COACH-ING (COACHING-INGEGNERIA)
COACHING AND ENGINEERING INTEGRATION

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Abstract

Coach-Ing methodology is intended to support new generations of engineers. The aim of Coach-Ing is to provide tools, scenarios, and strategies that contribute to their individual training and to the collective training within the profession. The Coach-Ing methodology has been experimented and statistically validated by means of a large number of on-the-field activities, which have been conducted at the Council of Engineers of the Province of Rome and in some of the most important European high tech enterprises working in the Defence sector.
Coach-Ing blends the strategies of traditional coaching with the systematic and programmatic approach of engineering, culminating in a non-conventional model allowing the development of new creative and innovative abilities. The method guarantees to recognize the same level of the participants without any difference in approach, neither as a function of origin, sex, age, previous experiences. The experimentation allowed the identification of important results in a large number of samples, in terms of adaptability to new social contexts, new work environments, changes in professional paths, greater awareness of one's role, and strengthening of individual qualities. Numerical indicators will be illustrated and discussed, which have allowed us to evaluate and quantify - always at a statistical level - the improvement found during Coach Ing processes to find the best way for their life project. By means of Coach-Ing, Engineering and Coaching co-operate to create innovative, individual and collective, solutions.

Keywords: Coaching, Engineering , Coach-Ing

1. Introduction

It is a general thinking that Coach-Ing is "coaching for engineers", but it is a model suitable for all those professionals who intend to structure their business as a place of personal and professional growth, from both individual and collective viewpoints, by acquiring a new methodology. The Coach-Ing model comes from the idea of integrating the two disciplines, coaching and engineering, to develop individual and collective projects and personal /professional growth processes [1, 2, 3].
The model refers to both the strategic approach of coaching and the systemic and programmatic approach of engineering to achieve a structured process towards a defined outcome. The model allows the user to start from his or her knowledge and technical skills to create an original problem-solving system through the coaching approach. This integration is valid for professionals of any extraction, thanks to the flexibility of the coaching tool.
The value of integration between what is known at a professional level and the problem-solving method proposed by coaching allows the user to establish concrete results, measure them, monitor them over time, and maintain high motivation and tension towards the goal.
In addition, since coaching exploits the relationship and interaction between individuals, a multiplicative factor of intelligence and co-creation is produced.
That's why the Coach-Ing model can support new generations of engineers in the approach, choice and entry-level modes of work and proposal of their profession.
Coaching and engineering together become useful tools in defining strategies for integrating professional and personal goals. From this partnership comes out "Coach-Ing". Combining technical engineer skills with coaching social-relational skills, greater effectiveness in resolution and reaction is produced. Technicality and Emotional Intelligence are key elements of any profession and not only when contextualized.
Coaching is a relationship between coach and customer (single or group) where dialogue and listening are used to bring out full awareness of the reality that the customer lives. Coaching is useful to focus problems and to set the right solutions. Such awareness is the basis for activating – through a discovery dialog - the best cognitive resources supporting the customer in the problem-solving process

and in achieving the stated goals.
Coaching conversation uses therefore a highly powerful and transformative dialogue that allows to fully read reality and to apply resolution strategies [4].
Coaching skills such as listening, clean and neutral language, creativity, suspension of judgment and mental openness are integrated with skills typical of engineering approach (diagnostic, analytic and design) to build up the Coach-Ing model.
The Coach-Ing model is not only a sum of engineering skills and relational and behavioral coaching skills [5]. Starting from the original idea of integration, research experience reveals that the sum of the two competence fields, gives rise to a new additional field of expertise.
This latter is truly more than a simple sum; it is a system of new and fundamental skills that can help to manage and solve new problems in terms of both objectives and achievements.
The Coach-Ing model supports, in a very creative and powerful way, the acquisition of a new set of Competencies, through the discovery of own best resources, potential and skills.
The engineer will be no longer simply a consultant but a careful and curious analyst who will use and structure the content, knowledge and data of the interlocutor himself, as actor of the process and not just a "recipient".
Likewise the coach, he will also be a system engineer who will design and structure his own growth path.
A long test cycle has been experimented on a population of engineers, both freelancers and employees. It has been observed that, when coaching enters in the engineer's system of skills, the result is a rapid, effective and innovative responsiveness of individuals to the surrounding reality.
This result allows the individual to move in his own professional life with greater self-confidence and self-expression, involving co-workers and colleagues in a collaborative game as key element for success in the profession and life. These evidences support the utility of building Coach-Ing paths, supporting new generations of engineers in familiarizing with self-confidence, creativity and decision-making skills. Ultimately, young engineers will have a successful relational based approach that will accompany them in life and work [6]. To validate the Coach-Ing model, a training program has been structured in DIAEE – SAPIENZA University of Rome.
In this didactic path, students acquire information on the scenarios and work contexts they will meet after the degree. Students will learn to use their cognitive and emotional resources to transform the classroom experience into a project of life and work. Teaching methods include the support of organized working groups to share the contents of knowledge, experiences and personal resources.
The goal of the educational path is to raise students' awareness of relational skills as structure of their professional project, according with technical-specialist knowledge.

At the end of the training program, each participant will be able to:
- recognize her/his behavioral characteristics (in a conscious way);
- enhance her/his mental patterns;
- express the best of her/his personal resources;
- orient her/his best abilities to achieve consistent and challenging work aims.

Some Engineers and Coaches has designed fhe educational path by with a multi-year experience in the Coach-Ing model and process. All Participants are requested to be involved on the levels of will, creativity, commitment and innovation, to achieve their professional and life goals. These four elements are the required factors for the Coach-Ing use. In this model, these four elements (will, creativity, commitment and innovation) act on the engineer natural predisposition to design and on their aptitude to seek solutions and functionality.
These four elements also take part on coaching skills to consolidate and increase the ability to react in processes. The result is: re-solving how engineers and re-acting how coaches.

2. Methodology

Using the Coach-Ing model means to design two main components: a learning strategy during the classes (shown in the following) and a methodology and support tools to be used during the individual or group sessions (tables, matrix or organized list). During every single event, such as classes, sessions, meetings where the Coach-Ing model has been transferred to participants, we use tools to collect skills, capabilities, features, talents or other content/elements of the participants useful to work on the subject/goal.

Fig. 1 summarizes this process.

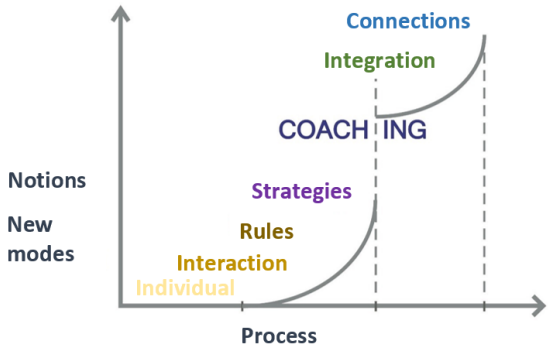

Figure 1 – Coach-Ing Process

These data are used to validate the process of the participants and to reach the expected improvement.
Every single meeting, classroom, workshop is divided into 3 working steps:
- Self,
- Others,
- Integration and recognition.

These steps have great value in 1 to 1 sessions too, where

the person must think on self, comparing himself to the surrounding world, reflecting on her/his present and past experiences. This makes her/him able to recognize and rebuild a new, more effective way to establish the result he/she wants to achieve and implement strategies to succeed .
The proposed format is based on the following elements:

Step I
1. Implicit theory - Experiential individual work;
2. From individual to group - Experiential group work;
Step II
3. Contents of the classroom: Skills and experiences;
4. Coach-Ing method transfer;
5. Experimentation of the method - Experiential rules and work;
Step III
6. Brainstorming on the different modes and strategies;
7. Sharing the classroom process - Recognition.

The method is aimed to enhance participants' talents and abilities at using daily action as a gym of growth, supported by the team working during the training classes [7].

3. Research Activity

The Coach-Ing Model started its experimentation and validation process over the last two years with the support of public and private organizations: SAPIENZA University of Rome, Rome Council of Engineers and several high tech private Companies.
These Organizations have promoted tests and research activities, training experiments, work groups and structured Interviews (sessions). All these data have been collected and processed in many contributions in terms of feedback from engineers, professionals, and engineering students.
All research participants had a common technical background and contributed to the statistical validation of the results identified in terms of:
- adaptability to new social contexts, new working;
- environments and professional changes;
- awareness of own role;
- creativity development;
- strengthening individual qualities.

Research data have been collected over two years of activity through:
11 Seminars
14 Working Groups
20 Laboratories
12 classrooms
Participants: 620
Participations: 830
Percentage of women: 35%
Participants were from:
Companies 45%
Free profession 35%
University 5%
Public Administration 15%

The research was conducted in two successive steps: a qualitative and a quantitative one.

Phase 1: Qualitative Research

Qualitative analysis was conducted using tools to detect:
- the interest in joining the Coach-Ing project;
- the degree of learning achieved during the course;
- the perception of the usefulness of what has been learned;
- the ability to integrate the engineering skills in entrance with typical transversal skills of coaching.

In this first phase, the objective of the research was to identify the Engineering skills as input of the Coach-Ing model [1].
This system was composed of nine core skills, as in the following Table 1 [8].
In the Coach-Ing classes, participants are invited to learn and to use seven skills of the Coaching methodology. These skills are trained by the facilitators in the classroom, and are explicitly transferred to the participants by individual and collective learning tools. These coaching skills are listed in Table 2.
At the end of the educational path, typical assessment tools - Role Playing, Tutorials, Questionnaires, Interviews - were used to bring out the results of the integration between the Engineering Skills System and the Coaching Skill System.

SKILL	*BEHAVIOR*
INITIATIVE AND ENERGY	BE PROACTIVE AND EFFECTIVE
WORK ORGANIZATION, TIME AND RESOURCES	PLANNING IN THE PERSPECTIVE OF OPTIMIZATION
ORIENTATION TO RESULT AND TASK	DEFINE QUALITATIVE AND QUANTITATIVE PERFORMANCES
SELF - INVESTMENT	CONTINUOUS LEARNING
DECISION MAKING	BE AWARE OF OWN CHOICES AND RELATED RISKS
PROSPECTIVE THINKING	HAVE AN EXPANDED TEMPORARILIZED HORIZON
PROPOSALS AND PROJECTS	SOLVING COMBINING VARIABLES
ANALYSIS AND SYNTHESIS	DEEP CONTEXT READING AND PRIORITIZING
SYSTEM VISION	PRESIDATE ALL VARIABLES IN THE GAME

Table 1 – Engineering skills [8]

In addition to the assessment tools, the research has been conducted also through observation and tests, executed by a group of the engineers, of a local community social network, called flyfish.zone. At the beginning of research, it was in a beta version and the group of engineers has participated to correct the test functionality. The testing group of engineers also attended many Coach-Ing events and meetings.
The research activity took place in the Council of Engineers and in several Companies to collect information on the actual transfer of Coach-Ing skills in the working context.

SKILL	*BEHAVIOR*
ADAPTABILITY	REACT EFFECTIVELY
COMMUNICATE	BE CLEAR AND EFFECTIVE
BUILD RELATIONS	BE OPEN IN THE REFERENCE CONTEXT
SOCIAL INTELLIGENCE	RULE RELATIONAL STRATEGIES
INTERCULTURAL SENSITIVITY	UNDERSTAND NEW WORKING APPRAOCHES
CREATIVITY AND INNOVATION	CHANGE BEHAVIOURAL PATTERNS AND SOLVE THROUGH NEW IDEAS
ASSERTIVENESSAND INFLUENCE	OPEN AND COGENT COMPARISONS

Table 2 – Coaching skills [8]

The social network, tested by the group of engineers, also worked as a sounding board and as accelerator of acquired skills, succeeding to consolidate the possession and re-use of these skills.
The exchange of information, networking and comparison worked in this direction, enhancing the effects of Coach-Ing integration.
At the end of these surveys, it has been observed that the Coach-Ing Model produced a combination of engineering skills plus coaching skills in a Capabilities System made up of Macro Skills Areas that contain different combinations of incoming skills.
In addition to qualitative surveys, these areas are based on the skills model adopted by a leading high-tech company, with a workforce of 80% engineers and technical staff.
This model proposes a resource-based approach to human resource management, starting from a concept of competence defined as a set of "intrinsic characteristics of an individual, which are related to performance, referred to a criterion, effective or superior in the job done "[8].
Fig. 2 shows the results of the qualitative research observations, in which the research group pooled the individual skills belonging to the two Coaching and Engineering reference systems in four macro areas:

1) Realization Area - focus on tasks and results;
2) Relational Area - Includes skills that facilitate relationships and mutual understanding;
3) Motivation & Project Area - Includes the integration capabilities between different perceptive schemes;
4) Cognitive Area - privileges all skills related to rationalization.

The Capabilities of the Coach-Ing model are:
Flexibility, Resilience, Agile & Speedy-Thinking, High-Achieving, Confidence, Courage, Optimism and Inspiration.
Each Capability contains several skills from Table 1 and Table 2.
Each Capability is defined by a group of single skills from different areas which can be used in different Capabilities.
These "unconventional" skills for engineers, shown in Fig. 2, allowed to identify new clusters of Capability generated by the integration between Engineering and Coaching, not as a combination of the incoming skills, but as a “transformable skill", characteristic of the Coach-Ing model.

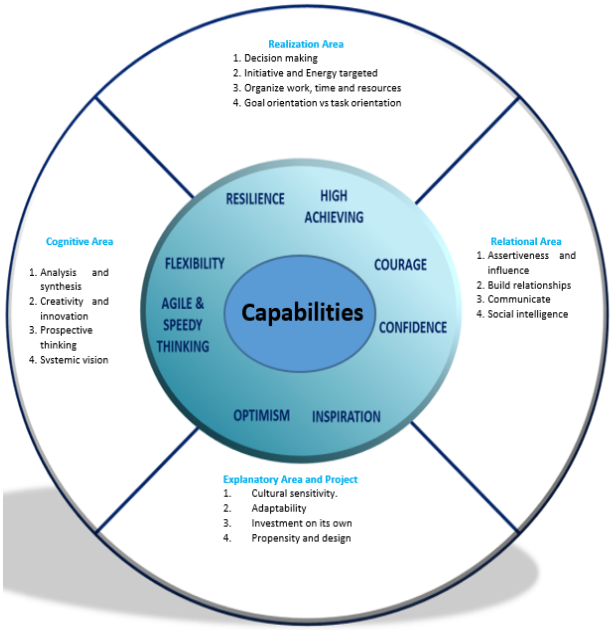

Figure 2. Capabilities System Coach-Ing

To execute the quantitative research it was needed to detail the four macro areas to better evaluate the results.
In the following, Capabilities and their associated skills/behaviors are listed:

Flexibility
Adaptability; Work, Time and Resources; Organization Intercultural Sensitivity

Resilience
Assertivness and influence; Adaptability; Energy; Orientation to Result and Task Communication; Self-Investment

Agile & Speedy Thinking
Creativity and Innovation; Prospective Thinking; Decision Making System Vision Analysis; Synthesis Social Intelligence

High Achieving
Prospective Thinking; Proposals e Projects Orientation Result and Task Energy; Adaptability

Confidence
Social intelligence; Build Relations; Intercultural sensibility; Assertiveness

Courage
Proposals and Project; Result Orientation; Decision Making; Energy

Optimism
Proposals and Project; Build Relations Courage; Adaptability; Assertiveness; Self-Investment

Inspiration
Assertiveness; Proposal and Project; Energy; Communication; Prospective Thinking; Self-Investment

Engineer, with coaching and technical transformable skills, must hold the skills that make him a competent, technical-minded engineer capable of reading the complexity of the context. She/he will be able to integrate in her/his own way of being in the work place, also enriching it with an awareness of personal identity made of her/his value not only cognitive but also relational.

Phase 2: Quantitative Research
The second phase of research, purely quantitative, had the purpose to verify the growth of "transformable skills" (Capabilities) in three groups of engineers:

1. Engineers from high tech Companies;
2. Engineers with diversified professional background who have tracked paths Coach-Ing;
3. Engineering students at the beginning of engineering skills construction process, with little awareness of behavior skills.

Each group consisted of 40 participants.
Quantitative research was conducted into two parts: the first one by collecting data on the above 3 groups, using a technical-behavioral questionnaire, the second one on the analysis and evaluation of the sessions 1 to 1 process.
The first 2 groups also participated to individual paths (sessions 1 to 1). Their skills were measured at the start of the path and at the end.
On the sessions 1 to 1 process the first two groups participated voluntarily.
The third group (composed by university students) is currently conducting a first cycle of classroom meetings where the Coach-Ing model is in use.
The same questionnaire for the assessment of competences was proposed to each of the three groups. The questionnaire consisted of 30 multiple-choice questions (four answers for each question). Each answer was representative of a behavior, and relevant skill, from Table 1 and Table 2.
As already said, these specific skills was related to specific behaviors; the same skills appear several times in the test answers.
The questionnaires submitted to the three groups led to some important technical-behavioral differences closely related to the use, knowledge and awareness of the macro skills (motivational and project area, relational area, area of development and cognitive area).
For the Group of engineers from the business world and not aware of the model, there has been a strong prevalence in the engineering skills of the Optimism, Achieving and Speedy Thinking areas.
The indicator of each skill is obtained as a weighted average of the number of times that same skill has been identified in response choices and the number of times that appears in the test.
Test answers lead to the indicators of individual skill. All skills have been suitably combined in groups associated to a more general skill, called Capability.
The indicator of each individual Capability was identified as the average value of the individual skill indicators that composes the group. This value, ranging from 1 to 5, returns the degree of personal confidence with his Capability.
With the same procedure, a general indicator was obtained, as the average value of the individual Capability. It was assumed as a confidence indicator with the Coach-Ing model.
The group of engineers trained with the Coach-Ing model shown to hold a similar level to the previous group with reference to engineering skills, but with a variable increase between 0.5 and 1 of the holding of coaching skills.
This occurred with the participation of the second group at the Coach-Ing path. Large space has been given to the contamination between the relational and motivational macro areas with the most closely cognitive and technical-operative macro areas.
Finally, the group of engineering students shown less knowledge of both engineering and coaching than previous groups of engineers, with values lower than other groups.

4. Results of the Research and Conclusions
The skill level measurement was performed according to the following Fig. 3.

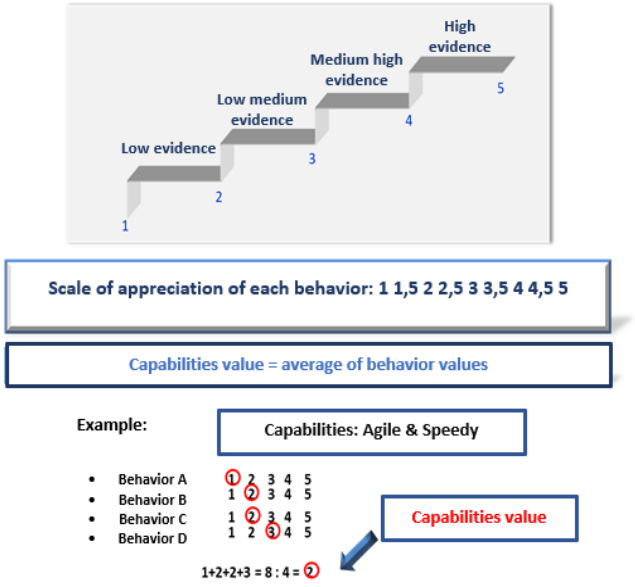

Fig. 3 - Skill level measurement technique

In details, the results shown by each group:
- The first group (from the Companies) - Strong prevalence (level 3.5) of engineering skills. The Coach-Ing skills reach an average of 2.5.
- Second group (the group aware of the model) - assessed

before and after the training on Coach-Ing model. In this case, the comparison between the start and the end of the process shows a significant integration between Engineering skills and Coaching skills. Before the training, the Coach-Ing skills level was as in the previous group around 2.5. After the Coach Ing model training, Coach-Ing specific competence areas had an average value of 3.3.

- The third group (future engineers) - had a starting level of Engineering skills of 1.1 and Coaching skills 0.8. This group is currently experimenting the training integration paths with the Coach-Ing model. It will be shortly possible to measure variations at the end of the path [9, 10].

As far as the second group is concerned, the composition and balance of skills began to improve following a specific training Coach-Ing.
Students group has a lower average competence in the two areas of expertise (Engineering and Coaching), but the small gap between them is likely to mean that as long as they do not enter in the work context, they will pay greater attention to behavioral sensitivity.
At the end of their university and training course, they will strengthen the engineering area, as the representatives of the other groups. Acting within the didactic-training of Engineering Degree Programs, with paths dedicated to strengthening and awareness of Coach-Ing skills, would allow maintaining the right mix of balance between technique and relationship, useful to the engineer's harmonious professional development.

All the data from the 1 to 1 sessions process of the first two groups of volunteers have been added to previous considerations.

1 to 1 sessions numbers can be summarized as follows:
6 months of experimentation
40 professionals not aware of the model coach ing
40 professionals familiar with the coach ing
2 coaches
proposed professional objectives:
change of role,
satisfaction in one's own role,
adaptation and assertiveness.

In 510 meetings, the 80 participants performed self-evaluations of coaching skills and engineering, acquiring the awareness that they can change the use of the engineering behaviors with the Coach-Ing model.
This model can transform in new behavior the old approach, through the acquisition of coaching skills.
Finally, the coaching skills, combined and integrated with engineering skills, once again demonstrated the growth of macro-areas of competence identified in the Coach-Ing Model.
In the first control group (where the model was unknown) the levels increased from 2.5 to 3.3. In the second control group, an increase of the value to 4.1 has been verified.
This validates the effectiveness of the model.

Skills such as adaptability, ability to build relationships and communication, once acquired, engages in proactiveness and design and decision-making which are typical of the engineer, making the individual flexible, resilient, collaborative and proactive.

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