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Master of Engineering in Internet of Things (IoTRAIN)

WP3 Quality Plan

D3.1 Quality control and monitoring plan

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Executive Summary

To guarantee the project quality, the Quality Control and Monitoring Plan (QCMP) is with respect to the Logical Matrix Framework (LMF) by devising qualitative and measurable indicators. A detailed task distribution regarding fulfilment of quality benchmarks (see LMF) to project partners can then be provided according to this. The related factors - qualitative objective, progress indicators and associated measures can influence the project work.

- Qualitative objective is an important part of the project process to control quality. It is the general goal of the project, which focuses on better adapting to changeable situations and working collaboratively.
- Progress indicators show the status of the ongoing project and how the plan has been implemented. Detailed metrics like meetings, progress reports, deliverables, publications, developed courses, surveys and purchase process are included.
- Associated measures will monitor the project to ensure the smooth progress and manage risk. To improve project quality, adequate peer assessment tools should be provided. In addition to internal quality monitoring, external quality experts will be appointed to give feedback.

This QCMP is effective during the project lifespan, and all partners can take responsibilities to update and evaluate it, which can help reach the optimal outcome.

Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Translation
QCMP	Quality Control and Monitoring Plan
LMF	Logical Matrix Framework
IoT	Internet of Things
HE	Higher Education
QC	Quality Committee
HEI	HE Institutions
EU	European Union
SMEs	Small and Medium-sized Enterprises
UMA	University of Manchester
USI	University of Siegen
CBHE	Capacity Building in Higher Education
UPB	University Politehnica of Bucharest
IAB	Industrial Advisory Board

1 Introduction

The WP3 in IoTrain project is dedicated to quality control and monitoring the project's progress towards providing high quality training materials in the domain of Internet of Things (IoT) as well as properly equipping the Iranian and Iraqi Higher Education (HE) staffs. The activities, indicators and measurements are continuously monitored and will be adjusted and adapted based on the course of the project and its progress. Quality control and monitoring will be carried out by a Quality Committee (QC), which is composed of exactly one representative from each partner HE Institutions (HEI). QCMP is an essential part of WP3, which can guarantee the project quality and assess the work which has been done.

1.1 Abstract

QCMP is proposed to assure high quality of the project implementation that aims at enhancing the IoT skills of the engineers by developing and strengthening the Middle East HE training and curricula with state-of-the-art European standards and technologies. This plan acts as the quality bible for the project and all partners will adhere to it. With the elaboration and expansion of LMF, three key aspects (i.e., qualitative objective, progress indicators and associated measures) are focused.

Qualitative objective is the goal to which the project will contribute. Only the specific qualitative objective can guide the high-performance work progress and give clear task distribution to project partners. There are many different aspects which should be considered when designing the qualitative objective to guarantee the project quality, such as industry requests of partner countries and European industry, skills in practice, active involvement of females and rural areas, and the links between university-enterprise cooperation, entrepreneurship, and employability of graduates in Middle East.

Progress indicators show the situation of project processes, which need to be performed effectively to reach the targeted outcome. The indicators include:

- Progress reports and project deliverables
- Program implementation at partner universities
- Number and the professional skills of graduates
- Number of joint university-enterprise events and companies
- Minutes of meeting
- Process of purchasing the equipment
- Employability opportunities
- Gender equality
- Involvement of rural areas

Associated measures are essential to evaluate the implementation performance. Peer assessment mechanisms should run according to the schedule and the agreed timeframe, which will help improve the project outcomes. The two external independent viewpoints in addition to the internal quality assurance practices will maximize the performance of the project and the quality of its deliverables. Surveys that can check the quality should be designed. Due to the well-prepared quality assurance level, the risks that may occur throughout the project can be managed.

Based on the developed key aspects, great quality can be assured.

1.2 Relation to other deliverables

The relationship between D3.1 QCMP and other deliverables in WP3 is shown in Fig. 1. It can be assumed that QCMP is related to all other deliverables because it is the basis and standard of others.

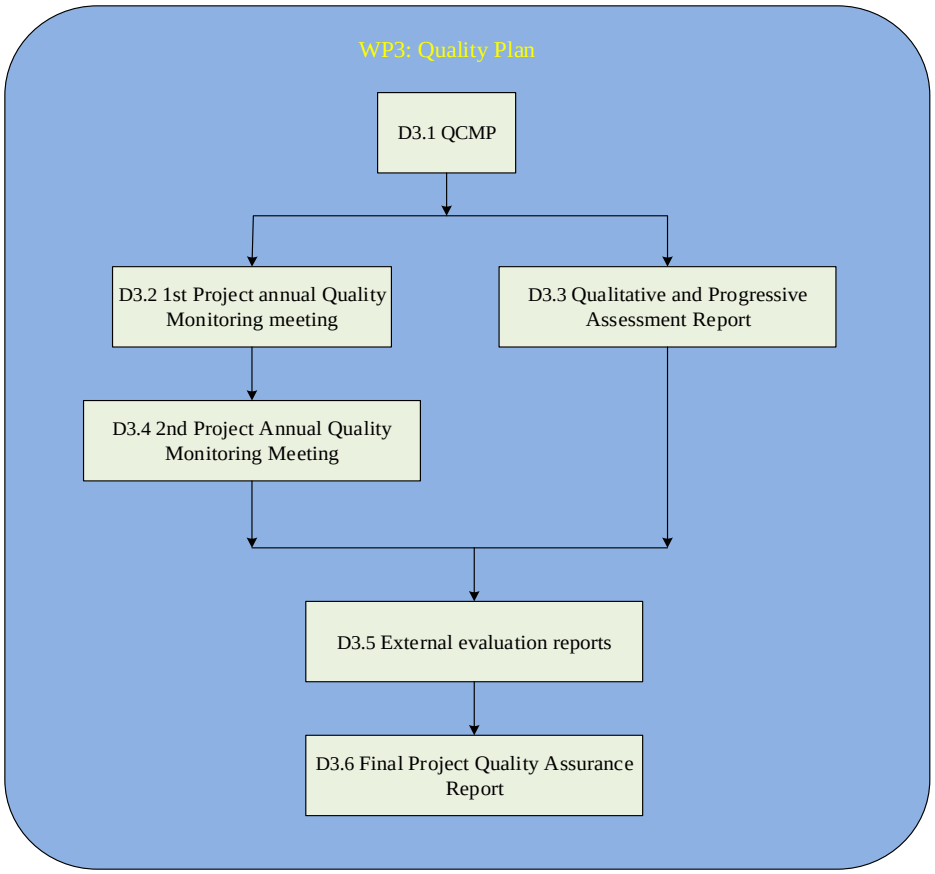

Fig. 1 The relationship between the D3.1 with other WP3 deliverables

D3.1 is a part of the overall quality assurance strategy and it will be reviewed and if necessary, adapted according to the project progress, emerging needs, and variations in the project context. Based on D3.1, D3.2 identifies shortcomings and plans next steps. Reports in D3.3 are mechanisms that are devised in order to provide a global picture of the project regarding its progress towards its goals and promises. D3.4 is the 2nd project annual quality monitoring meeting following D3.2. To ensure the quality of project and outcomes, two external quality experts will be involved in D3.5 to offer insights from a non-partner. High-quality and timely outputs will then be obtained. D3.6 presents the results of quality assurance measures of the project.

1.3 Relation between work packages

The D3.1 is a very important part in WP3. To see the role of D3.1 in global project, it is also helpful to see the relationship between WP3 and other work packages of the project. The relationship is shown in Fig. 2.

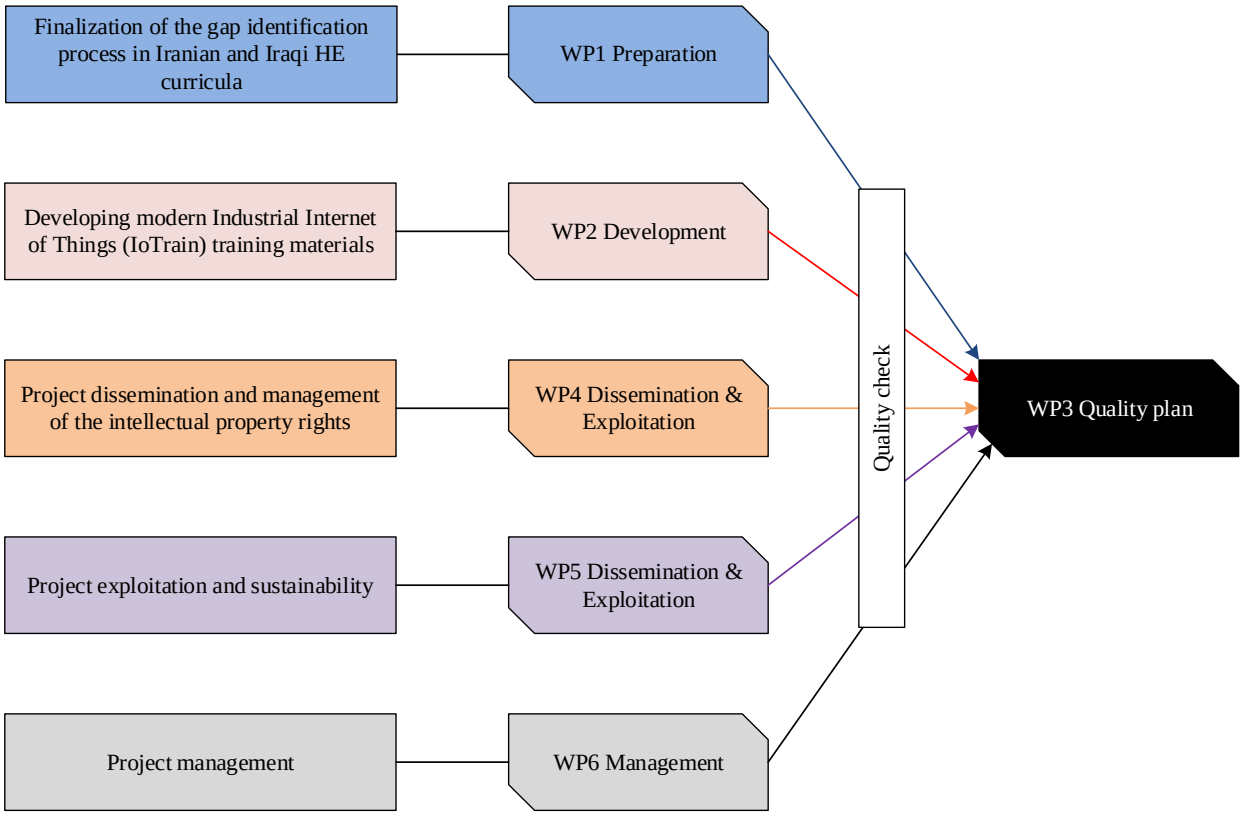

Fig. 2 The relationship between the WP3 and other work packages

WP1 is the fundamental step of the project to carry out the scoping, needs analyses,

initial planning, and preparation work. WP2 is one of the main and most important WPs, which will equip Iranian HE training programs in the domain of the IoT as driving technology with various applications and benefits. The most important part in WP4 is to overcome the insufficient or inadequate dissemination and activities in order to ensure the successful dissemination. Similar to WP4, WP5 needs to design an efficient and large-scale exploitation plan. In this regard, an industry exploitation workshop is foreseen in the project timeline in order to ensure that exploitation is successful. WP6 ensures high quality outcomes and reports regarding different aspects including progress, financial auditing, and quality. We can see that WP3 is a key part related to all WPs because the project quality should be controlled and monitored throughout the whole project period. The matching of every project task is on the level of project deliverables (not only project WPs).

2 Quality management strategy

Quality is the degree to which the project results fulfil the project's requirements. To meet the project requirements and achieve high quality outcomes, effective quality management strategy including quality control and monitoring is essential. Therefore, QCMP is designed for IoTrain to guarantee the improvement of IoT training of the engineering skills and competitiveness in Iran. Three key processes namely qualitative objective, progress indicators and associated measures are connected and interact to ensure efficient and high-quality work.

2.1 Qualitative objective

Qualitative objective gives the general goal and work direction for a project. The project can then be designed and planned effectively with high quality. The main goal of IoTrain is to improve the IoT skills of engineers and academics, and to achieve the modernization and internationalization of higher education in the Middle East (Region 6 countries). Huge changes introduced by Internet technologies in society and business are considered, so that continuous improvement processes will be achieved.

The objective of IoTrain can be categorized into technical objective, social objective, educational objective, and collaboration objective.

- Technical objective is to correctly identify and address the needs of tomorrow's job market in terms of IoT technology. Industrial needs related to IoT skills should be identified to fill gaps in current HE curricula with respect to the required IoT skills and develop new research areas. Besides, the IoT training modules should be provided. Existing modules in European HE systems need to be adapted and improved according to the needs of Iranian and Iraqi engineers. New advanced and high-quality teaching material for those lacking skills which are identified from the gap identification step should also be developed.
- Social objective is to help Iranian and Iraqi IoT graduates find jobs and improve national and international employability. In addition, the project will target engineers which are the 2nd largest groups of unemployed graduates in Iran and Iraq. The improvement of employability will bring economic development and social stability.
- Educational objective is to get establishment and alignment of study programs for a Master of engineering in IoT for serving the industry in Iran, Iraq, and the European countries. The links between university-enterprise cooperation, entrepreneurship and employability of graduates in Iran and Iraq will then be strengthened. On basis of the culture of practice-oriented and industry-motivated training in Iranian and Iraqi HE systems, the education

will be more theoretically oriented.

- Collaboration objective includes international collaboration to improve Iranian and Iraqi IoT graduates' competitiveness, development of academic-industry partnership and proposing new ideas related to long-term EU-Iran-Iraq collaborations. Students, researchers or teachers can exchange ideas by communication according to European Union (EU) standards. The extensive experiences and knowledge of the European partners can be transferred to Iranian and Iraqi counterparts.

By realizing the qualitative objective, the quality of project will be guaranteed. To achieve the mentioned objectives, intensive study of the educational and industrial situation in Iran and Iraq by the entire consortium should be done. Multiple groups targeted by IoTrain such as academia, HE staff, students, industry, Small and Medium-sized Enterprises (SMEs) are planned to be involved to project activities. Particularly they will be encouraged to be involved in the project summer/winter schools, workshops, and webinars.

2.2 Progress indicators

Progress indicators are important to evaluate and assess the project quality, and to show the status of project implementation. The design of progress indicators should be comprehensive, practical, and easy to be checked. The progress indicators in IoTrain include:

- Progress reports and project deliverables

Annual reports on results of project activity and project deliverables are important outcomes. They should be on time within budget and with the defined content. The progress of curriculum development and subjects in the field of IoT should be involved.

- Program implementation at partner universities

The number of applications and admission rate can show the implementation status.

- Number and the professional skills of graduates

The number of graduates can show the degree of dissemination of the project. Professional skills adaptive for industry can be obtained from the reports filled by employers from industry. The ability of students to complete courses is seen from their grades and quality of their thesis. The report form sample to evaluate the professional skills of graduates is shown in Table 1.

Fundamental information of company			
Company name		Establishment time	
Main business		Registration place	
Information of graduates			
Graduation year		Degree	

Gender		Home country and area	
Grade point average		Thesis score	
Position		Relatedness to IoT	
Skills evaluation (score from 0 to 10, 0 – No ability, 10 – Excellent ability)			
Theory knowledge		Practical skills	
Structure design ability		Network test	
Software		Hardware	
Vulnerability analysis		Bug fix	
Plan		Communication	

Table 1 Report sample to evaluate the professional skills of graduates

- Number of joint university-enterprise events and companies

More events and companies show the increasing interest from industry, which can provide better employability opportunities.

- Minutes of meeting

Communication is for sure one of the most essential foundations of successful project collaborations. Regular meetings are planned to make sure project partners will also physically visit each other's partner location at least once during the project. Meeting can provide mobility and exchange chances for students and staff.

- Process of purchasing the equipment

The cost of purchasing and the amount of equipment shows the practical condition of project.

- Employability opportunities

Surveys on graduates' first employment and relevance of IoTrain knowledge in their jobs can be designed to show the quality and relatedness of jobs. Regular surveys with updated career information can show the continuous employability situation. The survey form sample is given in Table 2.

Personal information			
Name		Gender	
Home country		Degree	
Graduation university		Graduation time	
Employment information			
1st job (If you have done several jobs after graduation, please add the contents from here to the end for all your jobs till now)			
Company name		Main business	
Registration place		Position	
Relatedness to IoT		Years of working	
Main work			

Please give a general description of your main work here:

Table 2 Sample of survey on graduates' employment

- Gender equality

The involvement of females is measured by the percentage of enrolled female students and percentage of the female teaching staff. The information of the female involvement can be from the admission records and annual statistics reports from each partner.

- Involvement of rural areas

The increase in the number of students enrolled from rural areas can narrow the gap between rural and developed areas.

In general, to measure the project quality, some key quality metric indicators are identified for each work package. Table 3 below summaries these metrics.

WP title	**Preparation**	**Development**	**Quality plan**	**Dissemination & Exploitation: Dissemination and management of the intellectual property rights**	**Dissemination & Exploitation: Exploitation and sustainability**	**Management**
WP No.	1	2	3	4	5	6
Key quality metric indicators	**WP1_K1:** Analysis of existing courses and resources **WP1_K2:** Market needs analysis and goal definition **WP1_K3:** IoT trainings gap identification report **WP1_K4:** Course development plan	**WP2_K1:** Final version of courses **WP2_K2:** Staff training and mobility in Siegen **WP2_K3:** Summer school in Iran and Iraq	**WP3_K1:** Quality control and monitoring plan **WP3_K2:** Project annual quality monitoring meetings **WP3_K3:** Qualitative and progressive assessment reports **WP3_K4:** External evaluation reports **WP3_K5:** Final project quality assurance report	**WP4_K1:** Dissemination policy and plan **WP4_K2:** Project website **WP4_K3:** Entrepreneurship and dissemination workshop **WP4_K4:** Dissemination and marketing materials **WP4_K5:** Newsletters and mailing lists	**WP5_K1:** Industry exploitation workshop **WP5_K2:** Sustainability plan and monitoring report **WP5_K3:** Exploitation plan	**WP6_K1:** Kick-off meeting **WP6_K2:** Project management handbook **WP6_K3:** Management and project progress meetings **WP6_K4:** Communication and collaboration tools **WP6_K5:** Interim financial monitoring report **WP6_K6:** Final project report **WP6_K7:** Project final meeting

Table 3 Quality metric indicators

2.3 Associated measures

Monitoring in quality control can assure the successful project development. In addition to the internal assessment, associated measures also include external evaluations. The peer assessment will be completed during the whole project. Qualitative and progressive self-assessment activities in the frame of (short) reports every six months by the WP3 leaders with the collaboration of all partners.

2.3.1 Quality committee

A QC will take responsibility to do quality control, monitoring and measurement. which is composed of exactly one representative from each partner HEI. This committee is chaired by UMA and is elected during the project Kick-off meeting.

The project coordinator University of Siegen (USI) will have an important role in the QC to ensure the quality of the developed outcomes within the project. They have enough experience to be able to define the knowledge requirements of the program and the enterprise needs for graduates and the training courses. They will help the course developers in the planning phase to decide on the contents of the courses. They will evaluate the developed courses, work plan, progress reports and involve industry from partner countries, to share their experiences, governmental institutions and consultancy companies will be also invited to review the new courses.

2.3.2 Monitoring activities and mechanisms

Some main activities should be monitored to trace the project quality in terms of the progress indicators. The main activities and mechanisms include:

- Partners will circulate summary and progress reports following each meeting, seminar or any other activity. The QC will ask the project partners after each meeting using a survey to make sure that the meeting has successfully addressed the defined agenda and targets.
- Different surveys will be conducted after training and workshops to check the quality. Surveys will target teachers, students, retrained professors and university administration, and management from the enterprises.
- Project deliverables will be reviewed internally by several (at least two) related partners. QC will define the review plan. To guarantee the quality of the project, two external quality experts will also be appointed to monitor the results, by providing individual assessment reports. Annual reports on results of project activity will be thoroughly analysed. Thus, the performance of the project and the quality of its deliverables will be maximized.
- The project website will take into account requests for enterprise and

university development in order to evaluate the interest of industry and business representatives in the education process.

- The process of purchasing the equipment will be monitored by the QC to make sure that the allocated budget has been spent in the most efficient way.
- USI (coordinator) has highly qualified staff and has extensive experience in managing EU- and internationally funded projects, in particular Erasmus+ Capacity Building in Higher Education (CBHE) projects. USI will regularly monitor and supervise the work of University Politehnica of Bucharest (UPB) and the external evaluator.

2.3.3 Review process

To ensure the quality of project outcomes, review process is quite essential. The two main parts in review process are internal evaluation and external evaluation. In review process, the activities and deliverables of the whole project will be checked and monitored. The general review process is shown in Fig. 3.

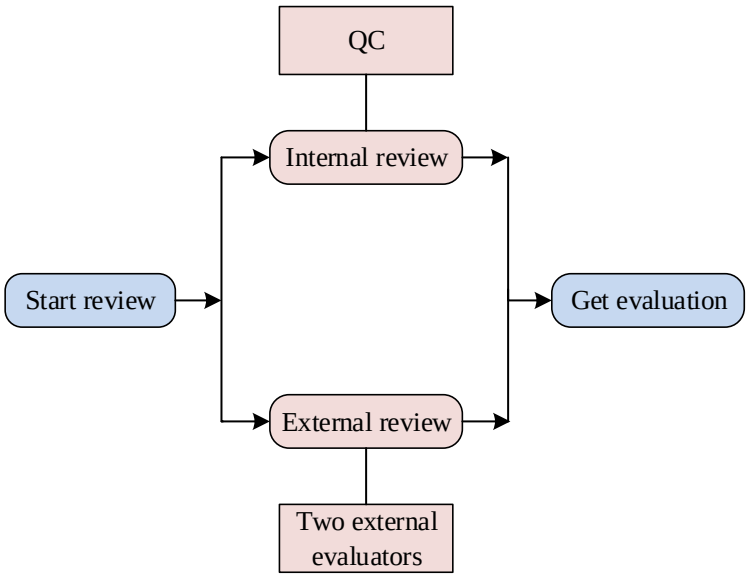

Fig. 3 General review process in quality monitoring

In the project, the projects' meetings, the project deliverables, reports, following ups on the reports and so on can be reviewed like this flowchart. Two external evaluators (one European, one Iranian) for major project activities are involved. External evaluation and involvement of external experts through an Industrial Advisory Board (IAB) if needed subcontract for measuring and ensuring feasibility of project's envisaged results.

To make review easier and more clearly, a review form can be used for reviewers to complete. A sample of the review form is shown in Table 4.

Date of review:	Reviewer type: ☐internal ☐external

Metric list	Score (0-10)	Comments
Structure		
Contents		
Readability		
Quality		
Integrity		
Expression		

Table 4 A sample of the review form. The score will be used to give the qualitative measurement of the quality.

2.3.4 Risk management

By applying the right measurement and monitoring, the risks that may occur can be managed. To guarantee the objectives of IoTrain project, is essential to identify and understand the significant project risks. The risk management is based on the early identification during monitoring and fast reaction to events that can negatively affect the outcome of the project.

Some main risks and ways to mitigate include:

- Not meeting the expected level of quality in the training materials. The training materials will be developed based on the results of the extensive analysis done in the gap identification report. Besides, the well-known European and also the Iranian and Iraqi HE partners can provide extensive experience in developing high-quality training materials. Further, the wise and accurate design of an effective project management strategy should consider possible obstacles and risks as well as appropriate reactions.
- Bias in activities and being blind to some qualitative aspects. UMA in Europe and USB in Iran who are assigned the quality control plan have extensive experience in understanding of the problem and will closely collaborate with each other and the coordinator.
- Financial shortage. Universities cooperation for facilitating procedures and supporting the program can co-finance it. Bank-to-bank transfer can be done from German partner to Iranian partner inside Germany or other mechanisms.
- Reluctance or delay of the partners in fulfilling the commitments. Regular and early enough reminder and coordination on the partners will be given.
- Not getting enough application for the master program. Early promotional program at each institute, other local universities or international universities can help guarantee the minimum students.

When risks are monitored during the measurement process, they should be managed

and solved as soon as possible to avoid the influence on project quality.

According to Section 2, the process of quality management strategy in quality control and monitoring plan can be presented in Fig. 4.

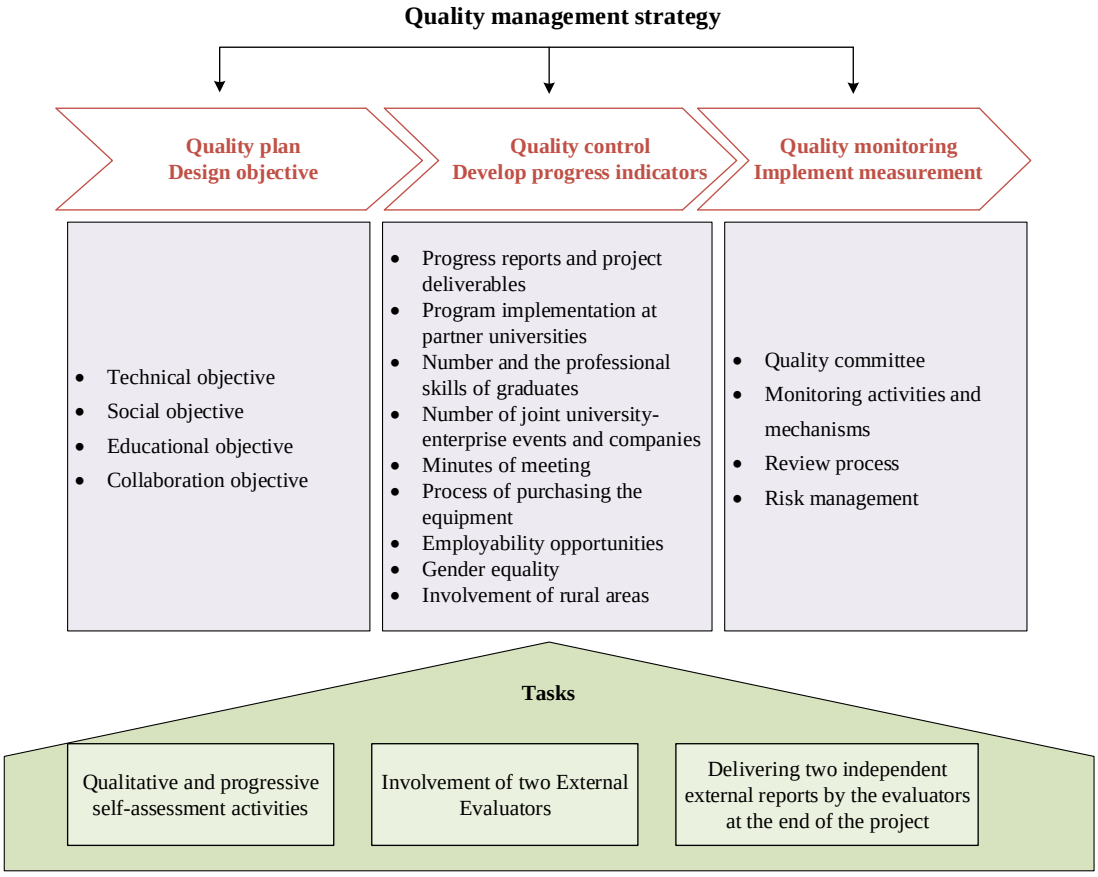

Fig. 4 Quality management strategy in quality control and monitoring plan

3 Summary and conclusion

This QCMP demonstrates the aspects and factors when monitoring the quality of activities within IoTrain project. Three key processes namely qualitative objective, progress indicators and associated measures in quality management strategy which can impact the project work from the start to the end are given in this QCMP. Procedures, monitoring activities and mechanisms are also provided. The project aims at obtaining high-quality outcomes with high effectiveness and efficiency. QCMP can guarantee the smooth progress of project and ensure the on-time deliverables and outputs. The QCMP will be reviewed and if necessary, adapted according to the project progress and to emerging needs and variations in the project context to reach the optimal outcomes.