

# VCSELS - MARKET AND TECHNOLOGY TRENDS 2019

## Market & Technology Report - May 2019

*New functionalities in smartphone and automotive are boosting the VCSEL market.*

### WHAT'S NEW

- In-depth supply chain analysis
- Analysis of epitaxy start-ups and small VCSEL companies
- Smartphone 3D sensing roadmaps, for front side and rear side
- Analysis of next-generation optics associated with VCSELS
- Focus on LiDAR opportunities for VCSELS

### REPORT KEY FEATURES

- Market volume and revenue 2018 - 2024
- Industry analysis, from epiwafer to system
- VCSEL manufacturing analysis
- VCSEL specification and cost analysis
- Analysis of 3D sensing's entry barriers

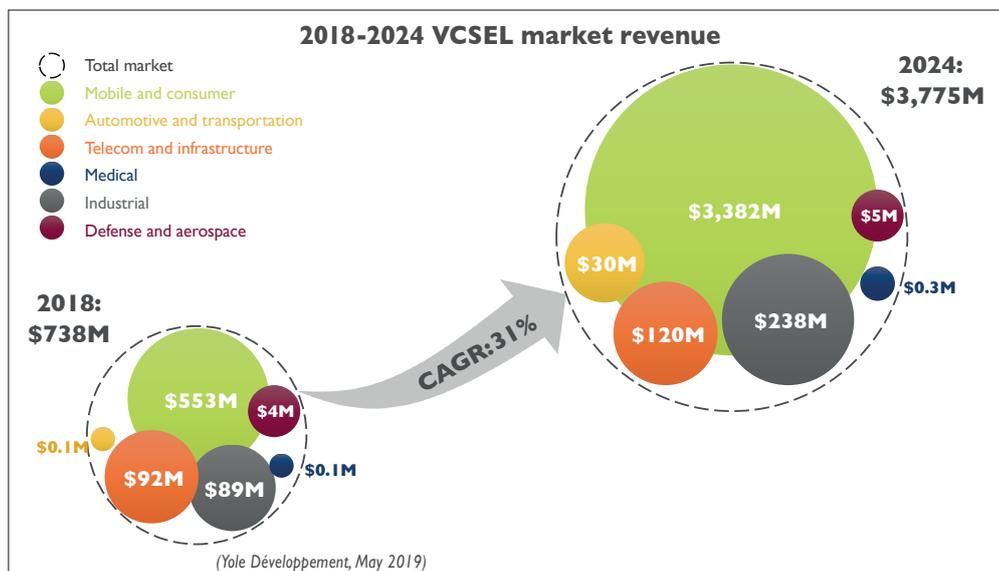
### A MARKET FUELLED BY SMARTPHONE APPLICATIONS

In November 2017, Apple released the iPhone X with a new feature called FaceID, which detects and recognizes the smartphone's owner and unlocks the phone, thanks to three different vertical cavity surface-emitting lasers (VCSELS) working together. With this ground-breaking implementation of VCSEL for front 3D imaging, Apple set the proverbial "cat among the pigeons" in the smartphone world, and consequently in the VCSEL industry.

Following the iPhone X's release, several smartphone manufacturers announced that their next flagship would embed a similar feature. Front 3D imaging was implemented as a first step, and more recently smartphone manufacturers have released new products with a rear 3D sensing module, using the time of flight (ToF) principle. Mobile and consumer VCSEL applications generated revenue of \$553M in 2018, with growth expected to reach to \$3,382M in 2024 at a CAGR of 35%.

Other applications are also expected to implement VCSELS in the mid to long-term in different market segments: mobile & consumer, automotive & transportation, and industrial. In LiDAR, VCSELS are expected to compete with Edge Emitting Lasers, especially for middle and short-range LiDAR. However, the use of VCSELS for long-range detection is still challenging due to VCSEL's limited-output optical power compared to EELs. Also, cost is still prohibitive. But due to their ability to easily be built in arrays, VCSELS are a good opportunity for reducing LiDAR cost and reaching the targets set by OEMs. In the long-term, the VCSEL market for LiDAR could generate a revenue of around \$800M by 2032.

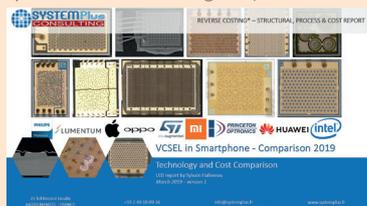
*This report presents a comprehensive overview of the main VCSEL applications, including an in-depth analysis of 3D sensing in the consumer and automotive landscapes.*



### LINKED REPORT

#### VCSEL in Smartphone – Comparison 2019

Structural, Process & Costing Report by System Plus Consulting – April 2019



Physical analysis and cost comparison of ten leading flagship smartphone VCSEL dies (dot projector, flood illuminator, and proximity sensor) from Apple, Huawei, Xiaomi, Oppo, Lenovo, and Intel.

*Bundle offer available - Contact us for more information.*

### A BOOMING MARKET, THANKS TO NEW TECHNOLOGIES AND LOWER COSTS

Since 2017, an increasing number of smartphones are implementing VCSELS. After Apple, Xiaomi and Oppo released their flagship phones with a 3D sensing feature, and even more recently the two market leaders, Huawei and Samsung, began implementing VCSELS. On the technology side, structured light, which was used for facial recognition for the first time on high-end smartphones, implies the use of two different VCSELS: one flood illuminator and one dot projector. Therefore, using these two light sources adds a tangible cost to the 3D sensing module. Meanwhile, a face recognition module using the

ToF principle was implemented by LG in early 2019. This leads to using only one VCSEL (a flood illuminator), and therefore a reduced cost of the 3D sensing module compared to modules using the structured light principle.

In 2017, the total VCSEL cost per smartphone was estimated at \$4 - \$5. In 2018, this dropped to \$2 - \$3, evidence of a strong price decrease. There are several explanations for this: higher volumes leading to a lower cost; more VCSEL manufacturers qualified by smartphone manufacturers (leading to lower margins); and higher manufacturing yields

leading to increased “good” VCSELS per wafer. In the future, a smartphone should embed VCSELS for proximity sensing and front and rear 3D sensing, with a total VCSEL cost around \$2.

This report presents the main specifications for VCSELS, with a detailed analysis of the VCSEL manufacturing process and a cost comparison split by VCSEL type. This report also shows the impact of smartphone applications on VCSEL design.



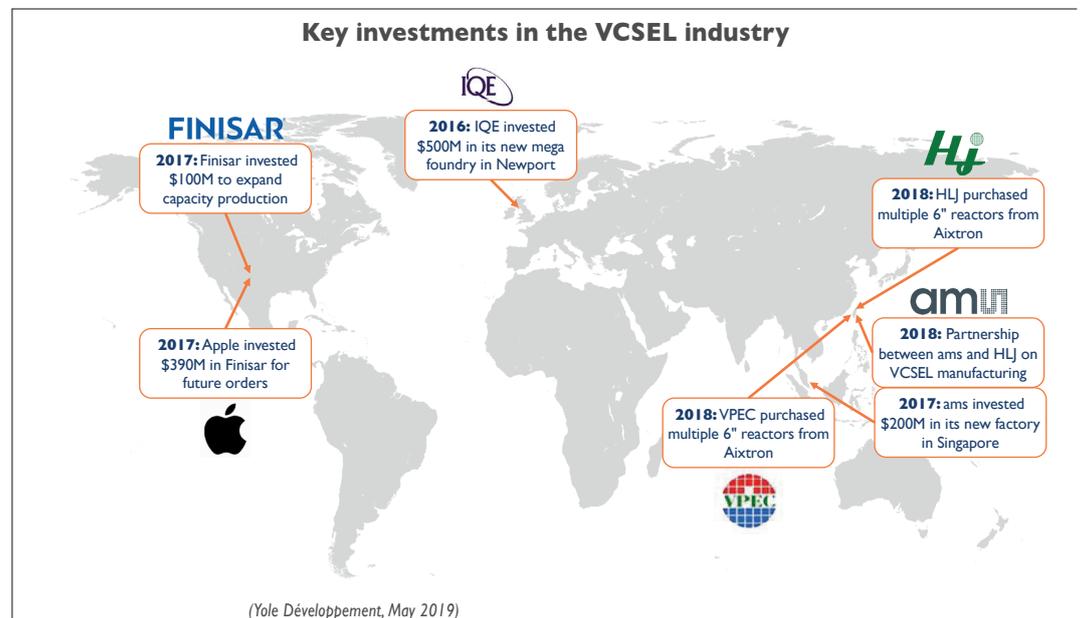
## HIGH INVESTMENTS FOR AN ALWAYS-INCREASING DEMAND

The supply chain of VCSEL manufacturers for consumer applications relies greatly on epiwafer manufacturers. Among these is IQE, which since 2016 has invested significant sums into a mega-foundry, targeted to hold 100 MOCVD tools. This will give IQE the ability to supply epiwafers for applications requiring a high volume of VCSELS, such as consumer applications and automotive applications (i.e. driver-monitoring and LiDAR). The observed manufacturing cost decrease is the result of several improvements, along with the transition from 4" wafer manufacturing to 6" wafer manufacturing processes, which resulted in a VCSEL cost decrease of 20%. Some players like IQE are already investigating 8" manufacturing based on silicon wafers to reduce costs even further, but this will take time since the industry has just moved to 6" and many challenges (for example, uniformity and wafer breakage) must be overcome. Moreover, this transition must be driven by an application requiring

high volumes and/or large dies. LiDAR could be one of these drivers, but not in the short-term.

With an increasing number of new applications using VCSELS, VCSEL manufacturers are expected to move strategically. Some could target datacom, since 5G applications could boost this market at short-term. Others could invest in automotive applications linked with autonomous vehicle development, where driver monitoring systems should be mandatory and LiDAR should be implemented in the majority of such vehicles. With this in mind, some acquisitions might occur in the coming years, but these should be dedicated to one topic, with highly-specialized companies or start-ups being targeted.

This report furnishes an in-depth analysis of the VCSEL industry, highlighting supply chain trends and key players. Also provided is an overview of new players and their positioning versus established players.



## REPORT OBJECTIVES

Provide market data for different VCSEL applications:

- Volume and revenue, by application and market segment
- Average selling price (ASP) and expected evolution
- Ranking of the top five VCSEL manufacturers

Offer a deep understanding of the VCSEL business value chain, players, and trends:

- Global list of VCSEL manufacturers
- Supply chain information for mobile applications: who supplies whom
- Supply chain analysis
- Comparison of VCSELS used in mobile applications

Give insights into manufacturing and associated challenges

- What is a VCSEL?
- Analysis of epiwafer players
- Thoughts on critical steps in VCSEL manufacturing

## COMPANIES CITED IN THE REPORT (non exhaustive list)

Aixtron, Alight, ams, Anadigics, Apple, Asus, Audi, Avago, AWSC, Blackmore, Bosch, Broadcom, Canon, Changelight, Continental, Emcore, Epistar, Epiworks, Excelitas, Finetech, Finisar, Foxconn, Fuji Xerox, Fujitsu, Global Communication Semiconductor, Google, Hamamatsu, Heptagon, Himax, HLJ, Honeywell, Honor, Huawei, Ibeo, II-VI, Infineon, Infinera, Inneos, Innoluce, Intel, IntelliEpi, IQE, JDSU, Kaiaam, Landmark Opto, Lasermate, Lasertel, Laytec, LeddarTech, Lenovo, LG, Lumentum, Luminar, Luxnet, Mantis Vision, Masimo, Namuga, Oclaro, Oculus, Omnivision, Oppo, Optovue, Optowell, Orbbec, Osram, Oxford Instruments, Philips Photonics, pmd, POET Technologies, Primesense, Princeton Optronics, Realsense, Riber, Ricoh, Robosense, Samsung, Sanan, Santec Corporation, SCAT, Seiko Epson, Seminex, SensL, Shiraz University, Sick, SinoSemic, SoftKinetic, Sony Corporation, Stanley, STMicroelectronics, Sumitomo Chemicals, Thorlabs, Trilumina, Truelight Corporation, US Lasers Inc., Veeco, Velodyne, Vertilas, Vertilite, Viavi, Vivo, Vixar, VPEC, Win Semiconductor, Xiaomi, ZF, and more.

## TABLE OF CONTENTS (complete content on i-Micronews.com)

<a href="#">Glossary and definitions</a>	<a href="#">4</a>	> Supply chain analysis	
<a href="#">Report objectives</a>	<a href="#">5</a>	- The art of making VCSEL epiwafers	
<a href="#">Report scope</a>	<a href="#">7</a>	- Positioning of new entrants	
<a href="#">Report methodology</a>	<a href="#">8</a>	- 2018 vs. 2024 supply model	
<a href="#">About the authors</a>	<a href="#">10</a>	- 2018 market share	
<a href="#">What we got right, what we got wrong</a>	<a href="#">12</a>	> Potential start-ups	
<a href="#">Executive summary</a>	<a href="#">16</a>	<b>Technology trends</b>	<b>144</b>
<a href="#">Context</a>	<a href="#">38</a>	> VCSEL technology description	
<a href="#">Market forecasts</a>	<a href="#">43</a>	> VCSEL manufacturing process	
> VCSEL market - Breakdown by application		- VCSELS vs. EELs	
> 2017 - 2024 market volume in Munits - Split by application		- What are the difficulties for 150mm wafers?	
> 2017 - 2024 market revenue in \$M - Split by application		- Transition to 8" or not?	
> Long-term forecast - Focus on automotive		> Analysis of 3D-sensing's entry barriers	
> Market growth drivers		- Overview	
> VCSEL ASPs		- Challenges for VCSEL IDMs to enter 3D sensing applications	
<b>Market trends</b>	<b>60</b>	> Next-generation optics associated with VCSELS	
<b>Market share &amp; supply chain</b>	<b>81</b>	- What is wafer-level optics?	
> Epihouse analysis		- Comparison of the 3D camera module in today's smartphones	
- Comparison of main players		> Mobile 3D camera - VCSEL cost analysis	
> VCSEL industry - Overview		- Players involved in the 3D sensing supply chain	
- Position on the supply chain, and business model		- VCSEL comparison	
> VCSEL industry - Trends		- World-facing 3D sensing	
- From datacom to 3D sensing		> LiDAR - Opportunity for VCSELS	
- Apple iPhone X - Supply chain		- Lasers for automotive LiDAR	
- VCSELS in iPhones - 2018 vs. 2024		- EELs compared to VCSELS	
- Android smartphone makers - Supply chain		- Replacement of EEL by VCSEL	
		- VCSEL ASP	
		<b>Conclusions</b>	<b>230</b>
		<b>Annex - Description of applications</b>	<b>237</b>
		<b>Yole Développement presentation</b>	<b>286</b>

## RELATED REPORTS

*Benefit from our Bundle & Annual Subscription offers and access our analyses at the best available price and with great advantages*



- LiDAR for Automotive and Industrial Applications 2019
- Edge Emitting Lasers: Market and Technology Trends 2019
- GaAs Wafer and Epiwafer Market: RF, Photonics, LED and PV Applications 2018
- Consumer Biometrics: Market and Technologies Trends 2018

Find all our reports on [www.i-micronews.com](http://www.i-micronews.com)



## AUTHORS

As part of the Photonics, Sensing & Display division at Yole Développement (Yole), **Pierrick Boulay** works as Market and Technology Analyst in the fields of Solid State Lighting and Lighting Systems to carry out technical, economic and marketing analysis. Pierrick has authored several reports and custom analysis dedicated to topics such as general lighting, automotive lighting, LiDAR, IR LEDs, UV LEDs and VCSELS. Prior to Yole, Pierrick has worked in several companies where he developed his knowledge on general lighting and on automotive lighting. In the past, he has mostly worked in R&D department for LED lighting applications. Pierrick holds a master degree in Electronics (ESEO – Angers, France).



**Pars Mukish** holds a master degree in Materials Science & Polymers (ITECH - France) and a master degree in Innovation & Technology Management (EM Lyon - France). Since 2015, Pars has taken on responsibility for developing SSL and Display activities activities as Business Unit Manager at Yole Développement (Yole). Pars is part of the Photonics, Sensing & Display division at Yole. Previously, he has worked as Marketing Analyst and Techno-Economic Analyst for several years at the CEA (French Research Center).

# ORDER FORM

## VCSELS - Market and Technology Trends 2019

### BILL TO

Name (Mr/Ms/Dr/Pr): .....

Job Title: .....

Company: .....

Address: .....

City: .....

State: .....

Postcode/Zip: .....

Country\*: .....

\*VAT ID Number for EU members: .....

Tel: .....

Email: .....

Date: .....

### PAYMENT

#### BY CREDIT CARD

Visa  Mastercard  Amex

Name of the Card Holder: .....

Credit Card Number: .....

Card Verification .....

Value (3 digits except AMEX: 4 digits): .....

Expiration date: .....

#### BY BANK TRANSFER

BANK INFO: HSBC, 1 place de la Bourse,  
F-69002 Lyon, France,  
Bank code: 30056, Branch code: 00170  
Account No: 0170 200 1565 87,  
SWIFT or BIC code: CCFRFRPP,  
IBAN: FR76 3005 6001 7001 7020 0156 587

#### RETURN ORDER BY

• MAIL: YOLE DÉVELOPPEMENT, Le Quartz,  
75 Cours Emile Zola, 69100 Villeurbanne/Lyon - France

#### SALES CONTACTS

- Western US & Canada - Steve Laferriere:  
+ 1 310 600-8267 – laferriere@yole.fr
- Eastern US & Canada - Chris Youman:  
+1 919 607 9839 – chris.youman@yole.fr
- Europe & RoW - Lizzie Levenez:  
+ 49 15 123 544 182 – levenez@yole.fr
- Japan & Rest of Asia - Takashi Onozawa:  
+81-80-4371-4887 – onozawa@yole.fr
- Greater China - Mavis Wang:  
+886 979 336 809 – wang@yole.fr
- Korea - Peter OK:  
+82 10 4089 0233 – peter.ok@yole.fr
- Specific inquiries: +33 472 830 180 – info@yole.fr

<sup>(1)</sup> Our Terms and Conditions of Sale are available at  
[www.yole.fr/Terms\\_and\\_Conditions\\_of\\_Sale.aspx](http://www.yole.fr/Terms_and_Conditions_of_Sale.aspx)  
The present document is valid 24 months after its publishing date:  
May 29, 2019

### PRODUCT ORDER - Ref YDI9024

Please enter my order for above named report:

- One user license\*: Euro 5,990  
 Multi user license: Euro 6,490

- The report will be ready for delivery from June 13, 2019  
- For price in dollars, please use the day's exchange rate. All reports are delivered electronically at payment reception. For French customers, add 20% for VAT

I hereby accept Yole Développement's Terms and Conditions of Sale<sup>(1)</sup>

Signature: .....

\*One user license means only one person at the company can use the report.

### SHIPPING CONTACT

First Name: .....

Last Name: .....

Email: .....

Phone: .....

### ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement has grown to become a group of companies providing marketing, technology and strategy consulting, media and corporate finance services, reverse engineering and reverse costing services and well as IP and patent analysis. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 80 collaborators worldwide covering MEMS and Image Sensors, Compound Semiconductors, RF Electronics, Solid-State Lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Nanomaterials, Power Electronics and Batteries & Energy Management.

The "More than Moore" market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and KnowMade, support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to grow their business.

#### CONSULTING AND ANALYSIS

- Market data & research, marketing analysis
- Technology analysis
- Strategy consulting
- Reverse engineering & costing
- Patent analysis
- Design and characterization of innovative optical systems
- Financial services (due diligence, M&A with our partner)

More information on [www.yole.fr](http://www.yole.fr)

#### MEDIA & EVENTS

- i-Micronews.com website & related e-newsletter
- Communication & webcast services
- Events: TechDays, forums...

More information on [www.i-Micronews.com](http://www.i-Micronews.com)

#### REPORTS

- Market & technology reports
- Patent investigation and patent infringement risk analysis
- Structure, process and cost analysis
- Cost simulation tool

More information on [www.i-micronews.com/reports](http://www.i-micronews.com/reports)

#### CONTACTS

For more information about :

- Consulting & Financial Services: Jean-Christophe Eloy (eloy@yole.fr)
- Reports: David Jourdan (jourdan@yole.fr) Yole Group of Companies
- Press Relations & Corporate Communication: Sandrine Leroy (leroy@yole.fr)

**Definitions:** "Acceptance": Action by which the Buyer accepts the terms and conditions of sale in their entirety. It is done by signing the purchase order which mentions "I hereby accept Yole Développement's Terms and Conditions of Sale".

**"Buyer":** Any business user (i.e. any person acting in the course of its business activities, for its business needs) entering into the following general conditions to the exclusion of consumers acting in their personal interests.

**"Contracting Parties" or "Parties":** The Seller on one hand and the Buyer on the other hand.

**"Intellectual Property Rights" ("IPR")** means any rights held by the Seller in its Products, including any patents, trademarks, registered models, designs, copyrights, inventions, commercial secrets and know-how, technical information, company or trading names and any other intellectual property rights or similar in any part of the world, notwithstanding the fact that they have been registered or not and including any pending registration of one of the above mentioned rights.

**"Products":** Depending on the purchase order, reports or monitors on MEMS, Imaging, SSL, Advanced Packaging, MedTech, Power Electronics and more, can be bought either on a unit basis or as a bundled offer (i.e. subscription for a period of 12 calendar months).

**"Report":** Reports are established in PowerPoint and delivered in a PDF format with an additional Excel file. 30 min of Q&A session with an analyst/author can be included for all purchased reports (except the ones bought in one user license). More time can be allocated on a fee basis.

**"License":** For the reports 3 different licenses are proposed. The buyer has to choose one license type:

- Single user license: one person at the company can use the report. Sharing is strictly forbidden.
- Multi-user license: the report can be accessed by an unlimited number of users within the company, but only in the country of the primary user. Subsidiaries and Joint-Ventures are excluded.
- Corporate license: the report can be used by an unlimited number of users within the company, but only in the country of the primary user. Subsidiaries are included, while Joint-Ventures are excluded.

**"Monitor":** Monitors are established and delivered in Excel. An additional PDF can also join it. Q&A with an Analyst is possible for each monitor with a maximum limit of 100h/year. Frequency of the release varies according to the monitor or service.

**"Seller":** Based in Villeurbanne (France, headquarters) Yole Développement provides marketing, technology and strategy consulting, media and corporate finance services, reverse engineering/costing services as well as IP and patent analysis. With more than 70 market analysts, Yole Développement works worldwide with the key industrial companies, R&D institutes and investors to help them understand the market and technology trends.

## 1. SCOPE

- 1.1 The Contracting Parties undertake to observe the following general conditions when agreed by the Buyer and the Seller. ANY ADDITIONAL, DIFFERENT, OR CONFLICTING TERMS AND CONDITIONS IN ANY OTHER DOCUMENTS ISSUED BY THE BUYER AT ANY TIME ARE HEREBY OBJECTED TO BY THE SELLER, SHALL BE WHOLLY INAPPLICABLE TO ANY SALE MADE HEREUNDER AND SHALL NOT BE BINDING IN ANY WAY ON THE SELLER.
- 1.2 This agreement becomes valid and enforceable between the Contracting Parties after clear and non-equivocal consent by any duly authorized person representing the Buyer. For these purposes, the Buyer accepts these conditions of sales when signing the purchase order which mentions "I hereby accept Yole Développement's Terms and Conditions of Sale". This results in acceptance by the Buyer.
- 1.3 Orders are deemed to be accepted only upon written acceptance and confirmation by the Seller, within [7 days] from the date of order, to be sent either by email or to the Buyer's address. In the absence of any confirmation in writing, orders shall be deemed to have been accepted.

## 2. MAILING OF THE PRODUCTS

- 2.1 Products are sent by email to the Buyer:
  - Within a few days from the order for Products already released and paid; or
  - Within a reasonable time for Products ordered prior to their effective release. In this case, the Seller shall use its best endeavours to inform the Buyer of an indicative release date and the evolution of the work in progress.
- 2.2 The Seller shall by no means be responsible for any delay in respect of article 2.1 above, and including in cases where a new event or access to new contradictory information would require for the analyst extra time to compute or compare the data in order to enable the Seller to deliver a high quality Products.
- 2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in article 3.
- 2.4 The mailing is operated through electronic means either by email via the sales department or automatically online via an email/password. If the Product's electronic delivery format is

defective, the Seller undertakes to replace it at no charge to the Buyer provided that it is informed of the defective formatting within 90 days from the date of the original download or receipt of the Product.

- 2.5 The person receiving the Products on behalf of the Buyer shall immediately verify the quality of the Products and their conformity to the order. Any claim for apparent defects or for non-conformity shall be sent in writing to the Seller within 8 days of receipt of the Products. For this purpose, the Buyer agrees to produce sufficient evidence of such defects.
- 2.6 No return of Products shall be accepted without prior information to the Seller, even in case of delayed delivery. Any Product returned to the Seller without providing prior information to the Seller as required under article 2.5 shall remain at the Buyer's risk.

## 3. PRICE, INVOICING AND PAYMENT

- 3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are expressed to be inclusive of all taxes (except for France where VAT will be added). The prices are re-evaluated from time to time. The effective price is deemed to be the one applicable at the time of the order.
- 3.2 Payments due by the Buyer shall be sent by cheque payable to Yole Développement, credit card or by electronic transfer to the following account:
 

HSBC, 1 place de la Bourse 69002 Lyon France  
Bank code: 30056  
Branch code: 00170  
Account n°: 0170 200 1565 87  
BIC or SWIFT code: CCFRFRPP  
IBAN: FR76 3005 6001 7001 7020 0156 587

 To ensure the payments, the Seller reserves the right to request down payments from the Buyer. In this case, the need of down payments will be mentioned on the order.
- 3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except in the case of a particular written agreement. If the Buyer fails to pay within this time and fails to contact the Seller, the latter shall be entitled to invoice interest in arrears based on the annual rate Refi of the "BCE" + 7 points, in accordance with article L. 441-6 of the French Commercial Code. Our publications (report, database, tool...) are delivered only after reception of the payment.
- 3.4 In the event of termination of the contract, or of misconduct, during the contract, the Seller will have the right to invoice at the stage in progress, and to take legal action for damages.

## 4. LIABILITIES

- 4.1 The Buyer or any other individual or legal person acting on its behalf, being a business user buying the Products for its business activities, shall be solely responsible for choosing the Products and for the use and interpretations he makes of the documents it purchases, of the results he obtains, and of the advice and acts it deduces thereof.
- 4.2 The Seller shall only be liable for (i) direct and (ii) foreseeable pecuniary loss, caused by the Products or arising from a material breach of this agreement.
- 4.3 In no event shall the Seller be liable for:
  - a) Damages of any kind, including without limitation, incidental or consequential damages (including, but not limited to, damages for loss of profits, business interruption and loss of programs or information) arising out of the use of or inability to use the Seller's website or the Products, or any information provided on the website, or in the Products;
  - b) Any claim attributable to errors, omissions or other inaccuracies in the Product or interpretations thereof.
- 4.4 All the information contained in the Products has been obtained from sources believed to be reliable. The Seller does not warrant the accuracy, completeness adequacy or reliability of such information, which cannot be guaranteed to be free from errors.
- 4.5 All the Products that the Seller sells may, upon prior notice to the Buyer from time to time be modified by or substituted with similar Products meeting the needs of the Buyer. This modification shall not lead to the liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.
- 4.6 In the case where, after inspection, it is acknowledged that the Products contain defects, the Seller undertakes to replace the defective products as far as the supplies allow and without indemnities or compensation of any kind for labour costs, delays, loss caused or any other reason. The replacement is guaranteed for a maximum of two months starting from the delivery date. Any replacement is excluded for any event as set out in article 5 below.
- 4.7 The deadlines that the Seller is asked to state for the mailing of the Products are given for information only and are not guaranteed. If such deadlines are not met, it shall not lead to any damages or cancellation of the orders, except for non-acceptable delays exceeding [3] months from the stated deadline, without information from the Seller. In such case only, the Buyer shall be entitled to ask for a reimbursement of its first down payment to the exclusion of any further damages.

4.8 The Seller does not make any warranties, express or implied, including, without limitation, those of sale ability and fitness for a particular purpose, with respect to the Products. Although the Seller shall take reasonable steps to screen Products for infection of viruses, worms, Trojan horses or other codes containing contaminating or destructive properties before making the Products available, the Seller cannot guarantee that any Product will be free from infection.

## 5. FORCE MAJEURE

The Seller shall not be liable for any delay in performance directly or indirectly caused by or resulting from acts of nature, fire, flood, accident, riot, war, government intervention, embargoes, strikes, labour difficulties, equipment failure, late deliveries by suppliers or other difficulties which are beyond the control, and not the fault of the Seller.

## 6. PROTECTION OF THE SELLER'S IPR

- 6.1 All the IPR attached to the Products are and remain the property of the Seller and are protected under French and international copyright law and conventions.
- 6.2 The Buyer agreed not to disclose, copy, reproduce, redistribute, resell or publish the Product, or any part of it to any other party other than employees of its company (only in the country of the primary user). The Buyer shall have the right to use the Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use the Product for purposes such as:
  - Information storage and retrieval systems;
  - Recordings and re-transmittals over any network (including any local area network);
  - Use in any timesharing, service bureau, bulletin board or similar arrangement or public display;
  - Posting any Product to any other online service (including bulletin boards or the Internet);
  - Licensing, leasing, selling, offering for sale or assigning the Product.
- 6.3 If the Buyer would like to use data coming from the Products for presentations, press announcements and any other projects, the Buyer needs to contact Yole Développement's Public Relations Director (info@yole.fr) to get an official authorization and verify data are up to date. In return the Seller will make sure to provide up-to-date data under a suitable public format.
- 6.4 The Buyer shall be solely responsible towards the Seller of all infringements of this obligation, whether this infringement comes from its employees or any person to whom the Buyer has sent the Products and shall personally take care of any related proceedings, and the Buyer shall bear related financial consequences in their entirety.
- 6.5 The Buyer shall define within its company a contact point for the needs of the contract. This person will be the recipient of each new report. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company. In the context of Bundle and Annual Subscriptions, the contact person shall decide who within the Buyer, shall be entitled to receive the protected link that will allow the Buyer to access the Products.
- 6.6 Please note that whether in Bundles or Annual Subscription, all unselected reports will be cancelled and lost after the 12 month validity period of the contract.
- 6.7 As a matter of fact the investor of a company, external consultants, the joint venture done with a third party, and so on cannot access the report and should pay a full license price.

## 7. TERMINATION

- 7.1 If the Buyer cancels the order in whole or in part or postpones the date of mailing, the Buyer shall indemnify the Seller for the entire costs that have been incurred as at the date of notification by the Buyer of such delay or cancellation. This may also apply for any other direct or indirect consequential loss that may be borne by the Seller, following this decision.
- 7.2 In the event of breach by one Party under these conditions or the order, the non-breaching Party may send a notification to the other by recorded delivery letter upon which, after a period of thirty (30) days without solving the problem, the non-breaching Party shall be entitled to terminate all the pending orders, without being liable for any compensation.

## 8. MISCELLANEOUS

All the provisions of these Terms and Conditions are for the benefit of the Seller itself, but also for its licensors, employees and agents. Each of them is entitled to assert and enforce those provisions against the Buyer. Any notices under these Terms and Conditions shall be given in writing. They shall be effective upon receipt by the other Party. The Seller may, from time to time, update these Terms and Conditions and the Buyer, is deemed to have accepted the latest version of these terms and conditions, provided they have been communicated to him in due time.

## 9. GOVERNING LAW AND JURISDICTION

- 9.1 Any dispute arising out or linked to these Terms and Conditions or to any contract/orders entered into in application of these Terms and Conditions shall be settled by the French Commercial Courts of Lyon, which shall have exclusive jurisdiction upon such issues.
- 9.2 French law shall govern the relation between the Buyer and the Seller, in accordance with these Terms and Conditions.