Nanotechnology, value creation for the built environment

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Presentation Background (I)

- This presentation describes the history of a new product entering into the market: NANOSEED.
  - The product market target is cement and derived products.
- Concrete is the most employed material by mankind (only behind water).
  - ~ $5 \times 10^3$ M Tons a year
- NANOSEED is a concrete hardening accelerator.
The product development was built upon the concrete hardening complex self-assembly process.

The problem solved has two characteristics:

- It is global.
- It is able to develop a clear impact on a Company balance sheet.

In consequence it has been transformed into a real Business Opportunity.

Nowadays we are facing the new company creation process.
From the Idea to the Business Opportunity (I)

- From a “didactic” point of view, the evolution of the NANOSEED business opportunity was based on the following three layer scheme:
  - An ideation process,
  - A technology process: product performance, proof of concept, validation at different levels, upscaling, production of a first product batch (20 tons),
  - A third process devoted to the development of the business concept: business plan, business model, IPR valuation, etc.

- The real process was not the result of independent actions, but a continuous interaction between them.
The whole process begun at the end of the CODICE project
- “Computationally Driven Design of innovative Cement-based Materials” Funded by the European Union (FP7-NMP contract 214030).

The knowledge generated and the numeric codes from CODICE allowed us to fully describe both:
- The stability and performance of CSH doped nanoparticles,
- The effect of these nanoparticles when added to a water plus cement mix.

Once a TRL 2 was achieved, the experimental work was initiated in parallel to an ideation process based on Design Thinking method.
- By this way the advancement on the proof-of-concept at lab-scale was guided by the ideation process results.
The Product

What are Nanoseeds:

Nanoseeds are very small Calcium Silicate Hydrate (CSH) crystals.

When added into concrete and evenly dispersed through the mix, they act as tiny nucleation sites for the hardening (chemical setting reaction) of concrete.

In conclusion, CSH seeds are a highly effective:

**concrete hardening accelerator**
Cement hydration process

CEMENT + WATER $\rightarrow$ Cementitious Matrix

Microstructure simulation, HYMOSTRUC code from TU Delft
Cement hydration process

Microstructure simulation, HYMOSTRUC code from TU Delft
Cement hydration process

% Hydration

1 day

Microstructure simulation, HYMOSTRUC code from TU Delft
Cement hydration process

Microstructure simulation, HYMOSTRUC code from TU Delft
Cement hydration process

% Hydration

Microstructure simulation, HYMOSTRUC code from TU Delft

90 days
Cement hydration process

Formation of nuclei on the cement surface (dormant period)

Once they are formed there is fast growth of CSH (acceleration)
Nanoseeds are added to develop concrete early strength

<table>
<thead>
<tr>
<th></th>
<th>REF</th>
<th>Nanoseed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cem II 42,5R</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Water</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>w/c</td>
<td>0,4</td>
<td>0,4</td>
</tr>
<tr>
<td>additive</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Comp. Strength (19h)</td>
<td>23,9</td>
<td>36,3</td>
</tr>
</tbody>
</table>

If additional CSH nuclei (CSH seeds) are added, to the cement + water mix, the formation of hydration products will be faster ...
Previous work

Codice Colloidal C-S-H Code (C^4) Model

R. González-Teresa et al.  
December 2013

Dolado et al.  
*J. Mater. Chem.*, 2011, 21, 4445-4449
Normal C-S-H growth

Seeded C-S-H growth
“Computational Design” of cheap CSH seeds

- Cheap raw materials
- Fast production (2 hours)
- High yield (> 60%)
Value Proposition (I)

- **Key features and benefits**
  - Early strength acceleration at low, ambient and high (heat curing) temperatures.
  - Good workability of the concrete.
  - Does not affect concrete durability aspects.
  - Possible to be used with any kind of additive. No chemical interactions.

- **IPR Protected**
  - European Patent Granted. Number 13382474.8
Value Proposition (II)

- Transformation of waste materials & by-products into low production cost nanoparticles
Nanoseed improves performance of the cement at lower production cost

Special cement production cost reduction

-30% to -40%
“Beach head market”:
- Special cements niche (key: rapid hardening)

Total addressable market
- 11 million ton/year

Estimated penetration of 1% to 5%
- 110,000 to 600,000 ton/year

Sustainable competitive advantage:
- Low raw material cost.
- Quick reaction process.

Our patents prevent competitors from using by-products in a competitive way (for this application), giving us a sustainable competitive advantage.
The Team: CEO

Born in 1963 in San Sebastian.

Master Industrial Engineer University of Navarra. MBA, IESE, Barcelona

Started his carrier in 1991 for IMENOSA in Madrid as a Project Manager in Morocco being responsible for the fulfillment of budget, terms and quality.

In 1994 was one of the founders (and CEO) in San Sebastian of KRANE: overhead cranes manufacturing, sales and service company. More tan 1500 sold cranes, 75 workers and 6 service delegations created within Spain in 10 years.

Joint-Venture manager between KRANE and KCI KONECRANES (finish license owner company). From 2004 CEO in different companies from different sectors in Basque Country, always reporting to the Board of Directors and being responsible for the established objectives in the Strategic Plans and Business Plans. Personally involved in Sales.

In the last 3 years CEO for a concrete manufacturing and delivering company in San Sebastian: 5 concrete manufacturing plants and 60 trucks.

Speaks fluent English, understands French and has both Basque Language and Spanish as mother tongue.
The Team: Support Ecosystem

**Clients**
Already in discussion with concrete companies that expressed interest

**NanoSeed**
Xabier Iriondo CEO

**Tecnalia**
*Construction Division*
Jorge S. Dolado, PhD Physics
Juan J. Gaitero, PhD Mat Eng

**Tecnalia Ventures (TV)**
Asier Rufino TV CEO MBA LBS
Aitziber Aramburu, IP expert MSc in Innovation
Gorka Hermoso, TV Portfolio Manager MBA, Richmond Univ.

**Investors**
Smart Capital

- NanoSeed technology developers
- Support in technology scaling-up and transfer
- Access to division’s current clients
- Support in business model definition
- Support in IP
- Willing to invest
Roadmap and Fundraising

2017

- European patent granted and PCT patent application.
- Proof of concept at lab scale.
- Industrialization confirmed through outsourcing of 20 Ton production (single batch).
- Strong team led by seasoned entrepreneur.
- Commercial traction from end clients.

Seed Round: 0.8M€

- Market validation and product launch
- Pilot Plant set up: Design and built
- Process variables optimization and new products development
- Intellectual Property

Spin Off

2018

Serie A: 1-2.5M€

- Business up-scaling
- Internationalization
- Install the first Production Plant
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