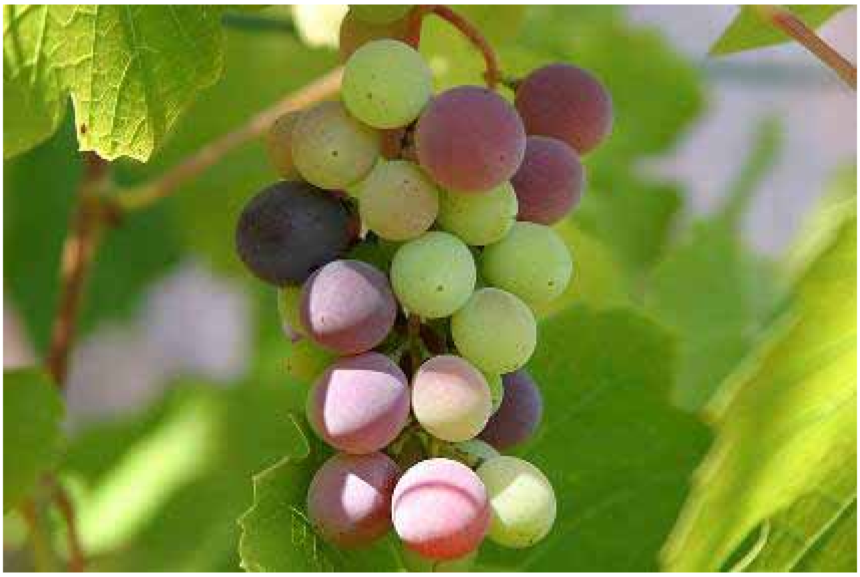
European
Global Product Realization

Student Project Description - AVIDOR

Research in and conceptual development of a micro spraying equipment for the viticultural industry



Spring Semester 2005

This student project is part of the
European Global Product Realization Course

Project owner company:

AVIDOR SA
Executive officer:
M. Jean-Luc Ducret - President

Switzerland
www.avidor.com

Participating universities:

Delft University of Technology

The Netherlands
www.tudelft.nl

Swiss Federal Institute of Technology

Lausanne, Switzerland
www.epfl.ch

University of Ljubljana

Slovenia
www.uni-lj.si

City University

London, United Kingdom
www.city.ac.uk

University of Zagreb

Croatia
www.unizg.hr

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1 Introduction

1.1 Résumé

The European Global Product Realization (EGPR) course 2005 is an academic virtual enterprise, consisting of five universities from Delft, Lausanne, Ljubljana, London, Zagreb and one Swiss industrial partner: AVIDOR. The general foundation basis of the enterprise, the rights and obligations of the partners and other terms and conditions are summarized in the document "The EGPR Constitution". The human resources of the academic enterprise are the academic instructors, university students and company specialists. The enterprise is formed for one study semester. The primary goals of the enterprise are to gain the professional and communication knowledge and the solution of the practical problem, assigned by the partner company. The EGPR 2005 student's project task is to develop the micro spraying device used to treat vineyards.

The people involved in the EGPR course will be brought together by advanced communication means, where videoconferencing is considered as the key communication tool. The students will gradually gain knowledge by attending lectures, given by renowned professors and other experts and professionals. Student international teams will be formed to bring together their knowledge from different fields to try to solve the problems arising from the assignment. The teams will then elaborate and present their research work during common sessions. At the end of the semester, students will develop physical prototypes of components of the spraying device. All people involved in the EGPR 2005 will finally meet in person during the closing workshop in Lausanne at the end of the semester in early June 2005, where all components will be assembled together and the research work publicly presented and evaluated.

1.2 Philosophy of the project

The philosophy of the project is to bring together students from different universities to work in international teams on a common project. The students differ in culture, skills and domains of interests. They are expected to work in a collaborative way in a virtual environment by dealing with many steps of the process of development of the physical working prototype of an innovative device or an improvement of an existing one. The students have to work in an international group, overcoming communication difficulties, assigning responsibilities, sharing ideas and opinions and present publicly their work during common sessions. To overcome the physical distance between the participants, students learn to use the videoconferencing as one of the key communication tools. The work is coordinated and supported at each location by staff members: a project leader, instructors and the technical staff. The role of the staff is to deal with all organizational issues and to monitor the progress of the student's work, to direct the work and to evaluate it. One of the crucial elements of the course is to materialize a physical prototype, which fulfils the requirements posed by the EGPR industrial partner. In order to achieve this, effort has to put into the manufacturing or the purchasing of the components of the final product. It is obvious, that students can achieve such an ambitious goal only by planning, intensive communication and distribution of the tasks within the group.

1.3 Goals

The goals of the project as a whole may be classified into four distinctive categories:

i) **To gain additional professional knowledge** in the fields of Industrial design, Mechanical engineering design, Electronics, Fluid mechanics and Agricultural machinery. This goal will be partially achieved by organizing the appropriate lectures, given by specialists in the field and partially by students performing autonomous research by studying the available literature and other public sources of information (e.g. internet).

ii) **To acquire communication skills**. Students will learn to use the communication equipment autonomously. They will share messages with other team members simultaneously, keeping all involved partners informed. They will organize presentations and present their work publicly to other groups, instructors, and industrial specialists and users. Individual ideas will have to be presented to other team members at a long distance geographically using the available communication media (videoconference equipment, documents and messages sent by e-mails, chat sessions, etc.).

iii) **To acquire teamwork skills**. Students will be organized into groups and will try to define the list of activities, necessary for completion of the assignment. They will develop the skills to formulate a concept by starting from scratch. They will organize brainstorming sessions to express and discuss the ideas and to evaluate them. Because students come from different universities, they will bring together different knowledge and experience. It is therefore expected that multiple aspects of the concept will be thoroughly considered. Students will share the individual tasks, which will be agreed upon in their team meetings. Students will learn to overcome the cultural and mental differences between the fellow team members. The teamwork will be presented publicly to other groups and the instructors.

iv) **To materialize the concept.** The industrial partner Avidor expects the materializaton of the chosen concept in the form of a working physical prototype. In order to achieve this, the project work has to be carefully planed and the milestones met at prescribed deadlines. The students will use local workshop facilities to materialize the components or purchase standard parts (components). The final product will be assembled during the workshop in Lausanne in June 2005.

2 The partners

2.1 Academic partners

In this section you will find the necessary basic information about each of the five participating universities: Delft Technical University, Swiss Federal Institute of Technology, University of Ljubljana, City University and University of Zagreb.

The tables below each university's information show the names and emails of the participants: professors, staff members and students. If you are interested in the detailed information of any of the participant, the complete documents are available on Blackboard (§4.1).

2.1.1 Delft Technical University, The Netherlands

University	Delft University of Technology *(Technische Univerisiteit Delft)*
Faculty, section, lab, etc.	Industrial Design Engineering, Department of Design Engineering, Section of Computer Aided Design and Engineering
Address	Landbergstraat 15 2628 CE Delft, The Netherlands
Responsible teacher	Prof. Dr. Imre Horváth
Contact person	Niels Moes
Telephone	+31 15 278 3006 or 3034
Other staff	Ernest van Breemen, Adrie Kooijman
Course name locally	Integral Design Project – international a.k.a. e-gpr
Number of project hours and number of ECTS or credits	336 hours 12 ECTS (1 ECTS is 28 hours; 1 year= 60 ECTS
Info about knowledge and skills of participating students	http://www.studyat.tudelft.nl have a look at the section about Industrial Design Engineering

Function	First name	Last name	e-mail
Professor	Imre	Horváth	i.horvath@io.tudelft.nl
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	Wietse	Zeedijk	w.zeedijk@student.tudelft.nl
	Anneke	van de Langkruis	a.s.vandelangkruis@student.tudelft.nl

2.1.2 Swiss Federal Institute of Technology Lausanne, Switzerland

University	Swiss Federal Institute of Technology Lausanne (*École Polytechnique Fédérale de Lausanne*)
Faculty, section, lab, etc.	School of Engineering Laboratory for Computer Aided Design and Production
Address	EPFL STI IPR LICP ME A1 403 (Bâtiment ME) Station 9 1015 Lausanne, Switzerland
Responsible teacher	Prof. Dr. Paul Xirouchakis
Contact person	Camille Boucarut
Telephone	+41 21 693 59 65
Other staff	Julie Hohenegger, Ian Stroud
Course name locally	European Global Product Realization (E-GPR)
Number of project hours and number of ECTS*) or credits	168 hours 12 ECTS (1 ECTS is 1 hour/per week for one semester; 1 year = 60 ECTS)
Info about knowledge and skills of participating students	• For the Microengineering students: http://smt.epfl.ch/formation/etudes/livretcours/documents/livretcours%202004_2005.pdf • For the Communication Systems students: http://ic2.epfl.ch/ssc/lc/php_u/livret.php?language=english • For the Computer Sciences students: http://ic2.epfl.ch/sin/lc/php_u/livret.php?language=english

Function	First name	Last name	e-mail
Professor	Paul	Xirouchakis	paul.xirouchakis@epfl.ch
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	Dominique	Wahl	dominique.wahl@epfl.ch

2.1.3 *University of Ljubljana, Slovenia*

University	University of Ljubljana (*Univerza v Ljubljani*)
Faculty, section, lab, etc.	Faculty of Mechanical Engineering Laboratory of Computer Aided Design (Lecad)
Address	Aškerčeva 6 1000 Ljubljana, Slovenia
Responsible teacher	Prof. Dr. Jože Duhovnik
Contact person	Dr. Tomaž Kolšek
Telephone	+386 1 4771 435
Other staff	Janez Krek, Matjaž Šubelj
Course name locally	Integralni razvoj globalnega izdelka (E-GPR)
Number of project hours and number of ECTS or credits	125 hours 11 ECTS (1 ECTS is 10 hours lectures or 20 hours exercises or 10 hours project; 1year = 61.5 ECTS)
Info about knowledge and skills of participating students	http://www.fs.uni-lj.si/e_studij_body.html

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	Primoz	Zupanc	zupi77@siol.net

2.1.4 *City University London, United Kingdom*

University	City University
Faculty, section, lab, etc.	School of Engineering and Mathematical Sciences
Address	Northampton Square London EC1V 0HB, England
Responsible teacher & contact	Dr. Ahmed Kovacevic
Telephone	+44 20 7040 8780
Other staff	Dr. W.D. Gunawardana
Course name locally	Design Project – EGPR
Number of project hours and number of ECTS or credits	172 hours in project, 240 hours in total 25 credits (1 credit = 10 hours; 1 year = 130 cred.)
Info about knowledge and skills of participating students	http://www.city.ac.uk/ugrad/engineering/index.html

Function	First name	Last name	e-mail
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Students (2)	Thierry	Gboho	ah362@city.ac.uk
	Vital	Gutierrez	dm326@city.ac.uk

2.1.5 *University of Zagreb, Croatia*

University	University of Zagreb (*Sveučilište u Zagrebu*)
Faculty, section, lab, etc.	Faculty of Mechanical Engineering and Naval Architecture, Chair of Design
Address	Ulica Ivana Lucica 5 10000 Zagreb, Croatia
Responsible teacher	Prof. Dr. Dorian Marjanović, PhD, B.Eng.
Contact person	Davor Pavlić, Dipl.Ing.M.E.
Telephone	+385 1 6168 117
Other staff	Ph.D. Neven Pavković, Dipl. Ing.M.E.
Course name locally	Konstruiranje pomoću računala Teorija konstrukcijskog procesa
Number of project hours and number of ECTS or credits	105 hours 8 ECTS (1 ECTS is 1 hour/week for 1 semester; 1 year = 60 ECTS)
Info about knowledge and skills of participating students	http://www.fsb.hr/ http://www.cadlab.fsb.hr

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	Ljerka	Božičević	ljerka.bozicevic@fsb.hr

2.2 Industrial partner – The Avidor Company

2.2.1 *General information*

Established in 1991 in Villars-Ste-Croix, close to Lausanne, in Switzerland, Avidor is a Swiss company, which provides wine growers and wine makers with modern vineyard mechanization tools. The company has two branch offices in Switzerland (~25 persons) for the sale of wine material to its local customers and a branch office in the USA (~2 persons) for the diffusion of its products in North America.

2.2.2 *Products*

Their main activity is the development, the manufacture and the diffusion of wine machines such as: hydrostatic crawlers, leaf removals, weed-seekers, etc.

Figure 1: Leaf removal

Figure 2: Hydrostatic crawler

The hydrostatic crawler (see picture on the right) is a caterpillar tractor, which moves across the grapevine. Several tools can be added to the crawler, for example frames to collect small boxes for grape, rotary harrows, trimming machines, etc.

The weed-seeker is an equipment to detect unwanted vegetation and to spray some treatment products, like phytosanitary products (§ 3.3). This equipment can be used for various applications like weeding.

All these products are useful for viticulture (§ 3.1 & § 3.2) and could be adapted to other types of culture, like agriculture.

Their main market is situated in Switzerland, but they also sell their products all around the world: France, Spain, Italy, USA, New Zealand, Australia, Chile, etc. Annually they sell approximately 100 leaf removal machines (5% in Switzerland, 95% in the rest of the world) and 50 hydrostatic crawlers (90% in Switzerland, 10% in the rest of the world). The machines sold in Switzerland and in other countries are exactly the same, no matter what country.

2.2.3 Services

Avidor proposes services for their customers. Indeed, the company is able to follow the wine making, offering some analyses of the wine-to-be. They also provide advice about the different phytosanitary products (§ 3.3), about wine making, etc.

2.2.4 Suppliers

Here is a short overview of the different suppliers of Avidor:

- Oenological products: IOC ("*Institut Oenologique de Champagne*") – www.oenology.org
- Tractors: Pierre tractor – pierretractors.vectorindustry.com
- Vine paling accessories: SCDC – www.scdc.fr
- Presses, De-stemmers: Vaslin-Bucher – www.vaslin-bucher.fr
- Wood pruning shears and saws: Felco – www.felco.ch
- Treatment station of phytosanitary products: Aderbio – www.aderbio.com

2.2.5 Competition

On the leaf-removal machine market, the main competitors are:

- Collard – www.collard.co.nz
- Pellenc – www.pellenc.com.au
- Lagarde – www.lagarde-sa.com

And on the hydrostatic crawler market, the main competitors are:

- Chappot – www.chappotmachines.com
- Niko – www.ebinger-rhodt.de/niko/uebersicht.htm

2.2.6 Contact person

Your main contact persons throughout the project will be:

- Mr. Jean-Luc Ducret – Director – jean-luc.ducret@avidor.ch
- Mr. Xavier Dufour – Engineer – xavier.dufour@avidor.ch
- Mr. Gregoire Mury – Workshop responsible – atelier@avidor.ch

You may also contact them by:

- phone: +41 21 632 92 35
- regular mail: Avidor SA
Case Postale 21
1029 Villars-Ste-Croix
Switzerland
- fax: +41 21 636 36 03
- msn: avidorjld@hotmail.com
- skype: avidorjld (M. Ducret – Director)
avidoratelier (M. Grégoire Mury – Workshop manager)

More information is available on their website at the following addresses:

http://www.avidor.com
http://www.avidor.ch

3 Project description

3.1 What is viticulture?

Viticulture is the technical term for the study of wine cultivation, where the Latin term "vitis" means vine and “cultura” refers to caring. Thus, viticulture refers to caring for the vine. It aims at producing grapes for eating fresh, for eating after drying (raisins) but mainly for making wine. In that respect, all the aspects of a vineyard (sun, soil, drainage, harvesting, etc.) need to be fully controlled and taken into consideration. They will all affect the quality of the grape and ultimately the wine it produces.

According to the figures given in 1995 by the International Wine Office, the worldwide area dedicated to vineyards is about 10 million hectares, dispatched as follows:

- Europe (mainly Spain, France, Italy): 68%
- Asia (mainly Turkey, Iran, China): 17 %
- Americas (mainly USA, Argentina, Chile): 10 %
- Africa (mainly South Africa, Algeria): 4 %
- Oceania : 1 %

3.2 Viticultural activities all year long

The growing of premium grapes is a constant struggle between ensuring a healthy growth, yet not so lush that the leaves and unwelcome growth overshadow the grapes. This struggle is what defines many of the activities carried out during the year. The following seasonal table highlights the main vineyard activities:

	Vegetative state of the vine	Viticultural activities
January	The vines are dormant (hibernation)	• Pruning – it is very critical to the vines as this determines the spur position to ensure proper growth and spacing of the shoots for that year
February	The vines are still dormant (more hibernation)	• Pruning continues • Selection of new fruiting canes and spurs
March	The vines emerge from hibernation Bud break	• First deep ploughing to let the earth breathe and uncover the base of the vine plant. • Selection of the non-primary shoots and laterals in order to select the strongest canes and to open the canopy to more light

April	Spur growing season	• Cleaning of the vine to ensure maximum exposure to light and air. • When the spurs are long enough there is a need to tuck them in the appropriate wires. • Risks of frost & hailstones
May	Spur growing season	• High risk of frost • Second ploughing to get rid of the weeds • To prevent mildew and powdery mildew, spraying is performed • Pruning of the branches to allow the sap to rise in the vine trunk
June	The vines begins to bloom	• More spraying is necessary to prevent powdery mildew
July	Grape ripening	• Regular spraying is necessary to prevent various diseases and fungus • Digging out of weeds • During early ripening, several passes are required through the vineyard to pull off the less desirable fruit → only the best fruit is selected to remain on the vine • Leaf-thinning begins by late July to ensure maximum exposure to light and air
August	Early ripening – when the grape berries change from green to purple colour	• Continue to dig out the weeds and tie the canopy with wires
September	Harvest	• Start to sample the sugar content ("*brix*") of the grapes almost every day to ensure that the grapes are picked at the maximum ripeness • Start of the harvest
October	Harvest	• Harvest continues
November	Beginning of hibernation	• Pruning of the long branches • Ploughing of the vineyard • Covering the base of the vine plant
December	Hibernation	• Beginning of winter pruning

Table 1: Viticultural activities all year long

Or, in summary:

Vine caring	Winter	Spring	Summer	Fall
Soil treatment	X	X	X	X
Pruning and diseases treatment	X	X		
Vine renewal (digging out & planting)		X	X	
Phytosanitary treatment	X	X	X	
Leaf thinning		X	X	

Pruning of the green branches			X	
Leaf removal			X	X
Harvest				X

Table 2: Viticultural activities according to the seasons

3.3 Phytosanitary treatments

3.3.1 Definition

Phytosanitary products are chemical products whose goal is to get rid of harmful pests and diseases.

The success of the phytosanitary treatment results from its efficiency, low cost with respect to the grape price, easiness of product application and the security it gives the winegrower.

3.3.2 History

Until the nineteenth century, the parasite diseases of the vine were more often than not considered as maledictions or fatality. The vine growers had to endue them without being able to do anything. In the second half of the nineteenth century, Europe saw the introduction of extremely noxious diseases and pests coming from the Americas (mildew, powdery mildew, phyloxera, black-rot, etc.).

Figure 3: Vine leaves with phyloxera disease

It has thus been necessary to treat vines, principally against those diseases (using fungicides) and secondarily against pests (using insecticides) such as the red spider, grape-worm, etc.

The European winegrowers had to struggle against the phyloxera which has ravaged many vineyards (see leaves picture).

This insect attacks the roots. Everything has been tried to combat this pest (even arsenic in large doses in the ground) and it was finally the use of a vine-root resistant to these insects which saved the vineyards. This is the reason that today the vine variety desired is grafted onto a vine-stock of another variety.

There are two principal diseases which are mildew and powdery mildew. These diseases need certain conditions in order to develop (humidity/temperature) and do not develop in the same manner in different geographical regions.

Throughout the years chemists have tried to find remedies for these diseases. At the beginning of the century copper was used against mildew and sulphur against powdery mildew. Then, by accident, the “Bordeaux Gruel” was discovered (a mixture of lime, sulphates and copper). The success is only partial but it is already a major progress. In certain regions these methods are still used. Copper has the disadvantage that it stops the growth of the plant.

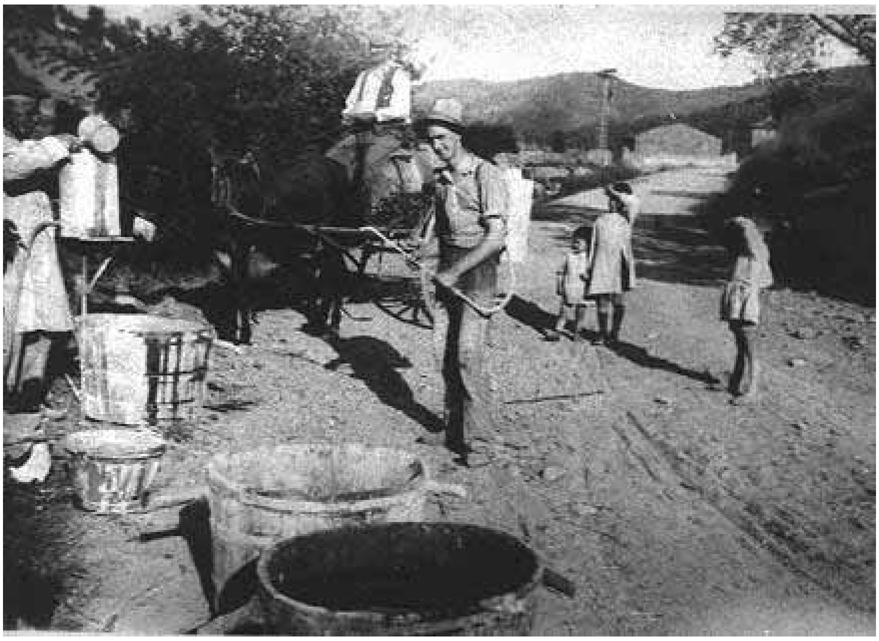


Figure 4: Spraying technology more than 60 years ago

So, to summarize, man discovers the diseases and then discovers the means to combat them. It is necessary to use the solutions that exist and, for this, to invent material to apply the different mixtures that have been discovered.

The main disadvantages of the chemical fight have appeared during the 1960's:

- appearance of parasite breeds resistant to pesticides
- toxicity of the anti-parasites products for the user
- potential residues on the grape berry
- environmental pollution
- secondary effects on the plant's application

The arrival of the negative side effects has led to a reflection on the requirements to better justify the product application.

Nowadays, most winegrowers agree on the necessity to justify viticulture protection in order to limit the use of phytosanitary products.

3.3.3 *Treatment products*

There are two kinds of phytosanitary products:

i) Contact products (usually in powder)

For example "Bordeaux Gruel" (in French "*Bouillie bordelaise*"), sulphur, etc.

ii) Systemic products (usually in liquid form)

The active substance of the systemic products is absorbed by the plant and gets into the leaves in order to be carried further by the sap. Thus we are interested in the dosage on the surface of the leaves. The regular dilution doses are around 1 to 2 % (example of a weedkiller: www.roudup.com)

The main producers are:

- Syngenta (Novartis): www.syngenta.com

- Monsato: www.monsato.com

3.3.4 *Materials and techniques*

The material used today principally includes:

- A reservoir which contains the mixture
- A pump which distributes the product towards the treatment nozzle and, at the same time, assures a circulation of the mixture in the reservoir

To learn more about nozzles, you may have a look at the following websites:

- Website explaining the way nozzles work: www.gov.on.ca/OMAFRA/english/crops/pub75/2care.htm
- N° 1 world manufacturer of nozzles: www.teejet.com
- Albuz nozzles: www.albuz.saint-gobain.com
- Table of nozzle regulation: pro.sirtem.fr/gdv/publications/reglages-albuz.htm

Spraying can be performed in four different ways:

i) Non-carried jet – estimated 18% of the market

The product arrives at the nozzle at a pressure of about 8 bars. The nozzle separates the mixture into droplets of varying size and, because of the pressure, arrives on the foliage. Put simplistically, this is the same as what happens when using a vaporiser to clean your windows.

Example of manufacturer:
Commander plus by Hardi International
www.commander-plus.com

ii) Carried jet – estimated 30% of the market

The same as for the non-carried jet but with the help of an air current generally created by a helix. The product is transported by the air to arrive at the foliage. Ideally one should have a lot of air with low speed in order to create turbulence so that the product envelops the foliage to be treated.

Example of manufacturer:
Tifone, Italy - www.tifone.it

iii) Atomizer, also known as pneumatic – estimated 50% of the market

Use of the air at high speed using a tube for the air. The mixture arrives using a small tube and either through slight pressure or through gravity and Giffard effect, the liquid is distributed under pressure.

Example of manufacturer:
Berthoud, France – www.berthoud.fr

iv) Micro spraying – estimated 2% of the market

EnviroMist is the only manufacturer who offers a system approaching those which we would like to create and who hasn't yet managed to break through, even though they are present at trade-fairs.

EnviroMist - www.enviromist.com.au/profilec.htm

Micron is a company who is working with Enviromist on an adaptation:
http://www.micron.co.uk/flexidome.html

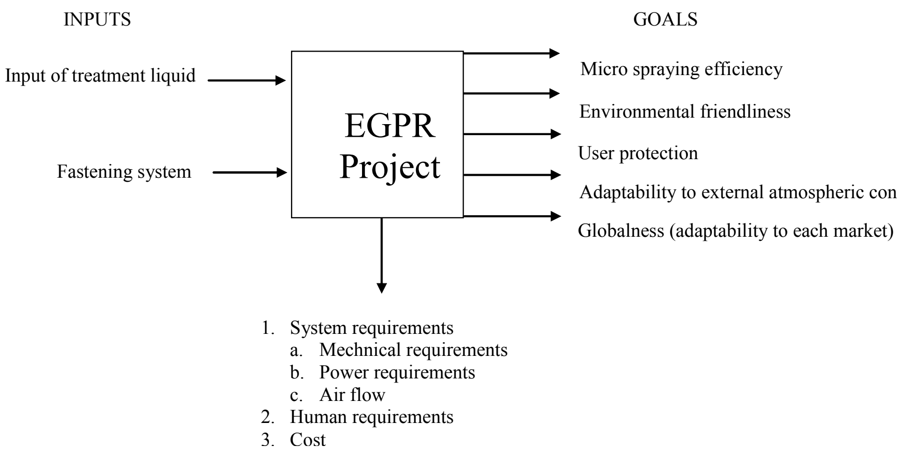
If it hasn't had the expected success yet it is because of the following reasons:

- Misleading advertising (identical active material only the quantity of water changes)
- Poor reliability of the equipment and its components
- Machine not adapted to the user community (hydraulic needs, droplet distribution not proportional to the foliage surface)
- Relatively high cost
- Technology coming from Australia where the disease problem is not as great (dry climate).

3.4 Project definition

There has been no major improvement in the application of phytosanitary products for the last 40 years. Nowadays 90% of the product goes elsewhere than on the target. Furthermore there is a rather poor coordination among the different people involved in the vine caring process: product manufacturers, viticultural machine tool manufacturers, environmental offices, users, etc.

The project task is to develop a device which will be used to treat the vineyards with the micro spraying technology.



3.4.1 *Input*

Input of treatment liquid

In this project, it is not necessary to focus on the phytosanitary liquid container (tank) which will feed the liquid to the device. There will be hose and a pump between the tank and your device. Each team may decide on the diameter of the hose which will bring the liquid to the device and also decide on the liquid flow they need.

Fastening system

The device to be realized should be adaptable to any existing machines, for example a caterpillar tractor, an over-the-row tractor, etc. Therefore it should include some kind of simple but robust fastening system. Once again, it is up to each team to design the fastening system they want.

3.4.2 *Goals to achieve*

Micro spraying efficiency

The device should only spray droplets of the ideal size on both sides of each leaf of the whole canopy.

Environmental friendliness

There should be no loss of treatment product into the atmosphere, or any resulting pollution into the ground water, etc. The environmental regulations are becoming stricter day by day, so the device should be respectful of any environmental legislation according to each market (Europe, USA, New Zealand, Australia).

User protection

The device should prevent the user from receiving any phytosanitary liquid which is being sprayed on the vine.

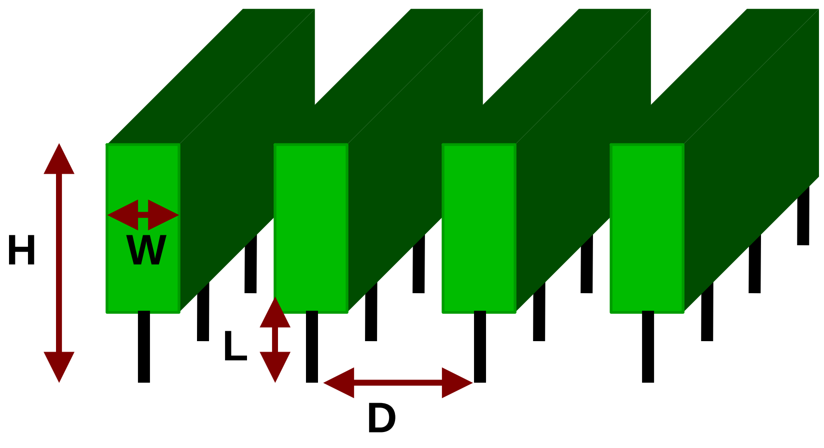
Adaptability to external atmospheric conditions

The size of the droplets sprayed on the leaves should be variable according to the phytosanitary product used and the atmospheric conditions (humidity, temperature, etc.): for example, according to the weather, the size of the droplets will have to be smaller or larger to prevent the liquid from evaporating while being carried to the leaves.

Globalness

First, the target market is composed of all the people who need to apply phytosanitary products all around the world. The teams should focus on the following countries: Europe, USA, New Zealand, Australia.
Secondly, the machine should adapt to the different types of vineyards and plant growing. To fulfill this, the machine should be able to adapt to these different types of plantations:

i) Lower vine (i.e.: Champagne, Bourgogne)



H = Height of the vegetation: 1 meter
L = Leaves start at : 20-30 cm from the soil
W = Width of the vegetation: 30 cm

D = Distance between the vine rows: 1 to 1.5 meters

ii) Mid-height vine (Majority of the world's vineyard. i.e.: south of France, Entre-deux-Mers (Bordeaux))
H = Height of the vegetation: 1.5 to 1.7 meters
L = Leaves start at: 50 cm from the soil
W = Width of the vegetation: 40 to 80 cm
D = Distance between the vine rows: 1.8 to 3 meters

iii) Higher vine (i.e.: Australia, USA)
H = Height of the vegetation: 1.8 meters
L = Leaves start at: 80 cm from the soil
W = Width of the vegetation: 80 cm
D = Distance between the vine rows: 2.5 to 3.5 meters

The above-mentioned heights and widths of the plants are reached at the end of May and last until the harvest (September-October). The first phytosanitary treatments are completed on vegetation which is still-developing.

3.4.3 *Requirements*

1. System requirements
Mechanical requirements
In order to spray all leaves, one or more devices could be used.
If possible, the device(s) should not exceed 30 kg and must be the most compact as possible.

Power requirements
On the current caterpillar tractors, the power available can be of 3 kinds: electrical, mechanical or hydraulic.

i) If electrical
The power supply available is 12 V.

ii) If mechanical
The caterpillar tractors used in the vine growing industry are equipped with power transmission. Their power intensity is related to the power of the tractor engine itself. Current tractors have a power of 40 HP available through the power transmission. The diameters of the propeller shaft used are all normalized.

iii) If hydraulic
The tractors used in the vine growing are equipped with hydraulic pumps with an overall flow going from 0 to 50 litters/min, at a maximum pressure of 180 bars. They are also equipped with female hydraulic plugs and controlled by the user with either an electrical or a mechanical command (lever).

Air flow
An air flow will be necessary to diffuse the phytosanitary liquid. The diffusion will have to target only the foliage of the vine and be respectful of the surrounding environmental constraints.

Human requirements
The device should be easy to maneuver and use.

It should also be controllable by the user through a control panel at his/her reach.

The aesthetics of the device should be carefully studied to give a comforting, modern and functional image.

Costs
According to a first estimation, the total cost of the device should not exceed 2000 or 3000 euros. According to the performance achieved, it might be possible to get some funding from the environmental offices for the end-user.

3.5 An example from Avidor

3.5.1 How does the Avidor prototype work

The prototype made by Avidor is separated into the two following parts:

Figure 5: the Avidor prototype

- Air flow:

A hydraulic motor makes a helix spin which assures the airflow and carries the droplets onto the vine leaves. The airflow is directed towards the upper centre of the vegetation so that the droplets can only reach the inside of the canopy (other possibilities could be studied).

- Droplet formation

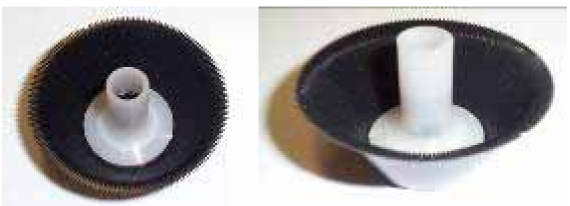


Figure 6: the striated cup of the prototype

By means of an electric pump, the treatment product is pumped out of a tank and brought to the device diffusion head. The flow must be gauged in order to regulate the liquid flow on the distribution head. Inside this distribution-diffusion head is an electric motor, which drives a striated cup (see pictures on the left). Once the droplets reach this striated cup, they break up into millions of small particles, thus forming a fog which is transported to the vine leaves.

If the striated cup's rotation speed could vary, the size of the droplet created could also be variable. If the droplets are too small, they will evaporate. If they are too big, the concentration of the active substance they contain is also too high and may stream along the foliage: which means a loss of product and a bad application.

3.5.2 Pictures

More pictures of the Avidor prototype are available on the Blackboard (§4.1).

3.5.3 Movie

A movie showing how the prototype is handled is available on the Blackboard (§4.1).

3.5.4 Scheme of the prototype

As yet, no plans of the prototype exist but if requested, they can be prepared by the company (hydraulic drawing, electrical drawing, etc.)

3.5.5 Results

The prototype has demonstrated that the basic notion is good and that repartition of droplets was possible. The machine was used during one year in a real vineyard and no disease appeared. However there were some problems with the liquid control. A commercially viable version is needed with extra intelligent functions configurable for the world market. Avidor would like innovative prototypes which may become the basis for the next generation of treatment equipment.

3.6 How to start with the project

To start with the project the international teams should:

- Do some research about the market, the Avidor company, its needs, etc.
- Do some research about the existing machines,
- Do some research about the competitors,
- Do some research about existing microspraying techniques the market
- Do some research about environmental legislations in Europe, USA, Australia and New Zealand,
- Establish a detailed list of requirements

4 Collaboration, schedule & deliverables

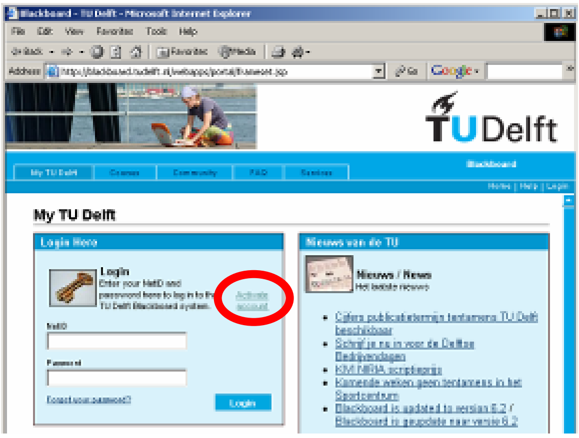
4.1 Collaboration means

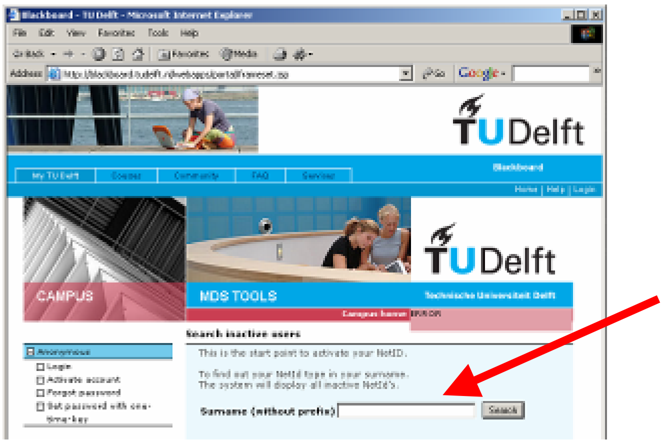
For group communication, the students may use the following means:

- Videoconferences (see details with your local staff members)
- Chat sessions: msn, icq, etc.
- Emails
- Telephone, fax, etc.

To exchange files, the Blackboard platform will be used: blackboard.tudelft.nl
Each participant will get a login and password to have private access to that platform. When you want to log on to the Blackboard for the first time, here is what you should do:

- Go to http://blackboard.tudelft.nl/
- Click on “Activate account”
- In the next window, enter your last name and follow the instructions.





4.2 Calendars – schedules

Due to different academic calendars, 3 universities will start on the 7th of February (Delft, Ljubljana, London) while the other 2 will join the project on the 7th of March. On Blackboard, you will find 2 important documents:

- The academic calendars = a table which shows the education weeks vs exams and holiday weeks according to each university,
- The course schedule = during the course, all the participants (students & staff members) will meet by videoconference twice a week, on Mondays and Thursdays from 12:00 to 13:45 CET (11:00 to 12:45 GMT). Those sessions will be of 2 types:
    - Lectures: given by professors or industrial experts of the 5 countries The abstracts of those lectures are also available on Blackboard.
    - Project reviews: there will be 3 reviews during the whole course and we will expect each team to make 1 presentation (~20min + 10 min Questions & Answers) and 1 short written report.

At the end of the 2005 course, all participants will gather for the final workshop which will take place in Lausanne, Switzerland from Sunday, 5th June until Sunday, 12th

June. More information about the workshop will be communicated later during the course.

4.3 Deliverables and assessment

4.3.1 Deliverables

The following deliverables are expected from each team:

- 3 intermediate reports (each project review should result in a short intermediate report) → deadline: 3 days before each project review
- 1 working prototype
- 1 presentation → deadline: Friday, 10th June 2005
- 3 posters
- 1 report → deadline: Friday, 24th June 2005

4.3.2 Assessment

The table below shows the list of criteria with which the student work will be assessed during the 2005 course:

Criteria		Weight factor
Work during semester	Level of completeness of the prototype before workshop	1
	The intensity of the communication	1
	Level of the problem elaboration during the project reviews	1
	Report completeness and structure	2
Posters	The design and the general impression of the graphics	1
	The relevance and the completeness of the information presented in the poster	2
Presentation	The relevance and the completeness of the information presented	2
	How the group presented the research work and criteria for decision making	1
	How the group presented the elements, which are of high interest for the company (new features, manufacturing cost)	1
	The elaboration of the mass manufacturing solutions	1
	The quality of the questions posed to other teams during the presentations	1
Prototype	Level of completeness of the prototype	1
	The expected performance and operation	1
	The new value for the company (demonstration of the features: light weight, power consumption, better design; the perfection of the design for mass manufacturing; optimization level in terms of assembly)	1
	The inventive way of presenting the prototype	1
	Prototype level of perfection according to the agreed limitations	2
	Total	20

We wish all the participants a fruitful and successful EGPR course!
- Jean-Luc Ducret [Avidor] and all EGPR staff members -