Minor *A-Systems: High Tech Agricultural Solutions*

The minor A-Systems, co-developed by Fontys Engineering and HAS Agricultural University, has a total study load of 30 European Credits (EC), the duration is 1 semester.
During this minor, the student himself is in charge. He decides for himself what has to be learned and in what way. In 20 weeks, the student will work on various aspects and assignments in order to develop himself as a link between agriculture and technology in the business community.

The learning outcomes of this minor are:

- The student is able to use his/her biological and technological knowledge to make an analysis of an issue and to provide advice and a solution.
- The student is able to give a well-founded vision on technological developments that can be applied in the agricultural sector and can make a well-considered assessment of the impact on business and society.

In this minor, the project is central. The student directs his own learning path by choosing specific theoretical modules and practical skills.

The study program allows for 30 ECTS to be divided into the following parts, see Table below.

20 weeks (term 1 and term 2)	**ECTS**	**SBUs (study hours)**
Project (in groups)	15	420 hours = 21 hrs/week
Supporting courses (theory, communication & statistics)	13	364 hours = 18 hrs/week
Knowledge sharing day (incl. preparations)	1	28 hours
Assessment of knowledge (incl. preparations)	1	28 hours

In the minor *A-Systems: High Tech Agricultural Solutions* programme we work with a so called problem driven approach. This means that the main course, the project, determines which supporting courses are most suitable and relevant for each student. Resulting in personal and development focused course list for all our students. That is why we cannot give a fixed set of courses in front. All students can get 30 ECTS for the programme and will receive an official transcript of records stating all the courses they took and the corresponding ECTS afterwards. A list containing almost all courses is available and given below:

- Plant science — Physiology, anatomy, photosynthesis, anatomy and morphology, soil cultivation;
- Animal science — Physiology, anatomy, behaviour and nutrition and health;
- Bio sensor — Detecting the presence of chemicals on living organisms or biological molecules;
- Abiotic actuator — Encouraging non-living chemical parts to influence living organisms;
- Data analytics — Big Data, Data Conversion, Data Clustering and Classification, hyperspectral, data intensive sensors/actuators, omics;
- Data synthesis — Big data, motor babbling, orchestration of multiple and possibly heterogeneous actuations (e.g. movement), data intensive actuators, omics;
- Ethics — Philosophy that deals with the critical reflection on the right actions;
- Machine vision — The camera as a sensor, image processing algorithms, recognition (deep learning), exposure;
- Digital Twinning — How to use Virtual Plant Modelling to increase productivity in deep learned workflows;
- Robotics — Field of robotics, types, species, kinematics, programming, tools;
- Internet of Things — Protocols, sensor & actuator subsystems, energy harvesting;
- System engineering — Systems Engineering is a holistic and interdisciplinary approach/methodology to enable the realization of successful systems. The intended system integrates, among other things, the above-mentioned themes as links in a

cyclical chain that aims to optimise the primary business process in the outside world, see Figure 2 below.

- Capita Selecta — Other courses on request

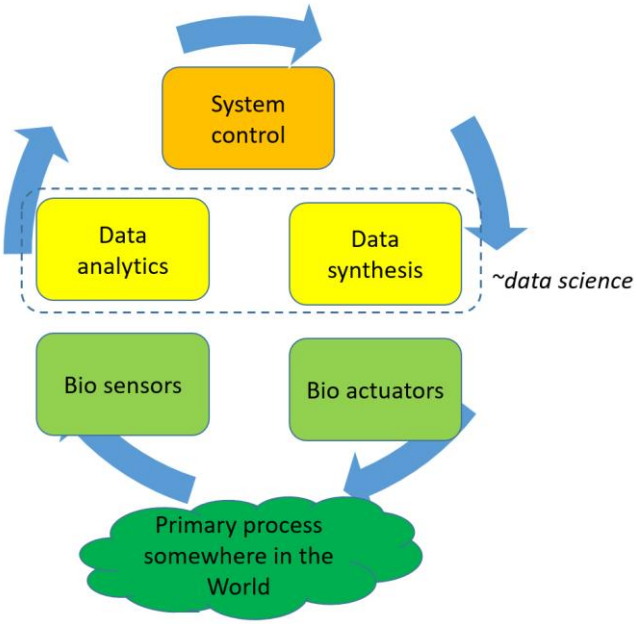

Figure 2: System Engineering, connecting themes