MATEMATICA
PER L'AUTOMAZIONE INDUSTRIALE
6 aprile 2016

BROVEDANI GROUP

- ❑ COMPANY PROFILE
- ❑ APPROACH
- ❑ NEBULIZER PROJECT
- ❑ LPG AFTERMARKET PROJECT
- ❑ CONCLUSIONS

Alessio Faraon
R&D Product Manager

BROVEDANI GROUP:
COMPANY PROFILE



BROVEDANI TIMELINE

1947

In 1947, Silvio Brovedani, a remarkably skilled mechanic and businessman founded a small workshop in Pordenone.



1972

In 1972 Benito Zollia and Felice Macuz took over the company.



1976

In 1976 the Company moves from Pordenone to new Headquarters in S. Vito al Tagliamento.



1978/79

Entry into the automotive industry

1980/85

Micro-mechanics with IBM and Olivetti



1995

Modugno (Bari) Plant start



1998/2000

Leader in diesel Common Rail components



2004

Brovedani Sk Start of operations



2009

Brovedani Reme MX Start of operations



2011

Brovedani SK Plant Expansion

2012

Brovedani Reme MX Expansion



ASIA
Potential future expansion

FACTS AND FIGURES

100 mln € Turnover

Approx. 1.000 employees

5 production plants

200 mln parts/year

125.300 sq.m. total surface

3 mln production phases/day

34.195 sq.m. covered areas



BROVEDANI PLANTS



Galanta – Slovak Republic



Total surface: 19.200 sqm
Covered Area: 8.500 sqm
Employees: 330
Production: 92 Mln pcs

Headquarter – San Vito al Tag.to (PN), Italy



Employees: 49

Plant 1 – San Vito al Tag.to (PN), Italy



Total surface: 37.800 sqm
Covered Area: 6.895 sqm
Employees: 222
Production: 52 Mln pcs

Plant 2 – San Vito al Tag.to (PN), Italy



Total surface: 9.800 sqm
Covered Area: 5.000 sqm
Employees: 170
Production: 49 Mln pcs

Queretaro – Mexico

Total surface: 20.000 sqm
Covered Area: 10.400 sqm
Employees: 120
Production: 6,2 Mln pcs

Modugno – Bari, Italy

Total surface: 26.500 sqm
Covered Area: 3.400 sqm
Employees: 56
Production: 7 Mln pcs

AUTOMOTIVE PRODUCTS

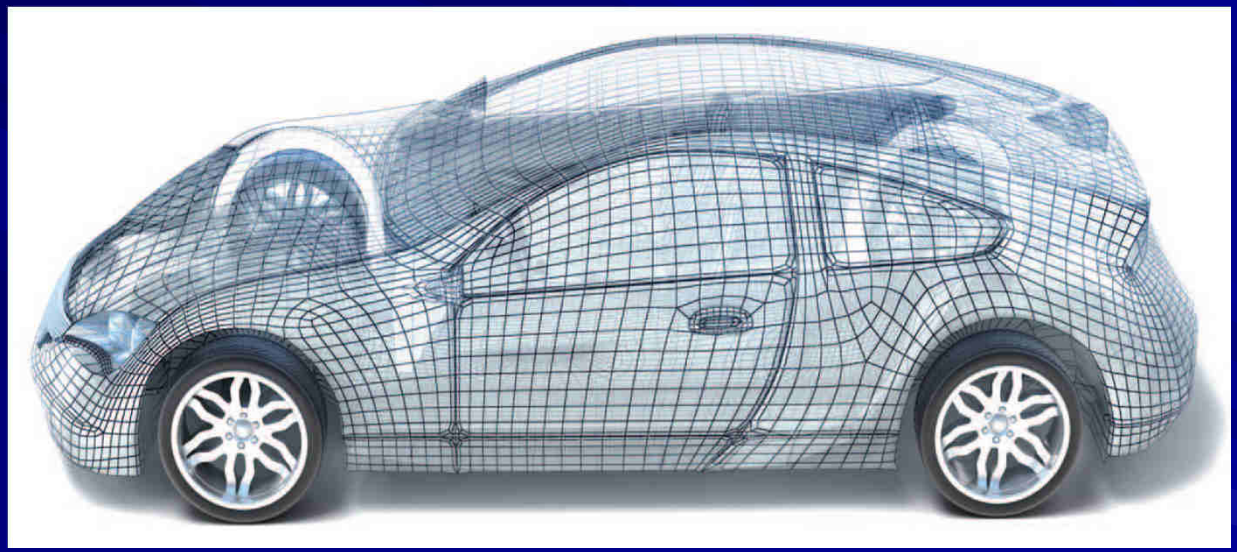
Brovedani components put the world in motion.

DIESEL INJECTORS



HIGH PRESSURE DIESEL PUMPS





BRAKE PISTONS



GEARBOX SHAFTS



STEERING GROUPS



SUSPENSIONS



GASOLINE INJECTORS



STARTERS



MINI LASH ADJUSTERS



AIR CONDITIONING COMPRESSORS



WATER AND OIL PUMPS



CUSTOMERS

AUTOMOTIVE

- BOSCH
- CONTINENTAL
- COOPER STANDARD
- CUMMINS
- DAIMLER
- DELCO REMY
- DELPHI
- DENSO
- EBERLE
- EATON
- CHASSIS BRAKES INT.
- NEXTEER
- HITACHI UNISIA
- INTERNATIONAL NAVISTAR
- MAGNETI MARELLI
- MAGNA
- METALDYNE
- SANDEN
- VCST
- ZF SACHS

OTHERS

- CASE NEW HOLLAND
- IBM
- KOVINOPLASTICA
- PIAGGIO
- PMA
- REXROTH
- ROTO

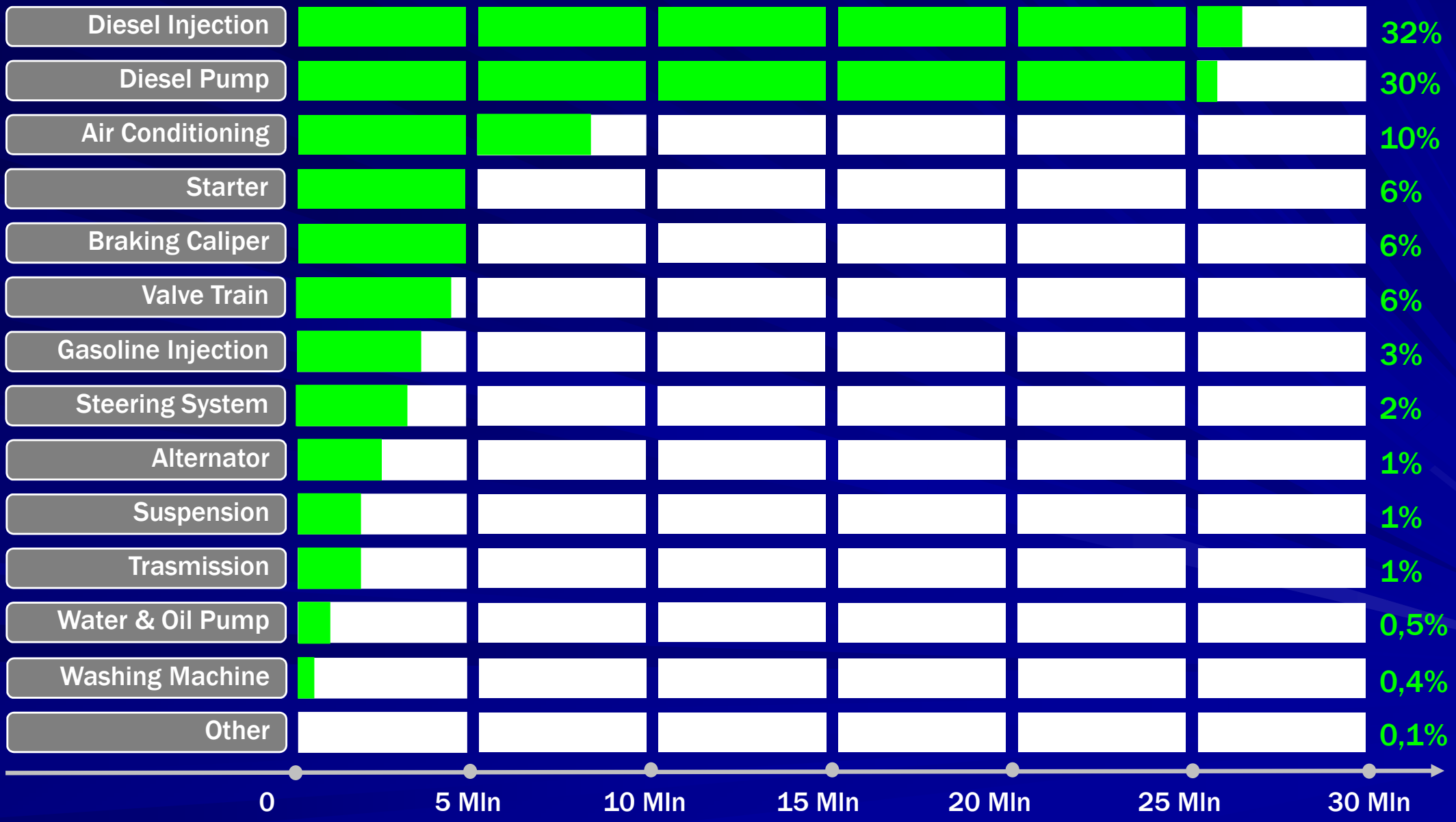
AEROSPACE

- TCS GROUP

HOME APPLIANCES

- AEG HAUSGERAETE
- BOSCH
- CIFUNSA
- ELECTROLUX

BRANCHES & APPLICATIONS



TECHNOLOGIES

MULTI SPINDLE



ROTARY TRANSFER MACHINE



MACHINING TRANSFER



TRANSFER BROVEDANI ENGINEERING



CENTERLESS GRINDING



POLISHING



VERTICAL CNC TURNING



WORKING CENTRE



TOOTHING



CHROME PLATING



LAPPING



INDUCTION HARDENING



FORM ROLLING



CENTERLESS FORM GRINDING



PLANE GRINDING



MICROGRINDING



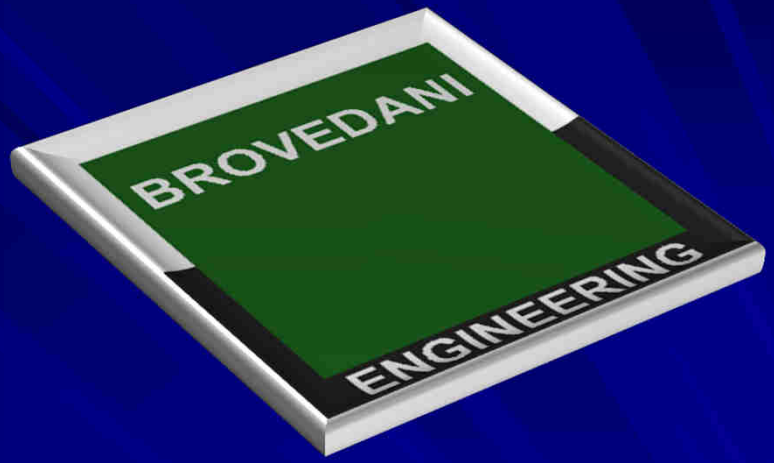
HONING



GRINDING TRANSFER



BROVEDANI ENGINEERING



Brovedani Special System & Machine Engineering (S&M Engineering).

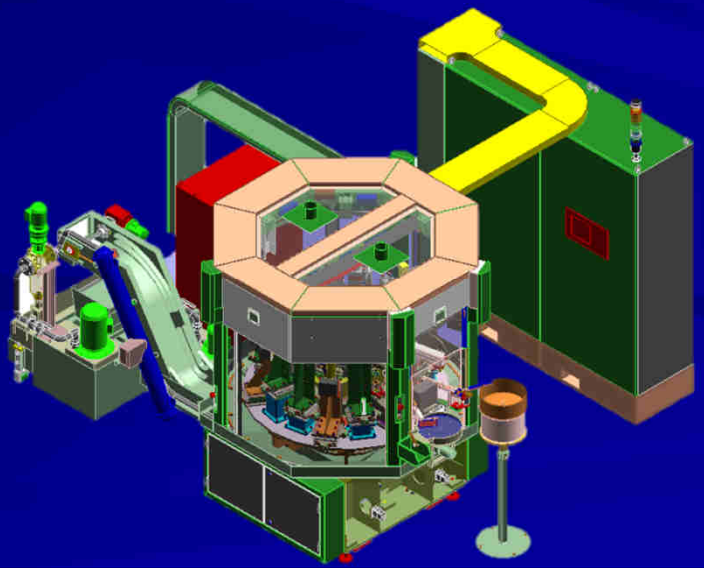
The staff is specifically focused on:

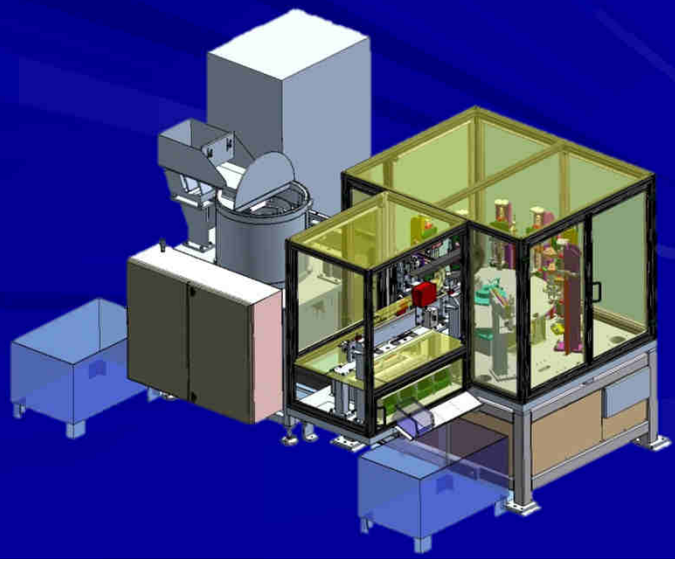
. Development machining center up to 14 controlled axes

. Development of automation following internal necessities

. Construction of visual and dimensional inspection machines for 100% control







MANAGING AND FOLLOW THE GROWTH

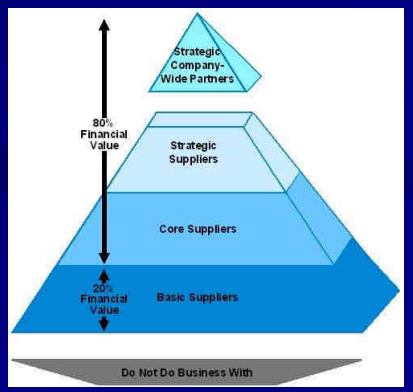


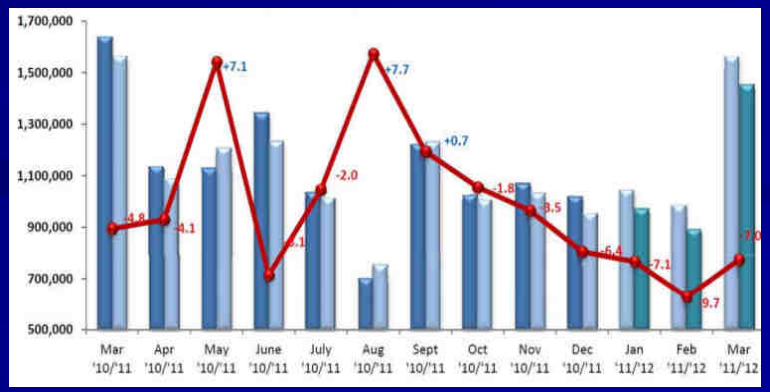







1. Focus on new products in core business
2. Open Innovation
3. Market and products diversification
   - Nebulizer
   - LPG Liquid Gas Injection
4. Brovedani Aerospace
5. Internationalization with focus on LCC
6. Increase technical competence and quality level
7. Alliance





HOW BROVEDANI MANAGE OPEN INNOVATION AND MARKET DIVERSIFICATION



A NEW RESOURCE

Dedicated resource

The new resource has to deal with innovation or rather with the innovation culture looking at 360°; its tasks and skill should be:

- Scouting for new business
- Advanced innovations in the mainstream
- Opportunity to management of grant awards
- Project management

Moreover other important aspects about organization are:

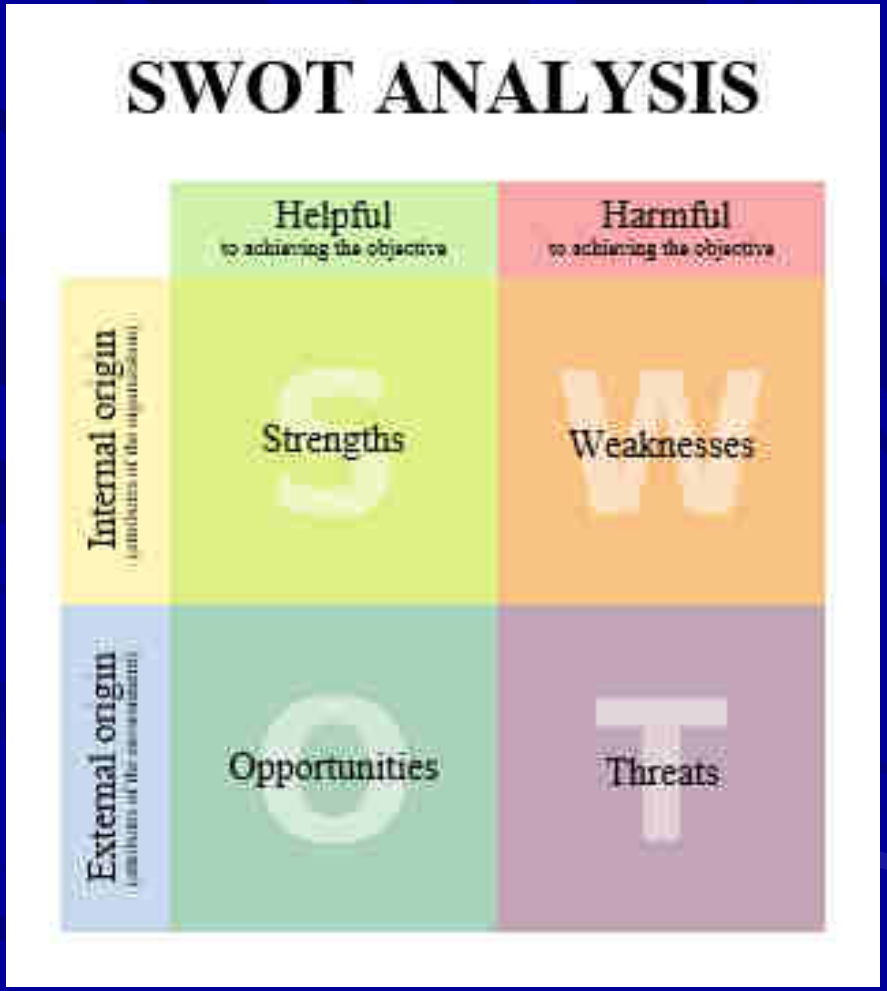
- The resource responds directly to the CEO and therefore has wide freedom of action within company structures
- She/he must be versatile to deal with different technological issues and with other matters (patents, contracts, networking, etc)
- Wide use of opportunity of grant awards in order to have a good self-sustainability because the timing to make business profitable is usually long and unpredictable

INTERNAL ANALYSIS

Internal analysis

To understand the current situation of the innovation culture within the company, a series of interviews with key people (about 20) in the company has been carried out .
The questions were simple and conversational for everyone but giving the opportunity to communicate freely ideas and criticisms.
The data were then analyzed and collected in a SWOT matrix that clearly highlights the situation of the company.

One way of utilizing SWOT is matching and converting. Matching is used to find competitive advantage by combining the strengths to opportunities or threat. Converting is to apply conversion strategies to turn weaknesses or threats into strengths or opportunities



INTERNAL ANALYSIS RESULTS

Internal analysis

S-O

The activities to transform the strengths into opportunities are relevant to the overall strategy of the company

W-O

The company weakness could be turned into opportunities through the actions described in 4 operational proposals.

S-T

Use of current skills (strengths) to solve the problem of mono-market (threat) can be dealt with 2 strategic projects

W-T

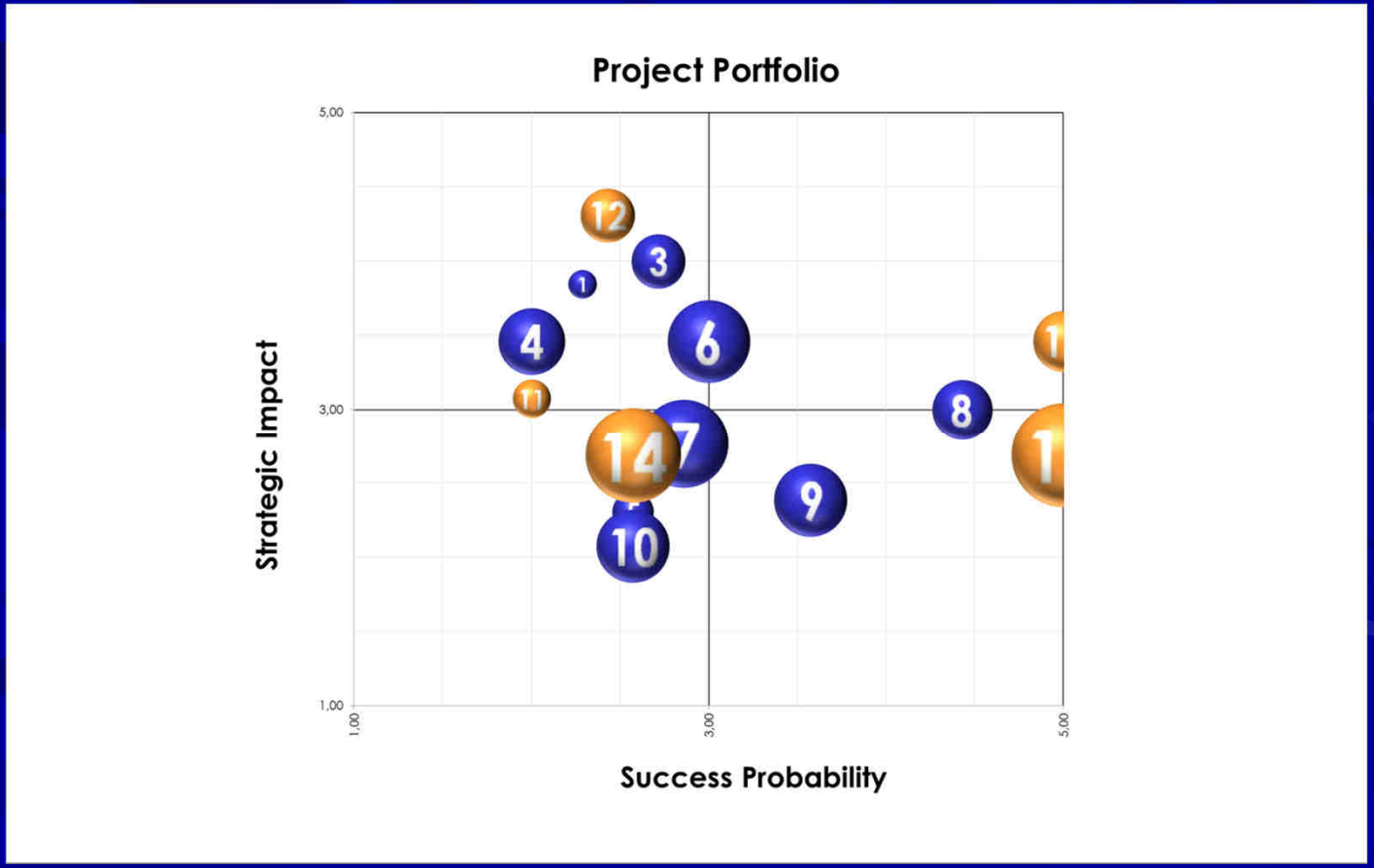
In order to prevent that threats become weaknesses 1 proposal has been done with the aim to protect and enlarge main company skills (knowledge management)

TREND ANALYSIS

Trend analysis

The trend analysis is a very useful tool for supporting strategic decision.
The social, economic, technological trend has been analyzed with brainstorming session inside the company, later ideas were generated and evaluated in terms of:

- Strategic impact
- Success probability
- Economic effect



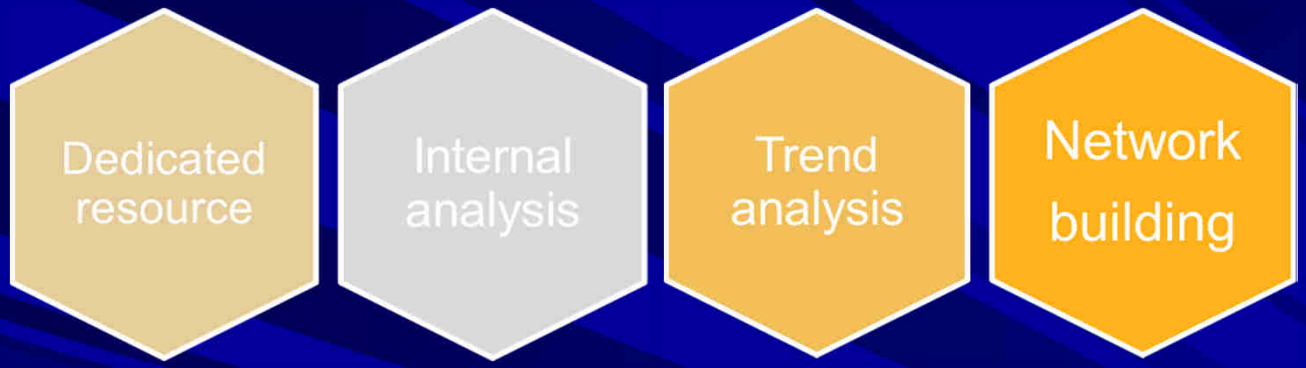
NETWORKING



The development of new businesses and innovation in general can be made more easily and effectively by cooperating with other organizations whether public or private.
It was therefore necessary to proceed with the creation of a network of persons and / or companies that share the same objective to focus on innovation and culture.
Regarding public contacts we were aimed at universities, according to their specific skills, building relationships that could be useful to both parties as through specific research activities, thesis, internships, company visits, lectures on specific topics, joint participation in research projects, etc,
Instead for private entities, mainly companies, it was tried to establish contacts for the development of common projects (supply chain) or for participation in tenders.

In both projects that Brovedani has undertaken, external companies have always been involved as project partners

OPERATIVE WAY



Market analysis

- Current market
- Future market
- Technological trend
- Similar market
- Competitor analysis
  - Product performances
  - Economical data
  - Patents and their trend

Resources needs

- Human resources
- Technological resources
- Partner research

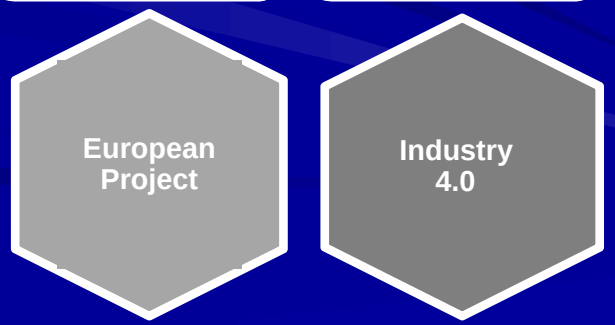
Economical approach

- Cost analysis
- Risk analysis
- Fund analysis
- Business plan

STRATEGIC PLANS

PROJECTS

ACTIVITIES

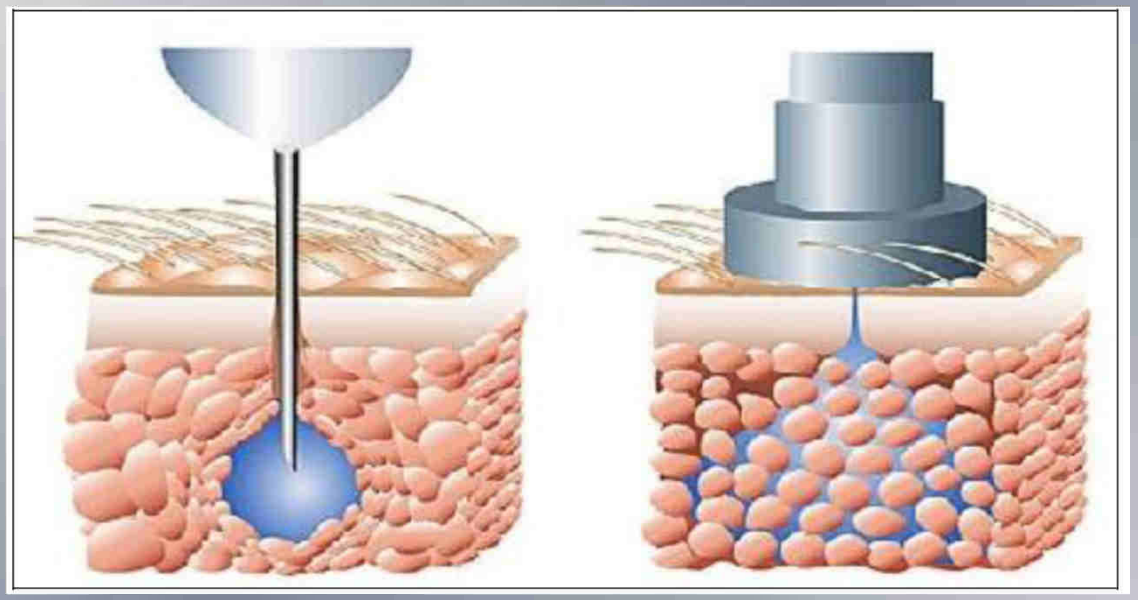


NEBULIZER PROJECT: THE ORIGIN

From the experience in production of component for injectors, Brovedani decided to “borrow “ its expertise and apply it in a different field, where high technological injector could be employed. The proposal of using an injector for medical scope was considered and after a deep analysis regarding technological issues and impact on potential market, a business plan has been drawn up.



NEBULIZER PROJECT: THE CONCEPTS



Drug delivery with a high pressure injector in the dermis and/or epidermis can spread the drug in a different way if compared to a conventional needle, improving the pharmacokinetic effect.

Improving kinetics of drug and shortening the maximum plasma insulin level, even Human Insulin if used with Injector could have the same performances of Analogue Insulin delivered with a conventional needle; saving for health national systems could be considerable

NEBULIZER PROJECT: ACTIVITIES

A clinical trial was necessary to demonstrate the performances of the Nebulizer with Human and Analogue insulin versus Analogue insulin with pen.

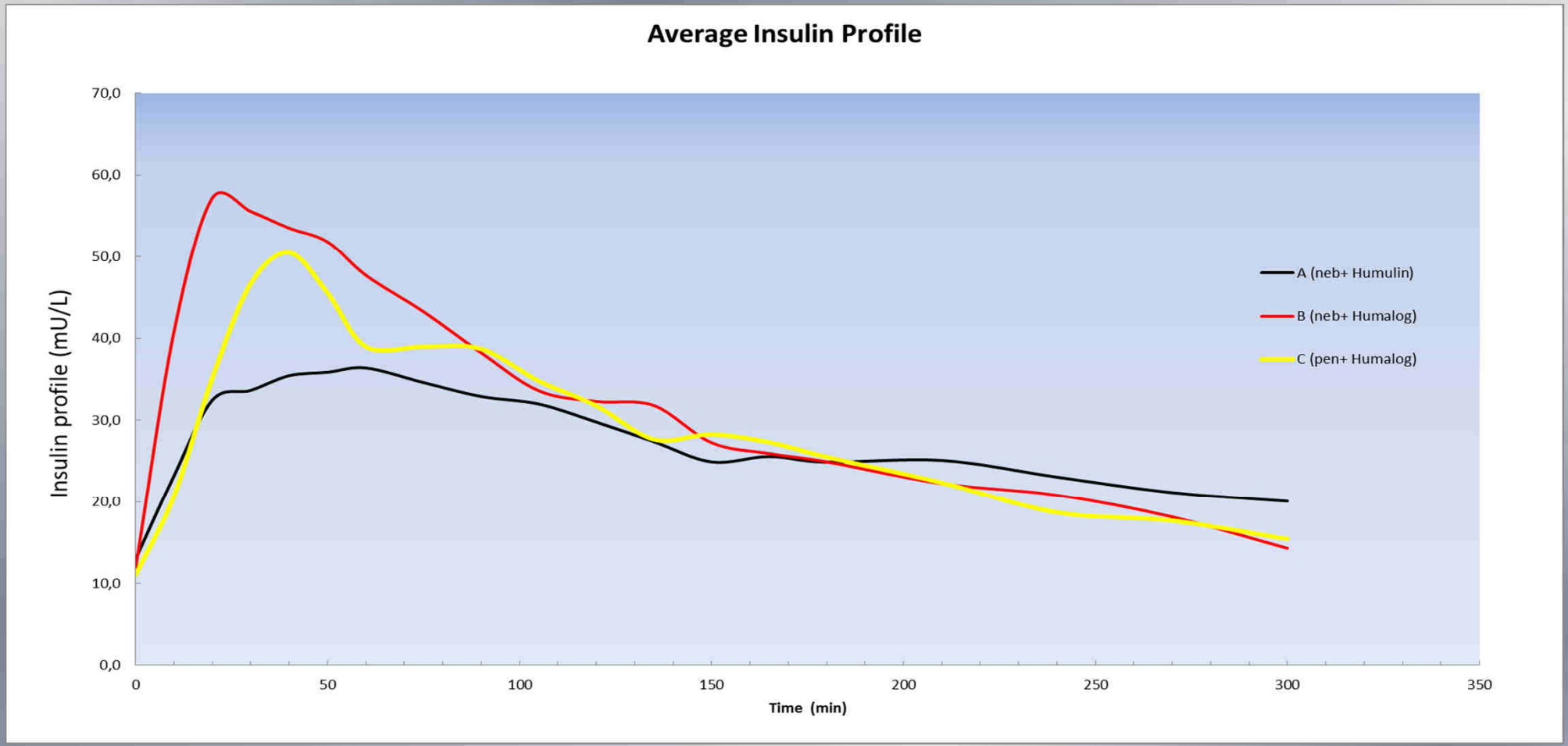
Brovedani was supported in this activity by an external medical consultant and an industrial partner already involved in medical device business.

The Clinical Trial has been interrupted due to insufficient recruitment.

The results are excellent when Analogue Insulin is used, but the final outcome is not satisfactory using Human Insulin .



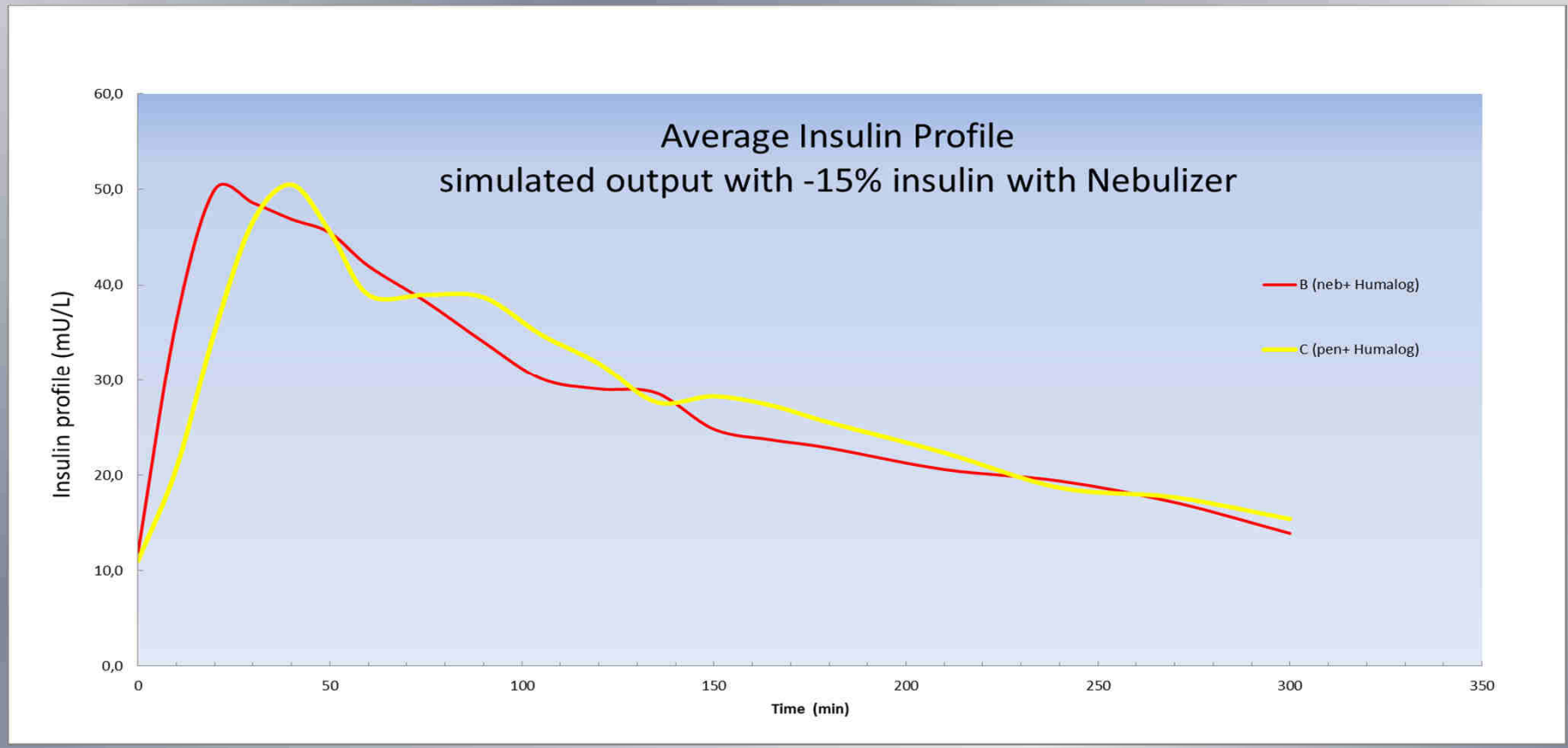
NEBULIZER PROJECT: RESULTS



* Results considering 9 patients

NEBULIZER PROJECT: RESULTS

Simulated Curves using previous results*



From simulations seems that less drug dose could be used with Nebulizer getting the same performances as pen or syringe

* Results considering 9 patients

NEBULIZER PROJECT: ADVANCEMENT

The excellent performances of Nebulizer, in terms of fast drugs uptake, could be used also for different pharmaceutical products and for other diseases

Needle free devices could be a valid solution of syringeability issues with new biological drugs

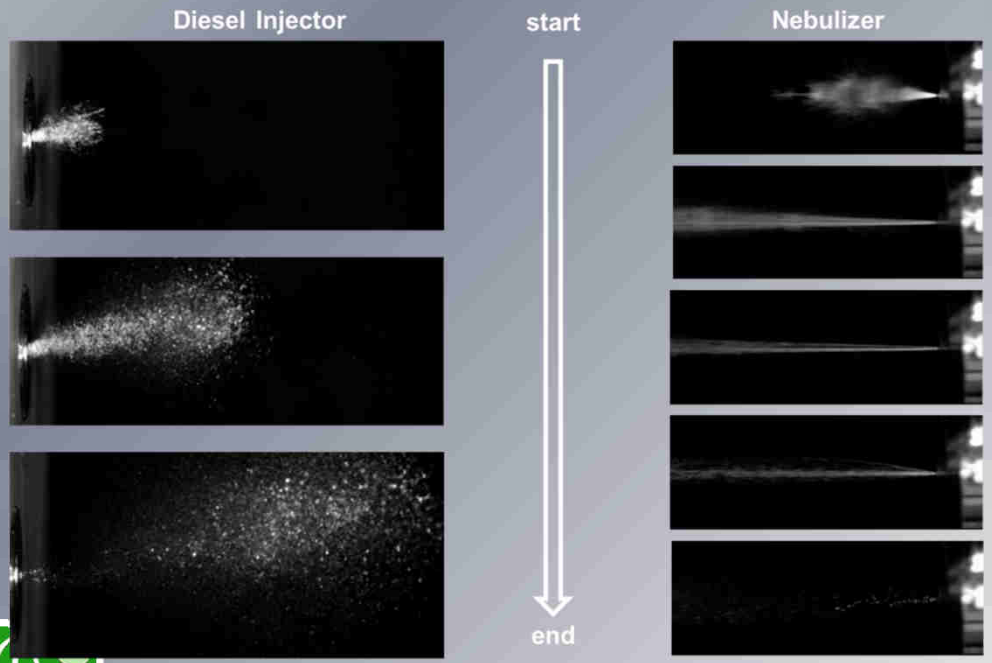
The project has not been stopped but the target and the approach has been modified slightly

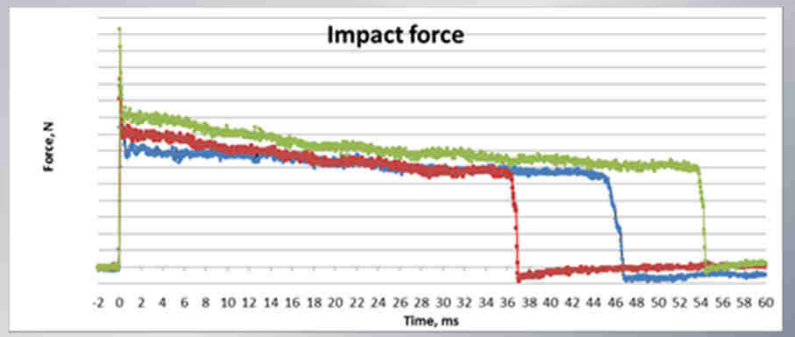
Now the target is not only a device for insulin delivery but a device for generic drug delivery and the approach changed increasing research activities and cooperation with other partners

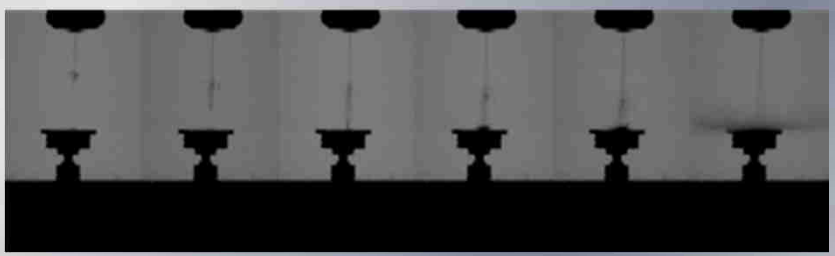
NEBULIZER PROJECT: NEW APPROACH

While process to get a good and performant component is well-established in Brovedani, some issues regarding specific behavior of injectors are not well known inside the company.

Therefore we obtain some help and support from University department (University of Perugia), that work specifically with injectors for diesel and gasoline engine.



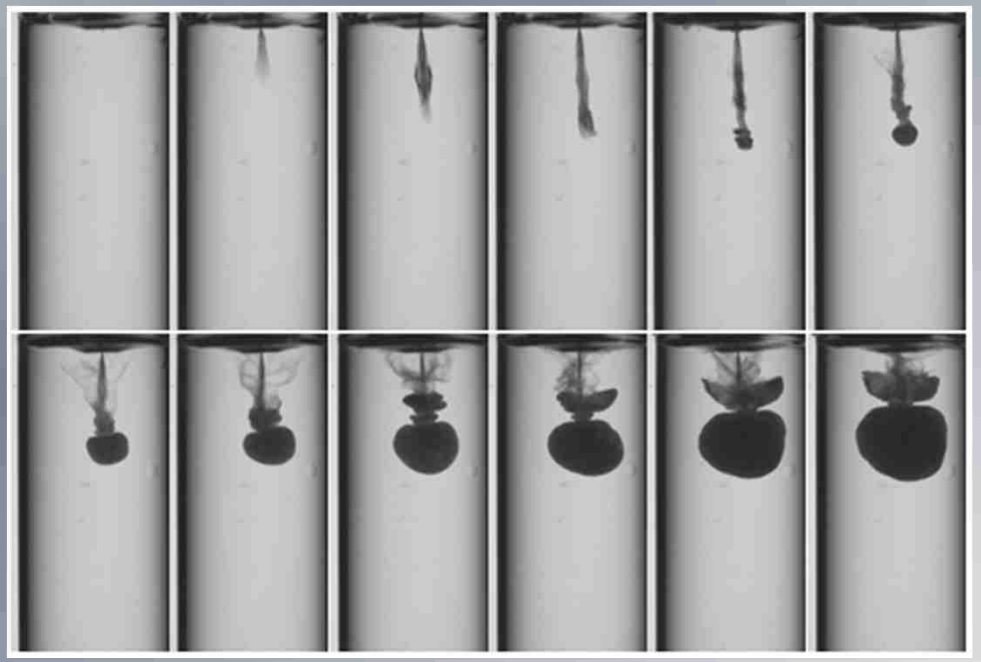


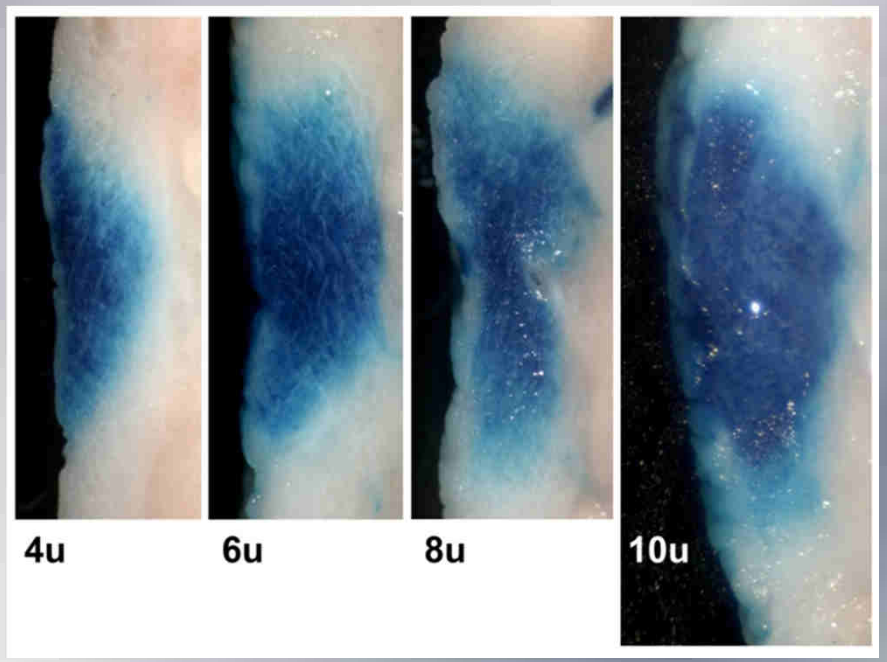


NEBULIZER PROJECT: NEW APPROACH

In order to understand deeply the behavior of jet in different means (gel, porcine skin, etc) and deepen the potential of Nebulizer with different drug formulation, a cooperation with Pharmacological department has been launched (University of Perugia).

The activities are carried out in close cooperation between Engineering and Pharmacological departments, for the purpose of having a wider approach to final products.





THE COMPANIES

Brum srl is a start-up which holds several international patents in the field of mechanics and energy.

Brovedani Group is a world leader in the production of precision engineering for the automotive industry.

BrumGas srl

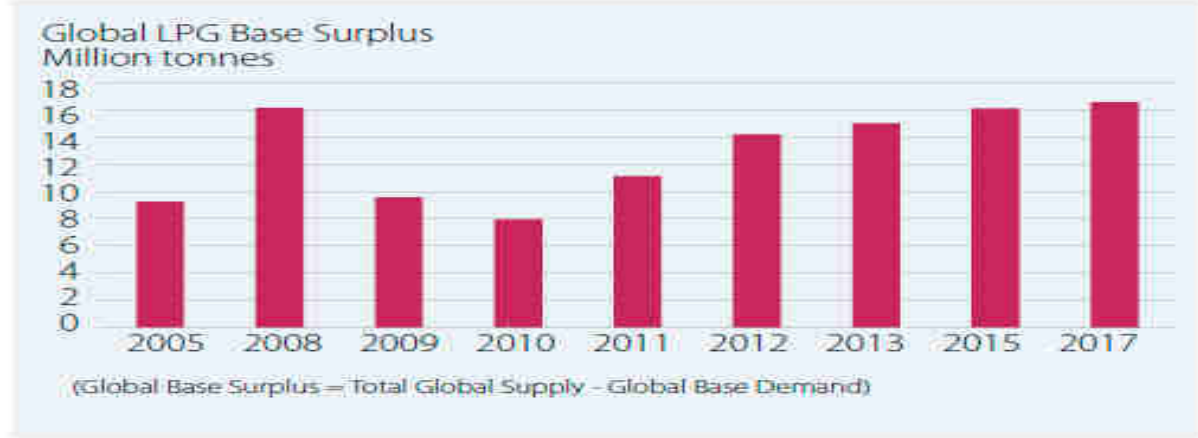
Brum srl and Brovedani Group spa have created a newco BrumGas srl for the technical and commercial development of the kit BrumGas, that is an LPG system for feeding engine of vehicles powered by gasoline and diesel.

KIT BRUMGAS AT A GLANCE

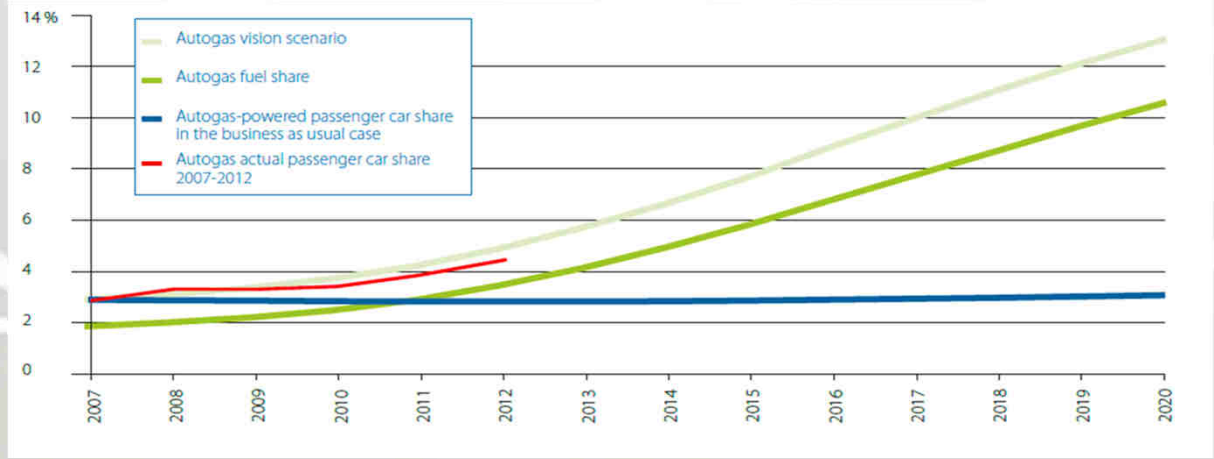
1. The kit BrumGas is an innovative system for the supply of liquid LPG in engine vehicles.
2. The system is valid for vehicles with indirect and direct injection.
3. The system is protected by several international patents.
4. The strength of this system is the low cost due to use of some existing components of the original engine system (rail, high pressure pump, injectors, LPG tank standard) and very easy mounting procedure.
5. The kit is suitable, with very little variation, for engines of all displacements

MARKET FIGURE AND TRENDS

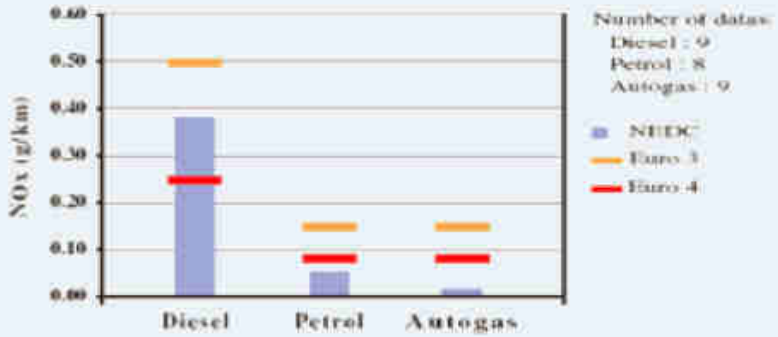
Reduced emissions and low production costs (due to surplus production) are the key factors for the increasing LPG share market in the future



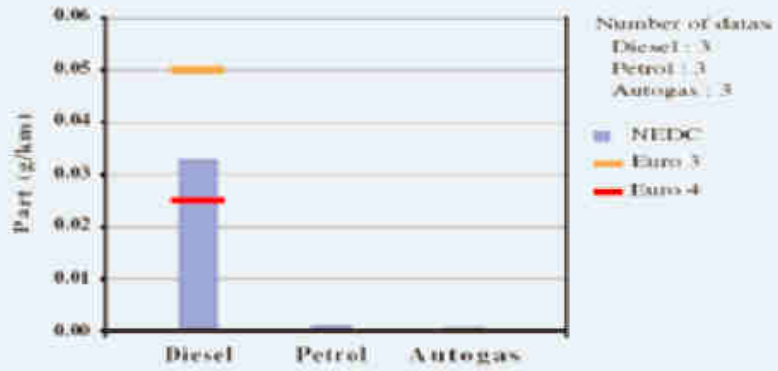
Source: IHS Energy Insight



NOx emissions



PM emissions



NEDC: New European Driving Cycle

SAFETY KIT BRUMGAS

The kit BRUMGAS meets the most stringent safety requirements because:

- is able to check LPG losses between tank and pump
- is able to check LPG losses between pump and rail
- is able to check LPG losses between rail and tank return
- Leakage of petrol between tank and rail can be detected as well
- The filling limit of 80% can be corrected to match the temperature in order to increase security (filling less than 80%)

STANDARD GASEOUS SYSTEMS vs KIT BRUMGAS

Standard LPG system
Gaseous injection



- Gas injection
- Poor performances
- High mounting time (more than 12 hours)
- Mounting needs skills and expertise and can condition performance and reliability
- Medium cost

Kit BrumGas
New liquid Injection system



- Liquid injection
- High performances (liquid injection)
- Low installation time (5 hours)
- Very simple to mount
- Low cost
- Less invasive

COMPETITOR LIQUID INJECTION vs KIT BRUMGAS

Existing liquid Injection system



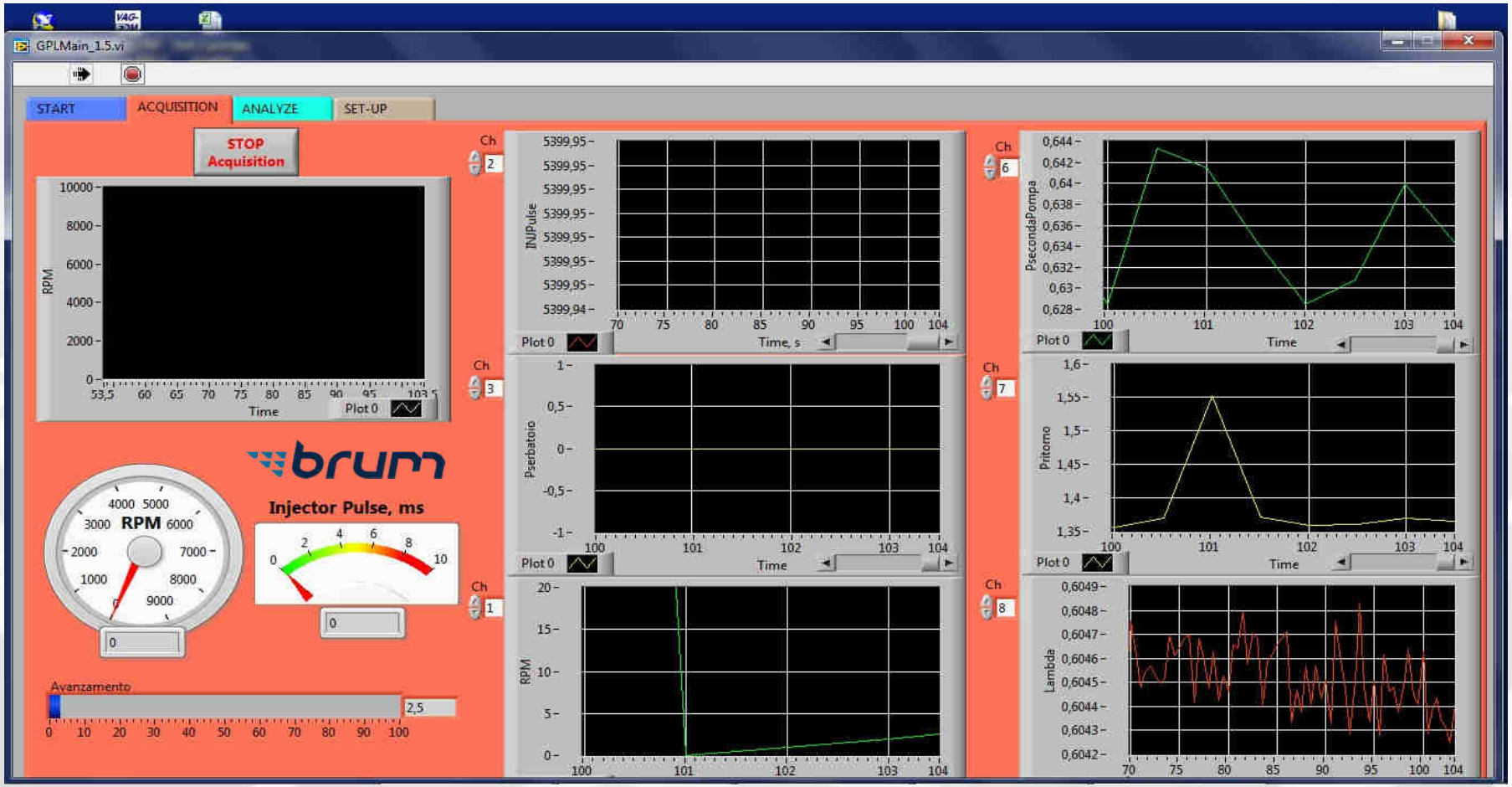
- Pump inside tank
- Need mounting new component (for indirect injection)
- High cost

Kit BrumGas New liquid Injection system



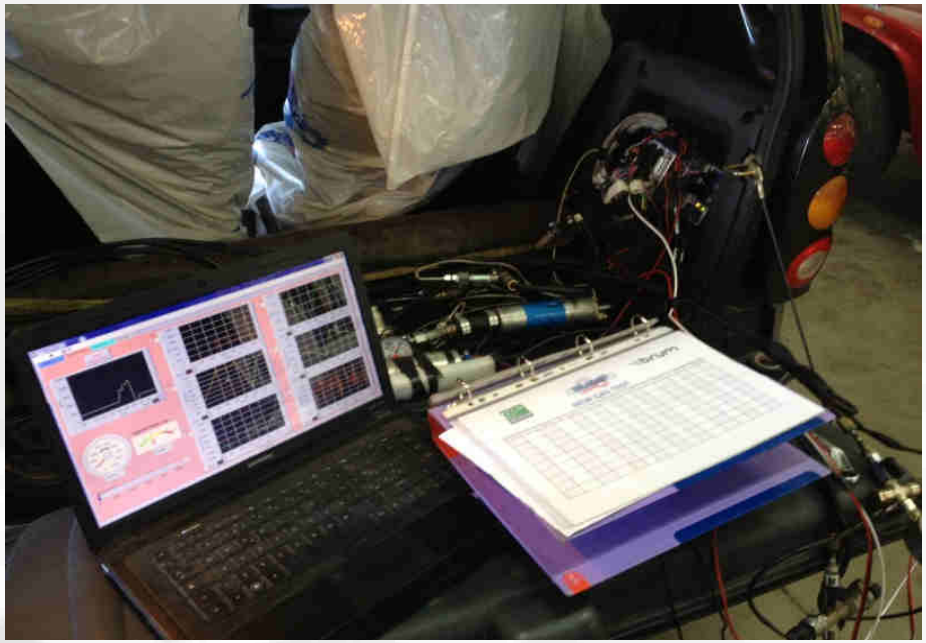
- External pump
- Very simple mounting
- More safety
- No need new component (both direct and indirect injection)
- Low cost

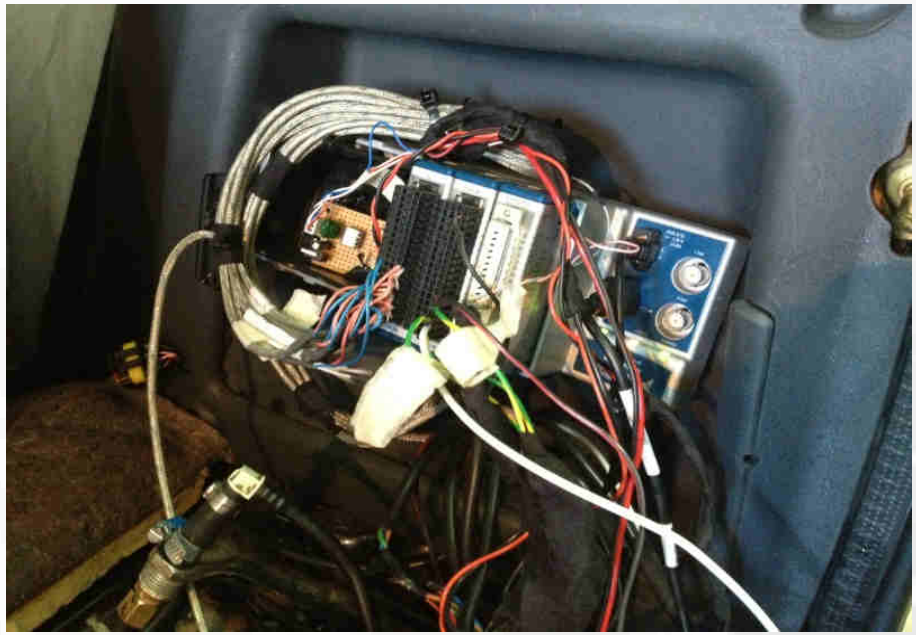
DEVELOPMENT ACTIVITIES



Acquisition system developed to analyze critical parameters of kit and engine: expertise has been found inside Brovedani and outside (company partner and University)

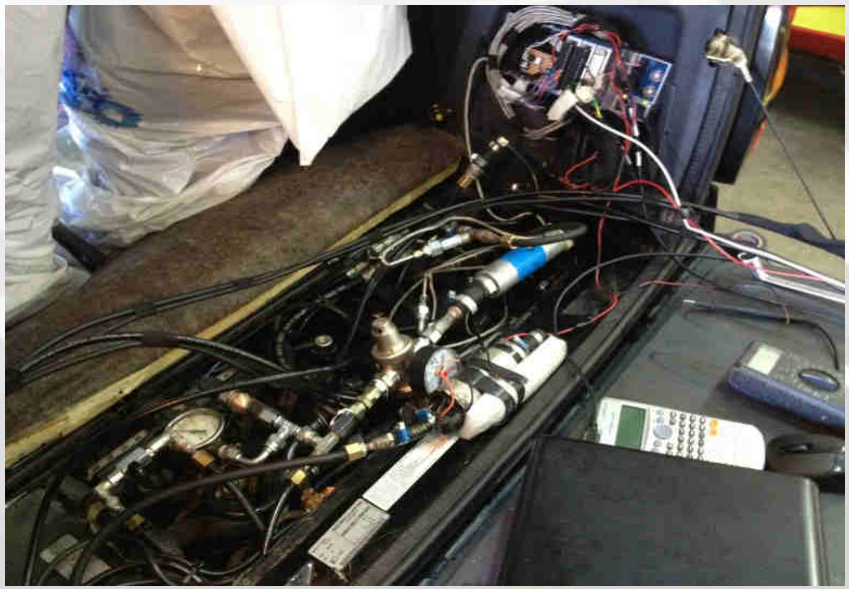
DEVELOPMENT ACTIVITIES



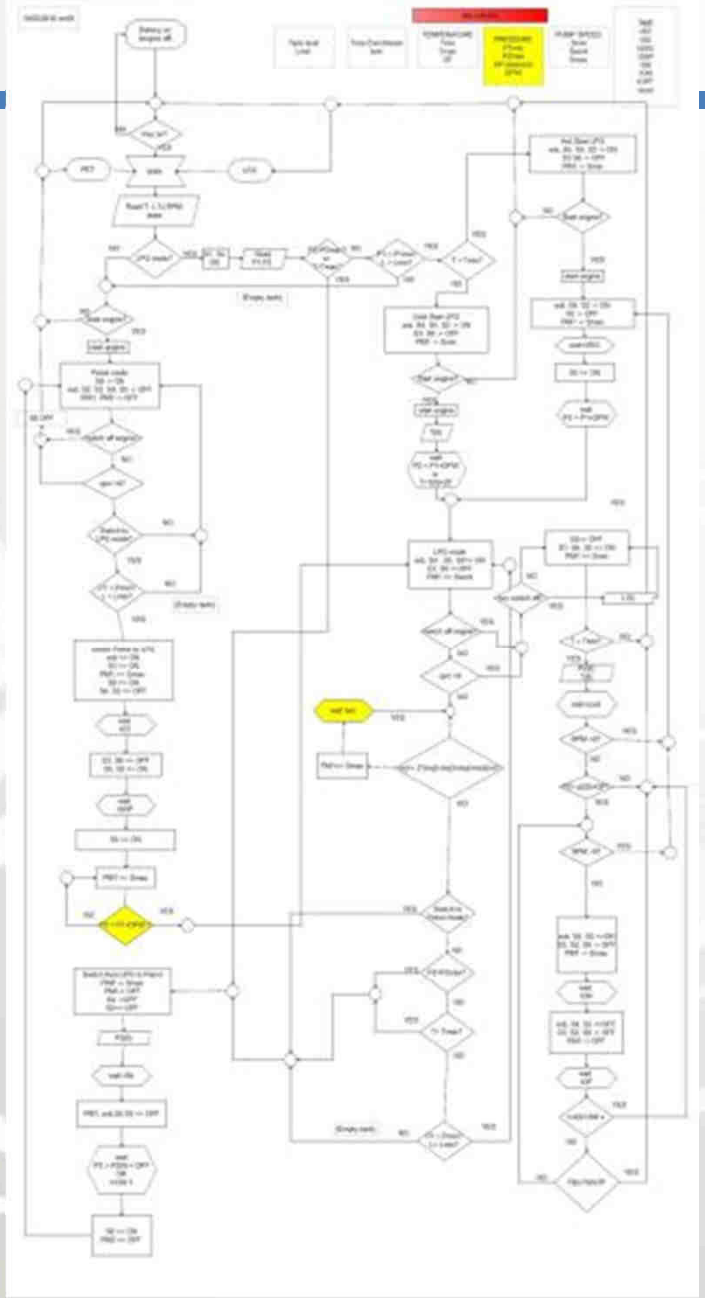


A car (Smart 900 cc 3 turbo 3 cylinder) has been used like a mobile lab to acquire data and optimize the mechanical configuration and the strategy control

Company partners provided the facilities for power and pollution test



LPG liquid Injection Project



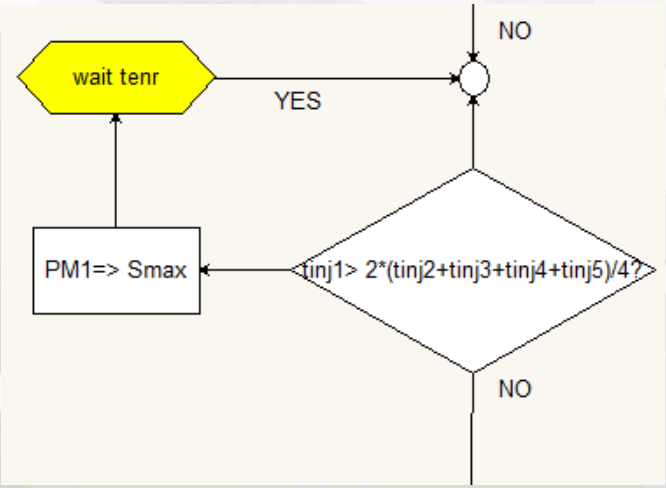
The electronic control both in terms of hardware and in terms SW (control cycle) has been designed

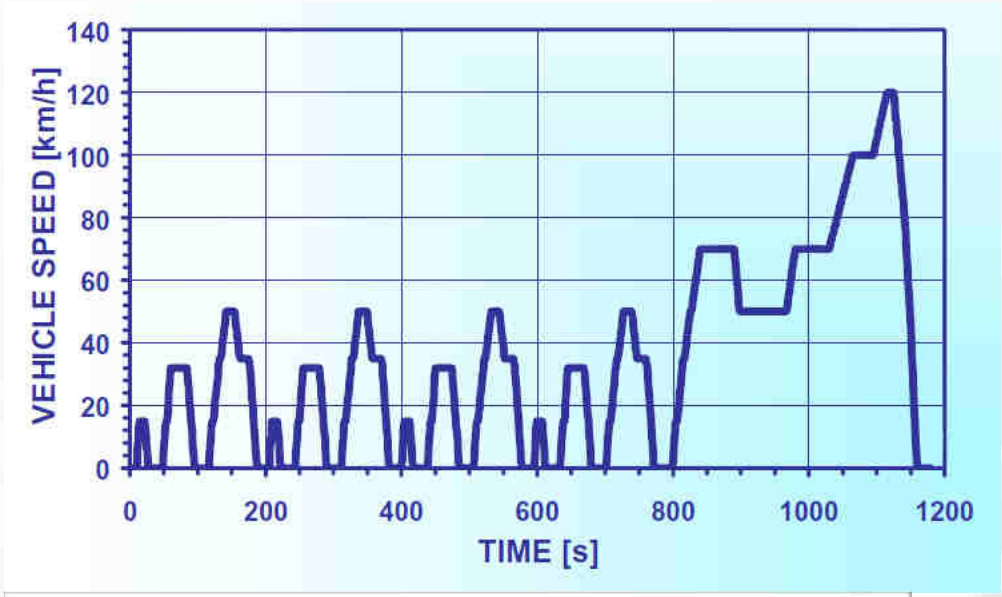
We chose to use an existing electronic control unit that would allow you to easily edit the control parameters and would allow registration of all data for post-processing analysis.

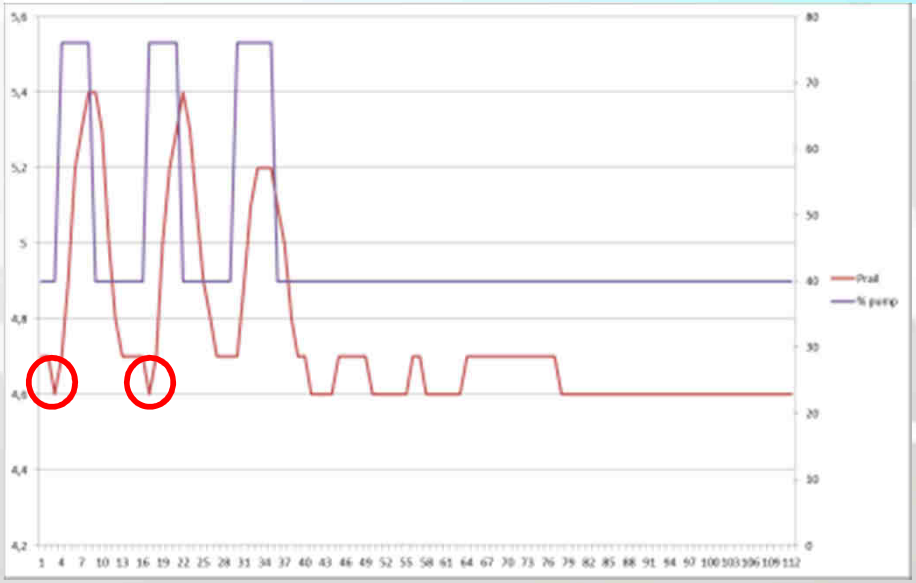
Of course the system must be transportable.



Some issues has been found during the emission test, carried out on dynamic test bench considering the Urban Cycle ECE, due to uncontrolled depression during fast acceleration. Problem has been solved with an improved algorithm of pumps speed and depression is lower than 0,1 bar



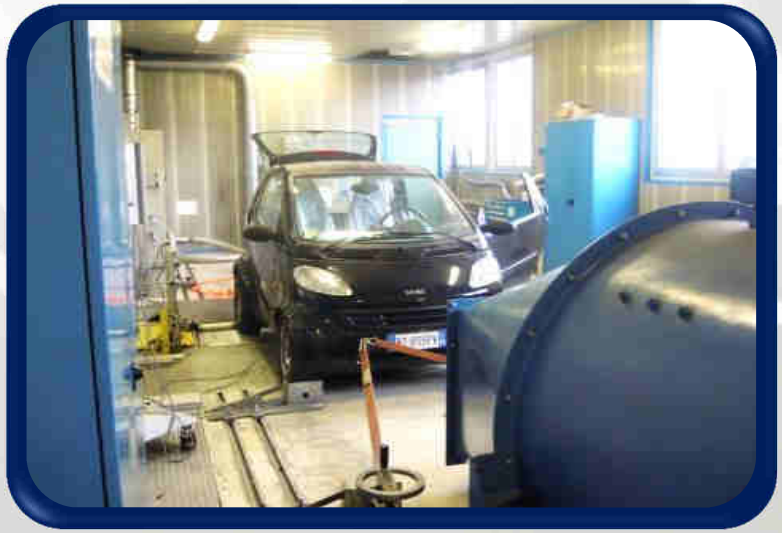




STATE OF THE PROJECT

- Several working prototypes (different kind of cars) prepared and tested (more than 50.000 km)
- Several tests on instrumented bench for pollution and power
- Final development in progress
- Next steps: external assessment, engineering and homologation





CONCLUSIONS

- Innovation is a necessity in general and in particular for Brovedani
- The approach to innovation should be as systematic as possible, consistent with the company's internal condition
- The aggregation and cooperation with external partners is crucial and strategic
- Sales and distribution agreement should be part of a general cooperation agreement
- Proficiency and skills have been found outside the company and costs could be reduced using different business models
- The innovation grows and changes during its course and it usually takes a long time to get results



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