KSE GRADUATE SCHOOL
BUSINESS

Abstract

VOXEL: startup in agricultural UAV services

by

Cpt. Pavlo Zhuk

MS, National Technical University of Ukraine “Kyiv Polytechnical Institute”, 2005

BS, National Technical University of Ukraine “Kyiv Polytechnical Institute”, 2004

Proposal Submitted in Fulfillment of the

Requirements for the Degree of

Master in Management

KSE Graduate Business School

06 2024

KSE GRADUATE SCHOOL
BUSINESS

Abstract

This master project explores the exciting potential of establishing a private enterprise that focuses on the agricultural sector in Ukraine. The company, leveraging the power of unmanned aerial vehicles (UAVs), will offer innovative services and technological solutions to small and medium-sized farming businesses. The study will delve into this venture's promising investment opportunities and thoroughly evaluate its viability.

In the context of developing countries, farming is in dire need of technological solutions. However, it still grapples with high entry barriers due to the complexity of understanding the benefits and operational complications. This research proposes a revolutionary approach, combining established crop management methods with futuristic high-tech ideas. Typically, farmers adhere to a set of rules based on average conditions, but every piece of land is unique. We aim to harness various UAV-based technologies to scientifically track the variances of yield, thereby enhancing management practices in response to various yield-causing elements. Precision agriculture offers an exciting opportunity for automation in gathering and analyzing data for accuracy, enabling farmers to make the best decision possible.

The service-based business model adopted by Voxel is a testament to our commitment to establishing clear and transparent relations with the farmer's market. We aim to offer an extended set of services that provide a competitive edge and lower the entrance barrier for small and medium-sized businesses to enter the technological solutions of the new era. This approach fosters a sense of inclusivity and ensures that all stakeholders can benefit from our innovative solutions.

In Voxel, we believe in the technological evolution of farming.

KSE GRADUATE SCHOOL BUSINESS

Acknowledgments

I am deeply grateful to the Ukrainian Armed Forces, State Border Guard Service of Ukraine, National Guard of Ukraine, National Police of Ukraine, Security Service of Ukraine and volunteers who contributed their time, effort, and lives during 2014-2024 to establishing peace and security in Ukraine. This work would not be possible without their contributions.

I am also indebted to my family for their unconditional love, understanding, and encouragement. Their unwavering belief in my abilities has been a constant source of motivation.

Table of Contents

Abstract 3
Acknowledgments 4
Table of Contents 1
List of Tables 4
List of Figures 5
Chapter 1: Project introduction 6
Problem introduction 6
Agriculture problematic in Ukraine. 7
Chapter 2: External analysis 9
Precision Agriculture 9
UAV applications in agriculture worldwide 10
Modern AI software-based application in farming 13
Chapter 3: Market and consumer 15
Regional focus 15
Market overview 15
Market context 17
Social Factors 17
Economic Factors 18
Technological Factors 18
Market segmentation 20
Chapter 4: Go-to-market strategy. 21

Purpose....21

Goals 21

Objectives 21

Target segmentation and ICP....21

Customer value proposition 23

Marketing mix....25

Product 25

Pricing 25

Placement.... 26

Promotion.... 26

Oversight....27

Marketing budget....28

Chapter 5: Organizational strategy 29

Mission statement 29

Organizational structure....29

Performance, resource allocation, and benchmarks....31

Chapter 6: Financials 32

Financial requirements....32

Credit planning....33

CAPEX 33

P&L statement 34

Balance sheet 35

Cashflow statement....36
Statement of retained earnings....37
Sensitivity analysis.... 37
Investment resume....39
Chapter 7: Project implementation....40
Business canvas and value proposition....40
Project management....42
Service profile and project structure.... 43
Risk Management....46
Internal – External peculiarities.... 46
Risk map and prioritization.... 48
Risk Reaction.... 49
Cost of risk reaction and KRI.... 51
Change management....53
Appendix A: Graphs for financial calculations....55
References....59

List of Tables

Table 1 *QOS comparison of RS platforms used in precision agriculture.* 9

Table 2 *A competitiveness matrix of UAV software applications* 14

Table 3 *The use of fertilizers and pesticides for the harvest of agricultural crops 2023* 15

Table 4 *Market segmentation* 20

Table 5 *Ukraine agricultural production and exports (2021/22 Marketing Year)* 23

Table 6 *Marketing budget* 28

Table 7 *Organizational sizing* 31

Table 8 *Organizational benchmarks* 32

Table 9 *Financing structure* 32

Table 10 *Credit planning* 33

Table 11 *CAPEX details* 33

Table 12 *Profit & loss statement* 34

Table 13 *Balance sheet* 35

Table 14 *Cashflow statement* 36

Table 15 *Statement of retained earnings* 37

Table 16 *Sensitivity analysis using IRR and NVP observations* 38

Table 17 *Investment resume* 39

Table 18 *Basic front office delivery team profile* 45

Table 19 *Typical project profile* 45

Table 20 *Risk register* 47

Table 21 *Risk costs* 51

List of Figures

Figure 1 Accuracy rate by RS technologies 11

Figure 2 Internal market analysis 17

Figure 3 External and internal factors analysis summary 19

Figure 4 Customer value map 24

Figure 5 Organizational structure. 30

Figure 6 Business canvas 41

Figure 7 Project implementation plan (simplified) 43

Figure 8 Risk Map 49

Figure 9 Voxel revenue projections. 55

Figure 10 Voxel EBITDA margin 55

Figure 11 Voxel EBIT 56

Figure 12 Voxel net profit projection 56

Figure 13 Voxel Operational profit. 57

Figure 14 Voxel dividend payout 57

Figure 15 Project implementation detailed 58

Chapter 1: Project introduction

Problem introduction

Agriculture is a vital component of the economy in many less industrialized countries, leveraging natural resources to yield income and export revenue. Improving agriculture productivity benefits individual countries' economies and contributes to global food production, as food insecurity and poor quality can negatively impact public health.

Natural resources, biotic variables, agro-inputs, and management impact agricultural production. It can only be a sustainable venture if there is harmony in the above interactions. Agriculture employs a large section of the population in emerging countries, such as Ukraine, where the agriculture industry brings 17% of annual GDP and up to 40% of foreign currency revenue, also involving around 14 of the population in various activities around this economic sector. Because of threats such as stagnant yield, degradation of land and water, scarcity of irrigation water, climate change and associated problems, vulnerability in farming, and low harvested yield by farmers the potential, Ukraine faces a significant challenge in achieving much-needed agricultural sustainability to feed the populous nation.

The optimal approach to enhance agricultural productivity and uphold sustainability within the constraints of limited natural resources while sidestepping adverse outcomes lies in maximizing resource and input utilization efficiency. Utilizing existing tools and integrating all available technologies into the agricultural framework is imperative to enhance agricultural yields and ensure the sustainability of crop production. Precision agriculture provides technological advancements with agricultural practices to increase productivity while curbing input expenses.

Agriculture problematic in Ukraine.

Ukraine is facing significant challenges in the economic sector due to active military operations throughout the country. However, agriculture remains a significant source of income, labor, and taxes.

First, there is the threat of loss of production potential and resources necessary for enterprises to function. A large part of the land is under occupation, constantly under fire, or in need of survey and demining, which makes its use impossible. There is a drop in the application of the necessary fertilizers and specialized means for plant protection, which harms yield indicators and disrupts the quality of the land.

Various agricultural lands were destroyed in the areas affected by hostilities. As of today, they require significant investment and reconstruction to restore their possibility of use. The hostilities also contaminated land intended to produce food. Approximately one-third of Ukraine's land fund is currently in the risk zone.

No less significant impact on the industry is the termination of the activity of a share of producers or a large-scale change in their activity, which is due to significant financial and economic losses. Due to hostilities, some qualified specialists and business owners stopped their activities or were forced to migrate altogether. According to the UN, their number is about 150 thousand people. As of today, it is unknown whether resuming their activities is possible. As a result, their complete exit from the field or a change in profile is possible. Producers of seasonal products, which formed the income and employment of the population of the villages, also suffered significant losses.

The Ministry of Agriculture data reveals that over 67 million tons of crops were harvested in 2022, affirming Ukraine's pivotal role in global food security. Following the signing of a grain

agreement, August 2022 saw the dispatch of 68 ships, facilitating the transportation of 1.72 million tons of Ukrainian agricultural products to 18 nations. Approximately 5 million tons of products were delivered throughout August via diverse logistical channels. Over 11 months in 2022, exports from Ukraine's agro-industrial complex and food sector totaled 50.9 million tons, amounting to 21.1 billion US dollars.

The capacity to innovate is a strategic tool for those firms that want to maintain their competitive position in the global market (Laforet & Tann, 2006). This is especially true for the agri-food sector, the largest manufacturing sector within the EU and one of the main drivers of the EU economy, contributing to economic output and employment (Traill, 1998). According to FoodDrinkEurope's Report 2017, the food and drink industry generated 4.24 million employees throughout the EU, over €1 trillion turnover, and a positive trade balance of €30 billion. Nevertheless, the agri-food sector has traditionally been viewed as a low-tech sector with slow rates of innovation concerning others (Dalla Corte et al., 2015; Bentivoglio et al., 2016). Agri-food enterprises operate in a complex and dynamic environment. To meet the increasing demands of consumers, government, and business partners, enterprises continuously have to work on innovations of products, processes, and ways of cooperation (Harsh et al., 1981). Nevertheless, it is not only research that leads to innovation; it also involves technology users. This fact is used in EU programs and policies to promote digital technologies as part of competitiveness and innovation (Wozniakowski & Jalowiecki, 2013).

As mentioned above, Ukraine's agricultural sector seeks solutions to many challenges, including military, logistical, financial, and economic. The Voxel project aims to provide one solution focused on agricultural efficiency and increasing technology penetration into the sector.

Chapter 2: External analysis

Precision Agriculture

Precision agriculture (PA) helps farmers make crucial decisions at the right time by analyzing a vast amount of data regarding the environment and crop details. Thus, PA helps the farmers march towards more high-quality production to meet the required demand. Remote Sensing (RS) is vital in crop evaluation and soil health conditions. It indicates the problems at the right time and helps resolve them wisely [2]. Various remote sensing platforms used for precision agriculture could be described as:

a) Ground-based

b) Satellite

c) Human-crewed Aircraft

d) Unmanned aerial vehicles.

Table 1

QOS comparison of RS platforms used in precision agriculture.

Platform	UAV	Satellite	Human-crewed Aircraft	Ground-based
Flexibility	high	low	low	low
Adaptability	high	low	low	low
Cost	low	high	high	low
Time consumption	low	low	low	high
Risk	low	average	high	low
Accuracy	high	low	high	moderate
Deployment	easy	difficult	complex	moderate
Feasibility	yes	no	no	yes
Availability	yes	no	yes	no
Operability	easy	complex	complex	easy

Note. From “Unmanned Aerial Vehicles (UAV) in Precision Agriculture: Applications and Challenges. Energies” Velusamy, P.; Rajendran, S.; Mahendran, R.K.; Naseer, S.; Shafiq, M.; Choi, J.-G. 2022, 15, 217. https://doi.org/10.3390/en15010217

UAV applications in agriculture worldwide

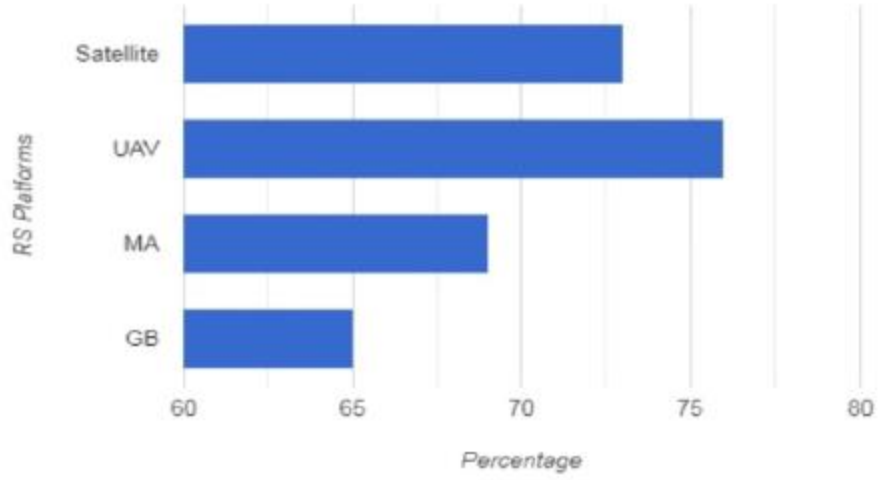
Technological advancements and the digitalization of agriculture enable significant strides in resource efficiency, fostering environmentally conscious and climate-smart farming practices. These innovations reduce agriculture's environmental and climate impacts, bolster resilience and soil health, and lower farmers' costs. However, the adoption of new technologies in farming has not met expectations and is unevenly distributed across the EU, particularly affecting small and medium-sized farms' access to such advancements. The challenges associated with intelligent farming vary across different agricultural production systems, with infrastructural limitations hindering widespread implementation [1].

Accelerating innovation requires establishing a collaborative framework involving farmers, cooperatives, extension professionals, scientists, and the private sector to effectively co-create knowledge. Farmers play a crucial role in this process by identifying priorities, collaborating with scientists to conduct research, and adopting and disseminating research findings. Technical solutions should enable farmers to enhance efficiency, freeing time for management tasks, such as monitoring and controlling emissions. These solutions should also enable farmers to demonstrate their products' quality, sustainability, and safety to consumers and policymakers.

For the last few decades, most agriculture fields have been using RS technologies for precision agriculture with different applications such as crop monitoring, Prediction of Yields, and Pest Management. Further, these techniques are also used for plant stress and nutritional deficiencies. RS technologies can detect pests and insects successfully in various crops and fields. Precision Accuracy is more important in the economic development of the agriculture field, and the accuracy yields monitoring the crop infected by the pest and the quality of the crop properly. The precision accuracy rate in the agriculture field by RS technologies is shown in Figure 1.

Figure 1

Accuracy rate by RS technologies



Note. From "Unmanned Aerial Vehicles (UAV) in Precision Agriculture: Applications and Challenges. Energies" Velusamy, P.; Rajendran, S.; Mahendran, R.K.; Naseer, S.; Shafiq, M.; Choi, J.-G. 2022, 15, 217. https://doi.org/10.3390/en15010217

The development of UAV-based remote sensing systems has taken remote sensing and Precision Agriculture (PA) one step further. The use of UAVs to monitor crops offers great possibilities to acquire field data easily, quickly, and cost-effectively compared to previous methods. UAV-based IoT technology is considered the future of remote sensing in Precision Agriculture. UAVs' ability to fly at a low altitude results in ultra-high spatial resolution images of the crops (i.e., a few centimeters).

This significantly improves the performance of the monitoring systems. Furthermore, UAV-based monitoring systems have high temporal resolution as they can be used at the user's will, enhancing the flexibility of the image acquisition process. In addition, UAVs are much simpler to use and also cheaper than manned aircraft. Moreover, they are more efficient than ground

systems as they can cover a large field quickly and in a non-destructive way, which is very important.

Unmanned Aerial Systems (UAS) are now very commonly used in remote sensing applications for Precision Agriculture. Equipped with sensors of different types, UAVs can be exploited to identify which zones of the crops need different management, e.g., some input. This allows the farmers to react on time to any problem detected. UAS can be used in various applications for Precision Agriculture, such as health monitoring and disease detection, growth monitoring and yield estimation, weed management and detection, etc. As the use of UAVs in PA applications has been very frequent in the last few years and is considered the future of remote sensing, it is a field that draws much attention. Thus, several reviews exist for their application in Precision Agriculture and Smart Farming.

In their early application in agriculture, the initial goal of UAVs was to derive direct image-based products. Nowadays, this has changed, and the applications of UAVs in agriculture are intelligence-based products that process images and provide informed decision-making applications to farmers. In this question, we thoroughly describe the different UAVs that can support different applications based on the different operational needs of agriculture fields.

Among the most popular applications of UAVs in Precision Agriculture is Weed mapping. Weeds are undesirable plants that grow in crops and can cause several problems.
They compete for available resources such as water or space, causing losses to crop yields and their growth. In addition to the problems in the growth of the crops, weeds can cause problems with harvesting. The use of herbicides is the dominant choice for weed control. In conventional farming, the most common weed management practice is spraying the exact amounts of herbicides over the entire field, even within the weed-free areas. However, the overuse of

herbicides can result in the evolution of herbicide-resistant weeds and can affect the crops' growth and yield. In addition, it poses a heavy pollution threat to the environment. In addition, the above practice significantly increases the cost. To overcome the above problems, Site-Specific Weed Management (SSWM) is used in precision agriculture practices. SSWM refers to the spatially variable application of herbicides rather than spraying them in the field. In this context, the field is divided into management zones, and each one receives customized management, as weed plants usually spread through only a few spots in the field. To achieve this goal, it is necessary to generate an accurate weed cover map for precise spraying of herbicide.

Modern AI software-based application in farming

Unmanned aerial vehicles (UAVs) equipped with artificial intelligence and visual analysis capabilities offer a promising solution to the challenges mentioned above faced in agriculture, particularly in precision agriculture (PA). To this end, commercial closed-source software and research agricultural products have been developed, leveraging digital farming technologies for precision agriculture and farming development.

Commercial products, including Pix4D, DroneDeploy, and Sentera FieldAgent, which are drone mapping software that can create UAV flight paths, capture aerial photographs, visualize crop health indices, and provide a timeline view of previous field scans for continuous monitoring. Agisoft Metashape also employs photogrammetry to create 3D maps, including crop yield and plant health maps. Botlink is a UAV-based agricultural software with a flight planning framework that can produce high-definition 2D and 3D outputs and vegetation indices. Lastly, Blue River Technology provides intelligent farm machines that use computer vision and deep learning

techniques to individually monitor each plant in the field, a capability currently lacking in integrated UAV products. Table 2 compares these various commercial agricultural products based on their technological features in farming.

Several research studies have also developed systems-level software for various agricultural practices, primarily focused on crop health and yield monitoring. These systems mainly utilize commercial usage-based pricing models for their flight planning and photogrammetric services, thereby hindering their customization for agricultural applications, as it requires a certain level of expertise for consolidation and overall management. Additionally, most aim to improve specific workflows such as estimating plant volume, monitoring vegetation canopy reflectance, and evaluating chlorophyll levels in rice paddies. Other practices include periodic crop status inspections, pH levels, acidity calculations, vineyard monitoring, and mapping [3].

Table 2

A competitiveness matrix of UAV software applications

Platform	UAV	Satellite	Manned Aircraft	Ground-based
Pix4D	+	low	low	low
Drone deploy	+	low	low	low
Sentera FieldAgent	+	high	high	low
Agisoft	low	low	low	high
Botlink	low	average	high	low
Blue River Technology	high	low	high	moderate

Note. From "CoFly: An automated, AI-based open-source platform for UAV precision agriculture applications" Emmanuel K. Raptis, Konstantinos Englezos, Orfeas Kypris, Marios Krestenitis, Athanasios Ch. Kapoutsis, Konstantinos Ioannidis, Stefanos Vrochidis, Elias B. Kosmatopoulos. https://doi.org/10.1016/j.softx.2023.101414

Chapter 3: Market and consumer

Regional focus

Since the logistic in agriculture plays major role, it's important to understand what regions in Ukraine would be in primary focus for Voxel deployment. As per Ukrstat report 2023, usage of fertilizer for perennial crops has top values in Odessa and Mykolayiv regions due to climate specifics. Secondary options are Zakarapattya and Ternopil.

Table 3

The use of fertilizers and pesticides for the harvest of agricultural crops 2023

Культури багаторічні (плодові та ягідні, горіхи, виноград, хміль та інші багаторічні культури) /
Perennial crops (fruits and berries, nuts, grapes, hops and other perennial crops)

	Площа насаджень, оброблена / *Plantation area treated with*						
	мінеральними добривами /		органічними добривами /		пестицидами /		
	тис.га / *thsd.ha*	у % до загальної площі насаджень / *in % to the total area of plantations*	тис.га / *thsd.ha*	у % до загальної площі насаджень / *in % to the total area of plantations*	тис.га / *thsd.ha*	у % до загальної площі насаджень / *in % to the total area of plantations*	
Україна	**22,4**	**50,8**	**2,6**	**6,0**	**30,1**	**68,1**	***Ukraine***
Вінницька	5,5	61,4	к	к	7,0	77,9	*Vinnytsya*
Волинська	0,8	81,2	к	к	0,8	81,4	*Volyn*
Дніпропетровська	1,9	61,5	0,4	14,0	2,5	78,3	*Dnipropetrovsk*
Донецька	к	к	к	к	к	к	*Donetsk*
Житомирська	0,5	76,0	к	к	0,4	54,8	*Zhytomyr*
Закарпатська	1,3	82,7	–	–	1,2	77,7	*Zakarpattya*
Запорізька	к	к	–	–	к	к	*Zaporizhzhya*
Івано-Франківська	к	к	–	–	0,2	62,1	*Ivano-Frankivsk*
Київська	0,6	42,2	к	к	0,7	46,2	*Kyiv*
Кіровоградська	к	к	к	к	0,1	12,9	*Kirovohrad*
Луганська	…	…	…	…	…	…	*Luhansk*
Львівська	0,4	63,7	–	–	0,4	56,4	*Lviv*
Миколаївська	**2,0**	34,8	–	–	2,8	47,8	*Mikolayiv*
Одеська	**4,9**	44,9	0,6	5,4	9,0	82,6	*Odesa*
Полтавська	к	к	–	–	0,3	49,4	*Poltava*
Рівненська	–	–	–	–	–	–	*Rivne*
Сумська	к	к	–	–	0,2	38,0	*Sumy*
Тернопільська	0,9	66,8	к	к	0,9	64,4	*Ternopil*
Харківська	0,3	31,0	к	к	0,4	48,5	*Kharkiv*
Херсонська	–	–	–	–	–	–	*Kherson*
Хмельницька	0,8	56,1	0,1	3,9	1,0	65,4	*Khmelnytskiy*
Черкаська	0,8	84,6	к	к	0,9	91,0	*Cherkasy*
Чернівецька	0,7	40,3	0,2	14,2	1,0	56,9	*Chernivtsi*
Чернігівська	к	к	–	–	к	к	*Chernihiv*

Note. From the 2023 report of Ukrstate agency https://ukrstat.gov.ua/operativ/operativ2018/sg/vmod/arch_vmodsg_u.htm

Market overview

The total addressable market (TAM) for precision agriculture in Ukraine is estimated to be around USD 60–70 million USD. We expect that Ukraine precision agriculture market will grow at an annual rate of approximately 10-15%. The current geopolitical situation in Ukraine, including conflicts and their resolutions, will significantly impact economic activities, including agriculture.

Assuming a conservative annual growth rate of 10% (taking a lower bound given the uncertainties and challenges in the region), we can estimate the TAM in five years:

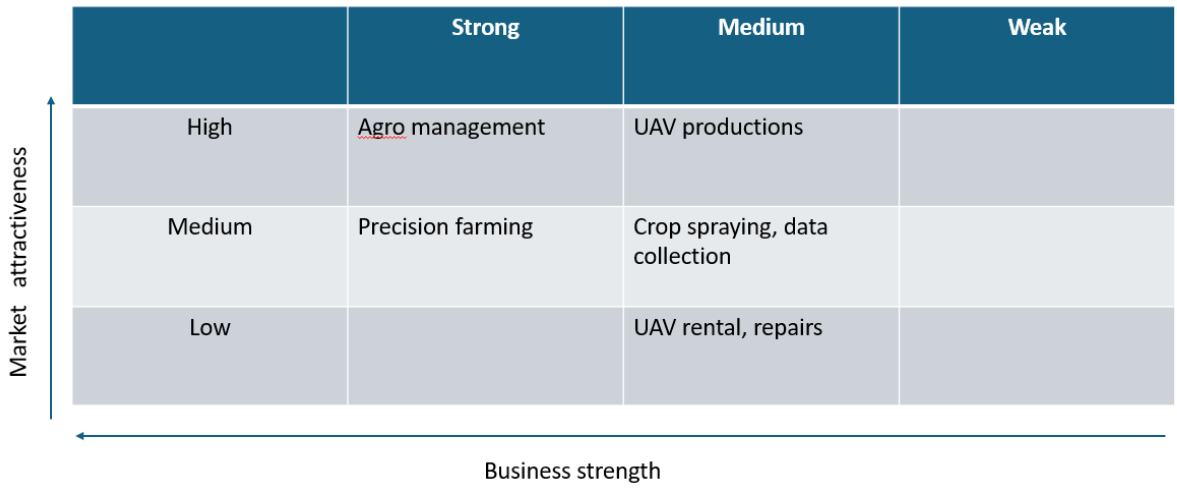
- TAM (Total Addressable Market) = $110,000,000 ($70mln as of 2024)
- SAM (Serviceable Available Market) = $110mln x 6,5% = $7.15mln (Odesa and Mykolaiv Oblast)
- SOM (Serviceable Obtainable Market) = $7.15mln x 14% = $0,99mln

Odesa region as the initial service region has been selected considering three main factors:

- Location: South region in Ukraine with ease of logistics
- Competition: No major players are operating in this region
- SAM: The percentage of agricultural land is particularly concentrated in the central and eastern parts of the country. Odesa oblast share is 3.5%.
- SOM: Obtainable market considers as segment which is reachable for the customer specific focus (farmers with specific crop cultures) and reaching 14% at best.

Figure 2

Internal market analysis.



Market context

Social Factors

- High unemployment rate in Ukraine creates a labor surplus in the market, potentially reducing labor costs. Voxel can capitalize on the available workforce to enhance service offerings, particularly in labor-intensive areas like data collection and field monitoring
- Deep historically lasting agriculture traditions: Voxel can leverage this deep agricultural engagement by collaborating with farmers to tailor technologies to specific local needs, thus enhancing adoption rates
- Emerging UAV production segment presents a significant opportunity for Voxel to integrate UAV technologies into precision farming service, offering advanced services like aerial imaging and crop monitoring.

Economic Factors

- High, but controlled inflation rate: will reflect on fluctuating costs for inputs and technology components. This challenge has to be addressed through managing budgets tightly and forecast costs accurately, considering potential fluctuations in pricing due to inflation.
- Turbulence in agricultural products export along EU integration path impacts Ukraine as a significant exporter of agricultural products. Quotas and activism of foreign farmers blocking trade routes can lead to delays, increased farmers costs, and reduced competitiveness in international markets. Such situations may have negative impact on Voxel receivables and overall financial stability.

Technological Factors

- Technological Revolution in UAV especially in agricultural applications, is transforming farming practices. UAVs offer detailed crop health monitoring, efficient spraying, and precise field mapping. Voxel solutions aimed to improve crop yields and reduce operational costs
- High Demand for Agricultural Efficiency push for technologies that enhance efficiency. Fulfilling this demand stretches from applying IoT devices and UAV drones to advanced analytics platforms that process data for actionable insights.

Figure 3

External and internal factors analysis summary

	Helpful	**Harmful**
Internal	STREGTHS Service/product with advanced data analytics, drone technology, and IoT-based monitoring systems Flexible turn-key service-based offer (no CAPEX) focus on specific challenges within the agricultural sector, that larger companies may overlook. Service delivery focus Experienced staff focused on customer needs Ukrainian brand	WEAKNESSES Dependency of service quality delivery on reliable internet and mobile services Complicated logistic during service delivery, logistic costs Cash collection from argo companies can be challenging Scaling of business depends heavily on logistic opportunities
External	OPPORTUNITIES Servicing high-marginal agricultural crops farmers ready to invest in tech Fundraising from the Ukrainian and the European Union governmental institutions of agro sector in the form of subsidies, grants, and educational programs More customer engagement via new product offerings (software services) Compete with more rich offerings - custom bundles	THREATS Political and Geopolitical Uncertainty Product replication by rivals Dependency from UAV producers Low-marginal agricultural crops farmers will be reluctant to invest in tech Customers turnover due to low switch cost AI/Computer vision competence loss due high market demand

Ukraine's agricultural productivity is high but can vary significantly due to less consistent application of advanced farming techniques and technology across its regions. Precision technologies are currently utilized by approximately 30% of farmers and cover about 15% of the agricultural land. The market has significant growth potential given the advancing adoption of

technology among small and medium agro-farms and the increasing interest from tech startups in the agricultural sector. The following SWOT analysis highlights that while significant challenges face the precision agriculture sector in Ukraine, considerable strengths and emerging opportunities could support its growth and sustainability.

Market segmentation

Table 4

Market segmentation

Who	Where	What	Priorities
Small farmers (150-500 hectares) *	Localized within a single area	Traditional crop types	Financial resource, time allocation
Middle size farmers and agro companies 500- 10,000 hectares	Localized within a single area	A mix of traditional and experimental crop types	Effectiveness of crop, growth
Large agro companies 10,000+ hectares	Does not have clear regional attachment	Large-scale production of high marginal crop types	Optimization, economy of scale

The competitive landscape in Ukraine's precision farming sector is influenced by local incumbents with varying strengths and weaknesses. Companies that can combine technological innovations and understand local farming conditions and economic realities tend to perform better. Direct competitors with advanced technological solutions and substantial financial backing pose a significant challenge to smaller players. In contrast, indirect competitors offer alternative solutions that can sometimes slow the adoption of new technologies.

Chapter 4: Go-to-market strategy.

Purpose

At Voxel, our mission is not just about technology; it's about making a real difference in farmers' lives. We are driven to help them increase productivity, profitability, and sustainability through affordable, innovative, and scalable technology.

Goals

Become the leading PrecisionAgro farming service provider in primary base region Odesa and Mykolayiv Oblast

Objectives

a) Leader with over 30% revenue market share in base region

b) Over 10% market penetration rate within the first two years in base region

c) Awareness of Voxel among agro SMEs by 70% within the first year

d) In 5 years, 1000 sq. km under service maintenance

e) 100+ commercial contracts on PrecisionFarming service subscription

f) Customer retention rate over 85%

g) Zero-debt company

Target segmentation and ICP

Voxel will position itself as an “affordable and turn-key agricultural services next door” partner. It will provide middle-sized farms specializing in experimental crops like hops, spices, and tobacco with precision farming technologies to scale up and grow. Its easy-to-integrate solutions

help to enhance yield, quality, and sustainability, ensuring business thrives in competitive markets. A typical portrait of the target farmer is the following:

- Farm Size: Typically, solvent farms range from 50 to 500 hectares. These farms are large enough to benefit significantly from precision agriculture technologies but may not have the same resources as larger corporate farms.
- Crop Types: We will focus specifically on high-margin, experimental crops such as hops, spices, and tobacco. These crops require precise agricultural practices to optimize yield and quality, making them ideal candidates for precision farming technologies.
- Location: Farms near your operational base or within a specific geographical region you can serve efficiently.
- Demographics: Age 40-55, owns a farm of around 100 hectares specializing in hops.
- Behaviors: Tech-savvy seeks new technologies to improve crop yields and operational efficiency. Active in farming communities and online forums. Environmentally conscious, prioritizes sustainable farming practices. Engages with agricultural consultants for best practices.
- Goals: The company wants to increase crop yield and quality to meet the demands of premium breweries, reduce waste, and increase market share in organic markets.
- Challenges: It struggles with traditional farming methods that do not provide the precision required for optimal hop growth. It needs affordable, reliable technology that can be easily integrated into existing operations. It also needs precise soil and crop management tools to maintain organic certification and optimize resource use (water, fertilizers).

Table 5

Ukraine agricultural production and exports (2021/22 Marketing Year)

	Production			Exports		
Product	**Volume (1,000 MT)**	**Rank Among Global Producers**	**% of Global Production**	**Volume (1,000 MT)**	**Rank Among Global Exporters**	**% of Global Exports**
Corn	41,900	#6	3.5%	23,000	#4	12%
Wheat	33,000	#7	4.3%	19,000	#5	9%
Sunflower	17,500	#1	30.6%	75	#9	3%
Barley	9,900	#4	6.8%	5,800	#3	17%
Sunflower Oil	5,676	#2	30.6%	4,950	#1	46%
Sunflower Meal	5,452	#2	27.5%	4,100	#1	54%
Rapeseed	3,015	#6	4.2%	2,700	#3	20%

Source: USDA WASDE and PSD Database, updated March 9, 2022

Customer value proposition

Voxel's value proposition is composed of the most impactful Customer Value Drivers. Voxel advanced precision farming technologies and UAV park are specifically designed for middle-sized farms growing high-margin experimental crops. With our IoT sensors, drones, and custom analytics suite, Voxel helps farmers increase yield and improve crop quality while reducing operational costs and environmental impact. Farmers do not need to study complex to operate systems as Voxel provides turn-key service including logistics, UAV management, data collection, and data management providing to customer compiled and processed analytics for efficient decision making. Data can be easily used within farmer operations, supported by dedicated local teams who ensure you maximize the value of your investment. Voxel engages with farmers and build long term partner relationships.

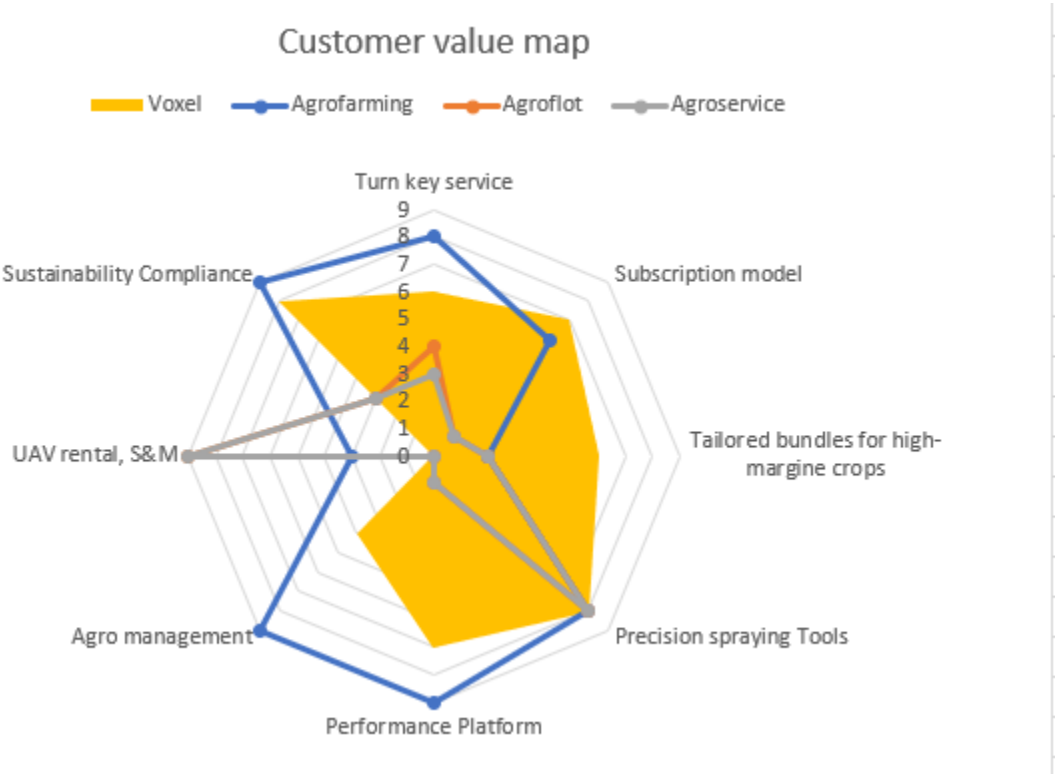
Customer Needs and Expectations:

- Increased Yield: Improved crop output per hectare

- Enhanced Crop Quality: Higher quality crops that can command premium prices
- Cost Efficiency: Reduction in waste and use of resources (e.g., water, fertilizers)
- Low impact on liquidity: Precision farming solutions should have a linear and predictable impact on cash flow
- Ease of Use and Integration: Simple, user-friendly technology that integrates seamlessly with existing farm operations. No need for additional headcount or high-profile in-house resources
- Sustainability: Environmentally friendly technologies

Figure 4

Customer value map



Marketing mix

The marketing mix aimed to ensure that Voxel, a precision farming startup, effectively reached its target audience and met their specific needs, leading to increased adoption and customer loyalty.

Product

Features: The product offers a robust composition of features and real-time data analytics, spraying, data post-processing, UAV imaging, computer vision, comparable dataset, and predictive analytics

Customization: Platform and features can be customized according to farming sizes and specific needs to increase adoption rates

Quality and Robustness: Durable and reliable products with consistent performance. Strong after-sales team skilled in agricultural technology to provide personalized services.

Pricing

Zero CAPEX: This is a full, turn-key managed service like an operating model, with no initial CAPEX and no additional resources needed from the farmer's side.

One of the key advantages of our precision farming technology is its affordability. This makes it accessible to middle-sized farms with budget constraints, thereby increasing our potential customer base and demonstrating our commitment to financial viability.

Flexible: Offer various pricing models (event-based, subscription-based, SaaS, and try-and-buy), such as pay-per-use, subscriptions, or financing options, that allow customers to scale as their needs grow.

USD 10,000 for the most minor project of 1-week duration, 30% discount for new customers.

USD 40,000 for a typical project of an established partner, 1+ month duration

Placement

Distribution Channels: During the first two years, the founder will run sales and through partnerships with local seeds and agricultural equipment suppliers.

Geographics: Initially, the focus will be on the Odesa and Mykolayiv region and farmers with high-margin crops that benefit most from precision farming.

Reach: The company will be close to the customer operating area so Voxel can provide onsite service at the farmers' field location. Establish feedback loops from farmers to refine features and usability.

Promotion

Promotion: SMM, Lead Generation, and Context Advertisement to cater to Voxel's target demographics

Content Marketing: Voxel will set up a YouTube channel with instructional videos highlighting the benefits of precision farming and Voxel-specific products. It will also run an SEO-optimized website that serves as both an informational resource and an engagement tool.

Conferences: Voxel will participate in agricultural events and conferences to demonstrate products and grow a professional network with potential customers.

Public Relations: Pitch success stories to media outlets. Organize webinars and workshops to educate and showcase Voxel products’ capabilities and benefits.

Oversight

To ensure that Voxel's marketing strategy and plan are effective, we will use the following performance evaluation metrics to steer operations, identify areas for improvement, and make informed decisions to optimize Voxel's marketing efforts:

- Customer Acquisition Cost (CAC). Business target: 10-30% of LTV
- Lead Generation. Business target: 10-20% MoM
- Conversion Rate. Business target: 5-8%
- Sales Growth. Business target: 20-50% YoY
- LTV (Lifetime Value). Business target: 800k-2,000kUAH per customer
- LTV/CAC ratio. Business target: (3:1)
- Customer Retention Rate. Business target: (80-90%)
- Churn rate. Business target: 5-10%
- Customer Satisfaction (CSAT): Business target: >80%
- Net Promoter Score (NPS). Business target: >60
- Brand Awareness. Business target: 25-40%

Marketing budget

The marketing budget for the next five years has been built for the projection, segmented by different cost centers, and the total cost has been allocated to Voxel's OPEX.

Table 6

Marketing budget

Cost Center	2025	2026	2027	2028	2029	Comment
Promotion	0%	0%	1%	1%	1%	SMM, Lead generation, Context Advertisement
Market research & analyti	20 000	20 000	30 000	50 000	50 000	Reports, Surveys, Interviews
Advertisement	0%	0%	2%	2%	1%	Catalogues, articles, campaigns, trials
Communication & PR	1%	1%	1%	1%	1%	Events, Conferences, Posters, Presentations

Cost Center, UAH th	2025	2026	2027	2028	2029
Promotion	0	0	559	840	1 106
Market research & analytics	20	20	30	50	50
Advertisement	0	0	1 118	1 679	1 106
Communication & PR	207	347	559	840	1 106
Total	227	367	2 265	3 409	3 368

Chapter 5: Organizational strategy

Mission statement

At Voxel, our mission is to introduce service delivery practices for farmers through UAV technology and access to precision farming technology. We are committed to empowering farmers with efficient, sustainable, cost-effective solutions that optimize crop yields while minimizing environmental impact. Through innovation and reliability, we want to enhance agricultural productivity and contribute to a more sustainable future for farming communities worldwide.

Organizational structure

Voxel is modeled as a small-to-middle-sized company for five years, which consists of multiple structural units:

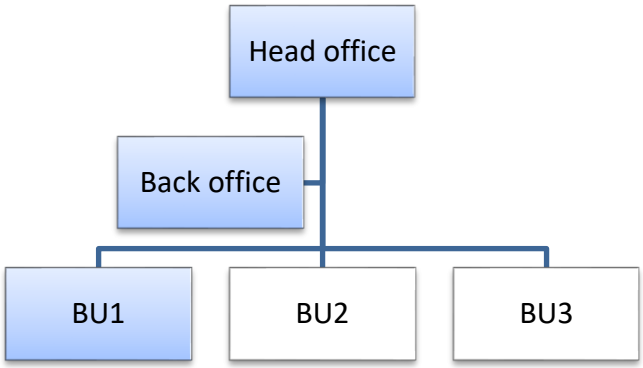
The head office consists of a Director(s) and Sales representatives. The director performs all supervising activities, including project delivery and relationship management. The back office is built mainly by contractors responsible for operational goals in recruitment, accounting, and technical support. The head of the back office is an accountant, who may become the company's partner or full-time employee in later years.

Business unit(s) – are scalable structures that might be remotely located in the latter years of business development to simplify the logistical delivery approach. Only a single business unit must be created at Y0/Y1 of the company establishment. However, starting from Y2, new business units must be created during intensive growth.

Each business unit has a single lead person assigned based on leadership skills and internal authority in the established team. Business units do not have any contracts and consist only of Voxel's full-time employees. All business units report directly to the primary office for operational goals; however, they are still subordinate to the chief of the back office for internal operational questions, such as reporting and accounting.

Figure 5

Organizational structure.



Performance, resource allocation, and benchmarks

From a goal-setting theory standpoint, performance goals are crucial in motivating leaders in business units. As they have clear performance goals, it will mobilize their efforts, direct their attention, increase their persistence, and affect their task strategies. Leaders will be motivated to control the process of proper accomplishment of tasks in time, as the Director will set the goal. Goals influence the individual's intentions, defined as the "cognitive representations of goals to which the person is committed." That is why this commitment will continue to direct their behavior until the goal is achieved.

5-years project for the project structure has been provided in the table below. Essential aspects to highlight is continuous sales growth and business unit size from Y1 to scaleup the organization.

Table 7

Organizational sizing

Functional level	Unit	type	2025	2025	2025	2025	2025
Employees							
Head Office							
Director	FTE	Direct labour	1	1	2	2	2
Sales	FTE	Direct labour	1	2	2	3	4
Business unit							
Operator	FTE	Direct labour	3	4	5	7	9
Agronomist	FTE	Direct labour	1	2	3	4	5
General specialist	FTE	Direct labour	2	3	4	5	7
Back office							
Recruiter	FTE	Opex	1	1	1	1	1
Accountant	FTE	Opex	1	2	2	2	2
Support engineer	FTE	Opex	1	1	1	1	1
Total			**11**	**16**	**20**	**25**	**31**

Organizational benchmarks are provided below to highlight an organizational scale approach.

Table 8

Organizational benchmarks

Organizational benchmark

	Ед.изм.	2025	2026	2027	2028	2029
Sales	UAH th	24 894	41 685	67 060	100 767	132 701
Employees	FTE	11	16	20	25	31
Employees / Revenue	FTE per 1M UAH	0,44	0,38	0,30	0,25	0,23
Revenue / total FTE	UAH th per FTE	2,26	2,61	3,35	4,03	4,28
Back office size	FTE	3	4	4	4	4
Front office size	FTE	8	12	16	21	27
Revenue / front office size	UAH th per FTE	3 112	3 474	4 191	4 798	4 915

Chapter 6: Financials

Financial requirements

In financial planning, incorporating a mix of equity and credit volume in the financing structure is essential for balancing risk and cost. Equity provides long-term stability and flexibility, reducing the burden of debt repayment and enhancing resilience during economic downturns. On the other hand, leveraging credit allows for efficient capital allocation and can amplify returns. Table 5 provides the financing structure and ratios required for the Voxel project.

Table 9

Financing structure

Financing	Total	%
Equity	8000	62%
Credit	5000	38%
Total	13000	

Credit planning

A credit line must be opened to finance the operational activities properly. Table 6 shows credit line and return calculations.

Table 10

Credit planning

	Unit		
Credit volume	UAH th	2 000	
% rate	%	19,00%	annual rate

	Unit	2025	2026	2027	2028	2029
Loan balance	UAH th	2 000	1 750	1 500	1 250	1 000
% payment	UAH th	380	333	285	238	190
Credit return payment	UAH th	250	250	250	250	
Total payments	UAH th	630	583	535	488	190

CAPEX

Capital expenditure (CAPEX) planning is integral to businesses for strategic resource allocation, ensuring long-term growth and viability. It guides investment strategies by determining optimal allocation for technology, equipment, facilities, or acquisitions. Effective CAPEX planning facilitates asset management, enabling maintenance and upgrades to sustain competitiveness. Table 7 provides CAPEX projection for Voxel, including ratio analysis, which allows it to manage capex volume better.

Table 11

CAPEX details

	Unit	2025	2026	2027	2028	2029
Total	UAH th	3 789	1 939	2 625	1 995	2 660
Capex/Sales		16,9%	5,3%	4,4%	2,0%	2,1%
Grand total 2025-2029	UAH th	13 008				

P&L statement

A profit and loss (P&L) statement is crucial for planning as it provides a snapshot of a company's financial performance over a specific period. It outlines revenues, costs, and expenses, allowing businesses to assess profitability, identify trends, and make informed decisions. By analyzing the P&L statement, companies can adjust strategies, allocate resources efficiently, and forecast future earnings, aiding in effective planning and sustainable growth. Table 8 shows the P&L statement for Voxel with the projection for five years.

Table 12

Profit & loss statement

		Unit	2025	2026	2027	2028	2029	CAGR25-29
	Sales without VAT	**UAH th**	**18 686**	**30 760**	**49 700**	**81 228**	**107 597**	52%
-	**Cost of Sales**	UAH th	15 052	24 399	39 158	63 111	82 337	
=	**Gross Profit**		**3 634**	**6 361**	**10 543**	**18 117**	**25 260**	58%
	Gross profit margin		*19%*	*21%*	*21%*	*22%*	*23%*	4%
-	**Operating expenses**	UAH th	2 331	2 506	2 935	4 162	4 095	18%
=	**Operating profit**		**1 303**	**3 855**	**7 608**	**13 955**	**21 164**	76%
	Operating margin	*%*	*7%*	*13%*	*15%*	*17%*	*20%*	16%
-	Depreciation/Amortization	UAH th	**681**	**831**	**965**	**1 126**	**1 317**	17%
=	**EBIT**	**UAH th**	**621**	**3 024**	**6 643**	**12 829**	**19 847**	87%
	EBIT margin	*%*	*3%*	*10%*	*13%*	*16%*	*18%*	23%
-	Interest Expenses	UAH th	380	333	285	238	190	
=	**Earnings before taxes (EBT)**	**UAH th**	**241**	**2 691**	**6 358**	**12 592**	**19 657**	94%
	EBT margin	**%**	*1,29%*	*8,75%*	*12,79%*	*15,50%*	*18,27%*	28%
			18%	*18%*	*18%*	*18%*	*18%*	0%
-	Taxes	UAH th	43	484	1 144	2 267	3 538	94%
	Taxes/EBT	*%*	*0,2*	*0,2*	*0,2*	*0,2*	*0,2*	0%
=	**Net income from operating activities**	**UAH th**	**198**	**2 207**	**5 213**	**10 325**	**16 119**	94%
	Net income margin	*%*	*1%*	*7%*	*10%*	*13%*	*15%*	28%

As per the P&L statement projection, we could see important financial performance indicators and margins highlighting crucial aspects of Voxels' enterprise dynamics. Operating profit, EBIT, SBT, and, most importantly, Net Income show positive dynamics during all five years projected.

Balance sheet

The balance sheet is essential for planning as it offers a comprehensive overview of a company's financial health at a specific time. It summarizes assets, liabilities, and equity, providing insights into liquidity, solvency, and overall stability. By analyzing the balance sheet, businesses can assess their capital structure, manage debt levels, and make informed decisions about investments, financing, and operational strategies, facilitating effective planning and risk management.

Table 13

Balance sheet

		Unit	2025	2026	2027	2028	2029	CAGR25-29
	BALANCE SHEET							
	ASSETS							
	Cash & cash equivalents	UAH th	997	434	1 348	6 412	16 975	239%
+	Accounts receivable	UAH th	2 457	4 045	6 536	10 682	14 150	52%
+	Inventory	UAH th	0	0	0	0	0	
=	**Total Current Assets**	**UAH th**	**3 454**	**4 479**	**7 884**	**17 094**	**31 125**	91%
	Property and equipment							
+	Property and equipment	UAH th	3 789	5 729	8 353	10 348	13 008	31%
+		UAH th						
+		UAH th						
-	Accumulated depreciation	UAH th	681	1 512	2 477	3 603	4 920	48%
=	**Total Non-Current Assets**	**UAH th**	**3 108**	**4 216**	**5 876**	**6 746**	**8 088**	24%
	TOTAL ASSETS	**UAH th**	**6 562**	**8 696**	**13 760**	**23 840**	**39 213**	65%
	LIABILITIES							
+	Accounts payable	UAH th	614	1 011	1 634	2 671	3 537	52%
	Total Current Liabilities	UAH th	**614**	**1 011**	**1 634**	**2 671**	**3 537**	52%
		UAH th	*2 840*	*3 468*	*6 250*	*14 424*	*27 587*	100%
+	**Long term debt**	**UAH th**	**1 750**	**1 500**	**1 250**	**1 000**	**1 000**	
=	**TOTAL LIABILITIES**	UAH th	**2 364**	**2 511**	**2 884**	**3 671**	**4 537**	
	SHAREHOLDERS' EQUITY	UAH th						
+	Chartered and additional capital	UAH th	4 000	4 000	4 000	4 000	4 000	0%
+	Accumulated retained earnings	UAH th	198	2 184	6 876	16 169	30 676	141%
+	Reserves	UAH th						
=	**Total Shareholders' Equity**	UAH th	**4 198**	**6 184**	**10 876**	**20 169**	**34 676**	78%
=	**TOTAL LIABILITIES AND EQUITY**	UAH th	**6 562**	**8 696**	**13 760**	**23 840**	**39 213**	65%

Cashflow statement

The cash flow statement is vital for planning as it tracks the movement of cash in and out of a company over a specific period. It provides insights into the sources and uses of cash, including operating, investing, and financing activities. By analyzing the cash flow statement, businesses can anticipate cash shortages or surpluses, manage working capital effectively, and make informed decisions about financing, investments, and dividend distributions. This aids in ensuring liquidity, optimizing cash flow, and facilitating strategic planning for sustainable growth and financial stability.

Table 14

Cashflow statement

		Unit	2025	2026	2027	2028	2029	CAGR25-29
	CASHFLOW STATEMENT							
	Cashflow from operating activities							
=	**Net income from operations**	**UAH th**	**198**	**2 207**	**5 213**	**10 325**	**16 119**	94%
+	Depreciation/Amortization	UAH th	681	831	965	1 126	1 317	17%
+	+ / - change in accounts receivable	UAH th	-2 457	-1 588	-2 491	-4 146	-3 468	30%
+	+ / - change in accounts payable	UAH th	614	397	623	1 037	867	30%
+	+ / - change in inventory	UAH th						
=			**-964**	**1 847**	**4 310**	**8 341**	**14 835**	100%
	Cashflow from operating activities	UAH th						
	Cashflow from investing activities							
-	Capital expenditures	UAH th	-3 789	-1 939	-2 625	-1 995	-2 660	11%
=	**Cashflow from investing activities**	UAH th	**-3 789**	**-1 939**	**-2 625**	**-1 995**	**-2 660**	11%
	Cashflow from financing activities							
+	Loans from commercial banks	UAH th	2 000	0	0	0	0	
-	Repayment of loans to commercial banks	UAH th	-250	-250	-250	-250	0	
-	Dividends	UAH th	0	-221	-521	-1 033	-1 612	94%
+	Equity financing	UAH th	4 000		0	0	0	
=	**Cashflow from financing activities**	UAH th	**5 750**	**-471**	**-771**	**-1 283**	**-1 612**	51%
=	**Total Cash Flow**	UAH th	**997**	**-563**	**914**	**5 064**	**10 563**	-366%
	Cash at the beginning of the period	UAH th	0	997	434	1 348	6 412	86%
=	**Cash at the end of the period**	UAH th	**997**	**434**	**1 348**	**6 412**	**16 975**	239%

Statement of retained earnings

The statement of retained earnings holds significance for planning as it details the changes in a company's retained earnings balance over a specific period. It shows how profits are reinvested in the business or distributed to shareholders as dividends. By examining this statement, businesses can evaluate their ability to fund future growth initiatives, assess dividend payout policies, and gauge overall financial health. Understanding retained earnings helps make informed decisions about capital allocation, strategic investments, and dividend distributions, thus enabling effective long-term planning and sustainable growth.

Table 15

Statement of retained earnings

		Unit	2025	2026	2027	2028	2029	CAGR25-29
	STATEMENT OF RETAINED EARNINGS							
	Income distribution							
=	**Net Income**	**UAH th**	**198**	**2 207**	**5 213**	**10 325**	**16 119**	94%
%	Dividend payout	%	0%	10%	10%	10%	10%	0%
-	Dividends	UAH th	0	221	521	1 033	1 612	94%
=	Current year retained earnings	UAH th	198	1 986	4 692	9 293	14 507	94%
=	Cumulative retained earnings	UAH th	**198**	**2 184**	**6 876**	**16 169**	**30 676**	141%

Sensitivity analysis

Net Present Value (NPV) calculates the present value of all cash flows associated with an investment by discounting them back to their present value using a specified discount rate, usually the company's cost of capital. A positive NPV indicates that the investment is expected to generate returns higher than the cost of capital, representing value creation for the company. Therefore, projects with positive NPV are typically considered economically viable and worthwhile investments.

Internal Rate of Return (IRR) is the discount rate that equates cash inflows' present value with cash outflows' present value, resulting in a zero NPV. In other words, it is the rate of return

at which the investment breaks even. Projects with an IRR higher than the company's cost of capital are considered attractive investments since they offer returns more significant than the required rate of return.

While both NPV and IRR are widely used in investment appraisal, they offer different perspectives. NPV provides a dollar amount representing the absolute value added by the investment, while IRR gives a percentage rate of return. In cases where projects have non-conventional cash flows (e.g., multiple sign changes), NPV is generally preferred as it is more reliable and straightforward. However, IRR is useful for comparing investments and determining which offers the highest return relative to its risk.

Table 16

Sensitivity analysis using IRR and NVP observations

Sensitivity analysis

			FV	FV	FV	FV	FV
	Years	Units	2025	2026	2027	2028	2029
1	Capital expenditures	UAH th	-3 789	-1 939	-2 625	-1 995	-2 660
2	Operational expenditures	UAH th	-2 184	-2 771	-5 102	-7 195	-6 974
3	Cashflow from operating	UAH th	-567	2 447	3 980	7 019	13 399
	Project cashflow	UAH th	-6 540	-2 263	-3 747	-2 172	3 764
	Cumulative cashflow	UAH th	-6 540	-8 803	-12 550	-14 722	-10 957
3	Payback period	years	4,91				
4	Discount rate (WACC)		12%				
			0	1	2	3	
5	Discounted cashflow (DCF)	UAH th	-6 540	-2 023	-2 995	-1 552	3 764
	Cumulative discounted	UAH th	-6 540	-8 563	-11 558	-13 110	-9 345
6	Discounted payback period	years	4,48				
7	NPV	UAH th	-8 445				
8	IRR 5 years period	%	-42%				

Based on sensitivity analysis calculation, we could conclude a payback period of 6 years, while the discounted payback period is 7 years. Negative NPV and IRR results show expected

investment un-attractiveness under a simplified project delivery model. Operational model improvements are required to make such projects more profitable and attractive from an investment point of view.

Investment resume

Investment resume (Table 13) has been built in order to summarize all aspect of financing and expenses during company operations. Figures are shown in USD in order to simplify the processing of data by international investors.

Table 17

Investment resume

		UAH/USD	50,2
		Units	
	Total financing required	USD th	119,52
	Construction period	months	0,00
	Start-up period	months	24,00
	Capital Expenditures into Fixed Assets, including:		
1	Drones	USD th	159,76
2	Office furniture	USD th	16,09
3	Office equipment	USD th	35,00
4	Employee electronics	USD th	49,50
	Capital structure		
	Credit financing	%	33,33%
	Equity financing	%	66,67%
	Equity financing required	USD th	79,7
	plus, the sum required to cover % interest expense in start-up period	USD th	28,4
	Credit financing required	USD th	39,8

Financial calculations are supported by graph visualization in Appendix A.

Chapter 7: Project implementation

Business canvas and value proposition

The Business Model Canvas (BMC) plays a crucial role in business modeling by offering a structured framework for entrepreneurs and organizations to visualize, analyze, and refine their business concepts. It consists of nine key building blocks that cover all aspects of a business's operations and value proposition.

These building blocks include for Voxel:

Customer Segments: key business segments for Voxel are agricultural and forestry farmers, however significant interest for data collection projects would be urban developers as well.

Value Proposition: The services offered by the Voxel as a main value proposition are crop health monitoring and spraying. Both type of propositions are providing value for optimization purposes as well as business insights highlighting and smart farming management purposes.

Channels: Partnership sales considered to be most important channel, however direct sales might be the option for established regions as well.

Customer Relationships: For the first years of company operations, main relationship type considered and included in current project modeling are service based contracts. However, for future purposes, option of revenue sharing projects might be offered in order to lower financial entrance barrier in precision farmers for new customers.

Revenue Streams: Main and the most significant revenue stream in Voxel are service based contracts. However, consulting services from existing agronomist and UAV operations team may be interesting in order to increase the network of leads for future sales.

Key Resources: Listing the essential assets, resources, and capabilities required to operate the business and deliver the value proposition.

Key Activities: Precision farming projects and data collection project are two main different type of activities which are offered, while still differentiated by service volume

Key Partnerships: partners were identified among the suppliers of seeds, UAV drones and spare parts.

Cost Structure: Main costs of the business includes logistic expanses due to onsite business delivery type, UAV and spare parts, salaries and software licenses.

Figure 6

Business canvas

Project management

Implementation plan and key objectives

Implementation plan with a horizon of 2 years includes multiple major parts, such as:

a) Enterprise kick-off phase (month -1, duration 2,5 month) – includes lawyer activity related to establishing legal entity, first equity investments, bank account opening and headquarter office rental. Main key objective – fully functional headquarter.

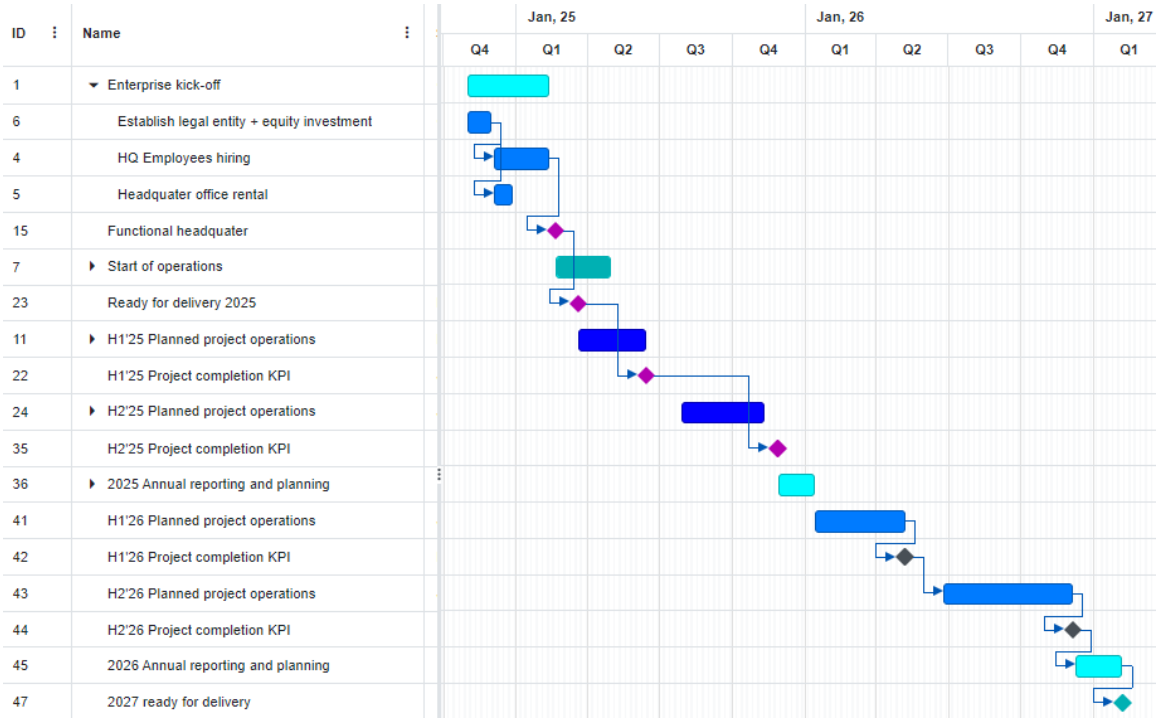
b) Start of operations (Q1 Y1, duration 2 month) – includes operational prerequisite activities which are required for normal operations, such as vehicle lease agreements, UAV equipment purchase, basic customer outreach and preliminary contracting activities. Additional non-blocking activity is software usage agreements. Main key objective for this phase – is ready for operations for the main front-office team;

c) Planned project operations for H1 and H2 - half-year delivery phases for the planned amount of delivered projects. Such phase finishes with main objective – reaching out planned amount of delivered customer projects, which is supported by H1/H2 project completion KPIs evaluation, as well as next half-year planning.
2025 H1 KPI is amount of completed projects (4 – small, 4 – medium)
2025 H2 KPI is amount of completed projects (1 – large, 5 – small, 4 – medium)
2026 KPI are averaged to 13 small, 11 medium and 2 large projects;

d) Annual report and planning phases are performed on periodical basis, in order to establish internal culture of results evaluation and plans adjustments.
2025 annual KPI is 25,000 th UAH in sales;
2026 annual KPI is 41,685 th UAH in sales;

Figure 7

Project implementation plan (simplified)



Service profile and project structure

In a service-based company, project management plays a critical role in ensuring the successful delivery of services to clients and understanding key deliveries, priorities, and roles within the team. This is particularly important when dealing with projects of varying sizes and complexities and markets that might require specific service volumes to be fine-tuned as per customers' requests. For modeling purposes during current project planning in Voxel, the decision has been taken to define three major project profiles: small, medium, and large, each with a different service delivery volume.

Each project profile has its unique set of challenges and requirements. For instance, small projects may require fewer human resources and less equipment than medium or large projects. On the other hand, large projects may involve complex logistics and higher resource allocations. It is important to mention that each type of project might be executed for a different delivery type: either crop spraying or precision farming. The assumption for the current modeling purpose is that the nature of the project does not directly impact service volume.

One key metric used to measure a project's service delivery volume is allocating human resources. This includes the number of personnel required to complete the project within the specified timeline. Equipment allocation is another important aspect, as certain projects may require specialized tools or machinery. Logistic costs, such as transportation and materials handling, also contribute to a project's overall service delivery volume.

The final project profiles directly impact the project prices. This is because the service delivery volume, which includes human resources, equipment allocation, and logistic costs, directly influences the project's overall cost. Understanding these cost drivers is crucial for project managers to develop accurate pricing strategies that meet the company's profitability goals and the client's budgetary constraints.

While building typical project profiles, defining the main front-office team profile, technical skills, and roles was important. The main skill set profiles, with requirements, were defined as agronomists, UAV operators, and general specialists. The general specialist mostly focused on technical questions of drone service, vehicle driving, repairs, pesticide refill, purchases, and the team’s logistics. The team profile is an important element that is the backbone of the delivery structure and input for recruiting specialists. The back office is considered to be out of the project team and consists of hired contractors acting on per-hour contracts, which are

the recruiter, accountant, and office support engineer. The head office includes director(s) and sales specialists. The back and head offices are not included in the service delivery price, and expenses for such specialists do not directly impact service prices.

While building the project structure, it was important to include major expenses in the price of the service in order to establish a reliable and sustainable business model. For simplicity of calculations, crop spraying and precision farming projects are united under the same project profiles.

Table 18

Basic front office delivery team profile

Specialist	Leading skills	Profile	Education	Previous experience, years
Agronomist	+	Team lead, agro specialist	MS	5
UAV operator	+	UAV technical specialist	BA	3
General specialist	-	Driver, assistant to UAV operator	Basic	2

Table 18 defines the project profile and service delivery volumes taken for the modling based on the empirical data taken by the simplistic project design approach and the inputs given during personal interviews with farmers.

Table 19

Typical project profile

Profile name	Duration, days	Milage, km	Team, FTE	UAV resource, times
Small	5	350	2,15	30
Medium	9	600	4,5	25
Large	20	1500	7,8	15

In conclusion, project management in service-based companies requires a deep understanding of the different project profiles and their corresponding service delivery volumes. By effectively managing human resources, equipment allocation, and logistic costs, project managers can ensure the successful delivery of services to clients while meeting the company's financial objectives.

Risk Management

Internal – External peculiarities

Operating UAVs in agriculture presents several inherent risks that operators must consider to ensure safe and effective deployment. One significant risk is related to airspace regulations and compliance especially during military operations in Ukraine. UAV operators need to navigate a complex web of regulations governing airspace usage Failure to adhere to these regulations can result in fines or even legal consequences. During special conditions, i.e. air alerts, when GNSS signals might be jammed which may cause loss of connection for UAV and as result have a negative effect to the operational business results.

Another risk lies in technical malfunctions or failures of the UAV itself. Despite advancements in technology, UAVs can still experience unexpected glitches or hardware failures, leading to loss of control or crashes. This not only poses a risk to the expensive equipment but also to personnel and property on the ground.

Additionally, weather conditions play a crucial role in UAV operations. Strong winds, heavy rain, or fog can impair visibility and affect the stability of the UAV, increasing the likelihood of accidents. Operators must carefully assess weather forecasts and exercise caution when flying in adverse conditions to mitigate these risks.

In summary, UAV operators in agriculture must proactively identify and mitigate various risks, including collision hazards, operational errors, environmental challenges, and regulatory compliance issues, to ensure safe and successful deployment of this technology in agricultural settings.

A risk register is a systematic tool used to document, track, and manage risks throughout a project or operation. In the context of UAV agricultural applications, a risk register would contain detailed information about identified risks, including their description, likelihood, impact, mitigation strategies, and responsible parties. To prioritize risks effectively, a risk register can utilize a scoring system based on factors such as likelihood, impact, and risk owner. Once risks are scored by known factprs, they can be sorted or filtered within the risk register to identify those with the highest priority for mitigation. This approach ensures that resources are allocated to address the most critical risks first, reducing the likelihood of adverse events impacting UAV operations in agriculture.

Table 20

Risk register

Risk	Risk group	Owner	Probability, %	Impact, UAH th
1. Compliance conflict	Compliance	Director	6	8
2. Project effort modeling mistake	Operational	Director	3	12
3. Project acceptance conflict	Operational	Director	5	50
4. UAV failure	Technical	Lead operator	1	20
5. UAV loss/crash	Technical	Operator	0,5	20-50
6. Weather effect	Operational	Agronomist	0,5	5% of proj. price
7. Vehicle failure	Operational	General specialist	0,1	5
8. Car incident	Operational	Director	0,01	200
9. Equipment stealing	Operational	Director	0,01	50

Risk map and prioritization

A risk map visualizes identified risks plotted on a matrix based on their likelihood and impact. In the context of UAV agricultural applications, a risk map could include various potential risks associated with operating drones in agricultural settings, such as technical failures, regulatory non-compliance, weather-related incidents, and data security breaches. Each risk is assessed according to its likelihood of occurrence and the potential impact it could have on the operation. Likelihood and impact are typically rated on a scale and used to position risks within different zones of the map. This visualization lets stakeholders quickly grasp the most significant risks and prioritize mitigation efforts accordingly.

Risk prioritization is important in risk management because it helps organizations allocate resources effectively. By focusing on addressing the most critical risks first, such as those with the highest potential impact or likelihood of occurrence, organizations can minimize disruptions and losses. Prioritization also considers interdependencies between risks and helps decision-makers understand where to focus their attention and resources. It facilitates clear communication with stakeholders about the organization's risk exposure and supports continuous improvement by adapting risk management strategies to changing circumstances.

While evaluating Voxel’s risks and developing risk map it was considered that uppwer bound for known risks are %5+ and thus it was decided to split known risks into three risk buckets:

a) Low risk (under 1 %);

b) Medium risk (1%-5%);

c) Significant risks (more than 5%).

In the same way three different buckets for Impact effect were created, where

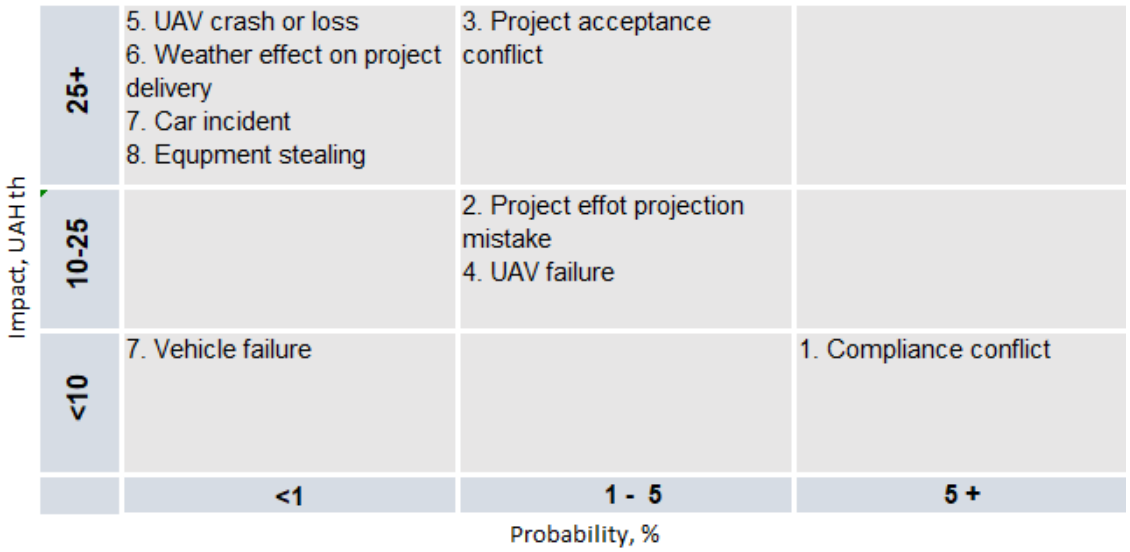
a) Low impact (less that 10,000 UAH);

b) Medium impact (10,000-25,000 UAH);

c) Significant impact (more than 25,000 UAH).

Figure 8

Risk Map



As per results of risk map analysis, the prioritization excesize has been performed where top 3 risk priorities were set for risk numbers (3), (2), (4) and (1) where first one is most prior.

Risk Reaction

A robust risk mitigation plan is essential to proactively identify, assess, and address potential threats to the success of agricultural projects. By systematically identifying and prioritizing risks, and implementing strategies to mitigate their impact, agricultural stakeholders can safeguard resources, optimize productivity, and ensure the successful execution of their projects (ordered by priority)

A mitigation plan has been created for the following prioritized risks:

Project acceptance conflict – the risk nature comes from the area's trust issue and the market's conservativeness to the new approaches in digital and robotics. Mitigation stragey for this risk is Avoidance. The plan includes actions on early stakeholder engagement and defining clear contract requirements and acceptance criteria. The educational part on the contract nature for each new and existing customer. The sales manager will execute the introduction and educational parts. The risk manager has been identified as Voxel's director.

Project effort projection mistake – the nature of this risk comes from the approach to modeling where a set of assumptions is taken in a changing environment. The mitigation strategy for this risk is Avoidance. The mitigation plan here includes continuous work on the data collection from existing projects, collecting more insights into the project's nature, and defining a more robust model. The risk manager has been identified as Voxel's director.

UAV failure – as with any other equipment that is continuously involved in intensive projects, technical failures are quite possible. The mitigation strategy for this risk is Acceptance. UAV itself as a technological product is no exception, and it is naturally impacted by different sorts of failures. In order to mitigate the risk, the operational plan includes periodical scheduled service tasks with a budget of 5% of the UAV price. Risk has been assigned to lead UAV operator in Voxel.

Compliance conflict – as was mentioned before, compliance conflicts could significantly impact UAV operations. The mitigation strategy for this risk is Reduction. However, a special permit procedure has been established for agricultural applications in Ukraine, which allows businesses to apply for UAVs in non-strategic areas. The risk is considered operational, with % a 5+ probability but relatively low impact, which might consist of penalty payment and a minor effect on the project delivery results. The mitigation plan for this risk includes early engagement

with policymakers in the county in order to receive proper permits. Risk manager has been identified as Voxel's director.

Cost of risk reaction and KRI

Understanding the cost of risk reduction allows organizations to allocate their resources effectively. Organizations can prioritize investments in risk reduction strategies by comparing the cost of implementing risk mitigation measures to the potential cost of the risks themselves. Armed with information about the cost of risk reduction, decision-makers can make informed choices about which risk mitigation strategies to pursue. Risk reduction costs are provided in Table 5 below.

Table 21

Risk costs

Cost of risk reduction	2025	2026	2027	2028	2029
1. Compliance conflict	4,8	1,02	1,5	1,8	2,04
2. Project effort modeling mistake	3,6	6,12	9	10,8	12,24
3. Project acceptance conflict	25	42,5	62,5	75	85
4. UAV failure	1,2	1,8	2,8	3,4	4,4
5. UAV loss/crash	1,05	1,575	2,45	2,975	3,85
6. Weather effect	5,70	9,68	14,24	17,09	19,37
7. Vehicle failure	0,08	0,12	0,18	0,2	0,24
8. Car incident	3,2	4,8	7,2	8	9,6
9. Equipment stealing	2,4	3,6	5,6	6,8	8,8
Total, UAH th	47	71,22	105,5	126,1	145,5

Key Risk Indicators (KRI) are measurable metrics designed to offer early alerts regarding potential risk events that may negatively impact an organization's operational objectives. These

indicators serve as input for managers, providing data and signaling any deviations from the expected norms. While working on Voxel's risk map, the following KRIs were developed:

a) To mitigate the risk of project acceptance conflict, periodical customer feedback monitoring, measuring positive and negative feedback ratios, and providing a comparative feedback structure among projects are recommended.
b) For project effort projection mistakes – continuous monitoring of financial expenses and project progress indicator reporting. Deviation from expense indicators and delivery rates will raise a red flag on the risk probability increase.
c) For UAV failure – the number of past incidents and feedback from periodical service procedures serve as main indicators of upcoming failure or major incident.
d) For compliance conflict – the number of past conflicts within the same area or for the same customer.

Change management

Resistance to change is natural, especially in traditional agricultural settings where established practices and routines are deeply ingrained. Proactively addressing resistance through effective change management strategies is critical for overcoming barriers to adoption and ensuring the successful implementation of precision farming initiatives. This may involve addressing concerns about job security, loss of autonomy, or perceived complexity of new technologies, as well as providing opportunities for involvement and empowerment in the change process.

One of the initial steps in implementing precision farming in traditional agriculture is to establish a clear understanding of the need for change. This involves educating stakeholders about the benefits of precision farming, including increased efficiency, improved yield, resource optimization, and environmental sustainability. By highlighting the potential positive impacts on productivity and profitability, farmers and agricultural workers are more likely to embrace the transition and actively participate in the change process.

Central to successful change management is securing buy-in from all stakeholders involved in the farming operation. This includes farmers, farmworkers, agronomists, seed suppliers, and other key players in the agricultural value chain. Engaging stakeholders early in the process, soliciting their input, and addressing their concerns fosters a sense of ownership and commitment to the change initiative. Open communication channels and regular feedback mechanisms are essential for maintaining stakeholder engagement throughout the implementation process.

In conclusion, implementing precision farming in traditional agriculture requires a holistic change management approach that addresses the cultural, organizational, and technical dimensions of transformation. By fostering stakeholder buy-in, providing training and support, managing resistance to change, and continuously monitoring progress, organizations can effectively navigate the complexities of change and realize the full potential of precision farming to enhance agricultural productivity, sustainability, and resilience in traditional farming operations.

Appendix A: Graphs for financial calculations

Figure 9

Voxel revenue projections.

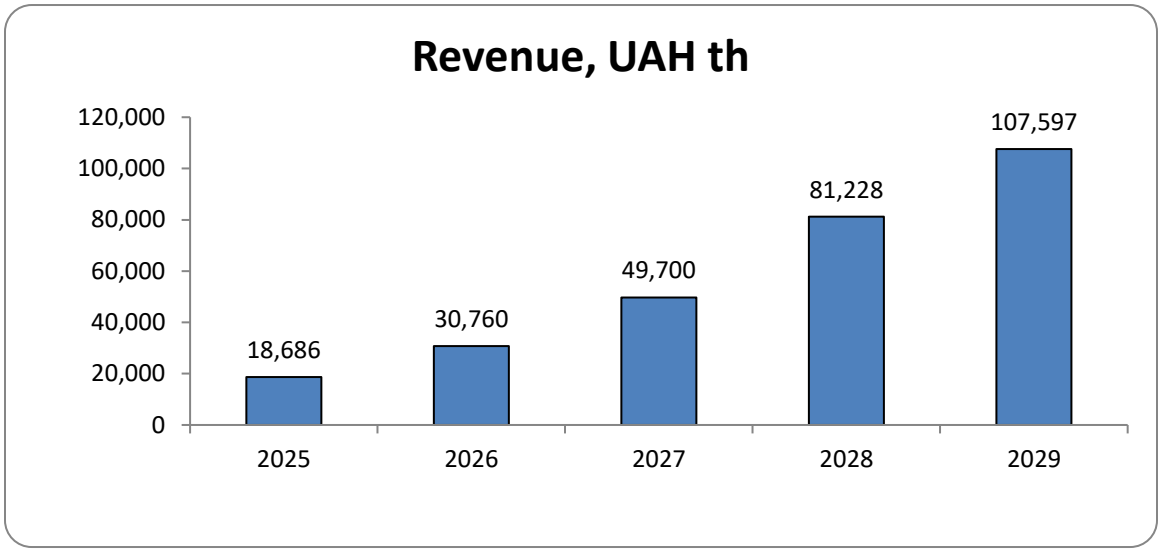


Figure 10

Voxel EBITDA margin

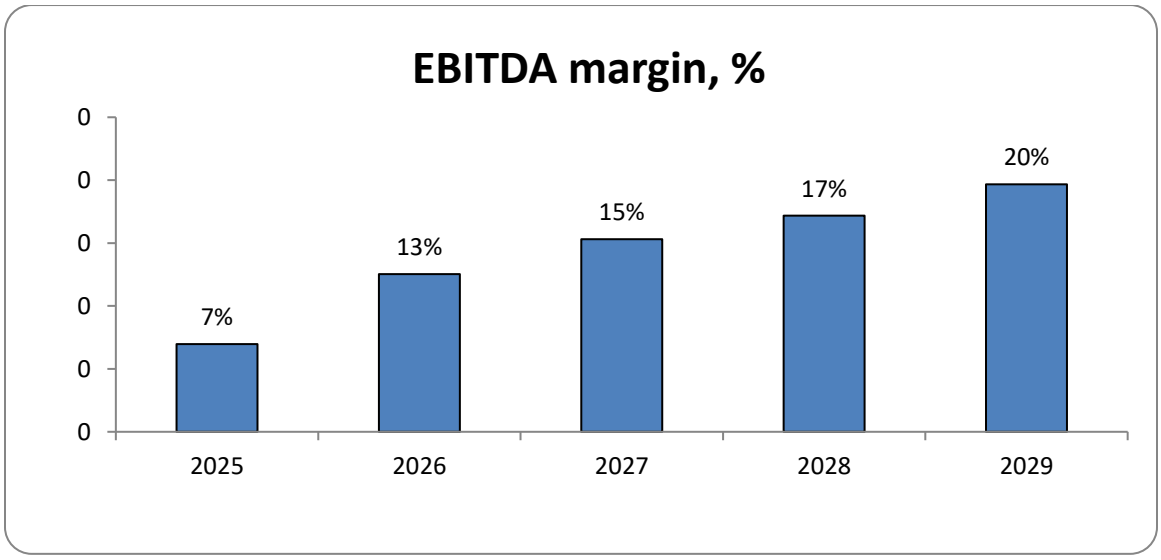


Figure 11

Voxel EBIT

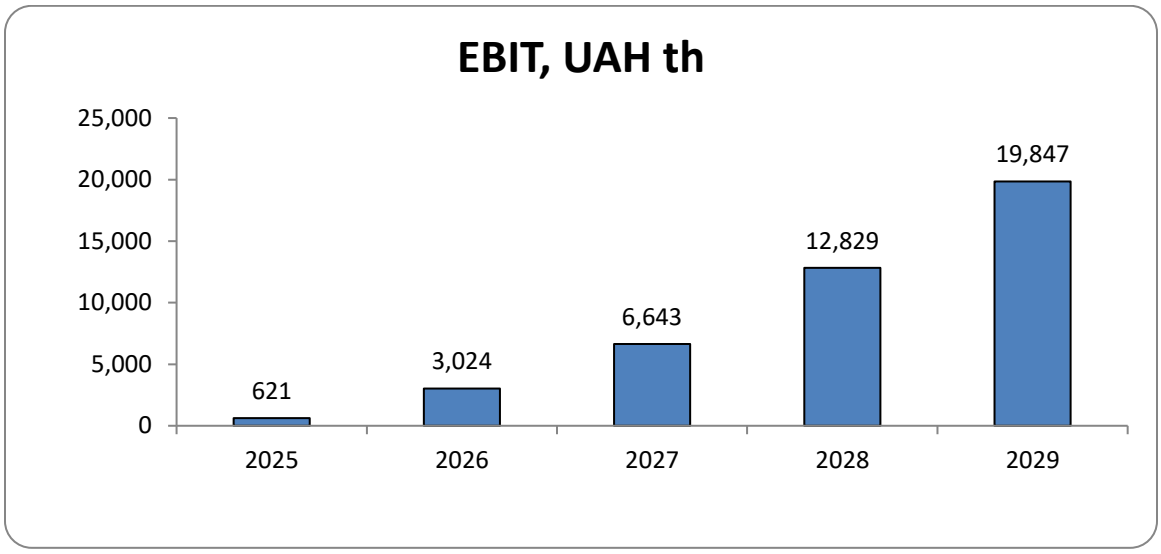


Figure 12

Voxel net profit projection

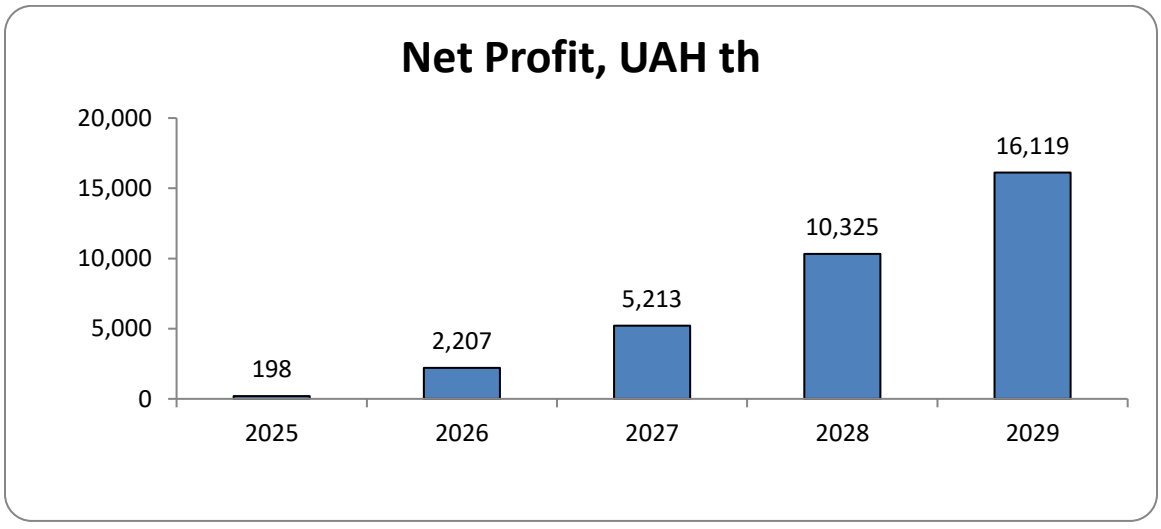


Figure 13

Voxel Operational profit.

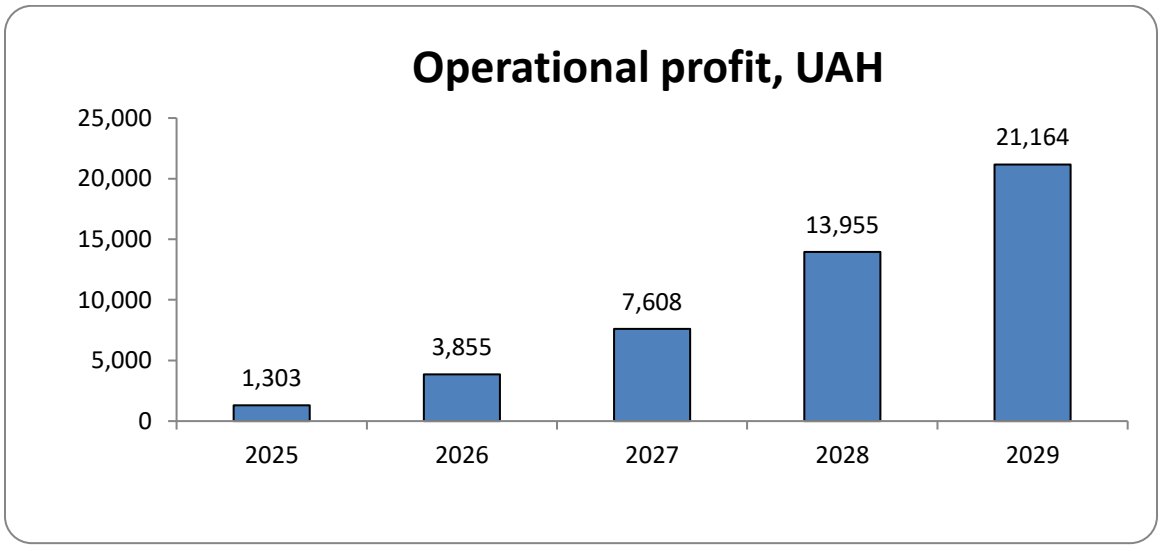


Figure 14

Voxel dividend payout

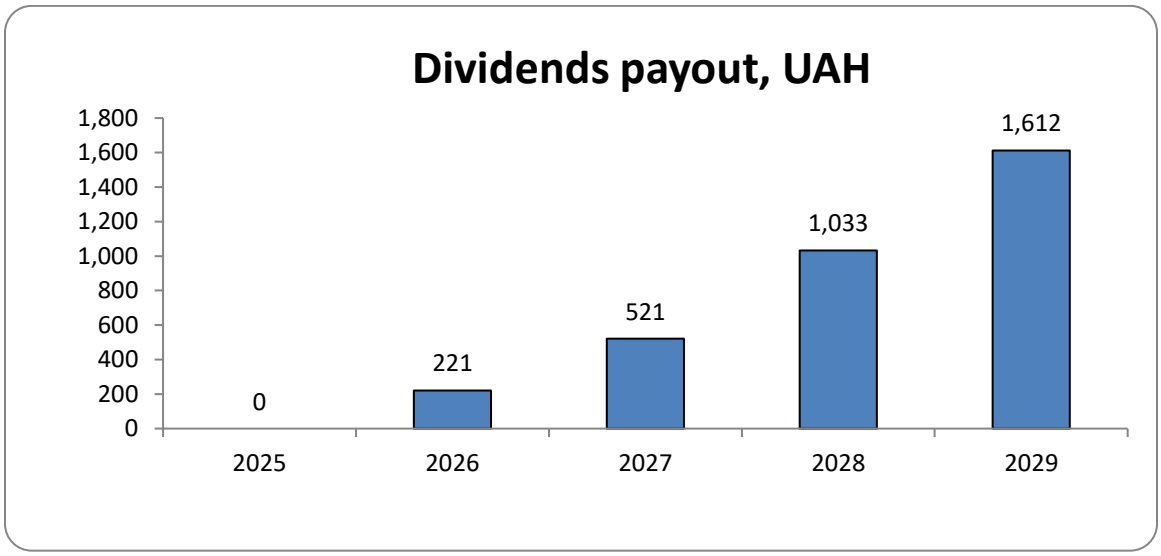
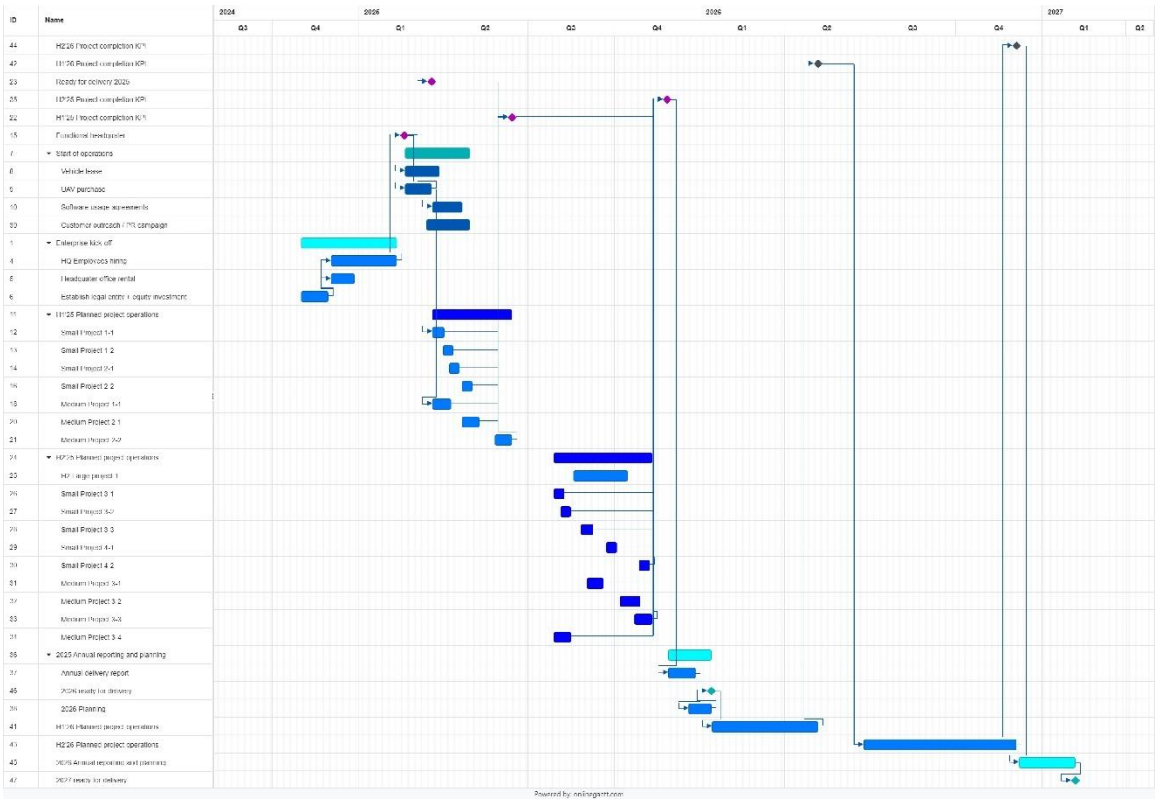


Figure 15

Project implementation detailed



References

1. **A compilation of UAV applications for precision agriculture (Section 2, Precision Agriculture)**

   Panagiotis Radoglou-Grammatikis, Panagiotis Sarigiannidis, Thomas Lagkas, Ioannis Moscholios,

   Computer Networks, Volume 172, 2020, 107148, ISSN 1389-1286,

   https://doi.org/10.1016/j.comnet.2020.107148

2. **Unmanned Aerial Vehicles (UAV) in Precision Agriculture: Applications and Challenges (Section 2, UAV applications in agriculture worldwide)**

   Velusamy, P.; Rajendran, S.; Mahendran, R.K.; Naseer, S.; Shafiq, M.; Choi, J.-G. 2022, 15, 217.

   https://doi.org/10.3390/en15010217

3. **CoFly: An automated, AI-based open-source platform for UAV precision agriculture applications (Section 2, Modern AI-based software in farming)**

   Emmanuel K. Raptis, Konstantinos Englezos, Orfeas Kypris, Marios Krestenitis, Athanasios Ch. Kapoutsis, Konstantinos Ioannidis, Stefanos Vrochidis, Elias B. Kosmatopoulos, 101414, ISSN 2352-7110,

   https://doi.org/10.1016/j.softx.2023.101414