

AUTONOMOUS VEHICLE – OPPORTUNITIES IN THE U.S.

INDUSTRY REPORT

November 2018

Business Sweden USA

CONTENT

- ▶ Introduction to Autonomous Vehicles in the U.S.
- ▶ Swedish Companies and Opportunities in the U.S.
- ▶ Recommendations and Next Steps

PURPOSE AND OBJECTIVES

Purpose

- ▶ To develop knowledge and understanding of the autonomous vehicle industry in the U.S. including key challenges and identifying business opportunities for Swedish companies

Key Objectives

- ▶ Providing a background and historical context of autonomous vehicle development in the U.S.
- ▶ Outlining specific stakeholders and major geographical hubs in the U.S. for autonomous vehicle activities
- ▶ Detailing current trends and technologies that are in demand on the U.S. market as well as current challenges
- ▶ Summarizing key opportunities for Swedish companies relating to current market strengths in Sweden
- ▶ Determining next steps and potential for related promotional activities in the U.S. for autonomous vehicles



EXECUTIVE SUMMARY

KEY FINDINGS

1

Three major stakeholder groups present in U.S. autonomous industry

2

U.S. autonomous activity centered around key regions and clusters

3

A large majority of global AV investment originate from U.S.

4

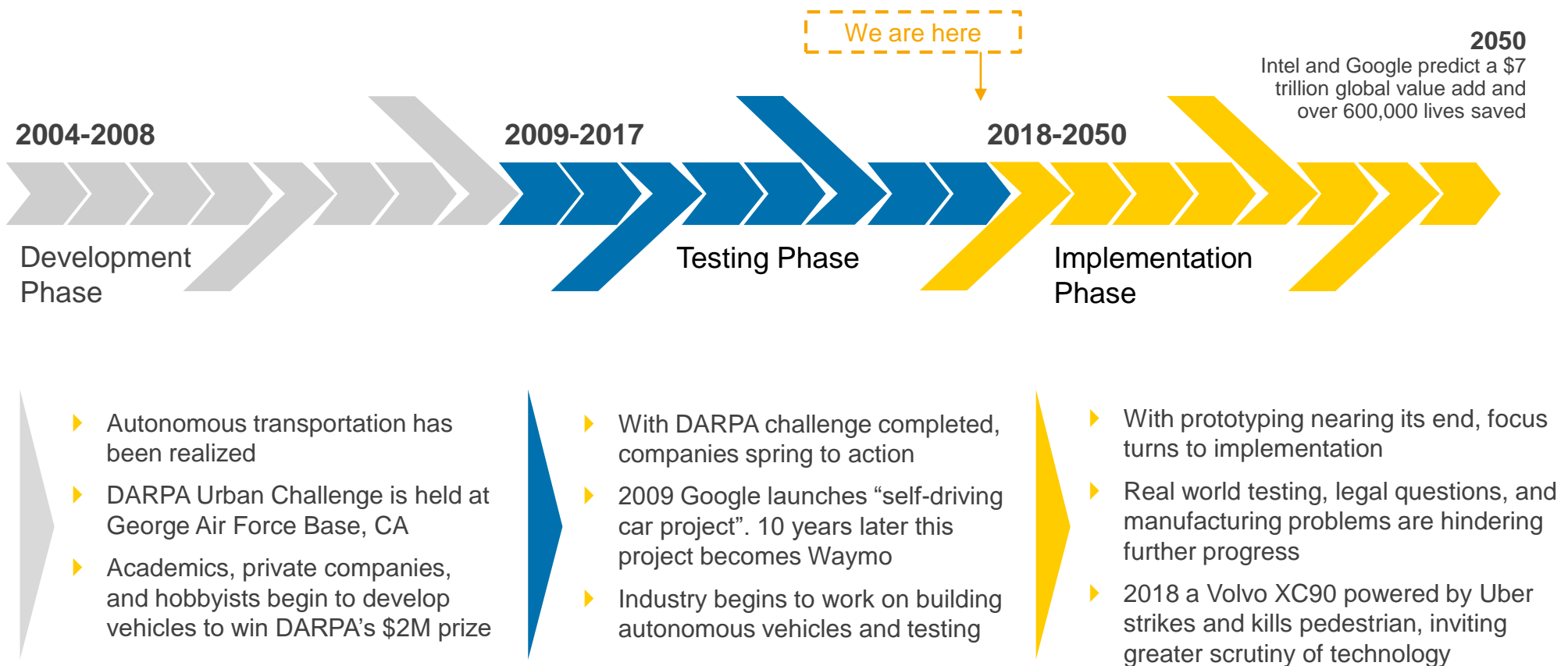
Swedish solutions and strengths match U.S. challenges

CONCLUSION

- ▶ Technology providers, Automotive-related companies and Regulatory agencies are most involved in the growth and development of the U.S. autonomous vehicle industry
 - ▶ Technology and automotive companies are ahead in development while U.S. government lags behind on passing official legislation, as the industry moves from testing to implementation
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- ▶ Specific U.S. geographical areas have unique activities and needs related to autonomous vehicles, so depending on the company's focus, different areas are more relevant
 - ▶ ICT-related activities can be found on the coasts, while developments in testing and vehicle technologies are mostly centered around the Midwest and traditional automotive regions
-
- ▶ The U.S. accounts for the majority share of recent investment into AV technologies, within top areas including microchips, sensors, connected technologies and AI
 - ▶ Both traditional transactions including acquisitions and partnerships and also startup investments play a large role in U.S. activity in the past four years
-
- ▶ Swedish companies show strengths in in the areas of regulations and safety, testing, and technology, where U.S. companies are currently struggling
 - ▶ Especially in the areas of safety, AV systems verification, and development of new software and hardware, there are opportunities for Swedish companies in the U.S. market



THE AUTONOMOUS INDUSTRY IS ON THE BRINK OF GOING FROM TESTING TO IMPLEMENTATION PHASE



AUTONOMOUS TECHNOLOGIES HAVE A LONG HISTORY THAT HAS ONLY RECENTLY ENTERED THE PUBLIC EYE

SOURCE: CBINSIGHTS, CHRIS URMSON PHD, DARPA, GOOGLE, INTEL, NEURAL INFORMATION PROCESSING SYSTEMS CONFERENCE, WIRED, WAYMO

THREE STAKEHOLDER GROUPS PLAY A KEY PART IN PACE OF U.S. AUTONOMOUS INDUSTRY DEVELOPMENT

▶ Technology Providers



Sensors, Radars, Software, Hardware

▶ Automotive Companies



OEMs, Suppliers, Ridesharing

▶ Regulatory Agencies



Transportation Agencies, Insurance and Vehicle Testing Bodies

Current Focus

- ▶ Creating software and hardware for sensor technologies
- ▶ Solve coding challenges
- ▶ Develop and implement updates for software ecosystems
- ▶ Ensure cybersecurity standards and practices are followed

- ▶ Emphasize standards alignment, research-based design, and educational attainment
- ▶ Fund and acquire existing autonomous driving companies
- ▶ Build infrastructure to mass produce new vehicles

- ▶ Emphasize industry knowledge, breadth of offering, and history of service
- ▶ Ensure company compliance where necessary
- ▶ Create effective policies to regulate the new field

Main Objective

- ▶ Create, develop, and update autonomous technologies

- ▶ Promote and enable new autonomous ecosystems

- ▶ Ensure public safety and legal growth of new industry

Key Players

- ▶ Intel, Velodyne (software)
- ▶ Echodyne, Metawave (radar, etc.)

- ▶ Toyota, Ford, Daimler, Tesla
- ▶ Uber, Lyft, Waymo

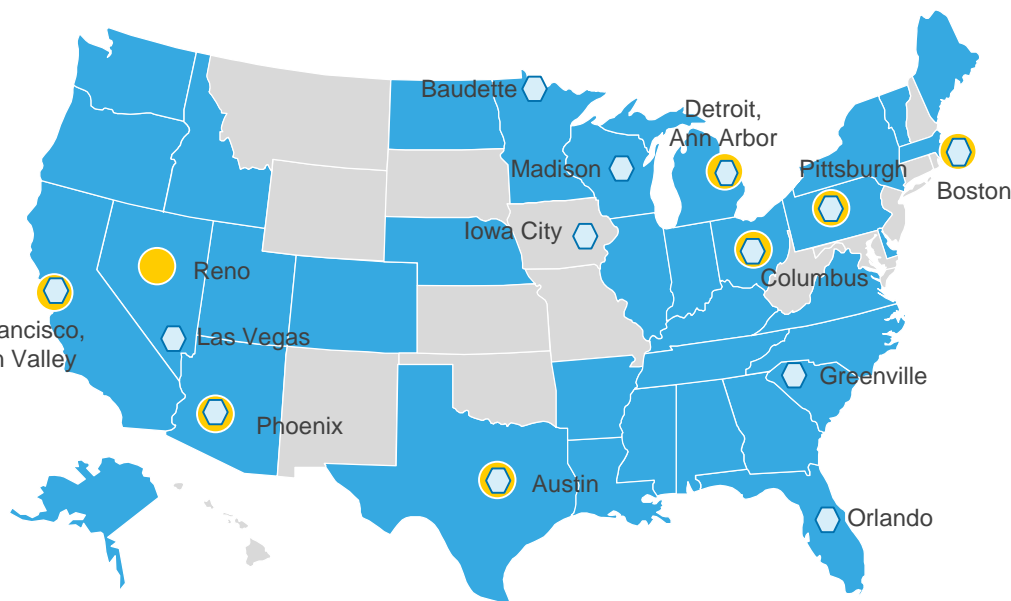
- ▶ U.S. Dept. of Transportation
- ▶ State and Local authorities

MANY CHALLENGES PRESENT IN AUTONOMOUS VEHICLE INDUSTRY MUST BE SOLVED THROUGH COLLABORATION



HUBS FOR AUTONOMOUS INNOVATION AND TESTING INCLUDE THE MIDWEST AND EAST AND WEST COASTS

STATUS OF LEGISLATION AND SECTOR CLUSTERS



- Hub city for AV innovation
- ⬡ Major testing facility or research center
- States that have passed official legislation regarding autonomous vehicles*

A FEW KEY REGIONS TAKING LEAD ON AV ACTIVITIES

- ▶ California, Nevada, and Florida were the first three states to authorize driverless vehicles, setting a precedent for others
- ▶ Silicon Valley is considered the global leader in autonomous vehicle development due to its number of technology, ICT, and engineering firms
 - ▶ Automotive firms such as Ford have also recently opened a research lab in Silicon Valley
- ▶ Automakers based in Detroit as well as tech companies such as Google are developing and testing autonomous vehicles in the area, partnering with research institutions
- ▶ Other traditional manufacturing states are developing testing and research facilities such as Ohio's new Transportation Research Center, noted to be the largest independent vehicle testing facility and proving grounds in the U.S.
- ▶ Swedish companies should focus on specific industry and technological clusters that are related to their business focus before deciding on a region or state to approach in the U.S.

AUTOMOTIVE OEMS COULD BE TARGETED IN THE MIDWEST, WHILE ICT FIRMS ARE LOCATED ON EAST AND WEST COASTS

SOURCE: AUTOMOTIVE NEWS, COMPANY WEBSITES, USNEWS, FORTUNE, TRANSPORTATION RESEARCH CENTER, CONFERENCE OF STATE LEGISLATURES, U.S. DEPARTMENT OF TRANSPORTATION

*NEW LAWS ADDRESS ROLE OF LOCAL TRANSPORT AUTHORITIES, FORMATION OF WORKING GROUPS, DEFINITIONS OF AUTONOMOUS DRIVING, AND OTHER TESTING AND SAFETY CONSIDERATIONS



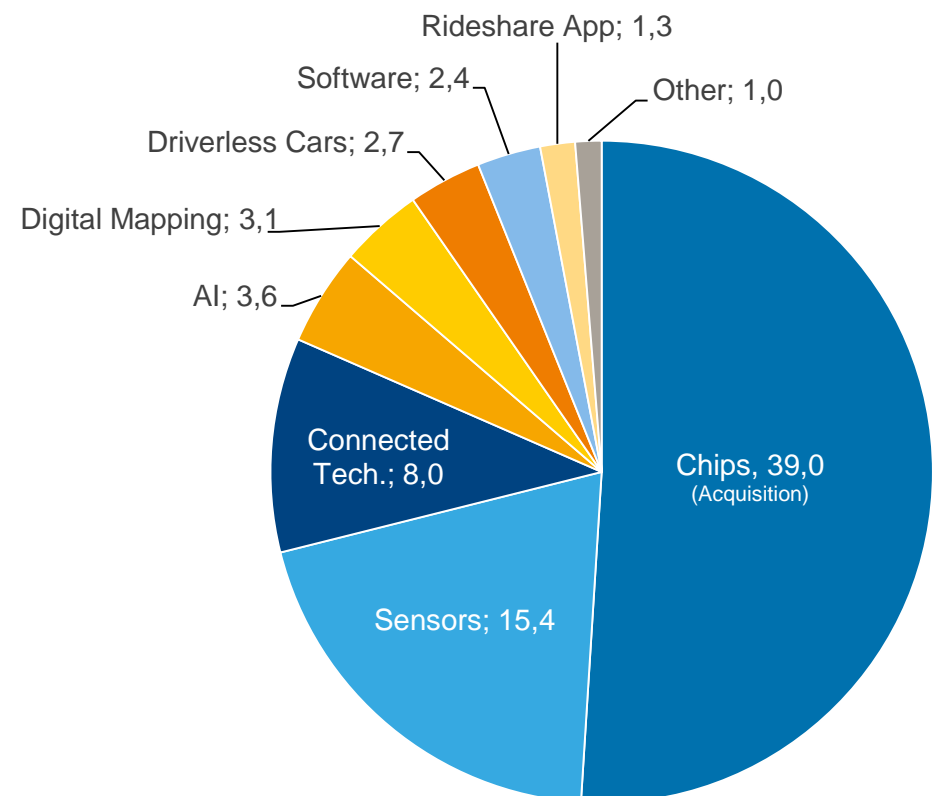
HEAVY INVESTMENT IN AUTONOMOUS TECH SHOWS PROMISE FOR SWEDISH COMPANIES SEEKING FUNDING

MAJOR RECENT INVESTMENT ACTIVITY IN THE U.S.

- ▶ Globally, between 2014 to 2017 there have been more than 170 investments* in AV technologies including 100+ startup and 60+ traditional investments
- ▶ Of these investments a majority is from U.S. based investors, reflective of current market, followed by China, Germany, Israel and UK
- ▶ Most traditional transactions included activity such as partnerships and acquisitions, while startups saw more monetary investments
- ▶ Top four areas of investment include microchips, sensors, connected technologies, and artificial intelligence (AI)
- ▶ Significant investment activity in the U.S. typically comes from automotive companies, private VC firms, and ICT-companies:



INVESTMENT IN BUSD PER TECHNOLOGY, 2014-2017



OPPORTUNITY EXISTS FOR SWEDISH COMPANIES DURING DEVELOPMENT PHASES TO ESTABLISH CONTACT WITH FIRMS TO ADD VALUE

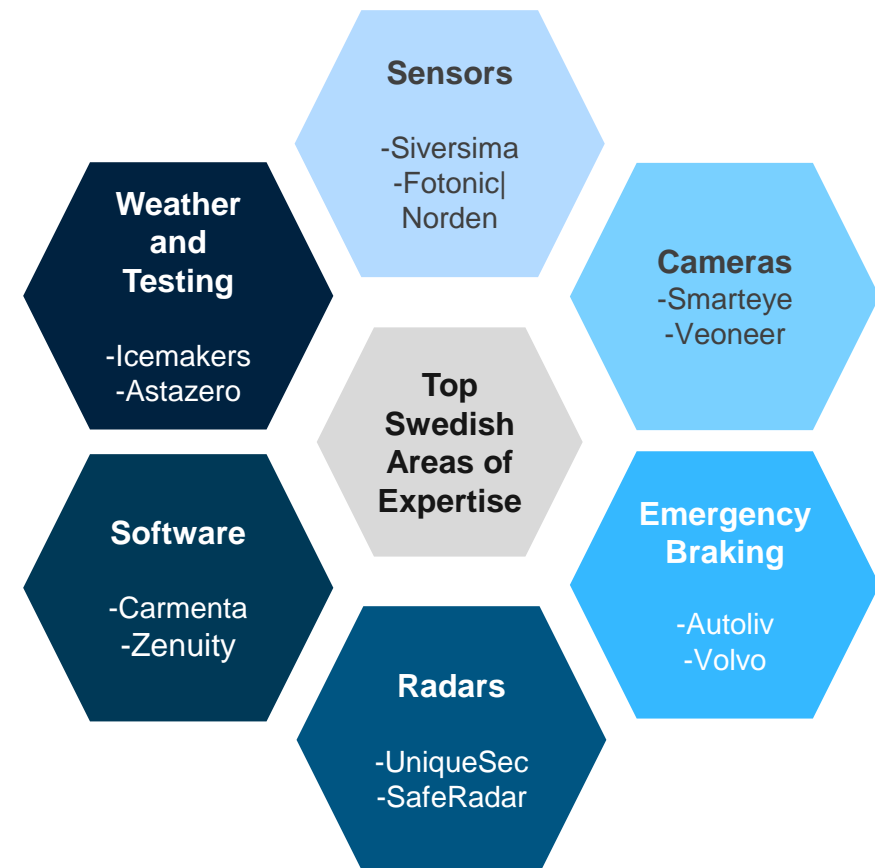


SWEDEN'S HISTORY OF LEADERSHIP IN SAFETY COULD POSITION COMPANIES AHEAD OF COMPETITION IN U.S.

TECH TRENDS LEAD TO BUSINESS OPPORTUNITIES

- ▶ Both the private and public sector in the U.S. are looking for solutions and companies to provide them with insight and new innovations to further develop the technologies in the AV Industry especially when it comes to safety and testing
- ▶ Beyond the automotive industry, other existing industries in the U.S., including hospitality, emergency medical services (EMS), and real estate are only beginning to think about how autonomous transportation will affect their business
- ▶ Within the U.S. industry, a major focus is on software development such as machine-to-machine learning, object recognition, pattern analysis, and artificial intelligence
 - ▶ In addition to software, increasing development and innovation is also centered around Radar, Lidar, Sensors, GPS and digital mapping
- ▶ Swedish companies, coupled with the country's long history of vehicle safety and innovations in the areas of ICT, telematics, connected cars, and mobile technologies, could potentially provide unique solutions to challenges faced by U.S. companies

AREAS WITH NOTABLE SWEDISH MARKET LEADERS



WHILE ALL-IN-ONE AV TECHNOLOGY COMPANIES ARE SPARSE, SWEDEN OFFERS WORLD CLASS NICHE SOLUTIONS

SOURCE: BUSINESS SWEDEN INTERVIEWS, BUSINESS SWEDEN ANALYSIS, COMPANY WEBSITES, COMET LABS, LATIMES

SWEDISH SOLUTIONS AND KNOW-HOW COULD BE KEY IN SOLVING CURRENT U.S. AUTONOMOUS CHALLENGES

TOPIC	U.S. SITUATION	CURRENT CHALLENGES	SWEDISH STRENGTHS
Regulations and Government Support	<ul style="list-style-type: none"> While there is pending legislation (Self Drive Act) and general guidance developed, no official laws have been passed on a federal level 	<ul style="list-style-type: none"> Automotive manufacturers and suppliers have taken on the burden of ensuring safety and are looking for industry support and solutions 	<ul style="list-style-type: none"> Sweden is a leading country for autonomous vehicle safety solutions, along with government-supported programs like “Drive Sweden” promoting collaboration between multiple stakeholders
Real-world Testing	<ul style="list-style-type: none"> With recent fatal accidents (e.g. Uber), regulatory agencies have tightened requirements for road testing and issuing permits 	<ul style="list-style-type: none"> With limited access to public roads for testing, safety and verification of autonomous systems has been a challenge for many stakeholders 	<ul style="list-style-type: none"> Sweden has many companies and non-profit organizations providing both on-road vehicle testing and virtual solutions for testing and verification of sensors and radars systems
Technology and Innovation	<ul style="list-style-type: none"> From a technological standpoint, there are new challenges with increased implementation of semi-autonomous technologies in new cars (e.g. ADAS) 	<ul style="list-style-type: none"> Specifically, there are issues that remain in the areas of cyber security, 3D mapping, and vehicle sensors 	<ul style="list-style-type: none"> A large number of Swedish companies have R&D and data security competence as well as experience with cellular and automotive sensor technologies

SWEDEN IS WELL-EQUIPPED TO HANDLE U.S. CHALLENGES RELATED TO REGULATIONS, TESTING, AND TECHNOLOGICAL INNOVATION

SOURCE: GUARDIAN, LA TIMES, STATESCOOP, ENGADGET, CBS NEWS, FREIGHTWAVES, STANFORD, WIRED, AZ CENTRAL, GOVERNMENT OFFICES OF SWEDEN, FORBES, THELOCAL.SE, DRIVE SWEDEN



FEEDBACK FROM SWEDISH COMPANIES REVEAL DIFFERENT PERSPECTIVES ON THREE MAIN TOPICS



FUNDING OPPORTUNITIES

- ▶ Some Swedish companies have provided feedback that they believe the U.S. offers more investment opportunities, and especially, smaller companies and start-ups are eager to join in the activity in the investment arena in the U.S.
- ▶ Certain companies are also open to the possibility of considering acquisition opportunities
- ▶ Larger companies, who are more established, already have significant funding or support from other larger industry partners to fund their business activities. Therefore, these types of companies are not seeking investments in the U.S.



U.S. REGULATIONS AND SAFETY

- ▶ Most Swedish companies do not see regulations as a major barrier in the U.S. markets and see it as an opportunity to be market leaders in this area
- ▶ This is true especially in the areas of safety and testing for autonomous vehicles, given the recent news and activity in the U.S.
- ▶ Swedish companies are hopeful, that although the U.S. is farther behind in areas such as safety regulations, that it can catch up to Swedish or European standards sooner rather than later



MEETINGS WITH STAKEHOLDERS

- ▶ The types of stakeholders that are targeted by Swedish companies differ according to the size of company as well as type of product or technology offered
- ▶ Certain companies are targeting automotive OEM's and suppliers for sales of their product or solution
- ▶ Other companies are focusing more on regulatory agencies and partners such as state Departments of Transportation or other stakeholders that deal with vehicle fleets
- ▶ Lastly, other companies who are functioning as a not-for-profit are seeking out stakeholders for partnership, testing, or research and development purposes



U.S. REGULATIONS, GEOGRAPHY, AND INVESTMENT ACTIVITY PROVIDE KEY AREAS OF OPPORTUNITY

KEY FINDINGS AND TAKEAWAYS



- ▶ While the U.S. is a leader in innovation and investment in the autonomous vehicle arena, it still lacks behind from a policy and regulatory standpoint
- ▶ The U.S. government has developed guidelines through various transport-related agencies, but has yet to pass official laws regarding autonomous vehicles



- ▶ As the U.S. has a large geographical scope, there are specific hubs with unique challenges and opportunities that are highly dependent on regional and industry needs
- ▶ Autonomous industry clusters are mainly situated on the coasts for developments in ICT and in the Midwest states for OEM and automotive-related activities



- ▶ The U.S. is very active in the investment arena in top four areas of microchips, sensors, connected tech and AI
- ▶ With a majority of 77 BUSD of recent publicly recorded funding coming from U.S. automotive, ICT and private VC firms, there is ample opportunity for companies to take part in investment activities

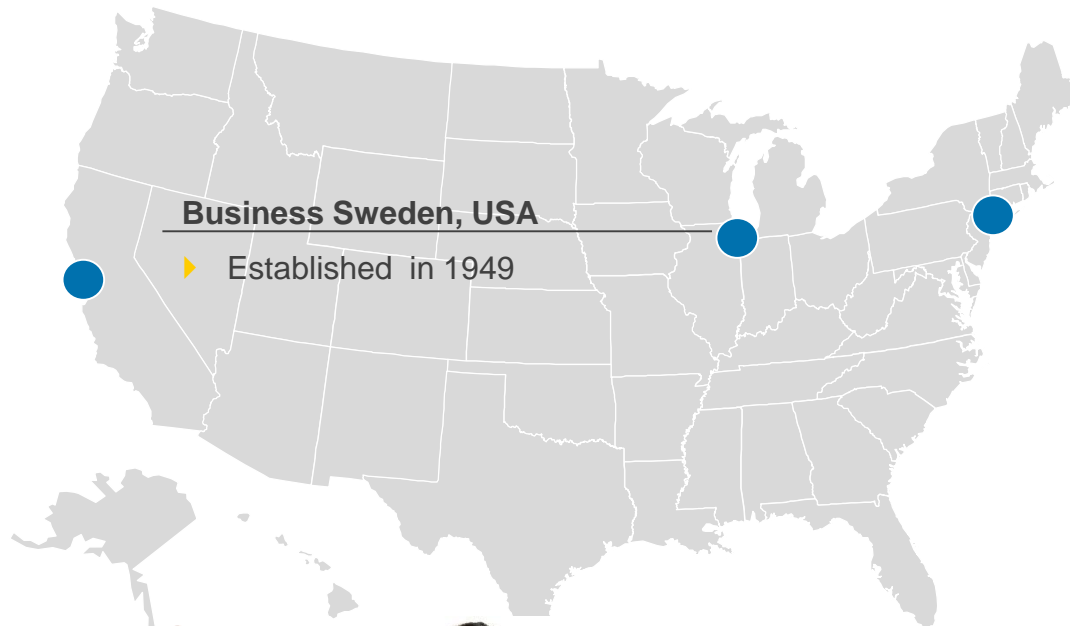
RECOMMENDATIONS

- ▶ Swedish companies who are familiar with and meet current European strict safety requirements could enter as market leaders in this area
- ▶ Swedish companies could also support and partner with U.S. governmental agencies to share knowledge in areas of real-world and virtual testing

- ▶ In order to successfully target opportunities in the U.S., Swedish companies must keep in mind their specific technological expertise
- ▶ Swedish companies focusing on ICT should focus their efforts on the coasts, and companies with testing or OEM focus should target the Midwest

- ▶ Swedish companies currently seeking funding in the areas of sensors, safety, radars, and software could target multiple investment players in the U.S.
- ▶ Swedish companies could also look into opportunities beyond investment, including partnerships or acquisition possibilities

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