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Case Studies and Applications of DAETE Model to Continuing Engineering Education

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Abstract- The need to choose appropriate methods to ensure quality of continuing engineering education has been an issue of research and of practice for years. Several initiatives were undertaken in the last decades to define the methods of proper assurance of provision and delivery of continuing engineering education. The quality models for education and training have a large variety of approaches that have been applied to all different levels from primary schools to adult learning. Methods employed had no significant success with continuing engineering education due to the particular nature of the training. A proposal for a project was elaborated between universities in Europe and in the USA to develop accreditation procedures to ensure quality of continuing engineering education (CEE) centres. The project (DAETE) applied an adaptation of the EFQM (European Foundation Quality Management) descriptors to the specific contexts of CEE centres. The DAETE model had also been applied in other contexts like accreditation and classification of CEE centers and for training managers of CEE centers staff. The paper also describes these applications of the model in different contexts with emphasis on useful conclusions. Recommendations for the adoption of the EFQM model to organizations involved in education and training are made with the consequent adaptations.

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Case Studies and Applications of DAETE Model to Continuing Engineering Education

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I. INTRODUCTION TO PROJECT

The goal of the project DAETE (Development of Accreditation in Education and Training in Engineering) was to obtain tools and methods that would ensure quality of the CEE (Continuing Engineering Education) centres. Since the project was publicly financed the final outputs are open for use by interested stakeholders like universities, accreditation agencies, CEE centres, human resources departments from companies and adult training organizations (DAETE 2020).

The common methods for ensuring quality in education and training have been educational benchmarking, implementation of diverse ISO norms, adoption of standards of practice, using specifications, external auditing, centres output valuation and management following PDCA (Plan, Do, Check, Act) approach. The choice of the method occurred during the first project meeting (AALTO, 2020). Meeting was fundamental to choose the project methodology, the action plan and the task distribution. Choice made by the consortium

was the model of EFQM (European Foundation for Quality Management) that was flexible enough to allow the possible acceptance by CEE centres in Europe and in the USA (EFQM 2020).

To mould EFQM to the CEE centres activities the partnership decided to start debating partners' experiences and practices in terms of quality control and accreditation for continuing engineering education and vocational training. Partnership then planned to analyse and to debate the models that can be used taking account the different experiences on both sides of the Atlantic, to produce guidelines advisable for quality assurance and accreditation, to test the recommendations and to adapt the guidelines to the feedback results.

In fact, CEE centres have, generally, a structure and operational contexts that are different from those existing in their own universities or higher education institutions. Some have large degrees of autonomy, others operate as private foundations or organizations and others are departments or units. CEE centres therefore need proper quality management tools and methods to allow diversity of structure and of operations. The consortium decided also that the project would focus on quality assurance of CEE centres and would not address the individual CEE courses quality.

II. LINKING CONTINUING ENGINEERING EDUCATION AND QUALITY

Exchanging theory and practices among the consortium members allowed in the first place a reciprocal understanding of the benefits of the methods and tools used. The diversity of the set of approaches added value in two fields. The first one is that environments that framed the developments of CEE quality have been different among the partnership. In Europe, the research and development about quality evaluation of CEE have been based on projects supported by public funding. In the USA, the quality assessment relies on market analysis indexes and financial indicators. The second is that in Europe the processes and procedures are preponderant to define quality of CEE while in the USA quality relies mostly on results.

EFQM was considered by the partnership as a good combination of processes and of results. This

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combination became a compromise between the management interests of the two groups of the consortium. The model became a practical tool to support CEE centres to achieve high levels of quality by benchmarking results and processes in order to achieve excellence. EFQM model is based on nine criteria. The criteria include five chapters on processes and four chapters on results. The first five criteria addresses what each CEE centre does and the other four criteria analyse results of each CEE centre.

The consortium realized and accepted that leadership and strategy success are achieved through proper combinations of people and of resources. Therefore, EFQM model criteria determine level of satisfaction of CEE centre users, fulfilment of people working in the centre and the impact on the centre in society. The EFQM model proposes self-assessment as a method of complete, systematic and regular analysis of the CEE centre activities and proposes that these results be compared with results of similar organizations.

EFQM model divides organizational processes into nine criteria, each with a certain number of sub-criteria. In the evaluation of the CEE centres the DAETE project created several sub-criteria in each of the criterion. It was necessary to adapt the sub-criteria to the processes and procedures to the needs of the CEE centres. The objective is that processes of a CEE centre maybe evaluated, developed and improved in the different functional areas. Regular monitoring, internally and externally, of these processes may improve the quality and effectiveness of each functional area. Evaluation of relevant results may be used to determine success against values of reference and allow management space to implement improvements.

DAETE model employed the same structure of chapters as EFQM model. It had however to adapt the sub-criterion to the context of CEE. This was done using a thorough debate leading to a set of thirty-six sub-descriptors divided by the nine chapters. A definition of the nine chapters was made and is presented later in the text. The sub-criterion indicators also needed to have a definition of level to comply with the requirement of EFQM model of having levels evaluated-The five levels reflect the development state for the each of the sub-criterion evaluated.

The evaluation of each sub-criterion for each CEE centre consisted in choosing of the five levels of proficiency. These levels of proficiency were chosen portray the state of development and to allow comparison among CEE centres. These levels are (DAETE 2020):

1. Quality depends exclusively on the individual (there is no process); Activities depend on individual initiatives and activities are not programmed globally.

2. Quality is based on basic processes; Responsibility for each activity is no longer individual and there is a tendency to share responsibilities across the CEE centre, with some short-term planning; There is some degree of process definition, however there is no documentation; Performance is assessed occasionally.
3. There is vision through processes and some quality assurance (intermediate processes); There are established standards, procedures and guidelines known throughout the CEE centre; Activities are carried out in accordance with these procedures; Activities are planned with medium-term objectives and indicators are defined for evaluation.
4. There is systematic evaluation and process improvement (sophisticated processes); The established procedures are systematically evaluated to create possible improvements; There is a clearly visible orientation for the CEE centre's user; The activities are planned with well-defined objectives, in the medium and long term.
5. There is the objective of having recognized external excellence (processes of excellence); There is an exchange of knowledge and experience throughout the organization, within the organization and with entities outside the organization (including competitors). The formulation and improvement of the CEE centre's procedures are in accordance with internal and external standards; The experiences and best practices are shared with other entities; There are partnerships and exchanges of information with users, trainers and other centres, etc.

After choosing the sub-criterion the partnership discussed the relative importance of each one. Each sub-criterion had a percentage of the points available for each criterion. The partnership adapted the CEE centres nine criteria of DAETE model as:

Leadership: CEE centres leaders develop and facilitate the fulfilment of the mission and vision of the continuing education centre. They develop organizational values and systems necessary for sustainable success and implement these through actions and behaviours. During periods of change, they maintain a constancy of purpose but whenever necessary, leaders are able to change the direction of the organization and inspire other members of the organization.

Policy and strategy: CEE centres implement the mission and vision, developing a strategy focused on stakeholders and that takes into account the external needs and those of the sector in which it operates. Policies, plans, objectives and processes are developed.

People: CEE centres manage, develop and unleash the potential of the organization's people at the individual level, based on teamwork and the organization. They

promote equity and equality, involve and empower people in the organization. CEE centres reward and recognize the people to motivate them to use the skills and knowledge to the benefit of the organization.

Partnerships and resources: CEE centres intend to manage external partnerships and with internal resources to support the policy and strategy in order to have an efficient functioning of the processes. During planning the management of resources and partnerships are done to balance the current and future needs of the organization.

Processes: CEE centres design, manage and improve processes in order to fully satisfy and generate more and more value for users and other interested parties.

User results: CEE centres thoroughly measure learning results in order to have good results.

Results of people in the organization: CEE centres thoroughly measure employee results.

Results related to society: CEE centres thoroughly measure the results that concern society.

Performance results: Excellent organizations thoroughly measure the key results of the policy and strategy adopted.

III. APPLICATION OF DAETE IN CEE CENTRES

The DAETE table makes part of the DAETE model and comprises the numerical information for each criterion and sub-criterion levels. The table allowed the CEE centres to register the self-evaluation values in terms of each sub-criterion. Since each sub-criterion had a fixed amount of points the levels multiplied by the points it was possible to have a number (between 0 and 1000 points) that reflected the performance of each CEE centre (DAETE 2020).

The table can be used as a self-diagnostic tool for each centre. The results can be applied to define areas in the centre for improvement. Any staff member of the CEE centre can fill the table. This table is generally filled by leaders of centre, institution, unit or department. When using the table it should be considered that there are different types of CEE centres with a wide variety of characteristics such as diversity of work areas, size, organization, financing, legal status, private or public, non-profit, commercial, etc.. Benchmarking with other centres needs to consider this type of differences that may constitute a bias.

Examples of questions that arise when filling the table are: "Why we feel that the level of activity is at this level? How do we interpret the context of the criteria or what are the evidences?" Some criteria are not relevant to certain groups of the staff and, therefore, it is advisable that scores are calculated as averages from various groups. Examples of results among three

university centres concerning the nine chapters reflect the differences among centres.

The difference of levels between universities is expressed in terms of chapter Leadership. University A had a total of 68 points and university B a total of 56 points. This chapter comprised the sub-criterion Development of vision and mission, Continuous improvement of management systems, Leadership and external relations and Leadership and motivation. The levels for university A for these sub-criterion were, respectively for each sub-criterion, 3, 3, 3, 4. For university B the results were, respectively for each sub-criterion, 3, 3, 4, 2. The differences of levels can express that university A has good examples and processes in terms Leadership and motivation while university B needs corrective actions to improve. University B showed also that sub-criterion Leadership and external relations is close to excellence (level 5) and may present procedures and processes that can help others improve their own.

It is relevant to notice that among the several answers obtained from the validation and testing of the centres has shown some patterns of results and of evaluations from the self-assessments. The first remark consists that no CEE centre attributed the level 1 to any of the sub-criterion. Since these self-assessments were not audited it is probable that this situation may happen and those making the self-assessment did not want to assume that. Another remark was that high ranking level respondents had the tendency to present high levels while lower level managers or staff had more modest evaluations. There was also noted that respondents from different areas in each CEE centre had different values for the same sub-criterion. That showed that the awareness of the development for each sub-criterion varies in accordance with the function performed by each respondent.

DAETE model proposed a path to excellence of CEE centres based on continuous improvement, self-assessment, good management practices and a planning discipline. The following steps towards excellence were proposed to the CEE centres [DAETE 2020]:

1. Assess where the CEE centre is now: One way to do this is to self-assess the CEE centre. The self-assessment process can help the centre to understand the current status in terms of quality.
2. Define the priorities of the activities of the centre: To align the activities and CEE centre strategy, it is necessary to understand the existing trends and areas for improvement. The fundamental concepts of excellence can be used to compare the centre strategy.
3. Identify what needs to be improved: Self-assessment can help provide a detailed map for

people in the CEE centre. It can help to answer: "Where do we need to improve?"

4. Identify how to improve: CEE centre staff and management can learn from other centres through comparison ("benchmarking"). It can help to identify good practices from other centres.

To validate and improve the DAETE model it was presented in several conferences, workshops and seminars to test, to disseminate and to explain goals, processes and benefits. For instance, just in 2010 there were several events: ASEE CIEC – Palm Springs, CA, USA; Building Quality in Online Programs Workshop – Madison, WI, USA; UCEA Annual Conference – San Francisco, CA, USA; EUCEN Conference – Rovaniemi, Finland; IACEE-CACEE Meeting – Beijing, China; LACCEI Conference – Arequipa, Peru; ASEE Annual Conference – Louisville, KY, USA; RECLA – Dominican Republic; IACEE 12th WCCEE – Singapore and AMECYD – Guadalajara, Mexico (October 2010).

As a result of this effort of dissemination, tuning and validation about 120 CEE centres, either academic or business oriented, experimented, criticised and validated the DAETE model. Results were of quantitative and of qualitative nature. During the collective sessions the results from each CEE centre were presented and discussed. This allowed a numerical benchmarking between centres.

Qualitative feedback was obtained through a description of the CEE centre that provided information about the dimension, type of operations, management structure, budgets, number of participants, etc. Another feedback was denominated as good examples. Good examples were defined by those related with sub-criterion with level 4 or 5 and were collected to allow other CEE centres to have access to good practices, to understand the procedures that led to the high score and learn from other centres activities.

IV. OTHER APPLICATIONS OF DAETE

Examples of the application of the DAETE approach comprehend several applications. One example is the adoption of a professional engineering association to externally accredit CEE centres that pay for each accreditation. Another example is the use of a derived model of the DAETE table by a CEE world organization as a consulting service to members. The third example is the use by CACEE (China Association of Continuing Engineering Education) to train CEE managers from CEE centres to improve the quality of results and of training (CACEE 2020).

The first application allows the Portuguese engineering professional association to evaluate providers of continuing engineering education and is based on the DAETE model. It is called ACCEDE and is composed by two phases. First phase is dedicated to a self-assessment by the provider using the DAETE

model. Results are subsequently provided to the engineering association. The second phase is composed by an audit of the CEE centre by an auditor nominated by the association. The engineering association has a set of auditors that were previously trained on using the DAETE model. Accreditation of the CEE centre is made based on the numerical result of the final DAETE table assessment. Below a certain number the centre is not accredited. A list of accredited CEE centres is available at the engineering association website. The audit report also includes a list of recommendations to improve the CEE centre (OE 2020).

Second application of DAETE model is called CPD-BQIP (Continuing Professional Development Benchmarking and Quality Improvement Program). It is available for institutional IACEE members that are interested in organizational quality improvement and benchmarking program. It has a database of results from the use of DAETE model facilitating improvement of the quality of the benchmarking data. Intended as part of the forefront in continuing professional development CPD-BQIP is considered as the first ever international standard for managing quality in CEE centres and programs at the organizational level. It is planned to assess quality of CEE centres with respect to standards, benchmark quality against peer institutions and share best practices among similar organizations, to allow continuous quality improvement (QP 2020).

The third application is relevant since CACEE deals with CEE of about 68 million professional and technical personnel nationwide. Staff from CEE centres are trained during a week on how to improve the quality of the management of respective organizations. The training is made each time on a dedicated training centre for about fifty managerial staff. Three days are dedicated to the DAETE model adopted to the country conditions. These days comprise the theoretical background of the EFQM, the description of the DAETE model, significance of descriptors, application of the model to respective CEE centre, presentation of results, debate about adaptation of sub-criterion, conclusions and remarks. It is relevant to notice the possible impact of the DAETE model in the quality of CEE in such a big country.

V. CONCLUSIONS AND RECOMMENDATIONS

Main conclusion is that DAETE model, based on EFQM, is available to improve quality of management of CEE centres. That improvement will have consequences at the level of engineering activities due to a better qualification of engineers. The validation phase and the diverse utilizations provided evidence of robustness, flexibility and effectiveness of the tool. It is possible that the DAETE model may be adapted to apply in other type of education and training organizations dealing with other knowledge areas and

levels of qualification. This is particularly relevant for the sector of education and training where quality evaluations are based mostly on processes and less on results/outputs.

The DAETE model is an appropriate combination of quality assessment mixing procedures and results/outputs indicators. Of course, the referred examples illustrate different uses of the DAETE model and also show the relevance and impact of the approach. Many CEE centres have also expressed the appreciation of having a tool that allows a self-evaluation tool that fosters reflection, diagnosis, action plan and improvement. It should be noted that the application of the DAETE model to different contexts, purposes and situations showed that it can be extended to other applications in education and training. It is relevant to notice that it can be used for accreditation of centres and for training like shown in the case studies description.

The first recommendation is that the DAETE model should be experimented thoroughly in other educational and training environments to test efficacy and efficiency. The examples show flexibility and scope that can cover other organizations. It should be possible to extend the DAETE model to a whole institution and verify if quality improvement can derive from the assessment results. The second recommendation is that the DAETE model application requires external auditing to ensure independence of the assessment and identification of the improvement actions. Self-assessment may help the self-diagnosis and reflection but maybe the results will be biased by the nature of connection the respondent to the CEE centre. The third recommendation is that the DAETE model should adapt the choice of sub-criterion due to the nature of the context where the CEE centre operates. For instance, the CEE centre may be funded by public sources or it may be private. In the first case, the profitability may not be relevant while in the second it is fundamental. As conclusion the DAETE model may be a tool and process leading to excellence in education and training if properly used and interpreted.

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Appreciation goes to all that participated that were truly involved and interested in the cooperation in improving quality of CEE and in promoting better education and training. The special recognition is dedicated to late Prof. John Klus that was a reference in CEE, in general, but an effective leader and expert in the DAETE project (IACEE 2011). For him barriers in the project were to be surpassed and his training as a civil engineer probably played an important role in that behavior. That leadership and wisdom were particularly relevant while dealing with different academic and professional cultures and with the idiosyncrasies of the

partners linked with the respective CEE contexts. He was fundamental to the conclusion of the project and to the successive steps that led to the dissemination and experimentation of the model. The European Commission and FIPSE also deserve appreciation for a project that was innovative and useful for quality of CEE and of education and training.

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