ASAP

The agricultural students are preparing for Industry 4.0

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The Agricultural Students Are Preparing for Industry 4.0

2019 – 2022

Final Report

Munkagårdsgymnasiet
Region Halland

Content

1. Introduction

Our society has been lately embodied in the new industrial revolution, so called the fourth industrial revolution – Industry 4.0. We have been going through the development of digitization, automation and robotic automation that penetrate all sectors including agriculture. Modern agriculture mechanization takes advantage of electronics, digital technology and automation. Changes that Industry 4.0 brings have substantial influence on required qualification on labour market and will also place new demands on graduates´ knowledge and skills. The students must be prepared for working in agriculture that will be based on new technologies, automation and digitization. The main orientation of future development is "precise agriculture" connected with technical progress in the area of navigation systems, electronics and IT. It is needed to implement new elements of vocational preparation with regard to new needs of labour market. It is important to strengthen the cooperation among schools and social partners. The process of implementation changes into curricula takes unfortunately specific time. From this reason we decided to realize this project. We used the opportunity how students and teachers could gain knowledge and experience by personal visits in agricultural companies, farms, by producers of agricultural mechanization or through experts´ workshops, at an international level, across EU countries. Because of there are different conditions how to adapt to Industry 4.0 into practice across Europe.

We wanted to give to the students and teachers of vocational subjects, opportunity to compare conditions for agriculture and implementation of new technologies into agricultural practice. This project should enable them to get real overview focused on concrete technologies and results of farming in a sample of four EU countries. Their participation in international learning activities should bring them new view on a real implementation of new technologies and conditions in agricultural sector in these countries. The participants should visit involved schools to compere agricultural education, and conditions for practical training or cooperation with social partners. This project should show them both the implementation of new technologies in agricultural sector and the level of agricultural education conditions and quality in the European framework. The project should increase vocational competences of students and teachers. Another goal was to increase students´ motivation to improve vocational knowledge and skills, including language skills. The last but not the least goal was the transfer of gained knowledge and experience to their schools, curriculums, school facilities and teaching to the partners´ schools.

We realized four international learning activities – three in physical form and one because of COVID pandemic in online form. These international learning activities took place in the United Kingdom, the Czech Republic and Sweden, the international learning activity in Denmark was replaced by virtual mobility. All international activities included presentations about partner countries, the situation in agriculture, the introduction of new technologies in agriculture, the education system and partner schools. Another part consisted of visits of the participants on farms, in agricultural companies, by producers of agricultural mechanization, that consisted from tours and discussions with the employees or the owner. The last part consisted experts´ workshops. The international learning activities included an accompanying cultural programme to familiarise the participants with the socio-cultural environment of the visited country.

The project started in school year 2019/2020 with 2-nd year students of agriculture. Students prepared presentations about their school, school farm, the Czech Republic and above all presentations of some enterprises which are leaders of the Forth Agricultural 'Revolution either in plant or animal production. Every participant of the project did his or her part in preparation and of course everyone presented his

or her work during the first meeting in our partner school Easton and Otley College in the United Kingdom in October 2019.

The work was interrupted due to pandemic so the students who started the project left the school. Another group of the 3-rd year students followed and went on with work on the project. In April 2022 they welcome participants form partners´ schools again with their own presentations introducing others to the Czech Republic, their school and school farm. During the week they with others visited some leading companies using modern technology. They became acquainted with some equipment (drones), some progressive suppliers of machinery (Pottinger) a farm using technology regarded as the feature of the Forth Agricultural 'Revolution (Eurofarms) and others. Before and after it they were searching on the internet to get more information and prepared their presentations for the next meeting. This meeting was held at Munkagårdsgymnasiet in Sweden in May 2022. The participants visited the machinery producer Väderstad, made excursion to Berte Mill and from an expert gain a lot of information about Swedish agriculture. The Danish School, farms and companies were presented online.

2. Sweden and Swedish Agriculture

Sweden is a very long country and from north to south Sweden is 1572km long. This means that agriculture in Sweden varies a lot between north and south.

Swedish agriculture from north to south

In the north the farmers focus on dairy cow production. This is because a shorter growing season and cold winters. Many farmers have a combination of dairy production and forestry. Up north we also have the Sami culture with special regulation how to use the forest and the areas close to the mountain areas. This is normally where the reindeers are kept. It´s not unusual with conflicts between dairy farmers and the Sami people if reindeers end up staying on arable land.

In southern Norrland a typical farm is different. Here is an example from Hudiksvall. The dairy farms have about 70 milking cows. They have about 180 hectares of arable land on which they grow about 110 hectares of grass. They also grow whole grain and some barley.

In Skåne which is the southernmost region you find many grain farms with lots of pigs similar to what you see in Denmark. Farmers do also grow beets, potatoes and a big variation of grain. In this region you will find the biggest farms in Sweden.

The Skabernäs Estate is one of the biggest farms in the country. They have 3200 hectares of arable land and 2000 hectares of productive forest. The climate in Skåne and in Denmark is very similar.

In Sweden we have about 59 000 farms. The expression “Full time farms” is a farm with the average size of 157 hectars. There are 14 000 of these farms. The next group of farms is the “Part time farm” which is about 17 hectares big in average. There are about 45000 farms like this. The number of people who are working full time with agriculture is 58 000. Totally there are 165 000 people working with agriculture in Sweden. These people work about 3 000 000 hectares in total.

3. Munkagårdsgymnasiet, an Upper Secondary School in the Green sector

Munkagardsgymnasiet (Munkagard) in Tvååker is an Upper secondary school within the Green sector.

The school was founded 1984 and will celebrate the 40 year anniversary 2024. The school was at first designed to be a Landscaping & Horticulture education site. After a few years the agriculture section was added on due to shortage of Green schools in our region, Halland. We offer students who live far away opportunities to stay in a student dormitory. We have room for approx. 125 students. The student´s study at Munkagard for three years. This includs 15 weeks of work placement at nearby farms and companies. After the education they can study at the Swedish Agriculture University if the students have chosen the right courses which makes them eligible to apply for studies at the Swedish Agriculture University Alnarp just outside Malmö.

Today we have 6 sections inhouse at Munkagard:

1 Landscaping/Horticulture	small garden production, maintenance, industrial and small scale plant production. Offered to adult students for 35weeks.
2 Animal care	dog keeping, pets, zoo animals, animals within farming
3 Agriculture	animal-production, cereal production, etc
4 Forrestry	mechanization in forestry, (harvesters, forwarders) and use of chainsaw and other equipment, hand felling etc.
5 Nature tourism	How to manage facilities and natural environments for nature tourism. Knowledge of technology, biology and economics.
6 Entrepreneur machine	Excavator training and loader training. Also offered to adult students.

Munkagårdsgymnasiet is situated in Halland which is a region on the southwest coast of Sweden. Halland consists of a thin stretch of arable land which consists of 150 000 hectars of arable land. Dairy production is the most common type of farming in this region. The rainfall is 900-1200mm/year. The high variation of soil types is a challenge when farmers are planning for new investments. Some farmers with many hectares with big variation of soil types find themselves with different types of machines for the same purpose

The annual Tractor Train event.

This event takes place in April every year and about 40-50 tractors take part. The students borrow a tractor for a few days every year. It's a very popular event among the agriculture students.

4. Agricultural education and conditions for practical training at Munkagårdsgymnasiet

The school farm at Munkagard consists of 200 hectares of arable land, 120 sows and 80 dairy cows. The students run the school farm together with the staff.
The school system in Sweden is nine years of general studies (elementary-high school) and then three years of upper secondary school. All student´s studies at Munkagard for three years.

The practical training starts in the autumn during the students first year. We begin by introducing them to tractor driving, milking and the basics of pig production. After six months, starting in spring, the students begin their "Driftsår", which means the students take care of the school farm for a year together with our staff. They work in small groups, one week at a time with either the pigs, cows or crop production. They plough, sow and fertilize the fields and harvest the fields later on in the autumn. They take care of the daily routines with the cows and the pigs as well.
The students work 5 weeks (3-4hour shifts Mon-Fri) with the animals and 5 weeks (3-4hour shifts Mon-Fri) with the crop production during their "Driftsår" at the school.
If they want extra training, they can come to the school on the summer holiday to practice more.
The practical training during this year is combined with studies on subjects such as animal care, mechanics and crop production in the classroom.

After the "Driftsår", the students do 15 weeks of practical training on nearby farms. They usually work at the same farm between 3-6 weeks before they move on to the next one.

After the 15 weeks of practical training, the students choose what they want to focus more on in their third year. They can choose from dairy/beef/sheep/pig production, mechanics or crop production (or a combination of two).

5. Cooperation with social partners

The cooperation with social partners is very important for the four schools in the project. We believe that the students must be informed and prepared about what the world view of agriculture, horticulture, forestry, landscaping and animal care is. All schools in the ASAP projects are in the forefront in the green sector and cooperate with various kind of companies – agriculture/horticulture companies, family farms or manufacturers, dealers and service providers of agricultural machinery. It is ongoing on the fields of:

- students´ placement for practical training
- participation of experts in teaching
- experts´ workshops
- excursions
- teachers' internships in companies
- lifelong learning courses for teachers and students
- innovating or creating a new curriculum.

6. Transnational Learning Activity in Sweden

64 participants from Denmark, Czech Republik, the UK and 21 from Sweden, altogether 85 people. Munkagårdsgymnasiet, Tvåker was the base for the workshop during week 20.

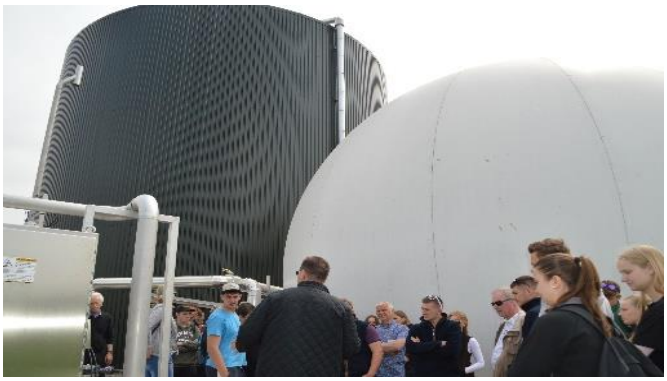
When planning for the ASAP-workshop in Sweden we decided to have focus on "Conservation Agriculture". During the Väderstad visit we saw the machinery that will be used more in future agriculture. The machines are developed in the way so we can minimize the use of tractors and because of this safe fuel and reduce soil compaction.

May 16th Travelday. The participants from UK and Czech Republic started the workshop directly from Landvetter Airport, Gothenburg on a bus to the east side of Sweden. The Danish and Swedish groups travelled in their own buses to the same area. All four countries stayed at the same Hostel close to Omberg.

Study visit -Vessige Biogas

Vessige biogas was the first visit. Farmers has come together in a project in which they produce biogas. The project was possible due to the circumstance that the farmers are located very close to each other. This is the future when we today experience high energi costs. The company is connected to Swedish national gasline.

https://www.vessigebiogas.se/



May 17th

Study visit at Väderstad factories –

The factory produces top modern machinery for field growing. Their most famous product is the Väderstad RAPID Sowing machine. Väderstad also have a company farm next door to the factory on which visitors can visit for demonstrations of different machines.

The ASAP-group visited the factory in smaller groups with Väderstad guides. Väderstad have many different information presentations. They believe it´s important to have many presentations for visitors with different focus. The presentation for our students was made for students on an upper secondary level.

Roundtrip at Munkagard school farm. All sections (horticulture-landscaping, agriculture, animal care and forestry) were presented by Munkagard students.

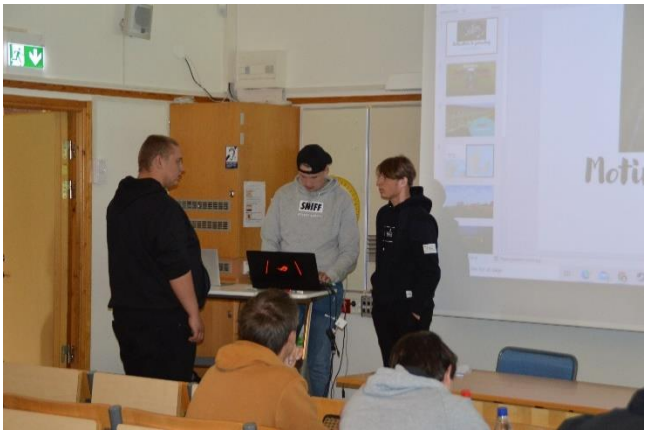
May 18th -19th.

Presentation of Munkagårdsgymnasiet and Swedish Agriculture. Our students gave a presentation about Sweden and Swedish agriculture.

Roundtrip at Munkagard upper secondary school. All sections (horticulture-landscaping, agriculture, animal care and forestry) were presented by Munkagard students.

The students from DK,GB, CZ and SE made presentations from their different agriculture perspectives.

Our students gave presentations over the theme: “My motivation for working and education in agriculture”, “The Danish education system”. The other countries made similar presentations.



In total we were about 85 participants taking part of the ASAP project. We needed to split the group in two halves. This meant that our hosts had to present their companies/farms twice. We are so grateful to our hosts. Without their interest for future Agriculture and agriculture students this workshop would have been difficult to pull through.

Study visit - Anders Axelsson Conservation Agriculture.

During the study visit at Anders Axelssons farm we saw the same machinery from Väderstad in use. Anders also explained his visions about future farming. The visions are no plowing and less harrowing. This is possible when using modern technique like the RAPID Sowing machine. The images are from this visit, the farmer made a long presentation about conservation farming. We went out to a field and saw the result after several years with conservation farming. This water test shows how quickly the water penetrated the soil, which documents that the conservation farming works buts still has some challenges especially with weeds.

Youtube-

"Conservation Agriculture in Sweden | New Holland CR9090 | Claydon Hybrid | John Deere"

Study visit -The Berte Group, (SIA-icecream, Berte Mill and Berte Farm)

The visit at Berte Group gave our students an insight how a well kept farm/company is organized and developed when they are in the front edge. The Berte Group is built up from three sections, SIA-icecream, the Berte Mill and the Berte Farm. The visit informed us of the importance, if possible, of having more than one operation running and by doing this minimize economic risks.

https://www.berteqvarn.se/

These three very active days with study visits and presentations were very successful. All students from each country were very active and asked a lot of questions throughout the visits.

Farewell Barbeque

May 20th

On this day was time for discussions and conclusion of this Transnational Learning Activity and for visit of Goteborg with guided tour about town greenery and climate changes.

7. Summarization of strengths and weaknesses between vocational preparation and the development in agricultural sector with emphasis on Industry 4.0 and new trends and technologies

New trends

Agriculture 4.0 – the future of farming technology

- system off-line (drones, soil sampling)
- collecting dates with time gap before application – soil analysis (NPK) – putting into SW-application, in CZ farmers use services (MJM Litovel since 90-th)
- system on-line (sensors)

Dates are immediately used in application (optical collecting dates from leaves of a plant and applying the results immediately – N-Yara sensor) – in CZ – quite often.

Precise Agriculture

- deals with the dates considering different conditions of the land,
- Is crucial to get the maximum amount of information about the land (soil composition, topsoil thickness, nutrient supply, etc.).

New technologies

1) Sensors

They are placed in the soil, on plants, in tractors, flatbed trucks – simply wherever it is necessary to monitor the condition of anything.

2) GPS and navigation

The use of GPS technology in agriculture could be divided into three areas:

- for navigation with manual control, where the operator controls the machine according to LEDs or display,
- for assisted steering navigation, where the operator only turns the machine at the headland,
- navigation with full autopilot (switch on/off of the individual sections).

3) Drones for agriculture

- crop and soil monitoring technology from the air,
- using unmanned aircraft gives possibility to take highly accurate multispectral images of soil blocks with coverage of up to hundreds of hectares per flight,
- give much higher resolution than satellite images, regardless of cloud cover.

4) Controlled Traffic Farming (CTF) and ComTrac System

The ComTrac system is a solution where all machines run in a single track. The remaining area is then not affected by the crossings. CTF works at multiples of 3/6/9/12 metres. The idea is driving in rails of these metres.

Positives of CTF

- less pressure on the ground
- no ploughing
- possibility of higher has-field
- less of nitrogen looses
- less of water erosion.

Negatives of CTF

- navigation and special machinery are a must

- in the Czech Republic you need escort to move machinery for CTF.

Digitalization of agriculture and precise agriculture application in the Czech Republic is currently utilised in different levels. Robotic milking operation is the furthest developed method in dairy cattle raising. There are also some farms that operate even robotic cattle feeding. The situation in plant production is more complicated. There are some applications of navigation systems used currently and the system of machinery movement in integrated traffic tracks (CTF) can be seen now. The systems of telemetry are also being developed in the practice. The machinery with ISO-BUS controlling, however, not always its potential is fully utilized, mainly in relation to precise agriculture. The applications that are most frequently used from precise agriculture are not dependent on external data collecting and processing, which is e.g. controlling of a working mesh change and related automatic sections or action elements turning off, also on headland.

The biggest complication in precise agriculture is cohesion between data collecting, their processing and consequent implementation of a particular intervention in the form of e.g. application maps. The systems that are used work mainly on-line. The existing problems are high cost of e.g. soil sampling and analyses, providing images by means of UAV, their processing, and also lack of qualified labour in this sphere. There are some companies which offer the services of their specialists who deal with these tasks, but the services are not complex. In case the company provides data collecting and processing from UAV or satellites, it does not offer soil or plants sampling and analyses. These services are offered by other companies. On the farms which mostly utilize a precise agriculture system are dependent on machine operators, they miss skilled management that would be able to link partial sections in a full meaning unit and by this way to ensure the system affectivity. Robotics in plant production is currently being tested, examined; we will have to wait for a “full” implementation.

Our school is facing to the current problems of the lack of qualified staff in the field of precise agriculture by adjusting of the existing curricula so that we could better prepare our graduates for the work in the systems of precise agriculture. Our school bought a simulator of precise agriculture in the form of a navigation system linked with an ISO-BUS controlled drill, a spreader of industrial fertilizers, and an applicator of plant protection preparations, in conjunction with physical automatic navigation system which is installed on a tractor, together with attachment of ISO-BUS compatible machines. The first of these ISO-BUS pendant machines is a spreader of industrial fertilizers with controlling of a working mesh change, automatic turning on and off on headland and applying fertilizers according to application maps. This tractor and spreader of industrial fertilizers unit is equipped with a sensor for variable application particularly nitrogen fertilizers in a real time. Another element for precise agriculture education is acquisition of an UAV equipped with two cameras for agronomic data collecting, in vegetation and also out of vegetation period, together with related hardware and software for processing the data obtained. The output will be obtained in the form of application maps for variable application of industrial fertilizers, the maps will be used in the work of the above-mentioned unit of a tractor and spreader of industrial fertilizers.

8. Conclusion

Participants gained new knowledge about Industry 4.0 implementation into agriculture, about production and using new technologies and mechanization into crop production and animal breeding, sources of alternative energy and sustainability. They had an opportunity to compare conditions for agriculture, agricultural business and implementation of new technologies in involved countries. Students are through increasing of vocational and language competences better prepared for labour market entering. This project supported further professional development of teachers. The involved teachers compered vocational education in agriculture and its conditions, shared experience, compere cooperation with social partners, facilities for vocational subjects and practice and transfer gained experience into their schools and curricula. They solved strengths and weaknesses between vocational preparation and the development in agricultural sector. During the project implementation were created webpage, Facebook account, presentations, photos from visited farms and companies, questionnaires for teachers and students and final brochures. In the connection with the project implementation were created new curricula for education in agriculture, a lifelong learning course about agricultural machinery and improved material equipment of schools.