

Emerging Non-Volatile Memories

Niche memory markets with a vast number of patents held by big companies

REPORT OUTLINE

- Emerging Non-Volatile Memories.
- Patent Landscape.
- February 2014.
- PDF & Excel file.
- 120+ slides.
- €2,990 – Single user license.
- €3,990 – Corporate license.

KEY FEATURES OF THE REPORT

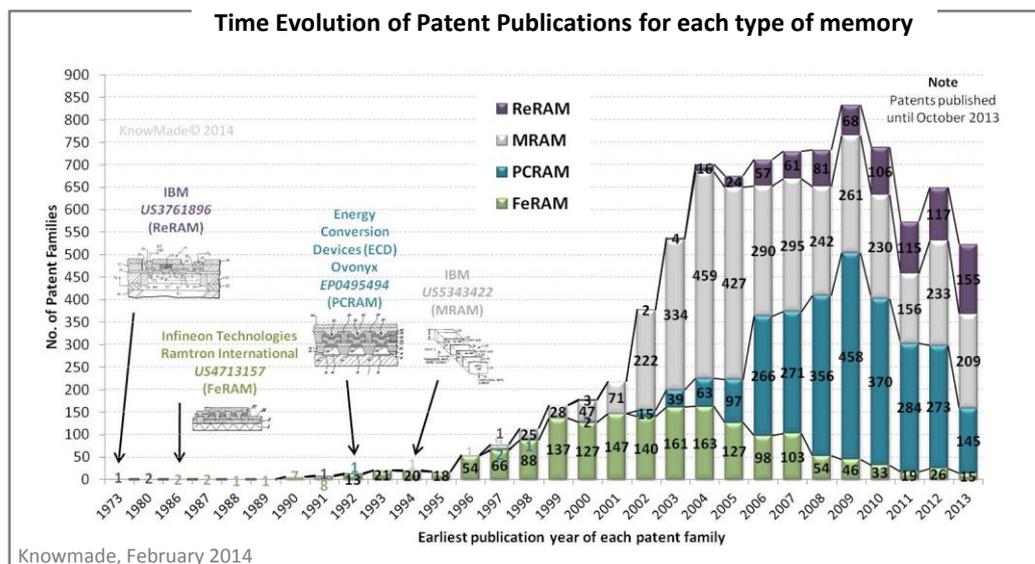
- Analysis of key players and technology key segments (FeRAM, MRAM, ReRAM, PCRAM).
- Time evolution of patent publications and countries of filings.
- Current legal status of patents.
- Ranking of main patent assignees.
- Joint developments and IP collaboration network of main patent assignees.
- Key patents.
- Granted patents near expiration.
- Overview of patent litigations.
- Relative strength of main companies IP portfolio.
- Matrix applicants/memory type for more than 50 companies.
- “emerging NVM IP” profiles of the main companies with key patents, memory types, litigations, licensing, partnerships and strategy.
- Excel database with all patents analyzed in the report with memory type segmentation.

OBJECTIVE OF THE REPORT

- Understand the IP landscape for emerging NVM.
- Identify key patents by memory type or assignee.
- Understand trends in emerging NVM IP.
- Identify the major players in emerging NVM IP and the relative strength of their patent portfolio.
- Identify collaboration networks between key players (industrial and academics).
- Have an overview of past and current litigations and licensing agreements.

The integration limit of flash memories is approaching, and **emerging Non-Volatile Memories (eNVM)** to replace conventional Flash Memories have been proposed. Ferroelectric RAMs (FeRAMs), Magnetoresistive RAMs (MRAMs), Resistive-change RAMs (ReRAMs) or Phase-Change Random-Access Memories (PCRAMs) are promising to change the memory landscape. The field of **eNVM** has shown an intensive patenting activity since early 1990s, with a substantial increase during the past decade.

Currently, there are **more than 8,600 relevant patent families** filed all over the world. Patent families were filed by more than **800 patent applicants** mainly located in **USA, Japan, Taiwan and China**. From a quantitative point of view, the most active companies are **SK Hynix, Samsung, Toshiba, Micron Technology and IBM**. In addition, startup firms do not file many patents and their main strategy is to license or sell their intellectual property.



The patents related to **MRAM** technology account for more than **40%** of filings. The main patent applicants are **Toshiba, Samsung and Renesas Electronics** which represent together almost 30% of the patents. The MRAM technology was growing between 2003-2007 with more than 50% of patents published during these years. Currently, the number of patents filed has remained stable, with about 200 patents filed per year.

About **30%** of patent families are related to **PCRAM** technology. They were mainly filed by **SK Hynix and Samsung**, they represent almost 40% of published patents. The PCRAM technology was increasing between 2002 and 2009, with more than 450 patent families published in 2009. Publication patents is decreasing these last 4 years, however more than 200 patents are still published every year. Patent filings will continue on PCRAM technology to further improve memory applications.

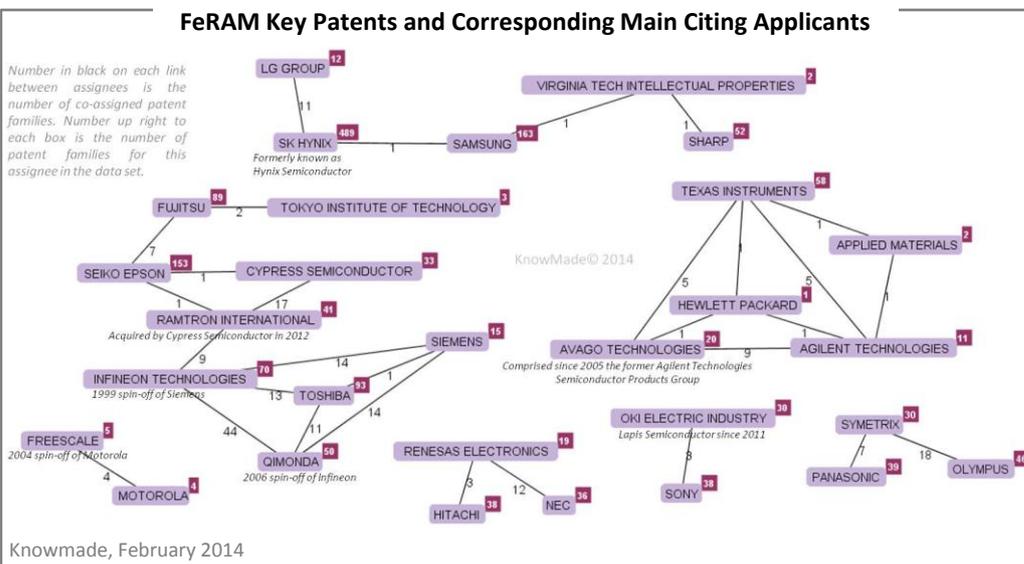
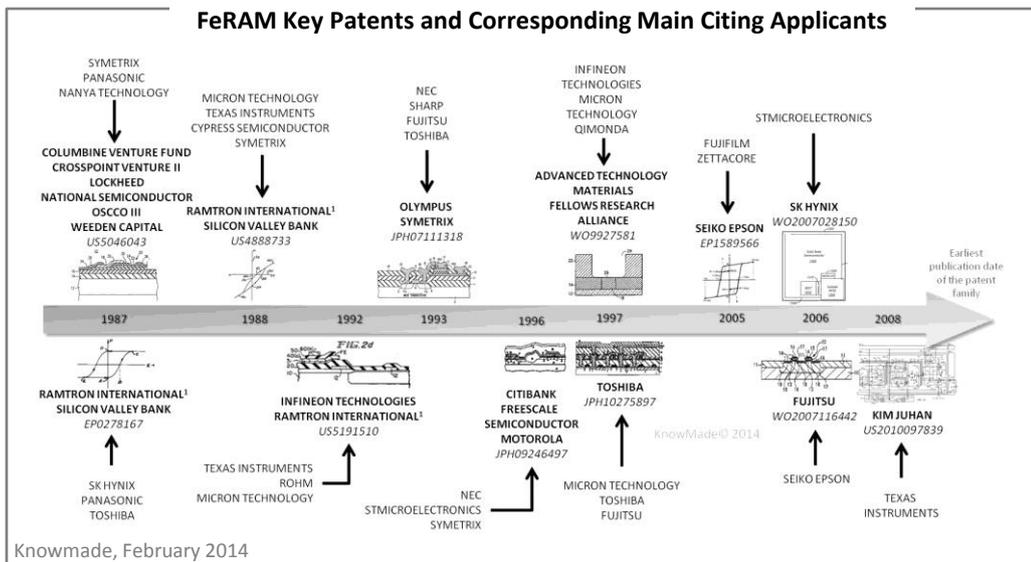
The patents dedicated to **FeRAM** technology represent **20%** of filings. They were mainly filed by **SK Hynix, Samsung and Seiko Epson** which represent almost 50% of published patents. FeRAM is a mature technology, and FeRAM is not an active patent field yet.

Patents related to **ReRAM** technology account for almost **10%** of new patent filings. ReRAM is the newest patented technology and the number of patent publications will continue to increase in the coming years. With over 100 patent families already filed, **Samsung** will play a significant role in this emerging technology development.

A VAST NUMBER OF PATENTS

Our search strategy combines automated and manual screenings that have led to the selection of more than 8,600 relevant patent families. Those have been segmented by type of memory that are analyzed in detail: FeRAM, MRAM, ReRAM, PCRAM.

For each memory type, the report provides a detailed analysis including the time evolution of patent filings, identification of the key players, collaborations networks, as well as the identification of the key patents based-on citations and impacts in eNVM technology.



KEY PLAYERS IDENTIFIED

Hundreds companies/academics are involved in eNVM IP. Most of the major NVM players are present in the list of the top patent assignees. The report provides a ranking and analysis of the relative strength of the top eNVM patent holders derived from their portfolio size and patent citations Networks. Based on this portfolio analysis as well as on their market interest, we have identified 10 major players that are profiled in this report. Each profile includes a detailed portfolio analysis with the time evolution of patent filing, key patents, memory types, litigations, licensing, partnerships and strategy.

AN USEFUL PATENT DATABASE

The report also includes an excel database with all patents analyzed in the report.

This database allows multi-criteria searches and includes :

- Patent publication number
- Hyperlinks to the original documents
- Priority date
- Title
- Abstract
- Applicants
- Technological segments
- Legal status for each member of the patent family

Patent Database for 8,600+ patent families

Patent Numbers (all members of the patent family)	Hyperlink to original documents	Oldest Priority Date of the Family (YYYY-MM-DD)	Title	Abstract	Assignee(s)	FeRAM	MRAM	ReRAM	PCRAM	Material	Process	cell structure	programming	Legal Status & Ac
US201042583	US201042583A	2008-12-31	Phase change memory	(US201042583)	HEDGS OPL CAPITAL				X			X		(US201042)
US201036128	US201036128A	2010-02-24	Memory cell and	(US201036128)	MACRONIX INTERNATIONAL			X			X	X		(US201036)
US201035069	US201035069A	2011-12-22	Calcium carbonate	(US201035069)	CROCUS TECHNOLOGY		X						X	(US201035)
US201033700	US201033700A	2010-08-06	MAGNETIC MEMORY	(US201033700)	SONY		X				X	X	X	(US201033)
US2010303379	US2010303379A	2008-03-27	HYBRID	(US2010303379)	IBM		X						X	(US201030)
JP201323661	JP201323661A	2013-08-19	Reluctance effective	(JP201323661-Machine)	SONY					X		X		(JP201323)
US2010307099	US2010307099A	2012-05-18	MAGNETIC MEMORY	(US2010307099)	TOSHIBA		X				X			(US201030)
US2010289829	US2010289829A	2012-05-08	MAGNETIC MEMORY	(US2010289829)	TOSHIBA					X				(US201028)
US2010286723	US2010286723A	2011-02-16	MAGNETIC RANDOM	(US2010286723)	AVALANCHE TECHNOLOGY		X			X				(US201028)
US2010286396	US2010286396A	2007-07-12	Embedded Magnetic	(US2010286396)	AVALANCHE TECHNOLOGY		X				X			(US201028)
US201031939	US201031939A	2012-01-18	Resistive random-	(US201031939)	WINBOND ELECTRONICS			X					X	(US201031)
US2010288397	US2010288397A	2010-09-17	MAGNETORESISTIVE	(US2010288397)	TOSHIBA		X				X			(US201028)
US2010284999	US2010284999A	2012-04-30	PHASE CHANGE	(US2010284999)	ADVANCED TECHNOLOGY				X	X				(US201028)
WO2013163653	WO2013163653A2	2012-04-27	MAGNETIC MEMORY	(WO2013163653)	VARIAN SEMICONDUCTOR		X			X	X			(WO201316)
US8569172	US8569172B1	2012-06-14	Noble metal/non-noble	(US8569172)	CROSSBAR			X		X	X			(US856917)
US2010285003	US2010285003A	2012-04-30	Phase Change Memory	(US2010285003)	MICRON TECHNOLOGY					X	X			(US201028)
US2010285002	US2010285002A	2012-04-30	Phase Change Memory	(US2010285002)	MICRON TECHNOLOGY					X	X			(US201028)
US2010286724	US2010286724A	2012-04-26	METHOD SYSTEM	(US2010286724)	MICRON TECHNOLOGY					X	X		X	(US201028)
US2010279240	US2010279240A	2010-11-04	HETERO-SWITCHING	(US2010279240)	JO SUNG HYUN			X		X	X		X	(US201027)
US2010280880	US2010280880A	2010-07-08	PHASE-CHANGE	(US2010280880)	SK HYNIX					X	X			(US201028)
US2010277178	US2010277178A	2012-04-30	MAGNETORESISTIVE	(US2010277178)	TAIWAN SEMICONDUCTOR		X				X			(US201027)
US2010279243	US2010279243A	2012-04-18	METHOD TO REDUCE	(US2010279243)	ADVANCED INTEGRATED		X				X			(US201027)
US2010270502	US2010270502A	2007-10-09	Semiconductor Phase	(US2010270502)	DEWINSON CHARLES H			X	X	X			X	(US201027)
US201027062	US201027062A	2010-04-08	Method and Apparatus	(US201027062)	ABEIDFARD BRAHIM		X						X	(US201027)
US8565012	US8565012B1	2011-06-06	Magnetic enhancement	(US8565012)	MAGSL		X			X	X		X	(US856501)
US2010272061	US2010272061A	2008-09-30	SPIN CURRENT	(US2010272061)	MICRON TECHNOLOGY		X			X				(US201027)
WO2013154991	WO2013154991A1	2012-04-11	SELF-REFERENCED	(WO2013154991)	EVERSPIN TECHNOLOGIES		X						X	(WO201315)
WO2013158690	US2013158690A1	2012-04-17	FREE LAYER WITH	(WO2013158690)	HEADWAY TECHNOLOGIES		X				X			(WO201315)
US2010270661	US2010270661A	2012-04-16	Magnetoresistive	(US2010270661)	LI SHAPING		X			X				(US201027)

COMPANIES CITED IN THE REPORT (NON-EXHAUSTIVE)

Adesto Technologies, Altis Semiconductor, Avalanche Technology, Beijing University, Crocus Technology, Crossbar, Cypress Semiconductor, Electronics and Telecommunications Research Institute (ETRI), Elpida Memory, Energy Conversion Devices, Everspin Technologies, Freescale Semiconductor, Fudan University, Fujitsu, Grandis, Hanyang University, Hewlett Packard, Hitachi, IBM, Industrial Technology Research Institute (ITRI), Infineon Technologies, Institute of Microelectronics (CAS), Intel, Intermolecular, Macronix International, Magic Technology, Micron Technology, Motorola, Nanya Technology, NEC, New York University, Oki Electric Industry, Olympus, Ovonyx, Panasonic, Powerchip, Promos Technologies, Qimonda, Qualcomm, Rambus, Ramtron International, Renesas Electronics, Rohm, Samsung, SanDisk, Seagate Technology, Seiko Epson, Semiconductor Manufacturing International Corporation (SMIC), Shanghai Institute (CAS), Sharp, SK Hynix, Sony, Spansion, Spin Transfer Technologies, STMicroelectronics, Symatrix, Taiwan Semiconductor Manufacturing (TSMC), TDK, Texas Instruments, Toshiba, Unity Semiconductor, Winbond Electronics.

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ABOUT KNOWMADE

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ORDER FORM

Emerging Non-Volatile Memories Patent Landscape

February 2014

SHIP 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 METHODS

Check

To pay your invoice using a check, please mail your check to the following address:

KnowMade S.A.R.L.
2405 route des Dolines, BP 65
06902 Valbonne Sophia Antipolis
FRANCE

Money Transfer

To pay your invoice using a bank money wire transfer please contact your bank to complete this process. Here is the information that you will need to submit the payment:

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Bank: Banque populaire St Laurent du Var CAP 3000 - Quartier du lac- 06700 St Laurent du Var
IBAN: FR76 1560 7000 6360 6214 5695 126
BIC/SWIFT: CCBPFRPPNCE

Paypal

In order to pay your invoice via PAYPAL, you must first register at www.paypal.com. Then you can send money to the KnowMade S.A.R.L. by entering our E-mail address contact@knowmade.fr as the recipient and entering the invoice amount.

PRODUCT ORDER

- Single user license EURO 2990
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*For price in dollars, please use the day's exchange rate. For French customer, add 20% for VAT.
All reports are delivered electronically in pdf format*

Signature:

I hereby accept Knowmade's Terms and Conditions of Sale

RETURN ORDER BY

E-mail: contact@knowmade.fr

Mail: KnowMade S.A.R.L. 2405 route des Dolines, BP 65 06902 Sophia Antipolis FRANCE

CONTACT

E-mail: contact@knowmade.fr

TERMS AND CONDITIONS OF SALES

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 Knowmade’s Terms and Conditions of Sale”.

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“Contracting Parties” or “Parties”: The Seller on the 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.

“License”: For the reports and databases, 2 different licenses are proposed. The buyer has to choose one license:

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2. Corporate license: the report can be used by unlimited users within the company. Subsidiaries are not included.

“Products”: Reports are established in PowerPoint and delivered on a PDF format and the database may include Excel files.

“Seller”: Based in Sophia Antipolis (France headquarters), Knowmade is a technology intelligence company specialized in the research and analysis of scientific and technical information. We provide patent landscapes and scientific state of the art with high added value to businesses and research laboratories. Our intelligence digests play a key role to define your innovation and development strategy.

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 Knowmade’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 [1] month from the order for Products already released; 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 Some weeks prior to the release date the Seller can propose a pre-release discount to the Buyer.

The Seller shall by no means be responsible for any delay in respect of article 2.2 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. 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. The prices may be reevaluated 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 Knowmade, PayPal or by electronic transfer to the following account:

Banque populaire St Laurent du Var CAP 3000 - Quartier du lac- 06700 St Laurent du Var

BIC or SWIFT code: CCBPFRPPNCE

IBAN: : FR76 1560 7000 6360 6214 5695 126

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 labor 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 [4] 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 saleability 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, labor 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. 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 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.

6.4 The Buyer shall define within its company point of contact for the needs of the contract. This person will be the recipient of each new report in PDF format. This person shall also be responsible for respect of the copyrights and will guaranty that the Products are not disseminated out of the company.

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 Grasse, 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.