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SPACE BUSINESS 4.0

Executive summary

Space Business 4.0 stems from the efforts made by the European Union for fostering innovation in the Space Sector. It is a technology-push project whose goal is to generate and validate a business model for a new startup operating in the Space Economy, leveraging the huge amount of satellite data produced in the Space sector. While in the past satellites were used almost exclusively for governmental applications, nowadays business customers represent the main revenue stream for most satellite-data-based companies. Available satellite images have variable spatial, spectral and temporal resolution. Therefore, they can be utilized for a wide spectrum of solutions, depending on the required precision level. In Phase 1 of the project three industries (Civil Engineering, Urban Management, Agriculture) were identified as the most promising ones. A business model was generated for each selected industry, starting from the most evident customer pains for each sector and then tackling these issues through the analysis of satellite data. The first business idea is a decision support system for smart cities based on Earth Observation (EO) data. The second is a web-based platform for optimizing market research in bidding processes for construction projects. The third is a multi-sided platform for the agricultural sector, removing information asymmetries along the agri-food supply chain. Subsequently, the concept selection phase had the goal to identify the most promising business model among the three generated, in order to proceed with its validation. In Phase 2 of the project the team focused on developing and validating the selected business model. Wapi is a multi-sided platform inspired by successful digital companies such as Facebook. Farmers receive free-of-charge technological consultancy based on the analysis of satellite images of their fields. They can have insights about irrigation, fertilization, pests and diseases, together with meteorological data and digital farm management tools. The choice of a free-of-charge business model allows to overcome economic barriers to adoption. The goal is to reach a critical mass of users and activate indirect network effects, attracting businesses interested in reliable and specific data about the agricultural sector. Thanks to a gamified and community-based user experience a prizing system encourages farmers to integrate this information with data about treatments, soil analyses and past performances. Farmers benefit from Wapi's community as they can signal early symptoms of crop diseases (e.g. blight) to neighbors, thus favoring prevention. An active user base permits to produce more data for businesses on the other sides of the platform, but also to increase the quantity of data given in input to Wapi's machine learning algorithms, with positive effects on the accuracy of the underlying mathematical and agronomic models. The business model has been validated by surveying 135 Italian farmers and by interviewing professionals from relevant customer groups. In the future, Wapi's priority needs to be the construction of a solid network of farmers: only once there is a sufficiently wide and active community of users, profit-side customers (food-processing firms, insurances, etc.) will be willing to pay for our data. To achieve this goal, it is required to potentiate the team by adding ICT and agronomic competences. Initial investments can be covered with founders' funds. However, to scale up quickly and gain large market shares it will be necessary to look for other forms of entrepreneurial finance such as Business Angels (the most likely), Equity Crowdfunding or Venture Capital.

Key Words: "Space", "Agriculture", "Satellite", "Data"

Project description written by the Principal Academic Tutor

In the recent past, Europe has invested in the creation of satellite networks providing high-quality data for Earth Observation and navigation, through the Copernicus and Galileo programs. Furthermore, the presence of a growing number of players in the sector increases the availability of satellite data. However, these data are not yet exploited in their full capacity.

Space Business 4.0 (SB4) stems from these baselines. SB4 has the goal to generate innovative business models based on satellite data. The team has been required to analyze the space ecosystem, highlight enabling and limiting factors for the creation of satellite-based business models, generate several innovative downstream applications, select the most promising, develop and validate it by interviewing prospective adopters.

SB4 has been supported by leading external partners and stakeholders operating in the space sector. These are the Italian Space Agency (ASI), the Italian satellite system company D-Orbit and Maxq, a firm supporting the growth of startups and SMEs in the space sector.

ASI and D-Orbit contributed to the project by outlining opportunities and limitations to the use of satellite data in downstream applications. Maxq actively supported the team in the development of the selected business models.

The project generated three research papers, presented in the XXV International Congress of the Italian Association of Aeronautics and Astronautics:

- "Analysis of Innovations in Earth Observation data exploitation" analyzes the evolution of EO-based startups, focusing on sectors of application and targeted customers.
- "Developing and monitoring smart cities: the potential of Earth Observation data" provides policymakers with an overview on how satellite data can revolutionize the management of modern cities.
- "Potential benefits of satellite data in precision agriculture: a comparative and empirical analysis of satellite-driven, IoT-driven and airborne-driven data-based precision agriculture startups" analyzes the ecosystem of data-based service providers for agriculture, identifying critical success factors for business models exploiting satellite data in the primary sector.

Part of the team at the International Congress of the Italian Association of Aeronautics and Astronautics (AIDAA) in Rome. From left to right: Luigi Mazzer, Lorenzo Piovani, Marijana Zora Kuzmanovic and prof. Franco Bernelli Zazzera.

Space Business 4.0's main outcome is Wapi, a multi-sided platform democratizing access to technological tools for farmers. Wapi represents an innovative proposal for reducing inefficiencies along the agri-food supply chain, eliminating information asymmetries and increasing productivity. Wapi's business model has been validated by directly interviewing prospective users. With the feedback of potential adopters, a mock-up illustrating the functioning of the application has been realized.

Team description

The team consisted of seven members. Lorenzo Piovani was appointed as team leader. The rest of the team was divided into two sub-groups, Management and Technical team. Jelena, Zora and Luigi were members of the Management Team. They oversaw market research, business model design, development and validation. The Technical Team was composed by Gianluca, Marco and Giuliano. They studied the data available from satellites, analyzed the key roles in the space supply chain and were in charge of the technical feasibility analysis of the business models.

Part of the team attending International Astronautical Congress in Bremen, Germany. From left to right: Jelena Petrovic, Lorenzo Piovani, M. Zora Kuzmanovic and Luigi Mazzer

Project goals

Due to the technology-push nature of the project, the project development was divided into two phases, with different goals.

In phase 1, the team explored the opportunities created by the availability of satellite data, with the following milestones:

1. Performing a state-of-the-art analysis of available satellite technologies (types of data, structure of the value chain, institutional actors involved)
2. Analyzing the global ecosystem of satellite-based startups (sectors of application, type of business model, relevant customer categories)

This preliminary analysis was the starting point for the generation of three innovative business models based on Earth Observation satellite data.

The goal of the second phase was to select, develop and validate the most promising among the proposed concepts.

Understanding the problem

Space Economy is expected to grow up to $1 trillion by 2040. High-resolution satellite images (in particular multispectral and SAR images) are becoming increasingly accessible for a wide set of users. Practical applications of such data have demonstrated that satellites can deliver tangible benefits in several domains. Space is a privileged observation point to monitor what happens on our planet, therefore remotely-sensed data constitute a valuable support for decision makers. In recent years, institutional actors, such as ESA, NASA and other governmental agencies have developed numerous initiatives to foster innovation in this direction (e.g. Copernicus Programme). Furthermore, private actors (e.g. Planet, ICEYE, DigitalGlobe) have entered the Earth Observation domain, contributing to the growth of the industry in terms of spatial/temporal/spectral resolution and data accessibility. Nevertheless, the diffusion of EO-based business models is still concentrated on traditional sectors (e.g. emergency management, environmental preservation). Governmental agencies remain a major customer segments for most providers of satellite images. Even if B2B business models are acquiring increasing importance, their clients are almost exclusively large multinational enterprises. Business models targeting small businesses and end users have achieved low diffusion so far.

Exploring the opportunities

We analyzed several sectors and their current challenges, to understand how satellite data could help solving such issues. We focused our attention on agriculture, civil engineering, mining, urban management, animal breeding, emergency management, advertising, logistics, naval transportation. Three promising industries (civil engineering, urban management, agriculture) were identified and three business models were generated:

- *Space City*, a decision support system for smart cities based on Earth Observation data
- *WorldCon*, a platform for market research optimization addressing construction companies bidding for projects in foreign markets
- *Wapi*, a multi-sided platform reducing information asymmetries along the agri-food supply chain.

Hence, we proceeded with the concept selection phase. First, selection criteria (economic, technological, organizational, social) were defined. Then, relevance weights were assigned to each dimension. Finally, after evaluating each alternative, the alternative with the highest total score – Wapi – was chosen.

Selection Criteria		Weights	Space City	**Wapi**	WorldCon
ECONOMIC	Market potential	0.35	1	**1**	0
	Business Model profitability	0.25	0	**2**	1
TECHNOLOGICAL	Technological feasibility	0.15	-1	**0**	1
ORGANIZATIONAL	Compatibility with team skills	0.05	-2	**-1**	1
	Stakeholders management simplicity	0.10	-2	**-1**	0
SOCIAL	Alignment with SDGs	0.10	2	**1**	-2
Total Score		1.00	0.10	**0.8**	0.25

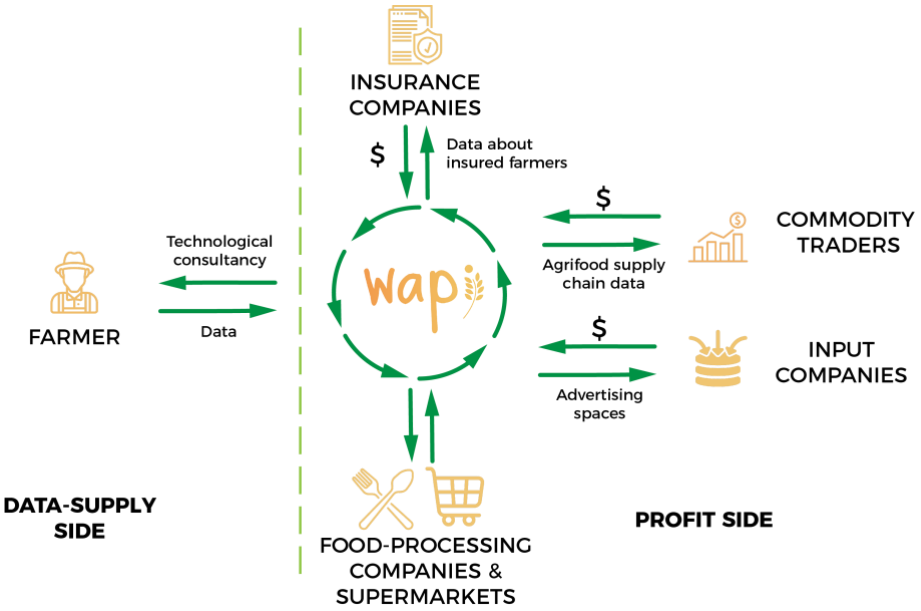
Concept selection: weighted decision matrix.
Legend: -2 (very low performances), -1 (low), 0 (medium), 1 (high), 2 (very high)

Generating a solution

Through the analysis of satellite images, farmers can receive procedural recommendations for treatments such as irrigation, fertilization and pest detection. It is also possible to forecast not only timing, but also yield and quality of the crop. Operationally, satellite images are translated into indicators such as NDWI, Nitrogen indices and Phosphorus indices, respectively describing the conditions of a field in terms of hydric, nitrogen and phosphorus requirements. Then, the calculated index is compared to a desirable value, i.e. the optimal value of the indicator given the context in which the crop grows (e.g. climate, soil, variety of product…), estimated experimentally. Finally, deviations from the optimal value are translated into operational recommendations for the farmer's daily activities. These methodologies have been developed since the early-1990s. Today, academicians unanimously agree on the economic and environmental benefits of satellite-driven precision agriculture. Nevertheless, the use of satellite images in agriculture remains limited to niche high-value-added applications and to large plantations in agriculturally advanced countries such as USA and Australia. The percentage of Italian fields cultivated with precision agriculture techniques amounts to less than 2%.

The first step for generating a solution was to study the reasons for this scarce diffusion. The team carried out on-site interviews to farmers and distributed an online survey about the diffusion of technology in agriculture. Both the interviews and the survey confirmed academic findings on the topic: the scarce diffusion of technological tools for diagnostics in agriculture is largely due to economic barriers.

Inspired by mainstream digital companies such as Instagram and Facebook, we decided to reverse the classical paradigm of precision agriculture services offered with SaaS business models. Therefore, we ideated Wapi. Wapi subsidizes farmers by providing free-of-charge precision agriculture services in exchange for data about their treatments. Thanks to these data, actors of the agri-food supply chain (generally, large established corporations with higher financial capabilities compared to farmers) can reduce information asymmetries that limit their profitability. In other words, Wapi solves productivity-related problems in agriculture by transferring the duty to pay from farmers to higher-budget actors of the industry.



Wapi: schematic representation of the platform's functioning

A second requirement that emerged from interactions with prospective adopters is the need for simplicity and user-friendliness. Existing solutions are technologically complex and create low engagement. This highlighted the

necessity for new, gamified solutions fostering frequent users-app interactions and encouraging collaboration among farmers (e.g. pest alarms).

Based on these requirements and thanks to the collaboration of experienced farmers (Società Agricola Stringa, Voghera (PV) and Società Agricola Dossena, Pieve Fissiraga (LO)), a mock-up was developed.

To validate the business model, we needed to collect feedback from prospective customers, from both sides of the platform. First, the mock-up was tested with farmers. This phase was particularly useful as potential users proposed corrections to the original version of the mock-up according to their direct needs. Second, the business model was validated with prospective data purchasers by studying inefficiencies in the agri-food supply chains from the point of view of both food-processing companies (e.g. Mutti Spa, Vini Alois) and insurance firms (Assicurazioni Generali Spa). The validation phase verified the assumptions of the business model.

Main bibliographic references

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