identify and capture vital road information on a continuous basis at scale. In the same way that Mapbox is able to extract anonymous GPS probe data from apps which use its SDK, Vision SDK will enable Mapbox to crowdsource road information to collect and maintain a higher definition version of its current map. Mapbox has not released details relating to its HD coverage at this point in time, but has created new HD Vector Map specifications and partnered with Intel’s Mobileye to deliver Mobileye’s RoadBook (lane level maps) from cloud to car using the specification.

Both HERE and TomTom are collecting HD road information using their own mapping vehicles. HERE is also crowdsourcing sensor data from 400,000 vehicles in order to keep its map HD Map up-to-date on a continuous basis, though HERE needs to scale to additional OEMs and partners to increase its effectiveness. HERE claims to be on target to have mapped over 1 Million KM globally by the end of 2018. TomTom has mapped 380,000 KM of

road so far and is not leveraging crowd-sourcing capabilities, nor implemented any real-time updates or map learning capabilities. Google is not offering HD maps, but is keeping these in house for its Waymo self-driving project. Waymo is currently limited to the US. For a deep dive into the HD Mapping sector please see the [report “HD Maps and Positioning for Autonomous Driving.”](#)

Map Coverage

Our rating for map making also considers map coverage. Each provider claims to offer global coverage. However notably, TomTom lacks coverage in both China and Japan. Google services are banned in China and therefore Google Maps is unable to participate in map making there. In contrast, HERE’s partnership with Navinfo in China and Pioneer in Japan, enables HERE to provide customers with access to both markets. Mapbox also covers China through partnership with eMapgo Technologies, which claims to be one of the top three mapping companies in China. Overall, Mapbox offers real-time traffic based navigation in over 40 countries today, while the other companies provide navigable maps in more markets.

In next generation maps which are essential for autonomous driving, HERE is part of the “One Map Alliance,” with Pioneer (Increment-P), Navinfo and SK Telecom, will enable high definition maps that align with HERE’s HD Live map specification will be available in Japan, China and South Korea.

Map making also extends to indoor environments and large public venues as consumers increasingly expect the outdoor navigation experience to be available everywhere. Google claims to have indoor maps available for over 10,000 locations worldwide, while HERE claims over 25,000 venues across 80 countries. Furthermore, HERE’s Venues Marketplace provides a single point for venue owners to provide their floorplans for publishing across different sources. In contrast Mapbox relies on partnerships for indoor maps, and TomTom currently does not offer indoor maps.

4.2.2 Map Freshness

Each location platform updates map content incrementally on an ongoing basis and leans on probe data as one source of change detection. While, Google and Mapbox typically publish these changes in real-time, HERE and TomTom update on a weekly cadence to validate and meet the requirements of its customers.

| | Google | HERE | Mapbox | TomTom |
|----------------------|--------|------|--------|--------|
| Map Freshness | 5 | 4 | 4 | 4 |

Out-of-date maps and POIs have long been a pain point for drivers using vehicle embedded navigation systems, with added frustration caused by expensive annual updates. In contrast, live location platforms like Google Maps and Mapbox update their maps incrementally on a continuous basis, which is shaping consumer expectation of their mapping experience across platforms and drives the preference for online services vis-à-vis embedded.

Both Google and Mapbox offer live location data on their platform, where maps are updated as soon as changes are detected and validated using AI techniques. In contrast, while both HERE and TomTom make map updates



using similar techniques, they make the refreshed data available on a weekly cadence to validate and meet customer requirements.

Weekly refresh rates have not been a barrier to either HERE or TomTom from supporting some major consumer-facing companies. HERE's customers include Amazon, Baidu (outside China), Bing Maps, Facebook (for online maps), and Tencent (outside China), among others. TomTom has also scored recent wins with Trivago and Zenly.

Probe Data

As discussed in [section 4.2.1](#), modern map maintenance and healing uses statistical analysis of large volumes of GPS probe and sensor data from smartphones, and fleets of GPS-equipped vehicles. GPS probe data is used to detect changes in the real-world. Detected changes are cross-referenced with other types of map data, for example satellite imagery, mapping vehicle survey data, or data from trusted partners, before the updated map is made available to location platform users. The larger the number of active GPS probes providing data the more rapidly and greater the probability changes will be detected:

- **Google:** With over 1 Billion users of Google Maps on their phones, Google has the largest number of consumer probes of all its location platform competitors. Google states that it updates its map 25 Million times each day.
- **HERE:** States it collects 4.9 Billion probe points daily, generated from millions of vehicles globally. In addition sensor data from over 400,000 vehicles, such as cameras to support road sign validation service, and breaking sensors to detect hard braking, supplement this data. Many changes are validated and released to customers on a weekly basis.
- **TomTom:** In August 2018 TomTom indicated it uses GPS probe data from 550 Million connected devices. TomTom states it makes 1.5 Billion changes to its digital maps per month. These include changes to road geometry, road features, altered junctions, new POIs or addresses using a combination of GPS probe data, community input from hundreds of Millions of map users, local map technicians and mobile mapping vehicles. However, while the average number of changes is double that of Google these updates are made available to customers on weekly basis.
- **Mapbox:** Mapbox anonymously collects location probe data from over 420 Million monthly active app users which use the apps of Mapbox's customer base. GPS location from these smartphone app users is essential to Mapbox's ability to provide live location services. Mapbox will supplement GPS traces with data streamed via its Vision SDK, which uses AI to identify road features in real-time without data connectivity.

However, while probe-based data can be used effectively for change detection and traffic flow patterns, additional techniques are necessary for a comprehensive update of maps across a large number of attributes and to meet all use-cases, including HD maps. Furthermore, without truly ubiquitous scale probe-data is not guaranteed to reach all areas, and therefore some parts of the map may take longer to get updated than others. Consequently, complimentary methods of maintaining map freshness remain essential for consistency and validation. Relationships with public authorities and providers of authoritative data can provide early warnings in changes to the road and traffic network.



In the automotive sector the precise maps required for automated driving need to be updated on a real-time basis, which is pushing both HERE and TomTom to deliver real-time map updates for customers and use-cases that demand live maps. HERE claims to publish 75% of its map data daily, and is preparing for even faster refresh rates to support autonomous vehicles. HERE's HD Live Map has been selected by both BMW and Daimler, two of its shareholders, to support their autonomous vehicles.

4.2.3 POI and Search

Google remains a leader in POI and search, covering 150 Million places across 200 countries. Google provides a superior level of granular information in its business listings. HERE, Mapbox and TomTom are aiming to catch-up by growing the number of place points, with Mapbox partnering with Foursquare.

| | Google | HERE | Mapbox | TomTom |
|-------------------|--------|------|--------|--------|
| POI Search | 5 | 4 | 3 | 3.5 |

In our previous reports we've based scores for POI and search on the number of POIs offered. However, as end-users increasingly expect accurate, granular and real-time information from searches we are taking into consideration how frequently the POI information is updated and made available to users of the platform.

Google remains a leader in POI and search covering 150 Million places across 200 countries. Google provides a granular level of information for its business listings, including opening times, parking availability, place reviews, restroom facilities, and more. Google claims to have more than 50 Million local guides which are users of Google Maps that contribute by answering questions about the places they have visited. It validates responses based on a threshold number of consistent answers provided by guides before publishing the information. Google's strength in local search advertising is highlighted in [section 3.5 of this report](#). A significant downside to Google POI search is that Google does not allow customization of search results, which limits its Google POI for specific use-cases.

HERE offers 126 Million places in its database a 47% increase on 85 Million places from last year. HERE believes it has significantly improved the value of its places offering through the launch of new data architecture in 2018, called Places Footprints. Place Footprints connects a place to the building that it is located in (through the building footprint) and links it to the address information (address and point address). HERE acknowledges it does not provide the type of detailed and granular metadata about venues which Google can provide; though is planning to add this level of granularity in 2019.

Mapbox relies on a combination of OSM place data and a recently announced partnership with Foursquare to provide 105 Million place addresses. Mapbox claims it supports 2 Billion search requests per week, and that its POI data is available as soon as it passes it is validated against secondary sources.

TomTom currently provides 120 Million point of interest globally, which are updated depending on how the method of acquisition e.g. from third-party data sources versus crowdsourcing. Crowdsourced POIs are added once they have passed quality checks while paid sources will provide updates on a weekly or monthly basis. TomTom claims its search results can be customized to meet customer requirements e.g. a retailer only displaying its stores on a map.



4.2.4 Developer Community

Google remains the 1000 pound gorilla in the developer location sector, although HERE, Mapbox and TomTom have accelerated their efforts to close the gap by attracting both enterprise and long-tail developers through partnerships with major cloud vendors and more aggressive pricing, respectively.

| | Google | HERE | Mapbox | TomTom |
|-------------------|--------|------|--------|--------|
| Developers | 5 | 3.5 | 4 | 2 |

Google has been a leading location platform for developers for some time. We estimate Google has multiple Millions of developers that use its map APIs - Google has stated it sees over “3 million location-informed apps and websites generating billions of requests daily, all powered by Google Maps API.” Google states it expects “most” Google Map developers to have monthly usage that will keep them in its free pricing tier, which it announced in May 2018. Therefore, Strategy Analytics believes most of these developers are likely to be long tail developers e.g. with low volume requirements, e.g. a local business embedding a static map into their mobile app or webpage. During this year Google has moved to extend the reach of its location APIs in the gaming. In March 2018 it announced Google Maps APIs are available to developers using Unity game engine, which is a popular developer platform among game developers, following the lead of Mapbox which announced a similar deal in February 2017.

Mapbox has its roots in providing developers with access to location services and location visualization tools. Overall, Mapbox claims to have 1.2 Million registered developers to its platform, of which more than 110,000 actively use its location services on a monthly basis. Mapbox claims over 600 enterprises leverage its developer tools. Mapbox has also made its location services available to developers of the Unity games platform, to enable developers to support location-based games.

HERE also claims the number of developers using its platform, both directly and indirectly in the “six-figures range,” and is aggressively targeting growth in the number of enterprise and long-tail developers that use its services. Historically, HERE has focused on licensing its platform to larger higher value enterprise opportunities. However, in October 2018 HERE introduced XYZ Studio in beta mode, to target a broad range of developers including students, small and medium businesses, data journalists and cartographers seeking to integrate map visuals into projects. XYZ will enable HERE to compete more directly with Mapbox, by providing a real-time map platform to meet users with less location intensive needs, such as those highlighted above.

TomTom acknowledges it is lagging Google significantly as a developer platform for location services, but is increasing its focus on acquiring B2B and enterprise developers. Although TomTom has not disclosed the size of its developer community it has stated the number of developers using its APIs and SDKs is in the tens of thousands range. TomTom has announced a number of enterprise customers, including hotel search company, Trivago, consumer social mapping company, Zenly, and business intelligence platform, Alteryx, among others, as evidence of growing traction of its enterprise business.

Both HERE and TomTom are aiming to close the gap on Google by making their developer tools available to the large cloud service providers like Amazon’s AWS and Microsoft’s Azure. In November 2017, Microsoft announced



TomTom as the supplier of location services for Azure Location Based Services, which means TomTom APIs will power the location services Microsoft offers through Azure. However, Microsoft's Bing Maps and Bing Enterprise continue to use HERE Location Services. HERE's location services are available to developers using Amazon's Web Services (AWS) via marketplace, and in January 2018 HERE rehashed and updated its service availability to include its entire HERE Location Suite in both AWS Serverless Repository and AWS Marketplace. In November 2018 HERE announced its Open Location Platform is available in the SAP API Business hub, which powers the SAP HANA cloud ecosystem with over 400,000 enterprises. HERE claims its location services are available to the 2 Million developers use AWS, and [2.5 Million across SAP, AWS and Baidu platforms](#), though clearly only a subset of these developers will be using HERE services. Nevertheless, these types of partnerships enable both HERE and TomTom to make their location APIs available more easily for developers to access.

Changes to Google Maps developer pricing (structure and levels) has created an opportunity for HERE, Mapbox and TomTom because some developers view Google Maps pricing change as unfavourable and are seeking alternative digital map platforms.

The change to pricing has provided developers which use Google maps with an opportunity to evaluate alternatives. Google mandates all Google Map developers register their credit card information. Despite Google claiming that the changes will not negatively impact most of its developers, Strategy Analytics has noted its new pricing model has made it difficult for developers to estimate their total cost and is upsetting many in the developer community. Therefore, these developers are looking for alternative location partners. Both HERE and TomTom have responded by altering their pricing to undercut Google:

- **Aug 2018:** HERE announced the availability of a freemium plan to attract the long-tail developer community and encourage developers to use its location APIs. Developers of public, private, paid and free applications and websites are able to make up to 250,000 monthly location API calls for free – as long as they have no more than 5,000 active monthly users of the SDK, or more than 250 managed assets per month where an asset tracking use-case is deployed. Beyond the 250,000 monthly transaction limit developers are charged \$1 per 1000 transactions on a pay-as-you go model.
- **Sept 2018:** TomTom announced its new developer plan to offer developers free maps and traffic tiles via its mobile SDK for both Android and iOS. It offers 2,500 free transactions per day (75,000) for other APIs. TomTom is clearly targeting Google Map developers by providing guides to assist developers making the switch from Google to TomTom. After the 2,500 daily free transaction limit is reached TomTom charges developers on a tiered volume basis, though developers need to pay for credits in advance.

To lower the barrier to attracting developers to use and test their location platforms, both HERE and TomTom have also removed the requirement for users to register credit card details.

Mapbox hasn't altered its pricing, and provides users with a pay-as-you-go model for using its (maps, geocoding, and directions) APIs. Mapbox provides a freemium tier, with the first 50,000 requests (SDKs and web) per month available for free. Mapbox charges \$0.50 per 1000 requests thereafter for mobile SDKs and for the web. Mapbox provides custom pricing for enterprise use-cases.



Each of the platforms provides APIs to meet the most common 'horizontal' location services which are relevant across industries, e.g. map tiles, routing, and geocoding, reverse geocoding, and search. However, HERE enables developers to support location services such as maps, search and navigation in hybrid mode where there is no internet connectivity. Mapbox enables enterprise developers to have access to location services without direct access to Mapbox servers via its Atlas tool. At this point in time Mapbox is the only vendor enabling developers to deploy AR-based, AI-enabled navigation experiences via its Vision SDK.

The location platforms also provide solutions targeted to the needs of specific industry verticals. For example, Google and HERE offers APIs and location services targeting mobility providers, Google and Mapbox have extended access to their location services to game developers via the Unity platform.

4.2.5 Map and Data Visualization

Mapbox is a leader in location data visualization tools. Mapbox Studio enables developers to customize individual map layers and provides developers with access to visualization tools such as Kepler.gl. HERE is aiming to close the gap with Mapbox Studio through XYZ, HERE's new location data management platform.

| | Google | HERE | Mapbox | TomTom |
|---------------|--------|------|--------|--------|
| Visualization | 4 | 4 | 5 | 3 |

Mapbox Studio has been used to create strongly differentiated and custom maps within a number of applications, including Snapchat's social map. Furthermore, Mapbox has achieved impressive adoption by business intelligence (BI) platforms, including Alteryx, IBM Cognos, Microsoft Power BI, Microstrategy, Tableau, and Uber Kepler GL. Mapbox has raised the bar for data visualization and map customization for developers. On the AR side Mapbox has deployed AR solutions in React Native and Mapbox announced it is partnering with Uber to bring those visualization capabilities to Mapbox developers.

However, HERE has responded by launching XYZ, a location data management platform, to target students, small and medium businesses, data journalists and cartographers. From a visualization perspective XYZ provides its own map data rendering solution, but also allows location data stored in the XYZ cloud to be viewed using tools such as Leaflet, Tangram, Three.js and Mapbox. In an October blog, Steve Coast, the founder of OSM, has gone as far as suggesting that XYZ has potential to usher in the era of Maps 3.0, enabling location data use and visualization for non-developers.

Overall, beyond the customized options, the map visualization options supported by the developer platforms are broadly similar. Typical map types include 2D street map views, terrain, satellite imagery, and hybrid views, as highlighted in Exhibit 7. Google's Street View maps are a differentiator, although HERE's partnership with Mapillary is aimed at providing similar capabilities. Mapbox's Vision SDK enables developers to integrate Augmented Reality (AR) into navigation-based applications.

Developers can further modify the appearance of these map types by applying different styles, overlaying different markers, for example changing fonts, the colour of boundaries, etc. Google Map's offers four basic map types



(roadmap, satellite, hybrid, and terrain) which can be modified using layers and styles, controls and events. Google offers a map styling wizard and the ability to control the prominence of roads, landmarks and labels. Mapbox provides some more off-the-shelf variants of its standard 2D Map, offering a light and dark mode. TomTom currently provides developers with the fewest visualization options via its map APIs and SDK. These options include day, night, and labels only. However, its vector map tiles can be customized for colour, fonts and labels.

Exhibit 7 Map Visualization Options Provided

| Visualization | Google | HERE | Mapbox | TomTom |
|-------------------|--------|------|--------|--------|
| Road Map | ✓ | ✓ | ✓ | ✓ |
| Terrain | ✓ | ✓ | ✓ | |
| Satellite | ✓ | ✓ | ✓ | ✓ |
| Hybrid | ✓ | ✓ | ✓ | ✓ |
| Street view | ✓ | | | |
| Augmented Reality | | ✓ | ✓ | |

4.2.6 Automotive Location Services

Technology and changes in consumer behaviour is influencing how vehicle makers deliver location-based services, such as turn-by-turn navigation and point-of-information (POI) search in vehicles. Smartphone mirroring solutions Android Auto and Apple CarPlay are gaining traction and popularity among consumers.

The [popularity of consumer smartphone apps such as Google Maps and Uber](#), among others, means consumers want access to innovative services in their car. On-board map updates are typically offered on an annual basis at a premium by car dealerships. These updates are usually already out-of-date by the time the user receives them. In contrast, smartphone map and navigation apps provide up-to-date navigation experiences, over-the-air and in real-time to consumers for free – albeit via a small smartphone screen. Therefore, it’s not surprising that initiatives which bridge the divide, such as Google’s Android Auto and Apple’s CarPlay, are popular with drivers. These solutions deliver a superior experience by providing navigation services users have an affinity for via the user friendly framework of the car infotainment system. Consumer research from our [In-Vehicle UX](#) service shows [rising interest in these smartphone mirroring systems](#). Therefore, both CarPlay and Android Auto compete with OEM embedded location services within the car.

From a strategic perspective, car makers face losing the ability to control the in-car experience, in much the same way that (beyond design and hardware) there is little differentiation in experience between different Android smartphones from different OEMs. Furthermore, OEMs are also losing potential access to first-party driver data, which can be used by OEMs to understand their customers, and to deliver personalized services and offers based on this understanding.

HERE is a leader in automotive, followed by TomTom. Both remain committed to providing innovative and differentiated solutions to enable vehicle makers to meet strategic objectives. Google’s deal to supply Volvo, Renault, Mitsubishi, and Nissan are a first win, with Mapbox also making some headway.



| | Google | HERE | Mapbox | TomTom |
|------------|--------|------|--------|--------|
| Automotive | 3 | 5 | 2 | 4 |

Both HERE and TomTom remain committed to enabling car makers to provide their own branded infotainment alternative to smartphone mirroring systems, which have a focus on safety and security ADAS (advanced driving assistance system). For example, HERE provides live connected vehicle services, including hazard warnings, live road sign information, and real-time traffic information based on a fleet of over 400,000 vehicles which share sensor data with HERE. Strategy Analytics believes that in order to compete with Google’s ecosystem advantage vehicle OEMs need to create their own ecosystem of infotainment apps that is able to rival the smartphone apps experience.

As long as car makers want to provide their own navigation and infotainment experiences there will be continued demand for location services from the automotive industry. Existing suppliers are well positioned but those which are able to support the evolving needs of car makers will be most successful.

HERE has historically had a strong position in the automotive industry through licensing its map and traffic data to car OEMs and vehicle infotainment makers, for use in their vehicle head units. HERE has also gained some notable success in moving up the value-chain in the luxury tier, with Jaguar embedding HERE’s HERE Auto guidance solution into both its XJ and XF flagship models. Audi integrated HERE Auto in the Audi A8, likewise Acura. These solutions enable drivers to plan their route via a mobile app and to access the same route via the vehicle head unit. HERE has announced the next iteration of HERE Auto, called HERE Navigation On-Demand, designed to enable car makers to provide a competitive alternative to Google’s navigation and car infotainment services via Android Auto. HERE claims all the OEMs have signed up to the initiative, and that integration with car sensors provides a differentiator to mirroring systems. Audi, BMW and Daimler each own a stake in HERE and they are all sharing vehicle sensor data to provide sensor-based real-time data solutions to the market. Strategy Analytics considers these kinds of service as significant service differentiators for HERE, although achieving further scale across a greater range of OEMs remains imperative.

HERE and TomTom’s dominance in supplying location services to car makers (e.g. navigation, traffic, and local search) is under threat as both Google and Mapbox target the evolving automotive sector for growth.

Notably, Google has scored its first major win with the car making alliance between Nissan- Renault-Mitsubishi. Volvo also announced it had selected the Android OS (and therefore Google Maps) to support its infotainment, at the expense of TomTom. These vehicle makers have confirmed they will ship cars with infotainment services built on Android. Nissan, Renault and Mitsubishi have effectively handed control of the in-car experience, and the end user, to Google. The integration of Android in the vehicle will be customized to meet the needs of car maker partners, but Google will most likely remain in control of data linked to the services it provides drivers, e.g. Google Maps, local search, and Google Assistant.

Mapbox has also scored wins with Rimac, with the Mapbox Navigation SDK for Qt and HD Vector Maps used to support maps and navigation on the C-Two autonomous-electric vehicle. Furthermore, Porsche and Subaru are using Mapbox’s location services to support location capabilities within their mobile apps. Mapbox’s visualization

and supporting customize user experiences are considered strengths, with Porsche and Mapbox collaborating on in-car-design experiences in December 2018. Unlike Google, Mapbox is an independent B2B2C location platform with ambition to support car makers address their strategic objectives rather than control the consumer relationship.

Meeting the needs of carmakers by providing secure and trusted, but also innovative and differentiated services which add value to the in-vehicle experience remains essential for all location service providers.

4.2.7 Openness and flexibility:

HERE, Mapbox and TomTom are open and provide developers with greater flexibility than Google. As a provider of its own services for end-users (e.g. search, advertising and navigation) Google restricts the use of its location services to use-cases where it does not compete.

| | Google | HERE | Mapbox | TomTom |
|------------------------------|--------|------|--------|--------|
| Openness/ flexibility | 2 | 5 | 5 | 5 |

TomTom makes its APIs available to any developer to use in conjunction with APIs from other services. The other platforms do not support the mixing of APIs. HERE claims flexibility and openness is at the heart of its Open Location Platform (OLP). The objective of OLP is to enable large enterprises to manage, analyze and productize large sets of location data. For example, OLP is being used to ingest and analyze sensor data from vehicles to provide enriched services such as HERE's Hazards and Road Signs products for automotive companies. HERE has also deployed HERE XYZ, a cloud-based location platform which enables developers to ingest, manage and visualize their location data, including via third-party map rendering tools, including Leaflet, Tangram, and Three.js, among others. HERE's primary restriction for its services relate to the provision of future autonomous use-cases for vehicles and drone navigation - developers are unable to use its developer tools for these use-cases.

Mapbox is an advocate of the open source framework, which it claims gives developers and designers the ability to choose between new, open and less expensive alternatives like Mapbox. Developers can leverage open source code into their apps. Examples include IBM incorporating the Mapbox-gl library into its Java Rave rendering engine that powers Watson Analytics. As an independent location platform Mapbox is not challenged by similar conflicts of interest as Google.

Google applies some notable restrictions on its location services, particularly to avoid potential rivals to its core business using its services. Notably, Google does not allow companies providing a listings service or a directory service to use Google Core Map services. Companies are unable to use Google Core Map to augment an existing ad product either. Similarly, Google does not allow developers to use its directions APIs, geo-location APIs, and maps SDK to create a real-time navigation product which provides functionality similar to its Google Maps for Android App. Furthermore, Google Core Map services cannot be used in applications which contain a non-Google map. For example, customers can not display its places listings on a non-Google map, or display street view imagery and non-Google maps in the same application.

4.2.8 Vision and Growth Leadership

HERE communicates a strong vision and innovation targeting different areas of the location sector, with its Open Location Platform, mobility marketplace and ad solutions. It is clear that Google and Mapbox are building their position in automotive, while TomTom is focused at driving its enterprise developer business.

| | Google | HERE | Mapbox | TomTom |
|----------------------|--------|------|--------|--------|
| Growth Vision | 4 | 5 | 4 | 3 |

HERE continues to demonstrate its strong vision for the future of location services as it launches initiatives such as its Open Location Platform (OLP) and its Mobility Marketplace. OLP is targeted at large enterprises across a variety of sectors as a private location cloud on which to ingest data, process and analyse it, and then productize it into a value-added data product. For example, OLP is used to aggregate sensor data from fleets for processing and converting into HERE’s Hazard service. HERE’s Mobility Marketplace is designed as a tool to enable airlines, hotels and other companies to offer their customers mobility options during the booking process.

Mapbox has grown the number of customers rapidly, and by announcing the Vision SDK has demonstrated leadership in innovation. The Vision SDK brings computer vision and machine learning together and it has announced similar plans to ingest and process sensor data to deliver location-enhanced insights. Strategy Analytics expects recently announced investment from Softbank to deliver benefits, directly and also indirectly.

From a position of strength in providing a range of location tools via its Google Maps platform, Google has started to make inroads into the automotive markets through deals with Volvo, and more recently the Nissan-Mitsubishi-Renault alliance to deploy cars based on Android Auto. Google’s company Waymo is focused on autonomous driving and has started a limited pilot of a self-driving pilot.

TomTom’s plan for growth is to focus in a laser like manner on growing demand for B2B cloud-based location services. TomTom will be spinning off its Telematics business, and is focusing on B2B opportunities as its focus on personal navigation devices (PNDs) declines and is sun set.

5. Strengths and Weaknesses

In the previous section Strategy Analytics highlighted specific capabilities on which to benchmark and score the different location platform providers. However, in reality, enterprises of different types will have different needs and requirements for their location platform. In this section we highlight the relative strengths and weaknesses of each of the location platforms. These strengths and weaknesses are summarized in Exhibit 8.

Exhibit 8 Strengths & Weakness Analysis of Major Location Platforms

| | Relative Strengths | Relative Weaknesses |
|---------------|--|---|
| Google | <ul style="list-style-type: none"> • Very deep pockets • Strong consumer brand recognition - a Billion monthly active users of Google Maps worldwide • Large base of GPS traces assist real time map changes • Largest number of POIs with the most granular info • > 50 Million Local Guides (Oct 2017) adding POI info • Millions of developers (>3 M apps use Google Maps) • Indoor venue maps - 10,000 locations | <ul style="list-style-type: none"> • Weak in automotive - perceived as a strategic threat to carmakers • No China presence • Concerns over privacy & use of data for advertising • Location data is walled garden |
| HERE | <ul style="list-style-type: none"> • Well resourced – 9K employees globally. • Strong in map content licensing and automotive • Influential investors and partnerships in key LBS growth areas – autonomous driving • Global coverage, including China, Japan and S.Korea • Strong growth vision and product lines • Full range of map making tools • Large enterprise customers (e.g. Amazon, MSFT) • Offline (hybrid) mode in absence of connectivity • Strong indoor venue marketplace | <ul style="list-style-type: none"> • Weak in long-tail developer v Google and Mapbox • Location data is not considered “live” |
| Mapbox | <ul style="list-style-type: none"> • 420 M monthly active location (GPS) probes • Leader in map data visualization • Independent and based on open principles • Location leader in Business Intelligence (BI) sector • Large developer community > 1 M registered devs. o/w >100K monthly active • Investment from Softbank • Presence in China | <ul style="list-style-type: none"> • Doesn't control its own map; OSM dependence • Susceptible to malicious map edits • Weak in automotive • Weak indoor/ venue coverage |
| TomTom | <ul style="list-style-type: none"> • Strong in map content licensing and automotive • Leader in traffic data (live and historic) • Focused on automotive and enterprise • Flexible for developers • Aggressive pricing of location services | <ul style="list-style-type: none"> • Reliant on Apple for probe data • Weak indoor/ venue coverage • Location data is not considered “live” • Declining consumer |



5.1 Google

| | Relative Strengths | Relative Weaknesses |
|---------------|---|---|
| Google | <ul style="list-style-type: none"> • Very deep pockets • Strong consumer brand recognition - a Billion monthly active users of Google Maps worldwide • Large base of GPS traces assist real time map changes • Google search is very popular for local search • > 50 Million Local Guides (Oct 2017) adding POI info • Millions of developers (>3 M apps use Google Maps) | <ul style="list-style-type: none"> • Weak in automotive - perceived as a strategic threat to carmakers • Not independent • Concerns over privacy & use of data for advertising • Location data is walled garden • No presence in China |

5.1.1 Strengths

Very deep pockets: Across its major competitors, Google has the deepest pockets which it can use for map-making, map maintenance, and evolving its platform to target services and applications which run on top of its maps. Although Google not all of Google's income will be used to support Google Maps, for context, Google's net income for the first 9 months of 2018 approached \$21.8 Billion. This compares to \$170 Million EBITDA for TomTom.

Popular consumer app: Google Maps is a very popular consumer brand (outside China) and has over 1 Billion users which delivers the following competitive advantages which includes: a huge number of probe data from smartphones to assist Google with map maintenance (e.g. new turn restrictions, new roads or routes, etc.); sufficient number of probes to offer crowd-sourced data on traffic flows on major roads; and from a UX perspective ideal for developers looking to drop in familiar and recognizable location services into their services.

Popular for local search: Google's popularity as a search engine has improved its ability to capture business details. Put simply, many businesses are motivated to claim and advertise on Google (and Google Maps) because Google is one of the main channels consumers use to research and find a broad range of local businesses. Businesses are incentivized to include useful information to listing to improve their organic search rank, leading to Google being able to serve up granular information for consumers.

Large community of local guides: To ensure place information remains as fresh as possible Google has amassed a base of 50 Million Google Map users as Local Guides which assist Google in adding useful granular information to its place listings, e.g. opening times, parking availability, wheelchair access, restroom facilities, etc.

Large developer base: Google Maps remains the most widely used location-platform by developers, although pricing changes have created a reason for developers to seek alternative platforms. Google claims over 3 Million apps use its map, although it admits it does not generate revenue from "most" of these because they only drive limited usage of location services.



5.1.2 Weaknesses

Google perceived as a threat: Until recently, Google’s ambitions to supply vehicle makers with location services have been stifled because of carmakers’ strategic ambitions to retain control of the in-vehicle experience for drivers and passengers. By providing premium infotainment services carmakers want to capture value-added opportunities. Google providing its services is considered a threat to these plans, although deals with Volvo and the Nissan, Renault, Mitsubishi alliance may alter the perception of other carmakers.

Not independent: Google provides search, advertising, navigation products for mobile and in-vehicle to consumers and businesses. Therefore, Google restricts developers from using its map services if they are building products which compete with Google’s own offerings.

Google is a closed platform: Although Google provides tools for developers its map data remains behind the wall garden and developers are not allowed to mix location services from different providers. For example, Google prevents developers from using Google map tiles with TomTom’s traffic service.

No presence in China: Google’s services are banned in China which makes its mapping platform useless for developers looking to deploy location services in China.

5.2 HERE

| | Relative Strengths | Relative Weaknesses |
|------|---|---|
| HERE | <ul style="list-style-type: none"> • Well resourced – 90K employees globally • Influential ownership and strategic partners • Strong in map content licensing and automotive • Investors and partnerships in key LBS growth areas – autonomous driving and China • Independent • Strong growth vision and product lines on key verticals • Full range of map making tools • Large enterprise customers (e.g. Amazon, MSFT) • Offline (hybrid) mode in absence of connectivity • Strong indoor venue marketplace | <ul style="list-style-type: none"> • Not as well funded as Google • Weak in longtail developer versus Google and Mapbox • Location data is not considered “live” |

5.2.1 Strengths

Owners and investors: HERE’s parents are carmakers Audi, BMW and Daimler, but HERE has received additional investment from Intel, Pioneer, Bosch and Continental. HERE partners with investor companies to identify future services and technology they can work on to deploy for consumers and businesses. For example, it is working with Continental on autonomous driving and Bosch across multiple areas such as autonomous driving, transportation and IoT. HERE is also well resourced and claims to have 9,000 employees globally. HERE is positioning as a strategic partner for companies across multiple sectors looking for an alternative to Google.



Established automotive supplier: HERE's map content powers a large share of embedded infotainment units and as a consequence HERE has a strong reputation as a provider of automotive grade maps and navigation software. As carmakers move from licensing map content to a more efficient platform-orientated business model, HERE and TomTom are under threat from Google and Mapbox.

Independent: Unlike Google, HERE is independent, despite Audi, BMW and Daimler as its parents. The only restrictions that HERE applies for developers is for the use of its location services in future applications such as autonomous vehicles and drone navigation.

Forward looking and innovative: HERE's strategic vision remains forward looking and extremely impressive as it positions to be a premium tier location partner across multiple domains. HERE claims its Open Location Platform (OLP) is successfully targeting a large number of verticals, opening up new opportunities and relevance for location enriched data. The OLP has been used by HERE to pool vehicle sensor data from Audi, BMW and Daimler to create its road hazards product. HERE has also created products which are customized for the needs of mobility service providers, including the mobility marketplace it launched at CES in 2018.

Indoor mapping strength: HERE has detailed floorplans for over 20,000 venues. It has also developed a marketplace to enable venue owners to provide their floorplans across a variety of different publishers, including Garmin and Motorola.

Hybrid map capability: HERE offers developers access to its hybrid mapping function, which allows users to download maps to their device for offline use. This capability is useful when users do not always have a data connection such as when travelling to other countries, when in areas with no or bad connectivity, or in large parts of the world where connectivity is not that ubiquitous yet.

5.2.2 Weaknesses

Not as well funded as Google: Although the names of companies which have invested in HERE is impressive Strategy Analytics expects HERE not to have a similar scale of resources at its disposal as Google.

Weak in longtail developer versus Google and Mapbox: HERE has a strong automotive presence and is well suited to meeting the needs of this sector and large enterprises. Historically, HERE has no focused on long tail developers, but over the past 18-24 months has started initiatives like XYZ and introduced a freemium location offer to encourage the longer tail of developers.

Location data is not considered "live": As a consequence of HERE's automotive strengths its location platform is geared to meet the needs of companies in this sector. Therefore, HERE provides validated, automotive-grade map updates on a weekly refresh cycle rather than on a real-time basis like Google and Mapbox.

5.3 Mapbox

| | Relative Strengths | Relative Weaknesses |
|---------------|---|--|
| Mapbox | <ul style="list-style-type: none"> • 420 M monthly active location (GPS) probes • Leader in map data visualization • Independent and based on open principles • Location leader in Business Intelligence (BI) sector • Large developer community > 1.2 M registered devs. o/w >100K monthly active • Investment from Softbank | <ul style="list-style-type: none"> • Not as well funded as Google or HERE • Doesn't control its own map; OSM dependence • Susceptible to malicious map edits • Weak and building slowly in automotive • Weak indoor/ venue coverage |

5.3.1 Strengths

Softbank Investment: While Mapbox does not have the resources to compete directly with Google or HERE, Strategy Analytics believes Mapbox stands to benefit both directly and indirectly from Softbank investment.

Map Visualization: Mapbox's leadership and strength in map data visualization, providing location visualization tools for the business intelligence sector, and GPS probe data from 420 Million monthly active users have been highlighted throughout section 4 of the report.

Developers: Mapbox has been built from the beginning to provide an alternative independent map platform for developers. As an independent provider it does not have a problem of conflict of interest like Google does.

5.3.2 Weaknesses

Not as well funded as Google or HERE: Despite investment from Softbank it does not have the resources to match Google or HERE.

Map making process: Mapbox doesn't build its own map per se, but relies on OSM as a foundational layer. Mapbox uses 130 sources of data in total to build its map. However, although Mapbox is a contributor to OSM, OSM lacks a formal review process. For some enterprises the use of OSM as a basis is considered a weakness due to lack of provenance and patchy coverage. Reliance on probe data is excellent for change detection but misses details without additional sources and complimentary collection methods.

Weak in automotive: As a relatively newcomer Mapbox does not benefit from the same established relationships which HERE and TomTom have with carmakers but like Google continues to build momentum. Mapbox location services are used to power ride-hailing services like lyft and used for mobile apps from Subaru, and Porsche.

Limited indoor map coverage: Indoor maps are not a focus for Mapbox and it uses a partner to achieve this.



5.4 TomTom

| | Relative Strengths | Relative Weaknesses |
|---------------|---|--|
| TomTom | <ul style="list-style-type: none"> • Strong in map content licensing and automotive • Leader in traffic data (live and historic) • Independent • Focused on automotive and enterprise • Flexible for developers • Aggressive pricing of location services | <ul style="list-style-type: none"> • Not as well funded as Google or HERE • Apple is reducing reliance on TomTom • Weak indoor/ venue coverage • Location data is not considered "live" • Declining consumer business |

5.4.1 Strengths

Established automotive supplier: TomTom’s map content powers a large share of embedded infotainment units and like HERE, TomTom has a strong reputation as a provider of automotive grade maps and navigation software. As carmakers move from licensing map content to a more efficient platform-orientated business model, HERE and TomTom are under threat from Google and Mapbox.

A leader in traffic data: TomTom is considered a leader in traffic data and is able to rely on probe data from Apple smartphone to enrich its other traffic data sources.

Independent: Unlike Google, TomTom remains independent.

Flexibility: TomTom is considered a leader in traffic data and is able to rely on probe data from Apple smartphone to enrich its other traffic data sources.

5.4.2 Weaknesses

Not as well funded as Google or HERE: TomTom has conducted a strategic review of its telematics division and is looking to sell it as it focuses on core areas like automotive and business-to-business (B2B)

Apple is reducing its reliance on TomTom: Although the relationship between Apple and TomTom will remain, Apple has elected to reduce its reliance on TomTom for map data, and will rely more on its own data efforts and sensor equipped vans and probe data. TomTom relies heavily on probe data from Apple and this remains at risk.

Limited indoor map coverage: Indoor maps are not a focus for TomTom which represents a gap.

6. How Can We Help You?

Strategy Analytics provides strategic and tactical support to global clients through a range of customized solutions:

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