COACH_ING EDUCATIONAL MODEL: analysis and application for business

Rome, Italy viviana.callea@uniroma1.it

Viviana Callea
FLY FISH SRL
Rome Italy
viviana.callea@uniroma1.it

Germana Remigi
FLY FISH SRL
Rome Italy
germana.remigi@gmail.com

Roberta Tempone
FLY FISH SRL
Rome Italy
robertatempone@gmail.com

Lia Matrisciano
SAPIENZA
Rome Italy
lia.matrisciano@uniroma1.it

Mihai Ursache
FLY FISH SRL
Rome Italy
mihai.ursache@flyfish.it

***Abstract*— The COACH_ING model is an educational framework where engineering skills and soft behavioral skills integrate in a new set of competencies to train students and young technicians in developing their readiness to enter the job market, with strong relational skills and awareness of the career path best suited to their skills and growth potential.**

The method uses a set of evaluation forms, direct-assessment and a multiple-choice questionnaire to analyze the level of confidence with technical engineering and relational coaching skills to design a training path for any participant.

This analytical approach will be used to assess and train multifactorial skills and personal attitude to meet specific professional families in engineering field.

We have already received various confirmations of the accuracy of our analyses on the profiling of professional families and we intend to expand the research to a greater number of subjects to refine our tool-set and enhance the models' effectiveness. (*Abstract*)

Keywords—coaching, engineering, education, job market, soft skills, strategies, awareness, potential (*key words****)***

I. INTRODUCTION

The COACH_ING model has been created to support students and professionals in the development and consolidation of programmatic, innovative and creative competencies to expand their aptitude and starting skills and make them more adaptable to the work environment [1][2].

The approach has been experimented through specific tools tested in individual and collective laboratories and training sessions, held from 2014 to today [3].

The results of the experiments were collected in a Data Base (MySkill), which groups together for each activity carried out, the skills acquired by the participants during the training process.

The COACH_ING model has been presented for the first time at the World Engineering Forum in 2017 and subsequently at the International Symposium on Environment Friendly Energies and Applications (EFEA) 2018 and following editions, further enriched by a potential investigation tool presented at EFEA 2021 [4][5][6].

The present work is an updating of previous ones in terms of COACH_ING set of competencies, the specific training to enforce them and the link to the job market. This evolution represents a further experimentation about how we can support young engineers in entering the job market [7]. By this work we intend to complete the three-step process towards employability of young engineers: Competence Assessment-COACH_ING Training model- Professional Families.

II. EXPERIMENTATION

Data collection began in 2014 in collaboration with the Council of Engineers of Rome, with companies in the technology sector, as well as with freelancers in the same working field.

The basic idea was to think of technical-specific competencies and soft skills from an integrated point of view, to verify the emergence of additional properties that enriched the skill set of the participants.

The fundamental Coaching skills such as listening, neutral language, creativity, suspension of judgment and open-mindedness have been integrated with typical Engineering skills, such as systemic, diagnostic, analytical and design approaches. By observing how brilliant engineers integrate technical competencies (ing-skills) [8] with socio-relational skills (coach-skills) [9][10], a more complex vision of capabilities (COACH-ING CAPABILITIES) has been highlighted. A training integrated approaches for young professionals engineers is closer to what is required today by the work environment [11].

ENGINEERING SKILL	*COACHING SKILL*	*SKILL COMBINATION*	***COACH-ING CAPABILITIES***
INITIATIVE AND ENERGY	ADAPTABILITY	Adaptability; Work, Time and Resources Organization; Intercultural Sensitivity; Orientation to result and task; Build Relations.	**FLEXIBILITY**
WORK TIME AND RESOURCES ORGANIZATION,	COMMUNICATE	Assertiveness and influence; Adaptability; Energy; Communication; Self-Investment.	**RESILIENCE**
ORIENTATION TO RESULT AND TASK	BUILD RELATIONS	Creativity and Innovation; Prospective Thinking; System Vision; Analysis and Synthesis; Decision	**AGILE & SPEEDY THINKING**

		Making.	
SELF - INVESTMENT	SOCIAL INTELLIGENCE	Prospective Thinking; Proposals e Projects; Orientation Result and Task; Initiative and Energy; System Vision.	**HIGH ACHIEVING**
DECISION MAKING	INTERCULTURAL SENSITIVITY	Social intelligence; Build Relations; Intercultural sensibility; Assertiveness, Build Relations.	**CONFIDENCE**
PROSPECTIVE THINKING	CREATIVITY AND INNOVATION	Proposals and Project; Orientation to Result and task; Decision Making; Energy, Social intelligence.	**COURAGE**
PROPOSALS AND PROJECTS	ASSERTIVENESS AND INFLUENCE	Proposals and Project; Build Relations; Adaptability; Assertiveness; Self-Investment Inspiration.	**OPTIMISM**
ANALYSIS AND SYNTHESIS		Assertiveness; Proposal and Project; Energy; Communication; Self-Investment.	**INSPIRATION**
SYSTEM VISION			

The properties emerging from the integration of the two categories of skills (engineering and coaching) highlight aspects related to complex problem solving, systemic vision and complexity approach. As it will be illustrated below, in years of experiments and field observations, we found out that working efficiency and the possibility of accessing the job market is more effective in individuals who have the complex skills resulting from this integration. To demonstrate the validity of this thesis, an experimentation was carried out in two successive phases: the qualitative and quantitative phase. The experimental data that emerged were collected in two years of activity (from 2014 to 2016) through:

Activities 2014-2016	***N° of participants***	***Origin***
11 seminars 14 working groups 20 workshops	620 participants 830 participations 14 participants/activity	Companies 45% Free-lancers 35% University 5% Public administration 15%

The objective of training activity is :

• Develop awareness of one's own behavioural characteristics;

• Enhance the ability to observe one's own communication signals, those of others and of the reference context;

• Learn to express (communicate, transfer) and make the best use of one's personal resources in achieving operational objectives;

• Use and direct one's best skills (talents) to achieve goals and challenges in personal and professional life.

At the end of the Training activity, participants are expected to increase the ability to react to stimuli and make decisions "solving as engineers and relating as a coach".

The complete training path lasts 3 months and it's articulated in: Self-Assessment, 5 workshops, 2 seminars, 5 working groups activities, 1:1 coaching Session.

The methodology is based on:

1. A "learning" strategy for training activities (implicit theory) [11];

2. Coaching approach to reduce the university dropout rate [12];

3. The use of factors impacting on study and professional efficiency [13];

4. Support tools for data collection to be used during individual or group sessions (tables, matrices, data sheets, question templates and/or organized and contextualized lists);

III. BUILDING COACH_ING SKILLS

Starting from a reductionist logic in order to focus the observation on behavioral specifics indicators to each skill, both on the engineering side and the coaching side, a second step has been building a more complex vision of the behaviours and skills of the participants, to verify which "emerging properties" arose from the integrated observation of all the skills involved.

We decided to assume the paradigm of complexity as a reference for the study and observation of COACH_ING behaviours and skills.

As Philip Warren Anderson, Nobel Prize for physics in 1977, argues, "More is different", that is, that the whole is often more than the sum of its parts, as it presents properties that are not the simple sum of the properties of its parts.

If we initially observed and identified the 16 competences distributed between the Engineering and Coaching areas, we realized that behaviours were often composed by a couple of those skills. So, the presence of an "Ing" competence was associated with the presence or greater propensity to develop at least one other "Coach" competence in real or simulated situations of the workplace. We therefore wanted to define this combination as a new area of complex competence (which we have called "COACH_ING Capabilities").

IV. BEHAVIOUR EVIDENCE

The objective was to observe and evaluate in the participants the presence of engineering and coaching skills, first separately, then integrated as prescribed by COACH_ING method [3].

Through ad hoc survey tools, data sheets, questionnaires, 1 to 1 interviews, group work and role-playing it has been possible to highlight for each participant:

a) areas of strength;

b) areas for improvement, both on the engineering side and on the coaching side;

c) the degree of learning achieved during the course;

d) the degree of applicability of what has been learned;

e) the personal ability to integrate engineering skills with soft ones;

The experimentation also included an operational and experiential phase through a test carried out on the beta version of a new social network. The group of engineers involved collaborated in solving the technical problems detected in the social network and then they used the social tool to confront each other and exchange information on issues of common interest, share development opportunities and work opportunities. This “fieldwork” allowed us to observe the COACH_ING skills in action.

V. DATA EVIDENCE

The second phase of research, purely quantitative, had the purpose to verify the development of "COACH_ING skills" in three groups of engineers, following development interventions with the COACH_ING model:

1. engineers from high tech companies (control group), who did not participate in the training with the COACH_ING model;

2. engineers with diversified professional backgrounds who have participated in COACH_ING courses;

3. engineering students with little knowledge of behavioral / managerial skills who followed an experimental support laboratory to propose themselves in the world of work;

Each group consisted of approximately 40 participants.

The quantitative research was conducted using two tools: Self-Assessment and 1:1 Sessions:

A. Self-assessment

The data collection on the 3 groups is based on a technical-behavioral questionnaire through which the participants self-assess the possession of the model's skills;

The questionnaire consisted of 30 multiple choice questions (four answers for each question) in which each answer was representative referred to one Coaching or Engineering skill.

B. 1-to-1 sessions

Following the self-assessment, training courses were started to support the development of COACH_ING skills, measuring participants skills at the beginning and at the end of the path.

The third group (made up of university students) was still conducting the university lab, so they did not participate in the 1 to 1 sessions.

VI. FIRST RESULTS

A. First group

(control group not subjected to COACH_ING training) - showed a strong prevalence of engineering skills (level 3.5). Coaching skills, on the other hand, reached an average of 2.5;

B. Second group

(Engineers trained with the COACH_ING model) - the group self-evaluated before and after the COACH_ING training, highlighting a significant integration between engineering skills and coaching skills at the end of the training. Before the training, the skill level was, as in the previous group, around 2.5. After the course, the group reached the value of 3.3;

C. Third group

(future engineers) - the group has had a starting level of engineering skills of 1.1 and coaching of 0.8. This group was still experimenting their skills in the university laboratory and at the time it was not possible to measure the level changes at the end of the course [4]. The data collected provided an initial validation of the effectiveness of the model. To further validate these results, we conducted other training interventions during the university laboratories in the two-year period 2018/2019 using the COACH_ING model [6]. The work was carried out by acting on two parallel levels: "the Self and the Professional", working respectively on both the person and the profession with the aim of developing an integrated and more aware approach to the labor market and a greater capacity for self-marketing. In particular, the students of the laboratory of the Faculty of Civil and Industrial Engineering Sapienza worked on the awareness of their characteristics and skills that can be spent in the professional world, with the aid of ad hoc tools, such as tables, lists / cards, as well as questions and questionnaires of verification for the measurement of the competences/abilities of the model. At the same time, each student had the opportunity to practice through experiments and group work [7]. The path used the 16 skills as evaluation parameters at the beginning and at the end of the path. The students were involved in training activities, group coaching and 1:1 coaching sessions according to the COACH_ING model and at the end of the whole process there was an average improvement of 1.5 in the skills of "investing in oneself" and "building relationships". In addition, in the final session of the course, each student presented their personal project for entry into the world of work to an audience of professionals from different working backgrounds, presenting their personal skills and skills developed. The evidence of the COACH_ING skills acquired was also confirmed by exponents of the labor market during a convention dedicated to COACH_ING method and results where the participants introduced themselves, their skills and working objective to exponents of the world of work.

VII. FURTHER DEVELOPMENTS OF THE COACH_ING MODEL TO SUPPORT EMPLOYABILITY:

At EFEA 2021 we presented the latest work, the DIRECT-ING project, which is an evolution of the COACH_ING model to measure skills potential development and growth by using Questionnaires and Focus-Groups. The experimentation was conducted on a sample of 155 participants, including high school students and aspiring freshmen of the engineering faculty, with the aim of detecting the potential to be developed through training with the COACH_ING method to train the engineers of the future and facilitate their entry into the world of work.

The DIRECT-ING survey tool consists of 20 questions with 4 multiple answers, the results of which can be successfully used as an orientation tool for students in the university choice and represent a valid support in creating a direct link between Engineering and high school. DIRECT-ING tools allow not only to detect the growth potential of students but also to establish a cross between this potential and the most coherent professional families. The professional families

referred to refer to the company functions and professions of greatest interest currently for the labour market:

- Research and development
- Marketing and sales
- Operation - Specialist technicians
- Freelance - Entrepreneur
- Project management
- Finance and control
- Support services
- Human resources

The intersection between Potential Analysis and Reference Professional Families, associated with the training methodology developed by the COACH_ING model, constitutes an integrated approach that aims at the growth of future generations of engineers, allowing them to enter the job market with the right technical and relational skills.

The combination of DIRECT-ING and COACH_ING teaching tools and approaches fill a gap typical of Technical Universities, traditionally not attentive to the development of the interpersonal and self-branding skills of their students.

The DIRECT-ING survey tools were used and validated within the Smart-MeetING project in which 21 recent graduates in Civil and Industrial Engineering ventured as speakers, organizers and managers of the first Engineering Open Day held by young people for young people. During the classrooms/preparation training of the 21 talents, we collected their self-assessments on both potential (DIREC-ING) and skills (COACH_ING).

The application of the two methodologies followed the following phases:

1) self-assessment of engineer skills

2) definition of the level of soft skills

3) proposal and drafting of an intervention project to animate the Open day

4) filling in the questionnaire for assessing one's potential skills.

5) match between the skills, potential and the 8 professional families chosen as a reference to evaluate the professional aptitudes of each of the participants.

Starting from job skills [8] and from an analysis of the professional roles currently mostly covered by engineers (data regarding engineering employment in 2020 published on the WorkING platform of the National Council of Engineers https://www.cni-working.it/pagina/osservatorio-delloccupazione-ingegneristica) an evaluation model was generated based on a set of specific skills attributed to each of the 8 professional families identified. The latter were thus assigned 8 complex capacities attributable to the COACH_ING model [8].

At the self-assessment stage through questionnaires (potential and skills) the type of data collected is represented by the following graphs.

The average of the responses to the questionnaires for surveying potential (DIRECT-ING) and skills (COACH_ING) automatically generates the percentage of matching with the various professional families, as shown in the following graph:

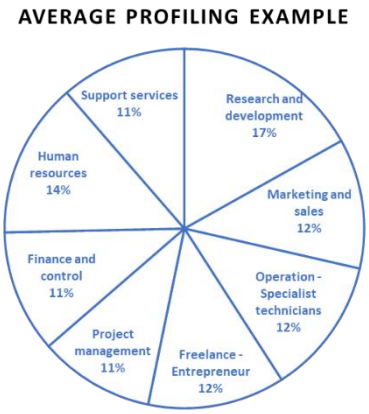

Fig. 1. Average profiling (potential/competence) by professional family

The young engineers had the opportunity to see their own complete profile of the skills possessed, their developmental potential and their professional aptitudes with respect to the current job market.

This photograph has aroused profound reflections and new awareness regarding aspirations and motivation to undertake targeted growth paths [12].

VIII. FROM PROFESSIONAL FAMILIES TO DEVELOPMENT PATHS

A further step was to identify from the results of the potential analysis **4 clusters** of in-depth training to design courses aimed to enhance the development and growth of young engineers: **teamwork, objectives and project, relation, communication (transmission of the objective).**

Through targeted development paths conducted with the COACH_ING approach, a young engineer has the opportunity to build a set of complex skills leading him to consolidate the attitudes that have emerged towards a single professional family and, at the same time, enable him to recognize himself more professional families and thus have greater attractiveness for the job market.

Having the details of the development themes associated with the different professional families, allows the young people to design specific and modular growth paths [13] based on the knowledge and awareness of which areas to train to meet the coverage on the labour market of several professional families. The following graphs represent the basic skills to train with 1:1 training and meetings for each thematic cluster and the combination of each cluster with the professional figures on the job market:

A. Group work

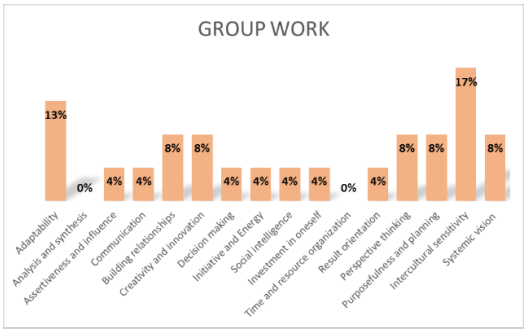

Fig. 2. Percentage of presence the 16 skills in the Group Work cluster

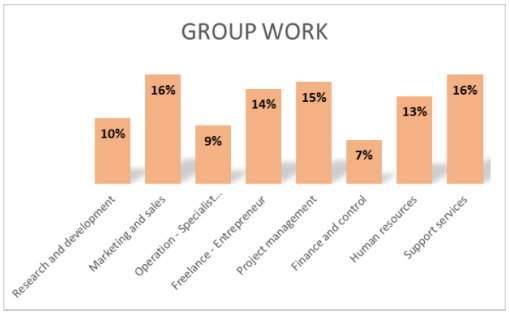

Fig. 3. Compatibility of the Group Work cluster with Professional Families

B. *Objectives and project*

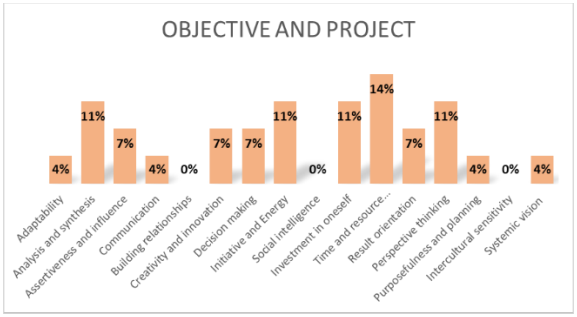

Fig. 4. Percentage of presence of the 16 competences in the Objective and Project cluster

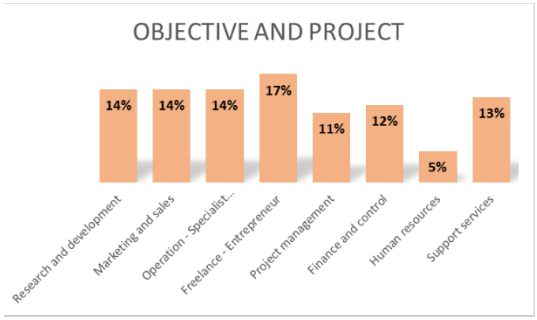

Fig. 5. Compatibility of the Objectives and Project cluster with Professional Families

C. *Relationship*

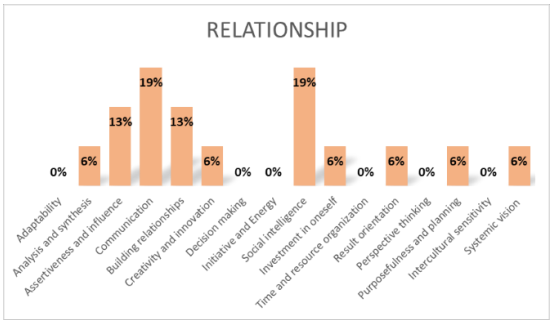

Fig. 6. Percentage of presence of the 16 competences in the Relationship cluster

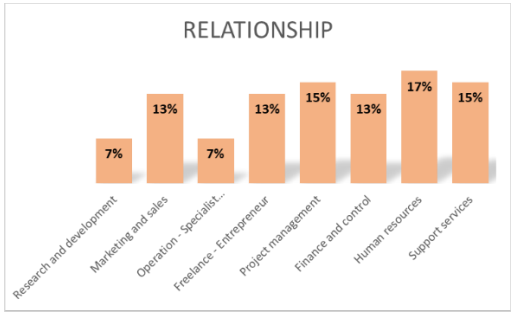

Fig. 7. Compatibility of the cluter Relationship with Professional Families

D. *Communication – transmission of the objective*

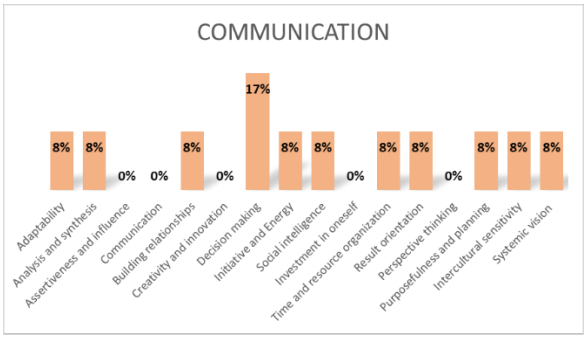

Fig. 8. Percentance of attendance of the 16 skills in the Communication cluster

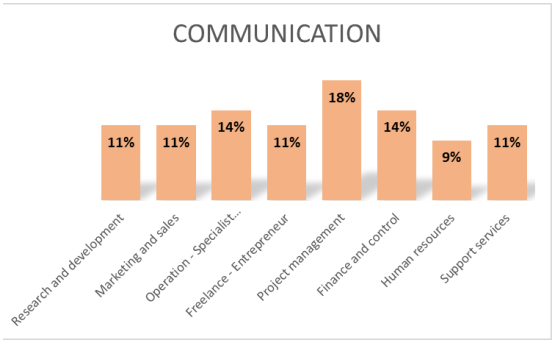

Fig. 9. Compatibility of the Communication cluster with Professional Families

In summary, the schematizations by thematic clusters and professional families can constitute not only the response feedback to those who fill out the questionnaire but also represent the starting point for specific works on which to focus the development objective that is more consistent with the needs of the interlocutor.

Some examples

In the first example (Fig. 10) we analyse the data concerning a professional who currently holds the role of Project Manager, who was given the questionnaire for the detection of potential (DIRECT-ING) and skills possessed (COACH_ING), crossed with the Professional Families towards which the subject shows a greater orientation.

Fig. 10. Professional families trend of the first subject

The results show a greater aptitude for professional families in the fields of human resources, freelance, project management and marketing and sales.

The second subject currently holds the role of researcher in the field of electrical machines. As we can see from the graph below, the results of his questionnaire highlighted a potential for the research field (17%) and for the human resources field.

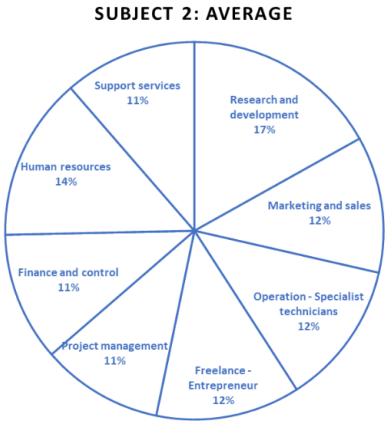

Fig. 11. Professional families trend of the second subject

IX. CONCLUSIONS

The training and development model of COACH_ING skills, supported over time the growth of complex behavioral dimensions originated from the integration of engineering and relational skills typical of Coaching, on populations of professional engineers and engineering students. In the years, COACH_ING model has been enriched with further tools (questionnaire of potential and professional families) to guide one's ability to present oneself on the labour market with the greatest positive impact.

The COACH_ING model represents an analytical approach to assess multifactorial skills and personal attitude to meet specific professional families in engineering field.

Universities can benefit of this contribution to graduate students orientation to job environment.

The method can be also used by companies to create synergy with University in enrolling talents among students.

Through the analysis of the data currently collected we have received various confirmations of the accuracy of our analysis and profiling of professional families. We intend to expand the research to a greater number of subjects and refine our tools to improve the effectiveness of the analysis implemented in the method, involving even more students, professionals and enterprises.

We expect that through the application of COACH_ING model we want to support students in choosing the most suitable professional path and orienting their future training to maximize their responsiveness to the labor market. Through the application of the model, we aim to place professionals on the market who are aware of their skills and are directed towards the professional roles that will be most in demand in today's and tomorrow's market.

[1] Organization for Economic Co-operation and Development (OECD) - “Transformable Skills training for researchers supporting career development” - World Science Forum (24-27 November 2013) - Rio de Janeiro (Brazil).

[2] Carla Cappiello – “Il Coaching: nessuno in cattedra” (Coaching: Nobody in the Chair) - Paper 1/15 - Council of Engineers of Rome, Italy (2015).

[3] Viviana Callea, Il coaching: un progetto per ognuno (Coaching – A Project for Everyone) - Paper 2/15 – Council of Engineers of Rome, Italy (2015).

[4] Viviana Callea, Ezio Santini e Roberta Tempone, COACH_ING (coaching-ingegneria): Coaching and Engineering Integration, World Engineering Forum Special Issue Roma (2017).

[5] Viviana Callea, Roberta Tempone, Lia Matrisciano, Antonio D'Andrea, Mihai Ursache, Giulia D'Angelo, Germana Remigi. Roberta Tempone, COACH-ING: From model to tool, EFEA Sofia, BULGARIA, March 24-26, 2021

[6] Viviana Callea, Ezio Santini e Roberta Tempone, COACH-ING, an integrated system of skills: experimentation and guided validation, EFEA Roma (2018).

[7] “COACH_ING – “Il coaching per riprogrammare la professione di ingegnere” (Coaching to reprogram the profession of engineer) - Press Release of Council of Engineers of Rome, Italy (2015).

[8] Lyle M. Spencer Jr., Signe M. Spencer – “Competence at Work: Models for Superior Performance” – Wiley, March 1993 - ISBN-10: 047154809X.

[9] John Whitmore – “Coaching for Performance: The Principles and Practice of Coaching and Leadership” (fully revised 25th anniversary edition) - Nicholas Brealey Publishing (2017) ISBN SBN 10:1473658128.

[10] Pierre Angel, Patrick Amar – “Le Coaching” - Presses Universitaires de France (2012) - ISBN : 9782130594833

[11] Pujitha Silva, Prasad KDV Yarlagadda - “Complete And Competent Engineers: A Coaching Model To Developing Holistic Graduates” - ,5th World Conference on Educational Sciences – WCES - Procedia - Social and Behavioral Sciences 116 (2014), pp. 1367 – 1372.

[12] Bettinger, E. P., & Baker, R. (2011) – “The Effects of Student Coaching in College: An Evaluation of a Randomized Experiment in Student Mentoring”. Retrieved http://cepa.stanford.edu/sites/default/files/bettinger_ baker_030711.pdf

[13] Bruinsma, M., & Jansen, E. P. W. A. (2007). “Educational productivity in higher education: an examination of part of the Walberg Educational Productivity Model.” School Effectiveness and School Improvement, 18, 45