Finding Good Friends to Learn from and to Inspire

Jens Bennedsen, Siegfried Rouvrais

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Jens Bennedsen[1] and Siegfried Rouvrais[2]

Abstract— **This innovative practice paper presents a self-evaluation model for study programs or institutions linked with a unique quality enhancement process. It focuses on enhancement at the study program level but can be used at different levels. The study program evaluates itself on 28 criteria. Based on such self-evaluation, it identifies a subset of the criteria it would like to improve. The improvement process has at its heart a cross-sparring collaborative and iterative approach, whereby paired study programs are to learn and inspire each other by being critical and constructive friends. This paper focus on the pairing – how can a good match be made so that there will be new insights and inspirations?**

The criteria draws upon an international super-set of criteria from engineering accreditation systems like ABET, EUR-ACE, CEAB or Engineers Australia, and is extensible. They are scored on process maturity levels as found in the most recent ISO/IEC 33020:2015 series, and complemented by contextual parameters such as the size of the study program, disciplinary main focus or geography.

The authors propose a pairing algorithm to find the best match for (engineering) study programs that want to learn from and to inspire each other. Based on four pilots conducted in the fall 2015, this paper reflects on the pairing of eight accredited engineering study programs.

Index Terms— **Engineering education, quality assurance, quality enhancement, collaboration, pairing, roommate.**

I. Introduction

Quality assurance models are often seen within institutions as a compliance requirement and the use of quality assurance processes to drive quality enhancement on a regular basis is somewhat tenuous. For quality in higher education, in a regular changing context where curriculum transformations are needed, there is a need for more integrated approaches, e.g. an approach that brings together assurance and enhancement. Such an approach should be constructively useful across engineering institutions, study programs and even countries.

Even if self-assessment reports are to be public in today's accreditation systems, as promoted by the European Association for Quality Assurance in Higher Education, institutional good practices are not so often shared by assessors among the large pool of audited institutions, whatever their score or maturity. What if a collaborative process could give the opportunity to establish international collaborations and to improve international best practice inspiration between higher education institutions (HEIs)?

The motivation of the Quality Assurance and Enhancement Marketplace European project (QAEMP) was to complement accreditation with more flexible and reactive collaborative enhancement processes. An innovative approach based on peer-based enhancement has been designed and implemented. It finds its roots in established model and process assessment from international standards and previous documented practice of the literature. Based on 28 quality criteria defined in the self-evaluation model, pairing of potential good friends' study programs lies at the heart of the process, in a win-win approach [1], [2]. As an innovative practice in engineering education quality, the proposed flexible and reactive process can be seen as a complement to the accountability focus of accreditation systems. To validate the project aims, a pilot study included eight recognized engineering programs, from six different countries. These eight programs did four cross-sparrings during one 6-month period.

This Innovative Practice paper reflects on the matching of study programs in pairs. The process is inspired by a sparring partner as in sport (i.e. someone who helps, for example a boxer to train for a fight by taking the part of an opponent) and carried out by physical meetings called cross-sparrings. Feedback analysis shows the constructive benefits of the collaborative process in the pilot study. The pilot study was done in an European context; future development zones for larger international scalability is to be explored.

This paper describes the context of the quality enhancement, the details of the proposed pairing algorithm, criteria used, and an evaluation of the result of its application in the context of eight graduate or post-graduate engineering programs as well as future enhancements of such a pairing algorithm.

The next section describes the context and related work. Following this, a description of the educational program enhancement model and process that was designed and implemented in the context of a European consortium of eight engineering institutions over the 2014-2016 period is described. The following section describes in detail the algorithm used for a pairing of programs. The next section discuss impacts and insights from the pilot study. In the final section, perspectives about extensions of the pairing system to other educational institution types and about how this collaborative enhancement model and process could impact educational practices at a much larger scale are discussed.

II. Context and Related Work

Nowadays, many accreditation systems are seen by institutional stakeholders as something that the institution has to

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do in order to ensure its national or international visibility, or to be allowed to confer diplomas and degrees. It is even more the case for small top tier institutions, since many countries worldwide are aligned with qualification frameworks, without chartered engineers recognition systems as in a UK-style, where the accreditation directly conditions the engineering qualification to the graduated students.

A. From Quality Assurance to Quality Enhancement

In engineering education, quality regulation via accreditation find its roots in the 1930s, right after the great depression. ABET [3] was founded in the same period, with the Engineers Council for Professional Development created in 1932. In France, the *Commission des Titres d'Ingnieurs* was created by the Law of 1934 [4] in order to control potential private institutions looking for opportunities and to regulate the engineering qualification and title.

Looking back, the definition of quality has had different interpretations [5]. The first English universities (e.g. Oxford and Cambridge) were self-governing institutions where quality was defined by the professors who had the power to remove unsuitable employees and hire new staff by a kind of peer-evaluation process. At the university of Paris a top-management system was in place. Here the rector had the power to make all decisions. In Bologna, the students ruled. They had the power to 'hire and fire' professors – a 'customer satisfaction' system.

Quality was not on the general publics agenda before the 1980s [6], [7]. Amaral [5] argues that four factors (massification of higher education, market regulation, new public management and a loss of trust in higher education institutions and their professors) were the reasons for the general growing interest in quality (and quality systems).

A lot of water has passed under the bridge since the eighties, quality assurance requirements are now more mature, chartered engineers have defined their outcomes and proficiency profiles worldwide. But, as a kind of habit, accreditation has tended to become a well known process conducted by special program designer groups, typically at top-management level. Accreditation has major impacts on engineering educational systems and institutions, but mainly when things start to go wrong. Typically, accreditation systems require a major visit and evaluation every four - six years, so the higher educational institutions tend to lose flexibility and agility due to the long time spans. Desperately, in some cases, accreditation is seen as a burden not giving value to the accredited element, thus faculty tend not to sustain efforts towards systemic enhancement. As [8] noticed:

> The recent UK developments have shown the limitations of an approach that was perceived as too intrusive. A quality assurance system that is perceived as creating work instead of creating quality will not yield the anticipated results. It induces compliance and window dressing. (p. 14)

But still, in many cases, the focus is very much on quality assurance and not so much on improvement. Generally speaking, when things are going rather well, accreditation may not have any real effect on the operational and reactive quality of the education programs at an institution. But context and requirements are changing. The increased focus over that last 20-30 years on accreditation systems including a variety of graduate attributes speaks its own language, as well as worldwide recognized trans-national evaluation systems (e.g. ABET [3] or EUR-ACE [9]). A tension between quality control, accountability and improvement is more and more extensively captured in the literature [10], [11], [2]. The so-called new public management has given rise to the view of students as customers, even more in a globalized perspective of higher education. This naturally gives rise to the focus on customer satisfaction. As a consequence, many countries' quality assurance and accountability systems focus on ensuring that the academic teaching and learning system 'meet clients' needs and expectations [12]. Does this mean that a program does not need to enhance, be reactive and anticipate transformations, or learn from others having faced the some same difficulties, but in other contexts? Gruba et al. [13] investigated how and where change in Australian Computer Science curricula came from. Their conclusion was:

> Our findings from the survey are consistent with our own experiences, namely, that curriculum change is driven or inhibited by factors such as vocal individuals and practical constraints rather than higher academic motives (p.109)

We need a process that is seen as fruitful by the involved partners and focus on the real key stakeholders in the program change.

B. Process Maturity for Quality Enhancement

An accreditation system typically consists of a measurement framework and an assessment model and process [14]. The assessment process describes how and when the assessment is done (how data is collected and validated and how the planning is done). The process focuses on the roles and responsibilities of the involved stakeholders, the inputs and the outputs. The assessment process is supported by an assessment model. The assessment model is based on a reference model that defines a set of best practices (or standards) related to the domain that needs to be assessed. The measurement framework defines the maturity levels to be considered and contains a set of assessment indicators which support the ratings against the various standards.

Flexible evaluation approaches offer institutions the opportunity to explore their programs through a quality lens and work towards a process of improvement. The focus of most accreditation systems tend to move to process maturity and continuous improvement rather than a measurement of the current status (even though that consideration is still an important part of the quality process in the auditor perspective). As an example, the EFQM (European Foundation for Quality Management) system is described by [15] as:

> A model that basically looks at an organization, its results, and the way the results lead to learning,

> improvement and innovation. It was developed for firms but can be applied to any kind of organization. (p.98)

As such, today's accreditation systems tend to follow models like EFQM [16], or Capability Maturity Model (for software development) [17] generically formalized in ISO 330xx series [18], [14].

C. Point of Departure for Collaborative Quality Enhancement

Starting from a group of institutions that have good relations through the CDIO community [19] and relying on Capability Maturity Models, a process inspired by a sparring partner as in sport was developed [20]. As Kontio et al. [20] wrote

> the initial project (...) aims at strengthening the cooperation of HEIs and disseminating the best practices of quality assurance methods and educational solutions (p.2)

The collaborative formalized process presented in this paper, and its pairing system, is a natural continuation and expansion of this previous work.

III. An Innovative and Collaborative Quality Enhancement Process

The proposed collaborative, incremental and iterative quality enhancement process is based on a prior self-evaluation, where the study program identifies quality criteria it wants to improve. The program scores itself on a six point scale (0-5) on 28 defined criteria. The enhancement process is done in four steps:

1) **Self-evaluating:** Evaluate one's program. This evaluation is based on the full list of criteria from the self-evaluation model.When the self-evaluation is finished, a program identifies 3-5 criteria it wants to improve (called learn-and-inspire criteria);
2) **Pairing:** Two programs are paired. A good match is two programs where the difference between their self-evaluation scores on the learn-and-inspire criteria is significant;
3) **Cross-sparring:** The two programs visit each other to learn from and to inspire each other. During the visits, the study programs discuss in detail how they do things related to the selected learn-and-inspire criteria;
4) **Enhancing:** Based on inspiration and observations, actions to develop ones own program are planned (and, potentially executed).

For things to happen, the process has to be flexible and not too time consuming. Therefore it is not required to have documentation for the scoring of a criterion – and two people from the same program/institution/... might not score completely the same [21]. Scoring therefore is typically done as a collaborative internal process where the institutional people involved in managing the program sits together, discuss and score. The purpose is definitely not subjective accountability for **quality assurance** but **quality enhancement**. However, the scoring has to be done in a thoughtful manner as the scores are used to find a complementing sparring partner.

A. Self-Evaluation Model

The 28 Quality Criteria (QC) focuses on the quality aspect of engineering programs. They are based on engineering (accreditation) frameworks such as ABET, EUR-ACE, CEAB. The are grouped into 10 theme areas: (1) Educational Program Philosophy, (2) Educational Program Foundation, (3) Learning and Teaching, (4) Assessment and Feedback, (5) Skills Development, (6) Employment, (7) Research, (8) Student Focus, (9) Faculty Development, and (10) Evaluation. For more details about the criteria, see [22]. They are scored from 0 to 5; 0 means the program has done absolutely nothing yet, 3 means it has a plan that is being implemented whereas 5 means that there is a continuous improvement process in place where the program continuously measures and improves on the given criterion.

The evaluation could be at different levels, e.g. course, program, institutional, or a group of institutions. Typically, the scores are done on a program level. However, some of the criteria typically are at institutional level (e.g. work facilities or additional support for learning). This has to be taken into account when selecting the learn and inspire criteria. In the pilot study, program level was the main focus, with programs in mechanical engineering, ICT engineering, computer science, and health engineering. The educational programs were at Bachelor (four in total) or Master level (four in total) from six countries in western Europe (Denmark, Finland, France, Iceland, Sweden, and the United Kingdom).

B. Reflections on the Cross-Sparrings in the Pilot Study

As described previously, four cross-sparrings were done in the fall 2015. Here we abstract the findings in the cross-sparrings. The interested reader can find more details in [23], [24], [25], [26]

In general, the process was found positive by the the partners, and fruitful discussions took place during the meetings. In one concrete example, the cross-sparring helped to identify development areas and to find improvement ideas connected to topics such as diversity, work-places, student employability and project-based learning methods.

The piloted self-evaluation and cross-sparring processes were to operate quite well. Also the practical arrangements were successful, and the visit programs supported the defined priority criteria of the both partners. Yet, it would have been beneficial to include even more people in the process especially during the visits. The fact that the participating programs represented different fields of engineering was found to be an important element in keeping the desired focus during the visits. On the other hand, the instructions and templates used in the evaluation and review could still be improved in terms of simplicity and usability.

One example of concrete inspiration is the good practices found by Aston University when they visited Turku University of Applied Sciences (TUAS):

- TUAS, while having similar cohort sizes to Aston, had a novel method of structuring these with cohorts typically broken down into a number of parallel classes of around 30 students. Each class would have at least one class rep and the small class sizes appeared to create a more collegiate relationship between students and staff;
- TUAS has a more developed approach to employability, industrial involvement and entrepreneurship than mechanical engineering at Aston. The development of a student consultancy, something which also exists in Astons own ICT group, while perhaps not directly replicable can act as inspiration for the development of entrepreneurship activity;
- Final year projects were all industrially linked and this was seen to be a key cornerstone of the TUAS ICT degree philosophy. [24](p. 45)

As a conclusion, Clark et. al. [24] wrote:

> This type of activity can be recommended to any programs interested in developing their operations. However, it is important to invest enough effort in the process from the very beginning. Also the pairing of the partners has a great significance. In this case, there was a nice combination of strengths and development areas present. In the optimal case, the cross-sparring should not just be a one hit but lead to an ongoing cooperation in the future. (p. 46)

IV. Towards a Right Match: Pairing Algorithm

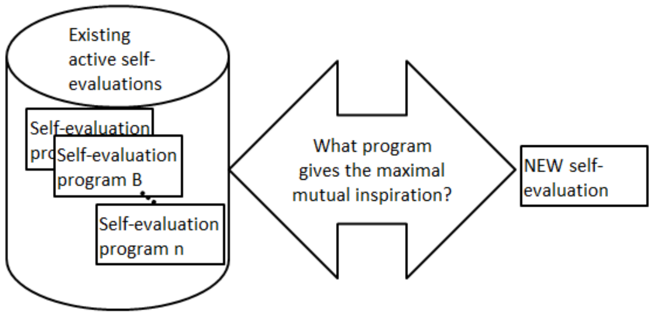
It is not obvious how to pair partners when they are sparring. In the self-evaluation, each study program selected three to seven quality learn-and-inspire criteria it wanted to improve. The suggested number is five for an incremental and reactive approach; the programs may choose between three and seven criteria, as confirmed by the pilot studies. The rationale is that the program stakeholders better know where it needs to improve and thus can be inspired.

The pairing algorithm goal is to find ‘the best’ match of a new self-evaluation with the existing pool of self-evaluations as described in Figure 1. It is important that both of the matched programs gain from the process. The following subsections elaborate on the algorithm and its design, starting from the pilot study specific case.

A. A Roommate Problem for the Pilot Study

Four pilot studies were conducted in the fall 2015, with eight accredited engineering study programs. The programs had scored themselves on the 28 criteria the previous semester. Even if the number of programs was limited, these studies permitted to benchmark the collaborative approach and analyze its flexibility. Two programs were from Finland, two from the UK, one from France, one from Denmark, one from Iceland and one from Sweden. These contextual factors were considered as exclusive in the pairing in the sense that programs from the same country could not be matched.

Fig. 1. The goals of the pairing algorithm

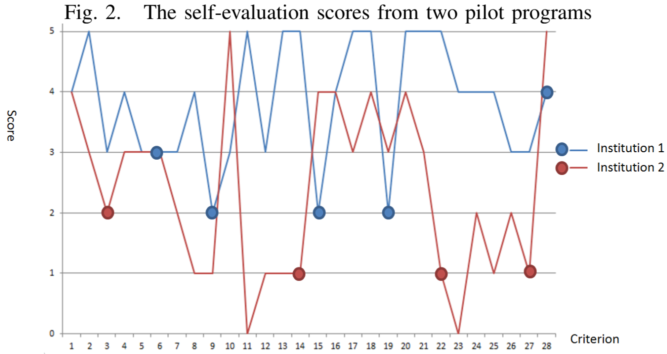


The eight programs engaged in a cross-sparring at the same time, thus requiring to manage a roommating of these programs [27]. In a strict order, a complete match corresponds to a set of 4 pairs of partners. A match is said to be stable if two partners prefer each other [28]. A stable match may fail to exist for certain contexts of partners and priority criteria. This was the case in this pilot study.

B. One to One Selection of Sparring-Partners

Generally, the criteria selected for a single match are the priority criteria where program stakeholders seen there is room for improvement, and thus search for inspiration from others in a repository. Each program in the repository can flag itself (or be flagged by the program leader) as pairing-ready or not, e.g. due to an ongoing process instance or non availability. The pairing algorithm thus tries to maximize the distance between the new self-evaluation and the self-evaluations in the database. As an example, Figure 2 describes criteria of two paired programs. For a more detailed description of how the actual cross-sparring of the two programs went, the interested reader could refer to [26].

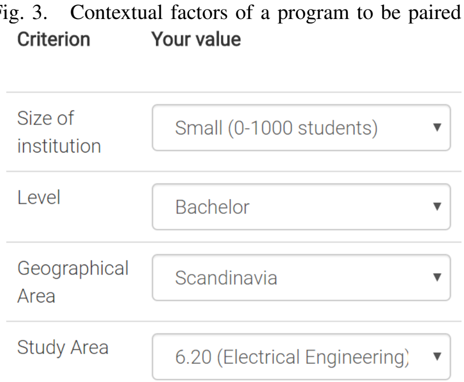
Fig. 2. The self-evaluation scores from two pilot programs



Apart from the actual self-evaluation criteria, there might be other contextual factors influencing a good match. Should the paired programs be active in the same discipline or perhaps get ideas from another field? Should they be at the same level (Bachelor or Master) or different? Should they be in the same geographical region or different (to be inspired by programs in another culture)? Should they be able to list their own preferences about the cross-sparring partner? The answer to these questions is not obvious. Consequently, in a one to one model, the algorithm leaves it up to the program leader to define what parameters among a predefined set of parameters is to be included in the pairing – and for those included, what should be the value from the program it would like to be paired with.

Based on discussions with the eight involved programs, four parameters were included in the implemented algorithm: the size of the program, the level of the program, the geographical area and the study area. Naturally many others can be relevant. In Figure 3 an example is given. Here the new program describes itself on the four parameters (it is a small program with up to 1000 students, the program is on the Bachelor level, it is located in Scandinavia and it is with electrical engineering). The first factor should be size of program, not institution.

Fig. 3. Contextual factors of a program to be paired



When matching, a program can be restricted by the context, e.g. by the fact that it is not practical to travel to the other side of the world for sparring, or it does not want to cross-spar due to conflict of interest (e.g. competitors at national level).

The program has the possibility to specify what other programs' contextual factors should be. Figure 4 gives an example of a program describing how the parameters of the other programs should be (i.e. the other program should be small sized, it should be in Scandinavia and it must be in another area than electrical engineering). In this case, the level of the program is not relevant.

When the program searches for a sparring-partner, it accepts that it will be part of the QAEMP database of programs. The last piece of information the program enters is the time frame when the program is willing to be paired with others (here from May 1st 2016 to May 1st 2017) as can be seen in Figure 5.

C. The Pairing Algorithm

As described previously, two kind of elements are taken into account when the best match is to be found:

1) **Contextual parameters** (cp_i): The four contextual parameters describing the program: the size of the program (cp_1), the level of the program (cp_2), the geographical area (cp_3) and the study area (cp_4);
2) **Learn-and-inspire criteria** (lai_i): The three to seven selected priority self-evaluation criteria (the learn-and-inspire criteria), out of the total of 28 where the program wants to be inspired from the spar.

Fig. 4. The goals of the pairing pairing parameters

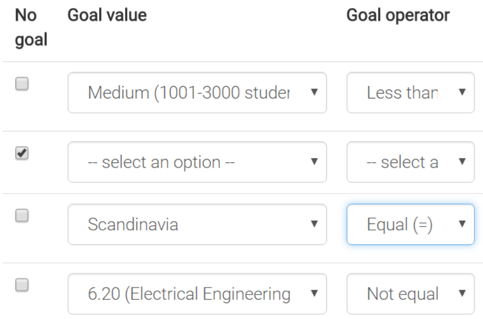
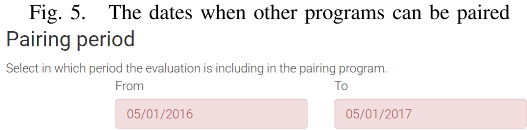


Fig. 5. The dates when other programs can be paired



The contextual pairing parameters are measured on the following scales:

1) The size of the program (cp_1): Small (0-1000 students), medium (1001-3000 students), large (3001+ students). The size can be compared using $<, \leq, =, \geq, >$;
2) The level of the program (cp_2): Bachelor or Master. Can be compared using $=$ or $\neq$;
3) The geographical area (cp_3): For now, the following areas are available, since the project has been running in Europe: Scandinavia, Central Europe, Eastern Europe, Southern Europe, Russia. Can be compared using $=$ or $\neq$;
4) The study area (cp_4): The areas described by the Erasmus subject area codes were taken [29], even if international UNESCO codes can easily be considered (cf. ISCED fields of education training classification). These can be compared using $=$,$\neq$, in-area (e.g. electrical engineering is in the engineering area), not-in-area (e.g. if the program is an electrical engineering program, all non-engineering programs will be considered).

In the following description, MP refers to all active self-evaluations (that is all agreeing self-evaluations to be paired today), $p.lai$ refers to the set of learn-and-inspire criteria selected by the program p and $p.cp_i$ refers to the i^{th} contextual parameter from program p. Likewise, $p.lai_i$ refers to the value (maturity level) of the i^{th} selected learn-and-inspire criteria from program p. Note that $p.comp_i$ refers to the comparator (e.g. $\neq$) used by program p for the selection of relevant other programs on pp_i.

As a first function, a distance is to be calculated between potential program pairs (i, j), where $criteriaDistance$

is the sum of the difference in values of the selected learn-and-inspire criteria, from both program i and j:

$$criteriaDistance(i, j) := \\ \sum_{c \in i.pc} j.lai_c - i.lai_c + \sum_{c \in j.pc} i.lai_c - j.lai_c$$

As an example, Figure 2 describes criteria of two paired programs where the distance was 14. In fact, the red vector of learn-and-inspire criteria of the program from institution 2 is $(2, 1, 1, 1)$ (the values corresponding the criteria from institution 1 is $((3, 5, 5, 3))$ and the blue of the program from institution 1 is $(3, 2, 2, 2, 4)$ (here the corresponding values are $(3, 1, 4, 3, 5)$. The two distance vectors are respectively $(1, 4, 4, 2)$ and $(0, -1, 2, 1, 1)$. The blue institution 1 of Figure 2 is then not expected to learn from the red program of institution 2 on its second priority criteria, since the value is negative (however equivalent on its first priority criteria).

Based on this distance function, the pairing algorithm is done in the following way, where $PossiblePartners_i$ is the set of all programs that fulfill the requirements in terms of contextual parameters set by program i, where $i.se$ being its input self-evaluation and $i.se.comp_i$ the operator used to compare with (i.e. the 4^{th} contextual parameter of the matched program should be $\leq$ the the $i.se.comp_4$ is $\leq$.

$$PossiblePartners_i := \{j \mid \forall j \in MP \ and \ \forall i \in \{1, .., 4\} : \\ \text{exists } i.se.cp_i : j.cp_i \ i.se.comp_i \ i.se.cp_i\}$$

$BestMatch$ is the program with the self-evaluation that has the highest distance (if existing):

$$BestMatch_i := j, \exists j \in PossiblePartners_i \\ \mid max(criteriaDistance(i.se, j.se))$$

V. Impacts and Insights on Program Pairing

This section discusses pairing. The discussion is based on the findings from the pilot study.

A. First Results of a European Pilot Study

In the second phase of the project after the cross-sparring, the pilots were asked to evaluate the pairing. The main result was very positive; all of the participating programs found the cross-sparring to be worth the time spent.

In the pilot, we experimented with different combinations of pairing-parameters: programs on the same level were paired as well as programs on different levels (bachelor with a master program), programs within the same area of engineering were paired as well as programs from different areas of engineering. In all cases, it is not possible to conclude what made the best match. E.g. one of the programs in Mechanical engineering was paired with a program in ICT. From the outset, the mechanical engineering people were not expecting to get many new ideas for improvements, but the cross-sparring turned out very well. Two bachelor programs within health-care technology engineering were paired; they found it very productive to be able to discuss common problems. For more details of the findings, see [26], [25], [23], [24].

B. Some Obstacles to Good Pairing

As always, the most important factor for a positive outcome of pairing and sparring is the people involved. If they see the process as something they have to do, the outcome is probably very limited. The root assumption is that all participants do it on a voluntary basis.

One of the practical problems with sparring process is the time commitment. All of the actual meetings took two days, but traveling adds to the total time. As an example, one program from Umeaa, Sweden was paired with a program in Belfast, Ireland [25]. The time to travel back and forth added two days to the cross-sparring. Extended to a broader geographical area would increase this even further.

VI. Discussion and Perspectives

The pairing in the pilot study was a little different than the pairing in general since all needed to be paired for completeness, in the same time. In this section we discuss the general pairing algorithm and self-evaluation criteria model.

A. Scalability: Is The Further Apart the Better?

ABET, as found in its Web search engine in April 2016, has 844 Schools registered [3]. CTI in France has 227 Schools registered in 2016, with 1058 educational programs accredited. The pool of accredited and non accredited engineering education programs is large, at international levels and at some national levels, e.g. as in China (cf. Chinese Engineering Education Accreditation Association). Such a pool potential opens the way to an iterative practice of cross-sparrings, along several 6-month periods.

The sample size for this work, with four pairs, can be seen as very small for a validation. The pairing of the eight programs was non stable, in Irving's algorithm definition. For roomating, Irving's algorithm has a $O(n^2)$ complexity. But in the general case, a partner has to find its best match in the pool of available programs, with a complexity of a $O(n)$, n being the number of available programs. The more the set of available programs to be paired is supplied with self-evaluations, the more possible sparring partners the pairing will find.

The $BestMatch$ of a program is defined to be an other program where the distance is the highest on the learn priority criteria of two programs, so as to learn from and inspire for each. Is this always the case? If a first program scored itself zero on all 28 criteria (i.e. no work plan at all on the criterion), including some priority criteria thus scored at zero, and another scores itself five on all, the two distance vectors will be valued with $+5$ (lot of to learn) for the first program but -5 (not to be inspired) for the other. Note that the two vectors may not have the same size since the number of priority criteria per partner can differ. The $BestMatch$ could then be the two programs when no other programs are available. It is arguable if this is actually the best match - the high-scoring program would possibly not find it very fruitful to be paired with a non mature process program. However, this is more seen as a theoretical problem, in so far as practice programs have good and not so good scores. In the actual implementation, after the match, both programs have to agree to the pairing. They will both be able to see the scoring of the sparring partner and then be able to determine themselves if they think the match will be fruitful. Pairing is a suggestion for a match, both programs have actively to accept the match.

As a perspective, taking inspiration from algorithms and rating scores (e.g. 'Elo Score') as found in social network applications or dating systems (e.g. Tinder) may permit to face scalability issues.

B. Future Work on Alternative Criteria

As of now, the criteria is a super-set of mostly European and US accreditation systems. Naturally, other accreditation systems may be included as well as other areas of focus. From the feedback in the pilot test, some of the programs indicated that 28 criteria were too many and they found some of them not to be relevant. Some of the criteria are more relevant if it is institutions that are paired, since student facilities are not connected to the specific study program but something that is at an institutional level.

One extension of the process could be, that a program or institution could only fill out the criteria that are relevant and a pairing then only calculates the included criteria. Naturally, an institution seeking to learn-and-inspire on a particular criterion should not be matched with another institution who has not scored itself on this criterion. If this was included, an institution that was performing an ABET accreditation could fill in the criteria relevant for that type of accreditation. In the pilot study, the partners involved were all engineering programs; however, the evaluation model itself is not restricted to engineering practice; areas like medicine, business, or humanities could just as well be paired.

The pairing parameters (see IV-C) could also be extended. The four parameters chosen fit the pilot study, but for a full scale implementation other criteria could be relevant. In the actual implementation, the parameters as well as the self-evaluation criteria are entity types and thus could easily be extended or changed.

VII. Conclusion

Creating change in engineering education through collaboration is not new [30]. Collaboration, even at competitive national levels across institutions, fosters transformations as a complement to accreditation. But, for a true win-win collaboration, institutions or program designers may learn and inspire each other. Complemented with an incremental approach, to makes things happen, the suggested model and process proves to be valuable and flexible in the short term. The process can be iterated every semester. This paper described and analyzed a pairing algorithm to find best matches for engineering educational program enhancement, where programs wanted to learn and inspire in pairs, on specific criteria per semester period. At the heart is a cross-sparring process, whereby programs are critical and constructive friends.

Such a collaborative process can give the opportunity to establish international collaborations and to improve international best practice inspiration between HEIs. The suggested cross-sparring model and process already has impacts on some Higher Engineering Institutions in Europe. Thanks to a pilot study, the innovative cross-sparring model has been put into practice to enhance engineering education quality and has been validated in 2015 in a European context. The flexible and reactive processes were recognized among the eight partners as a complement to the accountability focus of accreditation systems.

The criteria for enhancement draws upon an international super-set of criteria from engineering accreditation systems and is conceptually and contextually extensible to new ones. The ongoing 2016 combination of graduate attributes between the International Engineering Agreements of Washington Accord with that of the European Network for Accreditation of Engineering Education shows an example of the international dimension engineering education is moving towards. Thus, as a contribution to engineering education global quality, this novel process and pairing procedure definitely contributes to a more flexible and more continuous complement to quality assurance or accreditation evaluation systems in place in several countries, or among groups of countries, European or not.

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