Agile methodology in higher education quality assurance system for SDGs 4, 8 and 9 achievement: national experience

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Abstract

This paper is focused on considering agile methodology as an instrument to use in education quality assurance. We propose the Scrum method applicable for education quality assurance based on adapted Manifesto for Agile Education Quality Assurance and twelve principles behind it. The Scrum procedure is described and roles are distributed for two real-life cases of external and internal educational program quality evaluation. We illustrate that proposed Scrum procedure perfectly fits existing practices and can be used to enhance both external and internal quality assurance processes in higher education. We consider achievement of SDG 4 targets through proposed methodology as the necessary step to take in achieving SDGs 8 and 9. It is concluded that stakeholders feedback about their satisfaction by economic and innovative factors should be included in each sprint review procedure in proposed Scrum methodology. We discuss SDG 4 achieving within multilayered DIKW+DM hierarchy as a framework for education quality assurance that allow to join information processing, knowledge acquisition and corresponding decision-making algorithm.

Keywords

education quality, agile methodologies, scrum, sustainability

1. Introduction

Application of agile methodologies in education is a widely discussed topic nowadays. Due to the constant changing labor market demands, higher education institutions are forced to adapt approaches aimed at flexible learning. This matter is especially at hand due to worldwide orientation at life-long education: agility is of crucial importance for keeping the same pace as constantly changing requirements of society. Recent interest in application of agile methodologies to form innovative pedagogical tools is logical reaction of educational institutions aimed to address these challenges.

When building a model for generating knowledge and testing the “quality of education" system, one should also pay attention to the trends dictated by the world community. These

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trends have been outlined as Sustainable Development Goals in United Na- tions Millennium Development Goals and 2030 Agenda for Sustainable Development. Given that there is a separate Sustainable Development Goal (SDG) 4 dedicated to quality education, it is important to establish a link in the proposed approach SDG 4 and other SDGs. This idea is the basis of the presented material. Considering that the result of achieving SDG 4 is, among other things, the growth of economic indicators among stakeholders, it should be noted that there is a specific connection between SDG 4, SDG 8 and SDG 9. The role of university education is to ensure economic growth and create an innovative infrastructure in connection with the main stakeholders, which determines the need to consider mentioned relationship between SDGs.

However, labor market's main interest is not the education process itself, but its outcomes in form of trained graduate possessing skill-set suitable for current position or able to quickly adapt to position's specifics. Despite the small contribution in form of direct pedagogical innovations, employers are highly motivated to participate in education quality assurance activities. Therefore, the need arises to form educational quality assurance system that accounts interests of all stakeholders and allow them to collaborate in efficient and flexible framework. This paper attempts to provide Ukrainian higher education institutions (HEIs) with such quality assurance methodology developed upon agile philosophy and principles.

2. Literature review

Agile methodologies in education have their constant attention in forms of direct application to learning process [1, 2, 3]. As stated in [4], "By using Agile methodologies to design, structure and steer courses as a whole, or punctual activities and projects, instructors are offering a valuable framework and environment for students to develop valuable competencies that can serve to increase their performance in their work life and their development as responsible citizens living in a sustainable way". However, as we defined in the introduction, the aim of this article to propose not a learning tool, but education quality assurance method based on agile philosophy.

To determine the trending direction of research, a bibliometric analysis was carried out using data from the Scopus scientometric database (https://www.scopus.com/) using the VOSViewer (https://www.vosviewer.com/) and SciVal (https://www.scival.com/home) tools. The main task of bibliometric analysis is to determine the relationship between agile methodology and various aspects of the educational sphere. Bibliometric analysis was carried out using query "agile quality of education".

Analysis of the relationship between different keywords by specified query (figure 1) highlights the areas of application of agile in education. These keywords actually create a set of indicators for quality assurance in education. Individual clusters within the keyword map are of particular interest. The "scrum" cluster (figure 2) can be used as the basis to create an algorithm for assessing educational program quality. The "decision making" cluster (figure 3) is a prototype for testing the education quality system based on the DIKW model [5] and on the agile approach at the decision-making stage which in its turn is based on data, information and knowledge received.

The relevance of the proposed topic in terms of practical implementation is confirmed by

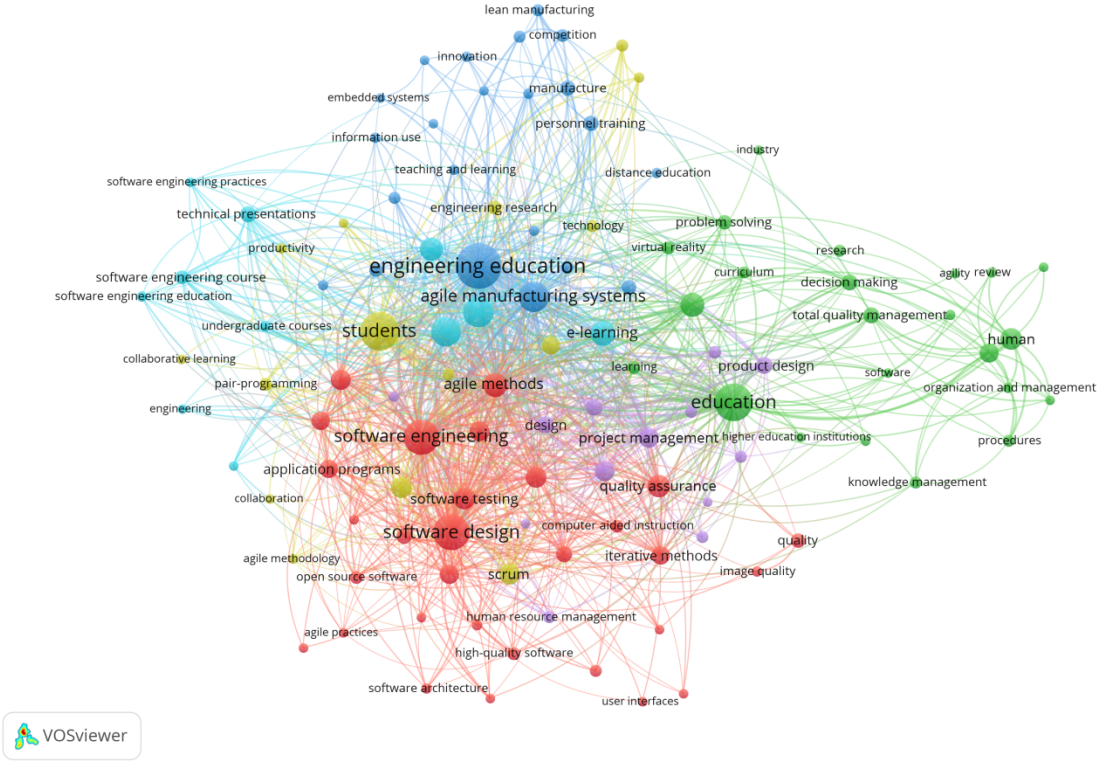

Figure 1: Keywords corresponding to the query “agile quality of education”.

the results of bibliometric analysis shown in figure 4. Topic clusters show the main points of influence of the quality of education including economic factors: learning environment, educational innovation, information quality, business model innovation , sustainable business etc.

These data allow to create a testing model with specific outcomes, which can be used to determine the degree of performance of the system “quality of education”.

As for the analysis of various indicators impact on the system “quality of education”, we refer to specific literary sources, systematizing them in following way:

- marketing and knowledge management as a basis for modeling the system “quality of education” [6, 7, 8, 9];
- main stakeholders the influence of the on the educational environment [10, 11, 12];
- ensuring the quality of education in general and personnel training quality [13, 14, 15, 16];
- socio-economic factors of the education influence [17, 18];
- quality of education and sustainable development [19, 20]].

Thus, the bibliometric analysis in general and the analysis of specific literary sources allow us to define a niche where it is possible to use the agile approach for ensuring the quality of education in relation to socio-economic indicators

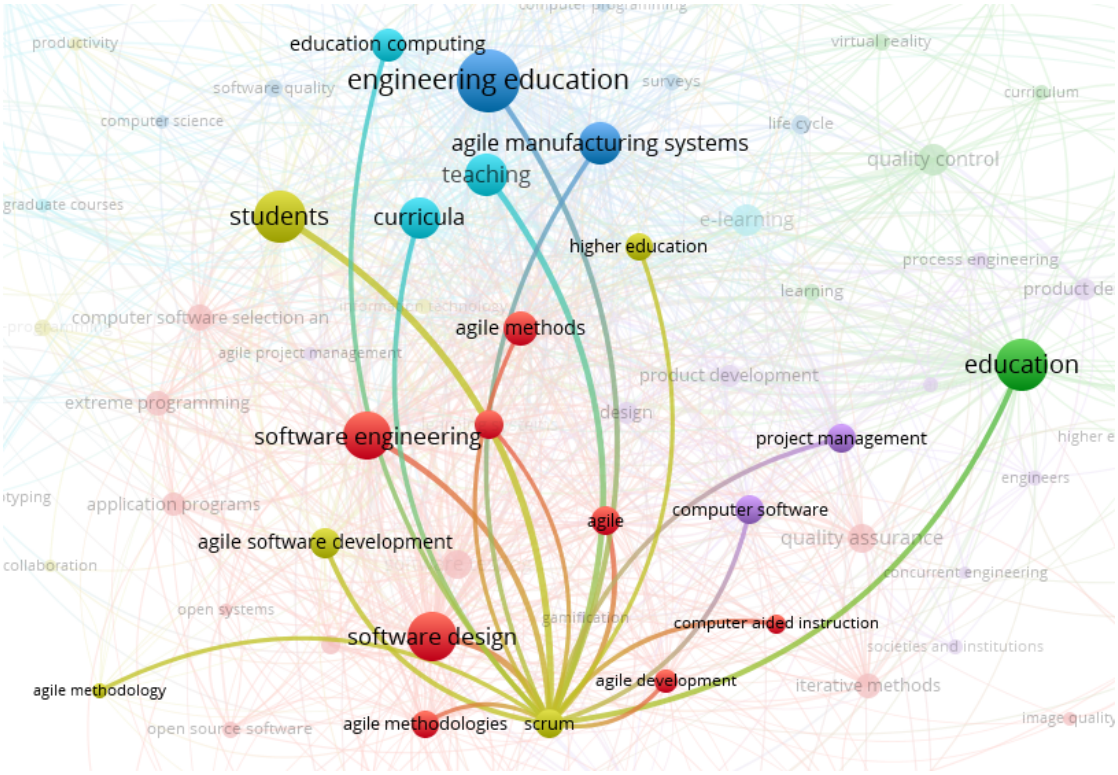

Figure 2: Cluster “scrum”.

3. Modelling of university quality education system utilizing agile methodology

Before we introduce direct agile applications in university quality assurance system, let us briefly discuss Agile Manifesto in terms of education quality. It can be formed as legacy of Manifesto for Agile Software Development [21] with corresponding alignment of twelve principles behind it [22]. Therefore, the Manifesto for Agile Education Quality Assurance can be adapted as follows:

- Individuals and interactions are valued over processes and tools (same as in software development);
- Education quality is valued over comprehensive regulatory framework;
- Stakeholder collaboration is valued over requirements discussion;
- Responding to change is valued over following a plan (same as in software development).

Introduced manifesto is based on following twelve principles:

1. Highest priority of education quality assurance is to satisfy all stakeholders through continuous improvement of learning quality.

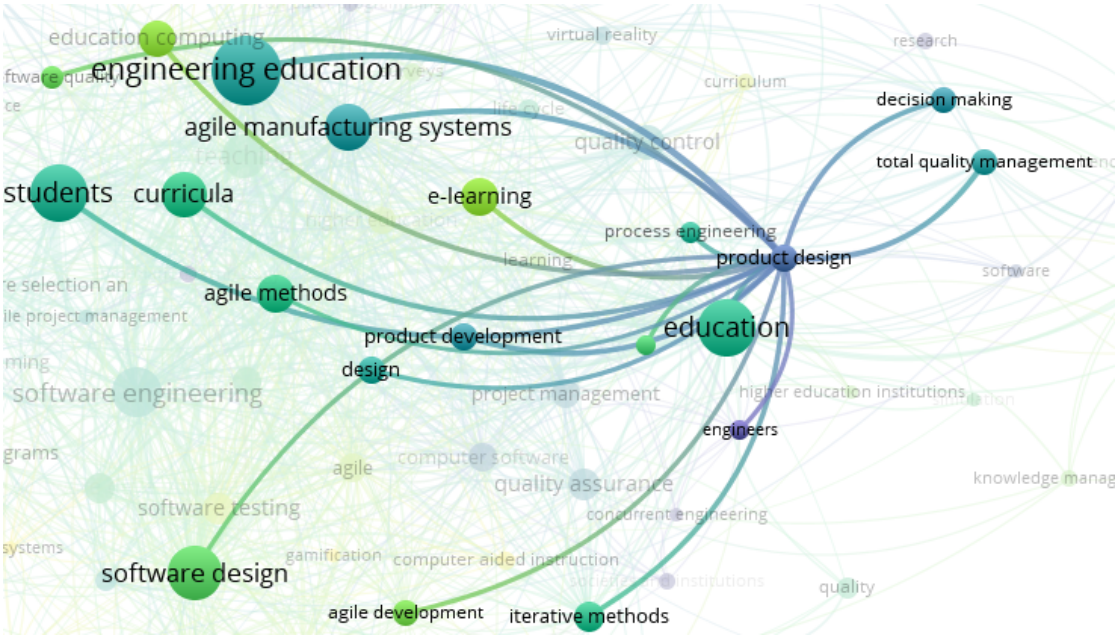

Figure 3: Cluster “decision making”.

2. Welcome changes in education quality criteria, even at formed systems.
3. Deliver evaluation results frequently, both internally and externally.
4. Frequent collaboration between all stakeholders: students, university management and employers.
5. Build the system around motivated individuals giving them the environment and support they need, and trust them to get the job done.
6. Face-to-face conversation is the most effective method of communication within quality assurance system.
7. Student level of knowledge is the primary measure of education quality.
8. Sustainable development is maintained throughout the whole system functioning.
9. Continuous attention to technical excellence and good design enhances agility
10. Simplicity – the art of maximizing the amount of work not done – is essential
11. Self-organization of the team fosters the best practices for education quality assurance.
12. At regular intervals, the team reflects on how to become more effective, then tunes and adjusts its behavior accordingly.

Note that some principles outlined for software development at [22] are perfectly applicable for education quality assurance and hence they are incorporated in unchanged form.

Hereby we propose few insights on how to build education quality assurance system based on agile principles and applicable for any Ukrainian higher education institution.

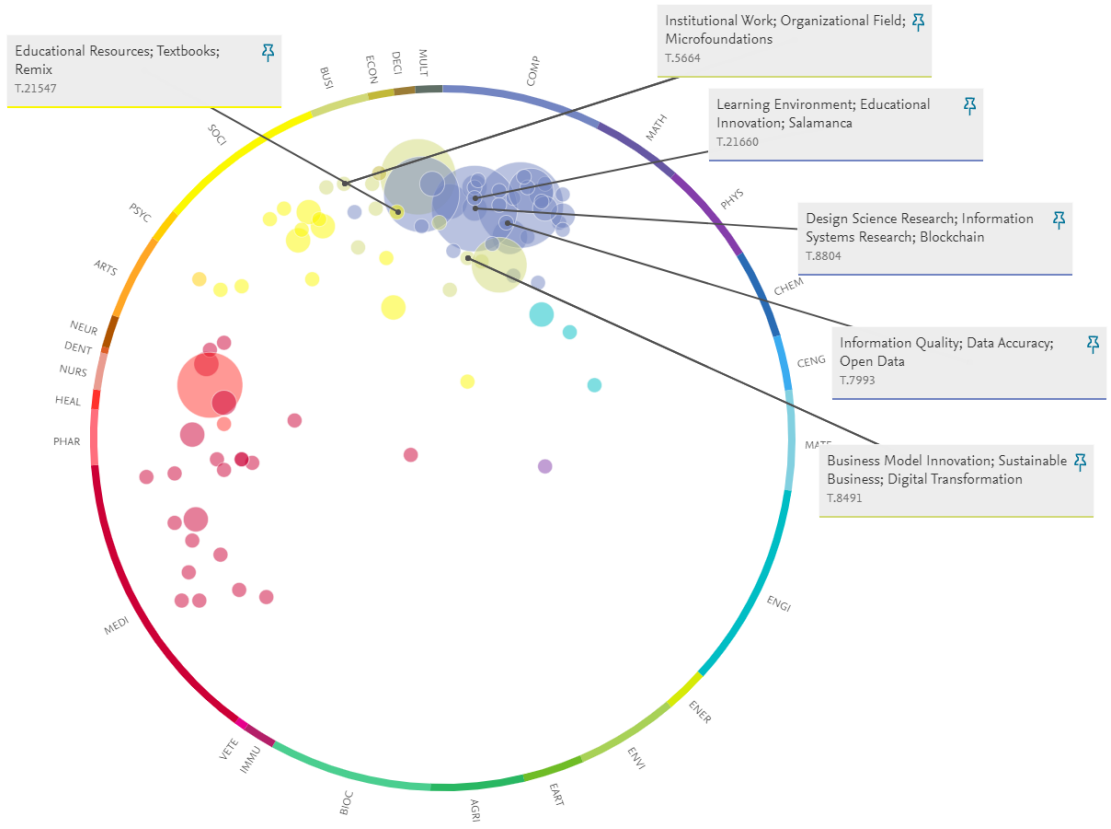

Figure 4: Top 25% topics by prominence defined by query “agile quality of education”.

3.1. Scrum method for education quality assurance

Scrum is the agile methodology widely used in project management and systems development. First published in [23] it has since gained significant development. Nowadays scrum is one of the most preferable agile methodologies with benefits in transparency, risk management and flexibility.

In this paper we propose scrum method for education quality assurance. This method allows organizing education quality assurance procedure in comprehensive way. It can be scaled from overall university performance evaluation (including both educational and scientific components) down to single educational program assessment on the department level. Figure 1 represents the diagram of proposed scrum method.

The process is comprised of the following steps:

1. *Forming of Educational Quality Assurance Backlog.* It is closely coupled with internal or external quality criteria (e.g. National Agency for Education Quality Assurance of Ukraine (NAQA) educational program quality criteria).
2. *Forming Evaluation Sprint Backlog.* Basically, Scrum team selects tasks (activities) from

Activities backlog formed on previous step to include in the next sprint (e.g. check academic integrity environment in the university).

3. *Performing Evaluation Sprint.* Along with direct fulfillment of sprint backlog tasks, team evaluates total Activities backlog completion taking new tasks for new sprint and/or including tasks failed on previous sprint (e.g. re-evaluate unclear points explained by university management).
4. Each spring gets reviewed and based on this retrospective team implements *sprint's deliverables* (e.g. recommendations for educational programs improvement).

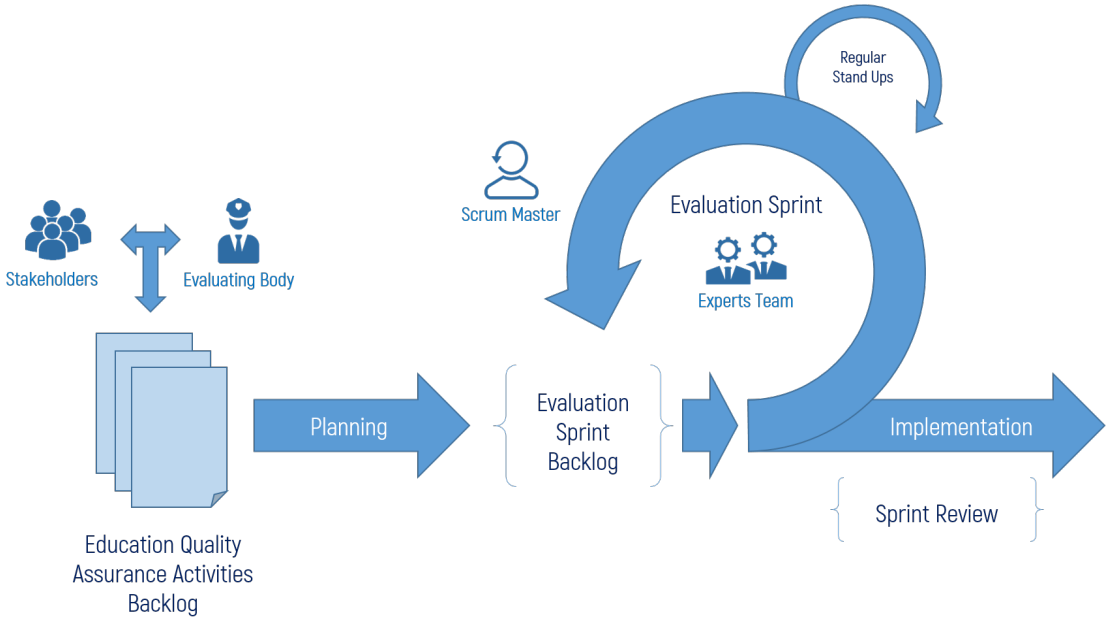

Figure 5: Scrum method for education quality assurance.

- **Stakeholders** provide their vision of education quality since they are highly motivated in high quality education due to direct economical connection to the graduates landscape. They also provide initial self-assessment report which is used as the base for activities backlog forming.
- **Evaluating Body** such as NAQA mostly contribute to forming of structured quality assurance backlog providing universal evaluation criteria and independent experts staff for external quality assurance. However, internal quality assurance department might also act as evaluating body in case of scaling Scrum method to internal quality assurance procedure.
- **Experts Team** perform the evaluation activities during each sprint in transparent and sharable way. Most of their evaluation activities should be backed by deliverables, e.g. meeting reports and grades. Scrum Master supervises their work.

- **Scrum Master** maintains the control over the sprint duration and ensures that tasks from sprint evaluation backlog are fulfilled. Regular Stand-up meetings during the spring help to keep all the stakeholders and team informed about each other's activities.

To illustrate the viability of proposed scrum method let us provide examples for external and internal quality of educational program assurance procedures. Based on existing practices (NAQA Evaluation procedure and internal assessment of educational program) we define Educational Quality Assurance Backlog, divide it by sprints and distribute roles according to positions of engaged staff. Figure 6 should be considered as key to be used with scrum method given in figure 5.

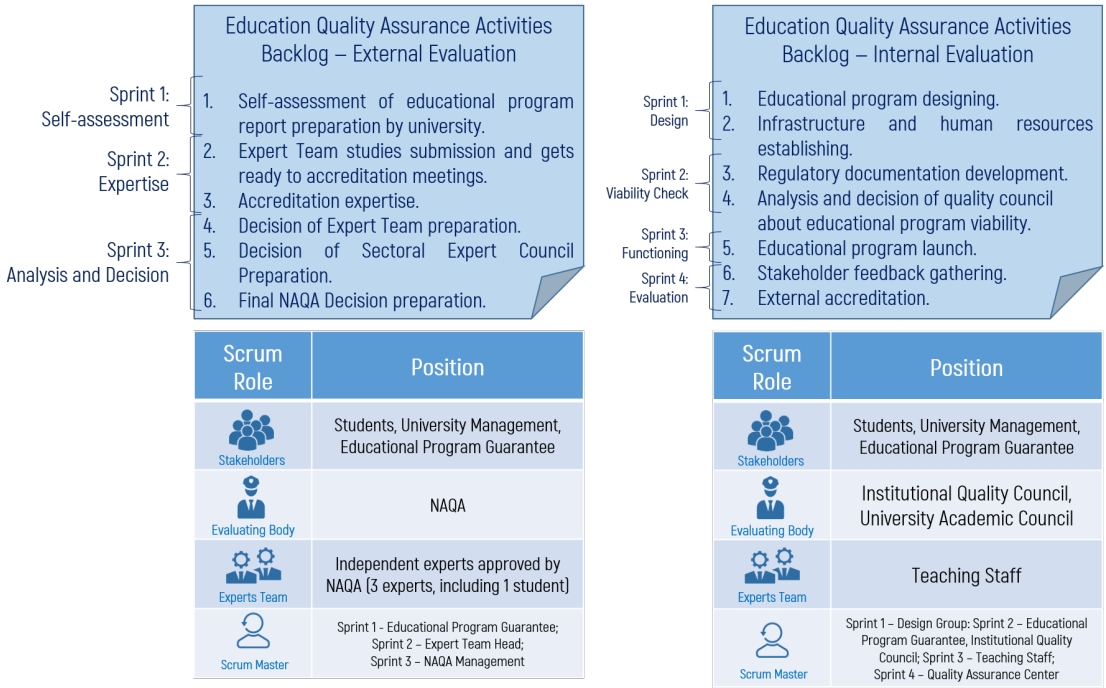

Figure 6: Scrum backlogs and roles for external and internal quality assurance procedures.

As figure 6 demonstrates, such distribution of roles and formation of Education Quality Assurance Backlog fully fits into scrum method described by figure 5. We should note that figure 6 was constructed based on existing evaluation procedures: external evaluation of educational programs by NAQA and internal evaluation of educational programs within the university.

Another important note to take here is that after reviewing the Sprint activities the evaluation outcomes (grades, recommendations to improve some parts of the program, staff evaluation reports) are than used as deliverables for university. Sprint review procedure is also closely coupled with stakeholders feedback collection about their satisfaction by economic outcomes (in terms of graduates competencies) that are provided by educational program and level

of innovation that industry gets from implementing educational program. Thus, proposed methodology connects clear SDG 4 tasks behind the quality assurance system and not so obvious in this context SDGs 8 and 9.

As can be seen from figure 6, external accreditation of educational program is included in Sprint 4 of internal evaluation procedure. This may seem counterintuitive on the first glance, but is backed by logic of educational program development, which is much more complex project than its accreditation.

3.2. University quality education system aimed at SDG achievement

SDG 4 is a combination of ten targets addressing problems of education quality and equality on different levels of education. The first two targets (4.1, 4.2) are intended to ensure equal access of all children to early childhood development and primary education with effective learning outcomes. This is followed by targets 4.3 and 4.4 stating the need to ensure equal access for all women and men to technical education and availability of quality employment for all graduates. Target 4.5 addresses the problems of educational access for vulnerable groups including people with disabilities, indigenous peoples and children in vulnerable situations. Target 4.6 is aimed to reduce both youth and adult illiteracy and innumeracy. Target 4.7 raises the need to focus educational content on the knowledge and skills promoting sustainable development, human rights, gender equality and culture of peace along with global citizenship. Additional targets 4A, 4B and 4C lay the timeframe and suggest means to fulfill targets 4.1–4.7 [24].

However, the quantitative measurements of the stated targets fulfillment is complicated despite the indicators formulated by SDG 4. According to [25], "Education quality, equality, inclusion, gender equality may be unmeasurable with current indictors, but if metrics are useful to enhance human rights agendas and develop strategies to tackle considerable injustices, then research and critical discussion is needed concerning what indicators might help develop policy, practices and accountability to realise the vision of SDG4. A frequent riposte to the complexity of ideas of quality, equality and inclusion in education is that they are actually unmeasurable."

Therefore, combining efforts aimed to achievement of the stated targets leads to the idea of the development of quality education system focused on SDG4 principles and aimed at fulfilling targets 4.1–4.7.

Figure 8 illustrates multidirectional pipeline focused on achieving SDGs 4, 8 and 9 through the university engagement. Each of the six stages is carried out in the presented sequence when the "initial data" for following stages are the results of the previous. Each of the stages is associated with the fulfilling of different SDG targets. In addition to SDG 4 and SDG 7, which connection with university activities was covered in [19], the diagram shows other SDGs that can be achieved during the implementation of the algorithm, in particular SDGs 8 and 9 discussed above. One can see that a cycle of university activities is organized between the main elements (nodes). Each stakeholder has the ability to influence the nature of the model implementation at a certain stage. In this case, stakeholders are initiators of error search and proposing changes on the stage testing phase (algorithm modernization, conditions for performing a particular stage, conditions for moving to the next stage, etc.) This fact is demonstrated in the description of the model testing algorithm. The model assumes that at the beginning of the algorithm implementation (when developing the technical task for each stage — the regulatory framework

of the university), the stages can be carried out in parallel. However, the effective implementation of the algorithm can be continued only when the result is achieved at the "Quality education system" stage.

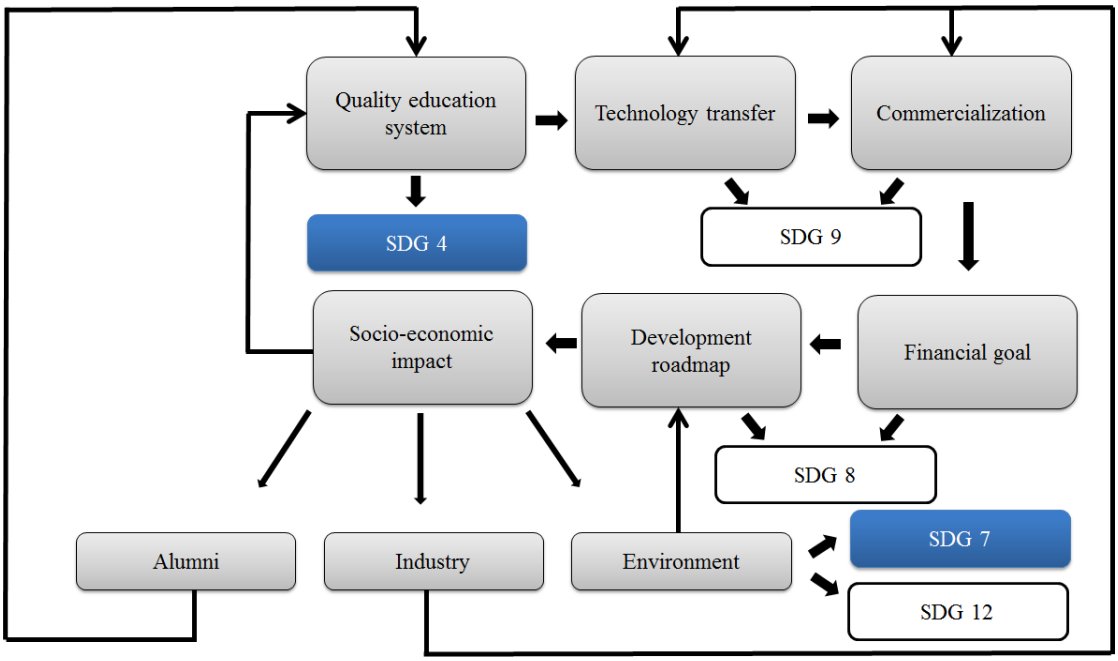

Figure 7: From quality education to innovations and economic growth.

One of the ideas of achieving SDG 4 on level of university is to use DIKW+DM hierarchy. Its aim is the modification of known DIKW information hierarchy to get multilayered framework for education quality assurance that allow to join information processing, knowledge acquisition and corresponding decision-making algorithm.

The agile approach is not recommended for all layers of the DIKW hierarchy. At the stage of collecting data, analyzing them, systematizing and obtaining an array of information, the data is not corrected due to their constancy. Only at the stage of knowledge generation as a tool for subsequent decision-making, it becomes necessary to assess certain factors degree of influence and revise the system's functioning model. At the same time, the procedure of internal quality control by the university and external quality control by independent educational agencies and external stakeholders is implemented. The report on the monitoring of the quality system is a guiding document for further revision of system structure, content, interrelation of elements and the degree of their mutual influence. This part of the model is tested and refined through an agile approach.

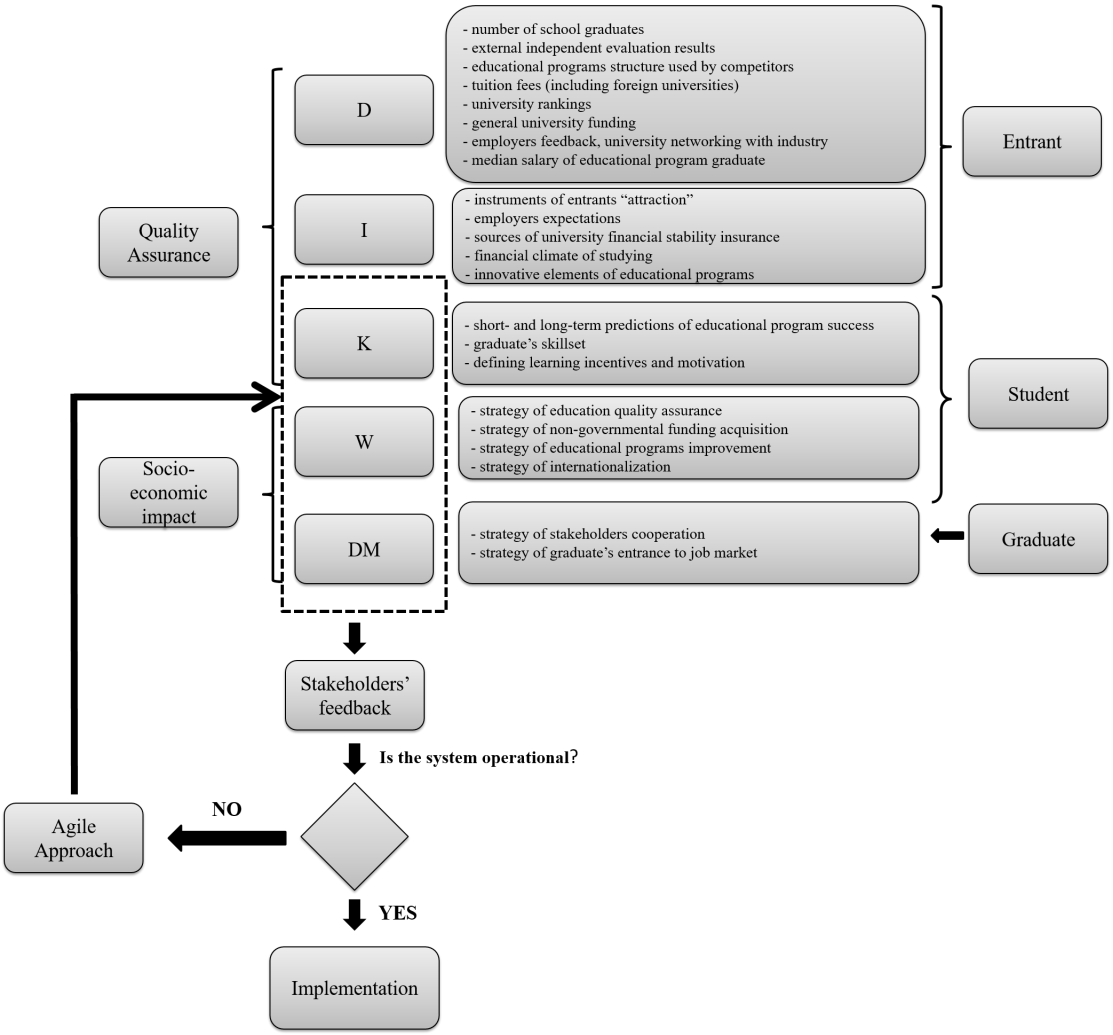

Figure 8: DIKW+DM Model incorporating agile approach on the system testing phase.

4. Conclusions

Therefore, in this paper we proposed Manifesto for Agile Education Quality Assurance and twelve principles behind it based on Manifesto for Agile Software Development. We used these principles to propose scrum method for education quality assurance. We defined the overall scrum procedure and distributed roles participating in planning, spring execution and implementation phases. It was illustrated that Scrum method perfectly fits existing procedure and staff roles and can be adopted with minimal adjustments by national HEIs.

A consistent approach to the optimal implementation method of quality assurance main tasks at the university allows solving other problems simultaneously. Achieving SDG 4 targets all continues the quality assurance journey beyond the educational process. The creation of

innovative infrastructures and the achievement of economic growth (thus fostering SDGs 8 and 9 achievement) are important outcomes of an effective model for ensuring the quality of education. Based on feedback from stakeholders about the degree of their "economic" and "innovative" satisfaction, subtasks are formed within the framework of internal and external assurance sprints of education quality assurance procedure.

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