

# MORPHOSENSE



**Make it Efficient!**

## COMPANY PRESENTATION



### **MORPHOSENSE**

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# Executive summary

## **Morphosense offers an efficient monitoring system based on high tech sensor network, via a customized dashboard to enable Structural Health Monitoring**

### **□ Markets**

The operating cost can be saved by using SHM systems, which facilitate condition-based maintenance for various civil infrastructure. The global SHM market was valued at USD 505.0 Million in 2014 and is expected to grow at a CAGR of 24.7% between 2015 and 2020. The key driving factors for such a market include the ageing infrastructure, government support, and the increasing need for effective solutions for maintaining infrastructure.

The rising demand for cost-effective and accurate inspection methods, aging infrastructure, and potential threat of damage due to natural calamities are creating demand for SHM across several applications. These are some of the driving factors for the SHM market

### **□ Value proposition**

MORPHOSENSE Offers a highly efficient monitoring system based on both MEMS sensors network and data fusion. Thanks to the signal processing to analyze the complete information, the technology is an efficient tool to provide a SHM through a customized Dashboard. It provides a real time, continuous monitoring for any Civil Engineering, Railroad, Maritime or Energy application, and gives all the information to optimize budget and maintenance planning.

The MORPHOSENSE offer includes a sensor node network, an easy set up on any structure – existing structure or under construction structure, measure and process interest parameters defined with user, informs the user in an effective representation.

### **□ Business Model**

The MORPHOSENSE business model is based on Data Oriented Services.

Thanks to the powerful technology, MORPHOSENSE propose a sensor nodes network to fix onto the structure to be evaluated. Once the sensor Nodes network is set, the system records all the parameters of the structure and give a complete Structural Health Monitoring. Therefore, MORPHOSENSE will propose a FULL PANEL OF SERVICES based on data, in a customized dashboard, including 3D deformation and modal frequency.

MORPHOSENSE provides then SERVICES enabling a Highly Efficient Monitoring in a real time mode and in a continuous way. A periodic report with parameters defined with the user is received as part of a monthly subscription.

### **□ Intellectual Property**

MORPHOSENSE has a strong IP thanks the two fundamentals patents (Method and Device for Acquisition a Geometric Shape, Patent US20080211808 and Method and Device for Acquisition a Deformable Geometric Shape, Patent US20080066334) which are licenced from CEA with exclusivity onto the domains covered by MORPHOSENSE. Furthermore, MORPHOSENSE has a know-how licence from CEA-Leti covering the design of MEMS-sensors network and associated algorithm for geometry and vibrations monitoring. The patent portfolio of MORPHOSENSE will increase thanks to R&D developments in progress concerning the next generation of MORPHOSENSE technologies.

## • Market Need and Company Solution

The operating cost can be saved by using SHM systems, which facilitate condition-based maintenance for various civil infrastructure. The global SHM market was valued at USD 505.0 Million in 2014 and is expected to grow at a CAGR of 24.7% between 2015 and 2020. The key driving factors for the SHM market in the Americas include the ageing infrastructure, government support, and the increasing need for effective solutions for maintaining infrastructure.

The solution type segmentation of SHM market covers hardware, and software and services required in SHM.

The rising demand for cost-effective and accurate inspection methods, aging infrastructure, and potential threat of damage due to natural calamities are creating demand for SHM across several applications. These are some of the driving factors for the SHM market.

The SHM market is dominated by Advitam Inc. (France), COWI A/S (Denmark), Digitexx Data Systems, Inc. (U.S.), Geocomp Corp. (U.S.), Geokon, Inc. (U.S.), GeoSig Ltd. (Switzerland), Hottinger Baldwin Messtechnik GmbH (Germany), Nova Metrix LLC, (U.S.), SODIS LAB (Russian Federation), and Strainstall UK Limited (U.K.) among others.

The market is worldwide and divided as

- North Americas
- Europe
- APAC
- RoW (Austria, Middle East, Africa)

The MORPHOSENSE system can be seen as

- A sensor node network (including the master node to drive the network) including the HW part (with really accuracy MEMS) and SW part (embedded software, data logger, data fusion, signal processing, and IHM software)
- An easy set up on any structure – existing structure or under construction structure
- Measure and Process interest parameters defined with users : 3D deformation, collapse measurement, vibrations, modal frequency of the structure, shock detection...
- Informs the user in an effective representation (warning, report, data files...)



The main target in term of application domains are Bridges, Dams, Tunnels, Buildings, Stadiums.

Requests are focused on:

- Cost optimization for the structure maintenance
- Looking for a disruptive solution to measure interest parameter to perform an efficient monitoring
- Insurance, securing facilities and risk management

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- **Market analysis**

MORPHOSENSE Offers a highly efficient monitoring system based on both high tech MEMS sensors network and data fusion. Thanks to the signal processing to analyze the complete information, the MORPHOSENSE

The sequencing of two phases to address the target market

- **EXPERTISE | Segment : DIAGNOSTIC**

The segment expertise and diagnosis regarding empowered entities responsible structures (Councils, Cities, ANDRA, or, SNCF, Bouygues, Vinci, Eiffage as dealers structures) to establish a diagnosis when a failure is detected on a structure by the support of its monitoring team. The indicators provided by Morphosense enable the responsible structure to objectify a recommendation to prosecute or not to repair the structure.

***NB*** : All entities in this segment encountered by Morphosense confirm that monitoring of deformation and vibrations of a structure over a short period (days to weeks) after the anomaly identified simplifying and consolidating expertise. All also confirm that this is not usually done because the current solutions are either not specific enough (optical fibers or drones / video, for example) or too long to implement and not suited to monitoring over several days (theodolites for example).

The penetration of this first segment will allow Morphosense acquire an indisputable reference in terms of technical credibility and visibility in the field of construction. It will allow Morphosense obtain initial feedback on its product (performance, uses, improvements, etc.)

A partnership is going on between EGIS and Morphosense

- **DATA ORIENTED SERVICES | Segment : PREDICTIVE MAINTENANCE**

This segment is the responsibility of entities in critical structures whose need is to follow in the long term (and not in emergency mode) the structural health of their structure / building over time upstream of a defect/anomaly.

Two reasons for this need for real time and continuous monitoring:

(i) **Predictive Maintenance.** Predictive maintenance is to act upstream of the detection of an anomaly to reduce technical and financial impact or even avoid it when possible. This anticipation leads to economic gain because the work is of much lower magnitude once the anomaly is detected or seen. In addition, less substantial work also induce less disruption in the functioning of a structure such as a road or rail bridge.

⇒ The MORPHOSENSE offer allows macroscopic and centralized visualization of structures that have a "suspicious behaviour geometric " ( slight swelling or a distorted increases without exceeding a critical threshold )

(ii) **Logging before and after an event (anomaly, earthquake, work, etc.).** This need is expressed by all the masters of works in charge of structures located in areas of high seismic risk. Following an earthquake, a diagnosis (see first segment) assesses some of the damage. However, it is not uncommon for buildings and structures that have no apparent damage yet to collapse a few weeks later. A lack of information about the past of the structure before the event (or anomaly). Monitoring over time of two fundamental parameters (deformation and modal frequencies) allows precisely to quantify the effect of this event and to manage risk.

⇒ The MORPHOSENSE offer give the possibility to assess whether the structure is still capacity to its primary function regardless of its visual appearance. This recurring problem is the subject of building standards by countries such as Italy and Japan.

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## • International Development

The segment of expertise as described above is by nature international. However, not all countries are not sensitive to monitoring their structure and the more generally speaking to the question of the safe operation of the structures under their responsibility or they delegate the responsibility to a third party company. The first countries affected by the interest to follow the civil structures identified by Morphosense are:

- The EU countries (Italy is far ahead of standardization related to monitoring structures).
- The United States. In particular the state of California subject to seismic risk.
- Japan for the same reasons as Italy and California
- Canada - this country is subject to drastic temperature changes as well as very low temperatures (< -30 °). The park structures of this country is aging and the federal state currently engages in a reflection and substantial funding on the development of new structures and the associated monitoring.
- China - This country is reviewing its management policy of its own structures (so many of them). So this is more a problem of quantity than legalization.

**Therefore thanks to a patented system architecture - Morphosense offers a solution with both measurements: deformation and vibrations where no competitor is able to do so.**

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## • Value Proposition

MORPHOSENSE Offers a highly efficient monitoring system based on both high tech MEMS sensors network and data fusion. Thanks to the signal processing to analyze the complete information, the MORPHOSENSE technology is an efficient tool to provide a Structural Health Monitoring through a customized Dashboard. It provides a real time, continuous monitoring for any Civil Engineering application, Railroad, Maritime or Energy application, and gives all the information to optimize budget and maintenance planning.

This solution will serve the railroad domains :

- By measuring the geometric deformation and vibrations of rail transport structures such as tunnels or bridges.
- By measuring the geometric deformation of the infrastructures such as building or train station.



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## • Business Model

The MORPHOSENSE business model is based on Data Oriented Services.

Thanks to the powerful technology, MORPHOSENSE produce and propose a sensor nodes network to fix onto the structure to be evaluated. The definition of the network is part of the expertise of the MORPHOSENSE team.

Once the sensor Nodes network is set onto the structure, the system can record all the parameters of the structure, this give the possibility to get a complete overview of the Structural Health of the structure.

Therefore, MORPHOSENSE will propose a FULL PANEL OF SERVICES based on data, in a customized dashboard, including for example:

- 3D Deformation
- Modal Frequency

MORPHOSENSE provides then SERVICES enabling and Highly Efficient Monitoring in a real time mode and in a continuous way.

MORPHOSENSE provide a monthly (or periodic) report with parameters defined with the user.

The company (client) receiving the MORPHOSENSE Service contract a monthly subscription with a defined duration commitment.

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## • IP and Regulatory situation

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## • Team documentation

Co-founders are a very experienced team with more than 60 years of cumulative experiences in fields of technology, business development and trades. Morphosense is supported by a strategic committee composed of 4 international experts in fields of finances, signal processing and industries of public works. The core team is known for over 5 years and has learned to work together on Morphosense technology to which they contributed for several years in different ways (technical, marketing, trades...).

The curricula vitae of operational founders are given below.





**Alexandre PALEOLOGUE** is **CEO** (Chief Executive Officer) of Morphosense. Before co-founding the company in early 2016, he served for four years as program manager at Leti. He also served on CEA Tech's executive committee and oversaw the launch of a transversal cell technology unit to develop relevant technology strategies with CEA's industrial partners.

Prior to that, Alexandre worked in the military applications department at CEA in Bordeaux to spearhead the technical and programmatic activities associated with France's nuclear deterrence capability.

He began his career in 1992 in R&D in the optronics department at AIRBUS Defense & Space in Toulouse, and in 1996 he joined the systems division where he managed development of early warning systems.

Alexandre has a degree in engineering from the Technology University of Compiègne (UTC). Since 2016, Alexandre is CEO and founder of MORPHOSENSE.



**Pierre-Damien BERGER** is **CSMO** (Chief Sales & Marketing Officer) of Morphosense. Pierre-Damien holds a PhD in optronics conducted at INSA Lyon (1994-1997). He served for seven years in Atmel Company as head of R&D programs. Pierre-Damien joined CEA in 2007 and successively held the positions of program manager, Leti Sales Director and finally responsible for industrial partnerships at the CEA-Tech corporate level. His experiences in the start-up MOVEA between 2010 and 2011 allowed Pierre-Damien to appreciate the issues related to international development. Pierre-Damien is IoT representative for the French Tech at national level and very familiar with the associated industry.

Since 2016, Pierre-Damien is CSMO and founder of MORPHOSENSE



**Mikael CARMONA** is **CTO** (Chief Technical Officer) of Morphosense. Mikael Carmona received the Diploma in engineering (2007) and the Ph.D. degree (2011) in signal processing from the Institut National Polytechnique de Grenoble, the B.S. degree in mathematics (Agrégation 2007) from the Université Joseph Fourier de Grenoble. From 2011 to 2015, he has been an Engineer with the Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Grenoble. He worked on industrial projects dedicated to structural health monitoring with MEMS sensors network as project manager and technical task manager.

Since 2016, Mikael is CTO and founder of MORPHOSENSE.



**Matthieu BOSQUET** is **CPO** (Chief Product Officer) of Morphosense.

Matthew is graduated from PolyTech and specialized in the architectures for sensor networks (2011-2014), Matthew also holds a Masters degree in mechatronics, automation, robotics and signal (2013-2014). He meets Alexandre in 2014 as trainee. He joined CEA as R&D engineer at the end of the trainee. This opportunity will allow him to meet Mikael that he will develop, therefore, a new version of Morphosense structure dedicated to monitoring that will play key technological component for Morphosense. The close and complementary collaboration with Alexandre Paleologue and Mikael Carmona during the past two years, enabled the establishment of mutual trust and mutual reinforcing its commitment to continue the adventure with them by participating in the creation of Morphosense as co-founder. Since 2016, Matthieu is CPO and founder of MORPHOSENSE.

The Morphosense strategic committee is composed of international experts in main fields of interest for Morphosense.

- **Guy Lauvergeon** : financial expert, founder of ST NewVenture fund
- **Philippe Gotteland** : public work expert, networking in domain
- **Jean-Louis Lacoume** : signal processing international expert
- **Christophe Desrumaux** : CEA-i representative, investment fund

The functional structure of the Morphosense Company is then shown in figure below.



## • Financials

The 100 000€ of capital is today distributed between the founders as follows.

Name	Role in Morphosense	Shares held (in %)
Paléologue	CEO	37.5%
Carmona	CTO	37.5%
CEA-I	Co-founder	15 %
Lauvergeon	Strategic committee member	5%
Berger	CSMO	5%
Bosquet	CPO	1%

The equity capital is today around 350 K€. The French Public Investment Bank (BPI) is requested for an amount of reimbursable advance of up to € 300K. Private Banks are solicited up to 600 K € with a deductible of 2 years. A total amount of 1,2M€ will be available for the next 18 months enabling (i) technical finalization of the prototype in pre-industrial version, for the dedicated calibration tool development and (ii) commercial development in France and abroad.

A finalized fundraiser is anticipated for mid-2018. Depending upon the abroad development, the amount of fundraising will be comprise between 2 M€ at minimum and around 6 M€ maximum if abroad approach is well completed during 2017 and early in 2018.

Some technical and financials partnerships are in progress with OXAND and EGIS Companies. These discussions will end at the end of 2017.



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## • Company next steps

The first 6 months of 2017 will be devoted to looking and set-up in developing partnerships abroad. A mission to Taipei and Japan is already planned in early October 2016, and the contacts will be exploited early in 2017. Through a second attendee to the convention AQTR in Quebec in April 2017. The fundraiser will then start during summer 2017 with completion forecast for April 2018. The amount will be established according to the success of the abroad approach strategy.

3 main geography zones are clearly identified to set a proactive sales gait in 2017/2018

- France and Europe
- North America (Quebec & California)
- Asia with a focus on China and Japan

Business profiles will be hired to prospect and insure the MORPHOSENSE introduction on Markets. Some contacts are already investigate in China (through the IoT network) to target this market as the 4<sup>th</sup> zone for the future.

The first generation of MORPHOSENSE technology is based on a robust wired architecture. It provides a continuous-time, accurate and exhaustive data flow. All of the raw data and processed data are stored from the beginning of the instrumentation of the structures monitored by MORPHOSENSE. In some cases, only alerts are necessary (detection of the overpassing of a threshold for examples) and the mountain of data does not interest the customer in charge of the structure. MORPHOSENSE strategy is to develop a new generation of its technologies that embeds the data processing directly onto the physical system. The followed objective is to optimize the data flow and, to be further, to design a wireless architecture. This will be possible as the data flow and the data processing will be optimized. This will allow to propose a more adapted service to customer by decreasing the cost due to the data storage and management which are useless for the customers. Furthermore, removing cables add an asset to the service as the installation and the maintenance of the system is easier and thus cheaper.