

# STATUS OF CMOS IMAGE SENSOR INDUSTRY 2021

## Market & Technology Report - August 2021

The CMOS Image Sensor industry maintained significant 7.3% YoY growth in 2020, reaching \$20.7B.

### WHAT'S NEW

- 2020-2026 forecast
- 2020 player rankings
- 2020 M&A activity
- Huawei ban timeline
- Foundry capacity analysis
- Ecosystem update
- Application update
- Market and technology update
- CIS and logic foundry profiles

### KEY FEATURES

- 2020 CIS revenue breakdown by market
- 2020 CIS revenue ranking by player
- 2020 CIS production ranking by foundry
- 2016-2026 CIS volume shipment forecast by application
- 2016-2026 CIS revenue forecast by application
- 2016-2026 CIS average selling price forecast by application
- 2016-2026 CIS wafer production forecast by application

### REPORT OBJECTIVES

Ecosystem identification and analysis:

- Determination of the application range
- Technical market segmentation
- Market trends and forecasts
- Key players, by market and analysis

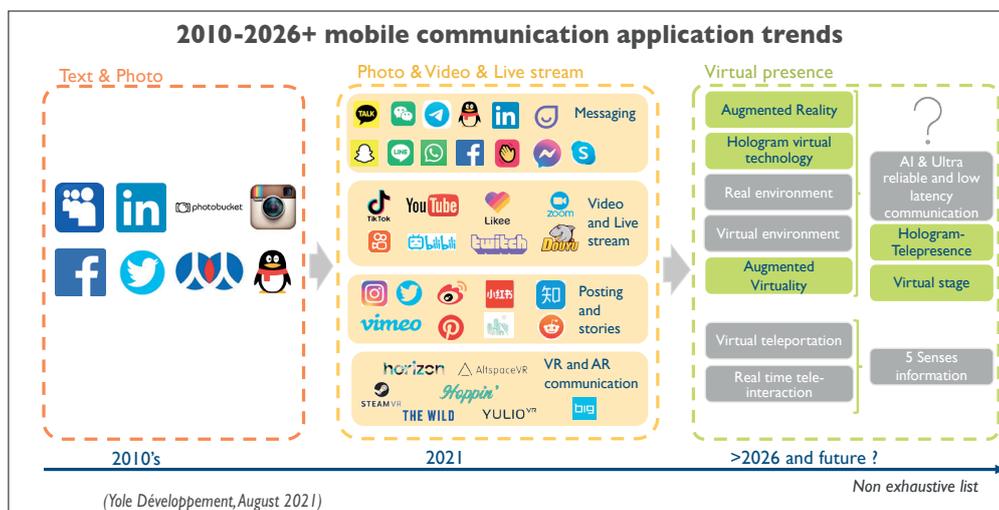
Analysis and description of markets and technologies involved:

- Detailed applications per market segment
- Major global actors
- Technology trends
- Main technical challenges

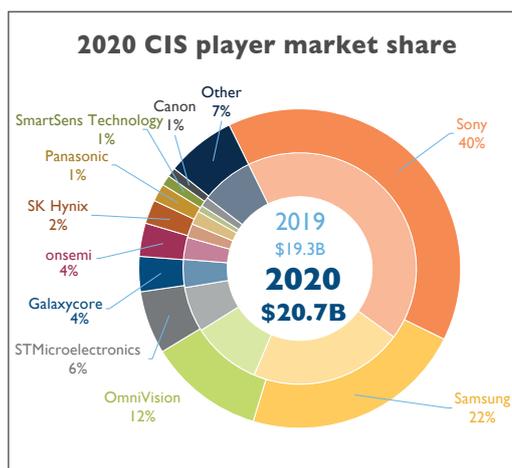
### CIS IS NOT JUST ABOUT MOBILE ANYMORE

Until 2019 mobile devices were certainly the main growth contributor to the CMOS Image Sensor (CIS) market. But in 2020 this is no longer the case. Computing, automotive and security markets have now outpaced the growth of mobile devices. The \$20.7B CIS industry is still dominated by mobile and consumer applications, representing more than 72% of revenues. Yet, despite all headwinds in 2020, computing, automotive and security have each grown to similar shares, reaching about 8% of CIS revenues, and 23% combined. They had represented 21% in 2019. In computing, higher demand for laptops and tablets in the COVID-19 context combined with the introduction of sensing cameras, such as 3D and fingerprint, has reversed a multi-year downward trend. In automotive and security, the high demand for cameras comes from smart car, smart home,

and smart building trends. Some future growth of the CIS market will therefore come from those markets, although mobile will still play a major role due to its sheer size. Looking more precisely at the growth forecast for mobile, social media has completely redefined our relationship to phones. Future technology for phone cameras will therefore primarily serve social media applications. We expect the production volume of mobile handsets to resume an upward trend in 2021, growing by 11.5% Year-over-Year (YoY), which is the major contributor to Yole Développement (Yole)'s CIS forecast upgrade. The combined need for real time distant communication and expression is rising. Combined with the growth of the other markets, the CIS industry should at least keep growing at 7.5% Compound Annual Growth Rate (CAGR) for the five years ahead.



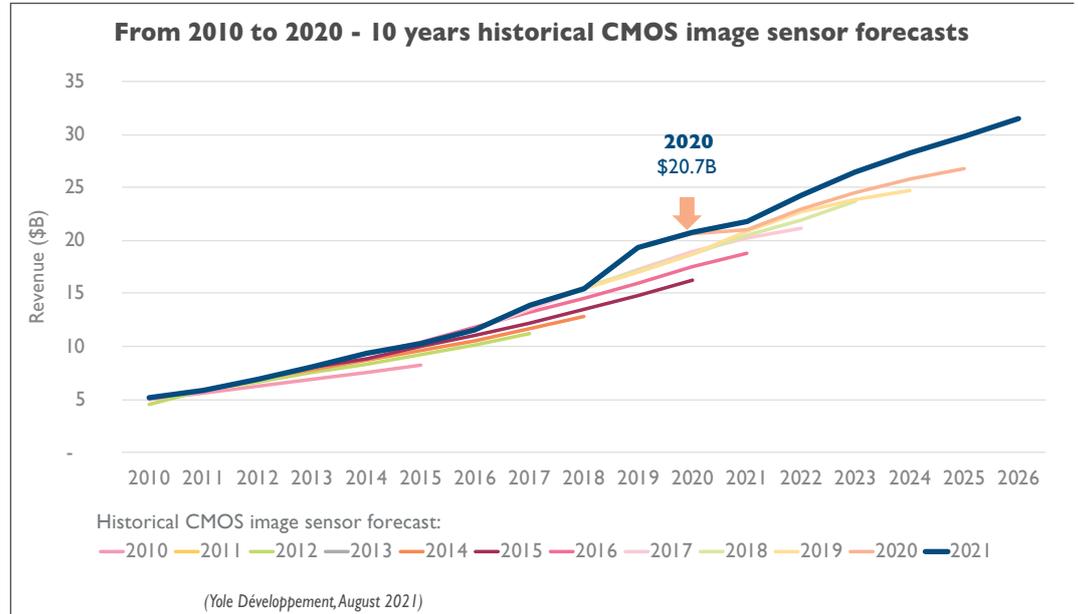
### THE HUAWEI BAN REORDERS THE CIS PLAYER GROWTH RANKING



2020 saw the combination of continuing high demand for cameras and sanctions on Huawei contributing to additional purchases of CIS in three quarters and then a brutal stop in the last quarter of the year. The COVID-19 pandemic did not play much role other than limiting capacity increases. Therefore CIS industry output stayed close to its structural limit all through the year, and especially in Q3-2020. For the full year, the whole industry grew by 7.3% YoY in revenue, in line with Yole's expectation. For CIS players, 2020 did not play out similarly to 2019, in fact it was almost the opposite, with the smaller players doing best. Sony lost two points of market share, SK Hynix

maintain, Samsung and Galaxycore gain one point and OmniVision gains two points. The dynamics of the Chinese players must be rationalized in the context of US-China trade tensions. CIS is one of the key strengths of the relatively small Chinese semiconductor sector. The tight links with Taiwanese foundry TSMC and the availability of new capacity at the Chinese foundries HLMC and SMIC have been highly profitable. Similarly, Korean players and foundries have benefited greatly in this

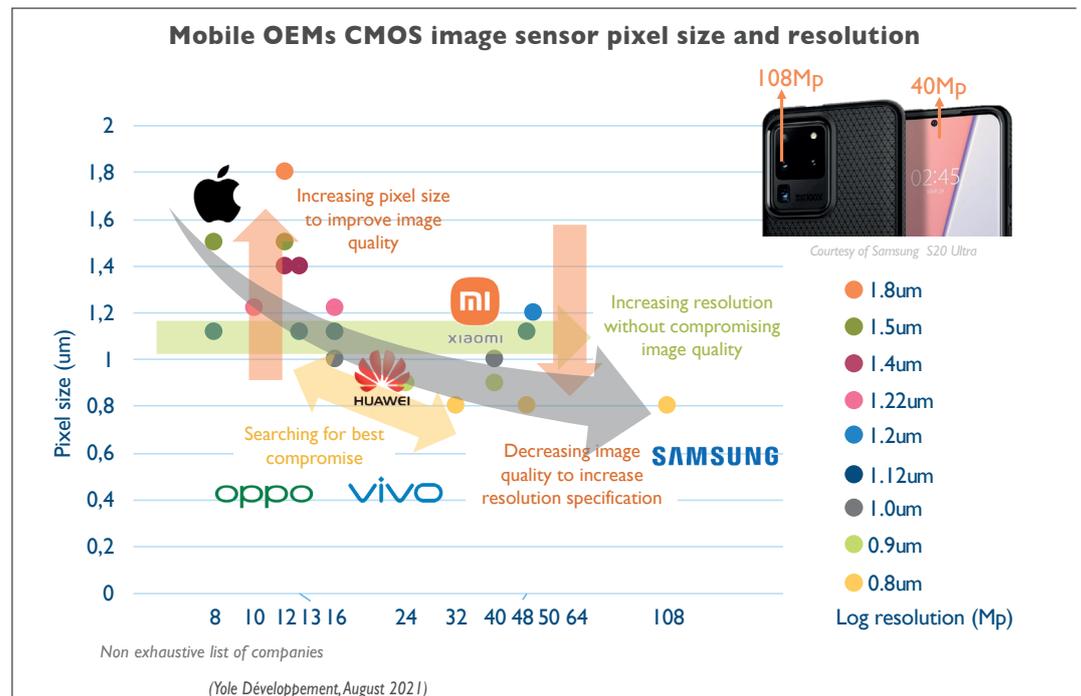
context. And for years to come semiconductor shortages may still dominate the economic landscape. Again, the Huawei ban is probably much to blame for the herd reaction for inventories we are currently seeing. It will take at least a few years before the bubble of the current rush for capacity bursts. Other semiconductor areas like memory or microprocessors have experienced this, but the CIS industry never has, but we now must keep it in mind.



## ACCESS TO ADVANCED STACKED CIS FOUNDRY CAPACITY HAS BECOME A PRIORITY

In this new edition of “The Status of the CMOS Image Sensor Industry 2021” report, we took much interest in foundry capacity. For many years the transition from front side illumination to back side stacked image sensors freed much needed CIS capacity. This was transferred to logic wafer demand. The CIS industry has been able to grow at double digit CAGRs without much investment in

dedicated foundries. Wafers could be sourced from established logic wafer fabs such as TSMC, Samsung and UMC. We have now reached the limit of stacking benefits. All major players are now able to output the stacked image sensors the market is asking for, therefore lifting competition to new levels. All those players have now to both increase CIS and logic wafer output or sourcing. Access to foundry



capacity in the context of semiconductor shortages has become a major challenge. Mobile device makers are either increasing pixel size, pixel resolution and/or number of cameras per handset, which is increasing CIS demand. The search for technological differentiation has reignited the race to shrink pixels. 2020 saw the introduction of 0.7µm pixels and in-pixel stacking technology in the Sony-Apple LiDAR

chip. This technology is opening up a new era of image sensor diversity, as neuromorphic and quantum image sensors are now in key innovators' plans. This new era will increase usage of image sensors, putting more strain on industrial capacity. We are just at the beginning of a new chapter of the CIS industry, and this Yole Développement report will keep you up-to-date.

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

Almalence, Ambarella, Apple, ams, Arm, Axis, Arclight, Basler, Bosch, Brigates, BYD, Caeleste, Canon, Clairpixel, Cmosis, Cognex, Continental, Core Photonics, CSEM, Dahua, DB Hitek, Dxomark, Espros Photonics, Evg, Excelitas Technologies, Fairchild Imaging, Flir, Forza Silicon, Fotonic, Foxconn, Fraunhofer, Fujitsu, Fujifilm, GalaxyCore, Gigajot, Given Imaging, GoPro, Gpixel, Grass Valley, Hamamatsu, Hasselblad, Himax Imaging, HikVision, HLMC, Honeywell, Hoya, HTC, Huawei, Image Lab, IMEC, Infineon, Invisage, Kingpak, Konica Minolta, Lattice, Leap Motion, Leica, Lenovo, LG, Luxima, Magna, Mantis Vision, Medigus, Melexis, Microsoft, Mobileye, Movidius, New Imaging Technologies, Nextchip, Nikon, NXP, Nvidia, Olympus, OmniVision, Omron, onsemi, Panasonic, PerkinElmer, Philips, Pixart, PixelPlus, Pelco, PMD Technologies, Pyxalis, Raytrix, Rosnes, Red, Samsung, Sanei Hytech, Seedevice, Sharp, Silicon Optronics, Sirona, SK Hynix, SMIC, Siemens, SmartSens Technology, Socionext, Soitec, Sony, STMicroelectronics, SuperPix, Teledyne, Teradyne, Trixell, TSMC, TowerJazz, TPSCo, UMC, Valeo, Videantis, Viimagic, WLCSP, Xiaomi, X-Fab, Xintec, Xperi, ZTE, and more...

**TABLE OF CONTENTS** (complete content on [i-micronews.com](http://i-micronews.com))

|  |           |   |            |
|--|-----------|---|------------|
| <b>Report methodology and definitions</b>                                | <b>7</b>  | <b>Consumer market trends</b>                               | <b>120</b> |
| <b>What we got right, what we got wrong</b>                              | <b>9</b>  | > Market dynamics   |            |
| <b>Executive summary</b>   | <b>14</b> | > Photography volume forecast                               |            |
| <b>Context</b>   | <b>32</b> | > Consumer home IoT volume forecast                         |            |
| > Global semiconductor market  |           | <b>Computing market trends</b>                              | <b>129</b> |
| > Huawei ban timeline  |           | > Market dynamics, volume forecast and market trends        |            |
| > Semiconductor shortages  |           | <b>Automotive market trends</b>                             | <b>135</b> |
| > History of triple disruption in photography                            |           | > Market dynamics, imaging trends and camera mix - forecast |            |
| <b>CIS market forecast</b>   | <b>48</b> | <b>Medical market trends</b>                                | <b>149</b> |
| > 2020 CIS revenue breakdown, by market, by player and by market segment |           | <b>Security market trends</b>                               | <b>161</b> |
| > 2016 – 2026 CIS volume shipment and revenue forecast                   |           | <b>Industrial market trends</b>                             | <b>169</b> |
| <b>Players and rankings</b>  | <b>66</b> | <b>Defense and aerospace market trends</b>                  | <b>178</b> |
| > 2020 CIS revenue rankings, by player                                   |           | <b>Technology trends</b>                                    | <b>185</b> |
| > 2020 CIS mobile market revenue breakdown, by player                    |           | > Pixel, resolution and optical format                      |            |
| > 2020 CIS automotive market revenue breakdown, by player                |           | > BSI opened the way to 3D semiconductor                    |            |
| <b>CMOS image sensor ecosystem</b>                                       | <b>85</b> | > In-pixel hybrid stack technology                          |            |
| <b>Mobile market trends</b>  | <b>91</b> | > 3D imaging and sensing                                    |            |
| > Mobile market dynamics and volume forecast by player                   |           | > Other technology trends                                   |            |
| > Imaging and sensing trend  |           | <b>Conclusions</b>  | <b>222</b> |
| > Cloud vs edge AI trend   |           | <b>Foundry profiles</b>                                     | <b>224</b> |
|  |           | <b>About Yole Développement</b>                             | <b>236</b> |

**RELATED REPORTS, MONITORS & TRACKS**



- CMOS Camera Module Industry for Consumer & Automotive 2020
- 3D Imaging and Sensing – Technology and Market Trends 2021
- Smartphone Camera Module Comparison 2020 Vol 3: Focus on Huawei
- Smartphone 3D Sensing Modules Comparison 2020

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**AUTHORS**

**Pierre Cambou** MSc, MBA, is a Principal analyst in the Photonics and Sensing Division at Yole Développement (Yole). Pierre's mission is dedicated to imaging related activities by providing market and technology analyses along with strategy consulting services to semiconductor companies. At Yole, Pierre is responsible for the CIS Quarterly Market Monitor while he has authored more than 15 Yole Market and Technology reports. Known as an expert in the imaging industry, he is regularly interviewed and quoted by leading international media. Previously, Pierre held several positions at Thomson TCS, which became Atmel Grenoble (France) in 2001 and e2v Semiconductors (France) in 2006. In 2012, he founded Vence Innovation, later renamed Irlynx (France), to bring to market an infrared sensor technology for smart environments. Pierre has an Engineering degree from Université de Technologie de Compiègne (France) and a Master of Science from Virginia Tech. (VA, USA). Pierre also graduated with an MBA from Grenoble Ecole de Management (France).



**Chenmeijing Liang** works as a Technology & Market Analyst within the Photonics, Sensing & Display Division at Yole Développement (Yole). As part of the Imaging team, Chenmeijing contributes analyses of CIS markets, related technologies and market strategies of the leading semiconductor companies, as well as the quarterly reports. Prior to Yole, she was engaged in the development of R&D projects. Chenmeijing was a member of Group PSA R&D department where she worked on Vehicle 3D Imaging projects. In addition, she assisted with various technical and commercial projects. Chenmeijing Liang holds a Master's Degree in the field of Applied physics and Optical engineering from Paris-Saclay University and University Pierre and Marie Curie (UPMC) (Paris, France).

## CONTACT



### Western US & Canada

Steve Laferriere - [steve.laferriere@yole.fr](mailto:steve.laferriere@yole.fr)  
+ 1 310 600-8267

### Eastern US & Canada

Chris Youman – [chris.youman@yole.fr](mailto:chris.youman@yole.fr)  
+1 919 607 9839

### Europe and RoW

Lizzie Levenez - [lizzie.levenez@yole.fr](mailto:lizzie.levenez@yole.fr)  
+49 151 23 54 41 82

### DACH (North Germany, Austria, Switzerland)

Neha CHAUDHURY - [neha.chaudhury@yole.fr](mailto:neha.chaudhury@yole.fr)  
+49 172 97 47 248

### South Germany & France

Martine Komono - [martine.komono@yole.fr](mailto:martine.komono@yole.fr)  
+49 173 69 43 31

### Benelux, UK & Scandinavia

Marine Wybraniez - [marine.wybraniez@yole.fr](mailto:marine.wybraniez@yole.fr)  
+49 171 81 42 641

### India and RoA

Takashi Onozawa – [takashi.onozawa@yole.fr](mailto:takashi.onozawa@yole.fr)  
+81-80-4371-4887

### Korea

Peter Ok - [peter.ok@yole.fr](mailto:peter.ok@yole.fr)  
+82 1040890233

### Greater China

Mavis Wang – [mavis.wang@yole.fr](mailto:mavis.wang@yole.fr)  
+886 979336809 +86 136 61566824

### Japan

Miho Ohtake – [miho.ohtake@yole.fr](mailto:miho.ohtake@yole.fr)  
+81 34405-9204

Toru Hosaka – [toru.hosaka@yole.fr](mailto:toru.hosaka@yole.fr)  
+81 90 1775 3866

### Japan and Singapore

Itsuyo Oshiba – [itsuyo.oshiba@yole.fr](mailto:itsuyo.oshiba@yole.fr)  
+81-80-3577-3042

### Sales Coordination & Customers Service

David Jourdan – [david.jourdan@yole.fr](mailto:david.jourdan@yole.fr)  
+33 472 83 01 90  
Fayçal El Khamassi – [faycal.khamassi@yole.fr](mailto:faycal.khamassi@yole.fr)  
+33 472 83 01 95

## ABOUT YOLE DEVELOPPEMENT

Founded in 1998, Yole Développement (Yole) 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. With a strong focus on emerging applications using silicon and/or micro manufacturing, the Yole group of companies has expanded to include more than 120 collaborators worldwide covering MEMS and Image Sensors, Compound Semiconductors, RF Electronics, Solid-state Lighting, Displays, Software, Optoelectronics, Microfluidics & Medical, Advanced Packaging, Manufacturing, Power Electronics, Batteries & Energy Management and Memory.

The “More than Moore” market research, technology and strategy consulting company Yole Développement, along with its partners System Plus Consulting, PISEO and Blumorpho, supports 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
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- Design and characterization of innovative optical systems
- Financial services (due diligence, M&A)

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

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### CONTACTS

For more information about :

- Consulting & Financial Services: Jean-Christophe Eloy ([eloy@yole.fr](mailto:eloy@yole.fr))
- Reports & Monitors: David Jourdan ([david.jourdan@yole.fr](mailto:david.jourdan@yole.fr)) & Fayçal Khamassi ([faycal.khamassi@yole.fr](mailto:faycal.khamassi@yole.fr))
- Public Relations: Sandrine Leroy ([sandrine.leroy@yole.fr](mailto:sandrine.leroy@yole.fr))
- Marketing & Communication: Jean-Christophe Eloy ([eloy@yole.fr](mailto:eloy@yole.fr))

Definitions: **“Acceptance”**: Action by which the Buyer accepts these General Terms and Conditions of Sale in their entirety. It is done by signing the purchase order which states “I hereby accept Yole Développement’s General 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) placing an order pursuant to these General Terms and Conditions of Sale, with the exclusion of any individual consumer acting for his/her sole personal interest.

**“Seller”**: Headquartered in Villeurbanne (France), 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 dedicated teams of technology & market analysts, Yole Développement operates worldwide with the key industrial companies, R&D institutes and investors to help them understand the market and technology trends.

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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 as a one user license). More time can be allocated on a fee basis.

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1.2 These General Terms and Conditions of Sale shall be deemed valid and enforceable between the Contracting Parties after acceptance of an order from the Buyer by the Seller pursuant to Article 1.3 below. For such purpose, the Buyer, when signing the purchase order which mentions “I hereby accept Yole Développement’s Terms and Conditions of Sale” is deemed to have fully and unequivocally accepted these Terms and Conditions of Sale.

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. In the absence of any confirmation in writing, no order shall be deemed to have been accepted.

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  - 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 pursuant to Article 2.1 above, in particular in cases where a new event or access to new contradictory information would require the Seller analyst to dedicate extra time to compute or compare the data in order to enable the Seller to deliver a high quality Product.
- 2.3 The mailing of the Product will occur only upon payment by the Buyer, in accordance with the conditions contained in Article 3 above.

2.4. The mailing is operated through electronic means either by email via the sales department or automatically online via an email/password. The Buyer is responsible for ensuring that the Buyers platform has the required capacities and authorisations to receive the Product(s) emailed by the Seller. If the Product’s electronic delivery format is defective, the Seller undertakes to replace it at no charge to the Buyer provided that the Seller 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 with 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 written notification from the Buyer to the Seller, even in case of delayed delivery. Any Product returned to the Seller without the Buyer providing prior notification to the Seller as required under Article 2.5 above shall remain at the Buyer’s risk. In no event shall the Seller incur any liability for Products erroneously ordered by the Buyer, or for any request from the Buyer to replace a Product previously ordered by a different Product.

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3.1 Prices are given in the orders corresponding to each Product sold on a unit basis or corresponding to annual subscriptions. They are deemed to be inclusive of all taxes applicable in the country where the Seller is based (except for France where VAT will be added). The prices are re-evaluated from time to time by the Seller. 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, or made by 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 secure the payments due to the Seller, the Seller reserves the right to request down payments from the Buyer. In such case, the need for a down payment will be mentioned on the corresponding order.

3.3 Payment is due by the Buyer to the Seller within 30 days from invoice date, except as otherwise specifically agreed in writing by the Buyer and the Seller. If the Buyer fails to pay at the due date and fails to request and obtain from the Seller a payment extension, 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.

3.4 The Seller publications (reports, monitors, tracks...) are due for delivery only after receipt by the Seller of any payment due by the Buyer prior to delivery.

3.5 In the event of termination of the contract by the Seller attributable to Buyer misconduct during the contract, the Seller will have the right to invoice all work performed at the time of termination, 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 the choice of the Products purchased as well as for the use and interpretations the Buyer makes of the documents it purchases, of the results the Buyer obtains, and of the advice and acts the Buyer bases thereon .

4.2 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 a Product or the use of or the inability by the Buyer to use the Seller’s website, or any information provided on the website, or contained in a Product;
- b) Any claim attributable to errors, omissions or other inaccuracies in a Product or interpretations thereof.

4.3 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.

4.4 Any Product that the Seller sells may, upon prior notice to the Buyer from time to time be modified by Seller or substituted with a similar Product meeting the needs of the Buyer. Such modification shall not lead to any liability of the Seller, provided that the Seller ensures the substituted Product is similar to the Product initially ordered.

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4.6 The deadlines that the Seller is asked to provide for the mailing of a Product are given for information purposes only and are not guaranteed. If such deadlines are not met, this shall not, without the agreement of the Seller lead to any claim for damages or right of cancellation of one or more orders by the Buyer, except for non-acceptable delays exceeding [3] months from the stated deadline. In such case only i.e. only in the event of a delay exceeding (3) months from the stated deadline the Buyer shall be entitled to ask for a reimbursement of any down payment previously made to the Seller, to the exclusion of any other damages.

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#### 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 a Product, or any part of it to any other party other than employees of the Buyer Company (and only in the country of the Primary User for Multi-User Licenses). The Buyer shall have the right to use Products solely for its own internal information purposes. In particular, the Buyer shall therefore not use any 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 a Product or any derivative thereof.

6.3 If the Buyer would like to use data coming from a Product 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 confirm that the 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 for any infringement of the obligation described in Article 6.3 above, whether such infringement originates from the Buyer’s employees or any person to whom the Buyer has sent the Products. Furthermore, the Buyer shall initiate and personally take care of any related proceedings in coordination with the Seller, and the Buyer shall bear the related financial consequences in their entirety.

6.5 The Buyer shall define within its Company an identified user who shall serve as a contact person for the License purchased by the Buyer. This person will be the recipient of each new report. This person shall also be responsible on behalf of the Buyer, for compliance with all copyrights and other obligations relating to the protection of the Seller’s IP rights and general compliance with the terms of the License purchased by the Company. In the context of Bundle and Annual Subscriptions, the contact person shall decide within the Buyer which person(s) shall be entitled to receive the protected link that will allow the Buyer to access the Products.

6.6 It is acknowledged and accepted by the Buyer that whether purchased in the form of Bundles or Annual Subscription, all unselected reports will be deemed cancelled and lost after a period of 12 month following acceptance of the corresponding order by the Seller in accordance with provisions of Article 1.3 above .

6.7 It is further acknowledged and agreed by the Buyer that any investor in the Buyer Company, any external consultant of the Buyer Company or any joint venture done with a third party in which the Buyer Company is involved , is not entitled to use a Product, without paying to the Seller the full price for a license to the required Product..

#### 7. TERMINATION

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 incurred by the Seller, pursuant to such cancellation or postponement.

#### 8. MISCELLANEOUS

8.1 All the provisions of these General Terms and Conditions of Sale are for the benefit of the Seller, but also for that of its licensors, resellers and agents. Each of them is entitled to assert and enforce these provisions against the Buyer.

Any notices under these Terms and Conditions shall be given in writing and shall be effective upon receipt by the other Party.

8.2 The Seller may, from time to time, update these General Terms and Conditions of Sale, and the Buyer, shall be deemed to have accepted the latest version of such General Terms and Conditions of Sale, once they have been duly communicated to the Buyer by the Seller.

#### 9. GOVERNING LAW AND JURISDICTION

- 9.1 Any dispute arising out or linked to these General Terms and Conditions of Sale or to any Licenses or Products purchased in application thereof shall be submitted to the French Commercial Court of Lyon, which shall have exclusive jurisdiction upon such issues.
- 9.2 French law (without reference to any applicable conflict of law provisions) shall apply to these General Terms and Conditions of sale and any agreement between the Buyer and the Seller made pursuant thereto.