TECHNICAL REPORT – ENG1 (SEM2) [2022/23]

# Report on the potential implication of the automated technology developed by farmwise.

Matriculation Number: s2235848

## Executive Summary

This report is taken on the behalf of Cargill incorporated to assess the possibility of using technologies developed by Farmewise. Their technologies include apparatus such as Vulcan, a reliable precision weeding device that uses an intelligent computer vision and machine learning to identify and remove weed with a high degree of accuracy.

*Figure 1 (ADAM RODNITZKY, 2021)*

There is a need for this product as it will make agricultural practices more sustainable. In addition, this will generate more profit as less workers are required. The market for this technology has an immense potential as it can target large scale farming a well as smaller scale farming such as family farms who cannot find people to employ and need.

The reputation of the company can also be enhanced by becoming a more sustainable company stepping into a way of looking at agriculture using new innovative technology attracting shareholders.

Some concerns might arise as we look at the use of farmwise on an international perspective. Companies will need to obtain a license to use the technology developed by farmwise. In addition, Farmwise is still at their early stages and does not have a lot of certifications for other countries like the EU yet.


*Figure 2 Farmwise incorporation, 2016*

Farmwise still differentiates themselves from rival companies that have more certification and have been experimenting in different countries by their flexibility. This is due to the technology developed which is more modular and easier to adapt to different farming practices and can perform a lot more tasks.

## Summary Recommendations

1. Due to factor such as cost, practicality, or compatibility with existing method larger companies operates it may be recommended to develop their own similar technology.
2. The company should invest in the technology as regardless of the high initial cost it will make the company more sustainable and decrease the wages that need to be paid.
3. It is recommended to use this technology for the image of the brand as it will greater their reputation as they are switching to more sustainable option as well as advancing in a new form of agriculture using innovative technology.
4. The technology will ne be able to be applied in every country of operation due to legal issues and licenses. Therefore, the company should focus in obtaining the technology and using it in countries where farmwise is still experimenting, so the company is still in the early stages of the technology.

# 1. INTRODUCTION

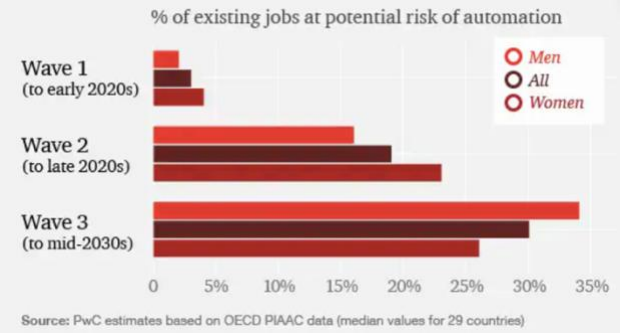


*Figure 3 (Fleming, 2020)*

Throughout recent years automated technology has had a significant impact in our society. Its application has been applied in a wide range of fields from repeating simple tasks in a factory to analysing images and being able to perform actions based on what it sees. More and more jobs are being replaced by automated machines which, despite a high initial cost, reduce the cost over a long period of paying salaries. The increased percentage of jobs at risk over the past few years can be seen from figure 3. This shows the importance of this technology in our everyday life and the impact it has.

Agriculture is one of the field automated technologies which will have an enormous impact over the next decades. Farmwise, Naio technology, blue river technology and many more are companies working to use automated technology and apply it to the field of agriculture. In recent years, technology has revolutionised the sector of agriculture. From autonomous tractors to drones who are used to monitor the condition remotely, dispatch fertiliser and more.

## 1.1 Introduction to farmwise

Farmers have two options against weed, hire more workers, or use herbicide. Workers require wages and the use of herbicide is becoming less and less effective due to the crops building a resistance to the chemicals (Department of Primary Industries, 2021). To tackle this problem, Farmwise has developed a technology which could replace the use of herbicide using automated technology which will also reduce the number of workers needed. Vulcan is a robot built by farmwise which uses three principal parts to automate tasks such as weeding, seeding, and transplanting. Unlike the Agrointelli robottie who can only plant potatoes.

## 1.2 Machine learning

Before the technology is placed into a robot which can then perform tasks. A bundle of algorithm needs to be made to know how to respond to the environment and to know which action to perform based on what it sees. To do so the artificial intelligence is trained using a large data base of images for it to recognize the various plans and crops and be able to understand it's environment. Machine learning will then be able to understand what the type of crop from the information given by the computer vision is.

## 1.3 Computer vision

Therefore, the technology to work Vulcan uses computer vision to recognise weed and understand it's environment. This can be done by the robot as it scans the environment using cameras and recognizes various shapes, colours and edges which are then sent and interpreted by machine learning which sends back information on what the crop is. The artificial intelligence is then able to proceed on deciding based on what the crop is and make the robotic perform an action in consequence.

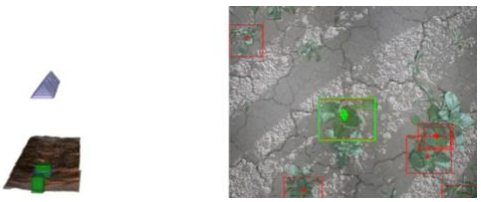

*Figure 4 Farmwise incorporation 2016 computer vison*

## 1.4 Robotics

The robotics aspect of the technology is the part which performs the task based on the information given by the machine learning. The robot needs to be designed to perform tasks such as weeding, seeding, and transplanting. For example, it may use a mechanical weeder to remove a weed or a seed dispenser to plant seeds.

### 1.5 Issues and concerns

The main issues and concerns that arise with the technology used by farmwise are one the cost but also the reliability of the technology. The initial cost of the product can be high, but it could be profitable in the long term. This technology is still at a very early stage, therefore, reliability might be a concern. This can be a risk to the crops which can be lost by weeding or seeding incorrectly. Other issues can count the legal issue as Cardill operates in over 70 countries so it will be complicated to get licenses.

## 2 Review

### 2.1 Market sector and application

Evidently the market for this technology is the agricultural industry. In that specific industry farmwise focuses on improving efficiency and sustainability using innovative technology.

Herbicide is one of the main reasons that could lead companies to use technology such as Farmwise. Herbicide can be very harmful for the people handling those products. Long term effect to the exposure of herbicide can have effect on the body such as DNA defects, cancer or even kidney damage (Suryawanshi, 2022). In addition to this, herbicides are not sustainable as they reduce plant mortality and decrease growth and reproduction of plants (US EPA, 2015). Finally, figure 5 shows how crops have acquired a certain resistance to herbicide. The graph demonstrates the number of species that have developed this resistance and the corelation shows how fast weed and plant can adapt to chemicals. These three points highlight the negative aspect of herbicide which despite its lower cost manifest why it would be interesting for certain companies to try and transition to the technology developed by farmwise.

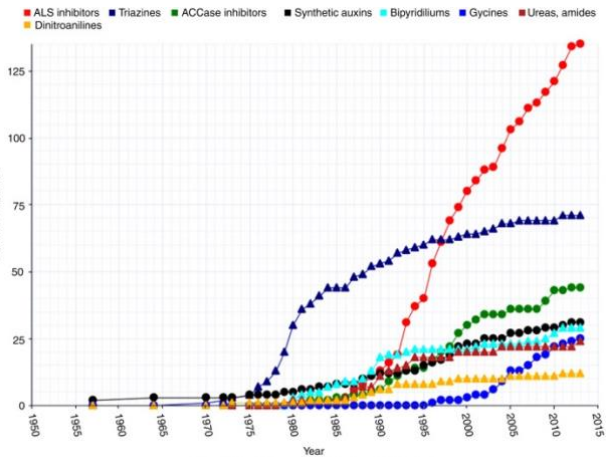


*Figure 5 (Burke and Bell, 2014)*

The potential market area for this technology is significant as it can target large scale farming as well as smaller family farms. If considering the initial cost of the technology Farmwise would probably be more targeted to large scale which have bigger capital to invest in these devices. In addition, smaller farms might not be able to opt for the technology as it might not be compatible with their existing farming practice. The type of crops farmwise operates with is still limited and therefore could also not apply to small farms which are located on a hilly or rocky terrain.

Industries are starting to find new ways to grow crops more efficiently while being more sustainable. This is why now is the perfect time to invest in companies such as farmwise who are still at an early stage but have already raised a consequent 45 million dollars (Evans, 2022) which demonstrate the potential of the company. Furthermore, the company only accepts pre-orders and is slowly testing their technology in farms across California and Arizona.

### 2.2 Government regulatory, policy or guidance alignment

A lot of large-scale farming such as Cargill operate in a wide range of countries from the USA to Europe and many more. The EU has put in place various laws in terms of the construction of such equipment. RoHS is one of the certifications required to build such equipment. The Restriction of Hazardous Substances in Electrical and Electronic Equipment (RoHS) is an EU rule that prevents the exposure of electronic and electrical waste from human and the environment.

Some EU rules obligate machinery in agriculture to be supervised by humans. These laws are set by the EU's General Data Protection Regulation (GDPR), and they surround the field of decision making by autonomous machines. According to the GDPR article 22 (Intersoft Consulting, 2013) people have the right to know when an important decision is made entirely by automated machine. GDPR also controls the use of data being stored and transferred.

Aside from laws on the construction and supervision there are other aspects a company should consider before implementing farmwise technology. Principally, the intellectual property rights such as patent or trademark. Farmwise has multiple patents (Farmwise Labs, Inc, n.d., 2023) on their technology and method of agriculture. Companies might also consider liability and insurance. Laws on autonomous technology is very complex and can be very different from case to case. Question arise as to who is responsible? These cases fall under product liability law which create liability upon the manufacturer or the individual who sells the product for injuries cause because of the product. There are also cases where the company using the machine is held responsible as they fail to properly train their staff on the safety measures and train them on how to use the equipment. Technological failure would fall under the responsibility of Farmwise; however, this can also be disclosed in the contract disposed by farmwise in the case the technology is still not final. Autonomous technology learns from experience and the company might sell their product on an experimental stage where the company could decline reasonability as the AI is still on a learning. All these cases are very specific to the case and listed in documents by the European commission (European Commission, 2023). Insurance is valuable to the company if the technology malfunction along with cyber liability insurances which would cover the company financially in the case of a data breach or cyber-attack.

### 2.3 Market comparison with alternative products

Many other companies are developing new technology to implement in the sector of agriculture. These different technologies all use autonomy to farm and have different application. The table below compares these different technologies.

*Table 1 Comparison of other technology*

| | **Farmwise** | **Ecorobotix** | **Naio technology** | **Carbon Robotics** |
|---|---|---|---|---|
| **Country of manufacture** | USA | Switzerland | France | USA |
| **Certification** | None | CE, UL, FCC | CE, RoHS | CE, FCC, RoHS |
| **Country of operation** | USA | Europe, USA, Asia | Europe, USA, Canada, Australia | USA, Canada, Europe |
| **Key feature** | • Computer vision<br>• Machine learning<br>• Autonomous weeding<br>• Crop health monitoring | • Computer vision<br>• Autonomous weeding | • Computer vision<br>• GPS<br>• Autonomous weeding<br>• Seeding and spraying options | • Laser based Weeding |

The table shows farmwise is the company with the least certification due operating only in the US. However, the technology they are developing is a lot more advance than other companies. From these companies none of them use machine learning which allows farmwise to create more complex robot with multitasking abilities and increased precision and accuracy. Another factor to consider would be the modularity of all those devices. From the information gathered it is hard to quantify or give precise information to add to the table but farmwise robot are more modular meaning they can more easily adapt to different farming practice.

## 3.0 SWOT ANALYSIS

| STRENGTHS | WEAKNESSES |
|---|---|
| • Reducing the use of herbicide.<br>• More sustainable practice.<br>• Higher efficiency and reduces the amount of people that need to be employed. | • The initial investment might be considerable considering machine like this can cost up to $150 000.<br>• The technology might not be suitable with the existing farming method.<br>• Concern might rise from employees as jobs will be replaced. |
| **OPPORTUNITIES** | **THREATS** |
| • Possibility to become a company which does not use herbicide and meet high demands in term of sustainability.<br>• Increase the market share as the company will become more effective and reduce cost.<br>• Using new innovative to farm the company might attract shareholders. | • Legal issues might arise as different countries have different laws on automated technology and farmwise does not yet have all the certification for other countries.<br>• The technology developed by farmwise is open to any other company which might also decide to use farmwise technologies.<br>• Other companies might turn out to be more efficient and better than farmwise. This would have a negative effect on the productivity and not have the expected return on the initial investment. |

## 4.0 CONCLUSIONS and RECOMMENDATIONS

Overall, there is a big market potential for technology such as farmwise. This would revolutionize the traditional method which uses pesticide and herbicide. This will completely change the health condition and safety risk of the people who work in that industry. Regarding large scale farming, this would make it more sustainable, less people would need to be employed and therefore reduce cost over the long term. However even on short scale farming it could help the agriculture be more sustainable as well as help smaller farms who are not able to find workers.

Given the information above it is recommended that:

1. Due to factor such as cost, practicality, or compatibility with existing method larger companies operates it may be recommended to develop their own similar technology.
2. The company should invest in the technology as regardless of the high initial cost it will make the company more sustainable and decrease the wages that need to be paid.
3. It is recommended to use this technology for the image of the brand as it will greater their reputation as they are switching to more sustainable option as well as advancing in a new form of agriculture using innovative technology.
4. The technology will ne be able to be applied in every country of operation due to legal issues and licenses. Therefore, the company should focus in obtaining the technology and using it in countries where farmwise is still experimenting, so the company is still in the early stages of the technology.

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