

An Archetype for Engineering Education Towards Industry 4.0 Enabled Sustainability

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1 Motivation

Educational accreditation bodies provide standards of the programs that students should meet. This is a high-level and broad perspective guideline [1]. On the other hand, educational institutes define course syllabi or Intended Learning Outcomes (ILOs) to guide the learning process and proffer a sense of measurable statement of acquiring a specific skill, which are used by academics and students [2]. There is a massive gap in engineering education to match the higher-level standards and the lower-level ILOs with the industrial needs. At the same time, these standards and ILOs are rigid and do not accommodate current edge technology advances (I4.0), especially those with promising potential for sustainable development [3]. Harmonization quantitatively with sustainability goals is another major challenge [4].

Archetypes (aka personas) have been widely applied in marketing segmentation and human-centered design, taking a singular fictitious instance mirroring people of the target markets (i.e., reflecting enduring personas that feed into the human experience) [5]. The archetypes allow communication of user needs and orient teams towards user experience [6]. The same abstraction process can be applied to the identification and representation of professional educational figures (e.g., engineers, biologists, designers), summarizing the specific set of possessed skills in between the higher-level standards and the lower-level ILOs [4].

Among the tangible benefits arising from the introduction of the professional profile archetypes is the definition of a common language between stakeholders (i.e., university and industry). This guarantees objective, repeatable, and standardized views, which enable the realignment of the educational and occupational framework and simplify the design of educational courses and communication between academia and industry.

2 Methodology

Defining engineering archetypes is a challenging process (cf. Figure 1). On the one hand, challenges are rising from potential inputs of educational bodies and the needs of the industrial sector. Different institutions adapt to different educational body standardizations. Numerous low-level ILOs for each course (average 250) do not help the industrial sector find its needs. Despite the global skilled worker market, there is a skill gap in many industries. One of the main reasons is the lack of common competencies standards. Rigidity in evolving existing frameworks with current edge technology is another challenge, especially with the rapid technology advancement.

On the other hand, defining archetypes that can match the industries and education is challenging. At the same time, the archetypes should enable the vital role of education in preparing new engineers who can realize social, economic, and environmental sustainability. Archetypes should be evolvable with technology and reliable to ensure that the competencies are required for a foreseen period. Another challenge is to define measurable archetypes that help different stakeholders find and satisfy their needs. Defining clustered competences is one way toward this end. The authors have learned many lessons from the previous attempt, a manual approach that relied mainly on experts [4], including time-consuming, non-comprehensive, and subjective to some extent. This highlights the need for more advanced techniques in a more comprehensive and systematic way, which is what is currently under development.

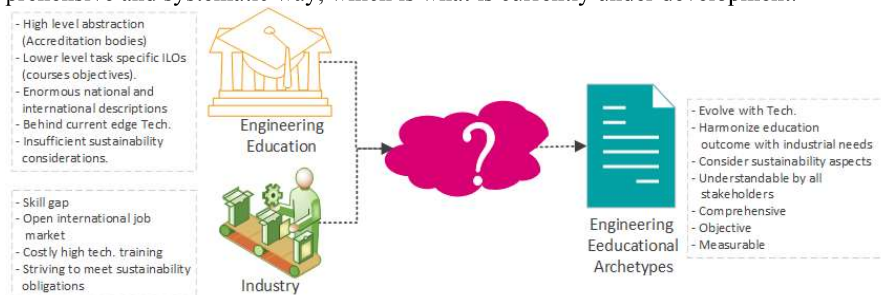


Fig. 1. Challenges of defining engineering educational archetypes.

3 Conclusion

The mismatching between education and industry calls for urgent identification of standardized professional figures descriptions for course design, assessment, communication, and job market integration. Two crucial topics for the industrial sector are the I4.0 contemporary edge technologies and sustainability. Unfortunately, they are not harmonized in the educational and occupational engineering frameworks. This work introduces a standardized professional figure description via archetype concept, representing the artificially generated centroid of a set of instances. The potential of archetypes is a clear, structured, measurable, comprehensive, and dynamic description of the main skills of a professional figure.

References

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