FLEXIGROBOTS

D2.6 ELSE factor analysis and guidelines

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List of Acronyms

Abbreviation / acronym	Description
AI	Artificial Intelligence
AI HLEG	High Level Expert Group on Artificial Intelligence
ALTAI	Assessment List for Trustworthy Artificial Intelligence
ATP	Agricultural Technology Provider
CAP	Common Agricultural Policy
CEPS	Centre for European Policy Studies
CSIC	Consejo Superior de Investigaciones Científicas (Spanish National Research Council)
D2.6	Deliverable number 6 belonging to Work Package (WP) 2
DA	Data Act
DGA	Digital Governance Act
DMA	Digital Markets Act
DPO	Data Protection Officer
DSA	Digital Services ACT
EASA	European Aviation Safety Agency
EC	European Commission
ELSE Factors	Ethical, Legal, Socio-Economic and Environmental Factors
EU	European Union
GDPR	General Data Protection Regulation
GHG	Green House Gas
INGO	International Non-Governmental Organisation
IT	Information Technology
LUC	Light UAS operator certificate
MCC	FlexiGroBots Mission Control Centre
MCT	Model Card Toolkit
ML	Machine Learning
MS	European Union Member State
NAA	National Aviation Authority

Abbreviation / acronym	Description
NGO	Non-Governmental Organisation
NNA	National Aviation Authority
PDRA	Predefined risk assessment
SAE	Society of Automotive Engineers
SORA	Specific Operations Risk Assessment
TCMV	Technical Committee – Motor vehicles
UAV	Unmanned Aerial Vehicle
UGV	Unmanned Ground Vehicle
UNECE	United Nations Economic Commission for Europe
VLOS	Visual line of sight
WP	Work Package

Executive Summary

The past years have shown both great progress and challenges in the development of new technologies. Algorithms and robots can greatly simplify human work and enable entirely new products, while at the same time exposing workers to new risks from physical harm to data breaches. It can be difficult for a technical innovation action like FlexiGroBots to keep an overview of all relevant Ethical, Legal, Socio-Economic and Environmental (ELSE) factors which could impact the project. This deliverable therefore provides an analysis of these ELSE factors.

This deliverable presents two main outcomes from the first half of the project: First, sections 2 to 4 provide an overview of the most important ELSE factors. An extensive literature review of 426 articles on robotics and AI in agriculture was conducted and the main arguments in the literature were systematically extracted and quantified (section 2 below). The review finds that the economic discussion focuses on increased productivity while some mention high barriers of entry in terms of monetary and human capital; the environmental discussion emphasises the potential for increasing resource efficiency, while others warn against high energy usage and electronic waste; legal perspectives focus on the lack of a coherent legal framework and specific legal challenges such as liability; ethical arguments focus on challenges, especially linked to issues such as privacy, bias or transparency; societal concerns focus on issues such as physical safety risks, inequality, or negative impacts for the labor market.

Based on this review, the team selected several key ethical and technical standards (section 3), which are being used in the FlexiGroBots project: The ALTAI questionnaire is used for the ethical assessment of the pilots and platform. Moreover, model cards as well as datasheets are proposed as a standard format for public reporting of algorithms and datasets produced by the project. Furthermore, as legal provisions can be particularly hard to navigate, section 4 provides an overview of key legal acts: the GDPR, legislation on autonomous vehicles, upcoming legislation on AI, contracting standards and the machinery directive.

Building upon these ELSE factor reviews, the second outcome of the deliverable is a concrete list of recommendations for the FlexiGroBots pilots and platform. The recommendations are ordered by priority and are addressed to specific partners to avoid diffusion of responsibility. Short term recommendations include measures for human safety such as a digital stop button or advice on data protection measures such as consent forms or anonymisation; in the medium term, the deliverable recommends the development of logging capabilities to determine liability or the creation of model cards and datasheets; in the long run, the platform should include CO2 tracking software to monitor energy usage and training and guidance materials should be developed for commercialisation after the end of the project. The

implementation and adaptation of these recommendations will continue throughout the lifetime of the project through the pilot assessment tasks T4.4, T5.4 and T6.4.

1 Introduction

1.1 Purpose of the document

This deliverable summarises how FlexiGroBots integrates ethical, legal, socio-economic and environmental (ELSE) considerations into the project. The technical pilots on autonomous agricultural robot systems in Spain, Finland and Serbia/Lithuania (WP4 -WP6) are at the core of the project and the FlexiGroBots platform integrates them on a technical level (WP2, 3). The ELSE research for this deliverable supports the pilots and the platform in three main steps: First, desk research on the literature on autonomous robots and on existing ethical and legal standards was conducted. Second, based on this research, several interviews were conducted to better understand the most important ELSE factors for the FlexiGroBots project. Third, based on the interviews and desk research, a list of recommendations for the pilots and platform were developed. The following sections describe this process and the main outcomes. The findings were discussed with the pilots and platform developers, inform the continuous pilot assessment (T4.4, T5.4, T6.4) and will feed into D7.9 “Report on ethical AI and Agri-Food”.

1.2 Structure of the document

This document is structured in four major sections after this introduction. **Section 2** presents the outcome of the literature review on Ethical, Legal, Socio-Economic and Environmental (ELSE) factors (2.2), as well as important private and public standards (2.3). **Section 3** summarises the process and outcome of the primary data collection through several rounds of interviews for the assessment of the pilots and the platform. **Section 4** provides a review of relevant legal considerations for the project, ranging from data protection, to autonomous vehicles, to contracting standards, and laws on artificial intelligence (AI). **Section 5** provides recommendations based on the preceding sections. The recommendations are targeted at the project overall and the pilots and platform in particular.

2 ELSE Literature Review

The literature review has two overarching objectives: first, to provide an overview of key Ethical, Legal, Socio-Economic and Environmental (ELSE) challenges and opportunities linked to robotics and AI in agriculture and related sectors (section 2.1 & 2.2). Second, to review existing solutions to these challenges, which the FlexiGroBots project can build upon (section 2.3).

2.1 Methodology

In order to create the ELSE literature review, we used two main types of sources: First, we systematically reviewed the websites of key journals, such as 'Artificial Intelligence in Agriculture' or 'Information Processing in Agriculture'. Second, we used the Google Scholar and Google search engine to query with a tailored list of key words.[1] This mix of sources ensured that key arguments from both the academic literature, as well as private and public stakeholders were included.

Each source identified through this processes was analysed manually and key arguments on opportunities or challenges of robotics and AI in agriculture were extracted in a standardised Excel file. In the Excel file, each row represents one unique argument from one source. If one source put forth multiple arguments, separate rows for each argument were added. After an initial process of extracting key arguments from each article, the key arguments were categorised in different overarching categories of main arguments. This standardisation of main arguments across hundreds of sources enabled us to provide the quantified overviews of main arguments shown below. In addition, meta data information such as the overarching ELSE factor an argument belongs to, or the link to the original source were extracted. The raw data with significantly more detail is too large for this Word file is available upon request in Excel file format.

2.2 Results and Quantification of Main Arguments

The resulting literature comprises a total of 426 different publications, from which 747 separated arguments on opportunities and challenges of either AI systems and/or robotics were extracted. More than 68% (291) of the publications are academic which also contribute

[1] The key words included: "Robotics in agriculture, economic challenges of robotics, business challenges of robotics, societal challenges of robotics, environmental challenges of robotics, legal challenges of AI, ethical challenges of AI, environmental challenges of AI, economic challenges of AI, business challenges of AI, societal challenges of AI".

more than two thirds (506) of all arguments. The arguments on challenges and opportunities are unevenly distributed across the five analysed ELSE factors (see figure 1): economic (255), environmental (85), ethical (228), legal (61), and societal (118) areas. Out of all of these arguments, around 40% talk about opportunities (298), which mostly belong to the economic (194) and environmental (68) cluster. These are also the only factors with more opportunities than challenges. Ethical, societal and legal arguments mostly address challenges. The ethical factor is the most skewed area with only 1 opportunity against 227 challenges recorded.

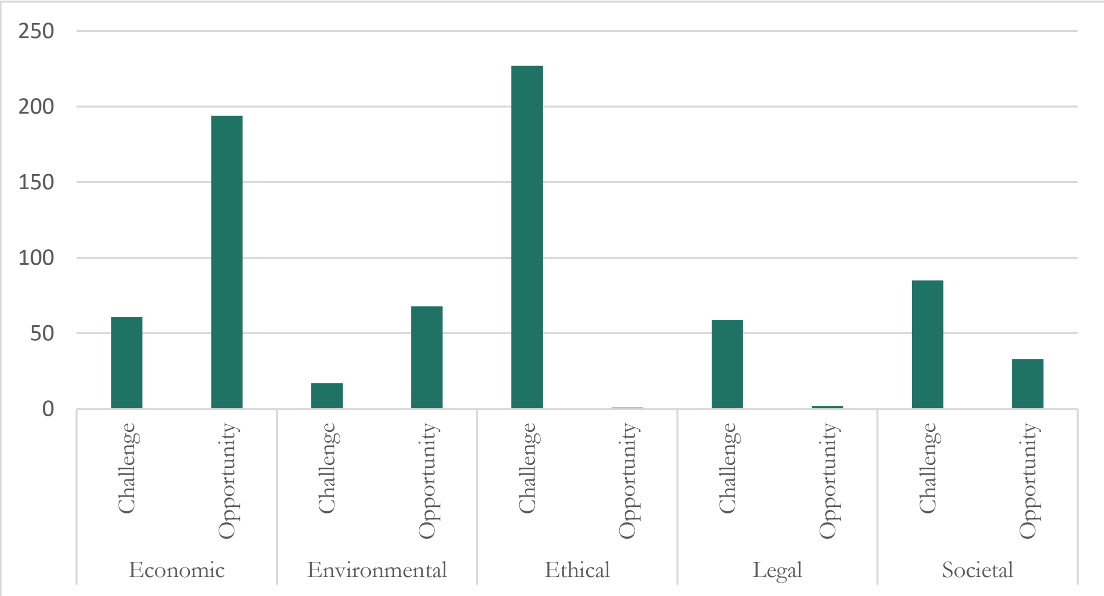

Figure 1 - Number of arguments by ELSE factors

Moreover, we analysed whether AI or robotics was perceived more as a challenge or as an opportunity. Overall, AI is perceived more as a challenge with 365 challenge arguments and 190 opportunity arguments, while robotics is perceived more optimistically (83 opportunities vs. 72 challenges). Regarding a mixed system between AI and robotics, there are more than twice as many opportunities than challenges (25 over 12).

Solution_type	Challenge	Opportunity	Grand Total
AI	365	190	555
Robotics	72	83	155
Both	12	25	37
Grand Total	**449**	**298**	**747**

Table 1 - Number of arguments by type of solution

The sector in which authors in the literature work was also analysed. If all authors work in academia, they talk more about challenges than opportunities (229 vs. 166). However, when there is collaboration between academic authors and authors from other sectors, the arguments are slightly more optimistic with 54 opportunities over 47 challenges.

Author_type	Challenge	Opportunity	Grand Total
Academic	229	166	395
Private sector	141	64	205
Academic, Private sector	21	26	47
Public sector	23	12	35
Academic, Public sector	11	21	32
Academic, Public sector, Private sector	13	5	18
Civil society (NGOs, INGOs, etc.)	7		7
Public sector, Private sector	2	2	4
Public sector, Academic	1	1	2
Academic, Public sector, Civil society (NGOs, INGOs, etc.)		1	1
Academic, Public sector, Private sector, Civil society (NGOs, INGOs, etc.)	1		1
Grand Total	**449**	**298**	**747**

Table 2 - Number of arguments by type of author(s)

2.2.1 Economic Benefits

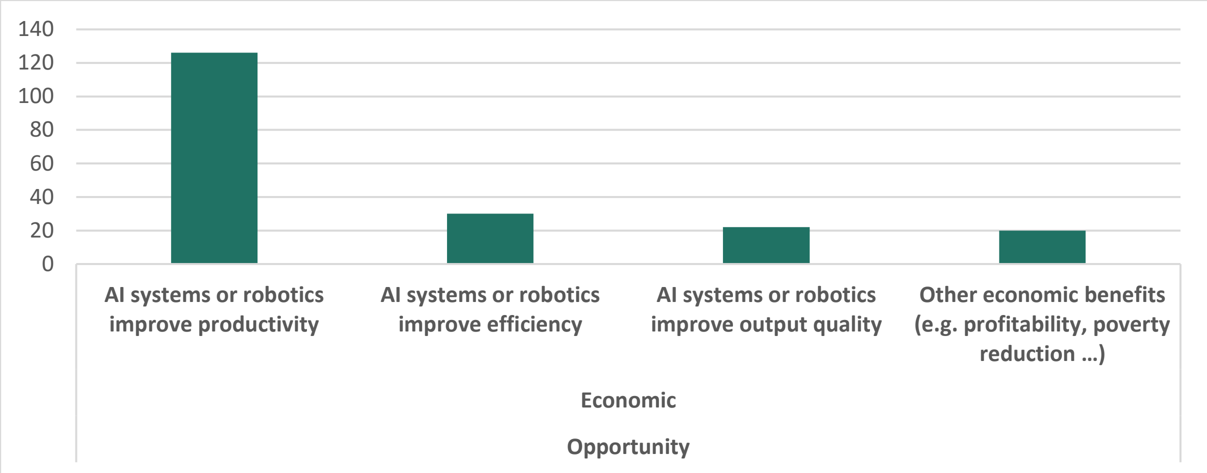

Figure 2 - Main Arguments on Economic Opportunities

Many agree that economic opportunities of AI and robotics lie in **the increase of productivity, efficiency, and output quality**. Eli-Chukwu (2019), for example, produces a review of AI applications in four major agricultural areas linked to the argument for **productivity growth**: soil management, crop management, disease management, and weed management. They show that AI systems can optimize harvest decisions and improve crop yields. Bedi and Gole (2021) praise the benefits of deep learning and machine learning in plant disease detection with a robust and time-saving system that can improve crop yield and profit. Ball et al. (2015) expect the "current trend in agriculture is to increase the farmer's productivity by using larger machinery" and argues that affordable autonomous robots will improve broad-arc agricultural productivity with "timely interventions" and "reduced soil compaction" through smaller robots. In the area of poultry production, robotics is an important part of precision livestock farming by providing "real-time supervision of environmental factors, animal health and yield, production, reproduction, and welfare in an automatic, continuous, and non-invasive form" Ren *et al.* (2020). Liu et al. (2021) analyse current trends in "agriculture 4.0" and projects that "an agriculture ecosystem with real-time farm management, a high degree of automation, and data-driven intelligent decision-making would greatly improve productivity".

Others argue that autonomous systems also **enhance efficiency** of economic activities. Tewari et al. (2020) develop "an image processing technique based real-time variable-rate chemical spraying system" which leads to a 33.88 % reduction in applied chemicals and therefore helps to avoid chemical waste. In sugarcane cultivation, applications of AI systems and robotics such as yield monitoring and sensors for variable rate nitrogen applications can also assist in improving efficiency (Alencastre-Miranda *et al.*, 2018).

In addition, some authors argue that AI and robotics systems can contribute to **output quality assurance**. Computer vision-based systems contribute to quality-control in apple-based industries (Moallem, Serajoddin and Pourghassem, 2017). Ma et al. (2018) develop a platform based on AI algorithms for raw milk monitoring and warning management which keeps raw milk under suitable temperature and preserves quality. Zhang, Zhang, and Liu (2019) show that with the help of non-contact technology supported by AI, the breeding industry can gain "real-time, efficient, convenient and accurate advantages", in this case, with better pork products.

There are also some expectations of application from AI and robotics to **reduce poverty and inequality**, and to **support diffusion of knowledge**. Mhlanga (2021) shows how AI can assist to map poverty in five African countries and provide necessary information like the optimal distance to water sources, the nearest market, or the nearest primary school, etc. AI applications can also allow farmers to obtain information better. Machine translation can help to deliver exact orders to different farm workers. AI systems can also extract knowledge from a real-time flow of large amounts of data from sensors, farm workers, and business climate (Smith and Smith, 2018).

2.2.2 Environmental benefits

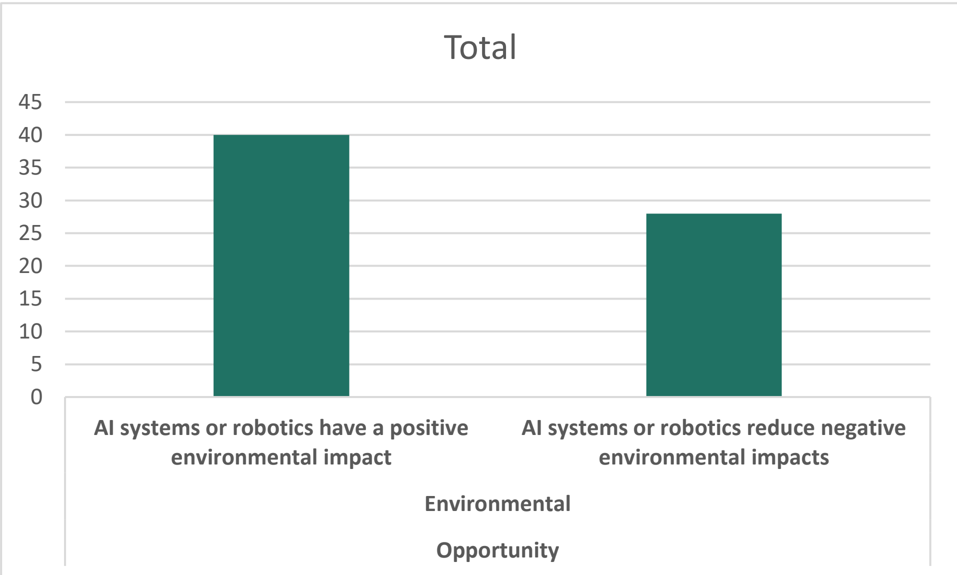

Figure 3 - Main Arguments on Environmental Opportunities

According to the literature, **AI and robotics technologies have a positive environmental impact and can reduce negative environmental impacts**. Cortés et al. (2000) presents an overview of AI applications in Environmental Decision Support Systems. These AI-based systems play an important role in identifying hazards, evaluating risks, and suggesting adaption strategies. Balafoutis et al. (2017) emphasize the benefit of variable rate irrigation systems that they can reduce greenhouse gas (GHG) emission with optimal irrigation scheduling. Toniolo et al. (2020) review AI applications in sustainable business models and conclude that companies can use AI tools to fulfil environmental criteria. Moreover, AI-based pest and disease detection can reduce the use of chemicals (Ngugi, Abelwahab and Abo-Zahhad, 2021). Hatfield, Cryder, and Basso (2020) mention the ability of "tools using remote sensing coupled with artificial intelligence and machine learning" to design adaptive strategies for more profitability and less environmental impacts.

Beyond agriculture, AI systems can, for example, also promote the use of clean energy. Asif (2020) argues that AI technology can improve the "integration of renewables into the existing grid and make renewable energy an equal player in the energy supply". Vinuesa et al. (2020) believe that AI applications "underpin low-carbon systems, for instance, by supporting the creation of circular economies and smart cities that efficiently use their resources".

2.2.3 Other Benefits

Both AI and robotics can contribute to **reduce human workload**. Raghavendra (2020) argue that computer vision based technology in food industries reduce the number of physically difficult tasks for workers. Marinoudi (2019) outline the way robots change the labour market in agriculture and how they can reduce "the impact of physically demanding, mundane, and arduous jobs" on humans.

Others also expect AI and robotics to **improve safety and health** in general. Lussault (2020) argues that with Automated Guided Vehicles and Automated Mobile Robots, workers will be relieved of "dirty and dangerous tasks". ABB (2021) advocates for the use of robots in construction as they "can make construction safer by handling large and heavy loads, working in unsafe spaces and enabling new, safer methods of construction".

Beyond agriculture, a report by Deloitte in 2020 argues in favour of the benefits of AI-enabled wearables when reducing the risks of falls among elderly citizens: "this application has the potential to help save 1,800 lives a year and decrease fall-related costs by as much as €3.8 billion". Moreover, they believe that algorithms can help in detecting clinical abnormalities with high accuracy and less costs (Deloitte, 2020). Furthermore, AI systems are projected to assist regulatory compliance. Kent (2021) show that AI solutions can analyse "external resources like the internet and social media to quickly verify compliance laws within government regulations and company policies". They can also assist in tax policy compliance by digitalizing auditing processes.

2.2.4 Economic Challenges

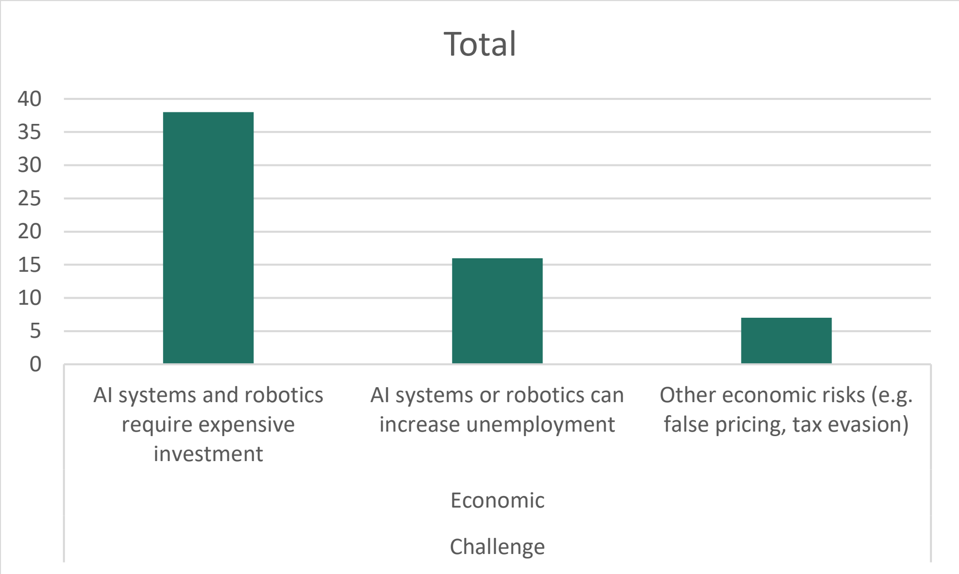

Figure 4 - Main Arguments on Economic Challenges

The most important challenge mentioned in the literature is that the **adoption of AI and robotics can be too expensive**. Indian farmers, for example, are reluctant to adapt AI solutions because of budget limitations (Kellengere Shankarnarayan and Ramakrishna, 2020). Kumar (2020) stress the costs of "expensive cameras, electronic and hydraulic controls" as the main barriers for AI-enabled crop management. Carbone, Garibaldi and Kurt (2018) argue that although swarm robotics is promising for precision agriculture, farmers may suffer from high operation costs that limit the number of deployed robots below the optimal level. Beyond agriculture, Sun and Medaglia (2019) investigate the adoption of IBM Watson, an AI solution, in public health care in China and find that its management costs exceed its benefits. The same concern is mention by Cheng *et al.* (2021), who believe that training AI models for recognising anatomic pathologies requires expensive investments, for example into advanced hardware. Davila Delgado *et al.* (2019) find that high initial capital investment is the biggest concern in construction to adapt robotics systems. They put forth the example of small construction companies where the cost of replacing a worker is bigger than the benefit of a robot.

Another important concern is the **loss of jobs** due to automation. A report by McKinsey&Company (2018) finds that around 400 million workers could be displaced by automation for the period of 2016-30. Manyika and Sneader (2018) estimate that robots have led to a drop in global employment of 1.3% between 2005 and 2014. However, the effect is different across countries: 0.54% in developed countries, but 14% in emerging countries. Walch (2019) mentions that "the most immediate concern for many is that AI-enabled systems will replace workers across a wide range of industries". Similarly, Kaplan and Haenlein (2020) point out that an advanced AI system can do certain tasks in a "better and cheaper" way than humans, which puts pressure especially on lower-skill employees the job market.

Moreover, some researchers think that AI systems and robotics can **create business risks,** such as false pricing or increased tax evasion. Ghallab (2019) warns against pricing algorithms that "can lead, even without any explicit agreement, to artificially higher prices, as with the illegal price cartel mechanisms". PwC (2018) expresses the possibility of tax erosion due to the ill-defined categories of AI projects that may affect public investment. For example, an AI-enabled project can be reported to support sustainable economic activities to receive funding, but it may not actually be sustainable by design.

2.2.5 Environmental Challenges

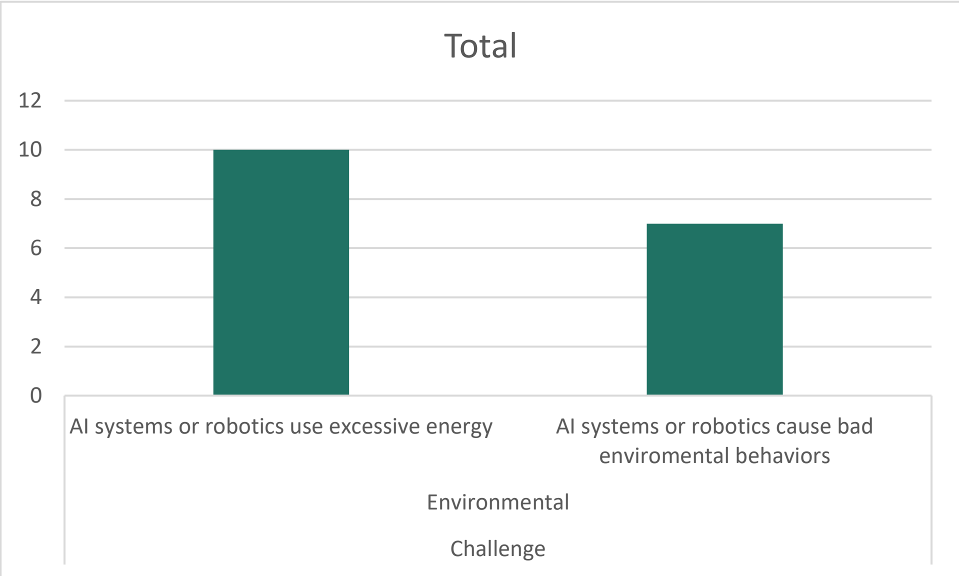

Figure 5 - Main Arguments on Environmental Challenges

Despite promising benefits, several publications mention the concern of **excessive energy consumption** and **electronic waste** from AI and robotics systems.

Running AI and robotics systems **consume a lot of energy** which can lead to GHG emissions. Mullins (2021) points out concerning increases of GHG emissions from the IT industry: from 2% to 14% within the next 20 years. Glenn Gow (2020) argues that AI systems require a lot of energy which can lead to higher CO2 emissions. Coeckelbergh (2021) voices concerns about the use of energy for data processing and storage. They estimate that "the process of training a single natural language processing model can lead to emissions of nearly 300,000 kg of CO2 equivalents, which is five times the amount produced by an average car over its lifetime". Similar impacts can be expected from computer vision algorithms used in agricultural applications. Moreover, robotics is also associated with **electronic waste**. Grémillet *et al.*

(2012) believe that "building robots, operating and trashing them use resources such as rare metals, energy, and ultimately generate electronic garbage".

A small number of arguments warn against an **increase in environmentally harmful behaviours** due to AI and robotics systems. Sparrow and Howard (2021) believe that "more powerful—and perhaps dangerous—pesticides might be used" if humans are no longer involved. Moreover, they warn that increasing the use of AI and robotics applications can lead to standardization in food systems, which, in turn, can motivate consumers to expect "perfect" food, "resulting in more food waste as fewer items are judged suitable for sale".

2.2.6 Legal Challenges

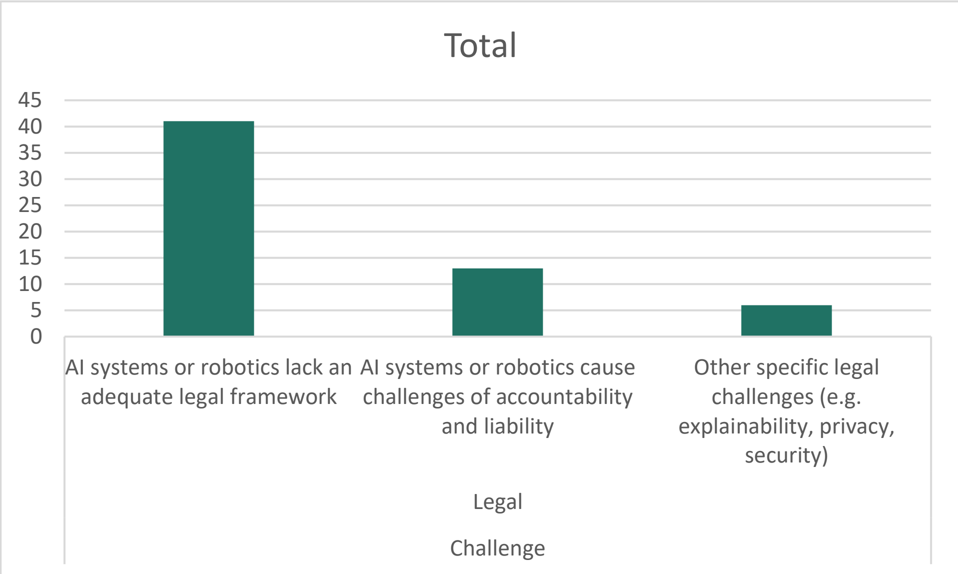

Figure 5 - Main Arguments on Legal Challenges

A large number of arguments points out that AI and robotics systems **lack an adequate legal framework**. The gaps in legal frameworks ranges from issues **of data ownership, intellectual property, to copyright and more**. For example, Dwivedi *et al.* (2021) also foresee the need in changing current legal frameworks for copyright, or Meltzer (2021) points to issues of intellectual property. Kaplan and Haenlein (2020) mention the legal challenge of privacy when dataset may contain privacy risks during the process of data collection. This poses a dilemma for governments: "too little regulation may inevitably lead to the violation of civil rights, while too much may motivate firms to move their AI investments to another jurisdiction".

The most frequently raised specific challenge is the challenge of **liability and accountability**. O'Sullivan *et al.* (2019) point out that "the robot, even if autonomous, may not be held liable for its actions or its inactions in case of damage" under current law. The legal question of liability is difficult for jurisdictions to address because of different contexts. Giuffrida (2019) raise the question "who is responsible for what when something has gone wrong?" as many different stakeholders are involved in the AI development process (developers, dataset providers, implementing organisations, resellers etc.). Loh (2018) asks the same question in the medical field in case of errors committed by a robot surgeon. In this context, the explainability of AI is an important field of research.

See section 4 for more details on legal considerations. Note that the ethical challenges listed in the figure above are not exhaustive and they partly overlap with ethical challenges.

2.2.7 Ethical Challenges

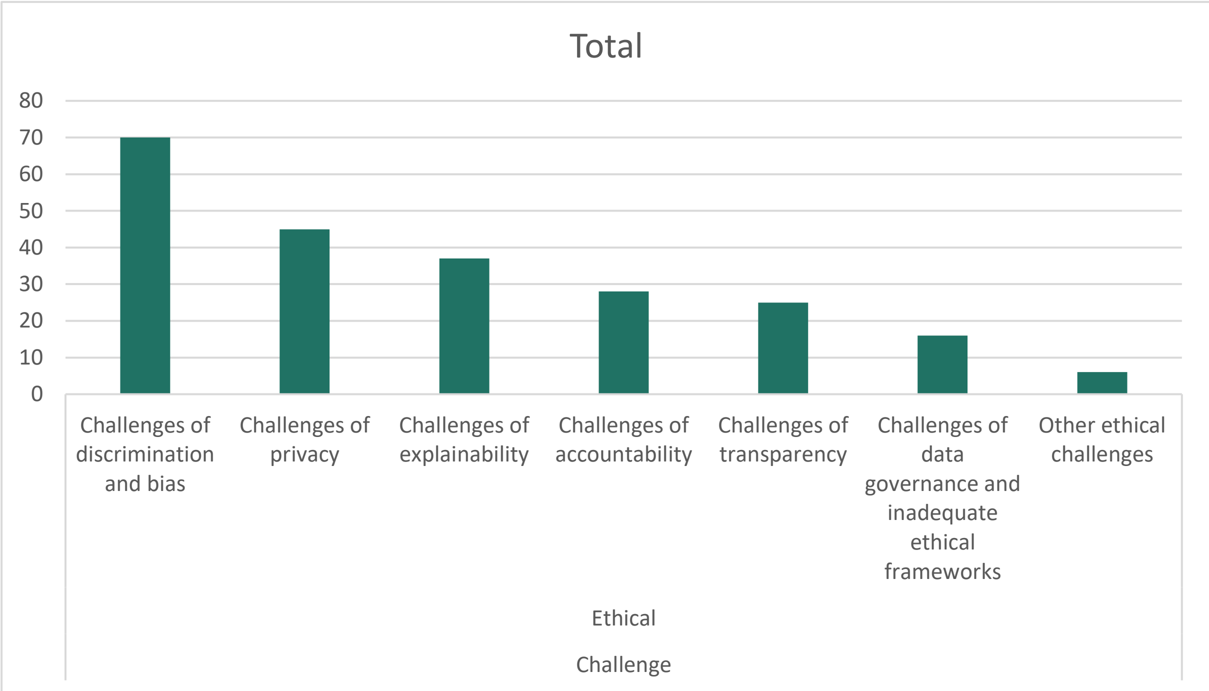

Figure 6 - Main Arguments on Ethical Challenges

The issue of **discrimination and bias** receives a lot of attention in the literature. For instance, Rodrigues (2020) warns against bias as one of the most pressing issues of autonomous systems. Interestingly enough for FlexiGroBots, there is hardly any explicit argument on discrimination in agriculture, but the literature either addresses general issues or the health care or finance sector. Larsson *et al.* (2019) give some examples when "automated ad-distribution tools [...] contained gender biases that were more likely to distribute well-paid job ads to men than women". Borenstein and Howard (2021) report on a case where "an AI system used for recommending follow-on healthcare services failed black patients by referring them at a lower rate than their white counterparts even when both groups had a similar diagnosis".

The challenges of **accountability** and **privacy** are also an important concern in terms of their ethical implications. Similar to the legal debate, the ethical literature also raise the question of "who is responsible for what?" in case of accidents or errors (Ma, Zhang and Zhang, 2018; Kellmeyer, 2019; Dogru and Keskin, 2020; Currie and Hawk, 2021). Regarding privacy, Mark (2019) warns that big data used by AI or ML-based solutions is vulnerable to privacy issues because it provides real-time information about many people. Kellengere Shankarnarayan and Ramakrishna (2020) say that two "farmers feared government officials gaining access to their private information and using it for market speculation". Jaremko *et al.* (2019) points out the dilemma between creating more training data to train better algorithms and using less data to adhere to data protection laws. Borenstein and Howard (2021) worry about the increasing use of facial recognition that can hamper privacy. They mention examples where the US government's use of facial recognition to identify protesters, but similar technology could also be used in agricultural contexts.

In addition, most AI tools face **transparency** challenges. For many applications, code is not available for independent review or contains deep learning algorithms which cannot be reviewed manually (Hall, 2018). Different sectors, such as health care, this can lead to loss of trust in the recommendations and force patients "to make choices without sufficiently understanding the relevant information" (Quinn *et al.*, 2021). In the case of public defence, "the AI black box and the resulting lack of explainability would open it up for risk in its application in highly regulated or critical environments" (Sharma, 2021). Transparency and explainability is an active field of research in the AI literature. While transparency challenges are rarely discussed in the agriculture technology literature, similar challenge also apply to agriculture.

2.2.8 Societal Challenges

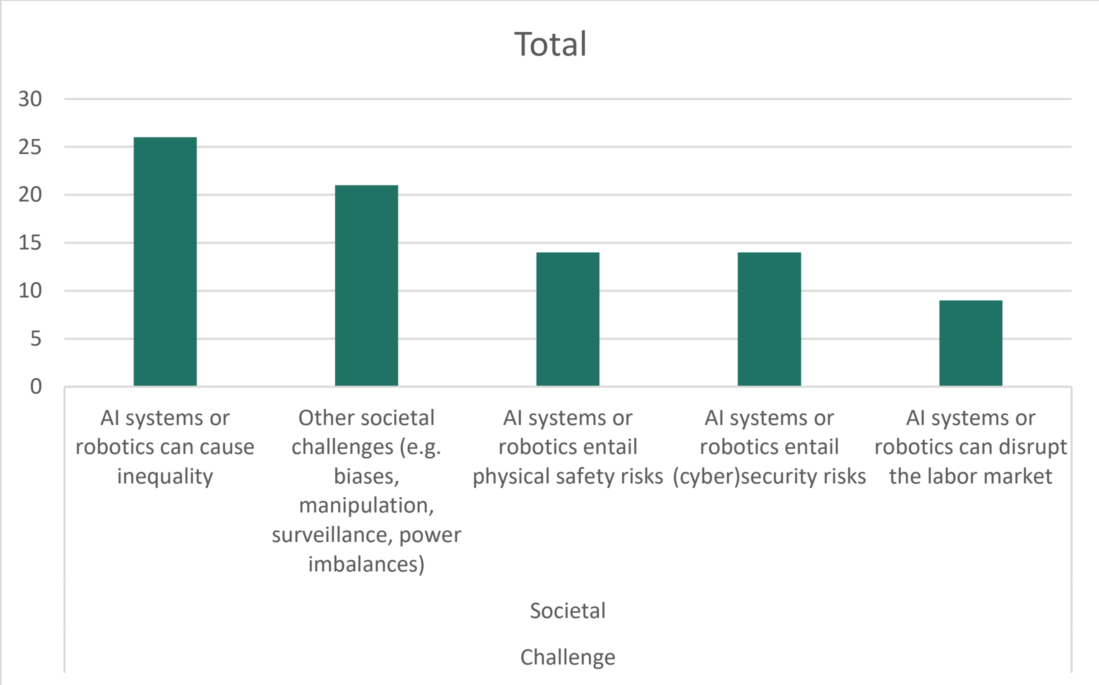

Figure 7 - Main Arguments on Societal Challenges

Inequality is the most frequently mentioned societal challenge. Zha (2020) warns that the benefits of AI systems will be distributed unevenly across regions, as these systems rely on internet access. Sparrow and Howard (2021) point to the case that because robots are designed for specific crops and animals, emerging economies in Africa, Asia, and Latin America are expected to benefit less. Farmers in some nations can also be out-competed because of this. Gwagwa *et al.* (2020) worry that AI solutions based on biased data can "entrench existing social and economic inequities, with AI systems reproducing the representation gaps and biases of the data sets on which they are trained".

Moreover, both **physical safety and (cyber)security** are frequently mentioned in the literature. Vasconez et al. (2019) point out the risk that heavy robots can hurt workers if not configured carefully. Additionally, several authors like Hagendorff and Wezel (2020) analyse types of cybersecurity risks regarding AI procedures: training dataset manipulation, input manipulation, and model stealing. Beyond agriculture, several authors like (Torresen, 2018) also mention the risk of AI tools to be used for "destructive and unwanted tasks", especially for military purposes.

Furthermore, AI and robotics systems can also **disrupt the labour market** which can entail negative social effects. Changes in the labour market are expected to be accompanied by issues related to integrating untrained workers, a weakening of labour relations/unions, and social security (Rodrigues, 2020). Beyond agriculture, Yu, Beam and Kohane (2018) argue that the implementation of AI in health care will do more harm than good when it includes "alert fatigue", "imposition of additional workloads for clinicians", and disruption of interpersonal communication. Carter *et al.* (2020) express the concern that human capacities will be hampered due to overreliance on AI solutions. Their work shows that "clinicians' diagnostic accuracy, [...], has been shown to decrease when they view inaccurately machine-labelled imaging data".

2.2.9 Conclusions of the Literature Review

The literature review has shown the diverse set of opportunities and challenges linked to robotics and AI in agriculture and other sectors. Regarding economic factors, most authors emphasize how new technologies can improve productivity and efficiency, while some other points out the high barrier for entry given high investment costs and the risk of unemployment. Environmental arguments show that these new technologies can have positive environmental impacts and mitigate negative impacts, while others warn against high energy usage and electronic waste. Legal arguments mostly focus on challenges linked to the lack of an adequate legal framework for AI and robotics and several authors mention the issue of specifical challenges such as liability and accountability. Ethical arguments focus on challenges, especially linked to issues such as discrimination, bias, privacy or transparency. Similarly, societal concerns focus on issues such as inequality, surveillance, physical safety risks, or negative impacts for the labor market.

Note that, depending on the specific issue, less literature specifically on agriculture is available, and the arguments put forth in the literature concern other specific sectors or AI and robotics in general.

2.3 Private and Public Standards

There are many initiatives trying to introduce standards for ethical AI, either through soft standards or hard law, from the private or public sector. Prominent examples for **soft private standards** are: (1) the "Model Cards for Model Reporting"(Mitchell *et al.*, 2019) proposed by Google. Model cards provide a standardized way for developers to report on technically and ethically relevant properties of their algorithms to enable others to better understand the capabilities and limitations of the respective algorithm. (2) The "Datasheets for Datasets" (Gebru *et al.*, 2021) proposed by Microsoft and others. Datasheets provide a standardized way for dataset authors to report on technically and ethically relevant properties of their datasets. (3) Several other, smaller initiatives exist, for example CodeCarbon (*About CodeCarbon*, 2022), which provides standardized software to calculate the carbon emissions produced during AI training.

Moreover, several **governments have proposed hard laws or soft standards** related to AI ethics: Australia is developing a voluntary AI ethics framework based on eight principles similar to the ALTAI requirements; Canada has developed a directive on automated decision-making; the German data ethics commission proposed a risk classification scheme with five levels of criticality; Japan proposed contract guidelines on the utilization of AI and data; Singapore developed a model governance framework on AI; the UK government provided a guide on using AI in the public sector; and the United States have drafted guidance for regulation of AI applications. For a comprehensive overview of these initiatives see (CEPS *et al.*, 2021).

Other standards, such as the Assessment List for Trustworthy Artificial Intelligence (ALTAI) have been developed in cooperation between public bodies (initiated by the European Commission) and private actors (European Commission, 2020a). This deliverable focusses on three main standards: The ALTAI questionnaire, Model Cards and Data Sheets.

2.3.1 The Assessment List for Trustworthy AI - ALTAI

The **Assessment List for Trustworthy Artificial Intelligence (ALTAI)** was proposed by the High-Level Expert Group on Artificial Intelligence (AI HLEG), which was set up by the European Commission in June 2018. The AI HLEG first proposed a set of ethics guidelines for trustworthy AI in April 2019 (European Commission, 2019b). In these ethics guidelines, the AI HLEG defined seven key requirements for trustworthy AI systems: (1) human agency and oversight; (2) technical robustness and safety; (3) privacy and data governance; (4) transparency; (5) diversity, non-discrimination and fairness; (6) environmental and societal well-being and; (7) accountability.

These initial guidelines were then subject to a piloting process with 350 stakeholders (Lemonne, 2019) to test them in practice and make them more practically applicable. This resulted in the final Assessment List for Trustworthy Artificial Intelligence in both PDF and online questionnaire format (European Commission, 2020a). The assessment list is composed on batteries of questions for each of the seven key requirements. See figure 9 for an overview of the different requirements.

FlexiGroBots project has chosen the ALTAI questionnaire as an important tool for the assessment of the pilots and platform. The questionnaire provides a concrete set of multiple-choice questions designed for the self-assessment of AI systems and it has been validated by many stakeholders and experts from diverse sectors and backgrounds. Section 3.1. describes in more detail, how the ALTAI questionnaire is used in the FlexiGroBots project. Section Recommendations provides the recommendations based on the ALTAI assessment.

Introduction

How to use this Assessment List for Trustworthy AI (ALTAI)

REQUIREMENT #1 Human Agency and Oversight

Human Agency and Autonomy

Human Oversight

REQUIREMENT #2 Technical Robustness and Safety

Resilience to Attack and Security

General Safety

Accuracy

Reliability, Fall-back plans and Reproducibility

REQUIREMENT #3 Privacy and Data Governance

Privacy

Data Governance

REQUIREMENT #4 Transparency

Traceability

Explainability

Communication

REQUIREMENT #5 Diversity, Non-discrimination and Fairness

Avoidance of Unfair Bias

Accessibility and Universal Design

Stakeholder Participation

REQUIREMENT #6 Societal and Environmental Well-being

Environmental Well-being

Impact on Work and Skills

Impact on Society at large or Democracy

REQUIREMENT #7 Accountability

Auditability

Risk Management

Figure 8 - Overview of the key requirements in the ALTAI questionnaire

2.3.2 Model Cards

There is a wide variety of organisations who provide commercial products and services powered by AI models and open-source contributors who freely share AI models for anyone to use. It is essential for customers and open-source users to understand key properties of these models (algorithms), in order to judge whether a particular model is the correct choice for their specific use-case. Different organisations have therefore started to develop reporting standards for AI models: model cards.

The overall objective of a model card is to (1) provide prospective users of a model with technical, legal and ethical information to help them decide if they should use a specific model and (2) to help model developers adhere to a set of standards before publication.

Model cards were originally proposed in a paper by researchers from Google in late 2018 (Mitchell *et al.*, 2019) and several organisations have adopted versions of this standard, such as SalesForce (2020) with an integrated model card generator, or IBM which developed a similar standard with its AI FactSheets (SalesForce, 2021). In 2020, Google also published a Model Card Toolkit (MCT) an open-source software package which facilitates automatic generation of model cards (Huanming and Hui, 2022; TensorFlow, 2021).

Variants of model cards are now being integrated into different model repositories, such as the TensorFlow Hub (TensorFlow, no date), Hugging Face Model Hub (Hugging Face, no date a) or the PyTorch Hub (PyTorch, no date). In practice, however, the information provided can be quite sparse. Google's TensorFlow Hub, for example, only provides superficial (ethical) information on its key models (TensorFlow, no date c) and the community-driven Hugging Face model hub strongly depends on contributors to provide sufficient information on the models they upload. The EU-funded AI4EU platform also provides a model repository, but the interface for uploading AI assets only requires a few pieces of information which would be relevant for a complete model card (AI4EU, no date a).

In the FlexiGroBots project, each published AI model will be accompanied by a model card which is based on Google's original proposal and was adapted to FlexiGroBots. The model card template was discussed among the partners and is available in section Model Card Template.

2.3.3 Datasheets

Datasets have become self-standing economic and academic assets, both for projects internally and for external users. To unlock the full potential of our data for the research community, the FlexiGroBots project will therefore publish several datasets. Creating high quality datasets and publishing them with the information necessary for external users is, however, not an easy task and is sometimes neglected.

The FlexiGroBots project therefore takes several measures to ensure quality and transparency of the datasets produced. First, each dataset creator follows the FAIR data principles and provides internal information on each dataset (*FAIR Principles*, 2016). This is assured internally through task 1.5 and data management questionnaires. Second, for the external publication of datasets this deliverable proposes a datasheet template, which will accompany each dataset published by the FlexiGroBots project. The datasheet templates enable data producers to provide all relevant information on their dataset in a concise and harmonised way for future external data users.

The datasheet template is based on a review of existing private and public standards for data reporting, similar to the review on model cards in the previous section. There are several data set repositories or platforms, which provide the technical infrastructure for sharing data. Examples are Zenodo (*Zenodo*, no date), Dataverse (Harvard Dataverse, no date), TensorFlow Datasets (TensorFlow, no date a), Kaggle (Kaggle, no date), Hugging Face Datasets (Hugging Face, no date b), Papers With Code (Papers With Code, no date) and more. While some of these platforms require certain types of information, none of them seem to have a strong policy for enforcing the provision of detailed information. The research community provides more detailed guidance on the information that should be provided. The FAIR principles provide general guidelines for making data Findable, Accessible, Interoperable and Reusable (Go Fair, no date). Moreover, the paper "Datasheets for Datasets" provides more specific questions which researchers should answer when publishing a dataset (Gebru *et al.*, 2021). It was developed by private sector and academic researchers and provides the most practical basis for dataset reporting.

Beyond private initiatives, law makers have also started to introduce legal requirements for datasets. The proposal for the EU's AI Act, for example, contains requirements for technical documentation (Article 11 AIA) for data used for high-risk AI systems (European Commission, 2021b). The law even explicitly mentions "datasheets" (Annex IV, 2d). The GDPR requires the provision of specific information specifically for personal data. Public funding programs incentivise beneficiaries to provide information on their data, for example through data management plans (European Commission, no date).

The FlexiGroBots datasheet template is based on the Datasheets for Datasets paper and includes information from other standards where necessary. Our datasheet template is available in two forms: First, the table in chapter 5.7 displays our template in Word format. Moreover, a raw Excel file is available, which partners (and externals) can use to fill in their datasheet information more flexibly. We recommend that each dataset published by FlexiGroBots is always accompanied by a tailored Datasheet based on our template.

3 Primary Data Collection

Beyond the desk research summarised above, CEPS conducted several rounds of interviews. These interviews comprised a general ethical assessment of the pilots and the platform (section 3.1), a specific assessment of data protection related questions (section 3.2) and further interviews with farmers and other stakeholders (section 3.3). These interviews resulted in recommendations summarised in section 5.

3.1 ALTAI Interviews

The general ethical assessment based on the Assessment List for Trustworthy AI (ALTAI) follows several steps in FlexiGroBots: *First*, an initial round of interviews with each pilot and the platform was conducted in August and September 2021. The interviews were led by CEPS with technical and well as managerial members of the respective partners. This setup followed the recommendation that the ALTAI "is best completed involving a multidisciplinary team of people. These could be from within and/or outside your organisation with specific competences or expertise on each of the 7 requirements and related questions" (European Commission, 2020a). During these interviews, the group discussed and filled in each question of the ALTAI questionnaire.

Second, based on the discussion and findings during the interviews, CEPS drafted a list of initial recommendations tailored to each pilot and the platform. These recommendations were shared with all partners in November 2021 and partners had the opportunity to provide feedback. The recommendations are organized by level of importance and topics and the partners were asked to start implementing the first recommendations.

As the FlexiGroBots pilots are not yet finished AI systems yet, but prototypes which are successively developed throughout the project, not all questions could be answered at this point. Moreover, the group noticed that some ALTAI questions are very general or do not apply to the project's agricultural robotics pilots in particular. A good example are questions regarding addictiveness of the AI system, which is very important for AI systems used in social media platforms, but less so for agricultural robots.

Third, the group therefore decided to follow-up on specific recommendations and questions which came up during the initial assessment in more targeted follow-up interviews. The first follow-up interviews focused on questions related to data protection and privacy (see the following section 3.2 for more details). All resulting recommendations are available in section 5.

3.2 Data Protection Interviews

The sections below summarise the findings based on a series of calls related to data protection with each pilot and the platform in January and February 2022 organised by CEPS.

3.2.1 Pilot 1, Spain and Vineyards (WP4)

Partners assured that no personal data is collected, stored or processed in the pilot. The main use case discussed was the **harvesting assistance** robots where small Unmanned Ground Vehicles (UGVs) follow workers and carry the vine grapes for them. The robots follow the workers through two types of data: (1) the distance to a yellow vest worn by all workers at all times; (2) randomized IDs transmitted via a Bluetooth sensor on the worker to the robot. The robots use this random ID to identify the worker they are assigned to. According to the partners, the randomized ID number cannot be linked to an individual worker by the robot. Robots do not record imagery data of workers and it was pointed out that all of the personal data of the workers is not processed by the robot but is "secure in the office".
Given the information provided by the pilot, possible issues related to the tracking solution were discussed. The pilot needs to be careful that it is not possible to determine what individual was assigned with the random ID number for the given interval of work. It was noted to the partners that automated decision making processes based on the personal data (localisation, movement) fall under specific rules of the GDPR, thus require additional attention and levels of safety.

Other use cases were also discussed. Regarding the Unmanned Aerial Vehicles (UAVs) disease detection use case, the partners explain that UAVs only operate when no one is on the field, for legal and safety reasons. The area of UAV operation is predetermined and checked for people before it begins. The same applies to the UGVs applying pesticides. UGVs are equipped with cameras to detect obstacles. Image data is stored for the duration of the project. Partners were informed that it is highly advised to ensure every person involved in the pilot has signed an appropriate data protection consent form. This form should also cover the potential publication of image datasets which could contain personal data. Alternatively, all published data could be anonymised. Additionally, partners voiced an interest in the regulatory sandbox solution and assured sufficient enquiries will be made with local data protection authorities.

3.2.2 Pilot 2, Finland (WP5)

Potential data protection implications of several use cases were discussed. For the **situation awareness and silage harvesting** use cases, images of wide fields are captured for planning and coordination purposes via Unmanned Aerial Vehicles (UAVs). The pilot explained that

images are taken from around 100m altitude via UAVs and the resolution of individual people would only be a few pixels. Individuals can therefore not be identified. The pilot notes that it is possible that images of areas beyond the border of the field are taken. They also mentioned that members of the team can sometimes conduct maintenance work around the drone while it is active and gathering data (images). Partners confirmed, however, that in regular circumstances nobody should be present in the field while survey mission is being conducted, and indicated they will continue to follow local law regarding drone missions.
Regarding the **survey missions for pest and weed detection,** UAVs fly at around 2m altitude to detect pests with the camera pointing down. Images of identifiable individuals could be collected in terms of resolution, but people are prohibited from entering the field by blocking the entrance. The same applies to the **rumex weeding UGVs** which is deployed after the drone and also uses cameras to scan its surroundings of a few square meters. The partners note that images of individuals could accidentally end up in the collected data, especially during the development phase. Regarding the **autonomous tractor**, the responsible partner explains that camera images by the tractor will not be stored and only object detection information without personal identifiers will be stored. They note that only the research team will be on the field while the tractor is operating and they are following local regulation on autonomous vehicles. The partners also explained that experiments were conducted on the grounds of a special research institute facility.

It is discussed that the issue of accidental personal image collection can be resolved through anonymisation or informed consent. Partners are working on implementing additional data protection consents for the whole Work Package including operators and external workers. Partners plan to publish videos on social media sites such as YouTube, and ensured they are aware of the required consent from team members. CEPS also reminded the partners of earlier recommendations, for example regarding safety and the legality of autonomous vehicles and suggested looking into local regulatory sandbox solutions.

3.2.3 Pilot 3, Serbia/Lithuania and Blue Berries (WP6)

Partners reflected on the state of personal data processing in the pilot, stating that personal data is neither collected, stored nor processed purposefully in the pilot’s design. Regarding data collection by Unmanned Aerial Vehicles **(UAVs, drones)** used during the pilot, the partners assured that images taken from the drones are procured in low resolution which does not allow for the recognition of any individuals on the ground. Furthermore, partners explained that people are not allowed on the field during UAV operations for safety reasons. According to the partners this practice is enforced by pilots who ensure that no one is on the field before any drones are airborne. Moreover, UAV flights are conducted early during the season, before workers are present for harvesting.

Considering the Unmanned Ground Vehicles **(UGVs)**, partners explained that robots do not collect or process any personal data. The UGV cameras are in close proximity to the blue berries and point from 1m hight downwards on the blue berries at around 30cm hight, making it very unlikely that people are captured on an image. It is to be noted that ground robots possess cameras of sufficient quality to identify an individual if the image would be taken by accident. Moreover, no people are allowed on the field during UGV operations for safety reasons.

Moreover, **other potential issues** related to data protection were discussed. Regarding the future publication of datasets, partners agreed that images should either be manually or automatically reviewed/anonymised before publication. Partners acknowledged CEPS' suggestion of keeping flight logs longer term for evidence purposes and agreed to pass this suggestion to people in charge of autonomous aircraft infrastructure. Partners also explained how the issue of trans-border data transfers was investigated and deemed non-threatening for the pilot and project as a whole. In cases of potential data transfers, partners assured that standard clauses ought to be sufficient. Partners were notified of the possibility of joining a data protection or innovation sandbox in Serbia and agreed to enquire on the matter with relevant local authorities.

3.2.4 The Platform (WP3 & WP2)

The main components of the platform where discussed task by task from a data protection perspective.

T3.1: AI platform: The AI platform provides tools for data scientists to process and analyse data. Users will be allowed to upload their own data, and there will be no control over what data is being processed on the platform by the user. It is discussed that the responsibility of processing the data lawfully lies with the users. The platform will probably collect some personal data for the purpose of registration and functioning of the platform website (for example via verification system like GitHub). The partner and their DPO will ensure that the collection and processing of this personal data is in line with the GDPR.

T3.2: Common data enablers and services: The partner explains that they provide an infrastructure for exchanging data and it is up to the users to ensure that their data exchanges are in line with the GDPR. The infrastructure enables users to specify specific information or policies related to their data exchanges, such as "this sub-portion of the data contains personal data, therefore do not do X with it based on the consent received". These policies can be technically enforced to some extent (e.g. limiting the number of downloads). It was discussed that IDSA will look deeper into their own data protection policy and experience from past projects and will reach out in case relevant points emerge.[1]

T3.3: Geospatial enablers and services: The responsible partner explains that no personal data is involved in this task. They are focussing on satellite images and the data cube. Satellite images have a resolution of around 20m2 per pixel, making it impossible to identify individuals. The partner also notes that drone images from the partners will be used in this task at a later stage. It is relevant that the pilots communicate any requirements related to data protection and the data transferred to this task.

T3.4: Common Application Services: In the people detection and tracking use case, a computer vision algorithm is used to discern three types of information: classify objects as a "person"; determine their position in the image; and determine their distance to the camera. Two potentially problematic personal identifiers were discussed: first, each "person" object receives a temporary ID. The partner explains that this ID only serves the purpose of tracking the same "person" object across several images. The IDs are not used to identify individuals but people in general. Second, the images contain people's faces, which can be linked to individuals. The partner explain that images of people are only processed during inference time and no personal data is stored. The partner also explains that the algorithms are trained on publicly available datasets. It was discussed that this constitutes processing of personal data. The partner explains that an anonymisation step before processing can be added by blurring peoples' faces. This anonymisation module would solve issues related to data protection and could also be used by other partners in- and outside of FlexiGroBots. The team decided to add the anonymization module to the project.

Other sub-tasks of T3.4 were also discussed. The partner explained, for example, that the "Vehicle Detection, Location & Tracking" use case was renamed to "Object Detection, …" as it might also involve identifying the position of people. For this and other sub-tasks, anonymisation of data (via the new anonymisation module) provides the best means of avoiding issues related to data protection.

T3.5: Mission Control Centre (MCC): Partners explain that the MCC will not collect or process personal data, it is only designed to help the operator plan, execute and survey missions. Displaying personal data, for example via a video feed, is not planned. This MCC will display synthetic images of the mission. CEPS points out that, if at a later stage personal data such as images or IDs could be visible via the MCC or if data storage is implemented, questions related to data protection should be reconsidered.

3.3 Other Interviews and Follow-Up

In order to gather additional primary information, several additional interviews with relevant stakeholders have been conducted. The interviews focussed on farmers, as they are the primary target group of the project. These interviews were explicitly designed to be exploratory, based on a semi-structured interview guide, to avoid framing stakeholders in their response behaviour and gather unfiltered information.

3.3.1 Interviews with farmers

This section provides a summary of the most important points raised by several farmers in three countries: Spain, Finland, and Serbia. In order to allow farmers to speak freely, responses are not attributed to individual farmers and the main arguments are summarised below.

The most frequently mentioned **economic challenge** are the recent increase in prices and inflation due to the war in Ukraine and the COVID-19 pandemic. All farmers mentioned that costs for key inputs such as fertilisers drastically increased and correspondingly many agricultural outputs also have become more expensive (e.g. from grains to strawberries). This has led to decreased demand and increased uncertainty, which, in turn, can lead to decreased investments. Farmers are faced with a difficult balancing act between covering costs and staying competitive.

Moreover, several farmers mention labour related issues. There is low supply of labour and high labour costs, due to the hard physical work. Some farmers therefore work with migrant seasonal workers, for example from Pakistan, India, Bangladesh (in Serbia). One farmer explains that they work well, harder, and more reliably than domestic workers. Some farmers also mention that the cost of capital investments (e.g. housing for workers) can be an issue, while others do not see this as a main challenge. One farmer also emphasizes the neglect of rural areas as an important issue. Rural areas are faced with poor infrastructure (e.g. access to electricity), which incentivises farmers to go closer to big cities. One farmer also mentions specific challenges linked to the plant breeders market, which makes it hard to disseminate and determine new varieties. Licenses need to be paid to breeders and local companies are not protected well enough. This can also lead to black propagation of plant varieties.

When asked about **legal and political challenges**, some farmers point out that government subsidies are helpful and important, especially the EU Common Agricultural Policy (CAP). Others believe that potential changes in the CAP and conditions for subsidies can cause uncertainty and that support for rural development is lacking. Moreover, one farmer mentions legal challenges linked to letting people and robots work in the same space (e.g. regarding data protection). Another farmer mentions that, while human operators need phytosanitary treatment applicator cards, there is legal uncertainty as to what is necessary for spraying robots. Furthermore, one farmer mentions that regional implementing administration (e.g. the Serbian Plant Protection Service) and certification do not work well enough yet. This can lead to farmers using uncertified plants infected with diseases. Another farmer mentions that prohibitions of certain chemicals e.g. in fertilizer products can lead to issues for farmers, as they depend on these chemical products to maintain productivity.

Regarding **technical challenges**, plant protection is an important challenge. Several technical (and non-robotic) solutions were mentioned: invitro techniques; root cutting; precision irrigation; biological plant protection; special hail nets against increasing UV radiation and increased temperatures due to climate change. Interestingly enough, most farmers did not deem monetary cost of new technologies to be prohibitive. Farmers express interest towards robotic solutions, if they work as advertised and are not too difficult to use.

The main **environmental challenge** is climate change. All farmers explain that they have been experiencing negative changes in the weather. Higher temperatures, droughts, a change in seasonal timing, and higher UV light radiation negatively impacted their farming activities. One farmer mentioned that this creates an incentive to move to areas with more favourable climate conditions, which, in turn, can be further away from cities and lack important infrastructure. Moreover, negative impacts of chemical products such as pesticides are mentioned and that it is a challenge to reduce them. One farmer emphasizes that they depend on pesticides and fertilisers to maintain productivity.

When it comes to **social challenges**, some farmers mention that a lack of knowledge and education can be an important issues. Some farmers do not know which technologies work and which do not and they can fall prey to traders who are trying to sell overpromising products. Moreover, some farmers mention that there can be a general scepticism against using new technologies, partly due to the advanced age of many farmers. Many farmers prefer doing their work as they have always done it, which can hamper the uptake of new technological solutions. In this context, demographic issues pose an important challenge. Most farmers mention that the average age of farmers is high and that it is very difficult to attract young people to work as farmers.

One farmer also mentions that there can be scepticism among workers against robotics solutions. Some fear that drones or wrist bands are designed to surveil and control their work although this is not the farmers intention. One farmer sees trust in these technologies as a relevant prerequisite for acceptance among workers. Another social challenge mentioned by two farmers are consumer expectations. Consumers demand perfectly looking plants and are very sensitive against damages, although plants would be perfectly eatable.

These interviews have highlighted that farmers are faced with a **myriad of challenges which will require a variety of responses**. The most important challenge seems to be the drastic increase of prices due to the COVID-19 pandemic and the war in Ukraine. It is clear that this issue require broader political responses beyond the control of individual farmers and projects. Similarly, the other challenges mentioned above will require their own tailored solutions.

When **robotics solutions** for some of the challenges above were discussed, the farmers were very interested in the solutions developed by FlexiGroBots. They explain, for example, that autonomous weeding and spraying robots can be very helpful in recognising issues in an early stage. Robotics can help decrease costs and increase quality, for example though shorter storage time. Moreover, the labour shortage can be partly addressed through robotics, as many younger people do not want to work on farms anymore. Interestingly enough, some farmers do not believe that costs of these new technologies is the biggest issue, while one farmer points to cost concerns. The lack of technical knowledge for operating robots and questions whether solutions work as advertised in practice are mentioned. These interviews have therefore shown how the solutions developed in FlexiGroBots can provide an important piece to the puzzle for solving some of the challenges farmers are facing today.

3.3.2 Other discussions with stakeholders

Moreover, the D2.6 team has started conversations with the developers of the AI4Europe platform. AI4Europe provides a central platform for sharing AI Assets, such as AI models or datasets (*AI4EU*, no date b). A review of AI4Europe and related platforms showed that platform providers could do more to incentivise developers of AI models and datasets to provide more detailed documentation on their AI assets. The D2.6 team therefore suggested improvements to the AI4Europe upload template which can nudge developers to provide more information, while being conscious of the reporting burden. The basis for these suggestions are the Model Cards and Datasheets proposed in section 5 of this deliverable. Discussions with AI4Europe are ongoing at the point of writing this deliverable.

4 Legal Reviews

Due to the innovative character of activities undertaken within the FlexiGroBots project many of its innovations are fall under existing and usually archaic regulations. This chapter aims to provide guidance on the most pressing matters concerning compliance with existing EU law as well as pointing out possible solutions to the outdated nature of some of the relevant regulation on the national level in the form of e.g. regulatory sandboxes and administrative permits.

The project also touches upon areas, which are currently largely unregulated. This chapter therefore also flags upcoming regulations in the areas of digital transformation, robot application and data governance for FlexiGroBots partners. Considering all relevant regulations in an early stage helps the partners future-proof solutions developed in the project.

4.1 Data Protection and GDPR

This section outlines key data protection principles and definitions which were considered in the FlexiGroBots project. These principles were taken into account during the data protection interviews in the preceding section and will guide subsequent assessments.

Data protection in FlexiGroBots project boils down to two mains issues: application and development. Within the scope of the project, partners simultaneously iterate on technology development and apply it during pilots. Personal data usage could become an issue whenever the developed technology breaches a provision of the overarching EU regulation on privacy and data protection. In some cases technology used to automate tasks on the ground relies on personal data. This technology should be developed and applied in line with the privacy norms of the General Data Protection Regulation (European Commission, 2016).

4.1.1 Personally identifiable data

In principle, the scope of the project does not foresee using personal data for the accomplishment of its goals. Many types of used technologies, however, come close to collecting personally identifiable data (Article 4(1) GDPR) as well as its intense processing. The process not being deliberate advances the risk of unintentional breaches of the GDPR. Additionally, many development tasks, especially involving field work, run into inevitable problems with personal data gathering during experimentation when iterating upon the data gathering technology. Finally, there always is a possibility of accidental personal data gathering and subsequent processing.

4.1.1.1 Profiling

Profiling means any form of automated processing of personal data, which consists in the use of personal data to evaluate certain personal factors of a natural person, in particular to analyse or forecast aspects related to the effects of a natural person's **work**, economic situation, health, personal preferences, interests, **reliability**, **behaviour**, **location** or **movement** (Article 4(4) GDPR). The concept of profiling has therefore three components: it must be any form of automated processing; must be carried out in relation to personal data; its purpose must be to assess certain personal factors of an individual (Article 22 GDPR). Many technologies applied in the project at this stage of development are for example close to performing profiling of workers on the ground using their location, movement and behaviour data.

4.1.2 Automated decision making

Automated decision-making relates to a decision-making process conducted by technical means **without substantive human intervention** (Article 22 GDPR). It can be a simple decision-making process based on direct conditional relationships. This process may also take into account profiling mechanisms and complex predictive algorithms that use tools based on artificial intelligence for the analysis of decision-making dependencies, as long as there is no active substantive human participation at any stage of their use. The subject of analysis in the decision-making process, as in the case of profiling, data coming from various sources, i.e. data provided directly by the individuals, observed data, and derived data i.e. inferred data.

4.1.3 Privacy by design

Article 25 (1) of the GDPR introduces a privacy-by-design rule. In carrying out this obligation, the controller is obliged to implement appropriate technical and organizational measures. Doing so controller should take into account the state of knowledge, the cost of implementation and the nature, scope, context and purposes of processing as well as the risk of violating the rights or freedoms of natural persons with a different probability of occurrence and weight resulting from the processing. An example of such measures may be ensuring the implementation of data protection rules in order to provide the processing with the necessary safeguards to meet the requirements of the regulation and protect the rights of data subjects.

The perspective of the data subject as the basis for the design of processing processes is one of the basic assumptions of the GDPR and is reflected, among others, in the privacy by design rule. This correlates with the assumptions for the development of artificial intelligence, as set out in the EU strategy (European Commission, 2018b) and the coordinated plan presented by the European Commission, as well as in the guidelines of the High-Level Expert Group (European Commission, 2019b).

Due to the multitude of technologies and their applications, the set of possible solutions constituting privacy by design is not permanent and unchangeable. On the contrary, its main advantage is precisely that it is a dynamic structure that constantly adapts to the changing environment in which the personal data subject to protection are processed. This flexibility is exercised by adopting following privacy by design rules (Cavoukian, 2009):

1. A proactive approach, not a reactive approach;
2. Privacy by default;
3. Privacy incorporated in the project;
4. Full functionality understood as achieving an added sum, not a zero sum;
5. Protection of privacy from the beginning to the end of the information lifecycle;
6. Transparency and clarity;
7. Respect for the privacy of users.

The principles of privacy by design constitute guidelines for administrators both when planning and when applying AI solutions.

4.1.4 Transparency principle

The purpose of the transparency principle is to provide data subjects with the fullest possible knowledge of the purpose, scope and context of data processing and, consequently, the possibility of exercising control over their own data. **Transparency is aimed at enabling data control, which is not limited only to the fulfilment of the information obligations under Article 12 and 14 of the GDPR, but also provides awareness of the entire processing process.**

In the case of using digital tools, e.g. collecting data or analysing them with the use of AI mechanisms, the analysis should include in particular privacy statements, privacy policies, service regulations, contract templates, consent clauses and information clauses. In the digital context, administrators may implement the use of additional tools to maintain the transparency of processing, in order to provide information tailored to the specificity of the goods or services offered to an individual data subject.

Examples of taking into account the guidelines for the implementation of the transparency principle: a control panel enabling the data subject to manage their privacy preferences and to read detailed information on data processing; or short push or just in time messages to deliver information at different points in the data collection process. Their use helps to disseminate information in easily digestible portions, because they are short explanatory information that usually accompanies the appropriate text fields or activities, messages sent by SMS or e-mail, or public information campaigns.

Explaining how the different components of a system work (AI algorithms or models, the combining of data and assignment of weights and labels) may prove difficult for the creators themselves. This is especially the case with AI based on deep learning, especially unsupervised or only partially supervised, and when learning is not based on methods using symbolic principles of reasoning. In simpler models, based on symbolic reasoning principles, explaining the relationship and functioning of the processing process and the principles governing automated decision-making may turn out to be easier, subject to variability over time.

Technological difficulties, however, do not release administrators from the obligation to maintain transparency in the course of data processing. Therefore, the essence of the problem is to find a solution that will allow the correct implementation of the rights of data subjects, in particular in connection with the obligation to inform about automated decision processing and its effects. Relevant information that the administrator is obliged to provide should concern the principles of operation of the algorithm, including the principles of combining and weighting data and the circumstances in which the decision made by an artificial intelligence will affect the data subject. Therefore, there should be no doubts that the controller is obliged to disclose at least general information about the decision-making principles and its possible consequences.

Therefore, ensuring transparency is not about detailed, technical knowledge about the structure, details of algorithms and other technical solutions. It is rather about the rules of the AI mechanism and decision-making processes. Said rule is laid down by the explanations contained in point 63 GDPR and in the detailed provisions shaping the information obligations under Article 12 (2)(f) and Article 14 (2)(g) GDPR. Pursuant to the current regulations, controllers are required to provide specific, easily accessible information on automated decision-making, based solely on relevant information about the principles, as well as on the significance and anticipated consequences of such processing for the data subject.

If the controller uses data processing models in making automated decisions referred to in the Article 22 (1) of the GDPR, including those based on AI models, they are obliged to: inform the data subject about it; provide relevant information about processing assumptions and; explain the meaning and the envisaged consequences of the processing so that the person can effectively contest the decision.

These guidelines on the scope of the necessary features to ensure information transparency are directly applicable to artificial intelligence mechanisms that use personal data in the data processing and inference processes. When formulating information on processing assumptions that relates to the operation of AI mechanisms, the controller should find simple ways to inform the data subject of the rationale or criteria on which the decision is based. This requirement is not intended to disclose any details of the algorithms used or to disclose the full algorithm.

4.2 Autonomous Vehicles

European Union shares competences on regulating autonomous mobility with the Member States (MS). In practice, this means that Member States exercise their own competence over regulating autonomous vehicles. The EU provided guidance for the MS in the form of framework formulated in strategy paper "*On the road to automated mobility: An EU strategy for mobility of the future*" published on May 17, 2018 (European Commission, 2018a). The table below provides an executive summary of the current state of regulation on autonomous ground vehicles.

Key Takeaways – Legal Framework on Autonomous Vehicles	
1.	All EU countries (except Spain) have ratified the **Vienna convention** on Road Traffic, considering the 2014 amendment to the convention (United Nations, 1968), as of 2021 all road legal vehicles ought to have a driver. (Opinions differ between MS)
2.	EU is also a contracting party to the **United Nations Economic Commission for Europe agreements of 1958** (*UNECE*, 1958) **and 1998 "***1998 Agreement on UN Global Technical Regulations" (UNECE*, 1998) which stipulate the international performance-oriented test provisions and administrative procedures for granting type approvals and global technical regulations for the construction of new vehicles respectively.
3.	A legislative framework dedicated to the approval of automated vehicles in the EU does not exist as of 2021, however, existing EU legislation is to a large extent already suitable for the placing on the market of automated and connected vehicles
4.	At the **EU level, Directive 2007/46/EC**, modernised in 2018 and applicable from September 1, 2020 (European Commission, 2007), regulates how new vehicles should operate and be designed. Within the EU, mass-produced cars may only be used on public roads if they are type-approved in compliance with the administrative procedures and technical requirements established by the Directive.
5.	Technologies not foreseen by current EU rules can be approved through the so-called EU exemption – granted on the basis of a national *ad-hoc* safety assessment. On April 9, 2019, the **Technical Committee – Motor vehicles (TCMV) of the Commission** published **guidelines on the exemption procedure for EU approval of automated vehicles** (*Guidelines on the exemption procedure for the EU approval of automated vehicles*, 2019). The goal of these Guidelines is to harmonize the practice of member states for the national *ad-hoc* assessment of automated vehicles and to streamline the mutual

Key Takeaways – Legal Framework on Autonomous Vehicles	
	recognition of such assessment, as well as to ensure fair competition and transparency. The guidelines focus on automated vehicles that can drive themselves in a limited number of driving situations (Levels 3 and 4 of SAE Levels of Driving Automation).
6.	**The TCMV Guidelines** (European Commission, 2019c) establish that the member state may grant a provisional approval to the vehicle type, valid only in its territory, provided that it informs the Commission and the other member states thereof without delay by means of a file containing the following elements: (a) the reasons why the technologies or concepts in question make the whole vehicle type incompatible with the current requirements; (b) a description of the safety and environmental considerations concerned and the measures taken; (c) a description of the tests, including their results, demonstrating that, by comparison with the requirements from which exemption is sought, at least an equivalent level of safety and environmental protection is ensured.
7.	Automated vehicles should be equipped with an on-board device that records the operational status of the automated driving system and the status of the driver to determine who was driving in case of an accident. Moreover, the vehicle shall be designed to protect the vehicle against automated vehicle hacking using state of the art techniques and must comply with EU data protection legislation.
8.	**Some countries** grant authorization on a case-by-case basis, others are focused more on modifying national laws to facilitate vehicle testing in their territory (Dentons, 2022).
9.	Automated vehicle are not synonymous with autonomous vehicles. Autonomous vehicle can perform all driving functions without any human assistance.
10.	There is a **six level classification** of driving technologies set up by the **SAE International**: No automation; Driver assistance; Partial automation; Conditional automation; High automation and Full automation (*SAE International*, 2021).

Table 3 - Key Takeaways on the Legal Framework on Autonomous Vehicles

4.2.1 Legal framework for Automated Ground Vehicles (UGVs)

Road traffic is a highly regulated area as it bears significant risks for all traffic users including pedestrians. The following sections outline the legal regime for Automated Ground Vehicles (UGVs) at the international, as well as the EU level.

4.2.1.1 International regime

All European countries (except Spain) have ratified The Vienna Convention on Road Traffic of November 8th 1968, which is a primary international treaty adopted to organise and facilitate road traffic and increase road safety by unifying traffic rules across contracting countries. Unfortunately, the dated legal reality of the Vienna convention causes problems for autonomous vehicles today, as the relevant principles laid down in Article 8 specify, that a driver is always fully in control and responsible for the behaviour of a vehicle in traffic: Article

8 (1): "*Every moving vehicle or combination of vehicles shall have a driver[...]*", Article 8 (5): "*Every driver shall at all times be able to control his vehicle[…]*".

The last amendment (2014) although changed the perception of vehicle use in real life, by adding "systems which influence the way vehicles are driven", as well as other systems, which can be overridden or switched off by a driver, are deemed to be in line with Article 8. The most notable interpretation issue is the remaining stipulation mentioning the necessity of a driver's presence. This issue is an international interpretation conundrum, as some countries insist that Article 8 does not prohibit testing nor using autonomous vehicles. This interpretation is based on the convention requirement that a driver must be able to control their vehicle, and is not determining whether a driver ought to do this when physically present in the vehicle, nor does article 8 define "control".

The European Union is also a contractual party to technical requirements for vehicles which are harmonized in the framework of **the two United Nations Economic Commission for Europe agreements,** both agreements apply in parallel. The **1958 agreement** provides the framework for establishing international UN Regulations with uniform performance-oriented test provisions and administrative procedures for granting type approvals, for the conformity of production and for the mutual recognition of the type of approvals granted. The **1998 agreement** concerns the establishing of global technical regulations for the construction of new vehicles, including performance requirements. Its purpose is to further enhance the process of international harmonization through the development of global technical regulations.

4.2.1.2 EU Law

A legislative framework dedicated to the approval of automated vehicles in the EU does not exist as of 2021, however according to Dentons (*Dentons*, 2021)*, existing EU law is to a large extent already suitable for the placing on the market of automated and connected vehicles.* At the EU level, Directive 2007/46/EC, reworked in 2018 and *applicable from September 1, 2020*, stipulates how vehicles should operate and be designed. Within the EU, mass-produced cars may only be used on public roads if they are type-approved in compliance with the Directive.

On April 9, 2019, the Technical Committee – Motor vehicles of the Commission published guidelines on the exemption procedure for EU approval of automated vehicles, to allow technologies not foreseen by current EU law to be approved through exemption of ad-hoc safety assessment. The goal of these Guidelines is to harmonize the practice of Member States and to allow for the efficient mutual recognition of the ad-hoc assessment. The guidelines focus on automated vehicles that can drive themselves in a limited number of driving situations.

According to the Directorate-General for Internal Market, Industry, Entrepreneurship and SME's the Guidelines (European Commission, 2019d)establish that the member state may grant a provisional approval to the vehicle type. The Guidelines stipulates that the vehicle shall always inform the driver, person responsible for operation or passengers about the operational status of the system in an unambiguous manner. For vehicles designed to operate only with no driver, a communication function shall be provided to send an emergency notification to an operation control centre. Automated vehicles should be equipped with an on-board device that records the operational status of the automated driving system and the status of the driver to determine who was driving in case of an accident. Additionally, the vehicle shall be designed to protect the vehicle against automated vehicle hacking using state of the art techniques and must comply with EU data protection legislation.

4.2.2 Society of Automotive Engineer's taxonomy of autonomous vehicles

An **automated vehicle** is a motor vehicle that has technology dedicated to assist the driver which means that elements of the driving performance can be transferred to computer system. Meanwhile, an **autonomous vehicle** is a fully automated vehicle equipped with technologies capable of performing all driving functions without any human assistance. In the FlexiGroBots pilots, partners use vehicles performing specific tasks, whether it is the transportation of crops or driverless tractors harvesting. It is important for the partners to determine the vehicles' role and technical specification.

To distinguish between different understandings of such technologies within policy domains, the Society of Automotive Engineers, SAE International, has proposed a six-level taxonomy of road vehicles (*SAE International*, 2021). The classification takes into account vehicle's capability to control its position, to distinguish between environments and to allow the driver not to be engaged in driving. Partners should determine which vehicles used in pilots fall under which SAE category. The use case of each autonomous vehicle should be checked by the partners for whether it uses public roads while preforming the tasks assigned.

4.2.3 Legal framework for unmanned aircrafts (drones)

Drones play a vital role in achieving FlexiGroBots's goals. There have been some major regulatory developments in recent years regarding unmanned aircrafts laying down laws for drone registration and use. Partners using drones in pilots should be aware of the current legal landscape on drones mainly in order to be aware of the future obligations regarding the renewal of pilot's licences as well as obligations that apply when modifying drones, among others.

The use and operation of unmanned aircraft is regulated in the EU in Commission Implementing Regulation (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft C/2019/3824 (European Commission, 2019a).

EU Regulation 2019/947 has entered into force on 31 December 2020 and supersedes all national regulation on unmanned aircraft. Regulation leaves space for national provisions on the matters concerning minimum age for remote pilot; conversion of certificates issued before the applicability of the EU Regulation, authorisation of model clubs and associations; fines when breaching the Regulation; use of geographical zones and insurance. Those provisions should be consulted on national level to ensure compliance.

Note, however, that implementation and entry into force of the Regulation is dispersed in time making and there is no single date of entry into force. It must be noted that the applicability date of EU Regulation 2019/947 has been delayed from 1 July 2020 to 31 December 2020, which has an effect on other dates within the Regulation:

- as of 31 December 2020, registration of drone operators and certified drones becomes mandatory;
- as of 31 December 2020, operations in the 'specific' category may be conducted after authorization has been given by the National Aviation Authority;
- between 31 December 2020 and 1 January 2023, drone users operating drones without class identification label can continue to operate in the limited category under Article 22 of EU Regulation 2019/947;
- as of January 2022, national authorizations, certificates, and declarations must be fully converted to the new EU System;
- from 1 January 2022, EASA Member States must make available information on geographical zones for geo-awareness in a digital format harmonized between the EU countries;

- as of January 2023, all operations in the 'open' category and all drone operators must fully comply with EU Regulation 2019/947 and EU Regulation 2019/945.

4.2.3.1 Definitions

'Unmanned Aircraft' means any aircraft operating or designed to operate autonomously or to be piloted remotely without a pilot on board: Aerial Work; Urban air mobility; Leisure flights, including with model aircraft; International IFR flights.

This definition includes all types of aircraft without a pilot on board, including radio-controlled flying models (powered fixed wing, helicopters, gliders) whether they have an on-board camera or not. The Regulations use the term UAS, unmanned aircraft system, to refer to a drone, its system and all the other equipment used to control and operate it, such as the command unit, the possible catapult to launch it and others. RPAS (Remotely Piloted Aircraft Systems) is a subcategory of UAS, which includes both RPAS and fully autonomous UAS. Fully autonomous UAS fly completely by themselves without the need for any pilot intervention (*Paragraph 30 of Article 3 of Regulation (EU) 1139/2018 / Article 2(1) of EU regulation 2019/947 and article 3(3) of EU regulation 2019/945)*.

4.2.3.2 Autonomous vs automatic

An **autonomous** drone is able to conduct a safe flight without the intervention of a pilot. It does so with the help of artificial intelligence, enabling it to cope with (in theory) all kinds of unforeseen and unpredictable emergency situations. This is different from **automatic** operations, where the drone flies pre-determined routes defined by the drone operator before starting the flight. For this type of drone, it is essential for the remote pilot to take control of the drone to intervene in unforeseen events for which the drone has not been programmed. While **automatic** drones are allowed in all categories**, autonomous** drones are not allowed in the 'open' category.

4.2.4 Drone Categories

There are three categories of drones. A drone can be operated in the in the 'specific' or the 'certified' category, when it does not meet the requirements laid out under the 'open' category. The open category concerns the majority of leisure drone uses and commercial activities. The open category is subdivided into three categories: A1; A2; and A3. Category A1 means 'fly over people but not over assemblies of people'. Category A2 refers to 'fly close to people'. A3 category applies to 'fly far from people'. Each open subcategory has its own set of requirements.

The specific category caters to riskier operations which are not covered by the open category. Flying under the specific category sets additional requirements on the pilots and flights, meaning operations require an operational authorisation from the National Aviation Authority (NNA) in which the operating pilot is registered, unless the operation is covered by a Standard Scenario (European Commission, 2020c).

The certified category is not relevant considering actions undertaken in the project and will not be examined in detail. The certified category applies to operations with the highest level of risk. Future drone flights with passengers on board such as air taxis, for example, will fall into this category. The approach used to ensure the safety of these flights will be very similar to the one used for manned aviation.

4.2.4.1 Open category

A drone can be operated in the "open" category when it:

- bears one of the class identification labels 0, 1, 2, 3 or 4 (see the table below); or
- is privately built and its weight is less than 25 kg; or
- it is purchased before 1 January 2023, with no class identification label as above;
- will not be operated directly over people, unless it bears a class identification label or is lighter than 250 g. (Please refer to subcategories of operations: A1, A2 and A3 to find out where you can fly with your drone);
- will be maintained in visual line of sight or the remote pilot will be assisted by a UA observer;
- is flown at a height of no more than 120 meters;
- will not carry any dangerous goods and will not drop any material (Article 4 and article 20 of EU Regulation 2019/947; Annex part A and Article 5(1) of EU Regulation 2019/947, Part1 to 5 Annex of EU regulation 2019/945).

The full list of requirements and limitations applicable to different classes of drones and conducted operations valid until 31 December 2023 are provided in the table below. Drones with a class identification label of C0, C1, C2, C3, C4 are expected to become commercially viable at the end of 2022 (European Union Aviation Safety Agency, 2022).

UAS		Operation		Drone Operator/pilot		
Class	MTOM	Subcategory	Operational restrictions	Drone Operator registration	Remote pilot competence	Remote pilot minimum age
Privately built	< 250 g	A1 (can also fly in subcategory A3)	- may fly over uninvolved people (should be avoided when possible) - no fly over assemblies of people	No, unless camera / sensor on board **and** a drone is not a toy	- no training needed	No minimum age
0					- read user's manual	16*, no minimum age if drone is a toy
Legacy drones (art. 20)						16*
1	< 900 g		- No expected fly over uninvolved people (if happens, should be reduced) - no fly over assemblies of people	Yes	- read user's manual - complete online training - pass online theoretical exam	16*
2	< 4 kg	A2 (can also fly in subcategory A3)	- no fly over uninvolved people - keep horizontal distance of 30 m from uninvolved people (it can be reduced to 5 m if low speed function is activated)	Yes	- read user's manual - complete online training - pass online theoretical exam - conduct and declare a self-practical training - pass a written exam at the CAA (or at recognized entity)	16*
3 4 Privately built Legacy drones (art. 20)	< 25 kg	A3	- fly away from people - fly outside of urban area (150 m distance)	Yes	- read user's manual - complete online training - pass online theoretical exam	16*

Table 4 - Requirements for different types of drones in the open category

Source: European Union Aviation Safety Agency (European Union Aviation Safety Agency, 2022).

4.2.4.2 Specific category

When operating under the 'specific category' if the operations can be conducted within the limitation of a standard scenario and using an appropriate drone, the drone operator only needs to submit a declaration to the National Aviation Authority and wait for the confirmation of receipt and completeness. For all other operations in the 'specific' category, an operational authorization issued by the National Aviation Authority is needed.

When operating under the 'specific' category, if the operations can be conducted within the limitation of a standard scenario and using an appropriate drone, the drone operator only needs to submit a declaration to the National Aviation Authority and wait for the confirmation of receipt and completeness. For all other operations in the 'specific' category, an operational authorization issued by the National Aviation Authority is needed (European Commission, 2021a).

If the conducted operation is not covered by the Standard Scenario and does not fall into the 'open' category, it requires an operational authorisation. In this case Pilots would either need to:

- run risk assessment of intended operation by using the Specific Operations Risk Assessment methodology (AMC 1 to Article 11 to Regulation 2019/947) and submit it to the NAA;
- run a predefined risk assessment (PDRA)(GM1 to Article 11 to Regulation 2019/947) which involves a simplification framework for the most common operations conducted in Europe.

In order to avoid this obligations drone operator may apply to the National Aviation Authority (NAA) for the Light UAS operator certificate. In this case the NAA reviews operator's organization and checks for compliance with subpart C to the Regulation 2019/947. NAA may decide to grand the operator a various degree of self-assessment and self-authorization of risk.

4.2.4.3 Usage

Regulation takes into account the weight and specifications of the drone and the type of operation it will be undertaking. Commercial drones available on the market are in the main spectrum.

When operating in the "open" category:

- those that will bear a class identification label (according to Regulation (EU) 2019/945) ranging from 0 to 6 from lighter to heavier models; or
- *those privately built; or*
- *those placed on the market before 1 July 2022.*

When operating in the "specific" category, all drones falling under this category including those without a class identification label. EU Regulation 2019/947 caters for most types of operation and their levels of risk. It does so through three categories of operations: the 'open', 'specific' and 'certified' categories.

4.2.4.4 Registration obligation

Unless they are certified, drones do not need to be registered (*Article 21 of EU regulation 2019/947)*. There is an obligation for registration for the drone operator/owner. Such registration can be completed with a National Aviation Authority of the EU country of residence. Registration will be valid for a period defined by National Aviation Authority.

However, the operator/owner does not need to register if owned the drone(s):

1. weighs less than 250g and has no camera or other sensor able to detect personal data; or
2. even with a camera or other sensor, weighs less than 250g, but is a toy (this means that its documentation shows that it complies with 'toy' Directive 2009/48/EC);

A drone is certified when it has a certificate of airworthiness (or a restricted certificate of airworthiness) issued by the National Aviation Authority. In this case, it requires a registration. A certified drone is needed only when the risk of the operation requires it. So, certification is never needed for drones operated in the 'open' category.

4.2.4.5 Geographical Zones

All EU Member States are obligated to publish maps which identify geographical zones with prohibition of drone traffic, or where flight authorization is a prerequisite of starting the drone flight operation (*Article 15 of EU Regulation 2019/947)*. Each Member State should have an easy way of accessing said maps, usually online or via dedicated apps, as it ought to be easy to identify when one can fly.

A flight authorization is not the same as an operation authorization which is a requirement in the "specific" drone category. A flight authorization is applicable to all operations in open or specific category and is issued by the authority/entity identified in the maps by a given state.

4.3 Contracting standards for FlexiGroBots

4.3.1 Ethical considerations of farm data ownership

The main aim of the FlexiGroBots project is to create solutions for precision agriculture and commercialise these technologies in the long run (increase yields, reduce waste, make the process cheaper, etc.). For this to work, FlexiGroBots partners are aiming to create (among other technologies) shared datasets which are diverse and substantial enough to achieve goals Agricultural Data Space infrastructure. The need for technologies developed on the project these solutions to work at scale leads to high dependence on third party providers (ATP's) by small and medium size farmers. This leads to lesser bargaining power on the side of farmers. Which, in turn, may lead to both inefficient and unjust commercial practices, by creating discrepancies between contracting parties. In order to commercialise this solution, partners of the project should consider implementing an ethical and legal standard of data ownership and agricultural service contracting for FlexiGroBots. CEPS will provide guidance and suggestions on data governance on contracting between Agricultural Technology Providers (ATP's) and data providers (farmers, agricultural landowners, etc.).

The potential of digitising European agriculture seems to be the way for creating a sustainable agricultural sector, to achieve that in line with *acquis communautaire* practices in this market, partners should follow best practices in contract law in agriculture as well as consider market specific dependencies resulting in an efficient sector (Renda *et al.*, 2019). For FlexiGroBots to be aligned with the concept of a Common Data Space for the agricultural community, the FlexiGroBots project should deal with the potential digital anticommons issue arising from the centralisation of data access by ATP companies (Hunter, 2003). To achieve this, CEPS proposes to integrate joint 'Privacy & Security Principles for Farm Data' which would be created by CEPS in line with the applicable EU regulations. Such a shift would ensure the betterment of the equal opportunities in the agricultural sector by creating a more disperse data governance industry standard.

The most important issues to consider for Privacy & Security Principles for farm data are:

- Security
- Privacy
- Transparency

Security and privacy are already a topic well developed in the EU, although GDPR does not identify GPS data (often used in farm data) as an individual's data, hence offer no protection. The incoming Data Services Act will also bear security implications.

Transparency does not only constitute responsible innovation, AI assurance and improving researcher- industry relations, but also implies adaptation of non-financial reporting by the ATP's.

The proposed solution would be to develop a set of contract rules for farm data and services. The initial work conducted with success in the US can constitute a starting point (AG Data Transparent, 2014). The original idea is to incorporate a set of contracting standards which would enforce a dual (*in development*) structure of data ownership (inspired by the dual class shares concept) emphasizing the need for farmers to keep full rights to their data (Posner and Weyl, 2019) while selling only limited rights relevant (and limited to) for the activity undertaken by ATP's (Jouanjean *et al.*, 2020). The standards should take advantage of digital solutions like smart contracts (Lakusic, 2021) which would be a version of adhesive contract, by removing the bargaining power of parties with contracts drafted in line with the standard provisions it would aim to restore market balance between parties, by nullifying the information asymmetry and off-balance bargaining power (Hoffman, 2018). This solution would also aim to minimise human bias as a source of negative externalities.

Standards will comprise of two dimensions: property dimension and contractual dimension.

4.3.2 Property rights

The ongoing problem in the digital markets are the monopolies created by the platforms offering certain service and subsequent monopsony as those platforms are one of the only places amassing the gathered data (buyers of data). Such behaviour can be observed in big agricultural service providers in the United States which hold considerable market power while at the same time make the transfer of agricultural data ownership a mandatory contract provision in addition to the other compensation for the provided service. In order to be compliant with EU's antitrust laws as well as the upcoming digital regulatory package (Digital Services Act, Digital Markets Act, EU Data Act, EU Data Governance Act) partners should consider incorporating property solutions that would enable the creation of socially desirable competition as well as ensure the transfer of fair value in exchange for the data provided. One of the main premises of such property structure is the fair compensation for the data provided, the value of which ought to be included in the contractual agreement. To ensure compliance with such values we propose a property structure based on a dual (at least) class system, meaning that owners of farm data would not transfer full "ownership" of the farm data to the ATP's during the duration of the contract. The property structure would allow ATPs to use the data only to fuel its services, for the duration of the contract. This constitutes second tier ownership. First tier owners (the farmers) would keep full property rights on the data generated by their agricultural activity, and they will be free to harness other additional value from their farm data despite using the ATP's services. The optimal structure of the property rights will be aligned with regards to the farm data utility curve as well as external systemic values.

4.3.3 Contract law

Digitizing the agricultural sector leads to medium and small farmers to rely mostly on third party providers to stay competitive. Agricultural Technology Providers (ATP) thus are in a comfortable position to gain a concentrated position on farm data market, leading to inefficiencies and dead weight loss. The could shift the power in the agricultural sector in favour of ATPs. Lack of know-how and the capital intensive nature of agriculture data analysis forces small and medium farmers into the lesser market situation and distorts the balance between equal parties in contractual situations leading to the rise of economy of scale in farm data market. Considering the sustainability of Common Data Spaces and its longevity depends on anticipating the EU's approach to digital platform regulation (Digital Markets Act; Digital Services Act) and multiple antitrust issues(MacDonald, 2006).

To deliver the goals of Common Data Space and ensure maximising effects of data value chains (Molly, 2021)(Mitchell, Lesher and Barberis, 2022), with consideration for privacy and security of the network, and in the future commercialise this solution, partners of the project should consider implementing an ethical and legal standards of data ownership and agricultural service contracting for FlexiGroBots. CEPS will provide guidance and suggestions on data governance on contracting between Agricultural Technology Providers (ATP's) and data providers (farmers, agricultural landowners, etc.).

4.4 Artificial Intelligence

Considering the state of the regulation of Artificial Intelligence (AI) in the EU, the first relevant step to take is to define the subject matter. AI is a multifaceted phenomenon whose operation depends upon a conjunction of components, technical solutions, and actors. AI is also famous for its vast spectrum of uses and applications. Therefore, the legal landscape of Artificial Intelligence is rather complex, as it means there is no complete regulatory framework for AI. Regulation of this technology will come as a combination of both AI-specific and general rules dealing with transversal aspect such as: data, cybersecurity, competition, intellectual property rights, consumer protection, etc.

4.4.1 AI Specific law

In the category of acts concretely mentioning AI we have only one legislative proposal: the AI Act. This proposal harmonises rules regarding AI application in line with EU laws and values. Compliance with the EU regulations is ensured by applying risk-based approach to AI systems.

Firstly, the AI Act prohibits AI practices posing unacceptable risks. It proposes bans on applying AI to manipulate persons through subliminal techniques or exploit the fragility of vulnerable individuals, and could potentially harm the manipulated individual or third person; on general purposes social scoring by public authorities; and on biometric identification in real time in public spaces for law enforcement purposes. Secondly, the proposal regulates high-risk systems which are part of a product under the EU product safety regulation; or are part of a stand-alone high-risk AI system list included in the proposal. Most common example of the latter are autonomous assessment of creditworthiness or automated recruitment. Providers of high-risk AI applications are obliged to maintain sound risk management systems. Feeding data to those applications of AI is strictly guarded by specific data governance and management rules.

Considering the current state of AI technologies in the FlexiGroBots project none of its applications seem to fall under the high-risk category. Partners should, however, monitor the development of the AI systems and periodically verify if any of the possible applications could be consider a high-risk application. Partners should especially monitor if a developed technology is relevant for EU product safety regulations.

4.4.2 Legal acts relevant for AI

There is a larger number of legal acts whose subject matter is not strictly AI but they are still directly or indirectly relevant. While there are legal acts that are intended to regulate, fully or partially, the use, marketisation, and application of AI systems, other acts may impact AI systems indirectly or even incidentally. Due to the disperse nature of the AI legal landscape it is crucial to determine possible risks when developing and applying AI technology.

4.4.2.1 Legal acts providing for rules on algorithmic processes and algorithm driven decision-making

Legal acts which refer to subject matter connected to AI are acts which provide for rules on algorithms and algorithmic systems more broadly, automation, or automatic decision-making. Legal provisions in these acts do not explicitly mention Artificial Intelligence nor its various systems by name. Acts that are included in this category are the General Data Protection Regulation (European Commission, 2016), the Digital Services Act (European Commission, 2020d), the Digital Markets Act (European Commission, 2020e), and various peer-to-business regulations (European Commission, 2019e). Despite not explicitly mentioning AI in their provisions, those acts are relevant for the real-life application of AI systems. Those acts include mentions of algorithmic rating, algorithmic decision-making, algorithmic recommender systems, algorithmic content moderation, algorithmic structures, automated profiling, and a variety of activities and actions conducted by automated means.

Acts in this category set rules for algorithms, *inter alia*: risk assessment, disclosure, accountability and transparency audits, on-site inspections, obtaining consent, etc. The definitions set in the AI Act categorise recommendations, decisions, predictions and various content, as well as resultant actions of the AI system in relation to its environment as a common and frequent output of applied AI technology.

Accordingly, legal acts providing rules for algorithmic processes and decision-making for various scenarios and purposes are relevant for an innovation action which creates and applies AI systems. Our analysis can provide meaningful insight into futureproofing created technology from imminent EU regulation in this field.

4.4.2.2 Legal acts paving the way for the development of AI

Moreover, there are legal acts which do not regulate AI, but create legal foundations upon which an AI-promoting economic and technical environment is created. It is important for the project to consider a broader scope of the AI environment, and especially the spectrum of its application which should promote fairness, safety and trustworthiness. This category includes acts relating to data governance, cybersecurity, infrastructure, digital identity, etc.

4.5 Machinery Directive

The Machinery Directive establishes a regulatory framework for mechanical engineering industry products (*European Commission*, 2006). Its purpose is to establish a balance between a free movement of machinery within the internal market and a high level of protection for machinery users and others. The Machinery Directive is currently undergoing a revision process (European Parliament, 2021), as it was pointed out in 2018 that the directive might not sufficiently cover new risks stemming from emerging technologies, in particular robots run on AI technologies. Despite the current version of the directive clearly hampering the application of precision agriculture (European Commission, 2020b), partners should remain in line with its provisions. CEPS will monitor and update partners on the developments regarding new proposals and relevant new provisions which may not come into force within the life-span of the project but most likely will influence the functioning of the end product for years to come.

5 Recommendations

This section presents the recommendations developed based on the interviews and literature review. Please note, that an earlier version of the recommendations was shared with the partners during the first year of the project and the implementation of some recommendations has already started at the point of submission of this deliverable.

5.1 Overarching Recommendations

#	Urgency	Recommendation	Recommendation target	Responsibility	Status	Follow-up
1	Short term	The direct line of communication between the project's Data Protection Officer (DPO, BioSense), the three pilots and the platform developers should be reinforced. To ensure that the project is compliant with the **GDPR**, the regulation should already be applied during the development phase ('privacy by design'). Calls between the DPO and technical partners should be set up to understand which GDPR standards should be applied and to help the DPO and CEPS develop recommendations. Both intentionally and accidentally collected personal data should be considered.	Pilots & Platform	BioSense/DPO (lead), all partners.	Data Protection interviews were conducted in early 2022 with all partners and more fine-grained recommendations were developed (see details for each partner below).	Q3 2022

#	Urgency	Recommendation	Recommendation target	Responsibility	Status	Follow-up
2	Short term	The pilots and platform developers should (re-)review the applicable **legal frameworks regarding autonomous vehicles**. CEPS has conducted an initial review of the legal framework, available in section 4.2 of this document. The pilots can take this review as a basis and then go deeper especially into their own national framework. Given legal uncertainty, consultations with regional authorities could be advisable.	Pilots & Platform	Pilots & Platform	[See the corresponding row in the table for each pilot]	Finalised
3	Short term	CEPS and the partners should continue assessing **ELSE impacts**. This should include both risks and opportunities related to Ethical, Legal & Socio-Economic factors. The ELSE assessment will be kept up to date based on tasks T4.4/T5.4/T6.4 for each pilot.	Pilots & Platform	CEPS, Partners (provision of information)	Additional interviews with stakeholders such as farmers were conducted.	Continued series of interviews in 2022 & 2023.
4	Medium term	CEPS suggests the adoption of standardised **Model Cards and Datasheets** to record essential information about the models and datasets which are published by FlexiGroBots. This should include information on accuracy metrics, training data, intended purposes, licenses etc. Model Cards and Dataset Sheets are useful to enforce standards and they enable the project to upload datasets and AI models in a standardised, informative format to platforms like AI4EU. The proposed template for the Model Cards and Datasheets is available in section 5.6 and 5.7.	Pilots & Platform	CEPS (development of template); Partners (provision of information)	The template for model cards and datasheets was proposed and discussed in this deliverable.	Adherence to the templates will be verified in upcoming ELSE calls.

Table 5 - Overarching Recommendations

5.2 Platform

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
1	Short term	The platform team should assess which platform components are relevant for **human safety** and coordinate with the pilots regarding physical human safety. For example, the reliability of the digital stop-button and mission planning should be assessed in light of human safety risks when working with heavy autonomous robots. Clarify with each pilot whether a digital stop-button via the Mission Control Centre will be technically possible. Some pilots explained that some robots will not have a remote connection in open fields. Could this also be an issue for other pilots?	Technical Robustness & Safety; Human Oversight	Platform Team, Pilots	The FlexiGroBots platform components do not pose a risk for humans. In the initial analysis, some doubts surged for the MCC but in the final version of the architecture proposed in D2.4, control activities and prevention of safety risks are delegated to the specific robot systems. An incorrect behaviour of Common Application Models embedded in autonomous vehicles, however, may lead to human safety risks (e.g., problems in the detection of persons). Therefore, robust safety systems should be implemented such as stopping whenever a moving obstacle (possible person or animal) is detected. Also the robot should stop whenever it detects that it has lost communication with the monitoring system in the field. Obstacle detection systems should be robust and use more than one type of sensor. Moreover, the project is considering elements of the ISO 18497 standard “Agricultural machinery and tractors — Safety of highly automated agricultural machines” (see D2.4)	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
2	Short term	The direct line of communication between the project's Data Protection Officer (DPO, BioSense), the technical developers of the platform should be reinforced. To ensure that the project is compliant with the **GDPR**, the regulation should already be applied during the development phase ('privacy by design'). Calls between the DPO and technical partners should be set up to understand which GDPR standards should be applied and to help the DPO and CEPS develop additional recommendations. Two groups of personal data need to be considered from the GDPR perspective: Intentionally collected personal data and accidentally collected data. Most importantly, there are some use-cases which involve the intentional collection and processing of personal data, such as T3.4, which involves the tracking of individuals with the objective to increase safety of robotic operations.	Privacy & Data Governance	T3.4 lead (Atos), DPO (BioSense)	Data Protection interviews were conducted in early 2022 with all partners and more fine-grained recommendations were developed (see details below).	Q3 2022
3	Medium term	If **personal data** is collected via the platform (for example via cookies on the website or user accounts), relevant provisions from the GDPR, such as the right to withdraw consent, the right to object and the right to be forgotten should be implemented in the platform before the platform goes live. (Tasks other than T3.4 do not to involve personal data.)	Privacy & Data Governance	Platform Team, Data Protection Officer (BioSense)	Currently, no personal data is being collected on the platform. However, if this problem arises, it will be tackled by implementing full GDPR requirements.	Q3 2022
4	Medium term	T3.4 should implement an **image anonymisation module** to remove personal identifiers from images. The image anonymisation module should be shared with all	Privacy & Data Governance	T3.4 Team	The anonymisation tool has been created.	Finalised

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
		partners to enable them to anonymise images if needed, for example before publishing image datasets.				
5	Medium term	The platform should establish a mechanism for users to **flag issues** related to technical problems, data protection, bias or other issues. This mechanism could be implemented via a feedback form on the website or an email address which is regularly checked.	Other	Platform Team	This requirement has been included in the backlog for the FlexiGroBots platform. Since it is not needed for the execution of the project's pilots, its implementation will depend on the progress with the rest of the features.	Q3 2022
6	Medium term	The platform team should discuss the **logging capabilities and requirements** with each pilot. Pilots might log different types of data in very different formats and harmonisation could be beneficial. It seems to be unclear whether data will be logged and stored via the platform or the pilots individually. Logging the robots' activities will be important to enable traceability and auditability, for example in case of incidents or external audits.	Transparency	Platform Team	Detailed logs will be generated and stored by each component of the platform. Since systems relying on the FlexiGroBots technology are based on a loosely coupled architecture where several partners can provide different components, a unique and central storage location is not foreseen. Consideration could be given to storing the data sent to the MCC by the robots, in other words, telemetry sent to and used by the MCC to monitor and visualise the mission.	Q3 2022
7	Medium term	While most data subjects are plants, not people, the risk of **bias and discrimination** should be considered for this tasks where personal data is processed. For example T3.4 involves the tracking of individuals to increase the safety of autonomous robots. The task lead should ensure that the accuracy of people recognition does not depend on factors such as the colour of worker's skin.	Diversity, Non-discrimination and Fairness	Task 3.4 lead (Atos)	Bias and discrimination are well known issues in Machine Learning. The common applications and services of the FlexiGroBots platform are being developed using State of the Art pre-trained models and variate datasets to address this matter.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
8	Medium term	CEPS will do interviews with other stakeholders and further reflect on potential biases and fairness risks and social impacts.	Diversity, Non-discrimination and Fairness; Societal and Environmental Wellbeing	CEPS	Additional interviews with stakeholders such as Farmers or the AI4Europe platform have been conducted	Q3 2022
9	Long term	Integrate **CodeCarbon** tracking software in the platform to track the energy consumption and CO2 equivalents. This would provide a way to measure the environmental impact of the AI Platform. See https://codecarbon.io	Societal and Environmental Wellbeing	AI Platform (Atos)	CodeCarbon was added to the backlog of the platform developers. The project will analyse the integration of tools like Kube Carbon to calculate the footprint of the project technologies, which are being mostly deployed over Kubernetes.	Q1 2023
10	Long term	Remember to implement **training & guidance materials** e.g. for human oversight, once the platform is more mature. Moreover, documentation for relevant components for end-users e.g. on risks should be drawn up.	Other	Platform Team, Pilots	The creation of detailed documentation for users and administrators of FlexiGroBots platform is considering modern practices that guarantee the maintainability of the project's results. Additional training material will be prepared as part of the activities of WP7 and more specifically in T7.4 Technology transfer and demonstrator roll out.	Q1 2023
11	Long term	Once the platform matures, **cyber-security** questions should be revisited.	Technical Robustness & Safety	Platform Team	The FlexiGroBots platform components will incorporate mechanisms to enforce cybersecurity and protect the confidentiality of the information, both at rest and in transit. In this sense, the first versions of the prototypes include authentication and authorization functionalities,	Q1 2023

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
					encrypt communication with secure protocols (HTTPS) and are based on updated software technologies.	

Table 6 - Main Recommendations, Platform

5.3 Pilot 1

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
1	1. Short term	Assess potential physical safety risks to people when working with heavy autonomous robots and take mitigation measures if necessary. For example, ensure that both a physical and digital stop button are functional. Especially the digital stop button can work less well across wide distances on the field. Some pilots explained that a digital stop button is technically not possible given the lack of connectivity.	Human Oversight; Technical Robustness & Safety	Pilot 1	Ground mobile robots, of small-medium size (RB-Vogui - 200 kg; Twizy - 600 kg), work at very low speeds (in the order of 3 km/h), so the response to a stop command is instantaneous, as the inertia is low. Robust safety systems are being implemented within the robot: 1) Immediate stop on detection of a moving obstacle (person or animal); 2) Immediate detection of loss of communication with the supervision centre in the field. 3.) Obstacle detection systems use more than one type of sensor (cameras, ultrasound, UWB, etc.).	Q3 2022
2	1. Short term	The direct line of communication between the project's Data Protection Officer (DPO, BioSense), the technical developers of the pilot should be reinforced. To ensure that the project is compliant with the GDPR, the regulation should already be applied during the development phase ('privacy by design'). Calls between the DPO and technical partners should be set up to understand which GDPR standards should be applied and to help the DPO and CEPS develop additional recommendations. Both intentionally and	Privacy & Data Governance	DPO/BioSense, Pilot 1, CEPS	Data Protection interviews were conducted in early 2022 with all partners and more fine-grained recommendations were developed (see details below). Agreement was achieved to distribute consent forms to people working in relation to the pilot. The consent forms will be filled in before the next field tests in August. Moreover, areas will be marked with signs informing of access prohibitions and possible dangers.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
		accidentally collected personal data should be considered.				
3	1. Short term	The coding instructions for annotators of different datasets should include an instruction to anonymise or remove personal data from the annotated datasets. Alternatively, the automatic anonymisation tool developed in T3.4 can be used for blurring faces in images.	Privacy & Data Governance	Pilot 1	The cameras on the UAV are pointed to the ground and the cameras on the ground robots to provide the Botrytis data are pointed directly at the vineyards plants so it is impossible to capture any person's face. Moreover, software will be used to blur faces if necessary.	Q3 2022
4	1. Short term	Pilots and Platform developers should discuss where the logs from robots will be stored. If possible, certain types of data should be collected in a harmonised format across pilots to facilitate auditability of robots in case of accidents. The interviews showed that it is not entirely clear yet where which logs will be stored and in what format (by the pilot or the platform?).	Accountability	CSIC	Telemetry data will be sent to, and used by, the MCC to monitor and visualise the mission. The MCC could store/log received data for further analysis. MCC is still under design and an agreement on a harmonised format has not been discussed/reached yet. In any case, ground robots and UAV's will store locally all mission related data.	Q3 2022
5	1. Short term	While a training for piloting drones is required by law, ground robots seem to be less regulated. The pilot should review existing standards and establish internal standards to ensure that UGVs are piloted safely.	Human Oversight	Pilot 1	Ground robots will not be piloted like UAVs, as they are fully autonomous, but they will always work under a supervision system with the ability to intervene if necessary. The supervision system will be close to the robots and under human operator control. As a rule, access to the robots' working area must be controlled and limited to authorised personnel only, as is the case in industrial manufacturing. Robots are also equipped	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
					with safety systems that are standard with mandatory shutdown in case of potentially dangerous situations.	
6	2. Medium term	Ensure the implementation of clear standards for data collection and testing of algorithms. Document the implementation of these standards throughout the project. This can, for example, include coding instructions for annotators and a codebook as well as logs on metrics for accuracy tests.	Robustness & Safety	Pilot 1	All the processes followed are documented in detail.	Q3 2022
7	2. Medium term	While no specific issues related to bias were detected at this time, CEPS and the pilot should continue thinking about potential risks for diversity or bias. CEPS will conduct interviews with a broader range of stakeholders, including workers/unions and farmers to assess ELSE impacts on them.	Diversity, Non-Discrimination and Fairness	CEPS, Pilot 1	Additional interviews with stakeholders like farmers have been conducted and will continue throughout the project.	Q3 2022
8	2. Medium term	A list of risks related to ELSE factors should be created and continuously assessed throughout the pilot process. (e.g. regarding physical safety, privacy risks, cyber security, impacts of the environment).	All domains	CEPS & Pilot, as part of T4.4	ELSE risks were identified in D2.6 and will be assessed throughout the project.	Q3 2022
9	2. Medium term	Consider the risks that the pest detection algorithm could identify useful insects like bees as pests and take mitigation measures during data collection, annotation and training.	Environmental impact	Pilot 1	In this case Botrytis is a plant disease and not insect related. The Botrytis detection system is designed to identify the disease symptoms to carry out precision treatment only on affected bunches. This has a much smaller effect on the useful insects than the treatment system currently applied, which	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
					applies phytosanitary treatment to all plants in an area, whether or not they have Botrytis.	
10	3. Long term	Reconsider cyber security risks and mitigation measures once the pilot is more mature.	Robustness & Safety	Pilot 1	Currently from a robot control perspective, Cybersecurity risks will be mitigated by having a supervision system in the field, with direct connection to the robots that allows operators to monitor missions and stop them in case of problems. Regarding data privacy or data transmissions and communications, cybersecurity risks will be reviewed in future stages of the pilot, as the MCC is currently under design.	Q1 2023
11	3. Long term	Create a user manual and introductory training materials for new users. This should be based on clear documentation created throughout the project.	Human Oversight	Pilot 1	A protocol is in place for the generation of documentation.	Q1 2023
12	3. Long term	In a later development stage, the user-friendliness and accessibility of the systems should become high priority. For example, the needs of disabled people and less technically savvy users should be considered, e.g. by taking disabilities like colour blindness into account in interface design. Consider the seven Universal Design Principles: https://universaldesign.ie/what-is-universal-design/the-7-principles/	Diversity, Non-Discrimination and Fairness	Pilot 1	The autonomy of ground robots favours the fulfilment of the 7 principles.	Q1 2023

Table 7 - Main Recommendations, Pilot 1

Detailed recommendations for personal data protection in Pilot 1

- **Harvesting assistance**: We recommend not to store the IDs linked to individual workers. Even if the ID is randomized and changed after a work day, it can still be linked to individual workers for a given time period. Not storing this data would help compliance with GDPR rules such as purpose limitation or data minimisation. We assume that storing these IDs is not necessary for the purpose of the pilot.
- For the other use cases: Ensure and enforce **clear measures for preventing people from accessing the field** during UAV and UGV operations to minimise the risk of accidental personal data collection and to increase safety. These measures can take the form of written instructions, trainings and signs on the field.
- A **consent form** should be filled in by everyone working with the robots, covering the case of unintentional personal data collection from UGVs and UAVs especially via images. The consent must cover all use cases and scenarios of accidental personal data collection discussed with the pilot. Moreover, the form should explain decisions taken by the harvesting assistance robots. The draft consent form is an integral part of the D1.3 Data Management Plan (M03). CEPS has provided the pilot with an updated draft consent form based on our discussions.
- T3.4 has developed an image anonymisation module, which can be used by the pilots on image data before processing or publication to avoid data protection issues.

5.4 Pilot 2

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
1	1. Short term	Assess potential physical safety risks to people when working with heavy autonomous robots and take mitigation measures if necessary. For example, ensure that both a physical and digital stop button are functional. Especially the digital stop button can work less well across wide distances on the field. Pilot 3 explained that a digital stop button is technically not possible given the lack of connectivity.	Human Oversight; Technical Robustness & Safety	Pilot 2	A physical stop buttons exist in every corner of the robot and remote control checks the connectivity continuously and robot is stopped is case of connectivity issues.	Q3 2022
2	1. Short term	The direct line of communication between the project's Data Protection Officer (DPO, BioSense), the technical developers of the pilot should be reinforced. To ensure that the project is compliant with the GDPR, the regulation should already be applied during the development phase ('privacy by design'). Calls between the DPO and technical partners should be set up to understand which GDPR standards should be applied and to help the DPO and CEPS develop additional recommendations. Both intentionally and accidentally collected personal data should be considered.	Privacy & Data Governance	DPO/BioSense, Pilot 2, CEPS	Data Protection interviews were conducted in early 2022 with all partners and more fine-grained recommendations were developed (see details below). The pilot confirms that it is compliant with the discussed GDPR requirements.	Q3 2022
3	1. Short term	The coding instructions for annotators of different datasets should include an instruction to anonymise or remove personal data from the annotated datasets. Alternatively, the automatic anonymisation tool developed in T3.4 can be used for blurring faces in images.	Privacy & Data Governance	Pilot 2	The pilot will not publish data sets with people.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
4	1. Short term	Pilots and Platform developers should discuss where the logs from robots will be stored. If possible, certain types of data should be collected in a harmonised format across pilots to facilitate auditability of robots in case of accidents. The initial interviews showed that it is not entirely clear yet where which logs will be stored and in what format (by the pilot or the platform?).	Accountability	Pilot 2	This point is currently under discussion as the relevant components are currently being developed.	Q3 2022
5	1. Short term	While a training for piloting drones is required by law, ground robots seem to be less regulated. The pilot should review existing standards and establish internal standards to ensure that UGVs are piloted safely.	Human Oversight	Pilot 2	Only authorized personnel can operate autonomous robots.	Q3 2022
6	2. Medium term	Ensure the implementation of clear standards for data collection and testing of algorithms. Document the implementation of these standards throughout the project. This can, for example, include coding instructions for annotators and a codebook as well as logs on metrics for accuracy tests.	Robustness & Safety	Pilot 2	Interoperability with the AI platform has been implemented.	Q3 2022
7	2. Medium term	While no specific issues related to bias were detected at this time, CEPS and the pilot should continue thinking about potential risks for diversity or bias. CEPS will conduct interviews with a broader range of stakeholders, including workers/unions and farmers to assess ELSE impacts on them.	Diversity, Non-Discrimination and Fairness	CEPS, Pilot 2	Additional interviews with stakeholders like farmers have been conducted and will continue throughout the project.	Q3 2022
8	2. Medium term	A list of risks related to ELSE factors should be created and continuously assessed throughout the pilot process. (e.g. regarding physical safety, privacy risks, cyber security, impacts of the environment).	All domains	CEPS & Pilot, as part of T5.4	ELSE risks were identified in D2.6 and will be assessed throughout the project.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
9	2. Medium term	Consider the risks that the pest detection algorithm could identify useful insects as pests and take mitigation measures during data collection, annotation and training.	Environmental impact	Pilot 2	Risk has been identified and mitigation measures considered.	Q3 2022
10	3. Long term	Reconsider cyber security risks and mitigation measures once the pilot is more mature.	Robustness & Safety	Pilot 2	The exact implementation of this recommendation will be decided at a later stage of the project.	Q1 2023
11	3. Long term	Create a user manual and introductory training materials for new users. This should be based on clear documentation created throughout the project.	Human Oversight	Pilot 2	The exact implementation of this recommendation will be decided at a later stage of the project.	Q1 2023
12	3. Long term	In a later development stage, the user-friendliness and accessibility of the systems should become high priority. For example, the needs of disabled people and less technically savvy users should be considered, e.g. by taking disabilities like colour blindness into account in interface design. Consider the seven Universal Design Principles: https://universaldesign.ie/what-is-universal-design/the-7-principles/	Diversity, Non-Discrimination and Fairness	Pilot 2	The exact implementation of this recommendation will be decided at a later stage of the project.	Q1 2023

Table 8 - Main Recommendations, Pilot 2

Detailed recommendations for personal data protection in Pilot 2

- Ensure and enforce **clear measures for preventing people from accessing the field** during UAV and UGV operations to minimise the risk of accidental personal data collection and to increase safety. These measures can take the form of written instructions, trainings and signs on the field.
- A **consent form** should be filled in by everyone working with the robots, covering the case of unintentional personal data collection from UGVs and UAVs especially via images. The consent must cover all use cases and scenarios of accidental personal data collection discussed with the pilot. The draft consent form is an integral part of the D1.3 Data Management Plan (M03). CEPS has provided the pilot with an updated draft consent form based on our discussions.
- T3.4 has developed an image anonymisation module, which can be used by the pilots on image data before processing or publication to avoid data protection issues.

5.5 Pilot 3

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
1	1. Short term	Assess potential physical safety risks to people when working with heavy autonomous robots and take mitigation measures if necessary. In particular, clarify for which UGV/UAV a remote/digital stop button can be implemented in pilot 3 and discuss with the platform developers (CSIC, Atos) how the digital stop button and remote oversight is handled by other pilots.	Human Oversight; Technical Robustness & Safety	Pilot 3	MCC integration with the Pilot 3 UGV is being implemented and it will include a digital stop button. Until then, the UGV will be steered manually.	Q3 2022
2	1. Short term	The direct line of communication between the project's Data Protection Officer (DPO, BioSense), the technical developers of the pilot should be reinforced. To ensure that the project is compliant with the GDPR, the regulation should already be applied during the development phase ('privacy by design'). Calls between the DPO and technical partners should be set up to understand which GDPR standards should be applied and to help the DPO and CEPS develop additional recommendations. Both intentionally and accidentally collected personal data should be considered.	Privacy & Data Governance	DPO/BioSense, Pilot 2, CEPS	Data Protection interviews were conducted in early 2022 with all partners and more fine-grained recommendations were developed (see details below).	Q3 2022
3	1. Short term	The coding instructions for annotators of different datasets should include an instruction to anonymise or remove personal data from the annotated datasets. Alternatively, the automatic anonymisation tool developed in T3.4 can be used for blurring faces in images.	Privacy & Data Governance	Pilot 3	The datasets do not involve personal data. In case personal data will be collected, a consent form will be signed.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
4	1. Short term	Clarify whether the fact that the pilot is situated outside of the EU has an impact on data protection related issues. For example, is there an adequacy agreement between Serbia and the EU? Are there specific measure which need to be taken in case personal data needs to be transferred between the Serbian pilot and EU partners?	Privacy & Data Governance	Pilot 3	Serbia Data Protection Law (Official Gazette of RS 87/2018) from 9 November 2018, with its' applicability starting from 21 August 2019 is fully in line with the EU's GDPR. All the work that will be conducted in Serbia follows the procedures and criteria that have been set and are in accordance with standards and guidelines of Horizon 2020 program, EU legislation, national legislation in Serbia, and professional standards. Personal data collection was not foreseen in Pilot 3, nor its transfer from Serbia to EU and vice versa. However, hypothetically in case there is a need for personal data transfer from Serbia to specific country/ies in EU, a "Standard Contractual Clauses" will be prepared and utilised in order to secure full legislative coverage of this action.	Q3 2022
5	1. Short term	Pilots and Platform developers should discuss where the logs from robots will be stored. If possible, certain types of data should be collected in a harmonised format across pilots to facilitate auditability of robots in case of accidents. The interviews showed that it is not entirely clear yet where which logs will be stored and in what format (by the pilot or the platform?).	Accountability	Pilot 3	We plan to store the data internally in the pilot. If a higher level of alignment between the pilots would be required, however, the data will be stored on the platform.	Q3 2022
6	1. Short term	While a training for piloting drones is required by law, ground robots seem to be less regulated. The pilot should review existing standards and establish internal standards to ensure that UGVs are piloted safely.	Human Oversight	Pilot 3	All UGV operators have went through internal trainings at BioSense's premises, i.e. in controlled conditions.	Q3 2022

#	Urgency	Recommendation	Domain	Responsibility	Status	Follow-up
7	2. Medium term	Ensure the implementation of clear standards for data collection and testing of algorithms. Document the implementation of these standards throughout the project. This can, for example, include coding instructions for annotators and a codebook as well as logs on metrics for accuracy tests.	Robustness & Safety	Pilot 3	We are tracking the metrics, i.e. performance of AI algorithms and documenting the progress. For data acquisition, we followed the procedure jointly written by Art21 and BioSense, which requires ground control points and other details.	Q3 2022
8	2. Medium term	While no specific issues related to bias were detected at this time, CEPS and the pilot should continue thinking about potential risks for diversity or bias. CEPS will conduct interviews with a broader range of stakeholders, including workers/unions and farmers to assess ELSE impacts on them.	Diversity, Non-Discrimination and Fairness	CEPS, Pilot 3	Additional interviews with stakeholders like farmers have been conducted and will continue throughout the project.	Q3 2022
9	2. Medium term	A list of risks related to ELSE factors should be created and continuously assessed throughout the pilot process. (e.g. regarding physical safety, privacy risks, cyber security, impacts of the environment).	All domains	CEPS & Pilot, as part of T6.4	ELSE risks were identified in D2.6 and will be assessed throughout the project.	Q3 2022
10	3. Long term	Reconsider cyber security risks and mitigation measures once the pilot is more mature.	Robustness & Safety	Pilot 3	This will be tackled in a subsequent reporting period.	Q1 2023
11	3. Long term	Create a user manual and introductory training materials for new users. This should be based on clear documentation created throughout the project.	Human Oversight	Pilot 3	This will be tackled in a subsequent reporting period.	Q1 2023
12	3. Long term	In a later development stage, the user-friendliness and accessibility of the systems should become high priority. For example, the needs of disabled people and less technically savvy users should be considered, e.g. by taking disabilities like colour blindness into account in interface design. Consider the seven Universal Design Principles: https://universaldesign.ie/what-is-universal-design/the-7-principles/	Diversity, Non-Discrimination and Fairness	Pilot 3	This will be tackled in a subsequent reporting period.	Q1 2023

Table 9 - Main Recommendations, Pilot 3

Detailed recommendations for personal data protection in Pilot 3

- Ensure and enforce **clear measures for preventing people from accessing the field** during UAV and UGV operations to minimise the risk of accidental personal data collection and to increase safety. These measures can take the form of written instructions, trainings and signs on the field.
- A **consent form** should be filled in by everyone working with the robots, covering the case of unintentional personal data collection from UGVs and UAVs especially via images. The consent must cover all use cases and scenarios of accidental personal data collection discussed with the pilot. The draft consent form is an integral part of the D1.3 Data Management Plan (M03). CEPS has provided the pilot with an updated draft consent form based on our discussions.
- T3.4 has developed an image anonymisation module, which can be used by the pilots on image data before processing or publication to avoid data protection issues.

5.6 Model Card Template

As described in section 2.3.2, we recommend that every ML/AI model developed and published by FlexiGroBots is accompanied by a custom model card. The purpose of the model cards is to help future external and internal users understand key characteristics of the model and judge whether it can be useful for their specific use-case. The model card below provides information on a fictional example as a guideline.

Model Cards for Model Reporting				
Based on Mitchell et al. 2019 **With elements from the draft EU AI Act, Annex IV, 2021**				
Category	**Question ID**	**Sub-Category**	**Question**	**Example Response**
1. Model details. Basic information about the model	1	Person or organization developing model	What person or organization developed the model? This can be used by all stakeholders to infer details pertaining to model development and potential conflicts of interest	CSIC (Spanish National Research Council), with partners in the FlexiGroBots project. https://flexigrobots-h2020.eu/
	2	Model date	When was the model developed? This is useful for all stakeholders to become further informed on what techniques and data sources were likely to be available during model development.	Start of development: December 2021 Publication of current version: 15.06.2022
	3	Model version	Which version of the model is it, and how does it differ from previous versions? This is useful for all stakeholders to track whether the model is the latest version, associate known bugs to the correct model versions, and aid in model comparisons.	1.0

Model Cards for Model Reporting				
	4	Model type	What type of model is it? This includes basic model architecture details, such as whether it is a Naive Bayes classifier, a Convolutional Neural Network, etc. This is likely to be particularly relevant for software and model developers, as well as individuals knowledgeable about machine learning, to highlight what kinds of assumptions are encoded in the system.	The model is a Vision Transformer (ViT), more specifically, the BEiT model pre-trained by Microsoft Research. The model was fine-tuned on images of grape vines in Italy.
	5	Paper or other resource for more information	Where can resources for more information be found?	For more information about the BEiT base model, see https://huggingface.co/microsoft/beit-base-patch16-224-pt22k-ft22k
	6	Citation details	How should the model be cited?	CSIC. 2022. A BEiT Image Classifier for grape vines. FlexiGroBots Project. Available online: [URL …]
	7	License and IP	Under which licence is the model published? If necessary, add any other information related to intellectual property (IP).	MIT
	8	Feedback on the model	E.g., what is an email address that people may write to for further information?	Angela Ribeiro, angela.ribeiro@csic.es; Joao Valente, joao.valente@wur.nl

Model Cards for Model Reporting				
2. Intended Use. Use cases that were envisioned during development.	9	Primary intended uses and purpose	This section details whether the model was developed with general or specific tasks in mind (e.g., plant recognition worldwide or in the Pacific Northwest). The use cases may be as broadly or narrowly defined as the developers intend. For example, if the model was built simply to label images, then this task should be indicated as the primary intended use case.	Classification of images of grape vines in two classes: Grapes healthy vs. infected by disease. The primary intended use-case is to identify grape vines infected by pests a disease to enable targeted applications of phytosanitary products. It does not differentiation between types of diseases.
	10	Primary intended users	For example, was the model developed for hobbyists, or enterprise solutions? This helps users gain insight into how robust the model may be to different kinds of inputs.	Intended users are technical providers of agricultural robotics solutions for automatic disease detection and extermination. Farmers can also use the model, but only when integrated into a broader system.
	11	Out-of-scope use cases	Here, the model card should highlight technology that the model might easily be confused with, or related contexts that users could try to apply the model to. This section may provide an opportunity to recommend a related or similar model that was designed to better meet that particular need, where possible. This section is inspired by warning labels on food and toys, and similar disclaimers presented in electronic datasheets. Examples include “not for use on text examples shorter than 100 tokens” or “for use on black-and-white images only; please consider our research group’s full-colour-image classifier for	The model has not been trained to identify diseases on other plants than grape vines. The model does not differentiate between types of diseases.

Model Cards for Model Reporting				
			colour images." Examples include "not for use on text examples shorter than 100	
3. Usage Information	12	Software requirements	What are software requirements and dependencies? If possible, please add a link to an open source repository like GitHub with details on dependencies, the environment and documentation.	The model was trained with the following Python packages on a Windows machine: PyTorch==1.10 Transformers==4.18 The model is distributed as a PyTorch model in a Docker image. Details are available on GitHub [insert URL if available]
	13	Hardware requirements - Training	What are hardware requirements for training the model (e.g. CPU or GPU)?	The model was trained with an Nvidia V100 GPU with 32 GB RAM
	14	Hardware requirements - Inference	What are hardware requirements for deploying the model (e.g. CPU or GPU)? What do users need to take into account regarding hardware regarding deployment and inference?	Inference requires a GPU (Nvidia V100 GPU 32 GB RAM) if more than 5 images need to be processed per second, otherwise a standard CPU is sufficient. The model was trained on images captured with a Panasonic Lumix DC-FZ82 camera with 18 Megapixels. Inference on images from a similar camera will perform best.

Model Cards for Model Reporting

	14	Technical usage Instructions	Provide any other information which helps users use the model. Ideally, add a code snippet illustrating a typical use-case. You can also add a link to a GitHub repository with usage instructions. This is inspired by model cards such as this: https://huggingface.co/microsoft/beit-base-patch16-224-pt22k-ft22k	from transformers import BeitFeatureExtractor, BeitForImageClassification
				from PIL import Image
				import requests
				url = 'http://images.cocodataset.org/val2017/000000039769.jpg'
				image = Image.open(requests.get(url, stream=True).raw)
				feature_extractor = BeitFeatureExtractor.from_pretrained('microsoft/beit-base-patch16-224-pt22k-ft22k')
				model = BeitForImageClassification.from_pretrained('microsoft/beit-base-patch16-224-pt22k-ft22k')
				inputs = feature_extractor(images=image, return_tensors="pt")
				outputs = model(**inputs)
				logits = outputs.logits
				# model predicts one of the 21,841 ImageNet-22k classes
				predicted_class_idx = logits.argmax(-1).item()
				print("Predicted class:", model.config.id2label[predicted_class_idx])

	15	Inputs and outputs	Provide a short description of the model's inputs and outputs	The model takes an image as input (768*768 pixels) and outputs a number, which

Model Cards for Model Reporting				
				corresponds to one of two classes: 0 = grape vine healthy; 1 = grape vine infected
4. Factors. Factors could include demographic or phenotypic groups, environmental conditions, technical attributes, or others.	16	Relevant factors	What are foreseeable salient factors for which model performance may vary, and how were these determined? Model cards ideally provide a summary of model performance across a variety of relevant factors including groups, instrumentation, and environments. For example: What specific instrumentation hardware or software was used to obtain the images, which could influence performance? For which specific environmental conditions was the model designed (e.g. summer in Italy)? Was training and evaluation conducted on specific demographic groups (e.g. mostly images from 18 - 30 year olds in the US)? For more details, see section 4.3 in https://arxiv.org/pdf/1810.03993.pdf	Environmental conditions: The model was trained on images from vineyards in Italy during the summer. Instrumentation: The images were captured with a Panasonic Lumix DC-FZ82 camera with 18 Megapixels. Groups: The model is not trained on images of people.
5. Metrics. Metrics should be chosen to reflect potential real-world impacts of the model.	17	Model performance measures	What measures of model performance are being reported, and why were they selected over other measures of model performance? Please provide all relevant metrics.	F1-macro: 0.72 Precision-macro: 0.78 Recall-macro: 0.68 F1-micro/accuracy: 0.95. Note: F1-macro should be treated as the primary metric, as most use-cases will deal with imbalanced data.

Model Cards for Model Reporting				
	18	Decision thresholds	If decision thresholds are used, what are they, and why were those decision thresholds chosen? When the model card is presented in a digital format, a threshold slider should ideally be available to view performance parameters across various decision thresholds.	We recommend a decision threshold of 0.5 softmax probability for binary image classification to decide whether a wine grape is infected or not.
	19	Approaches to uncertainty and variability	How are the measurements and estimations of these metrics calculated? For example, this may include standard deviation, variance, confidence intervals, or KL divergence. Details of how these values are approximated should also be included (e.g., average of 5 runs, 10-fold cross-validation).	The metrics were determined using a 60%-20%-20% train-development-test split. Hyperparameters were determined on the development set. The train and development set were then merged for final training and evaluation on the test set.
6. Training and Evaluation Data. Details on the dataset(s) used for the quantitative analyses in the card.	20	Datasets	What dataset(s) were used to (1) train and (2) evaluate the model? If possible, please add a link to details on the respective datasets used, for example a datasheet.	The model was fine-tuned on the FlexiGroBots Wine Grape dataset. The dataset as well as a detailed datasheet are available here [add URL]. The model was evaluated using a random 20% test split. . Moreover, the BEiT base model was pre-trained on the ImageNet-22k dataset at resolution 224x224. Details: https://huggingface.co/microsoft/beit-base-patch16-224-pt22k-ft22k

Model Cards for Model Reporting				
	21	Motivation	Why were these datasets chosen?	The Wine Grape dataset is specifically tailored to the intended use-case of pest identification on vineyards in Italy.
	22	Data Pre-processing	How was the data pre-processed for evaluation (e.g., tokenization of sentences, cropping of images, any filtering such as dropping images without faces)? Please provide a short description. You can also add a GitHub link to the respective pre-processing scripts.	Images are processed in colour and 768x768 pixels. For details, see the pre-processing script here: [add link to GitHub]
7. Quantitative Analyses	23	Disaggregated results and fairness	How did the model perform with respect to each factor (see question 15)? Quantitative analyses should be disaggregated, that is, broken down by the chosen factors. Quantitative analyses should provide the results of evaluating the model according to the chosen metrics, providing confidence interval values when possible. Parity on the different metrics across disaggregated population subgroups corresponds to how fairness is often defined. For an example, see figure 2. in https://arxiv.org/pdf/1810.03993.pdf	The model was only evaluated on one environment (grape vines in northern Italy) and specific instrumentation. Disaggregated results for different environments and instrumentation are therefore not available.

Model Cards for Model Reporting				
8. Ethical Considerations	24	Ethical Considerations	Example topics for ethical consideration: Does the training data contain sensitive information? What risks and harms could arise during the use of the model? Which mitigation measures are recommended? Are there particularly problematic use-cases? Did the model go through an ethical assessment procedure?	The training data only contains images of plants and was anonymised. The model itself does not pose risks, as it only classifies grape vines. Low accuracy can, however, lead to issues when embedded into a broader system for automatic phytosanitary product spraying. If the model is skewed towards predicting grapes as unhealthy, too many harmful phytosanitary products could be used and beneficial insects could be harmed. If grapes are classified as healthy too often, diseases could persist and reduce yield and quality. Ethical impacts of the model were discussed in the FlexiGroBots project.
9. Caveats and Recommendation s	25	Caveats and Recommendation s	This section should list additional concerns that were not covered in the previous sections. For example, did the results suggest any further testing? Were there any relevant groups that were not represented in the evaluation dataset? Are there additional recommendations for model use? What are the ideal characteristics of an evaluation dataset for this model?	Performance of the model was only tested for the environmental and instrumental factors explained above. If the model is applied in a different context, additional assessments should be conducted. Moreover, we recommend that users assess the model not only on our test data, but also in their own specific use-cases in a specific environment and instrumentation when embedded into a broader system for.

Table 10 - Model Cards Template

5.7 Datasheet template

As described in section 2.3.3, we recommend that every dataset published by FlexiGroBots is accompanied by a custom Datasheet. The purpose of the Datasheets is to help future external and internal users understand key characteristics of the dataset and judge whether it can be useful for their specific use-case. The template below provides information on a fictional example as a guideline.

<table>
<tr><th colspan="4">Datasheets for Datasets</th></tr>
<tr><td colspan="4">Based on Gebru et al. 2021
With elements from the draft EU AI Act, Annex IV, 2021</td></tr>
<tr><th>Category</th><th>Question ID</th><th>Question</th><th>Example Response</th></tr>
<tr><td rowspan="4">1. Motivation</td><td>1</td><td>For what purpose was the dataset created? Was there a specific task in mind?</td><td>The dataset is designed to be a training dataset for a machine learning classifier to identify the botrytis disease on grape vines.</td></tr>
<tr><td>2</td><td>Who created the dataset (e.g., which team, research group) and on behalf of which entity (e.g., company, institution, organization)?</td><td>The dataset was created by CSIC, the Spanish National Research Council.</td></tr>
<tr><td>3</td><td>Who funded the creation of the dataset?</td><td>The dataset was created as part of the FlexiGroBots project. The project received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017111.</td></tr>
<tr><td>4</td><td>Any other comments?</td><td>Additional information on the FlexiGroBots project is available here: https://flexigrobots-h2020.eu/</td></tr>
</table>

Datasheets for Datasets			
2. Composition	5	What do the instances that comprise the dataset represent (e.g., photos of plants, paragraphs from news articles)?	Photos of grape vines
	6	How many instances are there in total? (e.g. how many photos)	10000
	7	Is the dataset a sample, or does it contain all possible instances? If it is a sample, then what is the larger set? Is the sample representative of the larger set? Please elaborate.	The dataset comprises photos from a Farm in Galicia, Spain. It therefore represents a sample of grape vines infected by botrytis.
	8	Is there a label associated with each instance? If so, please describe the labels. If the data was annotated manually, please describe the coding instructions for annotators.	Images are annotated with two labels: healthy or infected. The labels differentiate whether a grape vine on the image is infected by botrytis or not. The coding instructions for annotators were: "…"
	9	Is there a codebook or more detailed documentation of each variable and meta data in the dataset? If so, please provide a link.	The annotator instructions and explanation of each variable is available here: [URL]
	10	Are you aware of any potential errors, sources of noise, or redundancies in the dataset?	The data were taken at different points in different crop lines to avoid redundancies. The manual labelling process ensured that all images are reviewed and errors are eliminated. The type of field acquisition ensures that there is no noise in the images.
	11	Does the dataset contain data that might be considered confidential or offensive (e.g., data that is protected by legal privilege or by doctor-patient confidentiality, or offensive images or texts)?	No.

Datasheets for Datasets			
	12	Does the dataset relate to people? E.g. a dataset relates to people if farm workers could be visible on some images.	While the main subject in the images are grape vines, people might be visible in the images.
	13	If the dataset relates to people, please elaborate on data protection measures that have been taken. For example, did individuals provide consent? Were they informed about their rights based on the GDPR?	All workers who could be visible provided explicit consent to the collection, processing and publication of the data. The consent followed the standards of the GDPR. As an additional step before publication, images were anonymised with an in-house face blurring software.
	14	Is it possible to identify individuals either directly (e.g. through their faces) or indirectly (i.e., in combination with other data) from the dataset?	No.
	15	Does the dataset contain data that might be considered sensitive in any way (e.g., data that reveals racial or ethnic origins, or locations or biometric data)?	No.
	16	Any additional information?	A future version of the dataset may include information about the weather during the acquisition of the images, e.g. humidity, temperature etc.
3. Collection Process	17	How was the data acquired? (e.g., hardware apparatuses or sensors, manual human curation, software programs, software APIs)	Images were captured with an Olympus OM-D E-M10 Mark IV camera by the CSIC team. The data was then manually annotated.
	18	Who was involved in the data collection process (e.g., students, crowdworkers, contractors) and how were they compensated (e.g., how much were crowdworkers paid)?	The data was collected and annotated by full-time employees at CSIC as part of their regular paid work.
	19	Over what timeframe was the data collected?	July/August 2021

Datasheets for Datasets			
	20	Was any ethical review process conducted?	The creation and processing of the dataset followed the ethical procedures of the FlexiGroBots project. For more details, see Task 1.5 and Deliverable 2.6 on the FlexiGroBots website: https://flexigrobots-h2020.eu/library/deliverables
	21	Any additional information?	NA
4. Pre-processing/ cleaning/ labelling	22	Was any pre-processing/cleaning of the data done (e.g., removal of instances, processing of missing values)?	Yes, the data was cleaned manually and algorithmically to exclude noisy, irrelevant data and anonymise images of individuals.
	23	Any additional information?	NA
5. Uses	24	Has the dataset been used for any tasks already? If so, please provide a description.	The dataset is currently being used in a pilot in the FlexiGroBots project. The pilot uses automated ground vehicles to automatically identify grape vines which are infected by botrytis and automatically apply pesticide treatment. More information will be available at: https://flexigrobots-h2020.eu/
	25	What (other) tasks could the dataset be used for?	The dataset can be used for any use-case which involves the identification of botrytis on grape vines.

Datasheets for Datasets			
	26	Is there anything about the composition of the dataset or the way it was collected and pre-processed/cleaned/labelled that might impact future uses?	Images were captured with a Olympus OM-D E-M10 Mark IV camera during the month of July/August 2021 during the day and good weather in northern Spain. The performance of algorithms trained on the data will probably be reduced in a different deployment context.
	27	Are there tasks for which the dataset should not be used? If so, please provide a description.	We only recommend using the dataset for the intended use-case described above.
	28	Any other comments?	NA
6. Distribution	29	Will the dataset be distributed to third parties outside of the entity (e.g., company, institution, organization) on behalf of which the dataset was created? If so, how and when?	The dataset will be uploaded in December 2022 on the Zenodo platform at … [URL]
	30	Does the dataset have a digital object identifier (DOI)?	[insert DOI if available]
	31	Will the dataset be distributed under a copyright or other intellectual property (IP) license, and/or under applicable terms of use (ToU)? If so, please describe.	The dataset is distributed under the MIT license.
	32	Do any export controls or other regulatory restrictions apply to the dataset or to individual instances? If so, please describe.	No.
	33	Any other comments?	NA
7. Maintenance	34	Who is supporting/hosting/maintaining the dataset?	Ángela Ribeiro, CSIC
	35	How can the owner/curator/manager of the dataset be contacted (e.g., email address)?	angela.ribeiro@csic.es

Datasheets for Datasets			
	36	If the dataset relates to people, are there applicable limits on the retention of the data associated with the instances (e.g., were individuals in question told that their data would be retained for a fixed period of time and then deleted)?	While the dataset was anonymised, the precautionary consent form filled in by individuals requires a retention limit of 5 years.
	37	Any other comments?	NA

Table 11 - Datasheets Template

6 Conclusions

In light of the great opportunities and challenges posed by new technologies from an Ethical, Legal, Socio-Economic and Environmental (ELSE) perspective, this deliverable presented two main outcomes from the first half of the project: First, sections 2 to 4 provide an overview of the most important ELSE factors. An extensive literature review of 426 articles on robotics and AI in agriculture was conducted and the main arguments in the literature were systematically extracted and quantified (section 2). Based on this review, the team selected several key ethical and technical standards (section 3), which are being used in the FlexiGroBots project: The Assessment List fo Trustworthy Artificial Intelligence (ALTAI) was selected for the ethical assessment of the pilots and platform. Moreover, model cards and datasheets are proposed as a standard format for public reporting of algorithms and datasets produced by the project. Furthermore, as legal provisions can be particularly hard to navigate, section 4 provides an overview of key legal acts: the GDPR, legislation on autonomous vehicles, upcoming legislation on AI, contracting standards and the machinery directive.

Building upon these ELSE factor reviews, the second outcome of the deliverable is a concrete list of recommendations for the FlexiGroBots pilots and platform. The recommendations are ordered by priority and are addressed to specific partners to avoid diffusion of responsibility. Short term recommendations include measures for human safety such as a digital stop button or advice on data protection measures such as consent forms or anonymisation; in the medium term, the deliverable recommends the development of logging capabilities to determine liability or the creation of model cards and datasheets; in the long run, the platform should include CO2 tracking software to monitor energy usage and training and guidance materials should be developed for commercialisation after the end of the project.

The implementation and adaptation of these recommendations has already started and will continue throughout the lifetime of the project through the pilot assessment tasks T4.4, T5.4 and T6.4. Moreover, results of the continuing ELSE analysis will be summarised in D7.9 and presented in a dedicated event at the end of the project.

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