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Email: customerservice@marketresearch.com
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GLOBAL LIDAR MARKET

By Components (INS, Laser, GPS/GNSS, Camera, MEMS), Product Types (Airborne, Mobile, Terrestrial), Applications (Corridor Mapping, Forestry, Mining, Topographic Surveying, Volumetric Mapping)

– Analysis & Forecast (2013 – 2018)



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1 INTRODUCTION

1.1 KEY TAKE-AWAY

- Market statistics with detailed classifications and splits by revenue and volume.
- The key trends related to the product technology, prices, and the applications that shape and influence the market.
- Analysis of the global market with special focus on high growth applications in each vertical and fast growing application market segments.
- Impact analysis of the market dynamics with factors, currently, driving and restraining the growth of the market, along with their impact on the short, medium, and long term landscapes.
- Detailed Porter's analysis, market life cycle analysis along with technology & market roadmaps, evolution & time-lines of each type of LiDAR product and their respective markets.
- Allied industry segments & value chain analysis of the global industry.
- Detailed segmentation of global market by technology with a focus on cross segment markets like product types, applications, and verticals.
- Illustrative segmentation, analysis, and forecast of the major geographical markets to give an overall view of the global market.
- The future of the global market & industry from both - technical and market-oriented perspectives.
- Detailed competitive landscape with identification of the key players with respect to each type of the market and market share rankings.
- Competitive intelligence from the company profiles, key player strategies, and game-changing developments such as product launches and acquisitions.

1.2 REPORT DESCRIPTION

The term 'LiDAR' is an acronym for Light Detection and Ranging, which has been derived from the common term 'RADAR'. LiDAR technology has been around in the military and research circles since the early XXs. A typical LiDAR system mainly consists of three major components:- a laser sensor, a Global Positioning System (GPS) unit, and an inertial navigation unit. The LiDAR system sends out laser pulses at the object/area to be mapped, and collects data by recording the pulses reflected by/from the object. In certain instances, as many as XX such pulses are sent out every second.

Early LiDAR systems were very bulky and; thus, were very expensive to operate. In the last two decades, technological progress has brought the size of a LiDAR system down to a point where, LiDAR, as a technology, has become a very accurate and affordable solution. The advancement in the GPS and inertial navigation unit technologies has also propelled the LiDAR market further.

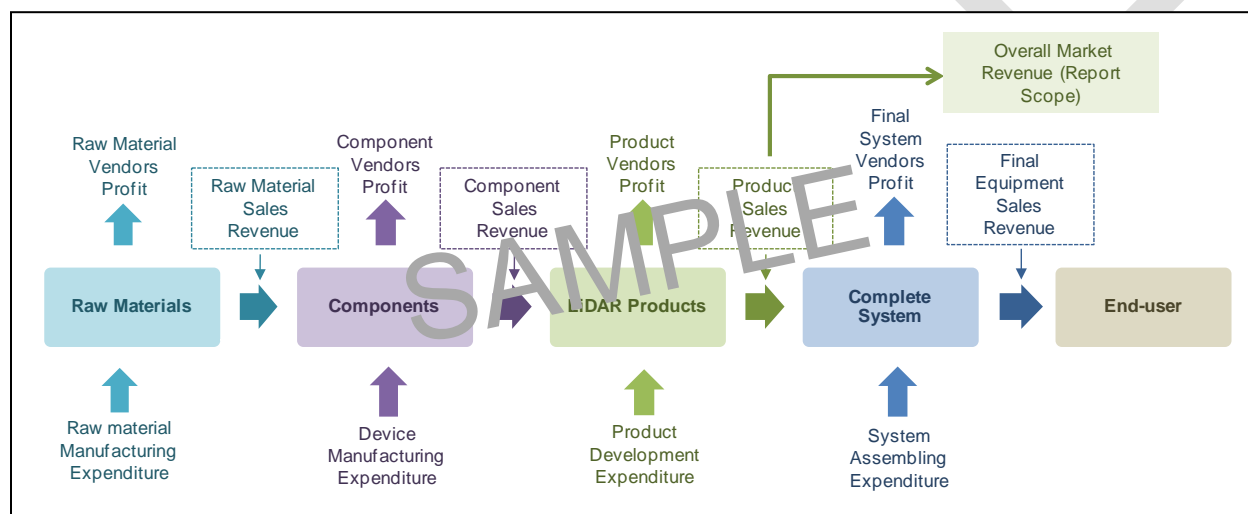
The report segments the LiDAR market on the basis of different types of products, technologies, components used, applications, and geographies. Further, it contains revenue forecast, and analyses trends in the market. The geographical analysis contains an in-depth classification for North America, Europe, and APAC; which consists of major countries covering the market. Further, the Middle-East and Latin America have been classified under the ROW region. Each of these geographies has been further split by the major countries existing in this market. The sections and the sub-segments in the report contain drivers, restraints, opportunities, current market trends, and the technologies expected to revolutionize the LiDAR domain. The report also gives detailed profiles of various companies, currently, active in these markets. In addition to the company profiles, the report does provide a Competitive Landscape (CL) of the key players for each of the markets. The CL covers market share analysis, mergers and acquisitions, collaborations, partnerships, new product developments, and the key growth strategies of each player.

1.3 SCOPE & MARKETS COVERED

An illustrative diagram of the complete LiDAR monetary chain, showing the clear view of the market is considered and analyzed in this report for obtaining quantitative data and statistics of the “LiDAR market”.

FIGURE 1

LIDAR INDUSTRY MONETARY CHAIN & MARKET SCOPE



Source: MarketsandMarkets Analysis

The figure above shows the flow of money in the form of a monetary chain, illustrating the flow of goods & services from one segment to the other in the LiDAR industry. It also shows the relationship and links between the major industry segments, with the analysis below, giving an insight into the effect of these industry segments on the overall market scenario.

The figure consists of four major check points, which are the key industry processes, namely semiconductors, components, products, and the complete final system (if product is assembled/integrated into a system or network).

Between each of the check points, there is a flow of revenue shown in terms of horizontal arrows. For example, the right arrow after the second box indicates the total LiDAR

components revenue (the total revenue of all LiDAR component suppliers, globally), which, if carefully observed, is the purchase capital for the next step— the product manufacturing process.

The figure also consists of vertical arrows above and below the boxes, among which, the ones below the boxes denote the additional expenditure for each process (apart from purchase); in short, it is the industry process expenditure; while the vertical arrows given above denote the total profit earned by the respective players in each process.

To connect the flow in mathematical terms, it is considered that every horizontal arrow is the sum of all the vertical and horizontal arrows, which precede (on the left-hand side) it in the figure. For example, the product sales revenue (the third horizontal arrow) is equal to the sum of money spent for components purchase by the product manufacturers (ODMs in this report); it includes all the expenditures for product development & manufacturing, and the final profit earned by the product manufacturers.

In this report, the figure indicated by the third horizontal arrow is the quantitative market data value for the “LiDAR market”. The overall sales revenue of all products represented by the third arrow in the figure, stood at approximately \$XX billion in 2013.

1.4 STAKEHOLDERS

Listed below are the major fields that the stakeholders of the global LiDAR technology market belong to.

- Raw material & manufacturing equipment suppliers
- Electronic Design Automation (EDA) & design tool vendors
- Laser technology players
- Remote sensing technology providers
- Photogrammetry solution providers
- GPS technology manufacturers

- Inertial navigation unit manufacturers
- High-end automotive and transportation players
- LiDAR Intellectual property players
- LiDAR technology platform developers
- LiDAR Component Manufacturers
- LiDAR Product Manufacturers (ODMs)
- LiDAR Original Equipment Manufacturers (OEMs)
- ODM and OEM technology solution providers
- Assembly, testing, and packaging vendors
- Distributors and traders
- Research Organizations
- Forums, alliances and associations

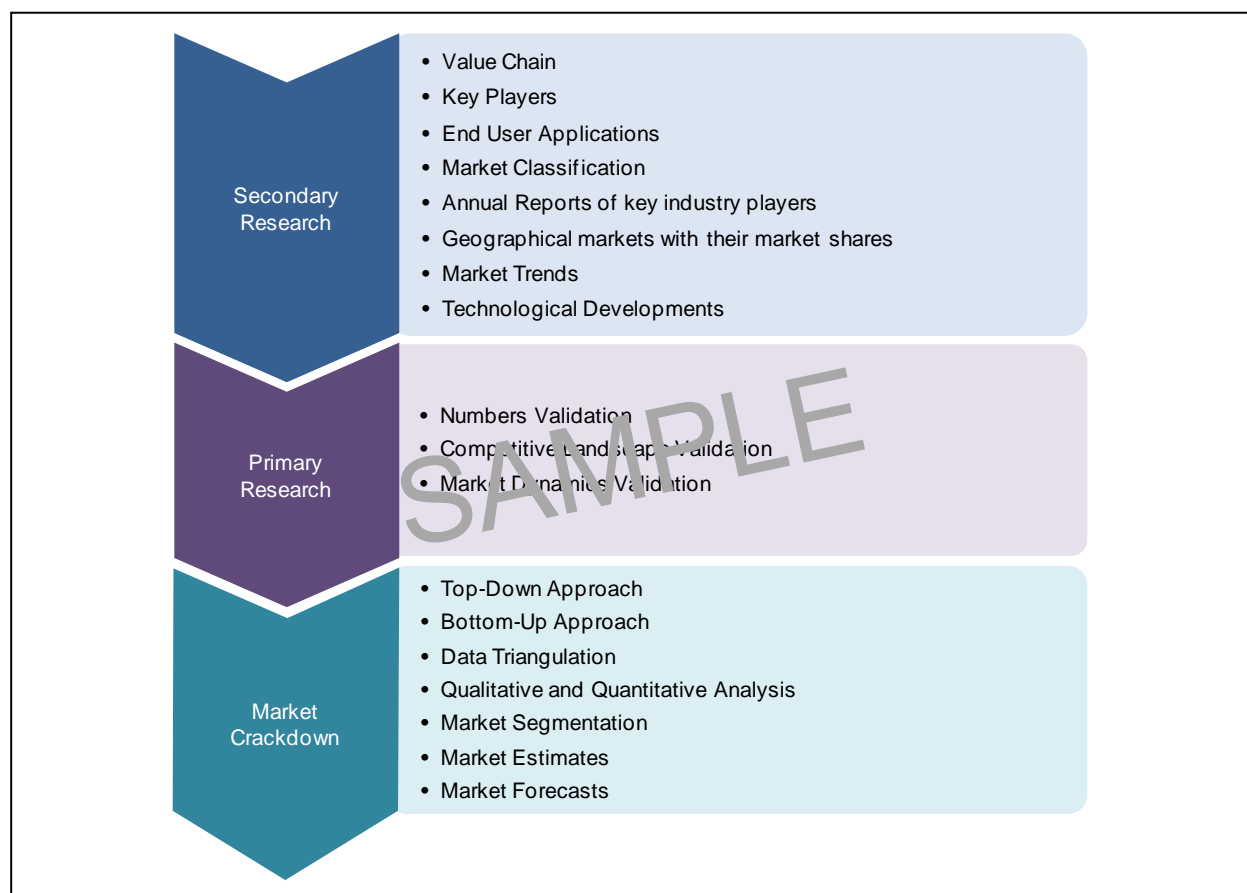
1.5 RESEARCH METHODOLOGY

This research study involved the usage of extensive secondary sources, directories, and databases such as IEEE, WSTS, Hoovers, Bloomberg, Business-week, Factiva, OneSource, and so on; to identify and collect information useful for an extensive technical, market-oriented, and commercial study of this global market. The primary sources are mainly several industry experts from core and related industries; and preferred suppliers, manufacturers, distributors, administrators, solution providers, technology developers, alliances, standards & certification organizations from companies, and organizations related to all the segments of this industry's value chain. All the primary sources were interviewed to obtain and verify critical qualitative & quantitative information as well as to assess the future prospects.

The following illustrative figure shows the market research methodology applied in making this report on the global LiDAR market.

FIGURE 2

RESEARCH METHODOLOGY



Source: MarketsandMarkets Analysis

In the extensive secondary research process for this research study, several secondary sources such as certified publications, articles from recognized authors, white papers, annual reports of companies, gold standard & silver standard websites, directories, and databases were used to identify and collect information useful for the study of this global market.

In the primary research process done for this research study, the primary sources – industry experts such as CEOs, vice presidents, marketing directors, technology & innovation directors and related key executives from various key companies, organizations in the LiDAR industry and related industries such as photogrammetry, and LiDAR sensor and software industry have

been interviewed to obtain and verify, both, the qualitative and quantitative aspects of this research study.

Secondary research was mainly used to obtain key information about the industry's value chain, market's monetary chain, total pool of key players, the end-user applications for each of the LiDAR products, market classification & segmentation according to industry trends till the bottom-most level, geographical markets, and key developments from both, market and technology oriented perspectives.

After the comprehensive market engineering to calculate market statistics, market size estimations, market forecast, market crackdown & data triangulation (the methodology for these quantitative data processes is explained in the sections below); an extensive primary research was mainly done to gather a detailed information; and verify, and validate critical numbers arrived at, segmentation types, industry trends, key players, competitive landscape of each type of LiDAR product & component markets; and obtain/evaluate key market dynamics such as drivers, restraints, opportunities, burning issues, winning imperatives, key player strategies, technology roadmaps, evolutions, and timelines.

Market engineering done for the total market crackdown, uses top-down and bottom-up approaches, extensively, along with several data triangulation methods to execute market estimation and market forecast for the overall segment and sub-segment markets listed in this report. Extensive qualitative and further quantitative analysis was also done from all the numbers arrived at, in the complete market engineering process, to list the key information throughout the report.

2 MARKET OVERVIEW

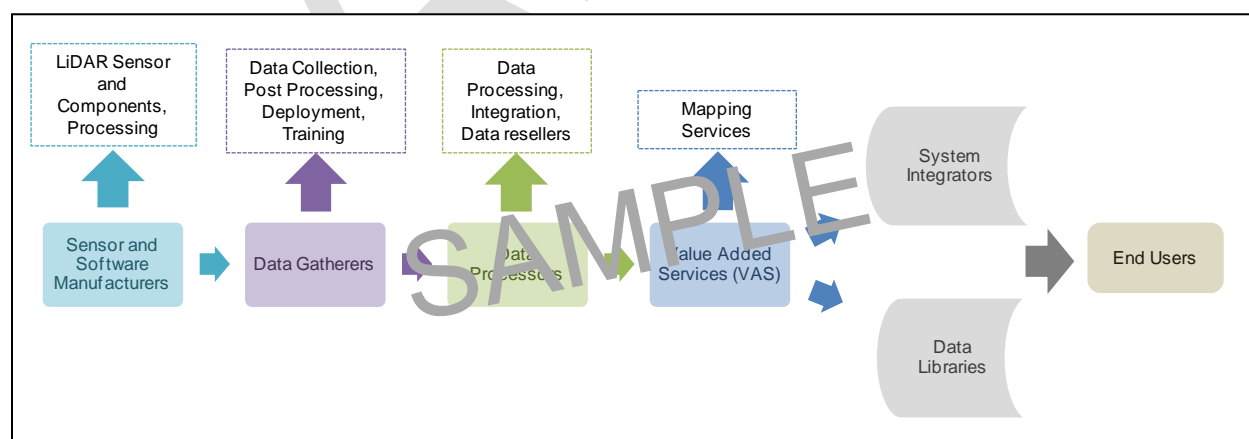
2.1 VALUE CHAIN ANALYSIS

The total value chain of the global LiDAR market when viewed from the electronics industry & semiconductor industry point of view, is a broad industry segment-related chain; a complex network/web interconnected between the various players related to the complete market, with several interconnections between them, along with flow of “value” in the form of goods & services.

The complete value chain of the LiDAR industry when classified into industry segments has two major streams – core industry segments and supporting industry segments. Goods & Service, in business terms— “value”, flows among the various industry segments present between the starting point – the raw material suppliers, and the end point – the end-users; mainly, through the core industry segments, with exchange of value at several intermittent stages, along with the supporting industry segments.

FIGURE 3

LIDAR INDUSTRY VALUE CHAIN



Source: MarketsandMarkets Analysis

The figure above is an illustration of the complex industry network for the LiDAR ecosystem's industry segments. The figure shows the network within the core industry segments; and the flow of goods and services from the first point – the sensor and software developer, till the last point – the end users. The figure also shows all the supporting industry segments for this value chain, at the top of the central part (core industry segments), with interconnections among various industry segments at intermediary stages.

To delve further into the value chain flow, the complete chain starts with LiDAR sensor and software development. The sensor manufacturers are the hardcore equipment providers who form the core of any LiDAR system. The software that connects all the systems together is also one of the key areas of this ecosystem.

In total, the complete set of component manufacturers, are connected to the next stage in the value chain— that of the data gatherers, who provide LiDAR services, which include data collection. The players in this space generally own several types of LiDAR sensors and; thus, are capable of providing varied data collection solutions. Some of the players in this segment also provide equipment deployment services, and also train professionals in the art of LiDAR data acquisition.

The data is then sent to the data processors that provide processing solutions, which include integration of data collected by different sensors and, in some cases, data reselling. The next step in the chain is the value added services providers, who mainly work on the processed data, and also provide mapping services.

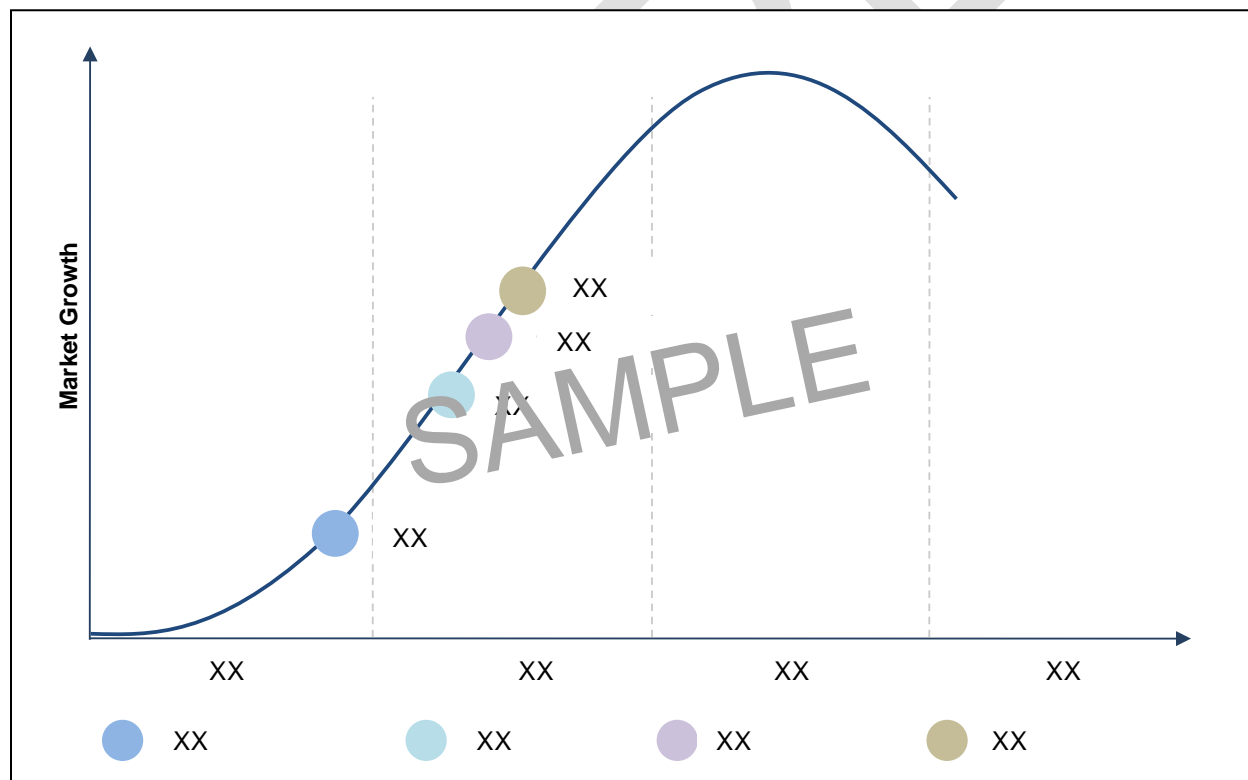
The final steps in the chain are classified, to some extent, under VAS, and include data libraries and system integrators who combine the services provided by different segments. It is important to note that with an appropriate amount of value addition at each stage in the value chain, from the first step till the last, at each interconnection between industry segments—the overall revenue of the players involved in various industry segments listed above, varies, depending on the products and services offered along with the industry segment(s) they are present in.

2.1.1 MARKET STAGES & LIFE-CYCLE

LiDAR market life cycle depicts the industry trend of LiDAR products. This life cycle has been categorized into four phases namely the introduction, growth, maturity, and decline. Introduction phase signifies that the product or technology is at the nascent stage and not yet commercialized, but can succeed in future. Growth phase signifies that the product or the technology has a strong demand and huge scope in the market and also the highest growth potential.

FIGURE 4

MARKET STAGES OF LIDAR PRODUCTS, BY TYPE, 2013



Source: MarketsandMarkets Analysis

Since LiDAR is in its early commercialization phase, almost all the applications are in the introduction and growth phases. LiDAR has been growing steadily since the early XXs, though

due to many restraining factors like cost and lack of awareness, the growth has been limited over the last five years. However, with the cost of sensors coming down gradually, and their usability and accuracies going up, LiDAR awareness is on the rise; it is expected that in the coming five years, the LiDAR market will reach a point closer to the top-end of the growth phase. As seen in the figure, the latest technology to come up in the LiDAR market is the hand-held LiDAR technology. It is expected that with the introduction of the low-cost, highly accurate technology, the LiDAR market will grow rapidly in the coming few years.

SAMPLE

3 MARKET SEGMENTATION, BY PRODUCT TYPE

3.1.1 LIDAR PRODUCT MARKET OVERVIEW

The following section gives the market data points for the various product types. Airborne, terrestrial, mobile, and short range LiDAR types are systems considered for the analysis.

TABLE 1

GLOBAL LIDAR MARKET REVENUE, BY PRODUCT TYPE, 2012 – 2018 (\$MILLION)

LiDAR types	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
Airborne	XX	XX	XX	XX	XX	XX	XX	XX
Terrestrial	XX	XX	XX	XX	XX	XX	XX	XX
Mobile	XX	XX	XX	XX	XX	XX	XX	XX
Short range	XX	XX	XX	XX	XX	XX	XX	XX
Total	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

The total revenue segmentation of LiDAR market by various product types is given in the table above. In 2012, the total LiDAR market was worth \$XX million with maximum contribution from the airborne LiDAR type. One of the reasons for the highest share of airborne LiDAR is its high average selling price. Also, as compared to other types, airborne LiDAR market is mature and, thus, reliable. Thus, it is preferred by users for whom the budget is not a constraint. However, it can be observed that the airborne LiDAR market has the lowest CAGR in the product type list. This indicates the shift in trend in the LiDAR market. Due to the innovations in terrestrial and mobile LiDAR systems, the cost-benefit ratio for these LiDAR types has surpassed that of airborne LiDAR system. It can be said that the terrestrial and mobile LiDAR systems are disrupting the airborne LiDAR market to some extent. The forecasted data points

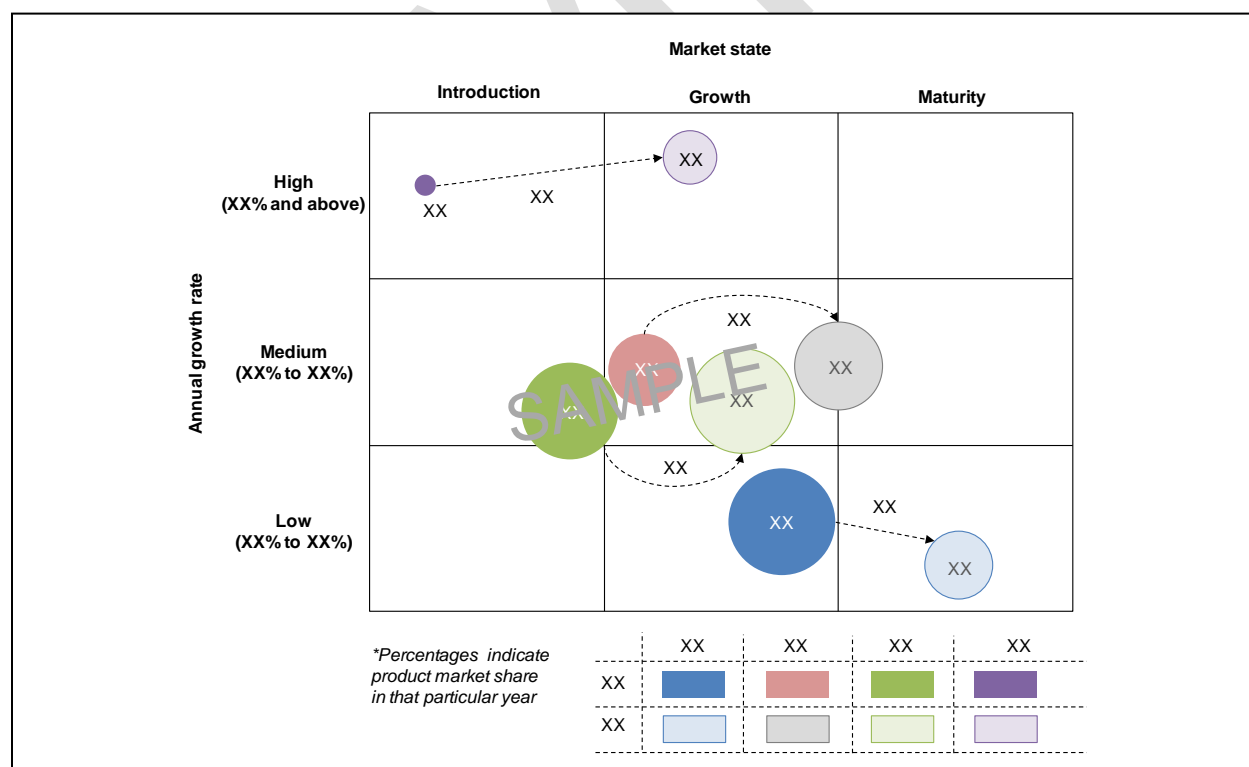
for the year 2018 supports the analysis. In 2018, the mobile LiDAR system and terrestrial LiDAR system is expected to contribute \$XX million and \$XX million, respectively, to the total estimated market worth \$XX million.

3.1.2 GROWTH RATE VS MARKET SHARE MATRIX: PRODUCT TYPES

The matrix shown below gives an overview of the various parameters related to the LiDAR product types. The matrix is used to map the annual growth against the market stage of various LiDAR product types. In the figure, 2013's and 2018's estimated data is represented. The bubble size and the percentage figure indicate the market share of the LiDAR products in that particular year.

FIGURE 5

PRODUCT TYPE: GROWTH RATE VS MARKET STATE MATRIX, 2013 – 2018



Source: MarketsandMarkets Analysis

It can be observed that, though, airborne LiDAR has the maximum share in 2013, it has been growing at a very slow rate. One of the reasons for this is the market stage of airborne LiDAR market. It is currently in the later growth stage; and by 2018, it is expected to reach the mid-maturity stage. The effect of low growth is estimated to affect the airborne LiDAR market share in 2018. By 2018, the share is expected to fall from XX% to XX%. On the other hand, the mobile and terrestrial LiDAR markets are expected to reach up to the later growth stage by 2018 with a considerable increase in the market share. This indicates the disruptive nature of the mobile and terrestrial technologies. They are expected to grow at the cost of the airborne LiDAR market.

TABLE 2

GLOBAL LIDAR MARKET SHIPMENT, BY PRODUCT TYPE, 2012 – 2018 (UNIT)

LiDAR types	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
Airborne	XX	XX	XX	XX	XX	XX	XX	XX
Terrestrial	XX	XX	XX	XX	XX	XX	XX	XX
Mobile	XX	XX	XX	XX	XX	XX	XX	XX
Short range	XX	XX	XX	XX	XX	XX	XX	XX
Total	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

Similar to the LiDAR revenue segmentation by various product types, the volumes shipped are also divided into four major types of LiDARs. The table above gives a detailed forecast of the respective data points. In 2012, the maximum shipments were recorded by the terrestrial LiDARs followed by the mobile LiDARs. The total market shipments were approximately XX units. Though the short range LiDAR has the lowest market share currently, it is expected to register the highest CAGR among all the product types considered for the analysis. It is estimated to record a CAGR of XX% annually from 2013 to 2018. Waxing at an exponential rate, short range LiDAR market shipments, by 2018, are expected to command XX% of the

total LiDAR shipments. Major reason for this exponential growth is the non-traditional use of LiDAR equipment. Short range LiDARs are expected to heavily penetrate the asset management, crime scene analysis, accident reconstruction, reverse engineering, building mapping, and 3D modeling applications.

TABLE 3

**GLOBAL LIDAR MARKET ASP,
BY PRODUCT TYPE, 2012 – 2018 (\$'000)**

LiDAR types	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
Airborne	XX	XX	XX	XX	XX	XX	XX	XX
Terrestrial	XX	XX	XX	XX	XX	XX	XX	XX
Mobile	XX	XX	XX	XX	XX	XX	XX	XX
Short range	XX	XX	XX	XX	XX	XX	XX	XX
Weighted ASP	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

The table above gives the pricing trend of various LiDAR types. All the prices mentioned above are to the base of thousand. It can be observed that, in 2012, the most expensive LiDAR type was the airborne LiDAR. It was priced approximately at \$XX; though the price is expected to fall at a compounded annual rate of XX%, it is expected to remain above \$XX mark till the year 2018. One of the major reasons for this steep price of airborne LiDAR is the requirement of state of the art equipment and devices. Airborne LiDAR is used for surveying and mapping larger corridors. Though the range and output power is vital, precision and accuracy is equally important.

Subsequently, the short range LiDAR is the most cost effective LiDAR product. . In 2012, it was approximately priced at \$XX. Weighted ASP of all the LiDAR types combined was \$XX in 2012; and with an annual decrease of XX%, it is expected to reach \$XX by 2018.

4 MARKET SEGMENTATION, BY APPLICATION

4.1 INTRODUCTION

LiDAR can be applied in a multitude of application sectors where mapping of large areas and digital imaging is required.

Applications considered for analysis are the Government, Civil Engineering, Military, Defense and Aerospace, Corridor Mapping, Topographic Surveys, Volumetric Mapping, and other applications. Others include niche applications such as: asset management, building mapping, reverse engineering, and accident reconstruction.

TABLE 4

GLOBAL LIDAR MARKET REVENUE, BY APPLICATIONS, 2012 – 2018 (\$MILLION)

Applications	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
Government	XX	XX	XX	XX	XX	XX	XX	XX
Civil Engineering	XX	XX	XX	XX	XX	XX	XX	XX
Military, Defense & Aerospace	XX	XX	XX	XX	XX	XX	XX	XX
Corridor Mapping	XX	XX	XX	XX	XX	XX	XX	XX
Topographic Surveys	XX	XX	XX	XX	XX	XX	XX	XX
Volumetric Mapping	XX	XX	XX	XX	XX	XX	XX	XX
Others	XX	XX	XX	XX	XX	XX	XX	XX
Total	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

The table above gives the market segmentation of LiDAR systems by various application types. There are various macro applications considered for the analysis, applications such as: the Government, Civil Engineering, Military, Defense and Aerospace, Corridor Mapping, Topographic Surveys, Volumetric Mapping, and Other applications. Out of the total market of \$XX million, the maximum share was contributed by the civil engineering application in 2012. However, the highest CAGR is expected for the corridor mapping application. It is expected to grow at the rate of XX% from 2013 to 2018. By the year 2018, civil engineering application is expected to dominate the LiDAR market.

5 MARKET SEGMENTATION, BY GEOGRAPHY

5.1 INTRODUCTION

The LiDAR market has been segmented into four geographies, namely: North America, Europe, APAC, and ROW regions. The maximum consumption of LIDAR systems is dominated by the western economies. However, the APAC region is showing a healthy growth in LiDAR market and is expected to reach considerable volumes by the year 2018.

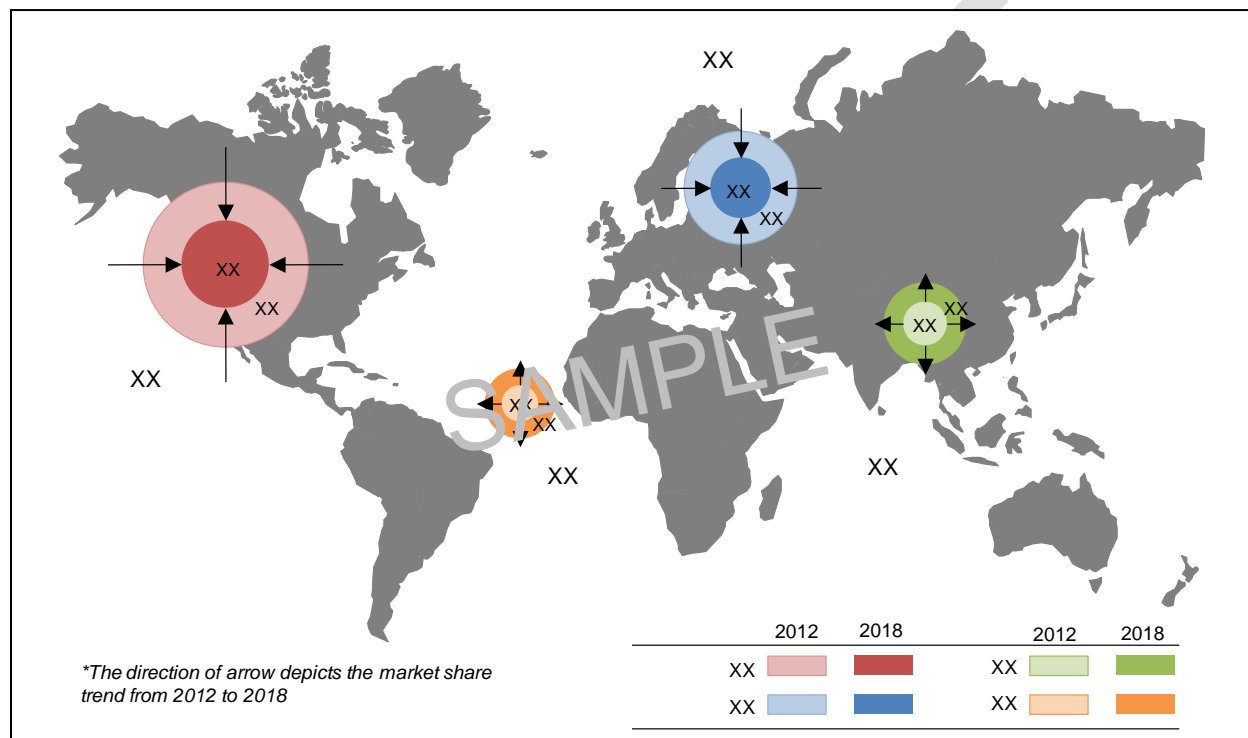
There are various reasons for the dominance of North America and Europe in the LiDAR market. One of the reasons is the large number of companies headquartered in this North America and Europe. Also, the demand from the North American and European region is largest due to the high penetration rate of LiDAR devices in various applications such as: The Government, Civil Engineering, Military, Defense and Aerospace, Corridor Mapping, Topographic Surveys, and Volumetric Mapping. Thus, it can be concluded that the LiDAR ecosystem in North America and Europe is much more evolved and established as compared to the other regions.

The chapter focuses on the geographic segmentation of various LiDAR product types and the forecast for the same. The following section gives an overview of the market data points for geographic segmentation of LiDAR market.

The figure gives an overview of the LiDAR market share trend from 2012 to 2018.

FIGURE 6

LIDAR REGIONAL MARKET SHARE TREND, 2012 – 2018



Source: MarketsandMarkets Analysis

The figure shows the regional market share of LiDAR systems. It can be observed that the maximum market share is contributed by North America followed by Europe. In 2012, North America had the share of XX%; however, it is expected to fall down to XX% by the year 2018. On the other hand, APAC's share in 2012 was only XX%, but with increasing adoption of LiDAR systems will see this market share to increase to XX% by the year 2018.

5.1.1 LIDAR GEOGRAPHY MARKET OVERVIEW

The market overview of geographic scenario for the LiDAR market is discussed in the following section. The geographic analysis is done to identify the regional concentrated pockets of LiDAR market. The table below gives an in-depth market data analysis for the four regions.

TABLE 5

GLOBAL LIDAR MARKET REVENUE, BY GEOGRAPHY, 2012 – 2018 (\$MILLION)

Region	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
North America	XX	XX	XX	XX	XX	XX	XX	XX
Europe	XX	XX	XX	XX	XX	XX	XX	XX
APAC	XX	XX	XX	XX	XX	XX	XX	XX
ROW	XX	XX	XX	XX	XX	XX	XX	XX
Total	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

The market split by various geographic regions is shown in the table above. In 2012, \$XX million out of the total \$XX million market revenue was alone contributed by North America. However, the highest CAGR is expected for the APAC region. It is estimated to grow from \$XX million in 2012 to \$XX million in 2018. The estimated rate of growth is XX% annually. With such a healthy growth rate, the APAC region is expected to overtake Europe and become the second largest market contributor by 2018. Thus, it can be observed that by 2018, all three major regions namely: North America, Europe, and APAC are expected to contribute equal value to the market. This indicates the large adoption of LiDAR systems across the globe.

6 MARKET SEGMENTATION, BY COMPONENT

6.1.1 LIDAR COMPONENT MARKET OVERVIEW

LiDAR components are the basic building blocks of any LiDAR system. These blocks remain unchanged even if the LiDAR type is changed. The market data points for each of the components mentioned above are given in the table below.

TABLE 6

GLOBAL LIDAR MARKET REVENUE, BY COMPONENT TYPE, 2012 – 2018 (\$MILLION)

Component	2012	2013	2014	2015	2016	2017	2018	CAGR% (2013 - 2018)
Inertial navigation system	XX	XX	XX	XX	XX	XX	XX	XX
Laser Diodes	XX	XX	XX	XX	XX	XX	XX	XX
GPS/GNSS receiver	XX	XX	XX	XX	XX	XX	XX	XX
Camera	XX	XX	XX	XX	XX	XX	XX	XX
MEMS mirror	XX	XX	XX	XX	XX	XX	XX	XX
Total	XX	XX	XX	XX	XX	XX	XX	XX

Source: MarketsandMarkets Analysis

The table above gives the market revenue grossed by various major components of LiDAR system. The components considered for the analysis are INS, laser diode, GPS/GNSS receiver, camera, and MEMS mirror. In 2012, out of all the components, the maximum market revenue was contributed by GPS/GNSS receiver systems. There are two reasons for this: firstly, the high price of GPS receiver systems and secondly, the indispensability of GPS/GNSS receiver for the LiDAR system. In 2012, it earned \$XX million and at a healthy CAGR of XX% from 2013 to 2018, it is expected to \$XX million by 2018.

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