

Drone in Agriculture: A Start-Up Case Study in Ragusa

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SUMMARY:

The present case study explores the possibility of creating a Start-up, that uses drone technology (APR) in farm production management: e.g. olives, vineyards, carobs, orchards, in small-medium enterprises. Considering the market value of a subject's production capacity whilst using trees' health, process improvement, plantation type mapping, and production record as parameters, we will try to analyze and understand if this new kind technology can be efficient to eventually determine an increase in the enterprise's investment rating for credit lending purposes, and to understand future cost expenditures (upkeep) to maintain increase in production in the global competitive market. The case study focuses on an existing small-medium enterprise which has known production record in the previous years.

ITALIANO:

La proposta di studio che presenteremo riguarda la creazione di una start-up che si basa sull'utilizzo di Drone come integrazione nella conduzione e produzione di un fondo agricolo, ulivi o altre piantagioni come frutteti, carrubeti, vigne. Con lo studio dei valori inerenti lo stato di salute delle piante ed elementi come, altitudine della coltura, incremento dell'efficienza, mappatura delle specie vegetali, indici concernenti la produzione, cercheremo di analizzare e comprendere se l'utilizzo di tale strumentazione, può risultare efficace anche per determinare il valore di mercato sia nei casi di compravendita sia per la determinazione del valore dell'Azienda per la garanzia creditizia, per tenere in considerazione quali possono essere le spese e gli interventi migliorativi da intraprendere per mantenersi competitivi sul mercato della produzione.

L'analisi prevede lo studio di un fondo agricolo per il quale si ha una conoscenza storica di produzione.

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1. INTRODUCTIONS

In the last decades, Surveyors, as a professional figure, particularly in Italy, have been called to constantly evolve and remain at par as the society of today changes and requires professional results done in less time and with the use of new technology and equipment.

This presentation focuses on a study or an idea for Young Surveyors that will start in the professional world, furtherly distinguishing himself from the rest of what could be considered traditional in the surveying field.

One of this most recent technology is the use of UAVs or Drones, commonly identified in Italy as SAPR (Sistemi Aeromobili a Pilotaggio Remoto).

2. THE PROJECT

2.1. Start-up Creation

As we said earlier, the figure of Surveyor is called to improve and constantly change, whether be it simply buying new equipment or starting to think of new work techniques, finding and developing new underdeveloped opportunities could potentially start a new sector competitive enough in the current job market.

Our proposal is to create a Start-up business that does not require high costs while maintaining excellent professional results. This could be achieved since this new trend on businesses, what the Millennials called *side-hustle*, integrates perfectly to the main line of surveying sector.

Our core idea is the use of drones as a primary tool to service small and medium local agriculture enterprises in monitoring crop management and analysis vegetation and plants' health.

2.2. Price to create the Start-up

Investing on an innovative start-up business in Italy could require an initial capital between €. 500.00 to a maximum of €. 2.600.00, depending on its type and its eligibility to government financial subsidies and benefits.

Another obligatory investment to take into consideration is the amount necessary to obtain a license to fly, operate and work with drones.

2.3. Drones and its Utility in Agriculture

A drone is an aircraft or a helicopter-shaped flying object which flies by radio waves as unmanned aerial vehicle or remotely piloted aircraft. Drones were initially developed for military purpose such as combat or reconnaissance but now they are used in diverse parts including leisure, agriculture, observation, etc...

Drones can be classified in two types: "fixed wing drones" and "rotary wing drones". The first drone type can fly for a longer time than rotary wing drones, because of its energy efficiency

due to air lift force during flight. The downside remains in its need of a wider space for take-off and landing.

On the other hand, rotary wing drones can take off and land vertically. However, it can only fly for shorter amount of time.

Recently, a noticeable trend regarding precision agriculture is on steady rise. The number of small and medium agricultural enterprises are also adopting drone technology in monitoring, analysis and crop management. The recent drop on prices of commercially available drones resulted on most farm enterprises to adapt this new method.

However, operating a drone and the succeeding data elaboration require a skilled and certified professional. The professional or drone operator in Italy, should also be compliant to the new (and unfortunately, changing) norms on aviation as prescribed by ENAC (*see ff chapter*).

For our start-up, we intend to use a popular rotary wing drone such as Phantom DJI 3. The choice was based largely on its ease of use and because of its basic standard package also resulted to be cost-efficient (€. 460.00 for the standard package, €. 850.00 for the professional package). It's pixel-to- flight height ratio is fairly decent for the main purpose it will serve.

Although Phantom DJI 3 has a limited flight time (maximum of 25 minutes), our start-up focuses on small-medium scale plantations and agricultural fields, which are easily covered in shorter period of time of flight.

The choice of collaborating with small and medium enterprises was easily undertaken since most agricultural fields in Italy are managed by family-run businesses. Moreover, the Italian Government also proposed some subsidies and tax breaks for young people who intend to start any agriculture-related business.

2.4. ENAC and Drones

In Italy, the authority responsible on the discipline of drone is ENAC (Ente Nazionale Aviazione Civile).

Depending on the drones' principal use, ENAC has created guidelines and different updates to know how, in which way and to which extent a drone could use for each circumstance.

The guidelines request to have a license to use drones in a professional way. The documentation is possible to acquire after a practical course and an exam in a flight school authorized from ENAC.

3. SERVICE AND FIELD APPLICATION

3.1. Field of Application for the new Start-up

The main purpose of our project is to work in cooperation and in collaboration with small and medium agricultural enterprises, optimizing the use of drones and cameras as main tools in order to provide new services such as analyzing the life of the trees using NDVI multispectral cameras, and to know and optimize the distribution of resources.

A recent case study conducted by the Department of Civil, Environmental , Building Engineering and Chemistry of the Politecnico di Bari, noticed a serious risk of rapid drying of olive trees in all Mediterranean's country due to the presence of *Xylella Fastidio (Xf)*, a

pathogenic regulated in Europe as a quarantine organism because it damages many plants around the world. The olive that has been infected is expected to die immediately as soon as the bacteria reaches inside its vascular system, restricting the flow of water from the trunk to the crown.

Such findings are definitely alarming considering that 95 % of the olive oil production in Italy is found on its Mediterranean regions, and Italy is the second olive oil producing country in the global market.

Xf is as serious threat for the production and gravely limits cultivation of olive trees. Without an effective control measure or a serious way to fight the bacteria, it is essential to identify and try to prevent plant contamination. A good step is to identify the first stages of the problem, then proceed on prevention and control, and to contain the pathogenic dissemination. This however, also signifies investing a lot of time and money.

Luckily, the rise of new measuring techniques and methodologies, such as the use of drones, result to be a favorable investment, time and money-wise.

As a secondary objective, our start-up wants could also be involved during the phases of buying or selling of the enterprise. By providing potential investment capabilities (improvement, production analysis, maintenance, risk management), this project can also be considered as a credit-lending tool providing a proper estimate of the land value or the enterprise's value.

For this paper, we took information about the production process of an enterprise in Sicily, southern Italy, that specializes in the production of organic olive oil. The study subject a Company known as "Frugentini" has been producing quality olive oil since 1980, and is in continuous improvement, even gaining awards and recognition on the National level. The Company's clientele consists not just of local restaurants and private entities, but also on a national scale.

During our initial inspection in the Company we learned that the annual production has been constant in the past years, or to say, between 3 to 5 metric tons of organic olive oil. It was also obvious that the olive harvesting and the succeeding production has been kept on the traditional methods done entirely by manual techniques. All in all, there are around 2000 olive trees in their lot.

Analyzing this data with the owner of the company, we knew that:

1. It takes around 15 to 30 days to control every plants for eventual presence of virus or problems of any sorts;
2. Harvesting (a data not important for us) takes about 2 months, beginning from September to November of each year.

Moreover, meteorological elements such as drought, frost or hailstorm are very important for the Company and for its annual production, as the result may also infer on the income. Although, frost and hailstorm are not possible to prevent, drought could easily be ridden off with an adequate irrigation. Our test subject, which represents the majority of small and medium agricultural enterprises, only conducts visual analysis of the plants' conditions just

by relying on the farmer's experience.

Our project or idea is to provide additional service in the company in order to optimize times and reduce costs.

3.2. Plant Analysis

To start with the analysis, our study focuses on the use of multispectral cameras with NDVI index.

Normalized Difference Vegetation Index or NDVI index is the most used technique to study and analyze vegetation as it relates to the presence of chlorophyll in plants.

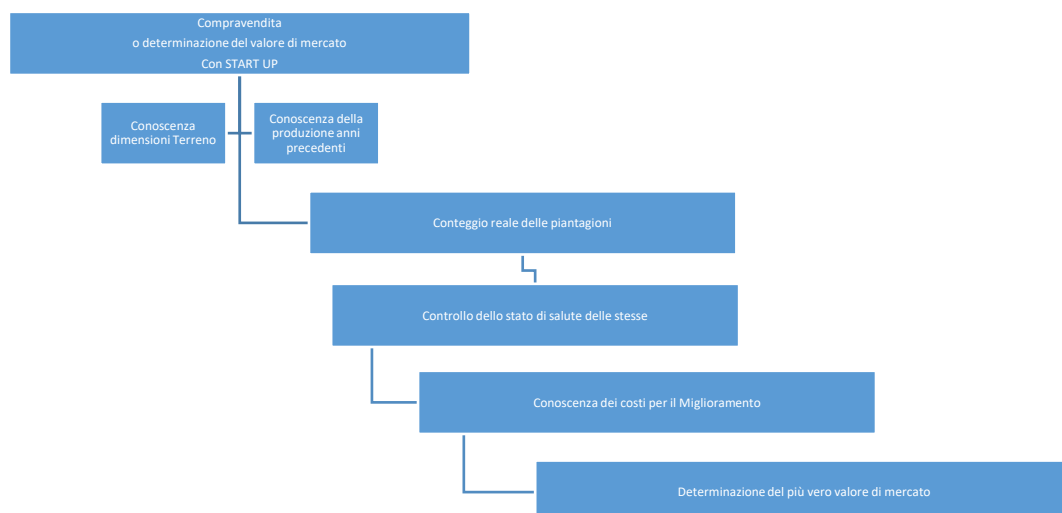
In the agricultural field, biological elements such as virus, bacteria, fungus, insects, etc., and abiotic elements like drought, pollution, frost, hailstorm or mechanical injury, are stress factors for the trees. These elements may determine an alteration on the plant's health, thus influencing its production, which may have a negative effect on the Company's image, stability and professional reputation.

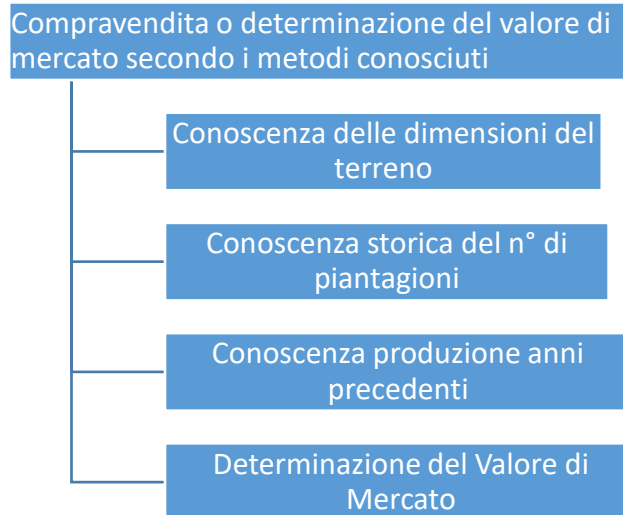
By providing aerial imagery and relative analysis for each flight, the company can identify which problems are present and which actions should be done to address them. Drones can also provide time series animations indicating crop development over the range of time. This additional information may provide additional insights on inefficiencies in the production process, cutting back and risks and improving crop management protocols.

3.3. Determining the Company's Market Value

Our idea of Start-up may also find use during the important phases of determining the market value of the company or solely, the land value where the plants are located. In Italy, agricultural enterprises are valued in terms of the extension of the land, number of existing and productive plants and annual production income. The first and the third variables are easily obtained while the second data, the number of productive plants, remains difficult to assess. Unfortunately, in most parts of Italy, just as much as we have observed in Frugentini, small and medium agricultural companies still conduct manual counting of plants although the plants' health and production status are unlikely considered during sale.

If we take in consideration the life status of the trees as the most important element, we can determine a more accurate market value thus giving the opportunity to the buyer to know exactly which action he or she must to do, and know beforehand the potential increase subsequent to the improvements for the company.





4. Survey

The survey should be divided in: 1) *preliminary phase*, done in the office where we pre-analyze the survey field, identifying control points that can be used or should be important for our work; 2) *field survey*, wherein with our topographical instrumentation. The control points are marked; 3) *flight programming and overfly*, which allows us to know, how to determine points in the physical space through the corresponding points in the photographic images. This is one of the most used and economical methods.

As we know the photogrammetric flight includes flight planning, a sequence of straight paths alongside the known points that will then serve to interface our flights with the data taken with the topographical instrumentation, and to elaborate it.

In our case, we plan a low height flight. With problems that may arise from possible bird passage and due to the perspective view, it is not possible to determine the distance between the objects. With that in mind, our work will be divided in two sections: the first planning the flight and the second one, post-flight elaboration.

Since we are flying on low altitude and in relation to the chosen flight speed, images are shot on a more frequent time interval. Additional factors to be considered during the flight, are backlighting and obstacles which are to be avoided.

Our survey will also include “overlap” parameter, and will have a sequence of images that must have at least 60% in common. This will give the opportunity to easily locate the common points in the images, facilitating image stitching and as a support in creating three dimensional models.

BIOGRAPHICAL NOTES

The authors, Dalmasso, Manaloto and Brancato, were part of the pioneer group of young surveyors who were chosen by the Consiglio Nazionale Geometri e Geometri Laureati after a thorough screening regarding every aspects of the Surveying profession in Italy. The group is in close contact with each respective Provincial College bringing in new knowledge and perspective in the profession.

The group has been active in various FIG congresses since its conception in 2009 and has maintained contact with other young colleagues, surveying professionals and researchers.

In 2012, both in the occasion of FIG Working Week in Rome and the National Congress of Italian Surveyors in Rimini, Dal Buono showed to be a reliable addition to the group bringing in other competence and expertise to the group.

Baldini joined in after FIG Commission 3's Annual Meeting in Bologna in 2014.

The group aims to be of aid to the National Council in rejuvenating the ever-evolving profession of Surveying in Italy, demonstrating other capabilities and technical capacities while pushing the boundaries towards the future of their chosen field.

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