



EXPERIENCE OF ALFA GROUP IN MANUNET PROJECTS

MANUNET Annual Conference

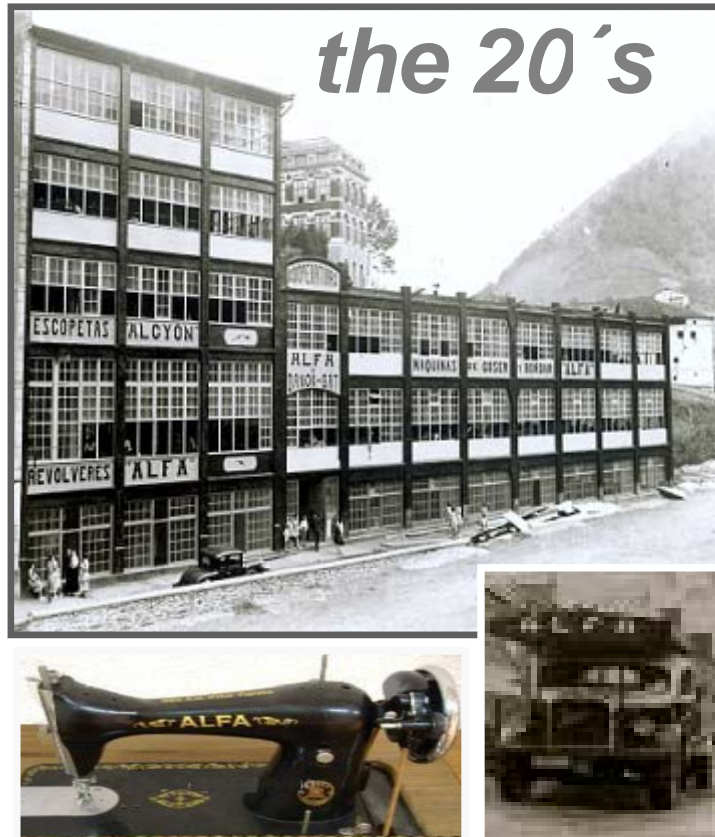
Florence, Italy

23 April 2009

Dr. Pedro Pablo Rodríguez – prodriguez@alfalan.es

- 1. BRIEF PRESENTATION OF ALFA GROUP**
- 2. PARTICIPATION OF ALFA UNITS IN MANUNET PROJECTS**
 - 2007: INVAUT
 - 2008: COMP- μ -INJECTION, LASCLEAN
 - 2009: QUAMINET
- 3. GENERAL CONSIDERATIONS OF MANUNET PROJECTS**
- 4. SUMMARY AND CONCLUSIONS**

1. BRIEF PRESENTATION OF ALFA GROUP

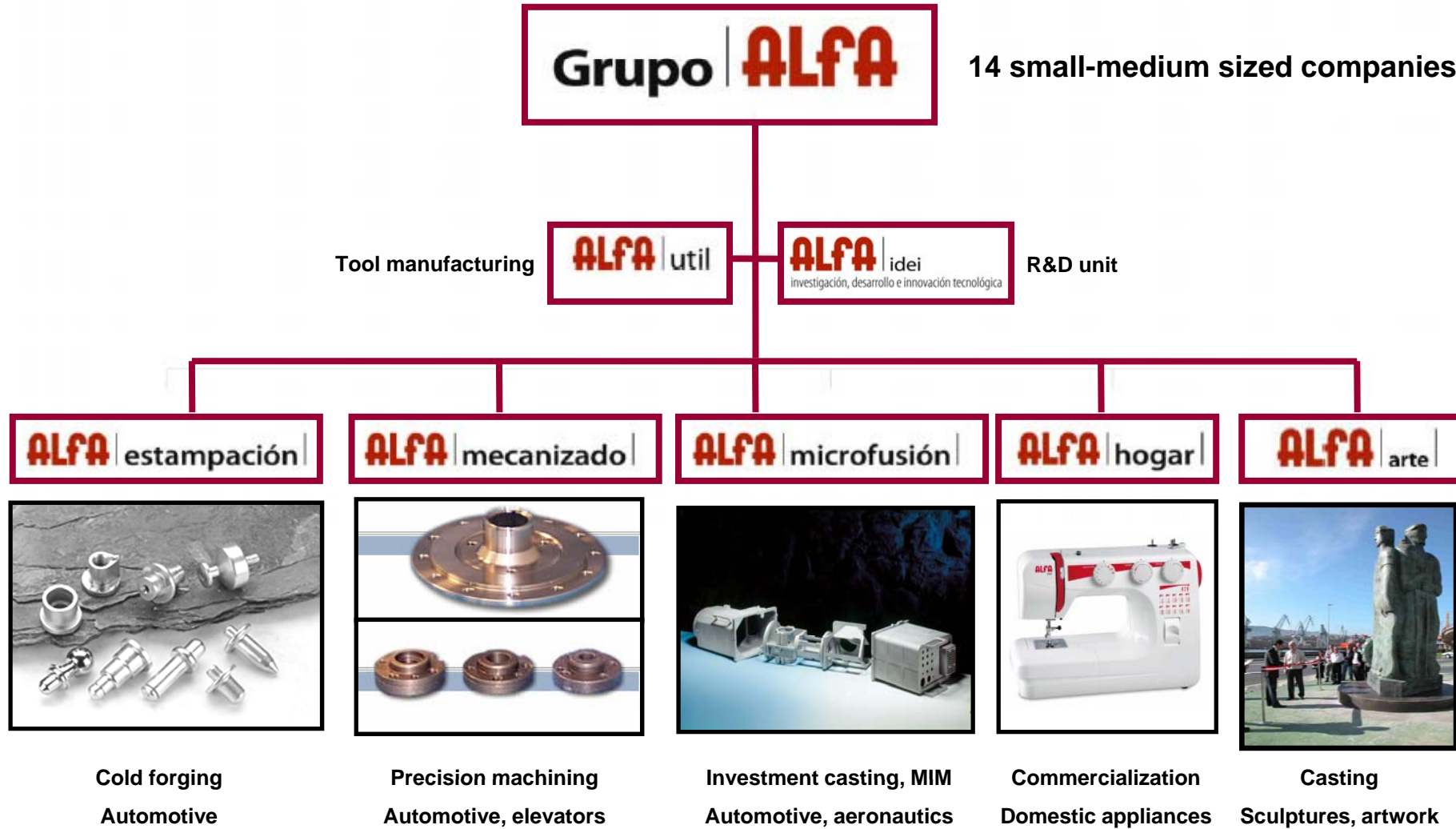


the 20's

Firearms, sawing machines



Industrial Applications, artworks, home appliances





2. PARTICIPATION OF ALFA UNITS IN MANUNET PROJECTS

Title: High Performance Magnesium Investment Casting for Automotive Applications

Duration: 3 years (2008-2010)

Budget: 1.345.000 €

Basque Country

North-Rhein Westfalia

ALFA | microfusión |
Investment casting foundry

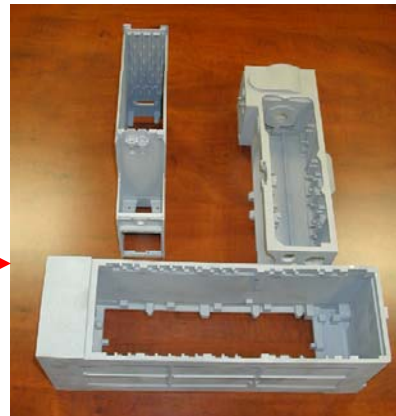
ALFA | idei
investigación, desarrollo e innovación tecnológica
Process development

GOI ESKOLA
POLITEKNIKOA
ESCUELA
POLITÉCNICA
SUPERIOR



MONDRAGON
UNIBERTSITATEA

Magnesium casting



Magnesium cast
housings for automotive
industry, substituting
aluminium and/or plastic

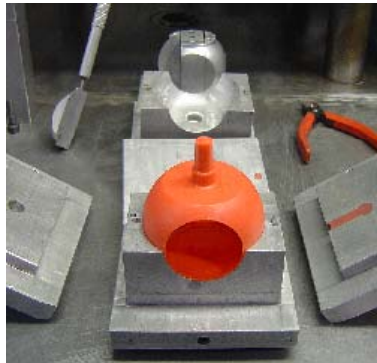


Casting simulation



End-user

Wax injection



Wax tree mounting



Ceramic coating



Pouring



Dewaxing



Final part



- **Advantages of magnesium:**

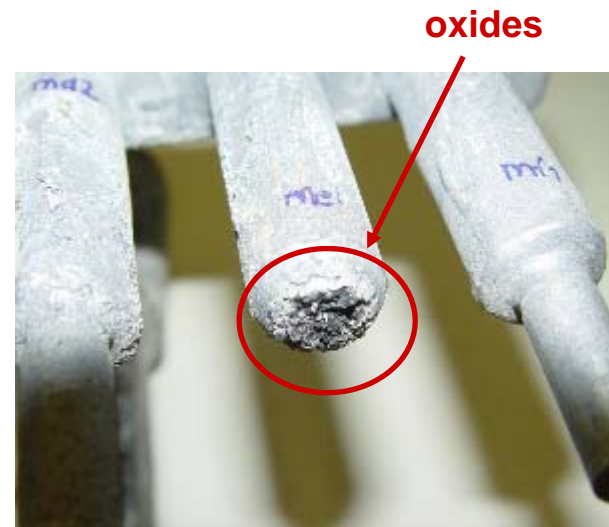
- Similar mechanical and thermal behaviour compared with aluminium alloys
- 30% weight reduction when substituting aluminium by magnesium

- **Disadvantages**

- High reactivity of molten magnesium with oxygen and ceramic mould → Oxides, mould burning
- Unknown rheological behaviour of the molten magnesium inside the ceramic mould

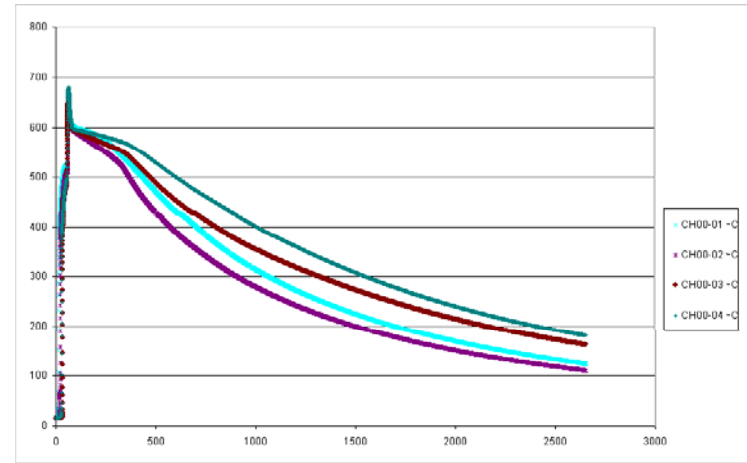
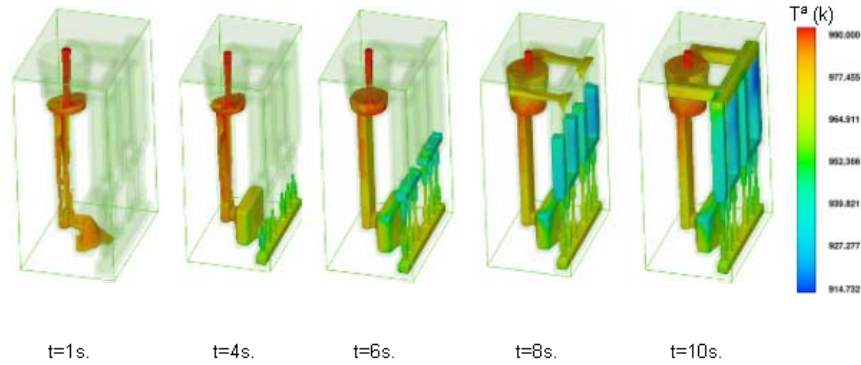
- **Technological challenge:**

- Develop a specific investment casting process for magnesium alloys



- **TARGET MARKET: Transport industry**

- 30% lighter products with advanced mechanical properties → reduction on fuel consumption
- Weight reduction improves vehicle performance by enhancing acceleration/deceleration.
- Magnesium parts can be tuned to critical frequencies where noise, vibration and harshness are reduced
- Lighter structures can be removed and/or reconfigured to allow easier egress and ingress; e.g. a 3rd-row magnesium seat is 18 Kg. lighter than a heavier steel fabrication.
- Magnesium castings can have reduced manufacturing cost vs. steel, especially for production volumes of less than 200.000 units/year. For example, a 30-part steel cross-car beam requires 30 expensive tools/gauges; the cast-magnesium version has only 6.
- A one-piece cast-magnesium cross-car beam can reduce dimensional error vs. stamped/welded steel elements.
- Magnesium has higher strength, stiffness, thermal stability and thermal conductivity vs. plastic; higher specific strength, ductility and impact resistance vs. aluminum as well as better damping and dent resistance vs. steel



Process design and modelling

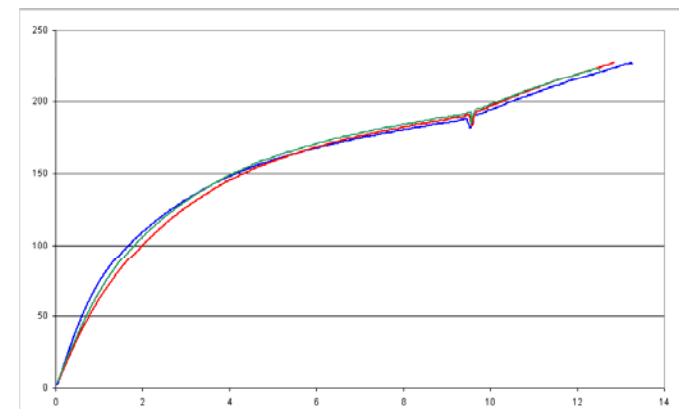
Process monitoring



Experimental tests



Microstructural and mechanical characterization



- **Reduce mold-metal reactions**
 - Development of an alumina-based coating
 - Development of inhibitors (NaBF_4 , SF_6 ,...)
- **Definition of casting conditions for magnesium alloys using a simulation/experimental approach**
 - Development of specific crucible for magnesium melting
 - Optimization of process parameters (melt and mould temperatures, pouring velocity, mould transfer time,...)
 - Calculation of solidification curves via thermocouples embedded in the mould
 - Supported by process simulation
 - Characteristics validated by end-user



• **1 Master Thesis**

- A. Gorosarri. *“Modelización y desarrollo del proceso de microfusión de magnesio para la elaboración de componentes aeronáuticos”*, Mondragon Unibertsitatea, July 2008

• **1 PhD**

- G. Arruebarrena. *“Relationship between Solidification, Microstructures and Mechanical Properties of Magnesium Cast Alloys”*, Mondragon Unibertsitatea, March 2009

• **4 presentations in scientific conferences**

- Spanish National Conference on Materials Science, San Sebastián (Spain), June 2008
 - N. Herrero Dorca, A. Gorosarri, G. Arruebarrena, P. P. Rodríguez, M. Oiarbide, I. Hurtado. *“Simulación y experimentación del proceso de microfusión para la aleación de magnesio AZ91E”*
 - G. Arruebarrena, I. Hurtado, H. Sarriegi, K. Weiss. *“Análisis de microestructuras y propiedades mecánicas en aleaciones de Mg coladas en coquilla por gravedad”*
- International Conference on Magnesium Alloys and Applications, Weimar (Germany), October 2009
 - N.Herrero-Dorca, G. Arruebarrena, H. Sarriegi, U. Beristain, U. Andres, Y. Bilbao, P. P. Rodriguez, K. Weiss, I. Hurtado. *“Investment Casting of a AZ91E Thin-Walled Complex Component”*.
 - G. Arruebarrena, N. Herrero, H. Sarriegi, K. López, P. P. Rodríguez, I. Hurtado. *“Thermal conductivity of high-pressure die-cast AM50 and AZ91D alloys”*

• **1 patent under preparation**

Title: Laser cleaning, polishing and multi spectral analysis of surfaces for artworks, artwork restoration and industrial applications

Duration: 3 years (2009-2011)

Budget: 1.690.000 €

Basque Country



Piedmont



Fonderia Artistica di Piero
de Carli e C. s.a.s.



UNIVERSITÀ
DEGLI STUDI
DI TORINO
ALMA UNIVERSITAS
TAURINENSIS



Title: Tools and methods for competitive μ -injection process industrialization

Duration: 2 years (2009-2010)

Budget: 1.361.000 €

Basque Country



Piedmont



Slovenia



Univerza v Ljubljani

Title: Adaptive quality control for the μ -injection moulding technology via neural networks

Duration: 2 years (2010-2011)

Budget: 1.601.000 €

Basque Country



Germany



3. GENERAL CONSIDERATIONS OF MANUNET PROJECTS

- **International project**

- Small consortium → easier management
- Local funding → well-known administrative process
- Many regions involved → it is possible to find good partners
- Very useful tool as a first experience in international projects for small companies

- **Two-stage process**

- No waste of time if project is not suitable

- **Efficient support by local agencies**

• **Extremely long administrative process, e. g. INVAUT project:**

- | | |
|-------------------------------------|--|
| • Idea | December 2006 |
| • Manunet 1st stage | June 2007 (approval: 11 July 2007) |
| • Manunet 2nd stage | October 2007 (approval: 3 December 2007) |
| • Project start date | 1 January 2008 |
| • Basque local programme (2008) | June 2008 (approval: February 2009) |
| • 70% of approved funding | March 2009 |
| • Remaining 30% of approved funding | 2010 (hopefully,...) |
| • Basque local programme (2009) | June 2009 |
| • etc... | |

4. SUMMARY AND CONCLUSIONS

- **ALFA experience in MANUNET projects is very satisfactory:**
 - 3 approved projects in 2007 and 2008 (out of 3 presented)
 - 1 project presented to MANUNET 1st stage in 2009
 - More to come
- **MANUNET projects allow transnational cooperation avoiding difficulties linked to conventional large-scale European projects**
- **MANUNET is a extremely convenient tool as a first experience in European projects for small-medium sized companies**

Everything seems wonderful, but:

- **Be patient with administrative process!!!**



THANK YOU FOR YOUR ATTENTION

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