Assessment procedure for the soft skills requested by Industry 4.0

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Abstract. In the context of an increasingly more performant global and informational environment, as the one found in the virtual organization, the process of selecting and evaluating the human resources holds a particular important role. The premise behind this article is that of the need to adapt the human resource performance to the requests of the industry 4.0 being supported by the organizational culture. Following the analysis of the state of the art literature we concluded that there is no clear procedure for the assessment of the constellation of skills and personal qualities – soft skills requested by industry 4.0. These capabilities should complete professional technical hard-skills; the procedure should provide a map for the constellation of capabilities necessary to adapt and perform, in specific industry 4.0 activities. Current psychological evaluation systems consider only some of such requested capabilities not always the most relevant. To solve this problem, we tried to identify and evaluate what we considered as the core of the complex various skills required. Our research was centred on the use of a psychological instrument for evaluating transversal capabilities. The capabilities map needed for the evaluation and selection of the human resource fit to work in the industry 4.0 environment was designed after the application of this complex system of evaluation on successive series of students from the University POLITEHNICA of Bucharest.

1 Introduction

The industrial revolution it was represented along the time by challenges offered by steam power in the nineteenth century, electricity in the early twentieth century, and automation in the 70s. All these waves of technological advancement reduced overall employment, however, today, the new jobs emerge and the demand for new skills grows. In our days, it's talk more and more about how fast technology advances and how these changes transform our life at both socially and professionally.

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Cyber-physical systems and the Internet of Things, big data and cloud computing, robotics, artificial-intelligence based systems and additive manufacturing are the integrated components of fourth industrial revolution.

A new challenge that concern employment is on the horizon, the fourth wave of technological progress: industrial growth of new digital technologies, the rise of new digital industrial technologies that are collectively known as Industry 4.0.

The 4th wave is an industrial revolution or we can talk about a global revolution?

2 The fourth industrial revolution as Industry 4.0

Industry 4.0 represents a significant transformation of the entire industrial production through the unification of digital technologies and the Internet with conventional industry. Klaus Schwab briefly explains the paradigm of the fourth industrial revolution as evolution since the discovery of steam power for cars, through the discovery of electricity for mass production followed by digitization for industrial automation and finally Industry 4.0 the fourth revolution eliminating the limits [1].

The Fourth Industrial Revolution intends to leverage differences between the physical, digital, and biological sphere. Therefore, it aims to integrate: Internet of Things – IoT, Cyber-Physical Systems – CPS and, Artificial-Intelligence IA, cloud computing, robotics based systems and additive manufacturing (figure 1). Fourth Industrial Revolution develops in robotics, 3D printing, artificial intelligence, nanotechnology and biotechnology. Such advancement will radically remodel the labor market worldwide generating a paradigm change in defining the skill background needed to address these challenges [2].

Fig. 1. Industry 4.0: a vision of the future industrial production

Schwab requires for responsible leaders and citizens to "together shape a future that works for all by putting people first, empowering them and constantly reminding ourselves that all of these new technologies are first and foremost tools made by people for people." [1]

The questions that arise are: How fast the technology advances and transforms our lives? How will this next wave of industrial evolution play out? How will job profiles involve? And what types of skills will be demanded?

The answers to these questions are critical to education, industry leaders and public politics as they have to seek to take full advantage of the opportunities arising from Industry 40 by ensuring that an appropriately skilled workforce, there are.

If we want to adopt Industry 4.0, the manufacturers will be able to increase their competitiveness, which will enable them to expand their industrial workforce at the same time that productivity increases. These capabilities identified as soft-skills can be developed during their academic studies and favourite underlie the formation of a complex series of competencies, including: teamwork and networking capacity; ability to communicate; personal effectiveness; self-development; creative and innovative thinking; leadership skills.

3 The constellation of skills and personal qualities – soft skills

As "soft skills" are presented not precisely defined aptitudes, but rather a cluster of personality traits which have a synergistic effect, contributing decisively to the personal and professional effectiveness. As a "cluster of skills and personal capabilities" soft skills describe the attitude of each of us, our compatibility with others and how we manage social interactions mostly in professional environement. This cluster should become "mandatory" to select human resources from the perspective of Industry 4.0. Unlike “hard skills”, which describe a specific set of technical skills, “soft skills” are recognized as transversal competences, being found at the junction between the professional and social skills. It is often said that hard skills help you to succeed at an interview, but you need soft skills to keep the job and reach to professional fulfilment [3].

Interest in high performance, good interrelation, and high professional self-development potential should shape the future employee profile, which will face the new challenges coming from Industry 4.0.

Whereas one of the means by which we can "control" these parameters is psychological evaluation of candidates as part of the selection process, we consider that we have to define and build a standard profile to match training needs, identification and development of soft skills. Identification and evaluation the cluster of psychosocial skills are required still by formative university years, in order to answer the question: are prepared students, future employees, to address the new challenges? The rapid evolution of technologies requires a cluster of psychosocial skills - soft skills - to act holistically to resist "technological wave."

Five years from now, over one-third of skills (35%) that are considered important in today’s workforce will have changed [4].

They will be brought together advanced robotics, autonomous transport techniques, artificial intelligence and human-machine learning, advanced materials, biotechnology and genomics. Current demands coming from leading global employers are redefining skills and workforce strategy for the future.

In this paper we propose the new concept of “constellation of skills and personal qualities”, referring to the soft skills and capabilities demanded by Industry 4.0. To define this new concept we start from the archetypal Jungian constellation. In our proposed concept around of three capabilities-stars, revolve a series of psychosocial traits: empathy, inter and intrapersonal skills, effective communication, adaptability, self-power, etc. In these constellations, creativity is the core of the top three skills demanded.

With the avalanche of new products, new technologies and new ways of working, employees should become more creative in order to benefit from these changes. Emotional

intelligence, which doesn't feature in the top today, is rated in our model as the second on the top skills needed.

The last of the three top skills is proactive thinking applied to new technologies. It assesses how human resources connect with the technological revolutionary model in order to implement change rapidly and sustain it in the global economy.

4 A map of the future - Case study

Are we prepared to face this Industry 4.0 reality? Is the young generation ready to cope with these challenges not only economic, industrial, global but especially social?

We must be prepared. Change won't wait for us: business leaders, educators and governments all need to be proactive in up-skilling and retraining people so everyone can benefit from the Fourth Industrial Revolution. The methodology described here, centred on a map of skills and personal qualities necessary to assess the specificity required by industrial environment 4.0. could be a useful tool in this reconversion process.

4.1 Methodology

This methodology is centred on the achievement of a map for the constellation of skills and personal qualities necessary to assess the specificity required by industrial environment 4.0. First we defined the conceptual backbone of this map. Then, we tested it by applying an instrument of psychological evaluation ABCD-M. This psychological assessment test has been applied to third-year students from three subjects: Robotics, Machine-tools and Logistics. The total number of students was 90 (Machine-tools 38, Logistics 19 and Robotics 33).

4.2 A "Pencil" for designing a map for the constellation of soft skills

The questionnaire that was used for the students' assessment was an ABCD-M complex personality test based on a psycho-lexical approach system compatible with Big Five.

ABCD-M personality questionnaire (the Romanian version of Big Five personality test) was created and benchmarked on Romanian population by M. Minulescu (2008). The survey is made of five supra-factors, each of them including other five facets: Extraversion (with the facets Activism, Optimism, Humour, Interpersonal skill, Personal self-assertion); Maturity (with the facets Respect, Adaptability, Friendship, Inhibition force, Force of the self); Agreeableness (Altruism, Romanticism, Affective warmth, Empathy, Honesty); Conscientiousness (Will, Spirit of perfection, Sensibility, Planning, Auto-discipline); Self-actualisation (Thoroughness, Tolerance, Refining, Independence, Creativity).

The total number of items is 151 each of them appreciated on a scale with 5 answering variants, from totally true to totally untrue. The consistency coefficient of the scales and the subscales varies between a minimum of .68 and a maximum of .76. We have chosen the respective questionnaire since it proposes a broad perspective on investigating personality [5-6].

To established a nuanced structure for our map of constellation of skills and personal qualities that better reveals soft skills, considering the three capabilities-stars defined above we had chosen: Interpersonal skills (E4), Personal affirmation (E5), Respect (M1), Power of ego (M5) Empathy (A4), Perseverance (C1), Spirit of perfection (C2), Self-discipline (C5), Refined (AC1), Refining (Ac 3), Independence (AC4) and Creativity (AC5).

One could notify that from the three capabilities stars only creativity could be identified as it is in this list. The other two are resulting from the other skills based on several

considerations (e.g. between self-esteem as "the power of ego" and performance, there is a strong connection, Empathy, Interpersonal skills and Personal affirmation imply situational awareness and the ability to choose the best answer that determine the best outcome for all stakeholders, Refined – implies an open attitude towards its completeness of a sophisticated person etc.)

4.3 Results analysis

The interpretation of results is a diagnosis illustrating the differences between the three specializations. This interpretation followed next protocol:

- Diagnosis of the five dimensions
- Diagnosis of the characteristics that define the constellation of skills and personal qualities-soft skills

In terms of low values and high values, the values obtained are situated closer the high values, especially for students Machine-tools specialization.

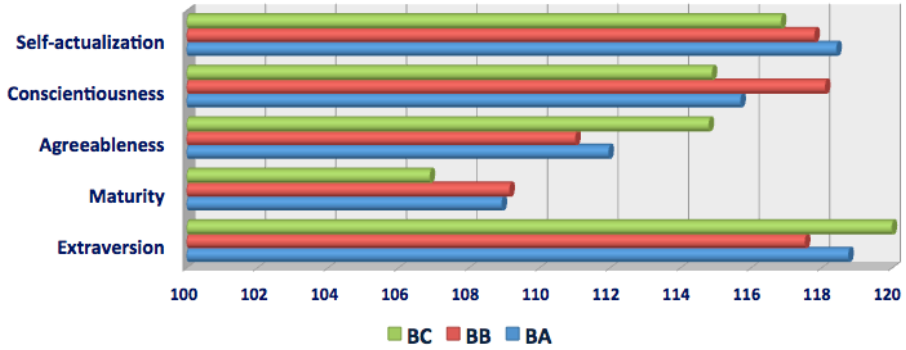

Fig. 2. Comparative values for all the five dimensions of ABCD-M

From the perspective of psychological dimensions considered relevant for describing soft skills (Conscientiousness and self-actualization), you may notice the following (figure 2 and 3):

- For dimension Conscientiousness - higher average values were recorded by students from robotics specialization, followed by machine-tools and manufacturing systems and logistics specialization.
- For dimension Self-actualization – we have on the first place the students from machine-tools and manufacturing systems, followed by robotics specialization and logistics specialization

Analysis of the five dimensions requires developing strategies to educational level (personal development, role playing, coaching, etc.) allowing the training and development of skills profiles as close specificity required by the new challenges.

A more nuanced differentiation arising of the processing and interpretation of data on the five dimensions subscales.

We considered relevant to describe features that are subordinated constellation of skills and personal qualities – soft skills, these subscales: interpersonal skills (E4), asserting personal (E5), respect (M1), strength of self (M5), empathy (A4), will (C1), spirit of perfection (C2), self-discipline (C5), Intellectual curiosity (AC1), refining (Ac 3), independence (AC4) and creativity (AC5).

Interpretation was accomplished in relation to the low values and high values. The first step was to create the schedule for each specialization. The reason for this assessment was given by the desire to identify critical values that would require establishing an intervention strategy.

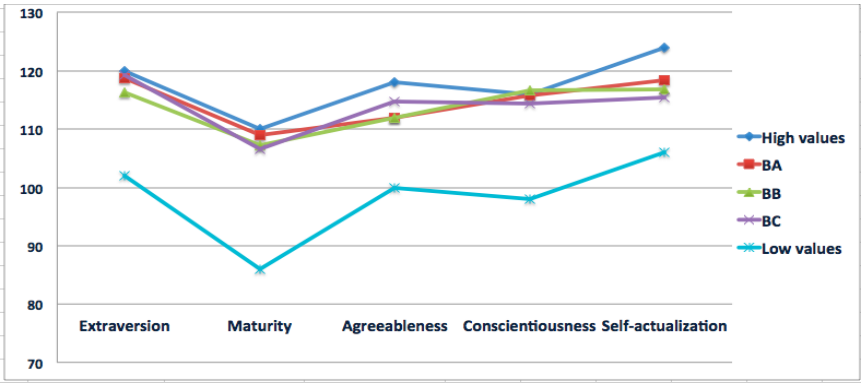

Fig. 3. Comparative average values reported at low and high values for all the five dimensions of ABCD-M

Where BA = Machine-tools ,
BB = Robotics,
BC = Logistics.

Average values for Machine-tools undergraduates (less refinement) are situated closer to the high values of the graph. Low value for Refinement indicates a closed attitude toward self-accomplishment, a low intellectual personal cultivation (figure 4).

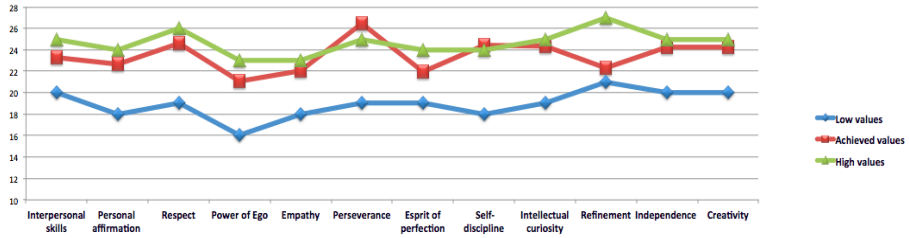

Fig. 4. The values for secondary scales of ABCD-M for Machine-tools' students

For Robotics undergraduates, average values are closer to high values, except for Empathy, Sense of perfection and Refinement (Figure 5).

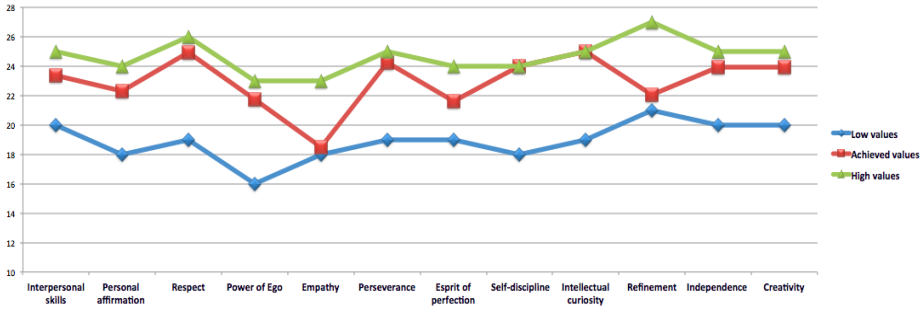

Fig. 5. The values for secondary scales of ABCD-M for Robotics' students

The low values represent:

- Low Empathy - people less intuitive, less concerned with others, selfish, devoid of understanding for others, cold and disinterested
- Low Esprit of perfection - superficial people, a lower accuracy in action, personal development, in pursuit of their goals.
- Low Refinement - closed attitude towards their accomplishment and low intellectual personal cultivation;

For Logistics undergraduates we have average values that are closer to the high values, except for Empathy and refinement. A description of personal characteristics to low levels is made above (Figure 6).

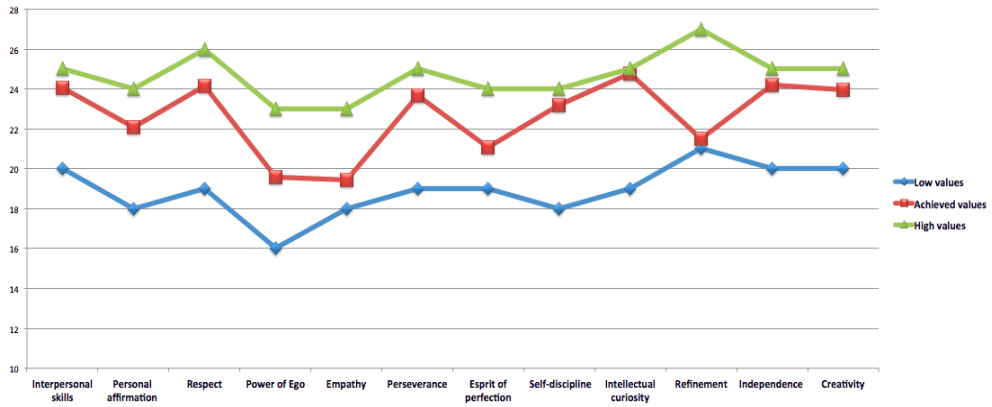

Fig.6. The values for secondary scales of ABCD-M for Logistics' students

The graph shown below captures average values obtained for subscales revealed differentiated specializations (Figure 7 and Figure 8).

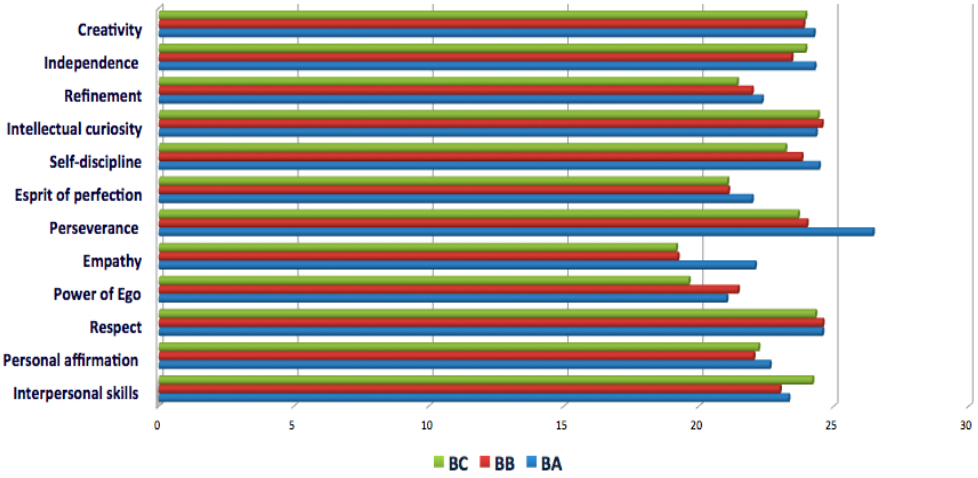

Fig. 7. Comparative values of ABCD-M secondary scales for different specializations

The results obtained at ABCD-M questionnaire shows the average values closer towards high values of interpreted grid. The final analysis of the results for all five dimensions correlated with the relevant subscales imposes rethinking development programs, personal training for future challenges.

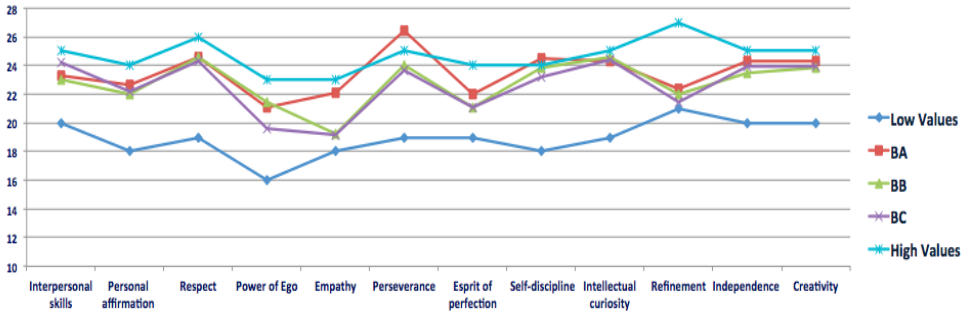

Fig. 8. Comparative average values reported at low and high values

5 Conclusion

Current psychological evaluation systems consider only some of the requested capabilities and not always the most relevant for smart manufacturing. To solve this problem, we tried to identify and evaluate what we considered as the core of the complex various skills required.

Our research was centred on the use of a psychological instrument for the assessment of these capabilities.

The constellation of skills and personal qualities map needed for the evaluation and selection of the human resource fit to work in the industry 4.0 environment was designed after the application of this complex system of evaluation on successive series of students from the University POLITEHNICA of Bucharest.

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