GF ACCORD

fast **BUSINESS INTELLIGENCE I ENTERPRISE VERDICTS**

Qualitative Business Analysis & Consultancy

Topics: Company_X, answers to specific questions asked by the client

For the attention of ...

| GF-ACCORD product type: | entry level version | treating few custom questions |

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1.1 Condensed Field and Company_X Product Profile (Ref_profile 1-14)

Company_X is a start-up active in the field of agricultural robots with main claimed competitive point the low price and the energy independence thanks to solar panels. The idea behind agricultural robots is the replacement of the farmers by robots that suppose to work equally or more efficient, more precisely, promote sustainable agriculture via minimization of the use of pesticides (among other elements), reducing water usage and increase of productivity. Europe, in particular, faces a significant challenge to stay a reliable and sustainable agriculture producer due to the development of very competitive markets. The arable land is reduced as is the available land water and the interest of young professionals on agriculture.
There is a world-wide favourite climate for sustainable agriculture and this is very positive for the business opportunity. In addition, due to increasing human population and other factors (e.g. use of crops for biofuel production) food shortage becomes a serious worry and the involvement of robots is a proposed potential solution. The start-up is active in a field that is interesting and promising and at the same time highly competitive.

Robotics usage in Agriculture: Technical Aspects:

A robot is a machine that can be programmed do specific manual tasks and calculations tasks. It usually consists of a “arm-hand equivalent”, or tool attached to a mobile (or not) body.

- Autonomous robots work based on their software without human intervantion. Cameras, sensors (TakkTile (cheap sensor), the Yara N-sensor that controls the amount of fertilizer spread at a specific area), are commonly used for data collection.
- Tele-controlled robots work under the partial control of humans and/or computer programs.
- Humans control remote-controlled robots with a hand-held device.

Following the current trends and current R&D activities internationally, it is envisaged that the impact in agricultural practices will be important comparable to the effect of the tractors in the past. The following need to be taken into account to understand the aforementioned:

- Progress in Global Positioning and Navigation Satellite System (GPS) technology has made possible the use of controlled traffic farming (CTF) to minimize soil compaction.

- Agricultural robots are equipped with sensors for navigation: GPS receivers, special units (IMU) that measure accelerations and rate of turn, cameras and other measuring instruments.

- Advanced algorithms for data analysis and fusion are used to extract information from the variety of sensors.

- Images captured by cameras are processed to detect and avoid obstacles.

The size limit of machines that can be practically used on the fields has been reached due to the social compaction factor. The use of multiple lighter/smaller robots that communicate and exchange data is an alternative. In addition the whole operation is more robust because the failure of one robot does not halt the whole operation.

When it comes to technology the progress is undisputable (if we focus on proof of concept). Areas needing improvement are: energy efficiency, reliability of the autonomous decision making, robustness, development of remote energy transfer solutions, harmony in the human robot interaction, management of inputs (fuel, fertilizer and agro-chemicals, which account for 16% of agricultural costs) .

It should also be mentioned that the benefits of using agricultural robots designed not only for weed management but also for harvesting can be significant. This is understood by the robot producers and they focus on this for some years now.

Next-generation robotics:

- Advances in robotics technology are increasing the daily human-machine interaction
- The use of better and cheaper sensors (i.e TakkTile an inexpensive tactile sensor that incorporates a conventional MEMS barometer, developed by the Harvard School of Engineering and Applied Sciences) could make a robot able to understand and respond better to its environment.
- Bio-inspired robots are very flexible and able to do chirurgical level operations.
- Thanks to the cloud-computing revolution robots are able to access data, instructions remotely.
- Fast Big-Data could assist real time decision making by the robots

Some Agricultural robots:

Company: Wall-Ye,Macon, France
Website: http://wall-ye.com
Product: Wall-Ye 1000 mobile pruning robot
Area of use: French grape vineyards pruning
Function: Autonomous pruning
Testing: Completed in 2013
Availability: For sale and as a service
Price: $30,000 -32000 per robot

Company: Company_X, Essert-Pittet, Switzerland
Website: http://www.Company_X.com/
Product: Lightweight autonomous robots initially for weeding
Area of use: Field testing in Switzerland; next year in Germany
Function: A robotic platform for weeding of spaced-row cultures, which includes advanced weed recognition algorithms, fast robotic arms, advanced sensor technology, high energy efficiency, and wireless communications
Testing: Currently with sugarbeet but plan to extend to colza, sunflower, corn and soya
Availability: First machines available for sale by end of 2015
Price: About 15'000 EUR ($18,750) per robot

Company: F Poulsen Engineering ApS, Hvalso, Denmark
Website: http://www.visionweeding.com
Product: ROBOVATOR thermal and/or hydraulic weeder
Area of use: 30 machines already at work in UK, the EU and Canada.
Function: Weeding and thinning of lettuce, cabbage, fennel and onions
Testing: In California (preceding expansion into North America)
Availability: Started selling in 2011 after 8 years of development
Price: The 5-row version sells in Europe for 80.000€ ($100,000)

Company: Naio Technologies, Toulouse, France
Website: http://naio-technologies.com/
Product: Naio Technologies Oz field robot
Area of use: Mostly in France
Testing: Testing next generation of Oz robot (with improved navigation capabilities) in real field conditions in France
Function: The Oz robot serves as an autonomous electric tractor which can be

used for weeding and as a transport from harvesters to accumulation points. Oz operates as a self-powered robotic implement rather than a towed implement
Availability: Began selling in 2013
Price: Initially robots are being rented to help customers get familiarized with the product line and to help optimize the utilization. Units are renting/leasing for $315 to $475 per month depending on configuration. Approx. €24'000 per piece

Company: Amazone-Werke Gmbh, Hasbergen, Germany
Website: http://info.amazone.de/DisplayInfo.aspx?id=14033
Product: BoniRob field robot
Amazone-Bosch BoniRob lightweight field robot
Area of use: Work on corn and wheat experimental plots in Germany
Function: Autonomous omnidirectional field robots working in “flocks” for multiple purposes
Testing: Multiple-purpose lightweight robot for weeding, applying fertilizer, inspection being developed with Robert Bosch GmbH
Availability: Only two built; no plans announced for commercialization at this time
Price: No information available

Comments:

- Most of the robots created so far are used for weeding or plucking vegetables or fruits, so quite simple operations involving GPS-tracking and simple weed recognition algorithms
- There are high maintenance fees and product updates for the softwares used in every robot which are not easily found/displayed on the internet so as not to discourage potential farmers from buying them.
- The rough price range for this kind of autonomous robots used for weeding is €15000-€80000, depending on the customization of configuration used on each robot.
- A very close competitor for a weeding robot would be Oz, which was created in Toulouse by a startup and costs €24'000 per piece.

Condensed *(because the client asked specific questions to be answered)* **SWOT analysis of agricultural robots with a secondary focus to sustainable agriculture | 05/15/15**

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Our Qualitative Business Analysis can be produced in three days only thanks to our home-made IT tools

Note: The analysis may indicate contradictory points. The reader is encouraged to accept that there are contradictory views

Strengths	Weaknesses
1. Robotic applications are expected, "by construction", to lower agriculture production costs positively impacting prices and subsidies ***2.*** Agricultural robots promote an economical use of fertilizers ***3.*** Robots work 24/7 and do not suffer from human bodily conditions ***4.*** Robots satisfy "100%" the hygiene and safety regulations ***5.*** Sustained accuracy thanks to lack of fatigue associated with repetitive actions	***1.*** "Imperfect technology" ***2.*** Risk of failure of the operation
Opportunities	**Threats**
1. Market growth for agriculture robots ***2.*** Robotic applications expected to reduce various negative environmental impacts of agriculture production ***3.*** Robotic applications expected to reduce chemical exposure of farmers and workers ***4.*** Sustainable agriculture: the	***1.*** Sustainable agricultural products: limitations for consumers ***2.*** Dependence of sustainable agriculture on water resources ***3.*** New policies and legislation for sustainable agricultural sector ***4.*** Impact of climate change on all types of agriculture ***5.*** Decrease of number of jobs for

market for developing countries **5.** Automation technology to solve labour shortage in labor-intensive agriculture **6.** Robotic applications: tools to help farmers solve increased food demand **7.** Creation of new jobs in the field of agricultural robotics	farmers

1.2 SWOT Analysis Extended

1.2.1.1 Strengths:

1. ***Robotic applications are expected, "by construction", to lower agriculture production costs positively impacting prices and subsidies.*** Development of robotic technology applications is expected to increase the level of replacement of labour work which will directly be reflected in labour costs. Lower labour costs will be further reflected in lower prices allowing farmers to increase the earnings, cover production costs and further invest in their activity. Drones serve as an example for this: they cost roughly 10,000 USD, but they reduce commuting time of farmers up to 2,000 km saving labour costs and depreciation. Moreover, lower labour and production costs for farmers will also reduce the size of agriculture subsidies provided by Governments which are further reflected in less expenses to the overall budget of a country or organization. The costs for fertilizers and pesticides are expected to decrease substantially. (Ref_1_Strengths)

2. ***Agricultural robots promote an economical use of fertilizers*** since in ideal cases they are applied locally with increased accuracy. Pesticides are not going to harm the nearby plants and unnecessarily pollute the soil.

3. ***Robots work 24/7 and do not suffer from human bodily conditions.*** No sickness, no fatigue, no health insurance needed, no syndicates to oppose the strategy of the management.

4. ***Robots satisfy "100%" the hygiene and safety regulations.*** Assuming that they are correctly programmed robots follow the standard procedure without deviation and this is of exceptional importance when sensitive operations able to affect the health of the consumer take place.

5. ***Sustained accuracy thanks to lack of fatigue associated with repetitive actions.*** When humans work in the field long hours the level of precision of their actions drops as the fatigue increases. Robots are only threatened by malfunction. Their level of accuracy is not decreased due to tiredness.

Summary of benefit factors for using agricultural robots

	Factors	Potential consequences
		For the professional user
Benefits	Improved work efficiency, productivity	Considerable improvement, less waste (water, resources, etc.)
	Reduced manual labor	Less payroll expenses of farmers
	Increased safety and reduced risk at work	Less work accidents while on the fields
	Increased operational availability and flexibility	Lower energy costs since robots are autonomous, therefore higher output
	Unprecedented service - PR effect	Embracing technological advancement portrays the image of an innovative agricultural company

1.2.1.2 Weaknesses

1. ***"Imperfect technology".*** Agricultural robots are involved in an extended set of very complex operations involving delicate mechanical operations, image recognition, decision making, navigation and in addition they need to be exceptionally energy efficient. Such a technology has not been perfected yet a premature adoption can have a negative financial impact. For simpler tasks, for instance grass cutting/trimming, there are robots that appear to work satisfactorily.

2. ***Risk of failure of the operation.*** Agriculture is closely connected to timing and seasons. The business of producers can be heavily damaged if a robotic solutions will fail.

1.2.1.3 Opportunities

1. ***Market growth for agriculture robots.*** Global markets for agriculture robots are expected to reach more than $16 billion by year 2020. The

size and the growth of the market makes it appealing to investors. (Ref_1_Opportunities)

2. ***Robotic applications expected to reduce various negative environmental impacts of agriculture production.*** Another problem to be solved by robotic application in agriculture is the reduction of environmental impacts of the agriculture production process, mostly from the usage of chemicals on soil aimed at increasing production. World Health Organization reports that 60% of natural resources (water & air) are being lost due to unsustainable land practices. Thus, the presence of innovative technologies is necessary to reduce these negative impacts and contribute to a sustainable agriculture production life cycle. Various robotic applications and technologies are needed to solve various agriculture environmental impacts for safer sustainable agriculture. (Ref_2_Opportunities; Ref_3_Opportunities)

3. ***Robotic applications expected to reduce chemical exposure of farmers and workers.*** Chemicals elements are used regularly in the process to increase agricultural productivity. Regulated by law, the usage of chemicals elements along with those of toxic ones, has decrease since the first introduction in 1960 but still they are not eliminated. The usage of robotic technologies is expected to decrease the exposure of farmers to the processes linked with usage of chemicals in agriculture thus resulting in improved health for them. (Ref_4_Opportunities)

4. ***Sustainable agriculture: the market for developing countries.*** Sustainable agriculture techniques are already developed and in place in wealthier countries (EU, USA, Japan, etc). Thus, there lies room for market development in developing countries. International organizations report that the world population is expected to reach roughly 9 billions by 2015 and 84% of it belongs to developing countries. (Ref_5_Opportunities)

5. ***Automation technology to solve labour shortage in labor-intensive agriculture.*** Statistics (2012) say that 71% of farmers in the US that work with labor-intensive crops face workforce shortage. Thus, introducing technologies that help with the automation of the work process of labor-intensive crops is expected to improve productivity in farming. (Ref_6_Opportunities)

6. ***Robotic applications: tools to help farmers solve increased food demand.*** With the increasing population and consequently, increasing demand for food production, international institutions foresee and plan an increase of 70-100% in world's real food supply y 2050. New

technologies are accepted to be helpful tools to meeting farmer's needs in reaching these goals. (Ref_7_Opportunities)

7. ***Creation of new jobs in the field of agricultural robotics.*** The ongoing research will lead to opening of new positions. In addition the maintenance of the robots will also create employment opportunities. These new opportunities will be suitable for the highly skilled workforce.

1.2.1.4 Threats

1. ***Sustainable agricultural products: limitations for consumers.*** Crops produced through sustainable agriculture techniques, like crop rotation, soil enrichment, natural pest predators, biointensive integrated pest management) are available in the market. Although needed due to increasing food demand, sustainable agriculture puts limits to that category of consumers who prefer to consume naturally produced products. (Ref_1_Threats)

2. ***Dependence of sustainable agriculture on water resources.*** Nearly 70% of worlds' surface water resources are used for farming. Regardless of the advances in technologies outside water economy, the increase in the volume of production is limited by these water shortages. It is expected that new technologies will help be more precise about effective water usage in agriculture. (Ref_2_Threats)

3. ***New policies and legislation for sustainable agricultural sector.*** With the changing landscape of the future of agriculture sector in the direction of sustainable agriculture, and with the need for introducing new technologies, new policies and legislation are needed. Investments are directly linked to policies and laws of the sector. Government officials' role in introducing and adopting new policies is crucial for companies that will operate in the sector. They may make implementation of business objectives harder or easier. Companies should make sure that new policies and laws will favor business development. In this framework, lobbying or networking activities, with the right Government Officials involved in the process, is needed to increase the positive chances of business plans implementation of companies. Corruption Perception Index in this framework helps with the networking process in less developed countries. There are cases where the policies of the government can be very beneficial, for example in India the income coming from agriculture is not taxed. (Ref_3_Threats)

4. ***Impact of climate change on all types of agriculture.*** Climate change, and especially global warming, will directly impact the

agriculture industry. An example is Africa. It is predicted that in approximately 3% of the land will not be possible to grow maize by 2050 and the farming system will have to change from crop & livestock system to livestock system. Farming should adapt to rising temperatures, decreased yearly rainfalls, droughts and even floods. (Ref_4_Threats)

5. ***Decrease of number of jobs for farmers.*** By definition agricultural robots will lead to a decrease of the number of farmers needed for the same result to be achieved as tractors did in the past. In countries with socialist policies and strong syndicates opposition is expected that could lead to a substantial delay to the adoption of the new robotic technologies.

1.3 Client's questions

1) Is there a market opportunity for the Company_X product in France, Switzerland or Germany?

Provided that the robots can replace the work of a number of workers/farmers for a cost which is lower than the summed salaries of the farmers that are being replaced, then clearly, it is an opportunity for profitability.

<u>Hypothesis</u>: a farmer's salary in France is roughly €30'000 per year (see table on the “Verdict section”). If the cost of the robot is €15'000, it costs half the salary of one worker.

If the robot can replace 4 workers what is the profit for the company? 8 times more money (very rough calculation) excluding maintenance fees. Even a 50% error in the above calculations shows the potential

It is evident that if the robot is performing as expected, then there will be no potential losses for the farm owner.

There are socio-political barriers that need to be taken into account, because farmers will have to be fired.

2) Is the Company_X technology competitive? Is the quality of the image recognition and real time decision-making algorithms, as well as any sensors used, cameras, solar panels, computing system, GPS systems, robotic arms, needed for the operation Company_X product, good enough to justify a competitive advantage?

Until this moment we received no technical information about Company_X and there are no technical details on the website.

We would like to attract the attention of the client to the following:

- Some of the companies team members have clearly the capacity to digest and use new electronics and software related technologies .
- Quite possibly three of the advisors have been involved in pioneering work about solar panels, robotic arms, multi-robot systems, sensors, intelligent vehicles and algorithms creation for the last three aforementioned technologies. An important question is if there are any agreements for proprietary use of some of these technologies by the Company
- The R&D unit of EPFL working on solar panels is exceptionally competitive. The research goals among other research goals at the EPFL energy and building physics laboratory focus on optimization of solar energy conversion systems through nanotechnology and device architecture optimization. As a consequence EPFL's new convention center is already equiped with an impressive glass facade composed of solar cells (1400 solar modules) covering a total surface area of 300m² (a word first). Does the company has access to the latest advancements? Is there an agreement?
- A commonly used class of algorithms used is the FMIS / RMIS (Real time management image information -can be 3d or natural image- and knowing what to do with it). It is supported by EU research funding. Which algorithms the company uses?
- Popular image recognition methods are: laser scanning , light curtain , ground penetrating radar
- At the technical University of Denmark in a Bsc thesis an interesting different energy related solution is presented. The solar panels are on a docking station and the robot “carries” a battery.

3) Is the question of perpetuity (thanks to solar panels) answered? Are they really autonomous?

We can not express an opinion without knowledge of the variant of the technology used. For full consultancy we will need to interview the team members.

4) Is the structure durable enough to not be needing repairs afterwards?

The issue of locomotion is still in question, since they are very light-weight. " Some kind of "Climbing capability" could be important. The robotic structure that the company proposes is very light-weight. They appear to promote the robot for specific classes of agricultural operations and at least to some extend the light-weight character of the robot seems to have been taken into account. *We observe that the wheels of Company_X are much smaller than those of Oz.*

Illustration 1: Oz Robot by Naio Technologies | no solar panels **http://naio-technologies.com/produit/oz-en/**

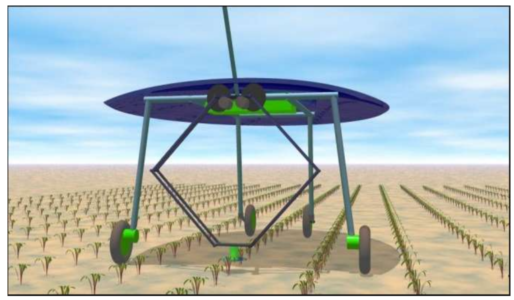

Illustration 2: Company_X Robot

1.4 Verdict

The market opportunity is well detected. There is no evidence that the Company_X team is the only one or one of the few which detected this need. The main question for the GF-ACCORD team is the competitiveness of the final product which is essential for sales success. Also important is the barrier related to decreasing farmer's jobs in France as syndicates are expected to resist. The only concretely competitive elements that we see is the low price "promise" (possibly the lowest or one of the lowest world-wide) and the also promised energy autonomy. We advice the client to investigate these points extensively.

Based on the tables below, the biggest opportunity would be in France due to the average farmer salary and the market size.

Global agricultural product (Ref_1_Verdict)	
2010	**2015 (exp.)**
$1,720.9 billion	$2,307.6 billion

Agriculture market size by country of interest (Ref_7_Verdict)		
France	**Germany**	**Switzerland**
€ 47.4 billion	€ 34 bill.	CHF 10 billion

Salaries in agriculture by country of interest (Ref_2_Verdict)		
France	**Switzerland**	**Germany**
€29'400 (2013)	CHF 30'000– 54'000 (range)	€16'300 (approx.)
		€8.50/h (min. gross wage from 2015)

We cannot imagine an explosive increase of sales of agricultural robots at this moment in time, when there is considerable unemployment.

The size of the organic market (a sub-set of the sustainable agriculture) is also of considerable size and in particular in France there is a lot of room for growth (an examination of the low French number is the subject of another analysis).

Global Organic* Market (Ref_10_Verdict)		
55 billion EUR (2013)		
USA	**Germany**	**France**
24.3 billion EUR	7.6 billion EUR	4.4 billion EUR

*The term "organic" is still highly ambiguous nowadays, since the regulations differ worldwide. A generally accepted definition is any plant that is grown without the use of any pesticides, fertilizers or growth supplements.

The agricultural robots can lead to a considerable decrease of use of pesticides and the numbers in the tables below indicate that there is space for considerable profit thanks to this.

The Global Pesticide Market (Ref_14_Verdict)

Lucintel, 2012: US $ 68.5 billion (2017 exp.)	**Bcc Research, 2010**		
	US $46.7 bill. (2008)	US $ 51.2 bill. (2009)	US $ 78.3 bill. (2014 exp.)

Pesticide Market share by company (2008) (Ref_15_Verdict)
1) Bayer (Germany) – 19%
2) Syngenta (Switzerland) – 19%
3) BASF (Germany) - 11%
4) Dow AgroSciences (USA) - 10%
5) Monsanto (USA) – 9%
6) DuPont (USA) — 6%
7) Makhteshim Agan (Israel) - 5%
8) Nufarm (Australia) - 4%
9) Sumitomo Chemical (Japan) – 3%
10) Arysta Lifescience (Japan) – 3%

Assuming that France is correctly accused of being a heavy pesticide user and as the weeding robots are removing the weeds without any pesticides, the opportunity is even greater. Thus, it must be repeated that the greater opportunity lies with France rather than with Germany.

The global agricultural robot market is growing fast at the moment.

Global agricultural robot market size (Ref_5_Verdict)	
2013	**2020 (exp.)**
$817 mil.	$16.3 bill.

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http://www.bccresearch.com/market-research/chemicals/agrochemicals-fertilizer-pesticide-markets-chm054a.html *(Accessed 15/05/2015)*
Ref 15_Verdict:
http://wcropchemicals.com/pesticide_regulatory_profile/ *(Accessed 15/05/2015)*

seen as a recommendation to invest in the company or to buy the product. The GF-ACCORD team spends maximum three days studying the subject, assisted by the GF-ACCORD software. GF-ACCORD does not follow a specific limited set of companies (listed for example). It studies ab-initio any company (listed or unlisted) or product.

End of the qualitative business analysis

Other GF-ACCORD products:

- Master analysis – many more answers – double the knowledge
- Personalized consultancy – problem solving
- Knowledge based assistance in international business development