

Project Title:

Efficient and Reliable Online Homologation Recommendation

Applicants:

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Background and Motivation

The Embedded Systems (ES) master program is 3TU master program, organized in close collaboration with the Technical University of Delft and the University of Twente. At the TU/e, it is a co-production of the departments of Mathematics and Computer Science and Electrical Engineering.

The ES master program admits students with BSc degrees ranging from Electrical Engineering and Electronics to Computer Engineering and Computer Science. It has, moreover, a predominantly international intake. Due to the multidisciplinary aspect of the program and the diversity of the intake, virtually all students admitted to it need to repair at least some deficiencies at BSc level.

For the purpose of repairing deficiencies at BSc level, the Embedded Systems program offers the possibility of *homologation*: taking BSc level courses as part of the master program.

In the past, assigning homologation packages to ES students worked as follows:

- Students with a BSc degree in Computer Science (CS) or Electrical Engineering (EE) from a Dutch university, which are automatically admitted to the program, had to take a fixed homologation package consisting of three courses from the BSc majors on Software Science or Electrical Engineering, respectively, as a mandatory part of their Embedded Systems program.
- International applicants were evaluated by the program manager Embedded Systems at the time of their admission, and on the basis of that evaluation, a homologation package was assigned.

The approach for students with a BSc degree in CS or EE from a Dutch university is out of date. These students nowadays have had a much larger elective space in their BSc program, which they may have used to already prepare for the ES master program. The approach for international applicants is inefficient and unreliable. It is inefficient because the program manager needs to assess the background of a student in much more detail than would be necessary for admission alone. It is unreliable because the admission data often does not provide sufficient detail about the contents of courses part of the BSc program of the applicant to assess his or her deficiencies.

The ES master program has undergone a considerable redesign to satisfy the requirements of the TU/e Graduate School. The mandatory part of the program has been reduced, and students now have a choice of four thematic streams. This has further complicated the task of assigning appropriate homologation. Whether a student has

deficiencies now only depends on his or her background, but also on the choice of stream.

Since the homologation package is considered part of the elective space of the program, it is to be preferred that students do not spend too much time on homologation.

Starting in the academic year 2015-2016, homologation is offered in the form of so-called *homologation modules*, special 2.5 EC variants of courses of the BSc majors on Software Science or Electrical Engineering. Students are allowed to spend at most 10 EC on such homologation modules, which then count as free electives in their study program. Students are no longer assigned fixed and mandatory homologation packages. Instead, at the start of the program, they are explained in rather general terms what are the prerequisite knowledge and skills for the mandatory courses of the ES program and for the different streams. At present it is, however, hard for students to assess whether they satisfy the prerequisite knowledge and skills.

Objectives

The goal of the project is to improve the method to assess to what extent an admitted ES student satisfies the prerequisite knowledge and skills needed for the ES program, and, on the basis of that assessment, provide a qualitative and reliable recommendation to the ES student on how to repair deficiencies.

The improved method should be reliable to the extent that, on the one hand, students do satisfy the prerequisites of the program after completing their homologation package, but, on the other hand, do not take homologation modules they do not need. If possible, the method should refer the student to a more efficient way of repairing deficiencies than taking an entire homologation module (e.g., refer the student to some online course content).

It is a concern that the method requires little or no interference of ES lecturers or ES program management.

We intend to implement the online test using the new LMS to be acquired by the TU/e. Thus, the project can, at the same time, serve as a test case for the LMS.

Scope

A previous project (Dutch title: *Handel met Voorkennis*), sponsored by the TU/e Innovation Fund in 2014, has resulted in an online test to measure prerequisite *knowledge*. The present project will build on the experience obtained in that project, and will focus more on how to measure prerequisite *skills*. Furthermore, the present project will focus on giving an adequate recommendation to the student.

We are simultaneously working on turning homologation modules into online courses that students may follow in their own time and at their own pace. This is a project on its own and thus not included in this proposal.

Expected Outcomes

At the end of the project the following results will be delivered:

- An automated online assessment testing prior (knowledge and) skills. Including:

- assessment items for all agreed upon prior knowledge and skills the students should have to successfully get through the master program.
- qualitative standardized feedback that students receive depending on their answers/solutions.
- an automatically generated advice for each individual student for a homologation package and/or use of online available study materials based on the assessment result.
- extra study materials that will be provided within the LMS, directly linked to the feedback the student receives. *(In some cases, it may not be necessary to follow an entire homologation module, but only part of it, and in some cases studying some piece of online course material may suffice.)*
- If necessary: a tool that extends the OnCourse/LMS system making automated analyses of the results possible.

Project Design and Management

Project planning

We distinguish the following phases in the project:

Design phase (January-April 2016):

In this phase we will start with compile a detailed description of commonly agreed knowledge and skills for the Embedded Systems program, in consultation with the lecturers of mandatory courses of the program and with the coordinators of the four ES streams. An online test will be designed to assess to what extent the student satisfies the prerequisite knowledge and skills. Furthermore, for every piece of knowledge and for every skill we will search for online or offline content addressing it.

Deliverables:

- A blueprint of required prior knowledge and skills
- An assessment design
- Content covering the topics in the assessment

Implementation phase (March-July 2016):

In this phase we will implement the online test and recommendation system. There is a basic infrastructure available for implementing online tests (e.g., we may use OnCourse or the new LMS). It will be necessary, however, to extend these systems with an automatic analysis of the results in order to determine the deficiencies in prerequisite knowledge and skills of the student and give high-quality recommendation.

Deliverables:

- An online assessment build in OnCourse/LMS
- If necessary: a tool that extends the OnCourse/LMS system making automated analyses of the results possible

Test phase (August-September 2016):

Students admitted to the ES master program, starting their studies on September 1, 2016, will be asked to determine deficiencies in their prerequisite knowledge and skills using the developed tool. In parallel, the project team will *manually* determine the deficiencies in prerequisite knowledge and skills for

every admitted student on the basis of admission information, and an associated homologation recommendation.

Deliverables:

- Assessment results and automatically generated advice from our pilot group
- Manually determined recommendations for the same group.

Evaluation phase (October-November 2016):

In the evaluation phase the project team will compare the results of their *manual* homologation recommendation with the recommendation by the tool. The quality of the recommendations will be discussed with (a selection of) the students.

Deliverables:

- Analysis on the assessment results and automatically generated advice from our pilot group versus the manually determined recommendations.
- Evaluation results
- A follow-up plan, based on the for mentioned results

Dissemination phase (December 2016):

Experiences on how to build a homologation recommendation system will be disseminated to TU/e education staff. It will be published in a suitable outlet if possible. The developed tool will be made available to managers and directors of other master programs at the TU/e, and to the program management of the other 3TU master programs.

Deliverables:

- Presentations of the project results for CEE Innovation fund, an education day of the department of Mathematics and Computer Science, the program directors/program managers of other multidisciplinary master programs at the TU/e, and the program directors of the 3TU master programs.
- Input for a 'toolkit' that can be made available through the TU/e intranet site

Project team

The project team will consist of Bas Luttk (CS expertise), Sander Stuijk (EE expertise), Bianca van der Aalst and/or Ludo van Meeuwen (online test expertise), and student assistants. Bas Luttk will act as project manager.

Lecturers involved:

In the design phase the lecturers of the mandatory courses of the ES master program will be consulted, in order to compile a detailed description of prerequisite knowledge and skills. Furthermore, lecturers of homologation modules will be consulted to help designing a suitable online test.

Budget

A considerable amount of work needs to be done (and is most efficiently done) by lecturers with relevant expertise (either as lecturer of a mandatory course, or as lecturer of a relevant bachelor course), and by the ES master program management. The hours spent on the project by these lecturers should be compensated for, e.g., by hiring extra personnel (student assistants, temporary staff, etc.).