Project Title and Applicants:

Title: **Challenge-Based-Learning@TU/e;** *a feasibility study on* ***CBL as a TU/e-tool for interdisciplinary projects*** *combined with a viability study of a* ***course that recognizes learning effects from extracurricular activities***

Applicants: dr.ir. S.P.G. Moonen experienced in OGO projects / design studio's; supervisor of Honors Academy track *Smart Cities*; initiator / *coach of students' team* VIRTUe participating in the Solar Decathlon 2018 in Dubai / supervisor of the *Multidisciplinary project* of ABP | UHD Innovative Structural Design (Unit SD), Department of the Built Environment, TU/e.

+ educational developer / education expert / support ESoE (via Douwe Beijaard)

Background and justification of the project:

Currently, quite a number of students in TU/e's bachelor (and master) take up a societal challenge resulting in activities and projects related to their studies. It often starts by putting together a (multidisciplinary) team of students, some recognized and supported by CvB as students' team, some aiming on a one-time challenge. Almost all teams are highly motivated to develop innovative science-based solutions to real-world challenges -in collaboration with staff, businesses and other organizations around us (TU/e, 2017).

The importance of such activities for developing socials skills is recognized by all stakeholders (university, faculty boards, and employers) and it creates wide international exposure. Also, as challenge based projects involve the society, CBL is a way to connect society and faculty. And last, but not least, the students' results can be regarded as one of the best examples of valorisation.

However, students are in most cases NOT rewarded for these activities in their curriculum by means of individual credits.

To fill in this gap, this initiative is to develop a new TU/e course: *Challenge based learning@TU/e*.

Problem description / soft skills for Engineers of the Future

Multidisciplinary engineering projects are a significant part of the educational innovation strategy of TU/e. CvB expresses the importance by developing a unique Innovation Space (Reymen, 2017), and rector Frank Baaijens explicitly expressed in his presentation at the *Groeidialoog* (13-12-2016) that industry and business highly appreciate the soft skills of TU/e students, in addition to their theoretical knowledge.

Yet, at the same time, education in soft skills remains a kind of headache in our education, both in Bachelor College and Graduate School. Despite many good initiatives, it is quite difficult to transfer the importance of soft skills towards students in regular courses of the Bachelor College (and Graduate School, too).

This is a great contrast to the many activities developed by teams of students, the many special activities of study associations, different students participating in contests, etc., where soft skills are developed in an integral and almost natural way. Yet again, these extra-curricular activities are in general NOT part of a students' study package (more specific, students in general do not receive credits for very useful and intensive activities), whereas it involves a large group of students who are challenged. Examples are

students of Solar Team Eindhoven (STE), University Racing Team (URE), TU/ecomotive, Storm, InMotion, CADE, SensUs, team fast, team VIRTU/e, Tech United, team T.E.S.T., BlueJay, iGEM-team, Sagrada Familia in ice, Da Vinvi's bridge in ice, Ice-dome, Bierkrattenbrug, GLOW-tensegrity project, Benelux Algorithm Programming Contest, *and many, many more*.

Objectives and expected outcomes of the project:

This proposal consists of three main themes: (1) examining **Challenge Based Learning (CBL)** in order to explore and design the outlines for a course, to rewards students for skills achieved in extra-curricular activities, (2) describing adequate learning goals and practical criteria to be able to make this distinction between the soft skills that deserving recognition and most other student activities that don't fit in this scope, and (3) discuss the findings of CBL and the concept of the course with Bachelor College and with Examination Committees of different Departments. And if evaluated positively, set up a plan for developing a course for this.

-1- Challenge Based Learning (CBL) as concept for TU/e

TU/e aims to have an increasing number of students involved in multidisciplinary assignments (in extracurricular activities) based on challenges, a.o. initiated via Innovation Space. Some challenges are external organised (f.i. by competitions) or are driven by curiosity (f.i. Storm's electric motor or Team FAST, building a car on formic acid). Based on our observations of students' activities in challenges, we consider this to be a very suitable educational concept. Because it emphasises the current situation, it rewards students for valuable results and hard work and it can be very effective in an outward, international, outlook expressing: "TU/e: Where innovation starts".

This part of the project aims at examining the principles of Challenge Based Learning (CBL), by means of a small literature study resulting in a case study (in which a students' challenge will be observed).

-2- exploring and designing the outlines for a course to reward soft skills

In this part of the project we will concentrate on a new course to reward soft skills; in fact it is a feasibility study if a CBL course fits in the Bachelor College. The target group of the course are all TU/e students who take part in a challenge (provided they are found to meet the applicable criteria for this course). In this context it is important to have a very clear coherence and meaning of a possible new course, thus a crucial issue in this proposal is to study if it is feasible to establish a set of unambiguous learning objectives (that will be described sufficiently SMART). Setting up the learning goals will be performed in close cooperation with educational experts and with the support of ESoE.

The learning objectives will be the basis to develop a course (*Challenge based learning@TU/e*). These learning objectives are essential to create rules and clear evaluation criteria, needed to decide whether a specific work of an individual student can fit into this course (and very important, what doesn't fit in this course). By following a well-defined line of clear learning objectives, leading to guidelines, rules and admission criteria, along with a set of required workpieces (that have to be handed over by a student), complemented by a coherent set of clear assessment criteria (described in a rubric), we hope that we can find a fair way to outline a 5 credit-course. In case we

can develop this, students can be offered an opportunity to receive educational recognition for a small part of their considerable time investments and development of crucial soft skills as a result of extracurricular activities. By offering such an optional course, a student will be able to integrate a part of the extracurricular activity in his individual curriculum. This part of the proposal requires consultation with exam committees of different departments and checking of the found goals and criteria.

From experience, we know that a student really appreciates the Universities' recognition of the hard work and excellent achievements by reporting the extracurricular activity in the transcript of his academic results (even though the amount of credits is primarily symbolic as it just represents a small part of the hard work).

And from an educational point of view, we will ask students to reflect on the achieved skills. The methodology of reflecting even deepens the knowledge and skills.

-3- discuss findings of CBL with Bachelor College and, if positive, further develop a new course

In the third part of the project, we will discuss our findings with the Bachelor College (and the Graduate School). In case of a favourable result, a complementary objective is to create an elective course in the BC's curriculum (and possibly a spin-off towards the Graduate School).

In conclusion, the aim of this proposal is to offer the Bachelor College

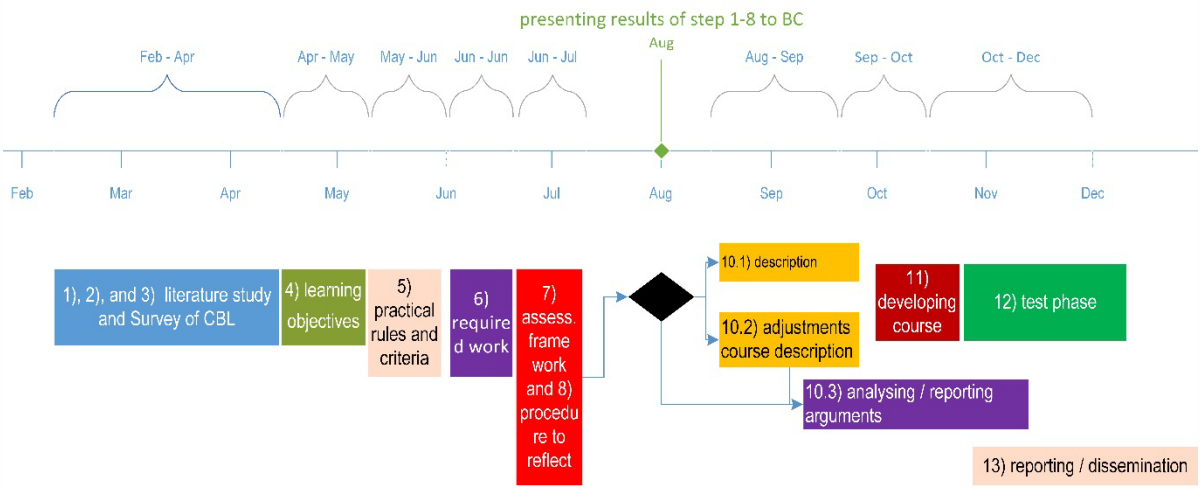
- a summary examination of the possibilities of Challenge Based Learning (as further development of Problem Based Learning);
- a set of unambiguous learning objectives, as basic prerequisite to study if a coherent and meaningful course can be developed to recognize a part of the extracurricular activities, under strict conditions, with practical rules and clear evaluation criteria, that can be used as clear-cut selection to decide if a specific part of the work of an individual student can fit into the new course; Part of this will be a description that indicates the required workpieces, that a student has to submit in order to verify compliance with the learning objectives, and a set of practical assessment criteria, described in a rubric, to make marking possible. Also a set-up for reflection to create more awareness of the developed soft skills is part of this.
- The results of the abovementioned items will be submitted to Bachelor College, for deciding on pro and cons of introducing such a method and such a course. And as a spin-off to the Graduate School, the same approach can be applicable, yet of course by using different learning objectives.
  The ultimate goals is that the course becomes available for all TU/e students with extraordinary activities to have their soft-skills development recognized.

Project design and management:

In accordance with the above mentioned plan, 13 (mostly) successive issues can be distinguished in the 3 parts of the proposal:

Challenge Based Learning (CBL) as new concept for TU/e	1	Small **literature study,** conducted to learn more about Challenge-Based-Learning (CBL);
	2	analysing existing activities of students' challenges by **advanced surveys**. selecting a specific activity of a student team to perform a case study;
	3	resulting in a *feasibility study*, aiming to set about the drafting of a concise manual setting out essential principles and guidelines for making **CBL a practical useful tool for TU/e's multidisciplinary projects**, including a good overview of pro and cons of this method;
exploring and designing the **outlines for a course** to reward soft skills	4	develop unambiguous *learning objectives* for a course focussing on soft-skills development as part of an extracurricular challenge;
	5	derive *practical rules* and *clear evaluation criteria*, applicable as clear-cut selection whether the proposed work of a student fits into the learning objectives;
	6	description of the *required workpieces*, that a student should submit in order to verify compliance with the learning objectives;
	7	develop an *assessment framework*, a set of practical assessment criteria, described in a *rubric*, to make marking possible;
	8	develop a procedure how a student can **reflect on achieved skills**. The aim is *to deepen the knowledge and awareness* of developed skills by means of reflecting;
discuss findings of CBL with Bachelor College and, if positive, further **develop a new course**	9	*presenting* the results of previous steps to the Bachelor College and other stakeholders in the university (Exam Committees), to **have a discussion** regarding found learning objectives, rules, criteria, required workpieces, assessments, rubric;
	10	in case the outcome of the previous steps meets with the Bachelor College's approval and based on outcomes of the discussions, **a plan will be made** for a new course and how *course descriptions* will be developed;
	11	make course description by *making adjustments* to (aspects of) the results, findings and opportunities;
	12	develop a *test phase and procedure*, to **evaluate** if the proposed course fills in the gap, as described above;
	13	*report* and *disseminate* to **make information and findings** of this proposal activities **accessible to others**.

Planning



Risks

Elaborating and developing step 1-8 can be well planned and is without risk. The actual "risk" is in step 9, where results of step 1-8 are presented to Bachelor College and other stakeholders. Here there are in principle two options: the set-up of the course fits in the curriculum, or it doesn't fit. If it fits, the course will be further elaborated. If it doesn't fit, the results from step 1-8 will be adjusted. In the unexpected event that after adjustments there is still not a fit with the curriculum, the project will be concluded with an evaluation and a reporting on this, including in documenting the principles of Challenges-Based-learning.

Dissemination and sustainability of the project:

Recognizing Challenge Based Learning as a tool for interdisciplinary projects stimulates the development of the engineers of the future and is perfect complementary to TU/e's activities to "*Innovation Space* on the Campus. In multidisciplinary teams, students develop innovative science-based solutions to real-world challenges – in collaboration with staff, businesses and other organizations around us." (TU/e, 2017)
In addition to this, an elective course, *Challenge Based Learning@TU/e* offers students an opportunity to receive recognition for soft skills as a result of an extracurricular assignment.

Documenting the feasibility study of CBL and by making a course description will make this project sustainable. Potential users are all TU/e teachers for integrating CBL as a tool for multidisciplinary assignments and all TU/e students for the new course.
The progress and the outcomes can be well disseminated via the channels of 4TU.CEE. Students will be informed via Innovation Space, study associations and the regular description of courses.

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