EUROPEAN EDUCATION AND CULTURE EXECUTIVE AGENCY (EACEA)

EACEA.A – Erasmus+, EU Solidarity Corps
A.4 – International Capacity Building

GRANT AGREEMENT

Project 101129077 — BIOMED5.0

PREAMBLE

This **Agreement** ('the Agreement') is **between** the following parties:

on the one part,

the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and

on the other part,

1. 'the coordinator':

MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET), PIC 948276657, established in MAIN ADMINISTARTIVE BUILDING AQ AFGHAN ROAD SINDH, JAMSHORO 76062, Pakistan,

and the following other beneficiaries, if they sign their 'accession form' (see Annex 3 and Article 40):

2. **SIR SYED UNIVERSITY OF ENGINEERINGAND TECHNOLOGY (SSUET)**, PIC 915845289, established in MAIN UNIVERSITY ROAD BLOCK 5 GULSHAN E IQBAL, KARACHI 75300, Pakistan,

3. **LIAQUAT UNIVERSITY OF MEDICAL AND HEALTH SCIENCES JAMSHORO (LUMHS)**, PIC 883413630, established in SINDH 75300, JAMSHORO 76090, Pakistan,

4. **SALIM HABIB UNIVERSITY (SHU)**, PIC 883629746, established in NC-24 DEH DIH KORANGI CREEK, KARACHI 74900, Pakistan,

5. **ZIAUDDIN UNIVERSITY (ZU)**, PIC 891803354, established in 4B SHAHRAH-E-GHALIB RD BLOCK 6 CLIFTON, KARACHI 75600, Pakistan,

6. **UNIVERSITY OF ENGINEERING AND TECHNOLOGY LAHORE (UETL)**, PIC 881141696, established in GT ROAD LAHORE, Lahore 54890, Pakistan,

7. **THE BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR (BUETK)**, PIC 887803074, established in BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR, KHUZDAR 89100, Pakistan,

8. **UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA (UETT)**, PIC 884685882, established in TEHSIL, TAXILA, UET, TAXILA 47050, Pakistan,

9. **UNIVERSITATEA TEHNICA CLUJ-NAPOCA (UTC)**, PIC 999897244, established in STR MEMORANDUMULUI 28, CLUJ NAPOCA 400114, Romania,

10. **DUBLIN CITY UNIVERSITY (DCU)**, PIC 999892588, established in Glasnevin, DUBLIN 9, Ireland,

11. **PAKISTAN ENGINEERING COUNCIL (PEC)**, PIC 881020640, established in ATTATURK AVENUE (EAST) G-5/2, ISLAMABAD 44000, Pakistan,

Unless otherwise specified, references to 'beneficiary' or 'beneficiaries' include the coordinator and affiliated entities (if any).

If only one beneficiary signs the grant agreement ('mono-beneficiary grant'), all provisions referring to the 'coordinator' or the 'beneficiaries' will be considered — mutatis mutandis — as referring to the beneficiary.

The parties referred to above have agreed to enter into the Agreement.

By signing the Agreement and the accession forms, the beneficiaries accept the grant and agree to implement the action under their own responsibility and in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

The Agreement is composed of:

Preamble

Terms and Conditions (including Data Sheet)

Annex 1   Description of the action[1]

Annex 2   Estimated budget for the action

Annex 3   Accession forms (if applicable)[2]

Annex 3a   Declaration on joint and several liability of affiliated entities (if applicable)[3]

Annex 4   Model for the financial statements

Annex 5   Specific rules (if applicable)

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[1] Template published on Portal Reference Documents.
[2] Template published on Portal Reference Documents.
[3] Template published on Portal Reference Documents.

TERMS AND CONDITIONS

TABLE OF CONTENTS

DATA SHEET

1. General data

Project summary:

Project summary
BIOMED5.0 aims to establish an international partnership between Pakistani, Irish, and Romanian higher education institutions (HEIs) to modernize and transform Biomedical Engineering (BME) education. BIOMED5.0 objective is to incorporate digital transformation enabling Industry 4.0/5.0 technologies in BME bachelor and master programmes aiming at increasing students' understanding and knowledge in Industry 4.0/5.0 technologies and to upgrade teaching labs and introduce innovative Virtual Reality, Augmented Reality and Mixed Reality laboratory sessions for enhanced students learning experience. The project aims to foster collaboration between Knowledge Triangle players, promoting innovation and entrepreneurship. To achieve these goals, BIOMED5.0 will revise the Programme Educational Objectives and Learning Outcomes for the targeted modules via stakeholder inputs. The project will develop and implement 6 new bachelor and master modules and introduce elements of Industry 4.0/5.0 technologies in 12 existing modules. 5 new micro-credential Open Online Courses (OOC) on Industry 4.0/5.0 will be introduced for professionals as life-long learning. BIOMED5.0 will develop VR/AR/MR based lab training sessions for diagnostic and therapeutic BME devices. The centre will act as a technology incubation hub to drive innovation and support entrepreneurship in BME and healthcare through providing access to fabrication labs and mentorship programmes. BIOMED5.0 will benefit approximately 640 academic and 80 lab staff, over 10,000 BME bachelor and master students, 500 working/open to work professionals, and more than 80 entrepreneurs. BIOMED5.0 will build the capacity of partner HEIs through trainings in Industry 4.0/5.0 technologies, transformative skills, and mental well-being to academic and lab staff, students, and entrepreneurs. BIOMED5.0 will increase awareness and adoption of digital transformation and BIOMED5.0 outcomes through comprehensive dissemination & communication efforts.

Keywords:

- Engineering
- Modernisation of Higher Education
- Innovation in learning, teaching and assessment practices supported by digital technologies
- Curriculum design and development
- Biomedical Engineering, Digital Transformation, Industry 4.0/5.0

Project number: 101129077

Project name: Capacity Building in Biomedical Engineering Education for Digital Transformation and Industry 4.0/5.0 Technologies

Project acronym: BIOMED5.0

Call: ERASMUS-EDU-2023-CBHE

Topic: ERASMUS-EDU-2023-CBHE-STRAND-2

Type of action: ERASMUS Lump Sum Grants

Granting authority: European Education and Culture Executive Agency

Grant managed through EU Funding & Tenders Portal: Yes (eGrants)

Project starting date: first day of the month following the entry into force date

Project end date: starting date + months of duration

Project duration: 36 months

Consortium agreement: Yes

2. Participants

List of participants:

N°	Role	Short name	Legal name	Ctry	PIC	Max grant amount
1	COO	MUET	MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY	PK	948276657	100 749.00

N°	Role	Short name	Legal name	Ctry	PIC	Max grant amount
2	BEN	SSUET	SIR SYED UNIVERSITY OF ENGINEERINGAND TECHNOLOGY	PK	915845289	85 255.00
3	BEN	LUMHS	LIAQUAT UNIVERSITY OF MEDICAL AND HEALTH SCIENCES JAMSHORO	PK	883413630	68 189.00
4	BEN	SHU	SALIM HABIB UNIVERSITY	PK	883629746	67 708.00
5	BEN	ZU	ZIAUDDIN UNIVERSITY	PK	891803354	88 412.00
6	BEN	UETL	UNIVERSITY OF ENGINEERING AND TECHNOLOGY LAHORE	PK	881141696	88 760.00
7	BEN	BUETK	THE BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR	PK	887803074	57 510.00
8	BEN	UETT	UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA	PK	884685882	60 237.00
9	BEN	UTC	UNIVERSITATEA TEHNICA CLUJ-NAPOCA	RO	999897244	41 467.00
10	BEN	DCU	DUBLIN CITY UNIVERSITY	IE	999892588	129 768.00
11	BEN	PEC	PAKISTAN ENGINEERING COUNCIL	PK	881020640	11 633.00
Total						799 688.00

Coordinator:

– MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET)

3. Grant

Maximum grant amount, total estimated eligible costs and contributions and funding rate:

Maximum grant amount (Annex 2)	Maximum grant amount (award decision)
799 688.00	799 688.00

Grant form: Lump Sum

Grant mode: Action grant

Budget categories/activity types: Lump sum contributions

Cost eligibility options: n/a

Budget flexibility: No

4. Reporting, payments and recoveries

4.1 Continuous reporting (art 21)

Deliverables: see Funding & Tenders Portal Continuous Reporting tool

4.2 Periodic reporting and payments

Reporting and payment schedule (art 21, 22):

Reporting				Payments	
Reporting periods			Type	Deadline	Type	Deadline (time to pay)
RP No	Month from	Month to				
					Initial prefinancing	30 days from entry into force/ financial guarantee (if required) – whichever is the latest
1	1	36	Periodic report	60 days after end of reporting period	Final payment	90 days from receiving periodic report

Prefinancing payments and guarantees:

Prefinancing payment		Prefinancing guarantee		
Type	Amount	Guarantee amount	Division per participant	
Prefinancing 1 (initial)	559 781.60	n/a	1 - MUET	n/a
			2 - SSUET	n/a
			3 - LUMHS	n/a
			4 - SHU	n/a
			5 - ZU	n/a
			6 - UETL	n/a
			7 - BUETK	n/a
			8 - UETT	n/a
			9 - UTC	n/a
			10 - DCU	n/a
			11 - PEC	n/a

Reporting and payment modalities (art 21, 22):

Mutual Insurance Mechanism (MIM): No

Restrictions on distribution of initial prefinancing: The prefinancing may be distributed only if the minimum number of beneficiaries set out in the call condititions (if any) have acceded to the Agreement and only to beneficiaries that have acceded.

Interim payment ceiling (if any): 100% of the maximum grant amount

No-profit rule: n/a

Late payment interest: ECB + 3.5%

Bank account for payments:

PK72HABB0000687902555910 HABBPKKA

Conversion into euros: n/a

Reporting language: Language of the Agreement

4.3 Certificates (art 24): n/a

4.4 Recoveries (art 22)

First-line liability for recoveries:

> Beneficiary termination: Beneficiary concerned

> Final payment: Coordinator

> After final payment: Beneficiary concerned

Joint and several liability for enforced recoveries (in case of non-payment):

Limited joint and several liability of other beneficiaries — up to the maximum grant amount of the beneficiary

Joint and several liability of affiliated entities — n/a

5. Consequences of non-compliance, applicable law & dispute settlement forum

Applicable law (art 43):

Standard applicable law regime: EU law + law of Belgium

Dispute settlement forum (art 43):

Standard dispute settlement forum:

> EU beneficiaries: EU General Court + EU Court of Justice (on appeal)

> Non-EU beneficiaries: Courts of Brussels, Belgium (unless an international agreement provides for the enforceability of EU court judgements)

6. Other

Specific rules (Annex 5): Yes

Standard time-limits after project end:

Confidentiality (for X years after final payment): 5

Record-keeping (for X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Reviews (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Audits (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Extension of findings from other grants to this grant (no later than X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

Impact evaluation (up to X years after final payment): 5 (or 3 for grants of not more than EUR 60 000)

CHAPTER 1   GENERAL

ARTICLE 1 — SUBJECT OF THE AGREEMENT

This Agreement sets out the rights and obligations and terms and conditions applicable to the grant awarded for the implementation of the action set out in Chapter 2.

ARTICLE 2 — DEFINITIONS

For the purpose of this Agreement, the following definitions apply:

Actions —   The project which is being funded in the context of this Agreement.

Grant —   The grant awarded in the context of this Agreement.

EU grants — Grants awarded by EU institutions, bodies, offices or agencies (including EU executive agencies, EU regulatory agencies, EDA, joint undertakings, etc.).

Participants — Entities participating in the action as beneficiaries, affiliated entities, associated partners, third parties giving in-kind contributions, subcontractors or recipients of financial support to third parties.

Beneficiaries (BEN) — The signatories of this Agreement (either directly or through an accession form).

Affiliated entities (AE) — Entities affiliated to a beneficiary within the meaning of Article 187 of EU Financial Regulation 2018/1046[4] which participate in the action with similar rights and obligations as the beneficiaries (obligation to implement action tasks and right to charge costs and claim contributions).

Associated partners (AP) — Entities which participate in the action, but without the right to charge costs or claim contributions.

Purchases — Contracts for goods, works or services needed to carry out the action (e.g. equipment, consumables and supplies) but which are not part of the action tasks (see Annex 1).

Subcontracting — Contracts for goods, works or services that are part of the action tasks (see Annex 1).

In-kind contributions — In-kind contributions within the meaning of Article 2(36) of EU Financial

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[4] For the definition, see Article 187 Regulation (EU, Euratom) 2018/1046 of the European Parliament and of the Council of 18 July 2018 on the financial rules applicable to the general budget of the Union, amending Regulations (EU) No 1296/2013, (EU) No 1301/2013, (EU) No 1303/2013, (EU) No 1304/2013, (EU) No 1309/2013, (EU) No 1316/2013, (EU) No 223/2014, (EU) No 283/2014, and Decision No 541/2014/EU and repealing Regulation (EU, Euratom) No 966/2012 ('EU Financial Regulation') (OJ L 193, 30.7.2018, p. 1): "**affiliated entities** [are]:
(a) entities that form a sole beneficiary [(i.e. where an entity is formed of several entities that satisfy the criteria for being awarded a grant, including where the entity is specifically established for the purpose of implementing an action to be financed by a grant)];
(b) entities that satisfy the eligibility criteria and that do not fall within one of the situations referred to in Article 136(1) and 141(1) and that have a link with the beneficiary, in particular a legal or capital link, which is neither limited to the action nor established for the sole purpose of its implementation".

Regulation 2018/1046, i.e. non-financial resources made available free of charge by third parties.

Fraud — Fraud within the meaning of Article 3 of EU Directive 2017/1371[5] and Article 1 of the Convention on the protection of the European Communities' financial interests, drawn up by the Council Act of 26 July 1995[6], as well as any other wrongful or criminal deception intended to result in financial or personal gain.

Irregularities — Any type of breach (regulatory or contractual) which could impact the EU financial interests, including irregularities within the meaning of Article 1(2) of EU Regulation 2988/95[7].

Grave professional misconduct — Any type of unacceptable or improper behaviour in exercising one's profession, especially by employees, including grave professional misconduct within the meaning of Article 136(1)(c) of EU Financial Regulation 2018/1046.

Applicable EU, international and national law — Any legal acts or other (binding or non-binding) rules and guidance in the area concerned.

Portal — EU Funding & Tenders Portal; electronic portal and exchange system managed by the European Commission and used by itself and other EU institutions, bodies, offices or agencies for the management of their funding programmes (grants, procurements, prizes, etc.).

CHAPTER 2   ACTION

ARTICLE 3 — ACTION

The grant is awarded for the action **101129077 — BIOMED5.0** ('action'), as described in Annex 1.

ARTICLE 4 — DURATION AND STARTING DATE

The duration and the starting date of the action are set out in the Data Sheet (see Point 1).

CHAPTER 3   GRANT

ARTICLE 5 — GRANT

5.1   Form of grant

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[5] Directive (EU) 2017/1371 of the European Parliament and of the Council of 5 July 2017 on the fight against fraud to the Union's financial interests by means of criminal law (OJ L 198, 28.7.2017, p. 29).

[6] OJ C 316, 27.11.1995, p. 48.

[7] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

The grant is an action grant[8] which takes the form of a lump sum grant for the completion of work packages.

5.2   Maximum grant amount

The maximum grant amount is set out in the Data Sheet (see Point 3) and in the estimated budget (Annex 2).

5.3   Funding rate

Not applicable

5.4   Estimated budget, budget categories and forms of funding

The estimated budget for the action (lump sum breakdown) is set out in Annex 2.

It contains the estimated eligible contributions for the action (lump sum contributions), broken down by participant and work package.

Annex 2 also shows the types of contributions (forms of funding)[9] to be used for each work package.

5.5   Budget flexibility

Budget flexibility does not apply; changes to the estimated budget (lump sum breakdown) always require an amendment (see Article 39).

Amendments for transfers between *work packages* are moreover possible only if:

- the work packages concerned are not already completed (and declared in a financial statement) and

- the transfers are justified by the technical implementation of the action.

ARTICLE 6 — ELIGIBLE AND INELIGIBLE CONTRIBUTIONS

6.1 and 6.2   General and specific eligibility conditions

Lump sum contributions are eligible ('eligible contributions'), if:

(a) they are set out in Annex 2 and

(b) the work packages are completed and the work is properly implemented by the beneficiaries and/or the results are achieved, in accordance with Annex 1 and during in the period set out in Article 4 (with the exception of work/results relating to the submission of the final periodic report, which may be achieved afterwards; see Article 21)

They will be calculated on the basis of the amounts set out in Annex 2.

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[8] For the definition, see Article 180(2)(a) EU Financial Regulation 2018/1046: '**action grant**' means an EU grant to finance "an action intended to help achieve a Union policy objective".
[9] See Article 125 EU Financial Regulation 2018/1046.

6.3   Ineligible contributions

'Ineligible contributions' are:

(a) lump sum contributions that do not comply with the conditions set out above (see Article 6.1 and 6.2)

(b) lump sum contributions for activities already funded under other EU grants (or grants awarded by an EU Member State, non-EU country or other body implementing the EU budget), except for the following case:

   (i) Synergy actions: not applicable

(c) other:

   (i) country restrictions for eligible costs: not applicable.

6.4   Consequences of non-compliance

If a beneficiary declares lump sum contributions that are ineligible, they will be rejected (see Article 27).

This may also lead to other measures described in Chapter 5.

CHAPTER 4   GRANT IMPLEMENTATION

SECTION 1   CONSORTIUM: BENEFICIARIES, AFFILIATED ENTITIES AND OTHER PARTICIPANTS

ARTICLE 7 — BENEFICIARIES

The beneficiaries, as signatories of the Agreement, are fully responsible towards the granting authority for implementing it and for complying with all its obligations.

They must implement the Agreement to their best abilities, in good faith and in accordance with all the obligations and terms and conditions it sets out.

They must have the appropriate resources to implement the action and implement the action under their own responsibility and in accordance with Article 11. If they rely on affiliated entities or other participants (see Articles 8 and 9), they retain sole responsibility towards the granting authority and the other beneficiaries.

They are jointly responsible for the *technical* implementation of the action. If one of the beneficiaries fails to implement their part of the action, the other beneficiaries must ensure that this part is implemented by someone else (without being entitled to an increase of the maximum grant amount and subject to an amendment; see Article 39). The *financial* responsibility of each beneficiary in case of recoveries is governed by Article 22.

The beneficiaries (and their action) must remain eligible under the EU programme funding the grant

for the entire duration of the action. Lump sum contributions will be eligible only as long as the beneficiary and the action are eligible.

The **internal roles and responsibilities** of the beneficiaries are divided as follows:

(a) Each beneficiary must:

   (i) keep information stored in the Portal Participant Register up to date (see Article 19)

   (ii) inform the granting authority (and the other beneficiaries) immediately of any events or circumstances likely to affect significantly or delay the implementation of the action (see Article 19)

   (iii) submit to the coordinator in good time:

      - the prefinancing guarantees (if required; see Article 23)

      - the financial statements and certificates on the financial statements (CFS): not applicable

      - the contribution to the deliverables and technical reports (see Article 21)

      - any other documents or information required by the granting authority under the Agreement

   (iv) submit via the Portal data and information related to the participation of their affiliated entities.

(b) The coordinator must:

   (i) monitor that the action is implemented properly (see Article 11)

   (ii) act as the intermediary for all communications between the consortium and the granting authority, unless the Agreement or granting authority specifies otherwise, and in particular:

      - submit the prefinancing guarantees to the granting authority (if any)

      - request and review any documents or information required and verify their quality and completeness before passing them on to the granting authority

      - submit the deliverables and reports to the granting authority

      - inform the granting authority about the payments made to the other beneficiaries (report on the distribution of payments; if required, see Articles 22 and 32)

   (iii) distribute the payments received from the granting authority to the other beneficiaries without unjustified delay (see Article 22).

The coordinator may not delegate or subcontract the above-mentioned tasks to any other beneficiary or third party (including affiliated entities).

However, coordinators which are public bodies may delegate the tasks set out in Point (b)(ii) last

indent and (iii) above to entities with 'authorisation to administer' which they have created or which are controlled by or affiliated to them. In this case, the coordinator retains sole responsibility for the payments and for compliance with the obligations under the Agreement.

Moreover, coordinators which are 'sole beneficiaries'[10] (or similar, such as European research infrastructure consortia (ERICs)) may delegate the tasks set out in Point (b)(i) to (iii) above to one of their members. The coordinator retains sole responsibility for compliance with the obligations under the Agreement.

The beneficiaries must have **internal arrangements** regarding their operation and co-ordination, to ensure that the action is implemented properly.

If required by the granting authority (see Data Sheet, Point 1), these arrangements must be set out in a written **consortium agreement** between the beneficiaries, covering for instance:

- the internal organisation of the consortium

- the management of access to the Portal

- different distribution keys for the payments and financial responsibilities in case of recoveries (if any)

- additional rules on rights and obligations related to background and results (see Article 16)

- settlement of internal disputes

- liability, indemnification and confidentiality arrangements between the beneficiaries.

The internal arrangements must not contain any provision contrary to this Agreement.

ARTICLE 8 — AFFILIATED ENTITIES

Not applicable

ARTICLE 9 — OTHER PARTICIPANTS INVOLVED IN THE ACTION

9.1 Associated partners

Not applicable

9.2 Third parties giving in-kind contributions to the action

Other third parties may give in-kind contributions to the action (i.e. personnel, equipment, other goods, works and services, etc. which are free-of-charge), if necessary for the implementation.

Third parties giving in-kind contributions do not implement any action tasks. They may not charge contributions to the action (no lump sum contributions) and the costs for the in-kind contributions are not eligible (may not be included in the estimated budget in Annex 2).

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[10] For the definition, see Article 187(2) EU Financial Regulation 2018/1046: "Where several entities satisfy the criteria for being awarded a grant and together form one entity, that entity may be treated as the **sole beneficiary**, including where it is specifically established for the purpose of implementing the action financed by the grant."

The third parties and their in-kind contributions should be set out in Annex 1.

9.3 Subcontractors

Subcontractors may participate in the action, if necessary for the implementation.

Subcontractors must implement their action tasks in accordance with Article 11. The beneficiaries' costs for subcontracting are considered entirely covered by the lump sum contributions for implementing the work packages (irrespective of the actual subcontracting costs incurred, if any).

The beneficiaries must ensure that their contractual obligations under Articles 11 (proper implementation), 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping) also apply to the subcontractors.

The beneficiaries must ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the subcontractors.

9.4 Recipients of financial support to third parties

If the action includes providing financial support to third parties (e.g. grants, prizes or similar forms of support), the beneficiaries must ensure that their contractual obligations under Articles 12 (conflict of interest), 13 (confidentiality and security), 14 (ethics), 17.2 (visibility), 18 (specific rules for carrying out action), 19 (information) and 20 (record-keeping)also apply to the third parties receiving the support (recipients).

The beneficiaries must also ensure that the bodies mentioned in Article 25 (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.) can exercise their rights also towards the recipients.

ARTICLE 10 — PARTICIPANTS WITH SPECIAL STATUS

10.1 Non-EU participants

Participants which are established in a non-EU country (if any) undertake to comply with their obligations under the Agreement and:

-   to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)

-   for the submission of certificates under Article 24: use qualified external auditors which are independent and comply with comparable standards as those set out in EU Directive 2006/43/EC[11]

-   for the controls under Article 25: allow for checks, reviews, audits and investigations (including on-the-spot checks, visits and inspections) by the bodies mentioned in that Article (e.g. granting authority, OLAF, Court of Auditors (ECA), etc.).

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[11] Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on statutory audits of annual accounts and consolidated accounts or similar national regulations (OJ L 157, 9.6.2006, p. 87).

Special rules on dispute settlement apply (see Data Sheet, Point 5).

10.2   Participants which are international organisations

Participants which are international organisations (IOs; if any) undertake to comply with their obligations under the Agreement and:

- to respect general principles (including fundamental rights, values and ethical principles, environmental and labour standards, rules on classified information, intellectual property rights, visibility of funding and protection of personal data)

- for the submission of certificates under Article 24: to use either independent public officers or external auditors which comply with comparable standards as those set out in EU Directive 2006/43/EC

- for the controls under Article 25: to allow for the checks, reviews, audits and investigations by the bodies mentioned in that Article, taking into account the specific agreements concluded by them and the EU (if any).

For such participants, nothing in the Agreement will be interpreted as a waiver of their privileges or immunities, as accorded by their constituent documents or international law.

Special rules on applicable law and dispute settlement apply (see Article 43 and Data Sheet, Point 5).

10.3   Pillar-assessed participants

Pillar-assessed participants (if any) may rely on their own systems, rules and procedures, in so far as they have been positively assessed and do not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries.

'Pillar-assessment' means a review by the European Commission on the systems, rules and procedures which participants use for managing EU grants (in particular internal control system, accounting system, external audits, financing of third parties, rules on recovery and exclusion, information on recipients and protection of personal data; see Article 154 EU Financial Regulation 2018/1046).

Participants with a positive pillar assessment may rely on their own systems, rules and procedures, in particular for:

- record-keeping (Article 20): may be done in accordance with internal standards, rules and procedures

- currency conversion for financial statements (Article 21): may be done in accordance with usual accounting practices

- guarantees (Article 23): for public law bodies, prefinancing guarantees are not needed

- certificates (Article 24):

    - certificates on the financial statements (CFS): may be provided by their regular internal or external auditors and in accordance with their internal financial regulations and procedures

- certificates on usual accounting practices (CoMUC): are not needed if those practices are covered by an ex-ante assessment

and use the following specific rules, for:

- recoveries (Article 22): in case of financial support to third parties, there will be no recovery if the participant has done everything possible to retrieve the undue amounts from the third party receiving the support (including legal proceedings) and non-recovery is not due to an error or negligence on its part

- checks, reviews, audits and investigations by the EU (Article 25): will be conducted taking into account the rules and procedures specifically agreed between them and the framework agreement (if any)

- impact evaluation (Article 26): will be conducted in accordance with the participant's internal rules and procedures and the framework agreement (if any)

- grant agreement suspension (Article 31): certain costs incurred during grant suspension are eligible (notably, minimum costs necessary for a possible resumption of the action and costs relating to contracts which were entered into before the pre-information letter was received and which could not reasonably be suspended, reallocated or terminated on legal grounds)

- grant agreement termination (Article 32): the final grant amount and final payment will be calculated taking into account also costs relating to contracts due for execution only after termination takes effect, if the contract was entered into before the pre-information letter was received and could not reasonably be terminated on legal grounds

- liability for damages (Article 33.2): the granting authority must be compensated for damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement only if the damage is due to an infringement of the participant's internal rules and procedures or due to a violation of third parties' rights by the participant or one of its employees or individual for whom the employees are responsible.

Participants whose pillar assessment covers procurement and granting procedures may also do purchases, subcontracting and financial support to third parties (Article 6.2) in accordance with their internal rules and procedures for purchases, subcontracting and financial support.

Participants whose pillar assessment covers data protection rules may rely on their internal standards, rules and procedures for data protection (Article 15).

The participants may however not rely on provisions which would breach the principle of equal treatment of applicants or beneficiaries or call into question the decision awarding the grant, such as in particular:

- eligibility (Article 6)

- consortium roles and set-up (Articles 7-9)

- security and ethics (Articles 13, 14)

- IPR (including background and results, access rights and rights of use), communication, dissemination and visibility (Articles 16 and 17)

- information obligation (Article 19)

- payment, reporting and amendments (Articles 21, 22 and 39)

- rejections, reductions, suspensions and terminations (Articles 27, 28, 29-32)

If the pillar assessment was subject to remedial measures, reliance on the internal systems, rules and procedures is subject to compliance with those remedial measures.

Participants whose assessment has not yet been updated to cover (the new rules on) data protection may rely on their internal systems, rules and procedures, provided that they ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subject

- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes

- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed

- accurate and, where necessary, kept up to date

- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- processed in a manner that ensures appropriate security of the personal data.

Participants must inform the coordinator without delay of any changes to the systems, rules and procedures that were part of the pillar assessment. The coordinator must immediately inform the granting authority.

Pillar-assessed participants that have also concluded a framework agreement with the EU, may moreover — under the same conditions as those above (i.e. not call into question the decision awarding the grant or breach the principle of equal treatment of applicants or beneficiaries) — rely on provisions set out in that framework agreement.

SECTION 2   RULES FOR CARRYING OUT THE ACTION

ARTICLE 11 — PROPER IMPLEMENTATION OF THE ACTION

11.1   Obligation to properly implement the action

The beneficiaries must implement the action as described in Annex 1 and in compliance with the provisions of the Agreement, the call conditions and all legal obligations under applicable EU, international and national law.

11.2   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 12 — CONFLICT OF INTERESTS

12.1 Conflict of interests

The beneficiaries must take all measures to prevent any situation where the impartial and objective implementation of the Agreement could be compromised for reasons involving family, emotional life, political or national affinity, economic interest or any other direct or indirect interest ('conflict of interests').

They must formally notify the granting authority without delay of any situation constituting or likely to lead to a conflict of interests and immediately take all the necessary steps to rectify this situation.

The granting authority may verify that the measures taken are appropriate and may require additional measures to be taken by a specified deadline.

12.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the beneficiary may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 13 — CONFIDENTIALITY AND SECURITY

13.1 Sensitive information

The parties must keep confidential any data, documents or other material (in any form) that is identified as sensitive in writing ('sensitive information') — during the implementation of the action and for at least until the time-limit set out in the Data Sheet (see Point 6).

If a beneficiary requests, the granting authority may agree to keep such information confidential for a longer period.

Unless otherwise agreed between the parties, they may use sensitive information only to implement the Agreement.

The beneficiaries may disclose sensitive information to their personnel or other participants involved in the action only if they:

   (a) need to know it in order to implement the Agreement and

   (b) are bound by an obligation of confidentiality.

The granting authority may disclose sensitive information to its staff and to other EU institutions and bodies.

It may moreover disclose sensitive information to third parties, if:

(a) this is necessary to implement the Agreement or safeguard the EU financial interests and

(b) the recipients of the information are bound by an obligation of confidentiality.

The confidentiality obligations no longer apply if:

(a) the disclosing party agrees to release the other party

(b) the information becomes publicly available, without breaching any confidentiality obligation

(c) the disclosure of the sensitive information is required by EU, international or national law.

Specific confidentiality rules (if any) are set out in Annex 5.

13.2   Classified information

The parties must handle classified information in accordance with the applicable EU, international or national law on classified information (in particular, Decision 2015/444[12] and its implementing rules).

Deliverables which contain classified information must be submitted according to special procedures agreed with the granting authority.

Action tasks involving classified information may be subcontracted only after explicit approval (in writing) from the granting authority.

Classified information may not be disclosed to any third party (including participants involved in the action implementation) without prior explicit written approval from the granting authority.

Specific security rules (if any) are set out in Annex 5.

13.3   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 14 — ETHICS AND VALUES

14.1   Ethics

The action must be carried out in line with the highest ethical standards and the applicable EU, international and national law on ethical principles.

Specific ethics rules (if any) are set out in Annex 5.

14.2   Values

The beneficiaries must commit to and ensure the respect of basic EU values (such as respect for

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[12] Commission Decision 2015/444/EC, Euratom of 13 March 2015 on the security rules for protecting EU classified information (OJ L 72, 17.3.2015, p. 53).

human dignity, freedom, democracy, equality, the rule of law and human rights, including the rights of minorities).

Specific rules on values (if any) are set out in Annex 5.

14.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 15 — DATA PROTECTION

15.1 Data processing by the granting authority

Any personal data under the Agreement will be processed under the responsibility of the data controller of the granting authority in accordance with and for the purposes set out in the Portal Privacy Statement.

For grants where the granting authority is the European Commission, an EU regulatory or executive agency, joint undertaking or other EU body, the processing will be subject to Regulation 2018/1725[13].

15.2 Data processing by the beneficiaries

The beneficiaries must process personal data under the Agreement in compliance with the applicable EU, international and national law on data protection (in particular, Regulation 2016/679[14]).

They must ensure that personal data is:

- processed lawfully, fairly and in a transparent manner in relation to the data subjects

- collected for specified, explicit and legitimate purposes and not further processed in a manner that is incompatible with those purposes

- adequate, relevant and limited to what is necessary in relation to the purposes for which they are processed

- accurate and, where necessary, kept up to date

- kept in a form which permits identification of data subjects for no longer than is necessary for the purposes for which the data is processed and

- processed in a manner that ensures appropriate security of the data.

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[13] Regulation (EU) 2018/1725 of the European Parliament and of the Council of 23 October 2018 on the protection of natural persons with regard to the processing of personal data by the Union institutions, bodies, offices and agencies and on the free movement of such data, and repealing Regulation (EC) No 45/2001 and Decision No 1247/2002/EC (OJ L 295, 21.11.2018, p. 39).

[14] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC ('GDPR') (OJ L 119, 4.5.2016, p. 1).

The beneficiaries may grant their personnel access to personal data only if it is strictly necessary for implementing, managing and monitoring the Agreement. The beneficiaries must ensure that the personnel is under a confidentiality obligation.

The beneficiaries must inform the persons whose data are transferred to the granting authority and provide them with the Portal Privacy Statement.

15.3 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 16 — INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS —ACCESS RIGHTS AND RIGHTS OF USE

16.1 Background and access rights to background

The beneficiaries must give each other and the other participants access to the background identified as needed for implementing the action, subject to any specific rules in Annex 5.

'Background' means any data, know-how or information — whatever its form or nature (tangible or intangible), including any rights such as intellectual property rights — that is:

(a) held by the beneficiaries before they acceded to the Agreement and

(b) needed to implement the action or exploit the results.

If background is subject to rights of a third party, the beneficiary concerned must ensure that it is able to comply with its obligations under the Agreement.

16.2 Ownership of results

The granting authority does not obtain ownership of the results produced under the action.

'Results' means any tangible or intangible effect of the action, such as data, know-how or information, whatever its form or nature, whether or not it can be protected, as well as any rights attached to it, including intellectual property rights.

16.3 Rights of use of the granting authority on materials, documents and information received for policy, information, communication, dissemination and publicity purposes

The granting authority has the right to use non-sensitive information relating to the action and materials and documents received from the beneficiaries (notably summaries for publication, deliverables, as well as any other material, such as pictures or audio-visual material, in paper or electronic form) for policy information, communication, dissemination and publicity purposes — during the action or afterwards.

The right to use the beneficiaries' materials, documents and information is granted in the form of a royalty-free, non-exclusive and irrevocable licence, which includes the following rights:

(a) **use for its own purposes** (in particular, making them available to persons working for the granting authority or any other EU service (including institutions, bodies, offices, agencies, etc.) or EU Member State institution or body; copying or reproducing them in whole or in part, in unlimited numbers; and communication through press information services)

(b) **distribution to the public** (in particular, publication as hard copies and in electronic or digital format, publication on the internet, as a downloadable or non-downloadable file, broadcasting by any channel, public display or presentation, communicating through press information services, or inclusion in widely accessible databases or indexes)

(c) **editing or redrafting** (including shortening, summarising, inserting other elements (e.g. meta-data, legends, other graphic, visual, audio or text elements), extracting parts (e.g. audio or video files), dividing into parts, use in a compilation)

(d) **translation**

(e) **storage** in paper, electronic or other form

(f) **archiving**, in line with applicable document-management rules

(g) the right to authorise **third parties** to act on its behalf or sub-license to third parties the modes of use set out in Points (b), (c), (d) and (f), if needed for the information, communication and publicity activity of the granting authority and

(h) **processing**, analysing, aggregating the materials, documents and information received and **producing derivative works**.

The rights of use are granted for the whole duration of the industrial or intellectual property rights concerned.

If materials or documents are subject to moral rights or third party rights (including intellectual property rights or rights of natural persons on their image and voice), the beneficiaries must ensure that they comply with their obligations under this Agreement (in particular, by obtaining the necessary licences and authorisations from the rights holders concerned).

Where applicable, the granting authority will insert the following information:

"© – [year] – [name of the copyright owner]. All rights reserved. Licensed to the [name of granting authority] under conditions."

16.4   Specific rules on IPR, results and background

Specific rules regarding intellectual property rights, results and background (if any) are set out in Annex 5.

16.5   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

ARTICLE 17 — COMMUNICATION, DISSEMINATION AND VISIBILITY

17.1   Communication — Dissemination — Promoting the action

Unless otherwise agreed with the granting authority, the beneficiaries must promote the action and its results by providing targeted information to multiple audiences (including the media and the public), in accordance with Annex 1 and in a strategic, coherent and effective manner.

Before engaging in a communication or dissemination activity expected to have a major media impact, the beneficiaries must inform the granting authority.

17.2   Visibility — European flag and funding statement

Unless otherwise agreed with the granting authority, communication activities of the beneficiaries related to the action (including media relations, conferences, seminars, information material, such as brochures, leaflets, posters, presentations, etc., in electronic form, via traditional or social media, etc.), dissemination activities and any infrastructure, equipment, vehicles, supplies or major result funded by the grant must acknowledge the EU support and display the European flag (emblem) and funding statement (translated into local languages, where appropriate):

Funded by the
European Union

Co-funded by the
European Union

Funded by the
European Union

Co-funded by the
European Union

The emblem must remain distinct and separate and cannot be modified by adding other visual marks, brands or text.

Apart from the emblem, no other visual identity or logo may be used to highlight the EU support.

When displayed in association with other logos (e.g. of beneficiaries or sponsors), the emblem must be displayed at least as prominently and visibly as the other logos.

For the purposes of their obligations under this Article, the beneficiaries may use the emblem without first obtaining approval from the granting authority. This does not, however, give them the right to

exclusive use. Moreover, they may not appropriate the emblem or any similar trademark or logo, either by registration or by any other means.

17.3 Quality of information — Disclaimer

Any communication or dissemination activity related to the action must use factually accurate information.

Moreover, it must indicate the following disclaimer (translated into local languages where appropriate):

> "Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or [name of the granting authority]. Neither the European Union nor the granting authority can be held responsible for them."

17.4 Specific communication, dissemination and visibility rules

Specific communication, dissemination and visibility rules (if any) are set out in Annex 5.

17.5 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 18 — SPECIFIC RULES FOR CARRYING OUT THE ACTION

18.1 Specific rules for carrying out the action

Specific rules for implementing the action (if any) are set out in Annex 5.

18.2 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such a breach may also lead to other measures described in Chapter 5.

SECTION 3   GRANT ADMINISTRATION

ARTICLE 19 — GENERAL INFORMATION OBLIGATIONS

19.1 Information requests

The beneficiaries must provide — during the action or afterwards and in accordance with Article 7 — any information requested in order to verify eligibility of the lump sum contributions declared, proper implementation of the action and compliance with the other obligations under the Agreement.

The information provided must be accurate, precise and complete and in the format requested, including electronic format.

19.2   Participant Register data updates

The beneficiaries must keep — at all times, during the action or afterwards — their information stored in the Portal Participant Register up to date, in particular, their name, address, legal representatives, legal form and organisation type.

19.3   Information about events and circumstances which impact the action

The beneficiaries must immediately inform the granting authority (and the other beneficiaries) of any of the following:

(a) **events** which are likely to affect or delay the implementation of the action or affect the EU's financial interests, in particular:

  (i) changes in their legal, financial, technical, organisational or ownership situation (including changes linked to one of the exclusion grounds listed in the declaration of honour signed before grant signature)

  (ii) linked action information: not applicable

(b) **circumstances** affecting:

  (i) the decision to award the grant or

  (ii) compliance with requirements under the Agreement.

19.4   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 20 — RECORD-KEEPING

20.1   Keeping records and supporting documents

The beneficiaries must — at least until the time-limit set out in the Data Sheet (see Point 6) — keep records and other supporting documents to prove the proper implementation of the action (proper implementation of the work and/or achievement of the results as described in Annex 1) in line with the accepted standards in the respective field (if any); beneficiaries do not need to keep specific records on the actual costs incurred.

The records and supporting documents must be made available upon request (see Article 19) or in the context of checks, reviews, audits or investigations (see Article 25).

If there are on-going checks, reviews, audits, investigations, litigation or other pursuits of claims under the Agreement (including the extension of findings; see Article 25), the beneficiaries must keep these records and other supporting documentation until the end of these procedures.

The beneficiaries must keep the original documents. Digital and digitalised documents are considered

originals if they are authorised by the applicable national law. The granting authority may accept non-original documents if they offer a comparable level of assurance.

20.2   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, lump sum contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 21 — REPORTING

21.1   Continuous reporting

The beneficiaries must continuously report on the progress of the action (e.g. **deliverables, milestones, outputs/outcomes, critical risks, indicators,** etc; if any), in the Portal Continuous Reporting tool and in accordance with the timing and conditions it sets out (as agreed with the granting authority).

Standardised deliverables (e.g. progress reports not linked to payments, reports on cumulative expenditure, special reports, etc; if any) must be submitted using the templates published on the Portal.

21.2   Periodic reporting: Technical reports and financial statements

In addition, the beneficiaries must provide reports to request payments, in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2):

-   for additional prefinancings (if any): **an additional prefinancing report**

-   for interim payments (if any) and the final payment: a **periodic report**

The prefinancing and periodic reports include a technical and financial part.

The technical part includes an overview of the action implementation. It must be prepared using the template available in the Portal Periodic Reporting tool.

The financial part of the additional prefinancing report includes a statement on the use of the previous prefinancing payment.

The financial part of the periodic report includes:

-   the financial statement (consolidated statement for the consortium)

-   the explanation on the use of resources (or detailed cost reporting table): not applicable

-   the certificates on the financial statements (CFS): not applicable.

The **financial statement** must contain the lump sum contributions indicated in Annex 2, for the work packages that were completed during the reporting period.

For the last reporting period, the beneficiaries may exceptionally also declare partial lump sum

contributions for work packages that were not completed (e.g. due to force majeure or technical impossibility).

Lump sum contributions which are not declared in a financial statement will not be taken into account by the granting authority.

By signing the financial statement (directly in the Portal Periodic Reporting tool), the coordinator confirms (on behalf of the consortium) that:

- the information provided is complete, reliable and true

- the lump sum contributions declared are eligible (in particular, the work packages have been completed, that the work has been properly implemented and/or the results were achieved in accordance with Annex 1; see Article 6)

- the proper implementation and/or achievement can be substantiated by adequate records and supporting documents (see Article 20) that will be produced upon request (see Article 19) or in the context of checks, reviews, audits and investigations (see Article 25).

In case of recoveries (see Article 22), beneficiaries will be held responsible also for the lump sum contributions declared for their affiliated entities (if any).

21.3 Currency for financial statements and conversion into euros

The financial statements must be drafted in euro.

21.4 Reporting language

The reporting must be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

21.5 Consequences of non-compliance

If a report submitted does not comply with this Article, the granting authority may suspend the payment deadline (see Article 29) and apply other measures described in Chapter 5.

If the coordinator breaches its reporting obligations, the granting authority may terminate the grant or the coordinator's participation (see Article 32) or apply other measures described in Chapter 5.

ARTICLE 22 — PAYMENTS AND RECOVERIES — CALCULATION OF AMOUNTS DUE

22.1 Payments and payment arrangements

Payments will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

They will be made in euro to the bank account indicated by the coordinator (see Data Sheet, Point 4.2) and must be distributed without unjustified delay (restrictions may apply to distribution of the initial prefinancing payment; see Data Sheet, Point 4.2).

Payments to this bank account will discharge the granting authority from its payment obligation.

The cost of payment transfers will be borne as follows:

- the granting authority bears the cost of transfers charged by its bank

- the beneficiary bears the cost of transfers charged by its bank

- the party causing a repetition of a transfer bears all costs of the repeated transfer.

Payments by the granting authority will be considered to have been carried out on the date when they are debited to its account.

22.2 Recoveries

Recoveries will be made, if — at beneficiary termination, final payment or afterwards — it turns out that the granting authority has paid too much and needs to recover the amounts undue.

The general liability regime for recoveries (first-line liability) is as follows: At final payment, the coordinator will be fully liable for recoveries, even if it has not been the final recipient of the undue amounts. At beneficiary termination or after final payment, recoveries will be made directly against the beneficiaries concerned.

Beneficiaries will be fully liable for repaying the debts of their affiliated entities.

In case of enforced recoveries (see Article 22.4):

- the beneficiaries will be jointly and severally liable for repaying debts of another beneficiary under the Agreement (including late-payment interest), if required by the granting authority (see Data Sheet, Point 4.4)

- affiliated entities will be held liable for repaying debts of their beneficiaries under the Agreement (including late-payment interest), if required by the granting authority (see Data Sheet, Point 4.4).

22.3 Amounts due

22.3.1 Prefinancing payments

The aim of the prefinancing is to provide the beneficiaries with a float.

It remains the property of the EU until the final payment.

For **initial prefinancings** (if any), the amount due, schedule and modalities are set out in the Data Sheet (see Point 4.2).

For **additional prefinancings** (if any), the amount due, schedule and modalities are also set out in the Data Sheet (see Point 4.2). However, if the statement on the use of the previous prefinancing payment shows that less than 70% was used, the amount set out in the Data Sheet will be reduced by the difference between the 70% threshold and the amount used.

Prefinancing payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency,

offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.2 Amount due at beneficiary termination — Recovery

In case of beneficiary termination, the granting authority will determine the provisional amount due for the beneficiary concerned.

This will be done on the basis of work packages already completed in previous interim payments. Payments for ongoing/not yet completed work packages which the beneficiary was working on before termination (if any) will therefore be made only later on, with the next interim or final payments when those work packages have been completed.

The **amount due** will be calculated in the following step:

> Step 1 — Calculation of the total accepted EU contribution

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the beneficiary, on the basis of the beneficiary's lump sum contributions for the work packages which were approved in previous interim payments.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution' for the beneficiary.

The **balance** is then calculated by deducting the payments received (if any; see report on the distribution of payments in Article 32), from the total accepted EU contribution:

> $\{$total accepted EU contribution for the beneficiary
>
> minus
>
> {prefinancing and interim payments received (if any)}$\}$.

If the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount due, the amount to be recovered and the reasons why and

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered and ask this amount to be paid to the coordinator (**confirmation letter**).

22.3.3 Interim payments

Interim payments reimburse the eligible lump sum contributions claimed for work packages implemented during the reporting periods (if any).

Interim payments (if any) will be made in accordance with the schedule and modalities set out the Data Sheet (see Point 4.2).

Payment is subject to the approval of the periodic report and the work packages declared. Their approval does not imply recognition of compliance, authenticity, completeness or correctness of their content.

Incomplete work packages and work packages that have not been delivered or cannot be approved will be rejected (see Article 27).

The **interim payment** will be calculated by the granting authority in the following steps:

> Step 1 — Calculation of the total accepted EU contribution
>
> Step 2 — Limit to the interim payment ceiling

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for the reporting period, by calculating the lump sum contributions for the approved work packages.

After that, the granting authority will take into account grant reductions from beneficiary termination (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the interim payment ceiling

The resulting amount is then capped to ensure that the total amount of prefinancing and interim payments (if any) does not exceed the interim payment ceiling set out in the Data Sheet (see Point 4.2).

Interim payments (or parts of them) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

22.3.4 Final payment — Final grant amount — Revenues and Profit — Recovery

The final payment (payment of the balance) reimburses the remaining eligible lump sum contributions claimed for the implemented work packages (if any).

The final payment will be made in accordance with the schedule and modalities set out in the Data Sheet (see Point 4.2).

Payment is subject to the approval of the final periodic report and the work packages declared. Their approval does not imply recognition of compliance, authenticity, completeness or correctness of their content.

Work packages (or parts of them) that have not been delivered or cannot be approved will be rejected (see Article 27).

The **final grant amount for the action** will be calculated in the following steps:

> Step 1 — Calculation of the total accepted EU contribution
>
> Step 2 — Limit to the maximum grant amount
>
> Step 3 — Reduction due to the no-profit rule

Step 1 — Calculation of the total accepted EU contribution

The granting authority will first calculate the 'accepted EU contribution' for the action for all reporting periods, by calculating the lump sum contributions for the approved work packages.

After that, the granting authority will take into account grant reductions (if any). The resulting amount is the 'total accepted EU contribution'.

Step 2 — Limit to the maximum grant amount

Not applicable

Step 3 — Reduction due to the no-profit rule

Not applicable

The **balance** (final payment) is then calculated by deducting the total amount of prefinancing and interim payments already made (if any), from the final grant amount:

> $\{$final grant amount
>
> minus
>
> {prefinancing and interim payments made (if any)}$\}$.

If the balance is **positive**, it will be **paid** to the coordinator.

The final payment (or part of it) may be offset (without the beneficiaries' consent) against amounts owed by a beneficiary to the granting authority — up to the amount due to that beneficiary.

For grants where the granting authority is the European Commission or an EU executive agency, offsetting may also be done against amounts owed to other Commission services or executive agencies.

Payments will not be made if the payment deadline or payments are suspended (see Articles 29 and 30).

If the balance is **negative**, it will be **recovered** in accordance with the following procedure:

The granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to recover, the final grant amount, the amount to be recovered and the reasons why

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered (**confirmation letter**), together with a **debit note** with the terms and date for payment.

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.3.5 Audit implementation after final payment — Revised final grant amount — Recovery

If — after the final payment (in particular, after checks, reviews, audits or investigations; see Article 25) — the granting authority rejects lump sum contributions (see Article 27) or reduces the grant (see Article 28), it will calculate the **revised final grant amount** for the beneficiary concerned.

The **beneficiary revised final grant amount** will be calculated in the following step:

Step 1 — Calculation of the revised total accepted EU contribution

Step 1 — Calculation of the revised total accepted EU contribution

The granting authority will first calculate the 'revised accepted EU contribution' for the beneficiary, by calculating the 'revised accepted contributions'.

After that, it will take into account grant reductions (if any). The resulting 'revised total accepted EU contribution' is the beneficiary revised final grant amount.

If the revised final grant amount is lower than the beneficiary's final grant amount (i.e. its share in the final grant amount for the action), it will be **recovered** in accordance with the following procedure:

The **beneficiary final grant amount** (i.e. share in the final grant amount for the action) is calculated as follows:

$$\{\{\text{total accepted EU contribution for the beneficiary}$$
$$\text{divided by}$$
$$\text{total accepted EU contribution for the action}\}$$
$$\text{multiplied by}$$
$$\text{final grant amount for the action}\}.$$

The granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to recover, the amount to be recovered and the reasons why and

- requesting observations within 30 days of receiving notification.

If no observations are submitted (or the granting authority decides to pursue recovery despite the observations it has received), it will confirm the amount to be recovered (**confirmation letter**), together with a **debit note** with the terms and the date for payment.

Recoveries against affiliated entities (if any) will be handled through their beneficiaries.

If payment is not made by the date specified in the debit note, the granting authority will **enforce recovery** in accordance with Article 22.4.

22.4 Enforced recovery

If payment is not made by the date specified in the debit note, the amount due will be recovered:

(a) by offsetting the amount — without the coordinator or beneficiary's consent — against any amounts owed to the coordinator or beneficiary by the granting authority.

In exceptional circumstances, to safeguard the EU financial interests, the amount may be offset before the payment date specified in the debit note.

For grants where the granting authority is the European Commission or an EU executive agency, debts may also be offset against amounts owed by other Commission services or executive agencies.

(b) by drawing on the financial guarantee(s) (if any)

(c) by holding other beneficiaries jointly and severally liable (if any; see Data Sheet, Point 4.4)

(d) by holding affiliated entities jointly and severally liable (if any, see Data Sheet, Point 4.4)

(e) by taking legal action (see Article 43) or, provided that the granting authority is the European Commission or an EU executive agency, by adopting an enforceable decision under Article 299 of the Treaty on the Functioning of the EU (TFEU) and Article 100(2) of EU Financial Regulation 2018/1046.

The amount to be recovered will be increased by **late-payment interest** at the rate set out in Article 23.5, from the day following the payment date in the debit note, up to and including the date the full payment is received.

Partial payments will be first credited against expenses, charges and late-payment interest and then against the principal.

Bank charges incurred in the recovery process will be borne by the beneficiary, unless Directive 2015/2366[15] applies.

For grants where the granting authority is an EU executive agency, enforced recovery by offsetting or enforceable decision will be done by the services of the European Commission (see also Article 43).

22.5 Consequences of non-compliance

22.5.1 If the granting authority does not pay within the payment deadlines (see above), the beneficiaries are entitled to **late-payment interest** at the reference rate applied by the European Central Bank (ECB) for its main refinancing operations in euros, plus the percentage specified in the Data Sheet (Point 4.2). The ECB reference rate to be used is the rate in force on the first day of the

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[15] Directive (EU) 2015/2366 of the European Parliament and of the Council of 25 November 2015 on payment services in the internal market, amending Directives 2002/65/EC, 2009/110/EC and 2013/36/EU and Regulation (EU) No 1093/2010, and repealing Directive 2007/64/EC (OJ L 337, 23.12.2015, p. 35).

month in which the payment deadline expires, as published in the C series of the *Official Journal of the European Union*.

If the late-payment interest is lower than or equal to EUR 200, it will be paid to the coordinator only on request submitted within two months of receiving the late payment.

Late-payment interest is not due if all beneficiaries are EU Member States (including regional and local government authorities or other public bodies acting on behalf of a Member State for the purpose of this Agreement).

If payments or the payment deadline are suspended (see Articles 29 and 30), payment will not be considered as late.

Late-payment interest covers the period running from the day following the due date for payment (see above), up to and including the date of payment.

Late-payment interest is not considered for the purposes of calculating the final grant amount.

22.5.2 If the coordinator breaches any of its obligations under this Article, the grant may be reduced (see Article 28) and the grant or the coordinator may be terminated (see Article 32).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 23 — GUARANTEES

23.1   Prefinancing guarantee

If required by the granting authority (see Data Sheet, Point 4.2), the beneficiaries must provide (one or more) prefinancing guarantee(s) in accordance with the timing and the amounts set out in the Data Sheet.

The coordinator must submit them to the granting authority in due time before the prefinancing they are linked to.

The guarantees must be drawn up using the template published on the Portal and fulfil the following conditions:

(a) be provided by a bank or approved financial institution established in the EU or — if requested by the coordinator and accepted by the granting authority — by a third party or a bank or financial institution established outside the EU offering equivalent security

(b) the guarantor stands as first-call guarantor and does not require the granting authority to first have recourse against the principal debtor (i.e. the beneficiary concerned) and

(c) remain explicitly in force until the final payment and, if the final payment takes the form of a recovery, until five months after the debit note is notified to a beneficiary.

They will be released within the following month.

23.2   Consequences of non-compliance

If the beneficiaries breach their obligation to provide the prefinancing guarantee, the prefinancing will not be paid.

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 24 — CERTIFICATES

Not applicable

ARTICLE 25 — CHECKS, REVIEWS, AUDITS AND INVESTIGATIONS — EXTENSION OF FINDINGS

25.1 Granting authority checks, reviews and audits

25.1.1 Internal checks

The granting authority may — during the action or afterwards — check the proper implementation of the action and compliance with the obligations under the Agreement, including assessing lump sum contributions, deliverables and reports.

25.1.2 Project reviews

The granting authority may carry out reviews on the proper implementation of the action and compliance with the obligations under the Agreement (general project reviews or specific issues reviews).

Such project reviews may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiary concerned and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent, outside experts. If it uses outside experts, the coordinator or beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The coordinator or beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information and data in addition to deliverables and reports already submitted. The granting authority may request beneficiaries to provide such information to it directly. Sensitive information and documents will be treated in accordance with Article 13.

The coordinator or beneficiary concerned may be requested to participate in meetings, including with the outside experts.

For **on-the-spot visits**, the beneficiary concerned must allow access to sites and premises (including to the outside experts) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the review findings, a **project review report** will be drawn up.

The granting authority will formally notify the project review report to the coordinator or beneficiary concerned, which has 30 days from receiving notification to make observations.

Project reviews (including project review reports) will be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

25.1.3 Audits

The granting authority may carry out audits on the proper implementation of the action and compliance with the obligations under the Agreement.

Such audits may be started during the implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the beneficiary concerned and will be considered to start on the date of the notification.

The granting authority may use its own audit service, delegate audits to a centralised service or use external audit firms. If it uses an external firm, the beneficiary concerned will be informed and have the right to object on grounds of commercial confidentiality or conflict of interest.

The beneficiary concerned must cooperate diligently and provide — within the deadline requested — any information (including complete accounts, individual salary statements or other personal data) to verify compliance with the Agreement. Sensitive information and documents will be treated in accordance with Article 13.

For **on-the-spot** visits, the beneficiary concerned must allow access to sites and premises (including for the external audit firm) and must ensure that information requested is readily available.

Information provided must be accurate, precise and complete and in the format requested, including electronic format.

On the basis of the audit findings, a **draft audit report** will be drawn up.

The auditors will formally notify the draft audit report to the beneficiary concerned, which has 30 days from receiving notification to make observations (contradictory audit procedure).

The **final audit report** will take into account observations by the beneficiary concerned and will be formally notified to them.

Audits (including audit reports) will be in the language of the Agreement, unless otherwise agreed with the granting authority (see Data Sheet, Point 4.2).

25.2 European Commission checks, reviews and audits in grants of other granting authorities

Where the granting authority is not the European Commission, the latter has the same rights of checks, reviews and audits as the granting authority.

25.3 Access to records for assessing simplified forms of funding

The beneficiaries must give the European Commission access to their statutory records for the periodic assessment of simplified forms of funding which are used in EU programmes.

25.4 OLAF, EPPO and ECA audits and investigations

The following bodies may also carry out checks, reviews, audits and investigations — during the action or afterwards:

- the European Anti-Fraud Office (OLAF) under Regulations No 883/2013[16] and No 2185/96[17]

- the European Public Prosecutor's Office (EPPO) under Regulation 2017/1939

- the European Court of Auditors (ECA) under Article 287 of the Treaty on the Functioning of the EU (TFEU) and Article 257 of EU Financial Regulation 2018/1046.

If requested by these bodies, the beneficiary concerned must provide full, accurate and complete information in the format requested (including complete accounts, individual salary statements or other personal data, including in electronic format) and allow access to sites and premises for on-the-spot visits or inspections — as provided for under these Regulations.

To this end, the beneficiary concerned must keep all relevant information relating to the action, at least until the time-limit set out in the Data Sheet (Point 6) and, in any case, until any ongoing checks, reviews, audits, investigations, litigation or other pursuits of claims have been concluded.

25.5   Consequences of checks, reviews, audits and investigations — Extension of findings

25.5.1 Consequences of checks, reviews, audits and investigations in this grant

Findings in checks, reviews, audits or investigations carried out in the context of this grant may lead to rejections (see Article 27), grant reduction (see Article 28) or other measures described in Chapter 5.

Rejections or grant reductions after the final payment will lead to a revised final grant amount (see Article 22).

Findings in checks, reviews, audits or investigations during the action implementation may lead to a request for amendment (see Article 39), to change the description of the action set out in Annex 1.

Checks, reviews, audits or investigations that find systemic or recurrent errors, irregularities, fraud or breach of obligations in any EU grant may also lead to consequences in other EU grants awarded under similar conditions ('extension to other grants').

Moreover, findings arising from an OLAF or EPPO investigation may lead to criminal prosecution under national law.

25.5.2 Extension from other grants

Findings of checks, reviews, audits or investigations in other grants may be extended to this grant, if:

(a) the beneficiary concerned is found, in other EU grants awarded under similar conditions, to

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[16] Regulation (EU, Euratom) No 883/2013 of the European Parliament and of the Council of 11 September 2013 concerning investigations conducted by the European Anti-Fraud Office (OLAF) and repealing Regulation (EC) No 1073/1999 of the European Parliament and of the Council and Council Regulation (Euratom) No 1074/1999 (OJ L 248, 18/09/2013, p. 1).

[17] Council Regulation (Euratom, EC) No 2185/96 of 11 November 1996 concerning on-the-spot checks and inspections carried out by the Commission in order to protect the European Communities' financial interests against fraud and other irregularities (OJ L 292, 15/11/1996, p. 2).

have committed systemic or recurrent errors, irregularities, fraud or breach of obligations that have a material impact on this grant and

(b) those findings are formally notified to the beneficiary concerned — together with the list of grants affected by the findings — within the time-limit for audits set out in the Data Sheet (see Point 6).

The granting authority will formally notify the beneficiary concerned of the intention to extend the findings and the list of grants affected.

If the extension concerns **rejections of lump sum contributions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings

(b) the request to submit revised financial statements for all grants affected

(c) the correction rate for extrapolation, established on the basis of the systemic or recurrent errors, to calculate the amounts to be rejected, if the beneficiary concerned:

   (i) considers that the submission of revised financial statements is not possible or practicable or

   (ii) does not submit revised financial statements.

If the extension concerns **grant reductions**: the notification will include:

(a) an invitation to submit observations on the list of grants affected by the findings and

(b) the **correction rate for extrapolation**, established on the basis of the systemic or recurrent errors and the principle of proportionality.

The beneficiary concerned has **60 days** from receiving notification to submit observations, revised financial statements or to propose a duly substantiated **alternative correction method/rate**.

On the basis of this, the granting authority will analyse the impact and decide on the implementation (i.e. start rejection or grant reduction procedures, either on the basis of the revised financial statements or the announced/alternative method/rate or a mix of those; see Articles 27 and 28).

25.6 Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, lump sum contributions insufficiently substantiated will be ineligible (see Article 6) and will be rejected (see Article 27), and the grant may be reduced (see Article 28).

Such breaches may also lead to other measures described in Chapter 5.

ARTICLE 26 — IMPACT EVALUATIONS

26.1 Impact evaluation

The granting authority may carry out impact evaluations of the action, measured against the objectives and indicators of the EU programme funding the grant.

Such evaluations may be started during implementation of the action and until the time-limit set out in the Data Sheet (see Point 6). They will be formally notified to the coordinator or beneficiaries and will be considered to start on the date of the notification.

If needed, the granting authority may be assisted by independent outside experts.

The coordinator or beneficiaries must provide any information relevant to evaluate the impact of the action, including information in electronic format.

26.2   Consequences of non-compliance

If a beneficiary breaches any of its obligations under this Article, the granting authority may apply the measures described in Chapter 5.

CHAPTER 5   CONSEQUENCES OF NON-COMPLIANCE

SECTION 1   REJECTIONS AND GRANT REDUCTION

ARTICLE 27 — REJECTION OF CONTRIBUTIONS

27.1   Conditions

The granting authority will — at interim payment, final payment or afterwards — reject any lump sum contributions which are ineligible (see Article 6), in particular following checks, reviews, audits or investigations (see Article 25).

The rejection may also be based on the extension of findings from other grants to this grant (see Article 25).

Ineligible lump sum contributions will be rejected.

27.2   Procedure

If the rejection does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the rejection, the amounts and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the rejection (payment review procedure).

If the rejection leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

27.3   Effects

If the granting authority rejects lump sum contributions, it will deduct them from the lump sum contributions declared and then calculate the amount due (and, if needed, make a recovery; see Article 22).

ARTICLE 28 — GRANT REDUCTION

28.1 Conditions

The granting authority may — at beneficiary termination, final payment or afterwards — reduce the grant for a beneficiary, if:

(a) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

(i) substantial errors, irregularities or fraud or

(ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) the beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings; see Article 25.5).

The amount of the reduction will be calculated for each beneficiary concerned and proportionate to the seriousness and the duration of the errors, irregularities or fraud or breach of obligations, by applying an individual reduction rate to their accepted EU contribution.

28.2 Procedure

If the grant reduction does not lead to a recovery, the granting authority will formally notify the coordinator or beneficiary concerned of the reduction, the amount to be reduced and the reasons why. The coordinator or beneficiary concerned may — within 30 days of receiving notification — submit observations if it disagrees with the reduction (payment review procedure).

If the grant reduction leads to a recovery, the granting authority will follow the contradictory procedure with pre-information letter set out in Article 22.

28.3 Effects

If the granting authority reduces the grant, it will deduct the reduction and then calculate the amount due (and, if needed, make a recovery; see Article 22).

SECTION 2   SUSPENSION AND TERMINATION

ARTICLE 29 — PAYMENT DEADLINE SUSPENSION

29.1 Conditions

The granting authority may — at any moment — suspend the payment deadline if a payment cannot be processed because:

(a) the required report (see Article 21) has not been submitted or is not complete or additional information is needed

(b) there are doubts about the amount to be paid (e.g. ongoing extension procedure, queries about eligibility, need for a grant reduction, etc.) and additional checks, reviews, audits or investigations are necessary, or

(c) there are other issues affecting the EU financial interests.

29.2   Procedure

The granting authority will formally notify the coordinator of the suspension and the reasons why.

The suspension will **take effect** the day the notification is sent.

If the conditions for suspending the payment deadline are no longer met, the suspension will be **lifted** — and the remaining time to pay (see Data Sheet, Point 4.2) will resume.

If the suspension exceeds two months, the coordinator may request the granting authority to confirm if the suspension will continue.

If the payment deadline has been suspended due to the non-compliance of the report and the revised report is not submitted (or was submitted but is also rejected), the granting authority may also terminate the grant or the participation of the coordinator (see Article 32).

ARTICLE 30 — PAYMENT SUSPENSION

30.1   Conditions

The granting authority may — at any moment — suspend payments, in whole or in part for one or more beneficiaries, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

   (i)   substantial errors, irregularities or fraud or

   (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings; see Article 25.5).

If payments are suspended for one or more beneficiaries, the granting authority will make partial payment(s) for the part(s) not suspended. If suspension concerns the final payment, the payment (or recovery) of the remaining amount after suspension is lifted will be considered to be the payment that closes the action.

30.2   Procedure

Before suspending payments, the granting authority will send a **pre-information letter** to the beneficiary concerned:

- formally notifying the intention to suspend payments and the reasons why and

- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

At the end of the suspension procedure, the granting authority will also inform the coordinator.

The suspension will **take effect** the day after the confirmation notification is sent.

If the conditions for resuming payments are met, the suspension will be **lifted**. The granting authority will formally notify the beneficiary concerned (and the coordinator) and set the suspension end date.

During the suspension, no prefinancing will be paid to the beneficiaries concerned. For interim payments, the periodic reports for all reporting periods except the last one (see Article 21) must not contain any financial statements from the beneficiary concerned (or its affiliated entities). The coordinator must include them in the next periodic report after the suspension is lifted or — if suspension is not lifted before the end of the action — in the last periodic report.

ARTICLE 31 — GRANT AGREEMENT SUSPENSION

31.1 Consortium-requested GA suspension

31.1.1 Conditions and procedure

The beneficiaries may request the suspension of the grant or any part of it, if exceptional circumstances — in particular *force majeure* (see Article 35) — make implementation impossible or excessively difficult.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the date the suspension takes effect; this date may be before the date of the submission of the amendment request and

- the expected date of resumption.

The suspension will **take effect** on the day specified in the amendment.

Once circumstances allow for implementation to resume, the coordinator must immediately request another **amendment** of the Agreement to set the suspension end date, the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the amendment. This date may be before the date of the submission of the amendment request.

During the suspension, no prefinancing will be paid. Moreover, no work may be done. Ongoing work packages must be interrupted and no new work packages may be started.

31.2 EU-initiated GA suspension

31.2.1 Conditions

The granting authority may suspend the grant or any part of it, if:

(a) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed or is suspected of having committed:

  (i) substantial errors, irregularities or fraud or

  (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.), or

(b) a beneficiary (or a person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings; see Article 25.5)

(c) other:

  (i) linked action issues: not applicable

  (ii) additional GA suspension grounds: not applicable.

31.2.2 Procedure

Before suspending the grant, the granting authority will send a **pre-information letter** to the coordinator:

- formally notifying the intention to suspend the grant and the reasons why and

- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the suspension (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

The suspension will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification).

Once the conditions for resuming implementation of the action are met, the granting authority will formally notify the coordinator a **lifting of suspension letter**, in which it will set the suspension end date and invite the coordinator to request an amendment of the Agreement to set the resumption date (one day after suspension end date), extend the duration and make other changes necessary to adapt the action to the new situation (see Article 39) — unless the grant has been terminated (see

Article 32). The suspension will be **lifted** with effect from the suspension end date set out in the lifting of suspension letter. This date may be before the date on which the letter is sent.

During the suspension, no prefinancing will be paid. Moreover, no work may be done. Ongoing work packages must be interrupted and no new work packages may be started.

The beneficiaries may not claim damages due to suspension by the granting authority (see Article 33).

Grant suspension does not affect the granting authority's right to terminate the grant or a beneficiary (see Article 32) or reduce the grant (see Article 28).

ARTICLE 32 — GRANT AGREEMENT OR BENEFICIARY TERMINATION

32.1 Consortium-requested GA termination

32.1.1 Conditions and procedure

The beneficiaries may request the termination of the grant.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the date the consortium ends work on the action ('end of work date') and

- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

The termination will **take effect** on the termination date specified in the amendment.

If no reasons are given or if the granting authority considers the reasons do not justify termination, it may consider the grant terminated improperly.

32.1.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the lump sum contributions for activities implemented before the end of work date (see Article 22). Partial lump sum contributions for work packages that were not completed (e.g. due to technical reasons) may exceptionally be taken into account.

If the granting authority does not receive the report within the deadline, only lump sum contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Improper termination may lead to a grant reduction (see Article 28).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.2 Consortium-requested beneficiary termination

32.2.1 Conditions and procedure

The coordinator may request the termination of the participation of one or more beneficiaries, on request of the beneficiary concerned or on behalf of the other beneficiaries.

The coordinator must submit a request for **amendment** (see Article 39), with:

- the reasons why

- the opinion of the beneficiary concerned (or proof that this opinion has been requested in writing)

- the date the beneficiary ends work on the action ('end of work date')

- the date the termination takes effect ('termination date'); this date must be after the date of the submission of the amendment request.

If the termination concerns the coordinator and is done without its agreement, the amendment request must be submitted by another beneficiary (acting on behalf of the consortium).

The termination will **take effect** on the termination date specified in the amendment.

If no information is given or if the granting authority considers that the reasons do not justify termination, it may consider the beneficiary to have been terminated improperly.

32.2.2 Effects

The coordinator must — within 60 days from when termination takes effect — submit:

(i) a **report on the distribution of payments** to the beneficiary concerned

(ii) a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work

(iii) a second **request for amendment** (see Article 39) with other amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the reports submitted in previous interim payments (i.e. beneficiary's lump sum contributions for completed and approved work packages).

Lump sum contributions for ongoing/not yet completed work packages will have to be included in the periodic report for the next reporting periods when those work packages have been completed.

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that

- the beneficiary concerned must not repay any amount to the coordinator.

If the second request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the second request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

Improper termination may lead to a reduction of the grant (see Article 31) or grant termination (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

32.3   EU-initiated GA or beneficiary termination

32.3.1 Conditions

The granting authority may terminate the grant or the participation of one or more beneficiaries, if:

(a) one or more beneficiaries do not accede to the Agreement (see Article 40)

(b) a change to the action or the legal, financial, technical, organisational or ownership situation of a beneficiary is likely to substantially affect the implementation of the action or calls into question the decision to award the grant (including changes linked to one of the exclusion grounds listed in the declaration of honour)

(c) following termination of one or more beneficiaries, the necessary changes to the Agreement (and their impact on the action) would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(d) implementation of the action has become impossible or the changes necessary for its continuation would call into question the decision awarding the grant or breach the principle of equal treatment of applicants

(e) a beneficiary (or person with unlimited liability for its debts) is subject to bankruptcy proceedings or similar (including insolvency, winding-up, administration by a liquidator or court, arrangement with creditors, suspension of business activities, etc.)

(f) a beneficiary (or person with unlimited liability for its debts) is in breach of social security or tax obligations

(g) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has been found guilty of grave professional misconduct

(h) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed fraud, corruption, or is involved in a criminal organisation, money laundering, terrorism-related crimes (including terrorism financing), child labour or human trafficking

(i) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) was created under a different jurisdiction with the intent to circumvent fiscal, social or other legal obligations in the country of origin (or created another entity with this purpose)

(j) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed:

   (i) substantial errors, irregularities or fraud or

   (ii) serious breach of obligations under this Agreement or during its award (including improper implementation of the action, non-compliance with the call conditions, submission of false information, failure to provide required information, breach of ethics or security rules (if applicable), etc.)

(k) a beneficiary (or person having powers of representation, decision-making or control, or person essential for the award/implementation of the grant) has committed — in other EU grants awarded to it under similar conditions — systemic or recurrent errors, irregularities, fraud or serious breach of obligations that have a material impact on this grant (extension of findings; see Article 25.5)

(l) despite a specific request by the granting authority, a beneficiary does not request — through the coordinator — an amendment to the Agreement to end the participation of one of its affiliated entities or associated partners that is in one of the situations under points (d), (f), (e), (g), (h), (i) or (j) and to reallocate its tasks, or

(m) other:

   (i) linked action issues: not applicable

   (ii) additional GA termination grounds: not applicable.

32.3.2 Procedure

Before terminating the grant or participation of one or more beneficiaries, the granting authority will send **a pre-information letter** to the coordinator or beneficiary concerned:

- formally notifying the intention to terminate and the reasons why and

- requesting observations within 30 days of receiving notification.

If the granting authority does not receive observations or decides to pursue the procedure despite the observations it has received, it will confirm the termination and the date it will take effect (**confirmation letter**). Otherwise, it will formally notify that the procedure is discontinued.

For beneficiary terminations, the granting authority will — at the end of the procedure — also inform the coordinator.

The termination will **take effect** the day after the confirmation notification is sent (or on a later date specified in the notification; 'termination date').

32.3.3 Effects

(a) for **GA termination**:

The coordinator must — within 60 days from when termination takes effect — submit a **periodic report** (for the last open reporting period until termination).

The granting authority will calculate the final grant amount and final payment on the basis of the report submitted and taking into account the lump sum contributions for activities implemented before termination takes effect (see Article 22). Partial lump sum contributions for work packages that were not completed (e.g. due to technical reasons) may exceptionally be taken into account.

If the grant is terminated for breach of the obligation to submit reports, the coordinator may not submit any report after termination.

If the granting authority does not receive the report within the deadline, only lump sum contributions which are included in an approved periodic report will be taken into account (no contributions if no periodic report was ever approved).

Termination does not affect the granting authority's right to reduce the grant (see Article 28) or to impose administrative sanctions (see Article 34).

The beneficiaries may not claim damages due to termination by the granting authority (see Article 33).

After termination, the beneficiaries' obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

(b) for **beneficiary termination**:

The coordinator must — within 60 days from when termination takes effect — submit:

  (i) a **report on the distribution of payments** to the beneficiary concerned

  (ii) a **termination report** from the beneficiary concerned, for the open reporting period until termination, containing an overview of the progress of the work

  (iii) a **request for amendment** (see Article 39) with any amendments needed (e.g. reallocation of the tasks and the estimated budget of the terminated beneficiary; addition of a new beneficiary to replace the terminated beneficiary; change of coordinator, etc.).

The granting authority will calculate the amount due to the beneficiary on the basis of the reports submitted in previous interim payments (i.e. beneficiary's lump sum contributions for completed and approved work packages).

Lump sum contributions for ongoing/not yet completed work packages will have to be included in the periodic report for the next reporting periods when those work packages have been completed.

If the granting authority does not receive the report on the distribution of payments within the deadline, it will consider that:

- the coordinator did not distribute any payment to the beneficiary concerned and that

- the beneficiary concerned must not repay any amount to the coordinator.

If the request for amendment is accepted by the granting authority, the Agreement is **amended** to introduce the necessary changes (see Article 39).

If the request for amendment is rejected by the granting authority (because it calls into question the decision awarding the grant or breaches the principle of equal treatment of applicants), the grant may be terminated (see Article 32).

After termination, the concerned beneficiary's obligations (in particular Articles 13 (confidentiality and security), 16 (IPR), 17 (communication, dissemination and visibility), 21 (reporting), 25 (checks, reviews, audits and investigations), 26 (impact evaluation), 27 (rejections), 28 (grant reduction) and 42 (assignment of claims)) continue to apply.

SECTION 3   OTHER CONSEQUENCES: DAMAGES AND ADMINISTRATIVE SANCTIONS

ARTICLE 33 — DAMAGES

33.1   Liability of the granting authority

The granting authority cannot be held liable for any damage caused to the beneficiaries or to third parties as a consequence of the implementation of the Agreement, including for gross negligence.

The granting authority cannot be held liable for any damage caused by any of the beneficiaries or other participants involved in the action, as a consequence of the implementation of the Agreement.

33.2   Liability of the beneficiaries

The beneficiaries must compensate the granting authority for any damage it sustains as a result of the implementation of the action or because the action was not implemented in full compliance with the Agreement, provided that it was caused by gross negligence or wilful act.

The liability does not extend to indirect or consequential losses or similar damage (such as loss of profit, loss of revenue or loss of contracts), provided such damage was not caused by wilful act or by a breach of confidentiality.

ARTICLE 34 — ADMINISTRATIVE SANCTIONS AND OTHER MEASURES

Nothing in this Agreement may be construed as preventing the adoption of administrative sanctions (i.e. exclusion from EU award procedures and/or financial penalties) or other public law measures, in addition or as an alternative to the contractual measures provided under this Agreement (see,

for instance, Articles 135 to 145 EU Financial Regulation 2018/1046 and Articles 4 and 7 of Regulation 2988/95[18]).

SECTION 4   FORCE MAJEURE

ARTICLE 35 — FORCE MAJEURE

A party prevented by force majeure from fulfilling its obligations under the Agreement cannot be considered in breach of them.

'Force majeure' means any situation or event that:

- prevents either party from fulfilling their obligations under the Agreement,

- was unforeseeable, exceptional situation and beyond the parties' control,

- was not due to error or negligence on their part (or on the part of other participants involved in the action), and

- proves to be inevitable in spite of exercising all due diligence.

Any situation constituting force majeure must be formally notified to the other party without delay, stating the nature, likely duration and foreseeable effects.

The parties must immediately take all the necessary steps to limit any damage due to force majeure and do their best to resume implementation of the action as soon as possible.

CHAPTER 6   FINAL PROVISIONS

ARTICLE 36 — COMMUNICATION BETWEEN THE PARTIES

36.1   Forms and means of communication — Electronic management

EU grants are managed fully electronically through the EU Funding & Tenders Portal ('Portal').

All communications must be made electronically through the Portal in accordance with the Portal Terms and Conditions and using the forms and templates provided there (except if explicitly instructed otherwise by the granting authority).

Communications must be made in writing and clearly identify the grant agreement (project number and acronym).

Communications must be made by persons authorised according to the Portal Terms and Conditions. For naming the authorised persons, each beneficiary must have designated — before the signature of this Agreement — a 'legal entity appointed representative (LEAR)'. The role and tasks of the LEAR are stipulated in their appointment letter (see Portal Terms and Conditions).

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[18] Council Regulation (EC, Euratom) No 2988/95 of 18 December 1995 on the protection of the European Communities financial interests (OJ L 312, 23.12.1995, p. 1).

If the electronic exchange system is temporarily unavailable, instructions will be given on the Portal.

36.2   Date of communication

The sending date for communications made through the Portal will be the date and time of sending, as indicated by the time logs.

The receiving date for communications made through the Portal will be the date and time the communication is accessed, as indicated by the time logs. Formal notifications that have not been accessed within 10 days after sending, will be considered to have been accessed (see Portal Terms and Conditions).

If a communication is exceptionally made on paper (by e-mail or postal service), general principles apply (i.e. date of sending/receipt). Formal notifications by registered post with proof of delivery will be considered to have been received either on the delivery date registered by the postal service or the deadline for collection at the post office.

If the electronic exchange system is temporarily unavailable, the sending party cannot be considered in breach of its obligation to send a communication within a specified deadline.

36.3   Addresses for communication

The Portal can be accessed via the Europa website.

The address for paper communications to the granting authority (if exceptionally allowed) is the official mailing address indicated on its website.

For beneficiaries, it is the legal address specified in the Portal Participant Register.

ARTICLE 37 — INTERPRETATION OF THE AGREEMENT

The provisions in the Data Sheet take precedence over the rest of the Terms and Conditions of the Agreement.

Annex 5 takes precedence over the Terms and Conditions.

The Terms and Conditions take precedence over the Annexes other than Annex 5.

Annex 2 takes precedence over Annex 1.

ARTICLE 38 — CALCULATION OF PERIODS AND DEADLINES

In accordance with Regulation No 1182/71[19], periods expressed in days, months or years are calculated from the moment the triggering event occurs.

The day during which that event occurs is not considered as falling within the period.

'Days' means calendar days, not working days.

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[19] Regulation (EEC, Euratom) No 1182/71 of the Council of 3 June 1971 determining the rules applicable to periods, dates and time-limits (OJ L 124, 8/6/1971, p. 1).

ARTICLE 39 — AMENDMENTS

39.1 Conditions

The Agreement may be amended, unless the amendment entails changes to the Agreement which would call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

Amendments may be requested by any of the parties.

39.2 Procedure

The party requesting an amendment must submit a request for amendment signed directly in the Portal Amendment tool.

The coordinator submits and receives requests for amendment on behalf of the beneficiaries (see Annex 3). If a change of coordinator is requested without its agreement, the submission must be done by another beneficiary (acting on behalf of the other beneficiaries).

The request for amendment must include:

- the reasons why

- the appropriate supporting documents and

- for a change of coordinator without its agreement: the opinion of the coordinator (or proof that this opinion has been requested in writing).

The granting authority may request additional information.

If the party receiving the request agrees, it must sign the amendment in the tool within 45 days of receiving notification (or any additional information the granting authority has requested). If it does not agree, it must formally notify its disagreement within the same deadline. The deadline may be extended, if necessary for the assessment of the request. If no notification is received within the deadline, the request is considered to have been rejected.

An amendment **enters into force** on the day of the signature of the receiving party.

An amendment **takes effect** on the date of entry into force or other date specified in the amendment.

ARTICLE 40 — ACCESSION AND ADDITION OF NEW BENEFICIARIES

40.1 Accession of the beneficiaries mentioned in the Preamble

The beneficiaries which are not coordinator must accede to the grant by signing the accession form (see Annex 3) directly in the Portal Grant Preparation tool, within 30 days after the entry into force of the Agreement (see Article 44).

They will assume the rights and obligations under the Agreement with effect from the date of its entry into force (see Article 44).

If a beneficiary does not accede to the grant within the above deadline, the coordinator must — within

30 days — request an amendment (see Article 39) to terminate the beneficiary and make any changes necessary to ensure proper implementation of the action. This does not affect the granting authority's right to terminate the grant (see Article 32).

40.2   Addition of new beneficiaries

In justified cases, the beneficiaries may request the addition of a new beneficiary.

For this purpose, the coordinator must submit a request for amendment in accordance with Article 39. It must include an accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool.

New beneficiaries will assume the rights and obligations under the Agreement with effect from the date of their accession specified in the accession form (see Annex 3).

Additions are also possible in mono-beneficiary grants.

ARTICLE 41 — TRANSFER OF THE AGREEMENT

In justified cases, the beneficiary of a mono-beneficiary grant may request the transfer of the grant to a new beneficiary, provided that this would not call into question the decision awarding the grant or breach the principle of equal treatment of applicants.

The beneficiary must submit a request for **amendment** (see Article 39), with

- the reasons why

- the accession form (see Annex 3) signed by the new beneficiary directly in the Portal Amendment tool and

- additional supporting documents (if required by the granting authority).

The new beneficiary will assume the rights and obligations under the Agreement with effect from the date of accession specified in the accession form (see Annex 3).

ARTICLE 42 — ASSIGNMENTS OF CLAIMS FOR PAYMENT AGAINST THE GRANTING AUTHORITY

The beneficiaries may not assign any of their claims for payment against the granting authority to any third party, except if expressly approved in writing by the granting authority on the basis of a reasoned, written request by the coordinator (on behalf of the beneficiary concerned).

If the granting authority has not accepted the assignment or if the terms of it are not observed, the assignment will have no effect on it.

In no circumstances will an assignment release the beneficiaries from their obligations towards the granting authority.

ARTICLE 43 — APPLICABLE LAW AND SETTLEMENT OF DISPUTES

43.1   Applicable law

The Agreement is governed by the applicable EU law, supplemented if necessary by the law of Belgium.

Special rules may apply for beneficiaries which are international organisations (if any; see Data Sheet, Point 5).

43.2 Dispute settlement

If a dispute concerns the interpretation, application or validity of the Agreement, the parties must bring action before the EU General Court — or, on appeal, the EU Court of Justice — under Article 272 of the Treaty on the Functioning of the EU (TFEU).

For non-EU beneficiaries (if any), such disputes must be brought before the courts of Brussels, Belgium — unless an international agreement provides for the enforceability of EU court judgements.

For beneficiaries with arbitration as special dispute settlement forum (if any; see Data Sheet, Point 5), the dispute will — in the absence of an amicable settlement — be settled in accordance with the Rules for Arbitration published on the Portal.

If a dispute concerns administrative sanctions, offsetting or an enforceable decision under Article 299 TFEU (see Articles 22 and 34), the beneficiaries must bring action before the General Court — or, on appeal, the Court of Justice — under Article 263 TFEU.

For grants where the granting authority is an EU executive agency (see Preamble), actions against offsetting and enforceable decisions must be brought against the European Commission (not against the granting authority; see also Article 22).

ARTICLE 44 — ENTRY INTO FORCE

The Agreement will enter into force on the day of signature by the granting authority or the coordinator, depending on which is later.

SIGNATURES

For the coordinator   For the granting authority

ANNEX 1

Erasmus+ (ERASMUS+)

Description of the action (DoA)

Part A

Part B

DESCRIPTION OF THE ACTION (PART A)

COVER PAGE

Part A of the Description of the Action (DoA) must be completed directly on the Portal Grant Preparation screens.

PROJECT	
Grant Preparation (General Information screen) — Enter the info.	
Project number:	101129077
Project name:	Capacity Building in Biomedical Engineering Education for Digital Transformation and Industry 4.0/5.0 Technologies
Project acronym:	BIOMED5.0
Call:	ERASMUS-EDU-2023-CBHE
Topic:	ERASMUS-EDU-2023-CBHE-STRAND-2
Type of action:	ERASMUS-LS
Service:	EACEA/A/04
Project starting date:	first day of the month following the entry into force date
Project duration:	36 months

TABLE OF CONTENTS

PROJECT SUMMARY

Project summary
Grant Preparation (General Information screen) — Provide an overall description of your project (including context and overall objectives, planned activities and main achievements, and expected results and impacts (on target groups, change procedures, capacities, innovation etc)). This summary should give readers a clear idea of what your project is about.
Use the project summary from your proposal.

BIOMED5.0 aims to establish an international partnership between Pakistani, Irish, and Romanian higher education institutions (HEIs) to modernize and transform Biomedical Engineering (BME) education. BIOMED5.0 objective is to incorporate digital transformation enabling Industry 4.0/5.0 technologies in BME bachelor and master programmes aiming at increasing students' understanding and knowledge in Industry 4.0/5.0 technologies and to upgrade teaching labs and introduce innovative Virtual Reality, Augmented Reality and Mixed Reality laboratory sessions for enhanced students learning experience. The project aims to foster collaboration between Knowledge Triangle players, promoting innovation and entrepreneurship.

To achieve these goals, BIOMED5.0 will revise the Programme Educational Objectives and Learning Outcomes for the targeted modules via stakeholder inputs. The project will develop and implement 6 new bachelor and master modules and introduce elements of Industry 4.0/5.0 technologies in 12 existing modules. 5 new micro-credential Open Online Courses (OOC) on Industry 4.0/5.0 will be introduced for professionals as life-long learning. BIOMED5.0 will develop VR/AR/MR based lab training sessions for diagnostic and therapeutic BME devices. The centre will act as a technology incubation hub to drive innovation and support entrepreneurship in BME and healthcare through providing access to fabrication labs and mentorship programmes.

BIOMED5.0 will benefit approximately 640 academic and 80 lab staff, over 10,000 BME bachelor and master students, 500 working/open to work professionals, and more than 80 entrepreneurs.

BIOMED5.0 will build the capacity of partner HEIs through trainings in Industry 4.0/5.0 technologies, transformative skills, and mental well-being to academic and lab staff, students, and entrepreneurs. BIOMED5.0 will increase awareness and adoption of digital transformation and BIOMED5.0 outcomes through comprehensive dissemination & communication efforts.

LIST OF PARTICIPANTS

PARTICIPANTS
Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
1	COO	MUET	MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY	PK	948276657
2	BEN	SSUET	SIR SYED UNIVERSITY OF ENGINEERINGAND TECHNOLOGY	PK	915845289
3	BEN	LUMHS	LIAQUAT UNIVERSITY OF MEDICAL AND HEALTH SCIENCES JAMSHORO	PK	883413630
4	BEN	SHU	SALIM HABIB UNIVERSITY	PK	883629746
5	BEN	ZU	ZIAUDDIN UNIVERSITY	PK	891803354
6	BEN	UETL	UNIVERSITY OF ENGINEERING AND TECHNOLOGY LAHORE	PK	881141696
7	BEN	BUETK	THE BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR	PK	887803074

PARTICIPANTS

Grant Preparation (Beneficiaries screen) — Enter the info.

Number	Role	Short name	Legal name	Country	PIC
8	BEN	UETT	UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA	PK	884685882
9	BEN	UTC	UNIVERSITATEA TEHNICA CLUJ-NAPOCA	RO	999897244
10	BEN	DCU	DUBLIN CITY UNIVERSITY	IE	999892588
11	BEN	PEC	PAKISTAN ENGINEERING COUNCIL	PK	881020640

LIST OF WORK PACKAGES

Work packages						
Grant Preparation (Work Packages screen) — Enter the info.						
Work Package No	**Work Package name**	**Lead Beneficiary**	**Effort (Person-Months)**	**Start Month**	**End Month**	**Deliverables**
WP1	Project Management and Quality Assurance	1 - MUET	169.00	1	36	D1.1 – A consolidated report on Project Quality Assurance and Communication Strategy D1.2 – Accreditation of Modernized Curricula by Academic Councils at HEIs
WP2	Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula	2 - SSUET	208.00	1	36	D2.1 – Resolutions of Curriculum Update and Revision Committee on Revised PEOs and LOs D2.2 – Report on incorporation of I4.0/5.0 technologies in BME curricula via new and updated modules D2.3 – Report on Open Online Courses developed for biomedical and healthcare professionals D2.4 – Report on feedback survey results from BME students
WP3	Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions	6 - UETL	392.00	1	36	D3.1 – Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions D3.2 – Report on procurement of lab equipment and corresponding lab designs in partner HEIs D3.3 – VR, AR and MR based lab sessions
WP4	Centre of Excellence in Biomedical Engineering	4 - SHU	198.00	1	36	D4.1 – Project Interim Report D4.2 – Report on staff and student training

Work packages

Grant Preparation (Work Packages screen) — Enter the info.

Work Package No	Work Package name	Lead Beneficiary	Effort (Person-Months)	Start Month	End Month	Deliverables
WP5	Project Impact and Outreach: Dissemination, Communication and Exploitation	3 - LUMHS	119.00	1	36	D5.1 – Report on project assessment

Work package WP1 – Project Management and Quality Assurance

Work Package Number	WP1	Lead Beneficiary	1 - MUET
Work Package Name	Project Management and Quality Assurance		
Start Month	1	End Month	36

Objectives

SO1.1: to establish project Executive Committee for effective project governance and management plan with clear project vision, objectives and governance structure
SO1.2: to develop and implement a comprehensive Quality Assurance Plan ensuring project deliverables meet the required quality standards
SO1.3: to continuously assess project risks and develop and update risk mitigation plan, minimizing potential impacts on project milestones and outcomes
SO1.4: to facilitate effective collaboration and promote productive partnerships and teamwork among project partners for successful project delivery

Description

This work package focuses on the effective management and governance of the project with the aim of ensuring successful project delivery. The specific objectives of this work package include establishing a project executive committee for effective project governance and management, developing and implementing a comprehensive quality assurance plan to ensure that project deliverables meet the required quality standards, continuously assessing project risks and developing and updating a risk mitigation plan, and facilitating effective collaboration and promoting productive partnerships among project partners. The outcome of this work package will be a well-governed project that is delivered to a high standard and meets the needs of all stakeholders

Work package WP2 – Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula

Work Package Number	WP2	Lead Beneficiary	2 - SSUET
Work Package Name	Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula		
Start Month	1	End Month	36

Objectives

SO2.1: to review the list of targeted modules and update programme educational objectives via stakeholders inputs
SO2.2: to increase students' understanding of Industry 4.0/5.0 technologies by developing and implementing two new UG and three new PG modules
SO2.3: to modernise and update BME curricula by introducing elements of I4.0/5.0 technologies in existing five UG and seven PG modules
SO2.4: to introduce five micro-credential Open Online Courses (OOC) on I4.0/5.0 and digital transformation for working/open to work professionals as life long learning and
stay relevant in digital age

Description

The goal of this work package is to modernize and update the biomedical engineering curricula in Pakistani higher education institutions (HEIs) to meet the needs of the rapidly changing technological landscape. The specific objectives include reviewing and updating the list of targeted modules, increasing students' understanding of Industry 4.0/5.0 technologies through the development and implementation of new modules, and introducing elements of I4.0/5.0 technologies into existing modules. Additionally, this work package will introduce five micro-credential open online courses on I4.0/5.0 and digital transformation for working or open-to-work professionals. The outcome of this work

package will be a modernised and updated biomedical engineering curriculum that prepares students for the demands of the digital age.

Work package WP3 – Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions

Work Package Number	WP3	Lead Beneficiary	6 - UETL
Work Package Name	Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions		
Start Month	1	End Month	36

Objectives
SO3.1: to enhance BME UG and PG students competencies, skills and employability potential by providing hands-on training on state-of-the-art laboratory facilities SO3.2: to develop VR and AR based lab training sessions for diagnostic and therapeutic biomedical engineering devices SO3.3: to upgrade engineering teaching laboratories with the purchase of modern equipment required for incorporating digital transformation enabling I4.0/5.0 technologies

Description
The goal of this work package is to enhance the competencies, skills, and employability potential of BME students in partner HEIs. To achieve this objective, the specific objectives of this work package include providing hands-on training on state-of-the-art laboratory facilities, developing virtual reality (VR) and augmented reality (AR) based lab training sessions for diagnostic and therapeutic biomedical engineering devices, and upgrading engineering teaching laboratories with modern equipment to incorporate digital transformation technologies. By upgrading teaching lab facilities and providing VR and AR-based training sessions, this work package aims to ensure that BME students are well equipped to face the challenges of the future and are equipped with the necessary skills to succeed in the rapidly evolving digital landscape.

Work package WP4 – Centre of Excellence in Biomedical Engineering

Work Package Number	WP4	Lead Beneficiary	4 - SHU
Work Package Name	Centre of Excellence in Biomedical Engineering		
Start Month	1	End Month	36

Objectives
SO4.1: to establish Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among knowledge triangle players SO4.2: to build capacity of partner HEIs through training in Industry 4.0/5.0 technologies, transformative skills and mental well-being to academic and lab staff, students and entrepreneurs SO4.3: to create a technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare through providing access to fabrication labs and mentorship programs

Description
The objective of this work package is to establish a Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among the different players in

the knowledge triangle. The specific objectives of this work package include building the capacity of partner HEIs through training in Industry 4.0/5.0 technologies, transformative skills, and mental well-being for academic and lab staff, students, and entrepreneurs, and creating a
technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare by providing access to fabrication labs and mentorship programs. By achieving these objectives, this work package aims to promote the development of new biomedical technologies and support the growth of entrepreneurship in the field, ensuring that Pakistan remains at the forefront of
innovation in the biomedical engineering sector.

Work package WP5 – Project Impact and Outreach: Dissemination, Communication and Exploitation

Work Package Number	WP5	Lead Beneficiary	3 - LUMHS
Work Package Name	Project Impact and Outreach: Dissemination, Communication and Exploitation		
Start Month	1	End Month	36

Objectives
SO5.1: to develop and implement a comprehensive dissemination, communication and exploitation plan to maximise the BIOMED5.0 impact and outcomes SO5.2: to increase awareness and adoption of digital transformation and BIOMED5.0 outcomes through efforts of a Societal Impact Champion SO5.3: to utilize digital media, organize annual conferences and participate in relevant international events engaging key stakeholders and promoting BIOMED5.0 benefits and outcomes

Description
The aim of this work package is to maximise the impact and outcomes of the BIOMED5.0 project through effective dissemination, communication, and exploitation efforts. The specific objectives of this work package include developing and implementing a comprehensive dissemination, communication, and exploitation plan, establishing a copyright policy to manage the intellectual property produced during the project, increasing awareness and adoption of digital transformation and BIOMED5.0 outcomes through the efforts of a societal impact champion, and utilizing digital media, organizing annual conferences, and participating in relevant international events to engage key stakeholders and promote the benefits and outcomes of the BIOMED5.0 project. By achieving these objectives, this work package aims to ensure that the results of the BIOMED5.0 project are effectively communicated and adopted, ensuring the long-term sustainability and impact of the project.

STAFF EFFORT

Staff effort per participant

Grant Preparation (Work packages - Effort screen) — Enter the info.

Participant	WP1	WP2	WP3	WP4	WP5	Total Person-Months
1 - MUET	78.00	72.00	96.00	36.00	24.00	306.00
2 - SSUET	9.00	36.00	11.00	6.00	6.00	68.00
3 - LUMHS	16.00	36.00	30.00	6.00	40.00	128.00
4 - SHU	36.00	12.00	36.00	72.00	6.00	162.00
5 - ZU	3.00	12.00	69.00	10.00	6.00	100.00
6 - UETL	6.00	6.00	93.00	3.00	3.00	111.00
7 - BUETK	3.00	18.00	18.00	12.00	18.00	69.00
8 - UETT	6.00	7.00	31.00	42.00	10.00	96.00
9 - UTC	3.00	2.00	1.00	3.00	2.00	11.00
10 - DCU	6.00	6.00	6.00	5.00	3.00	26.00
11 - PEC	3.00	1.00	1.00	3.00	1.00	9.00
Total Person-Months	169.00	208.00	392.00	198.00	119.00	1086.00

LIST OF DELIVERABLES

Deliverables
Grant Preparation (Deliverables screen) — Enter the info.
The labels used mean:
Public — fully open (⚠ automatically posted online)   *Sensitive — limited under the conditions of the Grant Agreement*   *EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444*

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D1.1	A consolidated report on Project Quality Assurance and Communication Strategy	WP1	1 - MUET	R — Document, report	SEN - Sensitive	4
D1.2	Accreditation of Modernized Curricula by Academic Councils at HEIs	WP1	1 - MUET	R — Document, report	SEN - Sensitive	24
D2.1	Resolutions of Curriculum Update and Revision Committee on Revised PEOs and LOs	WP2	2 - SSUET	R — Document, report	SEN - Sensitive	2
D2.2	Report on incorporation of I4.0/5.0 technologies in BME curricula via new and updated modules	WP2	2 - SSUET	R — Document, report	SEN - Sensitive	18
D2.3	Report on Open Online Courses developed for biomedical and healthcare professionals	WP2	1 - MUET	R — Document, report	SEN - Sensitive	18
D2.4	Report on feedback survey results from BME students	WP2	1 - MUET	R — Document, report	SEN - Sensitive	36
D3.1	Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions	WP3	6 - UETL	R — Document, report	SEN - Sensitive	2
D3.2	Report on procurement of lab equipment and corresponding lab designs in partner HEIs	WP3	4 - SHU	R — Document, report	SEN - Sensitive	12

Deliverables

Grant Preparation (Deliverables screen) — Enter the info.

The labels used mean:

Public — fully open (⚠ automatically posted online)

Sensitive — limited under the conditions of the Grant Agreement

EU classified —RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444

Deliverable No	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month)
D3.3	VR, AR and MR based lab sessions	WP3	6 - UETL	DEM — Demonstrator, pilot, prototype	SEN - Sensitive	18
D4.1	Project Interim Report	WP4	1 - MUET	R — Document, report	SEN - Sensitive	18
D4.2	Report on staff and student training	WP4	4 - SHU	R — Document, report	SEN - Sensitive	24
D5.1	Report on project assessment	WP5	3 - LUMHS	R — Document, report	SEN - Sensitive	36

Deliverable D1.1 – A consolidated report on Project Quality Assurance and Communication Strategy

Deliverable Number	D1.1	Lead Beneficiary	1 - MUET
Deliverable Name	A consolidated report on Project Quality Assurance and Communication Strategy		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	4	Work Package No	WP1

Description
This report will provide detailed information on Executive Committee establishment and a review of workplan. A complete administrative structure of the project teams (rolled out in EC meeting) shall be documented. The report will provide a comprehensive reporting mechanism, execution plan and Quality Assurance Plan for the project. This report will provide a comprehensive details on how to roll out the QAP of the project.

Deliverable D1.2 – Accreditation of Modernized Curricula by Academic Councils at HEIs

Deliverable Number	D1.2	Lead Beneficiary	1 - MUET
Deliverable Name	Accreditation of Modernized Curricula by Academic Councils at HEIs		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP1

Description
A report on accreditation of modernized curricula by the Academic Councils, as supreme bodies at Higher Education Institutions (HEIs), is a critical milestone in the realm of curriculum design. This deliverable encompasses the comprehensive evaluation, endorsement, and approval process undertaken by the Academic Councils to validate and accredit the contemporary curriculum enhancements

Deliverable D2.1 – Resolutions of Curriculum Update and Revision Committee on Revised PEOs and LOs

Deliverable Number	D2.1	Lead Beneficiary	2 - SSUET
Deliverable Name	Resolutions of Curriculum Update and Revision Committee on Revised PEOs and LOs		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	2	Work Package No	WP2

Description
The report will provide detailed information on revised PEOs and LOs for incorporating digital transformation enabling I4.0/5.0 technologies. These revisions will be made on the basis of discussions between subject matter experts, IAB members and students and it will be aligned with needs assessment made at the proposal preparation stage of BIOMED5.0. Format: Electronic Report, approx. 10 pages

Deliverable D2.2 – Report on incorporation of I4.0/5.0 technologies in BME curricula via new and updated modules

Deliverable Number	D2.2	Lead Beneficiary	2 - SSUET
Deliverable Name	Report on incorporation of I4.0/5.0 technologies in BME curricula via new and updated modules		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	18	Work Package No	WP2

Description
The report will provide detailed information on how the updated PEOs and LOs are matched by introducing new modules and update of existing modules in UG and PG BME programme. Format: Electronic Report, approx. 15 pages Language: English

Deliverable D2.3 – Report on Open Online Courses developed for biomedical and healthcare professionals

Deliverable Number	D2.3	Lead Beneficiary	1 - MUET
Deliverable Name	Report on Open Online Courses developed for biomedical and healthcare professionals		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	18	Work Package No	WP2

Description
A detailed report on OOC developed for working and open to work professionals to improve digital literacy in biomedical and healthcare industries. Format: Electronic Report, approx. 20pages Language: English

Deliverable D2.4 – Report on feedback survey results from BME students

Deliverable Number	D2.4	Lead Beneficiary	1 - MUET
Deliverable Name	Report on feedback survey results from BME students		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	36	Work Package No	WP2

Description
This report will summarise the finding of the survey and how the results were used to improve the teaching contents, delivery style and assessment modes for UG and PG BME programme. Format: Electronic Report, approx. 30 pages Language: English

Deliverable D3.1 – Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions

Deliverable Number	D3.1	Lead Beneficiary	6 - UETL
Deliverable Name	Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	2	Work Package No	WP3

Description
This report will provide detailed information on goals and objectives of the working group and planned activities and responsibilities. The report will provide a comprehensive map and framework between the PEOs and LOs matched with the proposed new lab sessions. Format: Electronic report, approx. 20 pages. Language: English

Deliverable D3.2 – Report on procurement of lab equipment and corresponding lab designs in partner HEIs

Deliverable Number	D3.2	Lead Beneficiary	4 - SHU
Deliverable Name	Report on procurement of lab equipment and corresponding lab designs in partner HEIs		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	12	Work Package No	WP3

Description
The report will provide detailed information on capacity building, lab facility upgradation and staff training on purchased equipment in each partner country HEI. Report will provide detailed information on the designed lab manuals. Format: Electronic report, approx. 30 pages plus lab manuals as annexures Language: English

Deliverable D3.3 – VR, AR and MR based lab sessions

Deliverable Number	D3.3	Lead Beneficiary	6 - UETL
Deliverable Name	VR, AR and MR based lab sessions		
Type	DEM — Demonstrator, pilot, prototype	Dissemination Level	SEN - Sensitive
Due Date (month)	18	Work Package No	WP3

Description
Executable files for installation of developed VR/AR/MR applications on headsets and electronic devices (smartphones). Format: VR/AR executable files

Deliverable D4.1 – Project Interim Report

Deliverable Number	D4.1	Lead Beneficiary	1 - MUET
Deliverable Name	Project Interim Report		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	18	Work Package No	WP4

Description
These interim report shall provide comprehensive information on the activities performed by the project teams till M18. Details about the establishment of CoE in Biomedical Engineering and establishment of FAB LABs at partner HEIs will also be included in the interim report. Format: Electronic Report, approx. 20 pages Language: English

Deliverable D4.2 – Report on staff and student training

Deliverable Number	D4.2	Lead Beneficiary	4 - SHU
Deliverable Name	Report on staff and student training		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	24	Work Package No	WP4

Description
This report will provide comprehensive information on the events organised for staff and students training, hackathons and seminars. Format: Electronic Report, approx. 20 pages Language: English

Deliverable D5.1 – Report on project assessment

Deliverable Number	D5.1	Lead Beneficiary	3 - LUMHS
Deliverable Name	Report on project assessment		
Type	R — Document, report	Dissemination Level	SEN - Sensitive
Due Date (month)	36	Work Package No	WP5

Description
This report will provide a comprehensive evaluation of the BIOMED5.0 project's impact on biomedical engineering education in Pakistan, specifically focusing on the modernisation of curricula, implementation of virtual reality sessions, improvement of teaching lab facilities, establishment of a Centre of Excellence, and capacity building efforts. The report will present the findings from the six case studies conducted to assess the BIOMED5.0 project's overall impact and achievements. Format: Electronic report, approx.40 pages Language: English

LIST OF MILESTONES

Milestones					
Grant Preparation (Milestones screen) — Enter the info.					

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
1	EC establishment and responsibility matrix is developed	WP1	1 - MUET	Minutes of the meeting; Appointment of Project Manager. Work plan executed and deliverables produced on-time.	1
2	Quality assurance and collaboration activities performed	WP1	1 - MUET	Appointment of QM and successful project evaluation for quality assurance.	36
3	PEOs and LOs revised to incorporate I4.0/5.0 in BME curricula	WP2	2 - SSUET	Structured map of PEOs and LOs matching the proposed changes and updated curricula is available	2
4	New modules developed and approved by PEC for UG and PG programme	WP2	2 - SSUET	New modules are added into programme guide in partner HEIs.	18
5	Selected existing modules are revised and ready for delivery	WP2	2 - SSUET	Delivery of updated modules in partner country HEIs	18
6	Completion of development of life-long learning Open Online Courses (OOC) on digital transformation and I4.0/5.0 in biomedical engineering and healthcare	WP2	1 - MUET	Availability of the developed OOC on MOOC	18
7	Successful pilot implementation of updated and revised BME Curricula and short courses with positive feedback	WP2	2 - SSUET	WP2 deliverables submitted. Engineering students equipped with essential skills to lead digital transformation using Industry 4.0/5.0 technologies	36
8	Inception of BIOMED5.0 Labs Working Group	WP3	6 - UETL	Report on terms of reference and responsibilities of the group	2
9	PEOs and LOs revision completed for upgrading lab sessions	WP3	6 - UETL	Report on mapping PEOs and LOs with proposed new lab sessions	2

Milestones

Grant Preparation (Milestones screen) — Enter the info.

Milestone No	Milestone Name	Work Package No	Lead Beneficiary	Means of Verification	Due Date (month)
10	Procurement of lab equipment completed	WP3	4 - SHU	Lab staff training completed on procured equipment.	9
11	VR, AR and physical practical sessions developed, implemented and improved	WP3	6 - UETL	Number of students trained and educated using the developed lab sessions	36
12	Centre of Excellence established at MUET	WP4	1 - MUET	Vision and mission statements, meeting minutes of SC.	12
13	Establishment of Fab Lab at partner HEIs	WP4	4 - SHU	Fab lab facilities are available to use by academics, students and entrepreneurs	12
14	Staff and students training events and hackathon successfully completed	WP4	4 - SHU	Staff training reports	36
15	Dissemination, communication and exploitation plan developed	WP5	3 - LUMHS	Project website is ready and planned WP5 activities are updated on the website.	3
16	Copyright policy and intellectual property management plan approved	WP5	7 - BUETK	Digital platform is made available (e.g. in the form of Google drive) to share the teaching contents.	2
17	Societal Impact Champion is appointed	WP5	3 - LUMHS	Onboarding of the Digital Transformation Societal Impact Champion for Education And Public Engagement (EPE) activities	2
18	EPE, stakeholder engagement activities and annual conferences are organized	WP5	3 - LUMHS	Planned activities are performed in timely manner	36

LIST OF CRITICAL RISKS

Critical risks & risk management strategy			
Grant Preparation (Critical Risks screen) — Enter the info.			
Risk number	**Description**	**Work Package No(s)**	**Proposed Mitigation Measures**
1	The developing world is contending with new educational trends. An inappropriate strategy towards adoption of digitalization in the curriculum of Biomedical Engineering program offered at HEIs at partner countries, can be catastrophic. Severity = High Likelihood = Low (due to strategy)	WP1	The strategic risk assessment process is tailored to the Specific Objectives (SOs) of the project. The initial step in the assessment process was based on deep understanding of the SOs. Through this process we have already established a foundation for integrating risk management with the strategy of the project.
2	Due to the slow process of approvals, schedule overrun may result in delay attainment of project objectives. Severity = Medium; Likelihood = Medium (Less Control)	WP1	The process of approval within HEIs of partner countries usually involve different authorities and is expected a time consuming process that usually results in delay. Nevertheless, through parallel scheduling of activities and proactive planning we have introduced a contingency plan so as to avoid lagging in schedule.
3	There is a risk that project may cost more than budgeted. Cost risk may lead to performance risk if cost overruns lead to reductions in scope or quality to try to stay within the baseline budget. Moreover, the instability in foreign exchange prices may affect the budget and introduce cost risk. Severity = High; Likelihood = Medium (Less Control)	WP1	We shall initiate process of procurement preferably online as soon as we get funding approval. We shall avoid involvement of third party vendors and shall apply for educational discounts. Moreover, a foreign exchange account shall be opened so as to avoid any limitation towards payments to propriety manufacturer
4	Lack of collaboration among the project partners	WP1	Through strong follow up on project

Critical risks & risk management strategy			
Grant Preparation (Critical Risks screen) — Enter the info.			
Risk number	**Description**	**Work Package No(s)**	**Proposed Mitigation Measures**
	may result in delayed dissemination of work packages and low quality of deliverables. Severity = Medium; Likelihood = Low (due to strategy)		milestones and effective performance benchmarking we shall avoid performance risk. A strong feedback mechanism and follow up plan is chalked out. Realignment of activities to the SOs shall help improve performance of the project.
5	Non acceptance by the Curriculum Approval Bodies at Partner HEIs. Severity = Medium; Likelihood = Low (due to strategy)	WP2	We have already deliberated the proposed changes to existing modules and introduction to new modules with the senior faculty of partner HEIs and consensus is already achieved
6	Non acceptance by the Employer/Industry: This kind of risk occurs when industry/employer is not given a role in curriculum design/revision. Severity = High; Likelihood = Low (due to involvement of stakeholders)	WP2	We have already involved the IABs (Industrial Advisory Boards) of the partner HEIs in the process of curriculum revision at the HEIs. The revision to the existing modules and introduction of the new modules is now on agenda of the upcoming meeting of the IAB's of the partner HEIs.
7	Delay in procurement of laboratory equipment Severity = Medium; Likelihood = Low (through detailed knowledge of market/manufacturers)	WP3	We shall ensure detailed knowledge of the equipment market and thus will ensure smooth shipments and shorter lead times.
8	Inadequate training Severity = Low; Likelihood = Low (through sufficient training opportunities)	WP3	We have decided to develop training component for laboratory equipment to ensure sufficient means of faculty training on the equipment.
9	Delaying the use of new equipment leads to its underuse- faculty resistance to change teaching means (apparatus). Severity = Low; Likelihood = Low (due to sufficient means of training)	WP3	Through sufficient training we can avoid delay in adoption of new laboratory facilities in teaching and intern respond to the resistance to change by the faculty.

Critical risks & risk management strategy

Grant Preparation (Critical Risks screen) — Enter the info.

Risk number	Description	Work Package No(s)	Proposed Mitigation Measures
10	Risk of failure of Incubation centre due to challenging requirements of technological facilities for prototyping. Severity = Low; Likelihood = Low (due to sufficient means of training)	WP4	We have deliberated the requirement of establishment of a Centre of Excellence with state of the art prototyping facilities such as FABLAB- digital fabrication, 3D printing, 3D scanning, CNC /miller machines for variety of materials so as to provide a rapid prototyping facility for new entrepreneurial setup.
11	Risk of failure due to lack of Entrepreneurial skills: the management staff in incubators may not come from an entrepreneurial background, they seldom possess the ability to meet the skills requirement of their clients. Severity = Low; Likelihood = Low (due to sufficient means of training)	WP4	Managerial trainings shall be provided to the management staff of the incubation centres so as to extend managerial support to the startups housed.
12	Risk of failure due to limited awareness: If partners are not made aware of project progress, findings, and outcomes, they may not recognize the value of the project or its potential impact. Severity = Low; Likelihood = Low (due to sufficient means of awareness and outreach)	WP5	Awareness and outreach campaigns through social media shall help building support, engaging stakeholders, gathering feedback and fostering collaboration to avoid failures due to limited awareness among stakeholders resulting in less engagement.
13	Risk of failure due to failure in dissemination of project findings. This can result in missed opportunities for collaboration, partnerships, and additional funding. Severity = Low; Likelihood = Low (due to sufficient means of awareness and outreach)	WP5	Project's progress monitoring and reporting is one of the major responsibilities of QA Manager. Findings on project execution shall be reviewed in EC meeting scheduled bi-annually to ensure that no opportunities are missed, collaborative efforts are carried towards strengthening of partnerships and additional resources for the project success.

TECHNICAL DESCRIPTION (PART B)

COVER PAGE

Part B of the Application Form must be downloaded from the Portal Submission System, completed and then assembled and re-uploaded as PDF in the system. Page 1 with the grey IMPORTANT NOTICE box should be deleted before uploading.

Note: Please read carefully the conditions set out in the Call document/Programme Guide (for open calls: published on the Portal).Pay particular attention to the award criteria; they explain how the application will be evaluated.

PROJECT

Project name:	Capacity Building in Biomedical Engineering Education for Digital Transformation and Industry 4.0/5.0 Technologies
Project acronym:	BIOMED5.0
Coordinator contact:	Abdul Qadir Ansari, Mehran University of Engineering and Technology

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PROJECT SUMMARY

Project summary (in English)

BIOMED5.0 aims to establish an international partnership between Pakistani, Irish, and Romanian higher education institutions (HEIs) to modernize and transform Biomedical Engineering (BME) education. BIOMED5.0 objective is to incorporate digital transformation enabling Industry 4.0/5.0 technologies in BME bachelor and master programmes aiming at increasing students' understanding and knowledge in Industry 4.0/5.0 technologies and to upgrade teaching labs and introduce innovative Virtual Reality, Augmented Reality and Mixed Reality laboratory sessions for enhanced students learning experience. The project aims to foster collaboration between Knowledge Triangle players, promoting innovation and entrepreneurship.

To achieve these goals, BIOMED5.0 will revise the Programme Educational Objectives and Learning Outcomes for the targeted modules via stakeholder inputs. The project will develop and implement 6 new bachelor and master modules and introduce elements of Industry 4.0/5.0 technologies in 12 existing modules. 5 new micro-credential Open Online Courses (OOC) on Industry 4.0/5.0 will be introduced for

professionals as life-long learning. BIOMED5.0 will develop VR/AR/MR based lab training sessions for diagnostic and therapeutic BME devices. The centre will act as a technology incubation hub to drive innovation and support entrepreneurship in BME and healthcare through providing access to fabrication labs and mentorship programmes. BIOMED5.0 will benefit approximately 640 academic and 80 lab staff, over 10,000 BME bachelor and master students, 500 working/open to work professionals, and more than 80 entrepreneurs. BIOMED5.0 will build the capacity of partner HEIs through trainings in Industry 4.0/5.0 technologies, transformative skills, and mental wellbeing to academic and lab staff, students, and entrepreneurs. BIOMED5.0 will increase awareness and adoption of digital transformation and BIOMED5.0 outcomes through comprehensive dissemination & communication efforts.

#§PRJ-SUM-PS§# #@REL-EVA-RE@# #@PRJ-OBJ-PO@#

1. RELEVANCE

1.1 Background and general objectives

Background and general objectives

Please address all guiding points presented in the Call document/Programme Guide under the award criterion 'Relevance'.

Describe the background and rationale of the project.

How is the project relevant to the scope of the call? How does the project address the general objectives of the call? What is the project's contribution to the priorities of the call (if applicable)?

Purpose

Background and Project Rationale

BIOMED5.0 project is dedicated to fostering partnerships for digital transformation in biomedical engineering among Higher Educational Institutes (HEIs) in Pakistan, Ireland and Romania. In compliance with the funding call mandates, this project is aligned with the European Commission's overarching priority area in CBHE call "Digital transformation" for Pakistan (Region 5).

Digital Transformation (DT) is providing significant impact on industries and societies across the globe and enabling the integration of digital technologies into all areas of business and society. Industry 4.0 and 5.0 (I4.0/5.0) are group of enabling technologies for digital transformation, improving the quality of

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life by changing the way people live and work[1].

In particular, digital transformation is having a profound impact on healthcare, which is why it is essential to introduce these technologies into biomedical engineering education. Biomedical engineering is the major driver of digital

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[1] M. Golovianko, et.al. Procedia Comput. Sci., vol. 217, pp. 102–113, 2023, doi: 10.1016/j.procs.2022.12.206.

transformation in healthcare industry. The healthcare sector is undergoing significant changes, with digital technologies playing a crucial role in enabling better patient outcomes, improving efficiency, and reducing costs. From innovations in advanced diagnostic and therapeutic systems using additive manufacturing and cyber-physical system to telemedicine and electronic health records using big data and predictive analytics, I4.0/5.0 technologies are transforming the way healthcare is delivered. This is why it is essential for biomedical engineers to have strong understanding of I4.0/5.0 technologies and their applications in healthcare.

Biomedical engineering is a critical multidisciplinary field that combines engineering, life sciences, and medicine to develop innovative solutions for improving human health. As such, it is essential for biomedical engineers to be well-equipped with the knowledge and skills required to develop and implement digital solutions for healthcare. The integration of Industry 4.0 and 5.0 technologies into biomedical engineering curricula will enable students to acquire the skills required to develop and implement digital solutions for healthcare.

In Pakistan, Biomedical Engineering is among the popular engineering programme in higher education as the relevant medical equipment manufacturing, biomedical engineering services and healthcare sectors demand large workforce. However, currently the curriculum for undergraduate and postgraduate programmes do not teach Industry 4.0 and 5.0 technologies and the digital transformation potential these technologies can bring. In order to prepare the next generation of biomedical engineers to address the challenges presented by the rapidly evolving healthcare section and to make them future proof workforce, it is critical to incorporate digital transformation technologies into biomedical engineering curricula.

Digital transformation is also changing higher education by providing a dynamic, flexible and student-centered learning experience. Using Industry 4.0/5.0 digital technologies, a blended learning experience are being developed for students to access course content online and participate in virtual labs to gain experience in training on equipment where physical access is not available. Innovative pedagogies to deliver teaching contents in virtual, augmented and mixed reality (VR/AR/XR) are providing a more personalised on-demand learning experience to students with fewer opportunities. The use of digital tools is helping educators to prepare students for the rapidly evolving digital world and the skills and competencies they will need to succeed in the future.

To prepare engineering graduates for digital age and make them the leaders of digital transformation, education in transformative skills needs to be delivered to students so that they can drive innovation with the necessary critical thinking, decision making, resilience, value addition, and entrepreneurship skills[2].

With the rapid technology advancements (such as use of social media) and changing economic landscapes, the engineering students are facing several challenges in their mental health and well- being[3]. These challenges are resulting in Depression, Anxiety and Stress (DAS) leading to isolation, loneliness and low self-esteem. The critical challenge is lack of awareness regarding importance of mental health and well-being for academic success, thrive in future prospects and form positive relationships with their families, friends and teachers. Digital tools can use "gold-standard" psychological assessment methods and provide a private online platform for students to self-evaluate their mental wellbeing without disclosing their identity. On the basis of mental wellbeing assessment, a digital platform can provide information on general DAS coping mechanisms, support services available in HEIs, seeking support from family and friends and seeking help from mental health professionals when necessary.

For the HEIs in Pakistan, a comprehensive capacity building programme would be beneficial focusing on introducing digital transformation technologies in biomedical engineering curricula for bachelor and masters programmes, develop VR/AR based labs and teaching labs facilities to provide enhanced learning experience to students with fewer opportunities.

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[2] M. E. Ita, et. al Biomed. Eng. Educ., pp. 1–13, 2023, doi: 10.1007/s43683-022-00101-3
[3] A. Danowitz and K. Beddoes, IEEE Trans. Educ., vol. 65, no. 3, pp. 257–266, 2022, doi: 10.1109/TE.2022.3182626.

The major points on Strengths, Weaknesses, Opportunities and Threats (SWOT) gathered in the needs analysis performed have been presented in Figure 1.

Strengths	Weaknesses	Opportunities	Threats
• Strong expertise in DCU & TUCN in digital transformation, Industry4.0/5.0 and VR • Strong expertise in Pakistani HEIs in BME, curriculum development, VR & AR development • Existing collaboration among BIOMED5.0 in educational development projects • Excellent project management and quality assurance skills • Excellent communication and dissemination skills • Established links with all elements of knowledge triangle (academia, research and industry)	• Lack of digital transformation and Industry 4.0/5.0 elements in BME • Lack of trained academic staff on Industry 4.0/5.0 technologies • Lack of appropriate lab infrastructure • Challenges in procurement of high-end BME modalities • Limited experience in Pakistani HEI academics on innovative pedagogies • Lack of technology incubation platform for biomedical engineering entrepreneurs • Digital literacy gap in BME and healthcare professionals	• Growing demand for Industry 4.0/5.0 technologies in the biomedical engineering and healthcare sector • Growing need for modernizing higher education curricula to align with Industry 4.0/5.0 technologies • Growing trend of virtual and augmented reality based training in academia • Potential for collaboration with industry partners to drive innovation and entrepreneurship • Potential to reduce digital literacy gap and assistance towards digital transformation of society as a whole	• Unskilled BME engineering workforce for digital transformation • Left behind in competition with other disciplines in Industry 4.0/5.0 technologies • Rapid advancements in BME technology and healthcare systems change employment types and opportunities • Limited access to high-end equipment • Lack of entrepreneurship platform, mentorship opportunity and availability of fabrication labs limit innovation and creation of new start-ups

Figure 1 SWOT Analysis performed for incorporating Industry 4.0/5.0 technologies in BME curricula and fostering cooperation for entrepreneurship and innovation

Why BIOMED5.0 is focusing on Industry 4.0 and 5.0 for Digital Transformation

The manufacturing industry has undergone significant technological advancements in recent years, leading to the development of Industry 4.0. This concept refers to the integration of advanced technologies such as the Internet of Things (IoT), artificial intelligence (AI), and robotics into the manufacturing process, resulting in improved efficiency, productivity, and customization.

However, the European Commission recognized that Industry 4.0, while having its benefits, needed to go beyond just improved efficiency and productivity. This led to the introduction of Industry 5.0 in January 2021[4,5], a vision for a future-proof industry that places sustainability, resilience, and humancentricity at its core. Hence the European Commission's focus has shifted towards Industry 5.0, which seeks to create an industry that is not only technologically advanced but also socially responsible and resilient.

Therefore, to fully realise the potential of Industry 5.0, a comprehensive understanding of the various factors that contribute to or hinder its successful implementation is necessary in all sectors, particularly for healthcare and biomedical engineering. This requires a sociotechnical and multidisciplinary approach that takes into account the technological, social, and human aspects of the transition. By doing so, policies can be optimized to encourage the uptake of Industry 5.0 principles and facilitate their implementation. As noted, Industry 4.0 and 5.0 are sometimes used synonymously, the applicant group has prepared BIOMED5.0 using both terminologies for a better understanding and clarity.

General Objectives

The general objectives of BIOMED5.0 project are developed to address the scope and general objectives of the CBHE call and presented in the table below:

CBHE Call Scope and Objectives BIOMED5.0 General Objectives

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[4] European Commission, Directorate-General for Research and Innovation, Breque, M., De Nul, L., Petridis, A., Industry 5.0 : towards a sustainable, human-centric and resilient European industry, Publications Office, 2021, https://data.europa.eu/doi/10.2777/308407

[5] European Commission, Directorate-General for Research and Innovation, Renda, A., Schwaag Serger, S., Tataj, D., et al., Industry 5.0, a transformative vision for Europe : governing systemic transformations towards a sustainable industry, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2777/17322

Support international cooperation projects based on multilateral partnerships	Establish international cooperation between Pakistani, Irish and Romanian HEIs to foster collaboration on capacity building in biomedical engineering higher education
Support the relevance, quality, modernisation and responsiveness of higher education in Pakistani HEIs for socio-economic recovery, growth and prosperity	Modernize and update the Biomedical Engineering (BME) curricula by incorporating Industry 4.0/5.0 technologies in bachelor and master programmes Enhance BME students' competencies, skills, and employability potential through hands-on training using Virtual Reality, Augmented Reality and state-of-the-art laboratory facilities
Reacting to recent trends, in particular economic globalisation	Establish a Centre of Excellence in Biomedical Engineering and promote digital transformation in education, research, and industry.
Reacting to recent decline in human development, fragility, and rising social, economic and environmental inequalities exacerbated by the COVID-19 pandemic	Train academic staff, students and professionals on Industry 4.0/5.0 technologies in biomedical engineering and healthcare industries Disseminate and communicate the impact and outcomes of the BIOMED5.0 project to relevant stakeholders and increase awareness and adoption of digital transformation.

BIOMED5.0 contributions to the CBHE call priorities

BIOMED5.0 project will establish new "Partnerships for transformation in higher education" in order to develop "Innovation in higher education" aiming at "Digital Transformation" in biomedical engineering education. Specifically, BIOMED5.0 will contribute to the following call priorities mentioned in the CBHE call:

Address different state of advancement and challenges of HEIs, enhancing the impact of the programme

BIOMED5.0 will be modernizing and updating the Biomedical Engineering (BME) curricula, enhancing students' competencies and skills, establishing a Centre of Excellence in Biomedical Engineering, and promoting digital transformation in education, research, and industry. These objectives aim to have a significant and long-term impact on the targeted Higher Education Institutions (HEIs) beyond the projects' lifetime and as such, benefit the society as a whole.

Introducing new approaches and initiatives in higher education:

BIOMED5.0 will introduce new approaches by incorporating Industry 4.0/5.0 technologies in the BME curricula, providing hands-on training, and implementing VR and AR based lab training sessions. This will help to update and modernize the BME programs and increase students' understanding of Industry 4.0/5.0 technologies.

Strengthening the capacities of HEIs

BIOMED5.0 will upgrade teaching lab facilities, implementing virtual reality sessions, and creating a technology incubation hub. This will help to strengthen the capacities of the targeted HEIs to address the 21st century challenges.

Transfer of experience and good practice

BIOMED5.0 will organise training for Pakistani HEIs in EU programme countries (Ireland and Romania) in order to transfer experience, competencies, and good practice by providing hands-on training, implementing virtual reality sessions, and capacity building of partner HEIs. The project outcomes should have a significant and long-term impact on the targeted HEIs, and as such, benefit the society as a whole.

1.2   Needs analysis and specific objectives

Needs analysis and specific objectives

Please address the specific conditions/objectives set out in the Call document/ Programme Guide, if applicable.

Describe how the objectives of the project are based on a sound needs analysis in line with the specific objectives of the call. What issue/challenge/gap does the project aim to address?

The objectives should be clear, measureable, realistic and achievable within the duration of the project. For each objective, define appropriate indicators for measuring achievement (including a unit of measurement, baseline value and target value).

Needs Analysis

BIOMED5.0 partners organised in-person and online meetings to carefully perform a technical needs analysis on the requirements of digital transformation enabling Industry 4.0/5.0 in biomedical engineering educational programmes in Pakistan HEIs. This analysis was focused on the development of BME sector in Pakistan and identify opportunities where incorporation of Industry 4.0/5.0 is possible and how the demands of education, biomedical and healthcare sectors can be met to contribute to the economic and social development of the country.

The needs analysis performed based on the issues, challenges and gaps faced by the following target groups:

Higher Educational Institutes (HEIs)

HEIs in Pakistan are facing a major challenge in keeping up with the fast pace of technological advancements. To address this challenge, the institutes need to adopt new and innovative teaching methods, including the integration of digital technologies in the curriculum. Additionally, HEIs need to acquire the necessary infrastructure and equipment to support the integration of these technologies. The HEIs must collaborate with international countries with experience in digital transformation enabling Industry 4.0/5.0 technologies and implement the learning experience in Pakistan.

The current biomedical engineering curricula for bachelors and masters programmes in Pakistani HEIs briefly include some elements of advanced digital technologies in the modules associated with the following Programme Learning Outcomes: PLO-02: Problem Analysis; PLO-03: Design/Development of Solutions; PLO-05: Modern Tool Usage; PLO-07: Environment and Sustainability; PLO-12: Lifelong Learning. These technologies include artificial intelligence, modelling and simulation, digital image processing, advanced diagnostic and therapeutic devices. However the major Industry 4.0/5.0 technologies essential for digital transformation in healthcare delivery, such as additive manufacturing for personalised prosthesis, cyber physical systems for advanced robotic surgeries, Internet of Medical Things for wearables and next generation telemedicine, computer aided diagnostics need to be incorporated into the curricula. There is a strong demand from biomedical engineering and healthcare sectors to equip students in the use of Industry 4.0/5.0 technologies to lead Digital Transformation initiatives. Hence the BME curricula should be updated with modules providing practical skills in the use of Industry 4.0/5.0 to address real-world challenge with solutions aiming at digital transformation.

Major biomedical engineering therapeutic and diagnostic equipment (such as CT scan, MRI, LINAC systems etc.) are extremely expensive to procure for teaching labs in Pakistani HEIs. Most engineering HEIs are not linked to hospitals. The limitation in procurement of high-end biomedical engineering equipment is affecting the education quality.

By integrating digital technologies in biomedical engineering education, the partner HEIs can contribute to several of the United Nations Sustainable Development Goals, including good health and well-being, quality education, and responsible consumption and production.

Biomedical engineering academic staff members/educators/teachers and lab teaching staff

Academic staff members, educators, and lab teaching staff in biomedical engineering need to keep pace with the rapidly changing technological landscape. They require training and skill development programmes to acquire the Industry 4.0/5.0 skills which are needed to integrate digital technologies in their teaching and research. Additive manufacturing, smart manufacturing, cyber physical systems, rapid prototyping of medical devices, Internet of Medical Things and big data analysis are the major identified technologies where trainings could have both immediate and long term impacts on these professionals for teaching capacities, research and innovation activities and overall career advancements.

Biomedical engineering students

Students in biomedical engineering need to be equipped with the latest digital technologies to succeed in the rapidly changing biomedical and healthcare job markets. They need access to updated curricula, digital teaching tools, and practical experience in the use of Industry 4.0/5.0 technologies. BME students are facing challenges in gaining first-hand training and understanding of the working principles of high- end BME equipment, which is critical for their professional development in the field. The graduates lack practical experience with these devices.

Transformative skills are crucial for leaders of innovation, who will be driving the digital and sustainable transition of industry, economy and society. Mental health degradation and lack of awareness is increasingly becoming a concern for engineering students in Pakistan, limiting their professional and personal development. Training on coping mechanisms for mental well-being related issues and provision of self-assessment tools to assess mental health can help address this critical issue.

Biomedical engineering industry sector

The biomedical engineering industry sector in Pakistan and around the globe are in urgent need of professionals with

advanced digital skills to keep up with the demands of Industry 4.0 and 5.0. To meet these demands, the HEIs need to provide students with a strong foundation in digital technologies and hands-on experience with Industry 4.0 and 5.0 technologies. BME industry sector needs student with first-hand experience and in-depth knowledge of high-tech equipment which are lacking in current fresh graduates. These technologies have potential in addressing challenges related to early diagnostics, higher accuracy in disease diagnosis and decision support systems for general physicians and medical specialists.

Healthcare sector

The healthcare sector in Pakistan is in dire need of professionals trained in digital technologies to improve the quality of healthcare services. Biomedical engineers equipped with digital skills can play a vital role in this sector by using technology to improve patient care and outcomes. This would decrease the mortality rate, improved patient care and lower healthcare burden on economy. Specifically, artificial intelligence and machine learning tools can be used to decrease the misdiagnosis by analysing large amounts of medical data, identify patterns in patient data and assist physicians in making informed decisions. Smart medical devices such as wearables connect via Internet of Medical Things can provide real-time monitoring and dosage control.

Working and ready to work professionals

Working and ready to work professionals in biomedical engineering need to continuously upskill themselves to keep pace with the rapidly changing technological landscape. They need access to training and development programs to acquire the skills needed to succeed in the industry. As noted, currently there are no courses available in Pakistan for addressing the needs of biomedical engineering and healthcare professionals aiming to bridge digital gap and upskill in Industry 4.0/5.0 technologies.

Society

The integration of digital technologies in biomedical engineering education has the potential to positively impact society by improving healthcare services and creating job opportunities. Improved patient outcome, lower costs associated with healthcare services, easy and early diagnosis and technology enabled post treatment monitoring would improve the patient experience at large and lead to a healthy society. There is a strong need to adapt new innovations and technologies to meet the United Nation's Sustainable Development Goals (SDGs) targets. Biomedical Engineering is among the critical engineering disciplines which directly address several Sustainable Development Goals aimed at by the United Nations, including zero hunger, good-health and wellbeing, clean water and sanitation, responsible consumption and production, life below water, and life on land. Therefore, BIOMED5.0 proposes integration of emerging digital technologies in biomedical engineering education so that future work force can contribute towards achievement of UN SDGs.

Economy

The integration of digital technologies in biomedical engineering education will have a strong positive impact on the economy by creating a skilled workforce and attracting investment in the healthcare sector. This could lead to increased productivity in both biomedical engineering and healthcare sectors. The innovations in BME sector would lead to expanding the export opportunities for Pakistani industry base in medical surgical devices and equipment.

Specific Objectives

In order to provide clear understanding of the BIOMED5.0 goals and develop a well structured, well- defined and well-measured project management, the following specific objectives are developed, in-line with the specific objectives provided in the CBHE call document:

CBHE Strand 2 Specific Objectives	BIOMED5.0 Specific Objectives and Contributions
Improve the quality of higher education in	SO2.1: to review the list of targeted modules and update programme educational objectives via stakeholders inputs

third countries and enhance its relevance for the labour market and society Improve the level of competences, skills and employability potential of students in HEIs in the third countries by developing new and innovative education programs Digital and entrepreneurial capacities enhancement	502.2: to increase students' understanding of Industry 4.0/5.0 technologies by developing and implementing new UG and PG modules 502.3: to modernise and update BME curricula by introducing elements of I4.0/5.0 technologies in existing five UG and seven PG modules 502.4: to introduce micro-credential Open Online Courses (OOC) on I4.0/5.0 and digital transformation for working/open to work professionals as life long learning and stay relevant in digital age Key Performance Indicators: New modules developed: three for bachelor and three for masters programmes and five OOCs by M12 Updated modules: five for bachelor and seven for masters programmes by M12 Updated curricula approval from relevant committees by M18 Implementation and testing of updated curricula and OOCs by M36 Students show above 90% satisfaction in understanding of Industry4.0/5.0 technologies and transformative skills in survey results after updated curricula implemented
Promote inclusive education in HEIs Innovative curricula and teaching methods Enhance the teaching mechanisms for HEI staff and students, quality assurance, inclusion, innovation, and knowledge base in partner country HEIs	503.1: to enhance BME UG and PG students competencies, skills and employability potential by providing hands-on training on state-of-the-art laboratory facilities 503.2: to develop VR and AR based lab training sessions for diagnostic and therapeutic biomedical engineering devices 503.3: to upgrade engineering teaching laboratories with the purchase of modern equipment required for incorporating digital transformation enabling I4.0/5.0 technologies Key Performance Indicators Lab facilities of 8 Pakistani HEIs upgraded by M12 Six virtual reality and 3 augmented reality teaching labs developed by M12; improved by M18 and tested and implemented by M36
A stronger link and cooperation with the private sector, promoting innovation and entrepreneurship; Increased students sense of initiative and entrepreneurship; Stimulate cooperation of institutions, capacity building and exchange of good practice Improve the training of teachers and continuous professional development in order to impact the longer term quality of the education system in the third countries Foster cooperation across different	504.1: to establish Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among knowledge triangle players 504.2: to build capacity of partner HEIs through training in Industry 4.0/5.0 technologies, transformative skills and mental well-being to academic and lab staff, students and entrepreneurs 504.3: to create a technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare through providing access to fabrication labs and mentorship programmes Key Performance Indicators Fully functional Centre of Excellence in Biomedical Engineering by M6 At least two start-ups facilitated and mentored by each partner Pakistani HEI each year (M12, M24, & M36) At least ten research and innovation development activities performed in the Fab Labs each year (M12, M24, & M36) 504.4: staff members trained in DCU (Ireland) and 16 staff members trained in TUCN (Romania) At least 160 staff members trained in Pakistan through reciprocation of trainings received in DCU and TUCN Raising awareness about mental health and wellbeing in at least 150

| regions of the world through joint initiatives | students from each partner Pakistani HEI, totalling to 1200 |
| | Organising three Industry 4.0/5.0 Hackathons and engaging 400 students by the eight partner Pakistani HEIs |

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1.3 Complementarity with other actions and innovation — European added value

Complementarity with other actions and innovation

Explain how the project builds on the results of past activities carried out in the field, and describe its innovative aspects (if any).

Explain how the activities are complementary to other activities carried out by other organisations (if applicable). Illustrate the transnational dimension of the project; its impact/interest in the EU area; possibility to use the results in other countries, potential to develop/cross-border cooperation among Programme countries and Partner countries, if applicable, etc.

If your proposal is based on the results of one or more previous or ongoing projects, please provide precise references to these projects.

The programme country partners Dublin City University (DCU) and Technical University of Cluj-Napoca (TUCN) are leading educational institutes in digital transformation, Industry 4.0/5.0, Virtual and Augmented Reality and advanced biomedical engineering. These universities have a strong international presence and a track record of successful collaborations with other universities and organisations.

Programme Country Expertise

Dublin City University (DCU)

Dublin City University is known as a University of Enterprise in Ireland. The DCU applicant team is leading R&D and educational development activities in several national, European and international programmes. The I-Form, the SFI Research Centre in Advanced Manufacturing is working closely with leading international manufacturing companies on digital transformation and Industry 4.0/5.0 technologies. DCU's Advanced Processing Technology Research Centre is a leading international research on product design and sustainability using digital manufacturing. DCU is leading the Advanced Metallic Systems Centre for Doctoral Training in Ireland, training the next generation of globally competitive doctoral level graduates with the knowledge, skillset, and mindset to lead the future advanced manufacturing industry. Biodesign Europe is a collaborative institute between DCU and Arizona State University. It is providing students and researchers with unique education and research experience on seeking inspiration from nature for solutions to human health, community safety and global sustainability issues.

The Technical University of Cluj-Napoca (TUCN)

The Technical University of Cluj-Napoca, Romania, an "Advanced Research and Education University" is a tertiary educational institution having both traditions and national and international recognition. TUCN comprises 12 faculties in the two academic centres, Cluj-Napoca and Baia Mare, as well as in locations, such as Alba-Iulia, Bistrita, Satu Mare and Zalau. The educational offer, aligned to the Bologna system, includes bachelor's, master's and doctoral programs, as well as continuous training programs. The university has 12 faculties, where more than 900 academic staff and more than 21,000 students carry out their activity. The fields of study have a wide range, from engineering to architecture, fundamental sciences, sociohuman sciences and arts. Also, within the Technical University, the Department for Continuing Education, Distance Learning and with Reduced Frequency organizes and conducts continuous education activities and programs, postgraduate courses, continuous professional development programs or courses or based on occupational standards.

TUCN is concerned with the international exchange of scientific values, and this trend is found in the over 400 inter-university collaboration agreements or in the large number of student mobilities. Opening up towards the European and world space of education and research through a steady process of internationalization is one of the major objectives of the university. Research is, along with education, the main priority of the Technical University of Cluj-Napoca. In all faculties of the university there are research structures, from collectives, groups and laboratories, to research centers and platforms. The performance anchored in the socio-economic environment, the international visibility and cooperation as well as the scientific novelty and interdisciplinarity are some of the characteristics of the research environment of the Technical University of Cluj-Napoca. Open research directions are oriented towards global priorities and perspectives: from the Information and communications technology to Renewable Energy and Ecology; from superconductivity, spintronics and nanomaterials, to management and

robotics; from mechatronics and electrical engineering to the automobile and the home of the future, or to urbanism and society. The Technical University of Cluj-Napoca, one of the 12 universities of "advanced research and education" in Romania, aims at engaging itself in producing outstanding scientific results and approaching interdisciplinary and multidisciplinary subjects. Furthermore, it strives to integrate the research results in the exchange of national and international values, to increase its national and international visibility, and also attract and create highly skilled human resources. Achieving these goals must strengthen its already established position as a university of "advanced research and education", and the recognition of the Technical University of Cluj-Napoca as a center of excellence in scientific

research with a high impact on the social and economic environment. Scientific research, by its creative nature, represents one of the most important methods both in teacher or researcher training and in educating university students in the spirit of innovation, irrespective of study level. In the Technical University of Cluj-Napoca basic and applied research, as well as innovation are promoted. The research topics cover the fields of engineering, science, and humanities. Research is conducted at department level, predominantly in over 70 accredited research structures. The new research strategy aims at creating self-sustainable interdisciplinary and multidisciplinary structures capable of outstanding scientific achievements, integrated within a multidisciplinary research institute. The coordination of the scientific research is performed by academic staff experienced in research, and especially by PhD advisers relying on the broad involvement of the faculty, the young researchers, and the students. Research teams enjoy the freedom of choosing their research topics, but their activities are in line with the national and international policy comprised within the strategy of research - development – innovation.

Past Activities and BIOMED5.0 Innovative Aspects

DCU applicant team is leading European Institute of Innovation and Technology (EIT) Higher Education Initiative funded project entitled "Innovation Capacity Building for Higher Education in Industry 4.0 and Smart Manufacturing (SMART-2M)"[4]. This project is focused on innovation capacity building for higher education, and it will develop innovation and entrepreneurial capacity in HEIs in Ireland, France, Greece and Serbia in collaboration with industry partners from France, Serbia, Belgium and Italy. The project is empowering innovators and entrepreneurs to develop world-class solutions to Industry 4.0 and smart manufacturing challenges and create growth and skilled jobs. The experiences gained in promoting and supporting institutional change in HEIs from SMART-2M project will enable the applicant team to strengthen the integration and contribution of partner HEIs to innovation ecosystems.

DCU team has gained following experiences which will be utilised in BIOMED5.0:

1. A well structured Entrepreneur Mentorship programme has been developed which will be utilised in BIOMED5.0 (WP4).

2. Online training programmes delivered to students from academia and enterprises in Digital transformation, Industry 4.0/5.0 and transformative skills. These programmes will be utilised for training students in Pakistan in value creation using Industry 4.0/5.0 (WP2).

3. The EIT knowledge triangle model: interaction between business, education and innovation is key action, that is being translated in BIOMED5.0 for capacity building in Pakistani HEIs (WP3).

4. Innovation ecosystem structure developed in SMART-2M will be used for establishment of Centre of Excellence in Biomedical Engineering in Pakistani HEIs (WP4).

DCU is co-leading Postgraduate level Certificate Programme on "Innovative Materials for Industry 5.0". DCU team lead, Dr Inam Ul Ahad has developed and implemented this industry focused programme tailored needs of professionals seeking a comprehensive upskilling in state of the art Industry 4.0/5.0 materials processing technologies and concepts. The programme is upskilling the participants to enable the digital transformation in their companies. The programme contents include the required elements of challenge based learning and training in transversal skills.

DCU team has gained the following experiences from this certificate programme development which will be utilised in BIOMED5.0:

1. Introduced innovative teaching methods to provide resilience, critical thinking, and new value creation skills. Academic team members from Pakistani HEIs will get training on innovative pedagogies from DCU team (WP2 & WP4).

2. Developed Virtual Reality lab programmes for additive manufacturing, laser processing, and materials characterisation. DCU team will use this experience and assist Pakistani HEIs to EU Grants: Application form (ERASMUS BB and LS Type II): V2.0 – 01.06.2022

develop VR/AR sessions for biomedical engineering labs (WP3 & WP4).

TUCN applicant team has been involved in several educational projects funded by European Commission. Focusing on the use of additive manufacturing technology beyond prototyping, the TUCN team is leading "Boosting the scientific excellence and innovation capacity of 3D printing methods in pandemic period (BRIGHT)" project. This project has developed teaching methods for higher education to provide knowledge and practical skills in developing, producing and testing of medical parts made by 3D printing technology. The project is also developing VR/AR programmes for certain medical applications. TUCN team will utilise BRIGHT project activities and experience in the complementary activities of BIOMED5.0 project, such as biomedical engineering curriculum revision, training of teachers on 3D printing for medical device prototyping, and development of VR/AR programmes.

TUCN team is leading European Network for 3D printing of biomimetic mechatronic systems (EMERALD) project which is focused on the use additive manufacturing technology for personalised prostheses 3D printing for disabled persons. EMERALD is creating a framework to collaborate with different stakeholders (manufacturing, mechatronics

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[4] Innovation Capacity Building for Higher Education in Industry 4.0 and Smart Manufacturing SMART-2M [https://smart2m.eu/]

and IT sectors, international and national higher education institutes and research centres and public institutes). EMERALD project experiences will be useful for BIOMED5.0 activities aiming at fostering collaboration for entrepreneurship and innovation.

TUCN team is also participating in the "Development of mechatronics skills and innovative learning methods for Industry 4.0 (MIND)" and Crossing Borders: Peer-to-Peer Education in Mechatronics (XP2P) projects, focusing on introducing Industry 4.0 technologies in higher education. These activities complement the planned work of BIOMED5.0.

Towards a 2030 Vision on the Future of Universities in Europe[5]

BIOMED5.0 project activities have been planned to complement the "European Commission's 2030 Vision on the Future of Universities in Europe". Following this policy report, BIOMED5.0 is using "Interdisciplinary Approach" of combining engineering, medicine and technology to upskill students with Industry 4.0/5.0. BIOMED5.0 is "Promoting the use of Technology in Education" by developing Virtual Reality and Augmented Reality based lab sessions and upgrading teaching labs with state-of-the-art technology equipment (hybrid CNC and 3D printer machines, screen printers, IoT sensor boards etc.). BIOMED5.0 aims to "Encourage Entrepreneurship and Innovation" by providing biomedical engineering graduates will Fab Lab facilities, organising Hackathons, and teaching transformative skills to lead innovation and digital transformation. BIOMED5.0 is "Supporting Regional Development" by establishing collaboration between EU programme countries HEIs and Pakistani HEIs to help bridge the gap between the developed and developing countries.

European Education Area (EEA)[6]

EEA is a comprehensive initiative launched by the European Commission (EC) with the goal of providing high-quality education and training for all Europeans. The BIOMED5.0 project, with its focus on establishing partnerships for digital transformation in biomedical engineering among Higher Educational Institutes (HEIs) in Pakistan, Ireland, and Romania, is complementary to the EEA program in several ways. BIOMED5.0 project aligns with the overarching priority area of "Digital Transformation" identified by the EC as critical for success in the EEA. By addressing this priority, the project helps to promote the digital transformation of the BME sector and supports the development of new educational models and approaches in this field. The focus on the digital transformation of biomedical engineering in the BIOMED5.0 project supports the development of the digital skills and competencies that are crucial for success in the modern workplace. This aligns with the goals of the EEA, which aims to provide Europeans with the skills and knowledge they need to participate fully in the digital economy and society.

European Commission's Digital Education Action Plan (DEAP)[7]

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[5] Towards a 2030 vision on the future of universities in Europe [Available here]
[6] European Education Area [Available here]
[7] Digital Education Action Plan [Available here]

CONCEPT

BIOMED5.0 vision is to empower the next generation of biomedical engineers in Pakistan with the digital transformation and Industry 4.0/5.0 skills necessary to advance the healthcare technology and improve patient outcomes, while fostering innovation and entrepreneurship among undergraduate and postgraduate BME students.

BIOMED5.0 will achieve these aims by working on four major pillars of education system with the concepts given below:

Curriculum Update

The following concepts have been developed to update the BME bachelor and master curricula:

- Stakeholders engagement

The Executive Committee will invite industry and student representatives to curriculum revision meetings. This will assist the EC to make informed decisions on the update of BME curricula.

- Use of innovative pedagogies

The academic team members will get trained on innovative teaching methods to develop and update the teaching contents and delivery and assessment methods. Use of real-life case studies for explaining the use of Industry 4.0/5.0 in biomedical engineering will allow students to apply their knowledge to real-life scenarios. Special focus will be on development of critical thinking skills, problem solving abilities and be resilient to failure. The educators will get training on these methods in DCU.

- Structured mapping of PLOs, PEOs and new and revised modules

The applicant academics from Pakistani HEIs are already serving in National Curriculum Revision Committee and have strong experience in curriculum development and revision according to Outcome Based Education system. This will result in relatively faster approval of the revised curricula from the relevant committees.

Introducing Innovative Lab Facilities for students with fewer opportunities

As the high-end biomedical engineering equipment are extremely costly, which can not be covered by the Pakistani

DEAP provides a comprehensive framework for the development of digital competences and the integration of technology in education. The BIOMED5.0 project could use this framework as a guide to inform its efforts to promote digital transformation in biomedical engineering education. DEAP highlights the need for innovative approaches to digital education and the development of new educational models and tools. The BIOMED5.0 project, by focusing on the digital transformation of biomedical engineering education, could contribute to this effort by developing and implementing new and innovative approaches to education in this field.

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2. QUALITY

2.1 PROJECT DESIGN AND IMPLEMENTATION

2.1.1 Concept and methodology

Concept and methodology

Please address all guiding points presented in the Call document/Programme Guide under the award criterion 'Quality of the project design and implementation'.
Outline the approach and methodology behind the project. Explain why they are the most suitable for achieving the project's objectives.

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Pakistani HEIs to promote innovation and entrepreneurship among BME students. The Fab Labs at each partner HEI is necessary due to geographical spread of the partner locations and number of expected users of these labs. Budget is requested by each partner HEI to procure rapid prototyping equipment for the Fab Labs. Figure 2 provides an overview of the vision and activities of the Centre of Excellence in Biomedical Engineering.

HEIs, the students have no or little opportunity to interact with major BME modalities. BIOMED5.0 will exploit Virtual Reality and Augmented Reality techniques to develop innovative laboratory teaching methods for providing hands-on trainings to the students. DCU and TUCN have already developed VR based lab sessions for mechanical and medical engineering students. The lessons from these developments in terms of feasibility, training structure and students feedback will be used to develop VR/AR labs in BIOMED5.0.

Fostering Innovation and Entrepreneurship

BIOMED5.0 will establish a Centre of Excellence in Biomedical Engineering which will act as a technology incubation hub and platform for knowledge triangle (academia, research and industry). Physically, the centre will be located in MUET. A steering committee with membership of all consortium partners will be formed to direct the centre activities. The centre will upskill educators and students in innovative pedagogies, Industry 4.0/5.0 technologies, transformative skills, mental health and awareness and promote digital transformation in education, research, and industry.

A major action of the Centre of Excellence will be the creation of Pan-Institutional Biomedical Engineering Digital Fabrication Laboratory (Fab Lab). These Fab Labs will be established in all partner
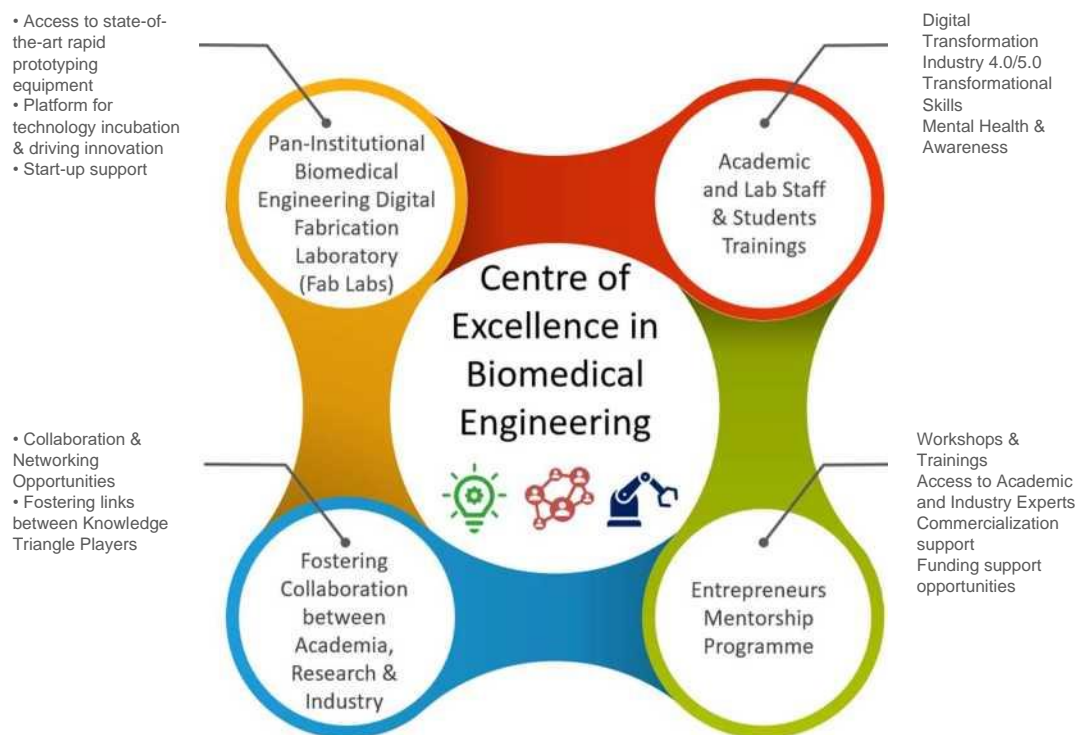
Figure 2 Centre of Excellence in Biomedical Engineering Vision and Activities

Organising in-person and online trainings and courses for academics, students and professionals

BIOMED5.0 will organise in-person events for trainings of academic staff members, where hands-on experience and higher level of interactions with the trainers are required. These include workshop on innovative pedagogies and trainings on Industry 4.0/5.0 technologies at DCU and TUCN. Mental health and well-being awareness seminars will be organised in-person at partner HEI to provide the participants more comfortable environment. To capture a large audience, online trainings and courses will be organised for students and professionals for life long learning. Industry 4.0/5.0 Hackathons will be organised for students to work on specific challenge and utilise critical thinking skills to develop digital transformation based solutions.

Stakeholder Engagement, Communication and Dissemination

BIOMED5.0 has carefully planned activities to disseminate and communicate the project's impact and outcomes to relevant stakeholders and increase awareness and adoption of digital transformation. BIOMED5.0 will appoint a Societal Impact Champion and utilize all forms of digital media and participate in international events to engage stakeholders and raise awareness. This will lead to bridge the gap in digital literacy in Pakistan and raise awareness on the digital transformation opportunities.

METHODOLOGY

The planned activities of BIOMED5.0 are divided into the following five work packages (Figure 3):

Work Package 1: Project Management and Quality Assurance

Work Package 2: Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula

Work Package 3: Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions

Work Package 4: Centre of Excellence in Biomedical Engineering

Work Package 5: Project Impact and Outreach: Dissemination, Communication and Exploitation

Figure 3 BIOMED5.0 Work Packages

A brief description of each work package is described below:

Work Package 1: Project Management and Quality Assurance (Leader: MUET)

This work package focuses on the effective management and governance of the project with the aim of ensuring successful project delivery. The specific objectives of this work package include establishing a project executive committee for effective project governance and management, developing and implementing a comprehensive quality assurance plan to ensure that project deliverables meet the required quality standards, continuously assessing project risks and developing and updating a risk mitigation plan, and facilitating effective collaboration and promoting productive partnerships among project partners. The outcome of this work package will be a well-governed project that is delivered to a high standard and meets the needs of all stakeholders.

Work Package 2: Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula (Leader: SSUET)

The goal of this work package is to modernise and update the biomedical engineering curricula in Pakistani higher education institutions (HEIs) to meet the needs of the rapidly changing technological landscape. The specific objectives include reviewing and updating the list of targeted modules, increasing students' understanding of Industry 4.0/5.0 technologies through the development and implementation of new modules, and introducing elements of I4.0/5.0 technologies into existing modules. Additionally, this work package will introduce five micro-credential open online courses on I4.0/5.0 and digital transformation for working or open-to-work professionals. The outcome of this work package will be a modernised and updated biomedical engineering curriculum that prepares students for the demands of the digital age.

Work Package 3: Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions (Leader: UETL)

The goal of this work package is to enhance the competencies, skills, and employability potential of BME students in partner HEIs. To achieve this objective, the specific objectives of this work package include providing hands-on training on state-of-the-art laboratory facilities, developing virtual reality (VR) and augmented reality (AR) based lab training sessions for diagnostic and therapeutic biomedical engineering devices, and upgrading engineering teaching laboratories with modern equipment to incorporate digital transformation technologies. By upgrading teaching lab facilities and providing VR and AR-based training sessions, this work package aims to ensure that BME students are well equipped to face the challenges of the future and are equipped with the necessary skills to succeed in the rapidly evolving digital landscape.

Work Package 4: Centre of Excellence in Biomedical Engineering (Leader: SHU)

The objective of this work package is to establish a Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among the different players in the knowledge triangle. The specific objectives of this work package include building the capacity of partner HEIs through training in Industry 4.0/5.0 technologies, transformative skills, and mental well-being for academic and lab staff, students, and entrepreneurs, and creating a technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare by providing access to fabrication labs and mentorship programs. By achieving these objectives, this work package aims to promote the development of new biomedical technologies and

support the growth of entrepreneurship in the field, ensuring that Pakistan remains at the forefront of innovation in the biomedical engineering sector.

Work Package 5: Project Impact and Outreach: Dissemination, Communication, and Exploitation (Leader: LUMHS)

The aim of this work package is to maximise the impact and outcomes of the BIOMED5.0 project through effective dissemination, communication, and exploitation efforts. The specific objectives of this work package include developing and implementing a comprehensive dissemination, communication, and exploitation plan, establishing a copyright policy to manage the intellectual property produced during the project, increasing awareness and adoption of digital

transformation and BIOMED5.0 outcomes through the efforts of a societal impact champion, and utilising digital media, organising annual conferences, and participating in relevant international events to engage key stakeholders and promote the benefits and outcomes of the BIOMED5.0 project. By achieving these objectives, this work package aims to ensure that the results of the BIOMED5.0 project are effectively communicated and adopted, ensuring the long-term sustainability and impact of the project.

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2.1.2 Project management, quality assurance and monitoring and evaluation strategy

Project management, quality assurance and monitoring and evaluation strategy

Describe the measures foreseen to ensure that the project implementation is of high quality and completed in time.

Describe the methods to ensure good quality, monitoring, planning and control.

Describe the evaluation methods and indicators (quantitative and qualitative) to monitor and verify the outreach and coverage of the activities and results (including unit of measurement, baseline and target values). The indicators proposed to measure progress should be relevant, realistic and measurable.

Project Management

The BIOMED5.0 project aims to revise and update the biomedical engineering curricula in Pakistani higher education institutions (HEIs) to meet the modern engineering education standards. Detailed activities planned in the project management and quality control work package (WP1) ensure the smooth execution of the project by establishing a comprehensive framework of measures to ensure project management and quality control. The project is designed according to the benchmark project management processes. Many project team members are PMI certified Project Management Professionals (PMP) and hence BIOMED5.0 is planned according to the standard Project Management practices.

Kick-off Meeting and Establishment of Executive Committee

An in-person kick-off meeting is planned at MUET in M1 which will be the first step towards initiating the project management and quality control measures in the BIOMED5.0. The BIOMED5.0 project Executive Committee (EC) will be established in this meeting, which oversees and coordinates all project management and administration activities. The EC will be responsible for preparing the Consortium Agreement, reviewing the project GANTT chart, and developing a responsibility matrix for the tasks proposed in WP1 to WP5. The EC ensures the quarterly meetings are held annually, at least one in-person and the remaining hosted online.

Quality Assurance, Monitoring and Evaluation Strategy

A quality assurance for project outcomes, monitoring of on-going work and quality evaluation strategy has been developed for BIOMED5.0 in WP1 and WP5. These components will continuously assess the project risks, ensure the implementation of quality control measures and ensure that the project outcomes and deliverables meet the quality standards required in HEIs. These components will be reviewed regularly and updated as needed. BIOMED5.0

Appointment of Quality Assurance Manager (QAM)

A Quality Assurance Manager (QAM) will be appointed to oversee the implementation of the Quality Assurance Plan (QAP). The manager will be responsible for monitoring the project's progress, ensuring that quality control measures are in place, and assessing project risks. QAM will also be responsible for ensuring that the project partners are aware of the QAP and are fulfilling their responsibilities in implementing it. BIOMED5.0 QAM will be responsible to carry out the following responsibilities:

Development of Quality Assurance Plan

The QAM will prepare a detailed Quality Assurance Plan (QAP) which focuses on ensuring compliance

with statutory requirements, maintaining the quality of the deliverables, and effectively implementing BIOMED5.0 WPs. The QAP aims to ensure that the project outcomes align with the Program Educational Objectives prescribed by the Pakistan Engineering Council. The quality characteristics to be considered in the QAP include Accessibility, Affordability, Relevance, Equity, Effectiveness, Efficiency, Flexibility, Accountability, Transparency, and Student-centeredness. The QM evaluates the project deliverables according to the criteria defined in the QAP and monitors the overall quality of the BIOMED5.0 project execution.

Project Progress Monitoring

The EC will meet quarterly to regularly monitor the project progress and to ensure that the project is on track and that all project activities are being carried out according to the project plan as described in the GANTT chart. QAM will be responsible to report project overall progress and work performed by project partners.

Independent Project Quality Assurance – Collaboration with Quality Enhancement Cells (QEC)

To get independent quality assurance over the project activities and outcomes, the QAM will establish a strong connection between the Quality Enhancement Cells (QEC) at the partner HEIs and gather feedback on BIOMED5.0 actions and activities. The QEC's involvement in evaluating the project activities, such as teaching content development, industry engagement, and event organization will ensure that the project team's achievements and project outcomes are of high quality.

Project Deliverables and Outcomes Evaluation Strategy

Quality control indicators and benchmarks will be developed for each of the five work packages of BIOMED5.0 noted in the sections below (Impact, Logical Framework Matrix and Workplan). The Quality Assurance Manager will ensure that the evaluation strategies for project deliverables and outcomes are in place and that the indicators and benchmarks are met. The evaluation strategies will include continuous quality evaluation, peer reviews, benchmarking activities, and mitigating actions.

Environmental Sustainability

BIOMED5.0 has been designed with an eco-friendly approach, aiming to minimise the environmental impact of the project implementation. To achieve this, the project has implemented several measures, such as avoiding unnecessary travel wherever possible and organising virtual meetings and trainings.

To facilitate effective communication and collaboration, the project team has planned to conduct most of the EC meetings online, except for one annual in-person meeting. This will significantly reduce the carbon footprint associated with travel, as project members will not have to travel frequently for meetings.

Furthermore, the project team has planned the training in Dublin City University (DCU) in a way that only one travel is required for both trainings on innovative pedagogies and additive manufacturing. Some sections of innovative pedagogy trainings will be conducted online to further reduce the budget and the carbon footprint associated with travel for the project's training activities.

To minimise the need for physical travel for students, most of the student training activities will be organised online, except for the mental health and awareness seminars. These seminars, due to their nature of delivery and topics, which will be organised face-to-face in each Pakistani HEI.

Overall, the BIOMED5.0 team is committed to implementing eco-friendly measures throughout the project's lifecycle to minimise its environmental impact. The measures implemented include reducing the use of printing and avoiding unnecessary travel wherever possible, and conducting most of the project activities online. By implementing these measures, the project aims to reduce its carbon footprint and contribute to sustainable development.

#§PRJ-MGT-PM§# #@CON-SOR-CS@#

NARRATIVE SUMMARY OF THE INTERVENTION LOGIC	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS AND PREREQUISITES
Goal (general objective) Identify the broader objective to which this project contributes To establish an international partnership between Pakistani, Irish, and Romanian higher education institutions (HEIs) to modernize and transform Biomedical Engineering (BME) education through the integration of Industry 4.0/5.0 technologies, state-of-the-art laboratory facilities, and hands-on training using Virtual Reality and Augmented Reality, establishment of a Centre of Excellence in Biomedical Engineering and the enhancement of BME students' competencies, skills, and employability potential, as well as the training of academic staff, students, and professionals on Industry 4.0/5.0 technologies in biomedical engineering and healthcare industries.	• Increased competence and knowledge in digital transformation and Industry 4.0/5.0 technologies in BME in academics and students • Enhanced learning experience in Industry4.0/5.0 technologies and BME modalities due to upgraded laboratory facilities and use of innovative VR/AR/MR sessions • Support provided by the Centre of Excellence in Biomedical Engineering to staff members, students, entrepreneurs, working and unemployed professionals in trainings, innovation, entrepreneurship • BIOMED5.0 project outcomes are fully exploited and disseminated and communicated to a large group of stakeholders	• Modernised curricula implemented and delivered in up to two study cycles by M36 • Approval/accreditation documents of new and updated modules • Procurement of equipment and upgradation of teaching laboratories in Pakistani HEIs by M12 and utilised by students in two study cycles by M36; Development and approval of VR/AR/MR lab sessions and implemented in two study cycles by M36 • Steering committee annual reports outlining performance of Centre of Excellence activities • Five impact assessment case studies conducted detailing exploitation and impact of BIOMED5.0 project	• Compliance with relevant project management and quality standards • Effective and efficient project management and immediate addressing the risks as they may arise • Feedback received from PEC and student representative fully incorporated into revised PEO and LOs • Timely development and approval of new and updated modules • Timely procurement of teaching labs and Fab Lab equipment
Purpose (specific Objectives) List the specific objectives that projects shall achieve • SO1.1: to establish project Executive Committee for effective project governance and management plan with clear project vision, objectives and governance structure •	• EC successfully developed and agreed on Consortium Agreement (CA) • Organisation of quarterly EC meetings	• Consortium Agreement signed by all partners by M6 • Report on EC establishment and workplan reviewed	• Delay in preparation and signature of CA • All proposed EC members participate actively in meetings

• SO1.2: to develop and implement a comprehensive Quality Assurance Plan ensuring project deliverables meet the required quality standards	• Quality assurance plans developed and implemented • Number of corrective actions taken in case of non-compliance with quality standards	• Percentage of project deliverables meeting quality standards • Report on detailed QAP, risk management and contingency plan (M3)	• Appointment of qualified quality assurance manager • Project team compliance with relevant quality standards
• SO1.3: to continuously assess project risks and develop and update risk mitigation plan, minimising potential impacts on project milestones and outcomes	• Risk mitigation plan is developed and included in the project plan • Percentage of project milestones and outcomes achieved despite identified risks	• Risk assessment reports submitted by QAM to EC (M12, M24, M36) • Annual project progress and evaluation Report	• Continuous monitoring of project progress and risks
• SO1.4: to facilitate effective collaboration and promote productive partnerships and teamwork among project partners for successful project delivery	• Number of partnership and collaboration meetings held • Percentage of project partners participating in the meetings • Number of joint project deliverables achieved	• Curriculum revision, BIOMED5.0 Labs Working group meetings minutes • Annual project progress and evaluation Report (M12, M24, M36)	• Effective communication channels between project partners • Active engagement of project teams on joint activities and tasks
Work Package 2 • SO2.1: to review the list of targeted modules and update programme educational objectives via stakeholders inputs	• Feedback from BIOMED5.0 academic staff members and representatives from PEC, students and industry is received and PEOs and LOs are updated accordingly.	• Two-day in-person meeting organised in MUET is organised and the following outputs are generated: Revised/updated programme educational objectives for UG and PG BME programmes • Revised/updated learning outcomes of individual targeted modules at UG and PG levels • Structured mapping of PEOs and LOs	• Meeting attendance by PEC, Students and Industry representatives
• SO2.2: to increase students' understanding of Industry 4.0/5.0 technologies by developing and implementing three new bachelor and three new master modules in biomedical engineering programmes • SO2.3: to modernise and update BME curricula by introducing elements of I4.0/5.0 technologies in existing five UG and seven PG modules	• Development of three new and revision of five existing modules for BME bachelor programme • Development of three new and revision of seven existing modules for BME master programme • The new and updated module descriptors and teaching contents will be sent to external reviewers for feedback. Suggested changes will be incorporated. • New and revised modules are approved/accredited by the competent authorities by M18	• Modules are ready to deliver by M18 for first study cycle • Report on feedback survey results from BME students • Percentage of students satisfactions in digital transformation and industry 4.0/5.0 competencies in survey results - Target: over 95%	• Willingness of stakeholders to participate in the review process • Availability of faculty and industry representatives to participate in the review process

• SO2.4: to introduce five microcredential Open Online Courses (OOC) on I4.0/5.0 and digital transformation for working/open to work professionals as life long learning and stay relevant in digital age	• Number of individuals who have completed the OOCs • Percentage of participants who report increased knowledge and skills in I4.0/5.0 and digital transformation • Percentage of participants who report increased employability or professional advancement as a result of completing the OOCs	• Records of OOC completion • Survey feedback from OOC participants	• Adequate promotion and marketing of the OOCs to reach the target audience • Enrolment of students in OOCs • Willingness of working professionals to invest time and resources in lifelong learning through the OOCs
• SO3.1: to enhance BME UG and PG students competencies, skills and employability potential by providing hands-on training on state-of-the-art laboratory facilities	• Establishment of BIOMED5.0 Labs Working Group • Revision of LOs completed for lab sessions	• Report on establishment of BIOMED5.0 Labs and revised PEOs and LOs for lab sessions (D3.1) • Students academic records who completed hands-on trainings on state- of-the-art equipment	• Timely procurement of lab equipment
• SO3.2: to develop VR and AR based lab training sessions for diagnostic and therapeutic biomedical engineering devices	• Number of VR/AR/MR based labs developed for teaching and training of biomedical engineering modalities • VR sessions lab manuals available and software guide is prepared • VR, AR and MR based lab sessions are ready for distribution to partner HEIs by M12 for testing and by M18 for implementation	• Software and documentation is available for the developed labs • Annual reports on BIOMED5.0 Lab work group activities	• Timely recruitment of software developers to assist with the development of VR/AR/MR sessions
• SO3.3: to upgrade engineering teaching laboratories with the purchase of modern equipment required for incorporating digital transformation enabling I4.0/5.0 technologies	• Lab manuals prepared for new teaching labs • Number of teaching labs upgraded and state-of-the-art successfully commissioned • Number of students participated in upgraded teaching labs	• Report on procurement of lab equipment and corresponding lab designs in partner HEIs (D3.2)	• Timely procurement of lab equipment • Lab staff training on purchased equipment

Work Package 4

• SO4.1: to establish Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among knowledge triangle players	· Successful formation of Steering Committee and acquisition of • physical space for Centre of Excellence in Biomedical Engineering	Annual reports on Centre of Excellence activities (M12, M24 & M36)	• Partner Pakistani HEIs' support for the Centre of Excellence activities and collaborations
• SO4.2: to run Centre of Excellence as · a technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare through providing access to fabrication labs and mentorship programmes ·	Number of biomedical engineering and healthcare start-ups • incubated and supported and jobs created Reports on mentorship programmes and workshops conducted • for start-ups Reports on fabricated biomedical engineering prototypes	Report on Fab Lab activities and services provided (D4.2) Annual report on Centre of Excellence activities (M12, M24 & M36)	• Willingness and availability of entrepreneurs to participate in the mentorship programmes and workshops
• SO4.3: to build capacity of partner · HEIs through training in Industry 4.0/5.0 technologies, transformative · skills and mental well-being to academic and lab staff, students and entrepreneurs	Timely and successful completion of training activities organised • in DCU, TUCN and in Pakistani HEIs • Number of academic staff members, lab staff members, students and entrepreneurs trained • • •	Attendance sheets of training sessions Pre- and post-training evaluation forms and reports Mental well-being support session reports Training certificates and reports Reports on staff and student trainings (D4.3)	• Willingness and availability of staff, students and entrepreneurs to participate in the training sessions

Work Package 5

• SO5.1: to develop and implement a · comprehensive dissemination, communication and exploitation plan to · maximise the BIOMED5.0 impact and outcomes	Communication and Dissemination plan is developed and • available for partners by M3 Number of dissemination and communication activities implemented in the plan •	Report on communication, dissemination and exploitation plan (D5.1)	• Timely execution of communication and dissemination planned activities
• SO5.2: to increase awareness and • adoption of digital transformation and BIOMED5.0 outcomes through efforts of a Societal Impact Champion	Number of stakeholders engaged and awareness raised about • digital transformation and BIOMED5.0 outcomes	Annual report on communication, dissemination and exploitation activities (D5.2)	• Timely appointment of Societal Impact Champion

SO5.3: to utilise digital media, organise annual conferences and participate in relevant international events engaging key stakeholders and promoting BIOMED5.0 benefits and outcomes	• Successful organisation of BIOMED5.0 annual conference Participation • of at least 250 persons in annual conference Participation of each partner • HEI in at least two international conferences Regular update of BIOMED5.0 website and social media accounts •	• Conference attendance and participation, feedback from participants, and media coverage of the events	• Interest and engagement of key stakeholders, and support from partner HEIs for event organisation
Outputs (deliverables) List the deliverables (grouped in work packages) that the project is committed to produce. These must be stated as results.			
Work Package 1 • D1.1 Report on EC establishment and workplan reviewed • D1.2 Report on detailed QAP, risk management and contingency plan • D1.2 Annual project progress and evaluation Report • D1.4 Final project completion report Work Package 2 • D2.1 Report on 1st meeting of curriculum update and revision committee on revised PEO and LOs • D2.2 Report on incorporation of	• All stakeholders actively participated in EC establishment and quarterly meetings • Quality Assurance Plan (QAP), risk management and contingency plans are ready by M6 • Percentage of the project tasks that were implemented by the project team • All deliverables completed and submitted to European Commission in time • The new and updated module descriptors and teaching contents will be sent to external reviewers for feedback. Suggested changes will be incorporated • Teaching contents are available for 18 modules which are	• Minutes of the EC meeting conducted • Photos and recordings, updates on website • Report on detailed QAP, management and contingency plan (D1.2) • Deliverables submitted to European Commission • BIOMED5.0 project outcomes • Revised PEOs and LOs are ready for development of new modules and revision of existing modules • Approval/Accreditation documents	• Active participation of key stakeholders in EC meetings • Active participation of project team members and key stakeholders in project meetings • Awareness and interest among target groups for exploitation of project outcomes and benefits • Constructive feedback received from external peer reviews • Availability of a

I4.0/5.0 technologies in BME curricula via new and updated modules	implemented in the revised curricula in bachelor and master programmes	• Enrolment forms and course certificates	supportive policy environment for project implementation and sustainability
• D2.3 Report on Open Online Courses developed for biomedical and healthcare professionals	• Five OOCs developed and available for online delivery	• Enrolment of working and unemployed professionals in OOCs	• Awareness and interest among target groups for upskilling and continuous professional development
• D2.4 Report on feedback survey results from BME students	• Feedback received from students enrolled in all 23 new and revised modules/courses	• 4.5 average score received on Likert scale on satisfaction with teaching contents, delivery style and knowledge level delivered by academics and retained by students	
Work Package 3			
• D3.1 Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions	• Successful nomination of members by partner HEIs for BIOMED5.0 Labs Working Group • Successful revision of learning outcomes for selected teaching labs		
• D3.2 Report on procurement of lab equipment and corresponding lab designs in partner HEIs	• Lab budget is fully spent by M12 and lab equipment procured and installed in partner HEIs	• Inventory of lab equipment procured and installed in partner HEIs; Corresponding lab designs approved and implemented	• Compliance with procurement regulations • Timely execution of tender process in partner HEIs
• D3.3 VR, AR and MR based lab sessions	• Students trained through VR, AR and MR sessions in two study cycles provide positive feedback	• Survey results	
• D3.4 Annual reports on BIOMED5.0 Lab work group activities	• Successful upgradation of labs and implementation of new teaching labs in BME programmes	• Upgraded labs are available for delivery by M18	
Work Package 4			
• D4.1 Annual reports on Centre of Excellence activities	• Successful collaboration with industry partners on technology transfer and innovation projects	• Impact assessment case studies	• Willingness of industry partners to collaborate

	• Successful organisation of events scheduled in workplan Mentorship • programme is developed and enrolment started by M12		with the Centre of Excellence
• D4.2 Report on Fab Lab activities and services provided	• Procurement of equipment for Fab Labs is completed by all partners by M12 • Entrepreneurs supported by Fab Lab equipment for prototyping	• Project newsletter on success stories of supported entrepreneurs	• Designated space to set up Fab Lab is provided by each Pakistani HEI
• D4.3 Report on staff and student training	• Positive feedback received from staff and students on completion of training programmes	• Attendance records from training sessions • Pre and post-training assessment scores • Feedback survey from staff and students	• Willingness of staff and students to participate in training sessions
Work Package 5 • D5.1 Report on communication, dissemination and exploitation plan	• Plan is presented to EC for approval by M3	• List of activities and events scheduled for engagement with key stakeholders •	• Willingness of stakeholders to engage in communication and dissemination activities
• D5.2 Annual report on communication, dissemination and exploitation activities • D5.3 Report on project assessment	• Records of dissemination materials produced and disseminated • Attendance records from dissemination events • Feedback from stakeholders	• Attendance records from dissemination events	• Willingness of stakeholders to provide feedback on project outcomes
Activities: List the key activities to be carried out (grouped in work packages) and in what sequence, in order to produce the expected results.			
Work package 1 • T1.1 Kick-off meeting and establishment of BIOMED5.0 Project Executive Committee	• Successful establishment of BIOMED5.0 Project Executive Committee and completion of kick-off meeting in M1	• Report on EC establishment and workplan reviewed (D1.1)	• Active engagement of project team and

stakeholders

• T1.2 Quality Assurance Plan preparation and execution	• Completion of Quality Assurance Plan according to established timeline and achievement of identified quality targets	• Quality Assurance Plan, quality targets, and expected performance reports.	
• T1.3 Collaboration with Quality Enhancement Cells in Pakistani HEIs	• Active collaboration with Quality Enhancement Cells in Pakistani HEIs	• QEC reports on project progress and quality	• Willingness of Quality Enhancement Cells in Pakistani HEIs to collaborate
T1.4 Risk Assessment and Mitigation Planning and Execution •	Identification of key risks and successful implementation of mitigation strategies, as evidenced by the number of identified risks that did not occur.	• Risk assessment reports, mitigation strategies, and progress reports prepared by Project Manager and Quality Assurance Manager	• Effective identification and assessment of risks and availability of resources for mitigation
• T1.5 Project Data Management Plan ·	Development and implementation of Project Data Management Plan throughout the project and its compliance with data management protocols and following open access policies where relevant	• Project Data Management Plan distributed to all partners	
• T1.6 Managing project budgets and · finances	Effective management of project budgets and finances, as evidenced by regular budget reports and adherence to financial guidelines	• Budget reports, financial guidelines, and compliance reports	
• T1.7 Conduct of Financial Audit ·	Completion of Financial Audit with no major findings or irregularities	• Annual/required financial reporting to European Commission	
• T1.8 Preparation of a Project Completion Report	· Preparation and submission of comprehensive Project Completion Report according to established timeline.	• Project completion report approved by European Commission	
• T1.9 Closing out the project and • conducting a post-project review.	Successful completion of post-project review with identification of areas for improvement and best practices	• Post-project review report and action items	
Work package 2			
• T2.1 Development and revision of • Programme Educational Objectives (PEOs) and Learning Outcomes (LOs) of BME UG and PG curricula in line	New and revised modules are approved/accredited by the competent authorities	• Modules are ready to deliver by M18 for first study cycle	• Effective collaboration and communication among partner HEIs to work on curriculum

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with Industry 4.0/5.0 needs assessment			revision and update
• T2.2 Development of new modules on I4.0/5.0 technologies for bachelor in BME programme • T2.3 Development of new modules on I4.0/5.0 technologies for masters in BME programme • T2.4 Incorporating Industry 4.0 and 5.0 Technologies into existing modules in undergraduate BME programme	• 95% students satisfactions rate in survey results in digital transformation and industry 4.0/5.0 competencies • 400 bachelor and 250 masters students from 8 Pakistani HEIs in participated in the first study cycle (M24)	• Survey results • Enrolment sheets	

• T2.5 Incorporating Industry 4.0 and 5.0 Technologies into existing modules in postgraduate BME programme

Work Package 3			
• **T3.1** Establishment of BIOMED5.0 Labs Working Group	• Establishment of working group in M1 with clear terms of reference, agreed upon roles and responsibilities, and a work plan to guide its activities.	• Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions (D3.1)	• Active participation from stakeholders
• **T3.2** Revision of LOs to update teaching laboratory sessions in UG and PG programmes	• Structured mapping of Learning Outcomes with proposed revision of existing and introduction of new teaching labs for selected modules		
• **T3.3** Designing of new lab manuals	• Development of new lab manuals, which demonstrate the		
• T2.6 Improving digital literacy by development of life long learning Open Online Courses for biomedical and healthcare professionals	• 500 biomedical and healthcare professionals with digital literacy through participation records in Open Online Courses	• Enrolment sheets	
• T2.7 Approval of new and updated modules through PEC and relevant bodies at HEI.	• Validated and accredited new and updated modules on Industry4.0/5.0 technologies	• Approval documents • Updated prospectus for BME bachelor and master programmes	
• T2.8 Pilot Implementation of Revised BME Curricula and Short Courses and Feedback	• Participation of 400 bachelor and 250 masters students from 8 Pakistani HEIs in first cycle (M24) and second study cycles (M36)		• Approval from relevant accreditation bodies and HEI governance bodies for new and updated modules.

	integration of Industry 4.0/5.0 technologies in the teaching laboratory sessions • Lab manuals sent to external reviewers for peer review and feedback received		
• **T3.4** Procurement of equipment for upgradation of lab facilities	• 100% equipment fund is utilised by M12 and relevant lab staff training is completed	• Purchase invoices, operating manuals, photos of the equipment after installation.	• Timely procurement of lab equipment
• **T3.5** Reinforcement learning of digital transformation technologies via laboratory sessions	• Reinforced learning of digital transformation technologies, through the laboratory sessions, which demonstrate how Industry 4.0/5.0 technologies can be used in biomedical and healthcare settings to enhance patient care and safety.		
• **T3.6** Development of VR lab sessions	• Development of virtual reality (VR) lab sessions that provide immersive learning experiences and offer opportunities for students to experiment and learn using Industry 4.0/5.0 technologies • The developed VR/AR/MR sessions will be trialled on several	• 95% of students satisfaction in survey with learning of BME modalities using VR/AR/MR methods	• Timely development of VR/AR/MR sessions
• **T3.7** Development of AR/MR lab sessions	participants (students and staff members) and feedback will be received and incorporated during development stages.		
• **T3.8** Approvals, pilot implementation and students feedback	• Successful integration of Industry 4.0/5.0 technologies into the laboratory sessions, and improvements in student learning and engagement	• Student feedback, assessments, and evaluation metrics that demonstrate improved student learning outcomes, and approvals from relevant bodies at the HEI	
Work Package 4 • T4.1 Establishment of Centre of Excellence in Biomedical Engineering	• Academic staff members from non-partner HEIs will be invited to visit the centre and provide feedback. • Timely completion of staff and students training programmes • Timely completion of mentorship programme • Number of students, staff and entrepreneurs trained and supported by the Fab Labs • Feedback from visitors and trainers on Likert scale 1-5 (Average rating of 4 on Likert scale) • 3000 people supported and trained over the life of the project	• Records of faculty and student participation in Centre of Excellence activities	Support and ownership from partner HEIs for interdisciplinary collaborations and centre activities
• T4.2 Pan-Institutional Biomedical	• Case studies will be performed to document and analyse the	• Usage statistics tracking the number of	

Engineering Digital Fabrication Laboratory (Fab Lab)	success stories of startups and young entrepreneurs supported by Fab Labs (T5.9); Expert feedback from experts in biomedical engineering and healthcare industries will be gathered to assess the quality and relevance of services provided by the centre 90% active usage of Fab Labs during business hours by M36 Support of 10 projects each year in each Pakistani HEI Fab Lab Average rating of 4.5 on Likert scale by the users.	users and frequency and duration of usage to ensure full utilisation of the available facilities	
• T4.3 Entrepreneur Mentorship Programme • T4.4 Academic staff training in Innovative Pedagogies • T4.5 Academic staff training in Industry 4.0 technologies • T4.6 Academic staff training in TUCN • T4.7 Promoting wider impact and human resource development in Pakistani HEIs through reciprocal training programs • T4.8 Laboratory staff trainings • T4.9 Students training on Industry 4.0/5.0 technologies • T4.10 Students training on transformative skills • T 4.11 Student training on mental health and well-being • T 4.12 Development of digital platform for Mental Health and Well-Being	Enrolment of at least 5 entrepreneurs in mentorship programme • at each Pakistani HEI The training structures have been developed by DCU and TUCN in previous and current funded projects. These training programmes will be modified and updated according to BIOMED5.0 project. Prior to trainings, meetings will be organised with the potential trainees to gather their feedback and perspectives on the training programme. The reciprocal training programmes at Pakistani HEIs will be reviewed by DCU and TUCN Five one day trainings will be organised in Year 2 and Year 3 of BIOMED5.0 project, targeting 3000 students each year Over 95% satisfaction in learning and knowledge gain Average 4.5 score on Likert scale	Pre-and post training surveys on digital transformation competencies and satisfaction level	
	Access to digital DAS system for mental health assessment	• 1000 annual student users from each Pakistani HEI accessing DAS system	
• T4.13 Industry 4.0/5.0 Technology Hackathons **Work Package 5**	• Four annual Hackathons organised in Pakistani HEIs • Attendance of 2400 students in the Hackathons	• Annual report	
• T5.1 Dissemination, Communication and Exploitation Plan	• Plan developed to maximum BIOMED5.0 project outcomes and activities planned to reach target groups and stakeholders through dissemination and communication activities	• Report on communication, dissemination and exploitation plan (D5.1)	
T5.2 Copyright policy and intellectual property management	Effective copyright policy is developed and agreed by all partners •	Copyright policy documents shared with partner HEIs	Compliance with relevant laws and regulations related to copyright and

			IP management.
• T5.3 Dissemination and Communication using Digital Media	• Bi-annual publication of newsletter and strong presence on Social Media • Updated BIOMED5.0 website • Number of subscribers and feedback • Targets: Feedback score of 4 or higher; 8000 subscribers by M12 • Web analytics such as page views and bounce rate • Targets: Engagement rate of 10% or higher; 20,000 followers on social media by M24	• Feedback from readers through surveys or emails • Analysis of engagement on social media platforms	
• T5.4 Digital transformation Societal Impact Champion for Education And Public Engagement (EPE) activities	• Number of attendees and diversity of attendees • Targets: Feedback score of 4 or higher; 6000 attendees from diverse backgrounds in all events	• Feedback from attendees through surveys and post-event feedback forms	
• T5.5 BIOMED5.0 Annual Conference and Stakeholder Engagement	• Number of attendees and diversity of attendees • Targets: • Feedback score of 4 or higher • 250 attendees from all stakeholder sectors	• Feedback from attendees through surveys	
• T5.6 Organisation of Master Classes in Industry 4.0/5.0 and Digital Transformation	• Number of attendees and diversity of attendees • Targets: Feedback score of 4 or higher; • 500 attendees from diverse backgrounds	• Recordings of master classes posted online	
• T5.7 Participation in International Conferences	• Participation in at least two conferences by each partner HEI • Number of publications in Q1 journals • Target: 4 research publications by each partner in relevant first quartile (Q1) journals	• Peer reviewed papers published online (Open Access)	
• T5.8 STEM outreach programme	• Number of schools and students reached • Targets: Feedback score of 4 or higher; • 8 schools and 800 students each year	• Feedback from students and teachers through surveys • Visit reports and stories in newsletters	
• T5.9 Impact Assessment and Case Studies	• Five case studies published and feedback received	• Feedback from readers through surveys or emails	
• T5.10 Sustainability Plan	• Two funding applications submitted by each partner HEI for continuation of BIOMED5.0 activities	• Applications submitted in national and international funding schemes • Records of exploitation opportunities identified and pursued	

2.1.3 Project teams, staff and experts

Project teams and staff
Describe the project teams and how they will work together to implement the project.
List the staff included in the project budget (budget category A) by function/profile (e.g. project manager, senior expert/advisor/researcher, junior expert/advisor/researcher, trainers/teachers, technical personnel, administrative personnel etc. and describe shortly their tasks. If required by the call, provide CVs of all key actors. If required by the Call document/Programme Guide.

Name and function	Organisation	Role/tasks	Professional profile and expertise
Prof. Dr. Bhawani Shankar Chowdhry Professor	MUET	Project Manager	Prof Bhawani Shankar is a Distinguished National Professor and former Dean of Electrical, Electronics, Telecommunication and Computer Engineering School with extensive research, administrative and management expertise. He is the focal person of all US Educational Foundation Pakistan (USEF) student exchange programs and Erasmus Mundus facilitator and coordinator including CBHE CENTRAL projects at MUET. Having vast international exposure as he remained Guest Scientist/Associate of the ICTP (under umbrella of UNESCO/UNU), Trieste Italy for Twelve (12) Years and European Union Erasmus Fellow. In the capacity of Guest Scientist/Associate, he visited the UNESCO/UNU ICTP, Trieste Italy for more than 18 months in 8 different intervals to attend international workshops and carry out research in Italian Labs. Under these Fellowships, he delivered Keynote lectures in Italy, England, Ireland, USA, France, Germany, Malaysia, China, Singapore, Pakistan, Spain, Cyprus, Norway, Bahrain, UAE, Thailand and Switzerland. Prof Bhawani acted as the lead person for four European Commission Erasmus Mundus exchange programs "Mobility for Life", "STRoNG-TiES" (Strengthening Training and Research through Networking and Globalisation of Teaching in Engineering Studies), INTACT (It's Time for CollaboratioNTowArds Close CooperaTion) and LEADERS (Leading mobility between Europe and Asia in Developing Engineering educations and ReSearch) and CBHE CENRTAL (Capacity building and ExchaNge towards attaining Technological Research and modernizing Academic Learning) Another five projects of EU International Credit Mobility got approved for fully funded staff motilities of one week and Masters/PhD students exchange motilities for 6 months. In 2015, he co-organized two weeks ICTP/UNESCO Regional workshop on "FPGA Based Instrumentation Systems", fully funded by the ICTP/UNESCO first time in Pakistan in which scientists from 27 regional countries were invited for participation. He coorganized first ever "Global Conference on Wireless and Optical communication" (GCWOC'16) at Univ of Malaga (UMA), Spain, Sep 05-07, 2016, GCWOC17 in Sep 2017, GCWOC'18 in Oct 2018 under the joint collaboration of MUET, UMA, Spain. The selected papers of the conference were published by Springer International Journal of Wireless Personal Communication and they have entrusted me the responsibility of its Lead guest editor. He is also heading HEC funded national centre of

			Robotics and Automation (NCRA) at MUET.
Dr Abdul Qadir Ansari	MUET	Senior Expert	Dr. Abdul Qadir Ansari, is currently the head of the department of Biomedical engineering at Mehran UET. He shall act as the Deputy Director in the proposed project. He worked as a Senior Manager in multinational company. He led several key projects. Under his leadership, the company achieved significant growth. Considering his vast management experience, he has taken the lead role of coordinating the tasks of management, planning, quality assurance, and evaluation. He earned his PhD from Mehran UET in 2012. Dr. Ansari's professional objective is to build his career as an academician and as a solution developer, particularly in the field of e-Health, M-Health application design, and infrastructure design that fosters outreach in health services provisioning. Dr. Ansari has research experience with OSL Research Group at the University of Illinois at Urbana-Champaign, IL, USA. He has served as a member on National Curriculum Revision Committee. Areas of his research include Remote Healthcare, Nanotechnology based solutions for healthcare. Dr. Ansari has published several articles in international and national journals of international repute. Dr. Ansari has contributed significantly to the field through his numerous publications and has a strong record of achievement, including securing research and development grants from the Higher Education Commission of Pakistan and NGIRI-IGNITE.
Prof Dr. Ahsan Ahmad Ursani, Professor	MUET	Senior Expert	Dr Ahsan Ahmed Ursani is currently working as a professor in the department of biomedical engineering at MUET Jamshoro. He possesses a vast teaching experience spanning over more than 25 years at MUET Pakistan, INSA de Rennes France, and South Asian University New Delhi. He has served as a teacher trainer, a researcher at INSA de Rennes, University of Limerick, and ICTP Italy. He is the founding chairman of the department of biomedical engineering at MUET. Dr. Ahsan Ahmad Ursani received in BE in Electronics Engineering (1995) from MUET, ME in Telecommunication Engineering (2003) from MUET, and PhD in Signal and Image Processing (2008) from INSA de Rennes, France. He has served as a member on National Curriculum Revision Committee, as well as an academic evaluator on Pakistan Engineering Council and Chartered Inspection and Evaluation Committee of Government of Sindh. Areas of his research include Signal and Image Processing, Biomedical Engineering, Natural Language Processing, Remote Sensing, Machine Learning, and Education Philosophy. Dr Ursani has several publications in national and international journals and conferences to his credit. Dr Ursani established first ever students' chapter of EMBS in Pakistan at MUET in 2014 and worked as the

			first advisor of the chapter. Dr Ursani has been the responsible contact person on an Erasmus+ staff mobility agreement between University of Tartu and Mehran University of Engineering and Technology signed in 2018-2019. Dr Ursani runs an educational channel on YouTube channel, showcasing videos on engineering, mathematics, general science, scientific history, physics, computing, programming, language learning and linguistics.
Dr. Abi Waqas	MUET	Senior Researcher	Dr. Abi Waqas is currently serving as an Assistant Professor in the Telecommunication Department of Mehran University of Engineering and Technology (MUET), Jamshoro. He is also serving as the Chair of IEEE Industrial Electronics Society (Karachi Chapter), Branch Counsellor at IEEE MUET Student Branch, and Student Chapter Advisor of Optical Society (OSA). Recently, he has been selected for Marie Skłodowska- Curie Actions (MSCA) fellowship co-funded by Science Foundation Ireland (SFI) to pursue his research in Photonics at Tyndall Institute. He is also invited by Dr. Lukas Chrostowski, Professor of Electrical and Computer Engineering at the University of British Columbia (UBC), Vancouver, Canada to join his group as a Research Fellow. He has done his bachelor's degree in Telecommunication Engineering jointly from Aalborg University, Denmark, and MUET, Jamshoro with distinction. He has done his Ph.D. in Information Technology (Integrated Photonics) with Photonic Devices Group under the supervision of Prof. ANDREA MELLONI (Full Professor in Politecnico di Milano, Italy and Group Leader at Photonic Devices Group) and co- supervision of Dr. DANIELE MELATI (Researcher at the Centre de Nanoscience et de Nanotechnologies – C2N, Université Paris-Saclay). He was awarded with the prestigious Erasmus Scholarship to complete his bachelor's and Ph.D. degrees in Europe. Recently, he was also awarded Erasmus+ KA107 research and staff exchange for teaching and research activities at Politecnico Di Milano, Italy. He has acquired several national and international funding worth 15 million PKR to pursue research in Pakistan and abroad. Recently, Erasmus+ KA171 (Higher Education Students and Staff Supported by External Policy Fund Index) project has been approved with Dublin City University, Ireland.Total project worth would be around 50 K Euros. Further, Erasmus+ Capacity Building (Strand 2) project in which he was integral part has been approved for funding. Total project worth would be around 720 K Euros. He worked with different Erasmus Mundus (EM) projects in MUET, Jamshoro i.e., Strong-ties, EM INTACT, EM LEADERS and EM CAPRIO. He is working as a board member of several professional societies: OSA, IEEE, PEC, and QS World Merit.
Dr Syed Amjad Ali	MUET	Senior Researcher,	Dr. Syed Amjad is currently working as Associate Professor in the Department of Biomedical Engineering at Mehran University of Engineering and Technology,

			Jamshoro, Sindh, Pakistan. His research interest includes robots, controlled dynamics & algorithm designing. Currently I am involved in various research projects with undergraduate, and Masters students in Department of Biomedical Engineering. I am also awarded research grant two time by NIGRI-IGNITE (National Technology Fund) and IEC (Innovation and Entrepreneurship Centre). He has served as an expert with Drug Regulatory Authority Pakistan (DRAP).
Engr. Maham Mahnoor,	MUET	Researcher	Engr. Maham Mahnoor is working as a Research Associate at Department of Biomedical Engineering MUET. She has published her research papers in HEC recognized journals and is currently supervising two research projects.
Dr. Sidra Abid Syed	SSUET	Researcher	Dr. Sidra Abid is currently working as Associate Professor and Chairperson Biomedical Engineering Department, SSUET, Karachi. Dr. Sidra is a graduate of Biomedical Engineering, done her masters in Communication and Signal Processing and PhD in Electrical Engineering (Application in Artificial Intelligence for diagnosis of Voice Disorders). She is currently working as an Associate Professor in Biomedical Engineering Department, Faculty of Computer and Electrical Engineering, Sir Syed University of Engineering and Technology, Karachi Pakistan. She is having a diversified Experience of Working as a Professional Biomedical Engineer in Industry and Academia for last past seventeen (17) years. She has been teaching the core courses in Biomedical Engineering undergraduate and post graduate program. She have got her several articles published at the research areas of COVID 19, Artificial Intelligence system for Medical Diagnosis, Vehicular systems, Novelty in Biomedical Diagnostic devices. Due to her affiliation and services in industry and academia she understands the gaps between industry and academia.
Dr. Sumbul Mujeeb	SSUET	Psychologist	Dr Sumbul Mujeeb is working as a Chairperson (Acting) in Department of Psychology and the In charge of 'The Centre of Wellness and Recreation' at Sir Syed University of Engineering and Technology (SSUET). She is a Clinical Psychologist and a Certified Hypnotherapist (ABNLP, USA) having an experience of more than 10 years in her field. She proudly introduced the course of Psychology first time ever in SSUET in the year 2009 leading to the establishment of B.S in Clinical Psychology Program at Sir Syed University of Engineering and Technology. She also served community under the umbrella of Professional Youth Foundation of Pakistan as Director Training and Assistant Training Director at TWC where she conducted various trainings in cooperate sector, Ranger Head Quarter, schools and Universities. She also served as a Consultant Counselor and trainer at PANAH Shelter Home and currently the part of Sister of the Good Shepherd (Maskan-E-Shafqat) as trainer and

			senior Psychologist.
Waqad Hashmi	SSUET	Junior expert/Researc her	Waqad is serving as a Senior Lecturer in Biomedical Engineering Department, He has been involved in Research groups of Artificial Intelligence, Digital Logic Design and Power Systems. His service to Academia is about of 15 years. He developed laboratory facilities to support this research and associated teaching. He have supported the Departmental strategy, to develop undergraduate programmes supporting the needs of local industry in the area of electrical engineering.
Dr. Sarmad Shamas	LUMH S	Lead LUMHS Team.	Dr. Sarmad Shams is currently serving as Associate Professor and HoD at Institute of Biomedical Engineering and Technology, LUMHS, Jamshoro, Pakistan. He received his Ph.D. in Biomedical Science and Engineering from Koc University, Turkey. He received MS degree from Hanyang University South Korea and BS from Sir Syed University of Engineering and Technology, Karachi, Pakistan in 2011 and 2007 respectively. He published several research articles in International journals and conferences. He has registered 6 patents as well. His research interests include sensors, prostheses, Artificial Intelligence, Biomedical Instrumentation.
Dr. Aatir Hanif Rajput	LUMH S	Psychologist	Dr. Rajput is a mental health professional, Researcher And Educationist. Dr. Aatir Rajput is a medical graduate who holds MBBS, Diploma In Applied Psychology, Masters In Applied Psychology, Diploma In Cognitive Behavioural Therapy, Masters of Medicine in Psychiatry (MD Psychiatry). He is Certified Health Professional Educationist (CHPE), Clinical Research Certified Professional (CRCP) and Medical Editor (CME). Dr. Rajput is currently serving as Senior Registrar at Department of Psychiatry & Behavioural Sciences, where he is involved in teaching and training of students in clinical psychiatry and behavioural sciences. Moreover, he is a founding member and Deputy Director of the Centre for Psychosocial & Academic Wellbeing, which looks after the student wellbeing in various aspects. He is also the Coordinator for Student Mentorship Program of Liaquat University of Medical & Health Sciences, Jamshoro. Dr. Rajput is acclaimed educationist and researcher who has over 60 research articles, published in peer reviewed national and international journals, to his credit.
Engr. Sasuee Khatoon; o	LUMHS	Researcher	Lecturer at IBET, LUMHS Jamshoro, She is member of different department committees like FYP Committee, HEC/PEC Documentation Committee,
Dr. M. Zeeshan Ul Haque	SHU	Senior Researcher	Dr. M. Zeeshan is an academician and research professional with more than 19 years of experience in teaching, research, and administration in biomedical engineering. He is currently serving as the Dean of the Faculty of Engineering and as professor and chairperson of the Department of Biomedical Engineering at Salim Habib University. He has completed his PhD, MSc, and BS degrees in Bioengineering, Medical Electronics and Physics, and Biomedical Engineering from the University of Auckland, NZ, Queen Mary University of London, and SSUET, Pakistan, respectively. He has research experience in the fields of biomedical instrumentation, modelling and simulation, biomaterials, and bio-signal

			processing and is currently supervising and working on various research projects. He has experience in academia industry collaboration with the health care industry and institutions on national and international levels.
Engr. Hassan Ali	SHU	Researcher	Engr. Hassan is currently working as a Lecturer in the department of biomedical engineering, Salim Habib University, Pakistan. He has 11 years of experience in teaching and research in the field of biomedical engineering. He is the member of Board of studies and Industrial Advisory Board of the department. He has supervised many BME undergraduate semester projects. He has published some research work in national international conferences and journal. His research interest includes, Rehabilitation engineering, Modelling and simulation, Medical Device Design and Advanced Biomaterials.
Prof. Dr. Muhammad Asif,	ZU	Senior Researcher	Dr. Muhammad Asif is a professor in the Department of Electrical Engineering at Ziauddin University. He did his Ph.D. in Control Engineering at the National University of Science and Technology, Pakistan, and has an MS in Electrical Engineering and Electronics from Universiti Sains Malaysia (USM), Penang, Malaysia. He worked with the USM Robotics Research Laboratory (URRG) and developed various robotics hardware and software. He has research experience in mobile robots, image processing, control systems, and bioinstrumentation. He is also the principal investigator of the Data Acquisition, Processing, and Predictive Analytics Lab, the National Center for Big Data and Cloud Computing, funded by the Higher Education Commission, Pakistan. He is currently working on cloud-based data acquisition and processing systems, edge and fog computing, big data analytics, and cloudbased medical devices.
Muhammad Usaid	ZU	Researcher	Mr. Muhammad Usaid received his Master's Degree from Ziauddin University. He carries 3 years of research and industrial experience. He has been involved in various AI, IoT and Artificial Intelligence based projects. He is a remarkable researcher and a skilled technical writer, with a proven track record of producing impactful publications.
Dr. Ali Raza	UET Lahore	Senior Researcher	Head of the Mechatronics and Control Engineering Department at UET Lahore, with a strong research background and extensive experience in curriculum and lab development, project management, and supervising robotics projects in the biomedical field
Dr. Nida Iqbal/Expert	UET Lahore	Senior Researcher	The Head of Department at the Biomedical Engineering Centre, UET Lahore, possesses a robust research background in biomedical engineering.
Dr. Gulistan Raja	UETT	Senior expert / advisor/ researcher.	Dr Raja is actively contributing in curriculum development and capacity building of faculty. In this regard, he was involved in the curriculum development of BS Electronics Engineering technology program by the Higher Education Commission, Islamabad in 2016. He is currently member of Engineering Curriculum Review & Development Committee (ECRDC), Pakistan Engineering for Electrical Engineering. He has also conducted various trainings and workshops on outcome-based system of education and accreditation for

			capacity building of faculty of various universities of Pakistan. Dr. Raja won a scholarship award by Government of Japan in April 1999 and completed a Masters in Information Systems Engineering from Osaka University, Osaka, Japan. During that, he has also worked in Synthesis Corporation, Osaka Japan. He completed his PhD in Electrical Engineering from UET Taxila in 2008. He received Best University Teacher award for year 2010 by Higher Education Commission, Islamabad. He has authored/co-authored more than 100 research publications in reputed international journals, and refereed conferences. Moreover, he has also supervised 3 PhDs and more than 60 M.Sc. Electrical Engineering Thesis at UET Taxila. He is a senior member of IEEE and has been member of technical program committees in many IEEE international conferences and reviewer in international journals. He was Chairman, Electronics Engg. Dept., UET Taxila from Mar. 2015 to Apr. 2018, Counselor of IEEE student branch UET Taxila from December 2009 to Nov. 2022 and Associate Editor, IEEE Access Journal from Aug. 2019 to Sep. 2022. He is Chair Awards and Recognition Committee, Islamabad Section since April 2018, Academic Editor PLOS-ONE Journal since Aug. 2020 and Associate Editor IET Journal of Engineering from Dec. 2020. He has also completed multiple research projects sponsored by various organizations. His research interests include signal and image processing, VLSI architecture of image processing systems and medical image analysis.
Dr. Furqan Shaukat	UETT	Researcher	Dr. Furqan Shaukat has more than fifteen years of teaching and research experience. He is the principal investigator of the HEC research grant of 8.34 Million PKR, titled , "EMeRALDS: Electronic Medical Records driven Automated Lung nodule Detection and cancer risk Stratification". He has also been the principal investigator of Faculty Research Grant UET Taxila of Rs. 1.74 million PKR. He is the recipient of prestigious Fulbright Scholarship 2022 for post-doc and a six month scholarship under the HEC scheme titled, IRSIP where he worked as a visiting research associate at CISTIB in University of Sheffield, UK. The proposed team is adequate, having sufficient experience in Medical Image Processing and Analysis domain and suffices the required skill to deliver the results in a timely manner.
Dr. Junaid Mir	UETT	junior expert / researcher and teacher/ trainer	Dr Junaid Mir has more than 14 years of teaching and research experience. His research work focuses mainly on biomedical signal and image processing. His PhD is from the University of Surrey UK and his doctoral work was funded by the UK Department for International Development (DFID). Dr Mir has authored more than 30 peer-reviewed international journal and conference articles. He has won number of research projects with a total grant exceeding €30K. He is currently working as a Co-PI in the HEC research grant of 8.34 Million PKR, titled , "EMeRALDS: Electronic Medical Records driven Automated Lung nodule Detection and cancer risk Stratification".
Dr Wazir Muhammad,	BUETK	Senior Researcher	Dr Wazir Muhammad working as Assistant Professor in the department of Biomedical Engineering, Balochistan University of Engineering & Technology, Khuzdar, Pakistan. He worked as Researcher and Teacher

			Department of Electrical Engineering, BUET, Khuzdar. Dr Wazir have a depth knowledge of Artificial Intelligence, specialization in deep learning, including natural, and medical image super-resolution. I have a proficient knowledge in data analysis using MATLAB, Python and Keras TensorFlow deep learning libraries.
Engr..Nazia Ejaz;	BUETK	Researcher	Engr. Nazia Ejaz is working as a lecturer at the Department of Biomedical Engineering at Balochistan University of Engineering and technology. She is working as a member of Outcome Based Education. She has worked at Ziauddin university for 7 years as a lecturer. Her specific area of research is automatic Gait Monitoring.
Dr Inam Ul Ahad; Assistant Professor; Senior Expert in Biomedical Engineering, Digital Transformati on; Advanced Manufacturin g; Smart Manufacturin g; Industry 4.0	DCU	DCU Team Lead; Senior Expert	Dr Ahad is working as Assistant Professor in the School of Mechanical and Manufacturing Engineering, Dublin City University. He worked as Research Development Officer in I-Form, the SFI Research Centre for Advanced Manufacturing and as postdoctoral researcher in an EU funded project Pan European Clusters for Technology Transfer and New Value Chains (ACTTiVAte). Dr Ahad is the Lead Principal Investigator in DCU for an Erasmus+ funded project, Collaborative e-platform for innovation and educational enhancement in medical engineering (CALLME). He is Principal Investigator in a European Institute of Innovation & Technology (EIT) funded project, Innovation capacity Building for Higher Education in Industry 4.0 and Smart Manufacturing (SMART-2M). He is currently developing a postgraduate certificate programme for training of industry employees on Innovative Materials for Industry 4.0. Dr Ahad is a Funded Investigator in IForm, the SFI Research Centre for Advanced Manufacturing and Supervisor in Advanced Metallic Systems Centre for Doctoral Training. Dr Ahad is leading Erasmus+ ICM programme in DCU with active collaboration with Pakistani HEIs. Dr Ahad has participated in seven large national and international consortia (I-Form, AMSCDT, ACTTiVAte, EXTATIC, Laserlab Europe, COST Action MP1203, and CEZAMAT). These projects are related to applications of sustainable manufacturing in science and technology and assessment of technologies to identify new cross border value chains across four industry sectors (healthcare, agro-food, ICT and aerospace), advanced manufacturing, biomedical engineering, healthcare, information and communication technology, laser and materials processing, advanced manufacturing, system development and integration, process parameter mapping, and data acquisition, processing and analysis.
Dr Owen Clarkin; Assistant Professor	DCU	Senior Expert	Dr Clarkin is working as Assistant Professor in the School of Mechanical and Manufacturing Engineering, Dublin City University. Dr Clarkin assumed the role of Course Director of Biomedical Engineering (BEng and MEng programmes) between 2016 and 2023 and headed the expansion of the programme and the development of an integrated MEng (biomedical engineering) pathway in 2020. Dr Clarkin is Principle Investigator of the Biomaterials Research Group and a Principle Investigator of Biodesign Europe, Medical Engineering Research Centre Engineering (MedEng) and Advanced Processing Technology Research Centre (APT). Dr Clarkin's main research focus is in injectable and adhesive biomaterial, as well as well as the integration of technology into engineering higher education. Dr Clarkin heads up the Engineering Teaching Enhancement

			Committee (ETEC) at DCU to develop a community of practice in innovative engineering pedagogy.
Dr Tanya Levingstone Associate Professor	DCU	Senior Expert	Dr Levingstone is an Associate Professor in Biomedical Engineering in the School of Mechanical and Manufacturing Engineering (DCU) and Chair of the BEng and MEng programmes in Biomedical Engineering in DCU. She teaches a range of subjects on these programmes including 'Surgical Device Technology (MM499)', Rehabilitation Engineering (MM498)' and 'Biomechanics of Tissue Engineering (MM517)' and has expertise in engineering curriculum development and renewal. She is a highly active researcher and is Assistant Director of the Advanced Processing Technology (APT) Research Centre, DCU, a PI in BioDesign Europe and a Funded Investigator in I-Form, the SFI Research Centre for Advanced Manufacturing. She leads a research team focused on the development of novel biomaterial and tissue engineering solutions for bone, cartilage and osteochondral defect repair and has extensive expertise in scaffold fabrication and in vitro and in vivo assessment. She has +30 highimpact publications (citations 2,193, h-index 21). She has attracted more than €5 million in research funding as PI and Co-I since joining DCU in 2017 and currently supervises 9 PhD students and 4 postdoctoral researchers.
Dr Khaled Benyonis	DCU	Senior Expert	Dr Khalid Benyounis brings extensive experience in the use of Industry 4.0/5.0 technologies in biomedical engineering application. He has strong expertise in laser material processing and a strong understanding of design of experiment, with practical applications in various industries. His expertise also extends to biomass and energy conversion for renewable energy. Additionally, he is expert in thermal coating for applications in the biomedical engineering.
Dr Muhannad Ahmed Obeiddi Assistant Professor	DCU	Senior Expert	Dr Obeidi is working as Assistant Professor in the School of Mechanical and Manufacturing Engineering, Dublin City University. He worked as a researcher at the I-Form Advanced Manufacturing Research Centre. His research work area is focused on the laser processing of materials in addition to the Additive Manufacturing (AM) and 3D printing of metals. He has rich experience in printing of different types of metal powders supported by respectful credit of published research work. Examples on printed metals are 316L SST, CoCr, NiTi, INC 718, and Al6061. Also, more research work on the post processing of AM parts including laser and electrochemical polishing for surface profile enhancement and heat treatment for the thermal stress release. On the laser processing of materials, Dr. Obeidi has rich experience in the surface modification of metals including laser hardening and wear resistance improvement in which he lead an industrial project to enhance the work life of a product by 500% by increasing the wear resistance. The project was carried out by using a fiber laser-nitriding process. Other laser treatment include welding, polishing, texturing, and cladding. Dr Obeidi approaches industrial partners and propose a problem-solving projects. He is a Funded Investigator in I-Form, the SFI Research Centre for Advanced Manufacturing and Supervisor in Advanced Metallic Systems Centre for Doctoral Training. Also, he

			deliver lectures on Advanced Manufacturing, Data Analysis, and Mechanics of Materials for post and undergraduate engineering students.
Dr Shadi Karazi	DCU	Senior Expert	Dr. Shadi Karazi is a highly accomplished educator and technology expert at Dublin City University's Business School. He has a wealth of experience in using technology to enhance the learning experience, providing expert support to individuals and program teams. Dr. Karazi is well-versed in engineering, engineering education, and technology-enhanced teaching, with a focus on utilizing learning management systems to drive effective educational outcomes. He is also a dedicated researcher and workshop facilitator, constantly seeking new ways to develop effective, evidence-based pedagogies.
Dan Stan	TU Cluj-Napoca	Project Manager	PhD, expert in mechatronics/robotics
Alin Plesa	TU Cluj-Napoca	Senior Researcher	PhD, expert in mechatronics/robotics
Emil Teutan	TU Cluj-Napoca	Senior Researcher	PhD, expert in mechatronics/robotics
Razvan Pacurar	TU Cluj-Napoca	Senior Researcher	PhD, expert in additive manufacturing, 3D printing
Dr Nasir Mahmood Khan Lead contact person from PEC	Pakistan Engineering Council (PEC)	PEC Representative	PhD, expert in engineering education, accreditation of engineering programmes, curriculum revision

Outside resources (subcontracting, seconded staff, etc)

If you do not have all skills/resources in-house, describe how you intend to get them (contributions of members, partner organisations, subcontracting, etc).

If there is subcontracting, please also complete the table in section 4.

Not applicable

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2.1.4   Cost effectiveness and financial management

Cost effectiveness and financial management (n/a for prefixed Lump Sum Grants)

Describe the measures adopted to ensure that the proposed results and objectives will be achieved in the most costeffective way.

Indicate the arrangements adopted for the financial management of the project and, in particular, how the financial resources will be allocated and managed within the consortium.

A Do NOT compare and justify the costs of each work package, but summarize briefly why your budget is cost

effective.

(n/a for prefixed Lump Sum Grants)

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2.1.5   Risk management

Critical risks and risk management strategy

Describe critical risks, uncertainties or difficulties related to the implementation of your project, and your measures/strategy for addressing them.

Indicate for each risk (in the description) the impact and the likelihood that the risk will materialise (high, medium, low), even after taking into account the mitigating measures.

Note: Uncertainties and unexpected events occur in all organisations, even if very well-run. The risk analysis will help you to predict issues that could delay or hinder project activities. A good risk management strategy is essential for good project management.

Risk No	Description	Work package No	Proposed risk-mitigation measures
1.1	The developing world is contending with new educational trends. An inappropriate strategy towards adoption of digitalization in the curriculum of Biomedical Engineering program offered at HEIs at partner countries, can be catastrophic. Severity = High Likelihood = Low (due to strategy)	1	The strategic risk assessment process is tailored to the Specific Objectives (SOs) of the project. The initial step in the assessment process was based on deep understanding of the SOs. Through this process we have already established a foundation for integrating risk management with the strategy of the project.
1.2	Due to the slow process of approvals, schedule overrun may result in delay attainment of project objectives. Severity = Medium; Likelihood = Medium (Less Control)	1	The process of approval within HEIs of partner countries usually involve different authorities and is expected a time consuming process that usually results in delay. Nevertheless, through parallel scheduling of activities and proactive planning we have introduced a contingency plan so as to avoid lagging in schedule.
1.3	There is a risk that project may cost more than budgeted. Cost risk may lead to performance risk if cost overruns lead to reductions in scope or quality to try to stay within the baseline budget. Moreover, the instability in foreign exchange prices may affect the budget and introduce cost risk. Severity = High; Likelihood = Medium (Less Control)	1	We shall initiate process of procurement preferably online as soon as we get funding approval. We shall avoid involvement of third party vendors and shall apply for educational discounts. Moreover, a foreign exchange account shall be opened so as to avoid any limitation towards payments to propriety manufacturer.
1.4	Lack of collaboration among the project partners may result in delayed dissemination of work packages and low quality of deliverables. Severity = Medium; Likelihood = Low (due to strategy)	1	Through strong follow up on project milestones and effective performance benchmarking we shall avoid performance risk. A strong feedback mechanism and follow up plan is chalked out. Realignment of activities to the SOs shall help improve performance of the project.
2.1	Non acceptance by the Curriculum Approval Bodies at Partner HEIs. Severity = Medium; Likelihood = Low (due	2	We have already deliberated the proposed changes to existing modules and introduction to new modules with the

	to strategy)		senior faculty of partner HEIs and consensus is already achieved.
2.2	Non acceptance by the Employer/Industry: This kind of risk occurs when industry/employer is not given a role in curriculum design/revision. Severity = High; Likelihood = Low (due to involvement of stakeholders)	2	We have already involved the IABs (Industrial Advisory Boards) of the partner HEIs in the process of curriculum revision at the HEIs. The revision to the existing modules and introduction of the new modules is now on agenda of the upcoming meeting of the IAB's of the partner HEIs.
3.1	Delay in procurement of laboratory equipment Severity = Medium; Likelihood = Low (through detailed knowledge of market/manufacturers)	3	We shall ensure detailed knowledge of the equipment market and thus will ensure smooth shipments and shorter lead times.
3.2	Inadequate training Severity = Low; Likelihood = Low (through sufficient training opportunities)	3	We have decided to develop training component for laboratory equipment to ensure sufficient means of faculty training on the equipment.
3.3	Delaying the use of new equipment leads to its underuse- faculty resistance to change teaching means (apparatus). Severity = Low; Likelihood = Low (due to sufficient means of training)	3	Through sufficient training we can avoid delay in adoption of new laboratory facilities in teaching and intern respond to the resistance to change by the faculty.
4.1	Risk of failure of Incubation centre due to challenging requirements of technological facilities for prototyping. Severity = Low; Likelihood = Low (due to sufficient means of training)	4	We have deliberated the requirement of establishment of a Centre of Excellence with state of the art prototyping facilities such as FABLAB-digital fabrication, 3D printing, 3D scanning, CNC /miller machines for variety of materials so as to provide a rapid prototyping facility for new entrepreneurial setup.
4.2	Risk of failure due to lack of Entrepreneurial skills: the management staff in incubators may not come from an entrepreneurial background, they seldom possess the ability to meet the skills requirement of their clients. Severity = Low; Likelihood = Low (due to sufficient means of training)	4	Managerial trainings shall be provided to the management staff of the incubation centres so as to extend managerial support to the startups housed.
5.1	Risk of failure due to limited awareness: If partners are not made aware of project progress, findings, and outcomes, they may not recognize the value of the project or its potential impact. Severity = Low; Likelihood = Low (due to sufficient means of awareness and outreach)	5	Awareness and outreach campaigns through social media shall help building support, engaging stakeholders, gathering feedback and fostering collaboration to avoid failures due to limited awareness among stakeholders resulting in less engagement.

5.2	Risk of failure due to failure in dissemination of project findings. This can result in missed opportunities for collaboration, partnerships, and additional funding. Severity = Low; Likelihood = Low (due to sufficient means of awareness and outreach)	5	Project's progress monitoring and reporting is one of the major responsibilities of QA Manager. Findings on project execution shall be reviewed in EC meeting scheduled bi-annually to ensure that no opportunities are missed, collaborative efforts are carried towards strengthening of partnerships and additional resources for the project success.

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2.2 PARTNERSHIP AND COOPERATION ARRANGEMENTS

2.2.1 Consortium set-up

Consortium cooperation and division of roles (if applicable)

Please address all guiding points presented in the Call document/Programme Guide under the award criterion 'Quality of the partnership and the cooperation arrangements'.

Describe the participants (Beneficiaries, Affiliated Entities, Associated Partners and others, if any) and explain how they will work together to implement the project. How will they bring together the necessary expertise? How will they complement each other?

In what way does each of the participants contribute to the project? Show that each has a valid role and adequate resources to fulfil that role.

Mehran University of Engineering Technology (MUET)

Mehran University of Engineering Technology (MUET) Jamshoro Sindh, recognized by Higher Education Commission (HEC) of Pakistan as a Research-Intensive University, is the coordinator of BIOMED5.0 project. Dr. B. S. Chowdhry is currently working as the Distinguished National Professor in Mehran UET. He has vast experience of academic, professional, and social leadership. Having experience of co-organizing and chairing several international conferences, leading various engineering fora as well as European Union funded projects including STRoNG-TiES, INTACT, LEADERS, CBHE CENRTAL, he is the ideal person to lead the Biomed5.0 project under Erasmus+ funding.

Professor Dr. Abdul Qadir Ansari shall act as the Deputy Director in the proposed project. He is currently the head of the department of Biomedical engineering at Mehran UET. In addition to this, he worked as a Senior Manager in multinational company. He led several key projects, including the expansion of the company's network infrastructure and the development of new products and services. Under his leadership, the company achieved significant growth. Considering his vast management experience, he has taken the lead role of coordinating the tasks of management, planning, quality assurance, and evaluation. He will report to the Director of the project. Professor Dr. Ahsan Ahmad Ursani shall act as the Quality Assurance Manager on the proposed project. He has experience of more than 10 years of as the head of the department of biomedical engineering. Being the founding chairman of the department, he played a key role in the establishment of the labs. In addition to this, he has worked as a secretary on the OBE committee of the university and guided various academic departments in developing OBE based curriculum. He has contributed greatly to the online educational videos through his YouTube channel. Therefore, he would be coordinating some of the curriculum-related tasks as well on those related to the establishment of the Centre of Excellence at the department of biomedical engineering at MUET.

Sir Syed University of Engineering and Technology (SSUET)

Dr. Sidra Abid Syed is Associate Professor and chairperson of Biomedical Engineering Department at Sir Syed University of Engineering and Technology (SSUET) Karachi Sindh. Dr. Syed will lead her team comprising Dr. Mariam Raziq, Engr. Sunila Afroz, Engr. Waqad Hashmi and Engr. Sania Tanvir to coordinate the tasks related to program educational objectives and learning outcomes of the undergrad and postgrad programs in biomedical engineering, and mental well-being of the students and staff.

Dr Sumbul Mujeeb is the Chairperson of Department of Psychology, in SSUET. Dr Mujeeb will lead the team responsible for tasks related to mental health and wellbeing. The team includes Dr Aatir Hanif, who is the Senior Registrar and Deputy Director of Centre for Psychosocial & Academic Wellbeing in LUMHS and Ms Nighat Altaf, who is the coordinator of Centre of Wellness and Recreation in SSUET. Dr Mujeeb will lead the team to develop the digital DAS assessment platform and organise mental health and wellbeing seminars in all partner HEIs.

Liaquat University of Medical and Health Sciences (LUMHS)

Dr. Sarmad Shams is currently serving as Associate Professor at Institute of Biomedical Engineering and Technology at Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, Sindh. He received his Ph.D. in Biomedical Science and Engineering from Koc University, Türkiye. His research interests include sensors, prostheses, Artificial Intelligence, Biomedical Instrumentation. The team at LUMHS comprises senior as well as junior faculty members. Being a part of the medical university, the team at MUMHS will coordinate the tasks of student and staff training on mental health and well-being. Dr. Sarmad along with his team members Dr. Aatir Rajput, Engr. Hiba Pervaiz, Engr. Natasha and Engr. Sasuee will be responsible for the Project Impact and Outreach: Dissemination, Communication and Exploitation work package.

Salim Habib University (SHU)

Prof. Dr. M. Zeeshan Ul Haque from is currently serving as the Dean of the Faculty of Engineering and as professor and chairperson of the Department of Biomedical Engineering at Salim Habib University (SHU). He has experience in academia-industry collaboration with the healthcare industry and institutions on national and international levels. Dr. Haque along with his team members from SHU shall coordinate the activities related to the procurement of the equipment for upgradation of the existing laboratory facilities and for the development of Digital Fabrication laboratories at the partner HEIs. Being located in the economic hub of Pakistan, SHU shall coordinate the tasks related to the mentoring of the students for entrepreneurship.

Ziauddin University (ZIAU)

Prof. Dr. Muhammad Asif is the team lead and principal investigator of the Data Acquisition, Processing Predictive Analytics lab at Ziauddin University, National Center in Big Data and Cloud Computing (NCBC). Having long research and teaching experience in electrical engineering in general and Machine Learning, Internet of Things, Cloud-based Instrumentation, Vision System in particular, and having worked on the funded projects on embedded and intelligent systems, he is most suitable for coordinating the tasks related to the development of new laboratory exercises.

University of Engineering and Technology Lahore (UETL)

A team of faculty members from the Department of Biomedical Engineering and Department of Mechatronics Engineering and from University of Engineering and Technology Lahore (UETL) shall coordinate the tasks related to the use of immersive technologies in teaching the biomedical engineering courses like Human Anatomy and Physiology. Dr. Ali Raza and Dr. Muhammad Ahsan Naeem and Dr. Nida Iqbal are the lead members from UETL on the proposed project. They possess the required laboratory experience of working with equipment related to immersive technologies. They will coordinate the tasks related to the development of lab sessions based on AR/VR and their evaluation.

Baluchistan University of Engineering and Technology, Khuzdar (BUET)

Dr. Wazir Muhammad is an Associate Professor and Chairperson of the Biomedical Engineering Department, Baluchistan University of Engineering and Technology, Khuzdar, Pakistan. He has more than 20 years of experience in University teaching. He serves as a postdoc researcher at Chulalongkorn University Bangkok, Thailand, under the supervision of Dr. Supavadee Aramvith. Associate Professor in Electrical Engineering, Chulalongkorn University Associate Head, Internationalization Head, Multimedia Data Analytics and Processing Research Unit. He has research experience in fields of Deep Learning based Image Super-Resolution, Medical Images Super-Resolution, MRI Image Super-Resolution, Brain Tumor Classification, Digital Signal Processing, Digital Image Processing, Convolutional Neural Networks, Electrical Circuits, and Neural Networks. Dr Nazia Ejaz is Assistant Professor in Biomedical Engineering Department, BUET. She will support Prof Wazir in carrying out activities assigned to BUET.

University of Engineering & Technology Taxila (UETT)

Prof. Dr. Gulistan Raja from University of Engineering & Technology Taxila (UETT) is a leading resource person in the field of training on capacity building for faculty and students alike. Furthermore, Dr. Raja has many projects funded by Higher Education Commission of Pakistan to his credit. Therefore, he has been assigned the responsibility of filing funding applications with the local funding agencies for continuation, advancement and sustainability of the project outcomes.

Dublin City University (DCU)

DCU team lead, Dr Inam Ul Ahad is Assistant Professor of Biomedical Engineering and Funded Investigator in the Advanced Metallic System Centre for Doctoral Training. Dr Ahad has co-developed two post-graduate level programmes in DCU, one for structured PhD students with industry co-funding mechanism and the other is focused on training of industry professionals in Industry 4.0/5.0 technologies. Dr Ahad has developed Virtual Reality based laboratory training sessions for large scale

advanced manufacturing and characterisation equipment. Dr Ahad will provide guidance and support in the development and upgradation of curriculum development, VR/AR/MR lab sessions, and trainings on advanced and additive manufacturing. Dr Owen Clarkin (Course Director of Biomedical Engineering) and Dr Tanya Levingston (Associate Professor in Biomedical Engineering), DCU will support curriculum development activities. Dr Shadi Karazi is a renowned educator and technology expert. Dr Karazi will lead the innovative pedagogy training programme at DCU.

Technical University of Cluj-Napoca (TUCN)

Dr. Sergiu-Dan Stan is an Associate Professor at Dept. of Mechatronics and Machine Dynamics in Technical University of Cluj-Napoca (TUCN), Romania. He organized the ERASMUS program at the level of the faculty of Automotive, Mechatronics and Mechanics. His and his teams' expertise include Internet of Things, Cloud-based E-learning, additive manufacturing, and Robotics. Dr. Stan will lead the team from Romania, a program country. The team led by Dr. Stan will be responsible for training the academic staff from the program countries on Industry 4.0/5.0 technologies including immersive technologies, additive manufacturing, internet of things, cloud computing and robotics.

Pakistan Engineering Council

Dr Nasir Mahmood Khan is Registrar in Pakistan Engineering Council and was Head of Accreditation Department at Pakistan Engineering Council (PEC). Dr Khan has diversified professional higher academic qualifications and rich working experience of over 30 years in engineering sector. Dr Khan is serving in various capacities in PEC including Field Projects Evaluation, Planning & Development, Quality assurance in Higher Education, Education Regulation, Standardization & Accreditation, Program Evaluation and Benchmarking, Policy making, representing Pakistan in various higher international professional forums/organizations (FEIAP/UNESCO for Asia & Pacific), FEIIC (OIC level)-EQAPS Project. Dr Khan is the Focal person for Washington Accord & IPEA of International Engineering Alliance (IEA) for Global Standardization of education), and International Reviewer of Tertiary Education under the umbrella of UNESCO/ FEIAP and IEA (WA) in Pakistan. Dr Khan will represent PEC in BIOMED5.0 project and provide guidance and support in curriculum development and update activities. Dr Khan will also serve as member of EC, Steering Committee and will play his role in strengthening and fostering collaboration between the knowledge triangle elements and government institutes.

2.2.2 Consortium management and decision-making

Consortium management and decision-making (if applicable)

Explain the management structures and decision-making mechanisms within the consortium. Describe how decisions will be taken and how regular and effective communication will be ensured. Describe methods to ensure planning and control.

Note: The concept (including organisational structure and decision-making mechanisms) must be adapted to the complexity and scale of the project.

Consortium Management and Leadership Structure

BIOMED5.0 project management and leadership structure is presented in Error! Reference source not found..
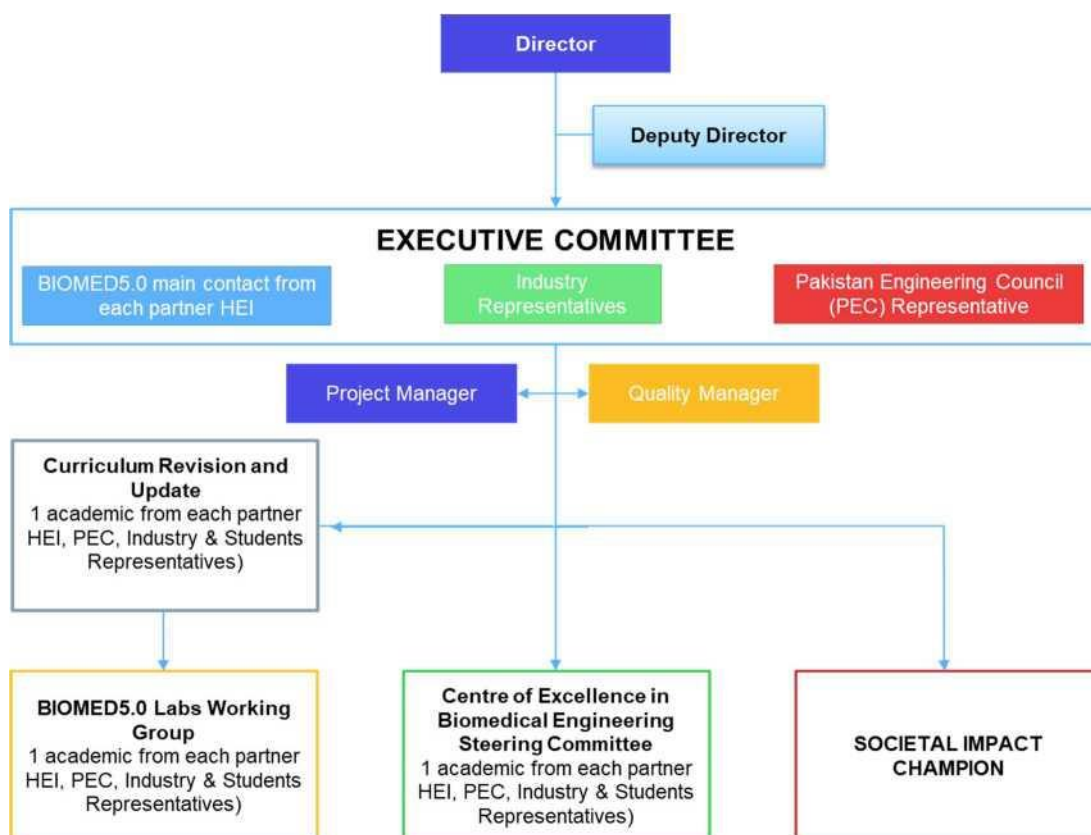
Figure 4 BIOMED5.0 Leadership and Project Management Structure

The BIOMED5.0 project will run for three years, during which the following management structure will be in place:

Director and Deputy Director: The Director will provide overall strategic direction for the project, while the Deputy Director will support the Director and assume their responsibilities when needed.

Executive Committee (EC): The Executive Committee will comprise the main contact person from each partner university, industry representatives, and the PEC representative. The EC will meet every quarter (at least once in-person each year) to discuss progress, identify issues, and make strategic decisions.

Consortium Agreement (CA)

After the Grant Agreement is signed, the EC will prepare the Consortium Agreement (CA) and all partners will provide their inputs. The CA is expected to be completed, agreed and signed by all partners within four months of BIOMED5.0 start date. The CA will detail the organisational structure, decision making and conflict resolution processes, project responsibilities, financial commitments and reporting, funds distribution mechanisms and partner obligations.

Project Manager (PM): The Project Manager will be responsible for all project work, including maintaining regular communication with partners, providing regular project updates, and presenting progress reports to the EC.

Quality Assurance Manager (QAM): The Quality Assurance Manager will be responsible for ensuring that all project deliverables meet the required quality standards.

Societal Impact Champion: The Societal Impact Champion will be responsible for communication and dissemination activities, including outreach to stakeholders, public relations, and media relations.

Curriculum Revision and Update Committee: The Curriculum Revision Committee will provide

recommendations for the curriculum to be taught in the project. It will comprise one academic member from each partner university, PEC, industry and student representatives. The committee will meet during the kick-off meeting to revise and update the Programme Educational Outcomes and Learning Outcomes. Followed by the kick-off meeting, the committee will meet online each quarter.

BIOMED5.0 Labs Working Group: The BIOMED5.0 Labs Working Group will implement the changes recommended by the Curriculum Revision Committee related to lab upgradation, equipment procurement and development of VR/AR/MR based sessions. It will comprise one academic expert from each partner HEI and PEC, industry and students representatives.

Centre of Excellence in Biomedical Engineering Steering Committee: The Steering Committee will oversee the Centre of Excellence in Biomedical Engineering, which will include providing strategic direction for the Centre, setting goals and targets, and monitoring progress. This committee will meet online every six months.

Decision-Making Mechanisms

The Executive Committee will be responsible for making major decisions related to the project. The Project Manager will present updates and reports on project activities to the EC for review and approval. The Steering Committee will oversee the Centre of Excellence in Biomedical Engineering, while the Curriculum Revision Committee will provide recommendations for the curriculum to be taught in the project.

Project Communication

Regular communication will be ensured through frequent meetings of the Executive Committee, Steering Committee, and other working groups. These meetings will provide an opportunity for partners to share progress, discuss challenges, and make decisions.

The Project Manager will maintain regular communication with all partners and provide regular project updates. The Societal Impact Champion will be responsible for communication and dissemination activities, including outreach to stakeholders, public relations, and media relations.

Planning and Control

The Project Manager will be responsible for developing and maintaining the project plan and ensuring that it is aligned with the overall project goals and objectives. The Quality Assurance Manager will be responsible for ensuring that all project deliverables meet the required quality standards. The Executive Committee will be responsible for making decisions related to any deviations from the project plan or budget. EC will also monitor the progress against the project plan and ensure that the project stays on track.

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3. IMPACT

3.1 Impact and ambition

Impact and ambition

Please address each guiding points presented in the Call document/Programme Guide under the award criterion 'Impact'.

Define the expected short, medium and long-term effects of the project. Who are the target groups? How will the target groups benefit concretely from the project and what would change for them?

BIOMED5.0 project has been designed to create a systematic impact in Pakistani HEIs by bridging the digital gap in biomedical engineering curricula, empowering educators and students to become engines of digital transformation supporting digital and inclusive economy and society. The project will utilise a comprehensive strategy involving updating BME curricula and labs, training teachers and students on Industry 4.0/5.0, establishing a Centre of Excellence with fabrication lab promoting technology incubation and entrepreneurship.

Target Groups

The following target groups have been identified as potential beneficiaries of the BIOMED5.0 project:

- Students (prospective and current biomedical engineering undergraduate and postgraduate students)

- Academic staff members (faculty and laboratory staff in biomedical engineering departments)

- Higher Education Institutions (collaborating institutions, academic administrators, and institutional decision-makers involved in curriculum development and implementation)

- Working professionals (biomedical engineering professionals seeking to upskill or reskill in Industry 4.0/5.0 technologies)

- Entrepreneurs (biomedical engineering and healthcare entrepreneurs seeking to innovate and drive digital transformation in the industry)

- BME industry (companies in the biomedical engineering and healthcare industries seeking skilled talent to drive innovation and digital transformation)

- Knowledge triangle players (academic, industry, and government partners collaborating to drive digital transformation in the biomedical engineering and healthcare industries)

- Society/General public (individuals interested in the intersection of healthcare and technology and the impact on society)

- European Commission (funder and regulatory body for the project).

Short, Medium and Long Term Impacts

The following table summarizes the short-, medium-, and long-term impacts of the proposed project activities in a quantifiable manner.

Short Term Impacts (During 1st and 2nd year of BIOMED5.0 Project)		
Expected Impacts	Key Performance Indicators	
Target Groups: Students, Biomedical Engineering and Healthcare professionals, entrepreneurs		
Increased awareness and understanding of Industry 4.0/5.0 technologies among masters and bachelor students via 3 new modules and 9 revised modules (first study cycle) (WP2, WP3, & WP4)	400 bachelor and 250 masters students from 8 Pakistani HEIs in first study cycle	
Improved understanding of high- end biomedical engineering modalities via Virtual and Augmented Reality sessions (Tasks T3.6 & T3.7)	Introduction of five new VR and two AR based BME teaching labs	
Access to state of the art medical prototyping, smart manufacturing and IoT sensor laboratories (Task T3.3 & T3.4)	Upgradation of teaching labs for five modules for bachelor and master students	

Cardiopulmonary Resuscitation (CPR) first aid trained students using Mixed Reality (MR) (Task T3.7)	250 students from each participating Pakistani HEI trained on CPR
Increased ownership, enhanced leadership skills and higher motivation by participating in project committees (Tasks T1.1, T2.1, T3.1, T4.1, & T5.1)	1 student representative from each Pakistani HEI participate in relevant project meetings
Availability of specialised upskilling Open Online Courses on Digital transformation enabling Industry 4.0/5.0 technologies (Task T2.6)	250 students participated in five OOCs in the first cycle
Assess to Centre of Excellence in Biomedical Engineering facilities, mentorship programme and entrepreneurship trainings	Enrolment of 5 students in mentorship programme at each Pakistani HEI; Participation of 150 entrepreneurs in annual start-up week (Task T4.3)
Target Groups: Academic and Laboratory Staff Members	
New knowledge and skills received in innovative pedagogies, digital transformation and Industry 4.0/5.0 (Tasks T4.4, T4.5, T4.6 and T4.7)	2 academic staff members from each partner Pakistani HEI will attend these trainings in DCU &TUCN; 50 staff members from each partner Pakistani HEI will get training through reciprocal programmes; 20 staff members from non-partner Pakistani HEIs will be trained
Development and implementation of new pedagogical approaches and teaching methodologies	23 new and updated modules developed, revised and approved for bachelor, masters and continuous professional development programmes
Enhanced confidence in teaching and incorporating Industry 4.0/5.0 technologies in BME curricula via assess to state of the art lab facilities and	Lab facilities upgraded in 8 Pakistani HEIs and 7 VR/AR sessions developed, approved and delivered in first study cycle
New cooperation and collaboration opportunities with partner HEIs through Centre of Excellence in Biomedical Engineering	Eight trainings and five Hackathon events organised (Task 4.8, T4.9, T4.11 and T4.12)
Target Groups: Higher Educational Institutes	
New HEIs participation in Erasmus+ programme	3 HEIs involved in any Erasmus+ programme for the first time
New departments participation in Erasmus+ CBHE programme	All 8 Biomedical Engineering departments from Pakistani HEIs will participate in Erasmus+ CBHE programme for the first time

Capacity building for facilitating students with fewer opportunities, refugees and internally displaced people (IDP) groups	Reduced digital gap in students from disadvantaged background (remote locations, refugees, internally displaced due to flood), enrolled in MUET, UETT and BUET
Capacity building of students, academic and lab technical staff members	90% satisfactory level of digital competence achieved as demonstrated by quality assurance surveys (Task T3.8)
Modernisation of curricula and lab facilities in biomedical engineering programmes (WP2 & WP3)	Innovative and modernised biomedical engineering curricula developed by partner HEIs
Capacity building in providing mental health awareness and well-being to students	Lower number of mental-health related incidents report on campus; Improved students' assessment results
Target Groups: Economic Entities and Society	
Participation of industry representatives in BIOMED5.0 committees strengthening knowledge triangle	Active participation of representatives of biomedical engineering and healthcare sectors in BIOMED5.0 committees (curriculum development, lab development and upgradation, Centre of Excellence activities)
Introduction to digital transformation benefits to society	Scientific progress communication to general public by Societal Impact Champion (Task T5.4)
Reduced digital gap due to capacity building of individuals	Overall improved digital competencies
Medium Term Impacts (During 2nd and 3rd year of BIOMED5.0 Project)	
Expected Impacts	Key Performance Indicators
Target Groups: Students, Biomedical Engineering and Healthcare professionals, entrepreneurs	
Enhanced practical skills and knowledge of Industry 4.0/5.0 technologies and high-end BME modalities via upgraded teaching labs and VR and AR based sessions (Tasks T3.6 & T3.7)	400 bachelor and 250 masters students from 8 Pakistani HEIs participated in new and updated teaching labs in 2nd study cycle
Access to state of the art facilities in Fab labs for final year, masters and PhD projects	Completion of 10 projects each year in each Pakistani HEI Fab Lab
Access to digital DAS system for mental health assessment (Task T4.11)	1000 annual student users from each Pakistani HEI accessing DAS system
Enhanced skills and knowledge in digital transformation enabling technologies through participation in training programmes (T4.8)	Five one day trainings will be organised in Year 2 and Year 3 of BIOMED5.0 project, targeting 3000 students each year

Increased awareness and understanding of Industry 4.0/5.0 technologies among masters and bachelor students via 3 new modules and 9 revised modules (2nd study cycle)	400 students from 8 Pakistani HEIs participated in new and updated modules in 2nd study cycle
Higher mental health awareness and stronger professional and personal development among students through trainings (T4.10)	400 (university wide) students from each participating HEI will attend mental health
Improved critical thinking, problem and challenge solving skills, improved innovation and design thinking skills, promotion of entrepreneurship among students (T4.12)	Four annual Digital Transformation and Industry 4.0/5.0 Hackathon events organised each year and targeting 2400 students participation
Support received by entrepreneurs (Task T4.3)	Enrolment of 5 entrepreneurs in mentorship programme at each Pakistani HEI in 2nd and 3rd year
Target Groups: Academic and Laboratory Staff Members	
Increased level of digital competence promoting digital transformation in biomedical engineering; improved quality in education delivery; Increased capacity and professionalism to work at international level, improved management competencies, introducing internationalisation strategies; lab staff trained on state-of-the-art Industry4.0/5.0 equipment	95% satisfaction of survey participants on digital competency achieved via BIOMED5.0 activities in Impact Assessment and Case Studies (Task T5.9)
Integration of Industry 4.0/5.0 technologies into the research and development strategies	At least two funding applications submitted by the researchers from each participating HEIs (Task T5.10)
Increased opportunities for research collaboration with Industries (Task T2.3 & T2.8)	5 Digital Transformative Technology student group projects with industries by each Pakistani HEI At least two industry co-funded applications (Task T5.10)
Professional development and gaining reputation through participation in international conferences (Task T5.7)	2 presentations and 2 conference proceedings published in international conferences by each partner HEI
Target Groups: Higher Educational Institutes	
Expertise developed by new comer HEIs to participate in international collaborative projects	3 new HEIs will gain experience in participation in international Erasmus+ CBHE programme

Successful capacity building of academic staff members in development of innovative curricula, organisation of educational events and participation in collaborative events	8 new biomedical engineering departments will gain experience in participation and successful completion of Erasmus+ CBHE programme
Offering new modules and innovative teaching labs to students	Increased students enrolment, improved students' learning experience
Increased funding opportunities for the institute as a result of successful industry partnerships and collaborations.	Experienced and trained academic staff members in Industry 4.0/5.0 will apply for funding in at least two different schemes
Increased number of academic publications and research projects as a result of the establishment of a Centre of Excellence in Biomedical Engineering.	HEI-HEI collaborations and industry transformative technology projects will result in 4 research publications on Industry 4.0/5.0 related topics by each participating HEI
Improved student satisfaction rates due to the use of new lab manuals and updated lab facilities.	More than 95% satisfaction in digital technology learnings by the students noted in survey results (Task T5.9)
Target Groups: Economic Entities and Society	
Reduced digital gap due to multifold capacity building of higher education system	Capacity building of over 10,000 persons over the life time of BIOMED5.0 project in digital transformation enabling Industry 4.0/5.0 technologies through direct learning and outreach and dissemination activities
Higher economic activity as entrepreneurs receive support via Centre of Excellence, Fab Lab, Mentorship programmes	2 start-ups supported by Centre of Excellence and mentorship programmes
BME and Healthcare sectors will have access to OOCs for employees professional development; Reduced unemployment due to upskilling of ready to work professionals	750 students completed OOCs in two study cycles (2nd year and 3rd year of BIOMED5.0 project)
Long Term Impacts (After 1-3 years of BIOMED5.0 Project)	
Expected Impacts	Key Performance Indicators
Target Groups: Students, Biomedical Engineering and Healthcare professionals, entrepreneurs	
Promotors and enablers of Digital Transformation in biomedical engineering and healthcare industries	Graduate biomedical engineering taking up lead roles in digital transformation by employing Industry 4.0/5.0 technologies

High employability of BIOMED5.0 graduates equipped with future proof and transformational skills	50% increased employability of graduates from BIOMED5.0 partner HEIs comparing to other HEIs' graduates
Improved continuous personal and professional development and higher mental health and well-being awareness	BIOMED5.0 graduates will be 100% more aware about their mental health and well-being in comparison with their peers
Target Groups: Academic and Laboratory Staff Members	
Increased experience and expert levels in Digital Transformation and Industry 4.0/5.0 technologies	1260 faculty members and 80 lab staff trained members will provide enhanced learning experience to BME students
Improved recognition and reputation in the field of Industry 4.0/5.0 technologies	Increased research publication outputs and participation in collaborative projects
Increased research opportunities and collaborations with industry partners in the field of Industry 4.0/5.0	Increased ability to identify and pursue research opportunities in emerging areas of Industry 4.0/5.0
Capacity built to further modernise the curricula	Increased ability to identify and evaluate Industry 4.0/5.0 and other emerging technologies and trends to inform BME curricular updates; Increased flexibility and agility in adapting BME curricula to meet evolving industry needs and demands; Improved ability to integrate emerging technologies and pedagogies into the curriculum to enhance student learning
Target Groups: Higher Educational Institutes	
Increased reputation as leading institutes offering modern BME curricula	Higher number of students enrolment in BME programmes
Demonstrate high employability of graduates	50% higher employability rate of graduates from participating HEIs in relevant sectors
Increased ranking at national and international level due to capacity building through educational, innovation and research activities	Upward movement of participating HEIs in national and international ranking lists; Increased interest and recognition among industry leaders and potential partners in the university's capabilities in the field of Industry 4.0/5.0 technologies
Target Groups: Economic Entities and Society	
"Future Ready" workforce available for Biomedical engineering and healthcare industries	Improved alignment of curriculum with industry needs and demands resulting in increased employability and competitiveness of BME graduates
Increased contribution of industries to the national economy through the adoption of advanced technologies and the creation of high-value jobs.	Improved ability of industries to compete globally through the adoption of advanced technologies and practices; Increased investment in research and development by industries to stay at the forefront of innovation; Improved productivity and efficiency of industries through the adoption of advanced technologies and practices

Reduced digital-gap in society	Increased access to digital technologies and resources for underprivileged communities; improved ability to bridge the digital gap between rural and urban areas
Improved social and economic development due to the development and deployment of innovative products and services that address societal needs and challenges.	Development of Industry 4.0/5.0 enabled products and services facilitated by the Centre of Excellence in Biomedical Engineering; Improved quality of life for patients and communities at large through, for example, the use of innovative medical devices and rehabilitation services
Development of a knowledgebased economy with a focus on Industry 4.0/5.0 technologies, leading to sustained economic growth.	Increased collaboration between academia, industry, and government to address societal challenges; Increased investment in education and research in Industry 4.0/5.0 technologies; Increased competitiveness of the country in the global economy
Early adoption of Industry 4.0/5.0 technologies leading to initial cost savings and improved productivity	BIOMED5.0 graduates enabling Digital Transformation will result in reduced operational costs in healthcare sector, improved efficiency and productivity in industries through the use of advanced technologies and practices; Improved ability to meet customer demands and expectations through the use of advanced technologies and practices; Improved ability to innovate and stay at the forefront of the industry through the adoption of advanced technologies and practices
Positive impact on society and the environment through the adoption of sustainable and efficient Industry 4.0/5.0 technologies.	Reduced environmental impact of industries through the adoption of sustainable and efficient technologies and practices Improved resource efficiency and conservation through the adoption of sustainable and efficient technologies and practices; Improved ability to meet sustainability goals and regulations through the adoption of sustainable and efficient technologies and practices

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3.2 Communication, dissemination and visibility

Communication, dissemination and visibility of funding

Describe the communication and dissemination activities which are planned in order to promote the activities/results and maximise the impact (to whom, which format, how many, etc.). Clarify how you will reach the target groups, relevant stakeholders, policymakers and the general public and explain the choice of the dissemination channels.

Describe how the visibility of EU funding will be ensured.

BIOMED5.0 Strategy for Communication, Dissemination and Visibility of Funding

BIOMED5.0 communication, dissemination, and visibility strategy is carefully designed to enhance the project's impact by effectively disseminating its outcomes and communicating its accomplishments to all intended target groups. This will be achieved through the regular evaluation and updating of the project outcomes deployment perspectives by collecting input from the BIOMED5.0 partners, students, and external stakeholders. Accordingly, detailed set of activities in Work Package 5 are strategically planned to establish a robust communication platform among partner HEIs, ensuring its visibility to stakeholders, academia, and other target groups. Additionally, WP5 aims to raise awareness among target groups about digital transformation and emerging technologies and ensure the sustainability of project outcomes beyond the project's lifetime, making it a critical component in maximizing the project's impact.

To ensure effective dissemination, WP5 tasks are tailored to address different target groups, including the general public, staff members, international audiences, industry stakeholders, national regulatory

agencies, and students, with all partners contributing to dissemination activities in their respective HEIs and regions. Certain activities will also be conducted at an international level.

Societal Impact Champion

The project team will hire a societal impact champion, responsible for developing and executing a communication and dissemination plan. This individual will work closely with the project team to ensure effective communication and engagement with the target audiences (T5.3).

Target Groups and Communication Channels

The table below provides the list of BIOMED5.0 target groups and selected communication channels:

Target Groups	Communication Channels
Students and BME and Healthcare professionals	Department newsletters, social media, posters, presentations, webinar style master classes, student representative in biomed5.0 project committees, training programmes, fab lab visits, digital transformation hackathons, internship opportunities
Staff Members	Emails, project meetings, training sessions; biomed5.0 annual conference
General Public	Social media, newsletters, press releases, public talks, conferences and seminars
Scientific Community	Peer-reviewed journal publications, Participation in international conferences; BIOMED5.0 Annual Conference
International Audience	Erasmus+ Project Results Platform[10] will be used to disseminate the BIOMED5.0 project results to international audience
Industry Stakeholders	Participating in BIOMED5.0 project committees and meetings
National Regulatory Agencies	Participation in project meetings and BIOMED5.0 Annual Conference

These dissemination and communication channels will be utilised in the following activities:

Newsletter: The project team will publish bi-annual newsletter, featuring updates on the project's progress, results, and upcoming events (T5.3).

Website and social media accounts: The project team will maintain a project website, featuring information about the project's activities, results, and events (T5.3). The project team will maintain a strong presence on social media and post project outcomes, progress and activities of interest to relevant target groups and general public.

Education and Public Engagement: Societal Impact Champion, together with project team members will organize workshops, public lectures, and other events to engage with the general public and communicate the project's importance and impact on society (T5.4).

STEM Outreach Programme: The following four activities are planned to be performed by each participating HEI: (i) Secondary and High Secondary school visits; (ii) 3D printing demonstrations in secondary and higher secondary schools; (iii) Fab Lab visits by schools; (iv) Women in STEM events in girls schools (T5.8).

Peer-Reviewed Publications: The project team will publish research articles in peer-reviewed journals to reach scientific communities (T5.5 & T5.7).

Open Access: The project team will ensure that project outputs are open access, including publications, data, and software, to promote wider dissemination and impact (T5.5 &T5.7).

A copyright policy will be developed and agreed upon by all partners to share the course and subject descriptions, course contents, and training materials.

Master Class Webinars will be organised to promote BIOMED5.0 Open Online Courses on Digital transformation enabling Industry 4.0/5.0 technologies and encourage enrolment of working and ready to work (unemployed) professionals (T5.6).

Conducting and Publishing of Case Studies The societal impact champion, in close collaboration with Quality Assurance Manager and Project Manager will prepare case studies on project outcomes and impacts. These case studies

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[10] Erasmus+ Projects https://erasmus-plus.ec.europa.eu/projects

will be published, as summary in print media and as impact studies in peer reviewed journals to reach a wider audience (T5.9).

BIOMED5.0 Annual Conference: The BIOMED5.0 Annual Conference is a crucial component of the dissemination and communication strategy for the project. From a strategic point of view, this annual conference will provide a unique opportunity to showcase the project's achievements, disseminate its results, and engage with key stakeholders and experts in the field. The conference will serve as a platform for the BIOMED5.0 team members to present their findings and share knowledge with the wider community. This is critical for ensuring that the outcomes of the project are accessible to all relevant stakeholders, including academics, students, policymakers, industry representatives, and the general public. By presenting at the conference, the project team would be able to communicate their results and demonstrate the impact of their work, raising the profile of the project and enhance visibility.

BIOMED5.0 annual conference will offer an opportunity for networking and collaboration with other experts and stakeholders in education, biomedical engineering and healthcare sectors. It will serve as an avenue for the project team to connect with potential partners, engage in discussions with other researchers, and establish new collaborations. These connections will be vital for advancing the project's objectives and ensuring the sustainability of the outcomes beyond the project's lifetime. The conference will also provide a chance to engage with policymakers and regulators, which is crucial for ensuring that the project outcomes are integrated into policy and regulatory frameworks. By engaging with the policymakers (e.g. Higher Education Commission Pakistan, Pakistan Engineering Council, Commerce Chambers representatives, SME body representatives etc.) at the conference, the project team would have opportunities to influence policy decisions and shape the regulatory landscape, ensuring that the project outcomes are incorporated into relevant policies and regulations.

BIOMED5.0 Annual Conferences are planned to serve as the key elements of the project's dissemination and communication strategy. These conferences will provide opportunities to showcase the project's achievements, engage with stakeholders and experts, establish new collaborations, and influence policy decisions. The annual conferences are expected to have significant impacts in disseminating the project outcomes and ensuring their sustainability post-project.

EU Funding Visibility

To ensure visibility of the European Union funding, the BIOMED5.0 project team will strictly follow acknowledgement guidelines provided by the European Commission, EACEA and Erasmus+. The guidelines provided in the project Grant Agreement on acknowledgements will be strictly followed. The project team members will clearly acknowledge the European Union's support in all communications and publications, in all formats and media. A formal statement, acknowledging the EU funding with grant reference number will be prepared and distributed to all partners. This statement and the European Union emblem or Erasmus+ emblem will be used according to size and colour requirements on all project-related publications, presentations, and communication materials. The project will also acknowledge the support of the EU in all project-related events and activities.

BIOMED5.0 will use Erasmus+ press pack (generic press release template) to generate the press releases for appropriate EU funding acknowledgement.

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3.3 Sustainability and continuation

Sustainability, long-term impact and continuation

Describe the follow-up of the project after the EU funding ends. How will the project impact be ensured and sustained?

What will need to be done? Which parts of the project should be continued or maintained? How will this be achieved? Which resources will be necessary to continue the project? How will the results be used?

Are there any possible synergies/complementarities with other (EU funded) activities that can build on the project results?

Follow-up of the project

A financial plan will be developed by the partner HEIs to ensure the project's continued operation and maintenance in the long term. Building capacity of local partners and stakeholders will be crucial for ensuring the project's long term impact. A robust monitoring and evaluation framework will be put in place to track the project's progress and assess its impact over time.

Sustainable Elements of BIOMED5.0

The BIOMED5.0 project has been designed to deliver sustainable and useful outcomes beyond the project life. The sustainable elements and outcomes of BIOMED5.0 are listed below:

Updated Curricula (New and Revised Modules)

One of the significant contributions of the project is the development of three new modules for bachelor and three for masters programmes. These modules have been designed to address the current gaps in biomedical engineering education and will be developed in collaboration with industry partners. Once approved by Pakistan Engineering Council (PEC),

these modules can be utilized by other universities and institutions to enhance their biomedical engineering programmes. To continue these efforts, it would require further collaboration with industry partners to ensure that the modules remain relevant and up to date. Similarly, the revised modules, five bachelor and seven masters updated modules, are sustainable and useful beyond the project life. These modules have been updated to align with the current trends and requirements in biomedical engineering education. They can be used by other institutions to update their biomedical engineering programmes.

Open Online Courses on Digital Transformation

Another significant outcome of the BIOMED5.0 project is the development of Open Online Courses. These five courses have been proposed to provide accessible and flexible learning opportunities for working and ready to work professionals seeking lifelong professional development and upskilling in emerging technologies. These courses will be uploaded on MOOC platform11, thus can be accessed by students across the globe, making them sustainable beyond the project life. To continue these efforts, it would require maintaining the online platform and updating the content regularly to ensure that it remains relevant.

Upgraded Laboratory Facilities

The upgraded physical laboratories are sustainable beyond the project life as they will enable the universities to provide high-quality practical training to their students. The new equipment and tools will facilitate the students in conducting research, experiments, and projects in the field of biomedical engineering. The university faculties can continue to use the upgraded laboratories and equipment for many years to come, providing students with hands-on experience in the field. To ensure the sustainability of the upgraded laboratories, the universities will need to allocate funds for their maintenance, repair, and replacement of equipment when necessary.

Virtual Reality/Augmented Reality and Mixed Reality Lab Sessions

The VR/AR/MR lab sessions are sustainable beyond the project life as they will enable the partner HEIs to provide students with hand-on training in virtual world on major biomedical engineering diagnostic and therapeutic modalities. BIOMED5.0 partner HEIs will continue to use the developed lab sessions to offer students immersive experiences that will enhance their understanding and knowledge of biomedical engineering. With the experience gained by the faculty members, the partner HEIs will have opportunity to continue to develop and expand the VR/AR/MR lab sessions to include new modules and topics. To ensure the sustainability of the VR/AR/MR lab sessions, the partner HEIs will need to allocate funds for the maintenance and update of the software and hardware, as well as for the training of faculty members to conduct the sessions. Additionally, the HEIs can seek partnerships with industry and research organizations to support the development and maintenance of the VR/AR/MR lab sessions.

Biomedical Engineering Centre of Excellence

The Biomedical Engineering Centre of Excellence established during the BIOMED5.0 project will be a long-term, sustainable investment in education, research, and innovation. It will offers state-of-the-art facilities, training, and mentorship opportunities for students and professionals, and supports interdisciplinary collaborations across academia and industry. The following activities and components will ensure the sustainability of the Centre beyond the project's lifetime.

Mentorship Programme

The mentorship program developed in the BIOMED5.0 project will be expected to have long-term sustainability beyond the project's life. The program can be maintained by integrating it into the regular curriculum of the participating universities, and by inviting industry experts to participate as mentors. The participating students will continue to benefit from the expertise and guidance provided by experienced mentors, even after the project ends. The program can also be extended to other

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11 https://www.mooc.org/

universities and institutions to expand its impact and sustainability.

Pan-Institutional Biomedical Engineering Digital Fabrication Laboratory (Fab Lab)

The Fab Labs established in the BIOMED5.0 project will have long-term sustainability beyond the project's life. These Fab Labs at Pakistani HEIs will continue to support innovation and entrepreneurship activities for start-ups, academic staff members, students and entrepreneurs. Regular maintenance and updating of the equipment and tools will be required to ensure the sustainability of Fab Labs.

Industry 4.0/5.0 and transformative skills trainings programmes

The training programs that will be developed for students in industry 4.0/5.0 technologies and transformative skills in the BIOMED5.0 project will continue to be delivered by the academic staff members. These training programmes will also attract students outside biomedical engineering domain and will have a wider audience in long run. Regular updates and revisions of the programs will be required to ensure their sustainability.

Mental Health and Awareness Seminar

The structure and contents of the mental health and awareness seminars conducted in the BIOMED5.0 project will be used to organise annual seminars after BIOMED5.0 project life. To ensure the sustainability of this initiative, it will be important to integrate mental health education and support services into the regular activities of the partner HEIs and

encourage participation from all (engineering and non-engineering) departments and faculties in the future. Regular updates and revisions of the seminar content according to projected participation and attendees' background will be required to ensure its sustainability and effectiveness.

Digital DAS System Developed for Mental Health Wellbeing Assessment

The digital DAS system developed for mental health well-being assessment in the BIOMED5.0 project is expected to have long-term sustainability beyond the project's life. The system will be uploaded onto SSUET web servers which will continue to host this programme after the BIOMED5.0 project life. Regular updates and maintenance of the digital platform would be required to ensure proper functioning of the system. Further expansion would be considered to provide some level of interaction with the trained psychologists.

Industry Partnership

Partnership with industries will bring about additional financial and technical resources, which will help to extend the reach and impact in the long run. Industry partners will provide market-oriented perspectives that will ensure the relevancy of the project outcomes with the needs of the market. Industry partners will also help to engage a wider range of stakeholders, such as governments, NGOs and communities, leading to a more comprehensive and sustainable approach to problem-solving. By working closely with the industry, the project outcomes are more likely to be adopted and integrated into the market, leading to a long-term and sustainable impact.

All in all, to continue these efforts, the partner HEIs have expressed keen interest and strong commitment to ensure that the outcomes remain relevant and up to date. The continuity of these elements will be strongly beneficial for the applicant team members. The applicant team would continuously explore the opportunities to secure further funding and resources to maintain the facilities, equipment, and organisation of events. Regular assessments and evaluations would be required to measure the impact and effectiveness of the outcomes and make necessary improvements.

Possible Synergies/Complementarities with other (EU Funded) Activities

BIOMED5.0 project team will continue to explore opportunities for aligning the project's objectives and activities with the relevant EU policies and initiatives, such as the European Education Area[11], the Horizon Europe Calls 2023 - Destination 6. A human-centred and ethical development of digital and industrial technologies[12]. The applicant team will focus on opportunities offered by other Erasmus+ programmes, including International Credit Mobility Programme[13], and Centres for Vocational Excellence[14].

By aligning with these initiatives, the project can contribute to the wider European agenda and promote the uptake and dissemination of its results beyond the project's lifetime.

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[11] European Education Area [Available here]
[12] Horizon Europe Calls 2023 – Destination 6 [Available here]
[13] Erasmus+ International Credit Mobility [Available here]
[14] Centre of Vocational Excellence [Available here]

#@WRK-PLA-WP@#

4. WORK PLAN, WORK PACKAGES, ACTIVITIES, RESOURCES AND TIMING

4.1 Work plan

Work plan

Provide a brief description of the overall structure of the work plan (list of work packages or graphical presentation (Pert chart or similar)).

BIOMED5.0 planned activities will be performed in the following work packages:
Work Package 1: Project Management and Quality Assurance (MUET)
Work Package 2: Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula (SSUET)
Work Package 3: Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions (UETL)
Work Package 4: Centre of Excellence in Biomedical Engineering (SHU)
Work Package 5: Project Impact and Outreach: Dissemination, Communication and Exploitation (LUMHS)
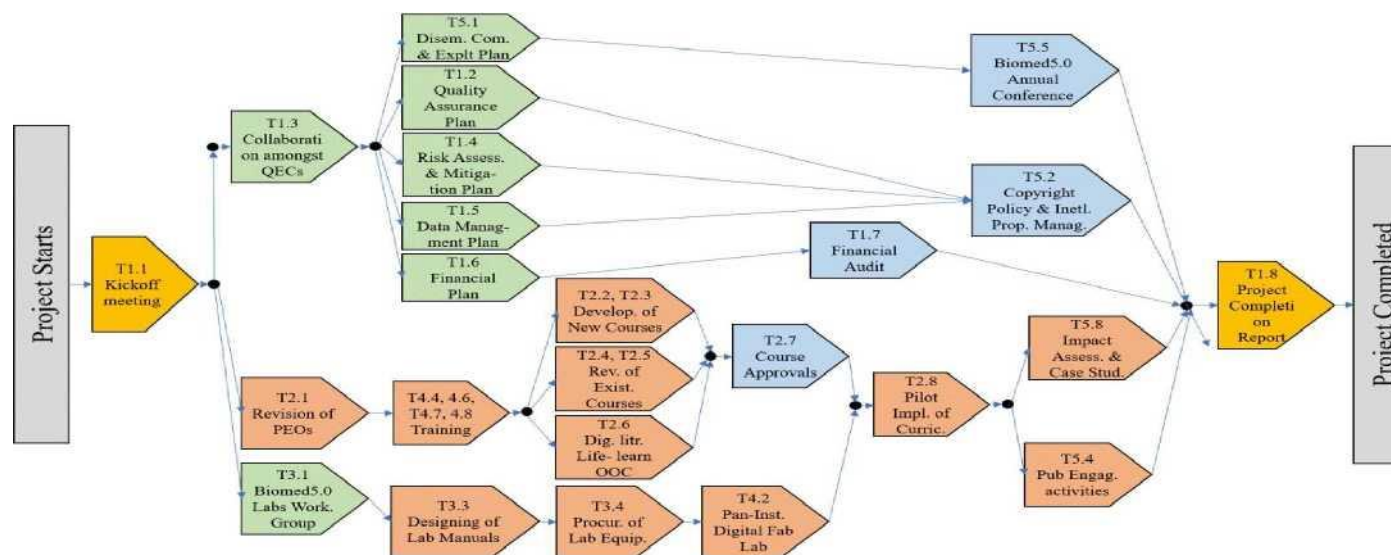
Figure 5 BIOMED5.0 PERT Chart

4.2 Work packages, activities, resources and timing

WORK PACKAGES

Work packages

This section concerns a detailed description of the project activities.

Group your activities into work packages. A work package means a major sub-division of the project. For each work package, enter an objective (expected outcome) and list the activities, milestones and deliverables that belong to it. The grouping should be logical and guided by identifiable deliverables/outputs.

Projects should normally have a minimum of 2 work packages. WP1 should cover the management and coordination activities (meetings, coordination, project monitoring and evaluation, financial management, progress reports, etc.) and all the activities which are cross-cutting and therefore difficult to assign to another specific work package (do not try splitting these activities across different work packages). WP2 and further WPs should be used for the other project activities. You can create as many work packages as needed by copying WP1. The last WP should be dedicated to Impact and dissemination

Please refer to the Call document/Programme Guide for specific requirements concerning the number and the typology of work packages.

Work packages covering financial support to third parties (• only allowed if authorised in the Call document/Programme Guide) must describe the conditions for implementing the support (for grants: max amounts per third party; criteria for calculating the exact amounts, types of activity that qualify (closed list), persons/categories of persons to be supported and criteria and procedures for giving support; for prizes: eligibility and award criteria, amount of the prize and payment arrangements).

-ù Enter each activity/milestone/output/outcome/deliverable only once (under one work package).

ï's Ensure consistency with the detailed budget table/calculator (if applicable). (n/a for prefixed Lump Sum Grants)

Objectives

List the specific objectives to which the work package is linked.

Activities and division of work (WP description)

Provide a concise overview of the work (planned tasks). Be specific and give a short name and number for each task.

Show who is participating in each task: Coordinator (COO), and if applicable Beneficiaries (BEN), Affiliated Entities (AE), Associated Partners (AP) and others, indicating in bold the task leader.

Add information on other participants' involvement in the project e.g. subcontractors, in-kind contributions.

Note:

In-kind contributions: In-kind contributions for free are cost-neutral, i.e. cannot be declared as cost. Please indicate the in-kind contributions that are provided in the context of the work package.

The Coordinator remains fully responsible for the coordination tasks, even if they are delegated to someone else. Coordinator tasks cannot be subcontracted.

If there is subcontracting, please also complete the table below.

Milestones and deliverables (outputs/outcomes)

Milestones are control points in the project that help to chart progress (e.g. completion of a key deliverable allowing the next phase of the work to begin). Use them only for major outputs in complex projects, otherwise leave the section empty. Please limit the number of milestones by work package.

Means of verification are how you intend to prove that a milestone has been reached. If appropriate, you can also refer to indicators.

Deliverables are project outputs which are submitted to show project progress (any format). Refer only to major outputs. Do not include minor sub-items, internal working papers, meeting minutes, etc. It is recommended to limit the number of deliverables to max 10-15 for the entire project. You may be asked to further reduce the number during grant preparation.

For deliverables such as meetings, events, seminars, trainings, workshops, webinars, conferences, etc., enter each deliverable separately and provide the following in the 'Description' field: invitation, agenda, signed presence list,

target group, number of estimated participants, duration of the event, report of the event, training material package, presentations, evaluation report, feedback questionnaire.

For deliverables such as manuals, toolkits, guides, reports, leaflets, brochures, training materials etc., add in the 'Description' field: format (electronic or printed), language(s), approximate number of pages and estimated number of copies of publications (if any).

For each deliverable you will have to indicate a due month by when you commit to upload it in the Portal. The due month of the deliverable cannot be outside the duration of the work package and must be in line with the timeline provided below. Month 1 marks the start of the project and all deadlines should be related to this starting date.

The labels used mean:

Public — fully open (li automatically posted online on the Project Results platforms)

Sensitive — limited under the conditions of the Grant Agreement

EU classified — RESTREINT-UE/EU-RESTRICTED, CONFIDENTIEL-UE/EU-CONFIDENTIAL, SECRET-UE/EU-SECRET under Decision 2015/444. For items classified under other rules (e.g. national or international organisation), please select the equivalent EU classification level.

Work Package 1

Work Package 1: Project Management and Coordination			
Duration:	M1 – M36	Lead Beneficiary:	MUET
Objectives			
501.1: to establish project Executive Committee for effective project governance and management plan with clear project vision, objectives and governance structure			
501.2: to develop and implement a comprehensive Quality Assurance Plan ensuring project deliverables meet the required quality standards			
501.3: to continuously assess project risks and develop and update risk mitigation plan, minimising potential impacts on project milestones and outcomes			
501.4: to facilitate effective collaboration and promote productive partnerships and teamwork among project partners for successful project delivery			

Activities and division of work (WP description)					
Task No (continuou s numbering linked to WP)	Task Name	Description	Participants		In-kind Contributions and Subcontracting (Yes/No and which)
			Name	Role (COO, BEN, AE, AP, OTHER)	
T1.1	Kick-off meeting and establishment of BIOMED5.0 Project Executive Committee	The BIOMED5.0 project will commence with a kick-off meeting hosted by MUET in the first month after Grant Agreement is signed. The main contact person from each partner HEI will attend this meeting. The BIOMED5.0 project Executive Committee (EC) will be established to lead the project as advised by Curriculum Revision Committee, BIOMED5.0 Virtual Labs Working Group, Centre of Excellence in Biomedical Engineering Steering Committee and Societal Impact Champion. The Deputy Director will be responsible to communicate with the EU project officer. EC will be composed of main contact persons from the partner HEIs. A Project Manager (PM) will be appointed by MUET to assist the Deputy Director to manage and coordinate the WP1 tasks. The EC will be responsible to prepare the Consortium Agreement which will be signed by all partners. The project GANTT chart will be reviewed at the kick-off meeting and a responsibility matrix will be developed according to the tasks proposed in WP1 to WP5. The Executive Committee will have quarterly meetings, at least one inperson and the remaining will be hosted online. The EC will be responsible for overseeing and coordinating all project management and administration activities, including monitoring of project milestones and deliverables, financial management, risk management, financial management and conflict resolution.	MUET SSUET LUMHS SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T1.2	Quality Assurance Plan preparation and execution	MUET as the coordinating HEI for BIOMED5.0 project will appoint a full time Quality Manager (QM). As an ISO-9001 certified institution, MUET upholds a comprehensive well-articulated quality policy to run university business, which will guide the preparation of a detailed Quality Assurance Plan (QAP) by the QM. The QAP will focus on ensuring compliance with the statutory requirements, maintaining the quality of the deliverables and effectively implementing BIOMED5.0 WPs. QAP will ensure active	MUET SSUET LUMHS	COO BEN BEN	No

		involvement of project participants in assigned WPs and tasks, promote responsible knowledge creation and dissemination, optimisation of resources, and preserving the environment.	SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
		The QAP will also aim to ensure that the project outcomes align with the Program Educational Objectives prescribed by the Pakistan Engineering Council, a national engineering accreditation body. The quality characteristics to be considered in the QAP include Accessibility, Affordability, Relevance, Equity, Effectiveness, Efficiency, Flexibility, Accountability, Transparency, and Student-centeredness.	BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
		The QM will evaluate the project deliverables according to the criteria defined in the QAP and monitor the overall quality of the BIOMED5.0 project execution.	DCU	BEN	
			PEC	BEN	
T1.3	Collaboration with Quality Enhancement Cells in Pakistani HEIs	The QM will establish a strong connection between the Quality Enhancement Cells (QEC) at the partner universities to gather feedback on BIOMED5.0 actions and activities. The QEC involvement in the evaluation of project activities (teaching content development, industry engagement and event organization) will assist and ensure the project team achievement of high quality in project outcomes.	MUET	COO	No
			SSUET	BEN	
			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	
T1.4	Risk Assessment and Mitigation Planning and Execution	The PM will prepare a continuous Risk Assessment and Mitigation strategy to identify potential obstacles or delays in project activities and create a plan to minimize or eliminate resulting impacts. The PM will ensure smooth and successful project completion in timely fashion. The PM will present	MUET	COO	No
			SSUET	BEN	

		the project progress at quarterly EC meetings (T1.1) to review the project timeline and identify lagging in the project activity schedule.	LUMHS	BEN		
			SHU	BEN		
			ZIAU	BEN		
			UETL	BEN		
			BUET	BEN		
			UETT	BEN		
			TUCN	BEN		
			DCU	BEN		
			PEC	BEN		
T1.5	Project Data Management Plan	A detailed Data Management Plan (DMP) will be developed by M2 and will be systematically updated whenever important changes to the project occurs, due to, e.g. development of new teaching contents, module descriptors, software for lab etc.. Data set reference and name; Dataset description; Standards and metadata; Data sharing; Archiving and preservation; Open Access; Easily Discoverable will be defined in the DMP. The DMP will ensure that data developed by partner HEIs is securely accessible and useable for the project and can be used by stakeholders where relevant.	MUET	COO		
			SSUET	BEN		
			LUMHS	BEN		
			SHU	BEN		
			ZIAU	BEN		
			UETL	BEN		
			BUET	BEN		
			UETT	BEN		
			TUCN	BEN		
			DCU	BEN		
			PEC	BEN		
T1.6	Managing project	The EC will be responsible for managing the budget spend in a timely and planned manner according to the proposed activities. The PM will be	MUET	COO		No

	budgets and finances	responsible to create financial reports.	SSUET	BEN	
			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	
T1.7	Conduct of Financial Audit	Directorate of finance at the partner HEIs, as per individual university procedure will carryout internal audit and further the accounts of the project will be presented to the external auditor, where required.	MUET	COO	No
			SSUET	BEN	
			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	

T1.8	Preparation of a Project Completion Report	Towards the end of the project-term, the project manager shall prepare a project completion report featuring a brief overview of project's objectives, achievements, and outcomes based on the employers' feedback, graduating student's feedback, and interviews. The report shall also include challenges faced, and lessons learned, along with a detailed financial report. This aims to identify areas for improvement, and provide valuable insights to stakeholders. The report would conclude with the key findings and recommendations for future work.	MUET	COO	No
			SSUET	BEN	
			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	
T1.9	Closing out the project and conducting a post-project review.	Followed by BIOMED5.0 third annual conference (Task 5.5), the project close out meeting will be organized present and discuss post project review and benchmarking the project attainment towards the aims and objectives.	MUET	COO	No
			SSUET	BEN	
			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	

	PEC					BEN	
Milestones and deliverables (outputs/outcomes)							
Milestone No (continuous numbering not linked to WP)	Milestone Name	Work Package No	Lead Beneficiary	Description		Due Date (month number)	Means of Verification
MS1	EC establishment and responsibility matrix is developed.	1	MUET	The kick-off meeting is organised and EC is established. The project workplan is reviewed and a responsibility matrix is developed.		M1	Minutes of the meeting; Appointment of Project Manager. Work plan executed and deliverables produced on-time.
MS2	Quality assurance and collaboration activities performed	1	MUET	QM is appointed and QAP is prepared and executed. Collaboration with QEC departments at partner HEIs established.		M36	Appointment of QM and successful project evaluation for quality assurance.
Deliverable No (continuous numbering linked to WP)	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month number)	Description (including format and language)
D1.1	A consolidated report on Project Quality Assurance and Communication Strategy	1	MUET	R	[SEN — Sensitive]	M4	Report in English

| D1.2 | Accreditation of Modernized Curricula by Academic Councils at HEIs | 1 | MUET | R | [SEN — Sensitive] | M24 | A report on accreditation of modernized curricula by the Academic Councils, as supreme bodies at Higher Education Institutions (HEIs), is a critical milestone in the realm of curriculum design. This deliverable encompasses the comprehensive evaluation, endorsement, and approval process undertaken by the Academic Councils to validate and accredit the contemporary curriculum enhancements |

Estimated budget — Resources (n/a for prefixed Lump Sum Grants)

Participant	Costs												
	A. Personnel		B. Subcontracting	C.1a Travel			C.1b Accomodation	C.1c Subsistence	C.2 Equipmen t	C.3 Other goods, works and services	D.1 Financial support to third parties		E. Indirect costs	Total costs
MUET	X person	X EUR	X EUR	X travels	X person s	X EUR	X EUR	X EUR	X EUR	X EUR	X grants	X EUR	X EUR	X EUR

	months			travelli ng									
[name]	X person months	X EUR	X EUR	X travels X person s travelli ng	X EUR	X EUR	X EUR	X EUR	X EUR	X prizes	X EUR	X EUR	X EUR
Total	X person months	X EUR	X EUR	X travels X person s travelli ng	X EUR	X EUR	X EUR	X EUR	X EUR	X grants X prizes	X EUR	X EUR	X EUR]
For certain Lump Sum Grants, see detailed budget table/calculator (annex 1 to Part B; see Portal Reference Documents).													

Work Package 2

Work Package 2: Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula			
Duration:	M1 – M36	Lead Beneficiary:	SSUET
Objectives			

SO2.1: to review the list of targeted modules and update programme educational objectives via stakeholders inputs

502.2: to increase students' understanding of Industry 4.0/5.0 technologies by developing and implementing two new UG and three new PG modules

502.3: to modernise and update BME curricula by introducing elements of I4.0/5.0 technologies in existing five UG and seven PG modules

SO2.4: to introduce five micro-credential Open Online Courses (OOC) on I4.0/5.0 and digital transformation for working/open to work professionals as life long learning and stay relevant in digital age

Activities and division of work (WP description)			
Task No	Task Name	Description	Participants	In-kind Contributions and

(continuous numbering linked to WP)			Name	Role (COO, BEN, AE, AP, OTHER)	Subcontracting (Yes/No and which)
T2.1	Development and revision of Programme Educational Objectives (PEOs) and Learning Outcomes (LOs) of BME UG and PG curricula in line with Industry 4.0/5.0 needs assessment	A detailed needs assessment has been performed by the partner HEIs on requirements and significance of integrating I4.0/5.0 technologies in BME curricula in Pakistan .In continuation of the kick-off meeting (Task 1.1), a two days in-person meeting will be organised to discuss the proposed PEOs, LOs, new and revised modules, with the goal of increasing students' awareness, knowledge and competencies in I4.0/5.0 technologies. Members of Pakistan Engineering Council curriculum revision committee and Industry Advisory Board (IAB) will be invited to join the meeting to ensure curriculum stays current and relevant. Students representatives will be invited to join the meeting as they will be the primary beneficiary of the project. This meeting will result in the following outputs: • Revised/updated programme educational objectives for UG and PG BME programmes • Revised/updated learning outcomes of individual targeted modules at UG and PG levels • Structured mapping of PEOs and LOs Final report on digital transformation needs assessment for biomedical engineering and healthcare industry	SSUET MUET LUMHS SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T2.2	Development of new modules on I4.0/5.0 technologies for bachelor in BME programme	Based on Task 2.1 outcomes and recommendations and the experiences and expertise gained in Innovative Pedagogies from Task 4.4, the following new modules will	SSUET MUET	COO BEN	

			LUMHS	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET UETT	BEN	
		be developed for undergraduate BME programme: Introduction to Industry 4.0 and 5.0 Technologies in Healthcare Industry (5 Credit Hours) (DCU) This module would provide students with an overview of Industry 4.0 and 5.0 technologies and their applications in the healthcare industry. The course would cover the basics of Internet of Things, Artificial Intelligence, Big Data, Cloud Computing, and additive manufacturing. The module will provide students with an understanding of the impact these technologies have on the healthcare industry. Computer Aided Diagnostics (5 Credit Hours) (UETT) This module would cover technologies used for early disease detection using image processing and analysis. The module would explain the extraction of region of interest with high accuracy from a range of diagnostic modalities (CT scan, MRI, and PET scan etc.). The students will gain knowledge and understanding of image enhancement, analysis and classification using artificial intelligence and deep learning techniques. The module will also briefly introduce computer-assisted systems used for diagnosis, decision making, and decision support in various medical applications. Digital Transformation in Biomedical Engineering (5 Credit Hours) (UETL) This module would provide students with an indepth understanding of how Industry 4.0 and 5.0 technologies are driving digital transformation in the biomedical engineering field. The course would cover the latest Industry 4.0 and 5.0 technologies and their applications	TUCN DCU PEC	BEN BEN BEN BEN	

		in biomedical engineering, including IoT, AI, Big Data, Cloud Computing and Additive Manufacturing. Additionally, the module would explore the opportunities and challenges that come with digital transformation in biomedical engineering, including ethical and privacy implications. The course would cover case studies and real-world examples of how these technologies are improving patient outcomes, reducing costs, and transforming the healthcare industry. Students would also have the opportunity to work on projects in laboratory sessions that demonstrate the practical applications of Industry 4.0 and 5.0 technologies in healthcare. For all these new modules, BIOMED5.0 will develop learning outcomes, module descriptions, teaching contents and delivery modes, and assessment plan. The developed modules will be reviewed by subject matter experts in partner HEIs and necessary revisions will be made before submitting to approval committees.			
T2.3	Development of new modules on I4.0/5.0 technologies for masters in BME programme Based on Task 2.1 outcomes and recommendations and the experiences and expertise gained in Innovative Pedagogies from Task 4.4, the following new modules will be developed for postgraduate BME programme: Industry 4.0 and 5.0 Technologies in Healthcare (5 Credit Hours) (DCU) This module would provide in-depth knowledge in the latest Industry 4.0 and 5.0 technologies, including cyber physical systems (CPS), cognitive computing, blockchain, augmented and virtual reality, robotics and automation, smart factories, mass customisation using additive manufacturing and their applications in		SSUET MUET LUMHS SHU ZIAU UETL BUET UETT TUCN DCU	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN	

				PEC	BEN	
			the biomedical and healthcare industries. The course would provide students with an in-depth understanding of these technologies and their impact on the healthcare industry, including their ethical and privacy implications. Healthcare Innovation and Entrepreneurship in the Era of Industry 4.0/5.0 (5 Credit Hours) (SSUET) This module would provide students with the opportunity to develop and commercialize Industry 4.0 and 5.0 technologies in healthcare. The course would focus on innovation and entrepreneurship, with an emphasis on the practical applications of Industry 4.0 and 5.0 technologies in healthcare. Students would work on interdisciplinary projects to develop and test their ideas, with the goal of bringing new Industry 4.0 and 5.0 technologies to the healthcare industry. Digital Transformative Technology Project (5 Credit Hours) (DCU) This challenge-based project will challenge students to utilise their knowledge of Industry 4.0 and 5.0 technologies to solve real-world problems faced by a biomedical engineering company or healthcare institute. Students will work on a project assigned by the company or institute, using digital transformation and advanced technologies to find a solution. This module will provide hands-on experience in problem-solving, project management, and implementation of Industry 4.0 and 5.0 technologies. The students will assess the impact of digital transformation on Biomedical Engineering and apply project management skills to bring the solution to life. The end goal is to present and demonstrate the successful implementation of their solution to the			

		biomedical engineering company. Each partner HEI has established Industry Advisory Boards (IAB). Board members will be engaged to identify industry challenges and identify company supervisor. For all these new modules, BIOMED5.0 will develop learning outcomes, module descriptions, teaching contents and delivery modes, and assessment plan. The developed modules will be reviewed by subject matter experts in partner HEIs and necessary revisions will be made before submitting to approval committees.			
T2.4	Incorporating Industry 4.0 and 5.0 Technologies into existing modules in undergraduate BME programme	This task is focused on integrating I4.0/5.0 technologies and digital transformation elements into existing BME undergraduate modules. Considering the training gained from Task 4.4 in Innovative Pedagogies, the approach for incorporating these elements will be to use case studies and real word examples and hence making the module more engaging and providing enhanced student experience. Guest lectures from expert speakers will be organised to provide first-hand information to students. It is proposed that these new teaching elements will replace 10% to 20% of the existing contents, depending upon the target module. The recommendations from Task 2.1 will be followed for update of existing modules. Following UG modules will be updated with proposed new teaching contents: 1. Biomedical Instrumentation (UETT) Smart medical devices and wearable technologies Internet of Medical Things (IoMT) Predictive maintenance of medical devices 2. Modelling and Simulation (SHU)	SSUET MUET LUMHS SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	

		Machine learning for medical diagnosis and treatment Predictive modelling in biomedical engineering Digital twinning for medical devices Medical Imaging 3. AI-based image analysis and diagnosis (UETT) Telemedicine and remote medical imaging Augmented and virtual reality in medical imaging 4. Emerging Trends in Biomedical Engineering Systems (SSUET) 3D printing in biomedical engineering Biomedical nanotechnology Biomedical sensors and wearables Bio-inspired robotics and AI 5. Signals and Systems (UETT) Digital signal processing in medical devices Control systems for medical devices and telemedicine Wireless communication and data transfer in medical devices			
T2.5	Incorporating Industry 4.0 and 5.0 Technologies into existing modules in postgraduate BME programme	In this task, following existing modules of postgraduate programme in BME will be revised and updated by incorporating I4.0/5.0 technologies and digital transformation elements: 1. Biomedical Engineering Design (SSUET) 3D Printing Techniques and Applications in Biomedical Engineering; Virtual and Augmented Reality in Biomedical Engineering; Digital Twins in Biomedical Engineering 2. Advanced Biomedical Signals and Systems (UETT) IoT in Biomedical Engineering; Cloud Computing in Biomedical Engineering; Data	SSUET MUET LUMHS SHU ZIAU UETL BUET UETT TUCN	COO BEN BEN BEN BEN BEN BEN BEN BEN	

			DCU	BEN	
			PEC	BEN	
		Analytics in Biomedical Engineering 3. Medical Instrumentation (UETL) Wireless Sensors in Biomedical Engineering; Wearable Technologies in Biomedical Engineering; Machine Learning in Biomedical Engineering 4. Statistics in Medicines (MUET) Big Data Analysis in Biomedical Engineering; Predictive Analytics in Biomedical Engineering 5. Digital Signal Processing for Measurement System (BUET) Artificial Intelligence in Biomedical Engineering; Deep Learning in Biomedical Engineering; Digital Signal Processing Algorithms in Biomedical Engineering 6. Ultrasonic Instrumentation and Imaging (UETT) Advanced Ultrasonic Imaging Techniques (e.g. elastography) in Biomedical Engineering; Image Processing Algorithms in Biomedical Engineering 7. Medical Imaging Processing (UETT) Computer-aided Diagnosis in Biomedical Engineering; Machine Learning in Medical Imaging; Image Analysis Algorithms in Biomedical Engineering			
T2.6	Improving digital literacy by development of life long learning Open Online Courses for biomedical and healthcare professionals	In an effort to increase digital literacy among working and job-ready professionals in the biomedical and healthcare sectors, a series of five Open Online Courses (OOC) will be developed and made freely available on MOOC[16]. With the accessibility of these weeklong online courses, professionals from a wide audience will have the opportunity to stay up-to-date with the latest advancements, improve their job skills, enhance patient outcomes, and remain competitive in their careers. The courses will be created by the subject matter	SSUET MUET LUMHS SHU ZIAU UETL BUET	COO BEN BEN BEN BEN BEN BEN	

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[16] https://www.mooc.org/

			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	
		experts from the partner HEIs as indicated in the list below. This initiative will have a far- reaching impact on improving digital literacy across the country. Digital Literacy for Biomedical Engineers and Healthcare Professionals (MUET & LUMS) This short course is designed to help biomedical engineers and healthcare professionals improve their digital literacy, including understanding the basics of digital transformation and Industry 5.0 technologies, using digital tools and platforms to improve patient outcomes, and incorporating digital technologies into their day-to-day work processes. The course would cover topics such as digital health data management, telemedicine, digital devices, and AI in healthcare. Digital Transformation in Healthcare Delivery Systems (SSUET & SHU) This short course would provide an in-depth understanding of how digital transformation and Industry 5.0 technologies are transforming healthcare delivery systems, including telemedicine, electronic health records, and data analytics. Advanced Biomedical Devices and Industry 5.0 (ZIAU, BUET) This short course would focus on the use of Industry 5.0 technologies in the development and implementation of advanced biomedical devices, including wearable devices and implantable devices. Artificial Intelligence in Biomedical			

		Engineering (SHU & UETT)			
		This short course would explore the use of AI in biomedical engineering, including its applications in medical imaging, drug discovery, and personalized medicine.			
		Cybersecurity in Healthcare and Biomedical Engineering (UETL & MUET)			
		This short course would examine the challenges and opportunities of digital transformation in healthcare and biomedical engineering, including the importance of cybersecurity in protecting sensitive patient data and medical devices. The course would cover best practices for cybersecurity in these fields.			
T2.7	Approval of new and updated modules through PEC and relevant bodies at HEI.	BIOMED5.0 project will collaborate closely with Pakistan Engineering Council (PEC) to improve the current BME curricula. on development, revision and update of current BME curricula. PEC is the competent authority for curriculum revision and update at the national level for Pakistani HEIs offering engineering programmes. Once the proposed new modules and revised modules will be incorporated into the national curricula for UG and PG programmes in BME by PEC, each partner HEI will start approval process from their institutional committees. Typically, this process will include content revision by Departmental Board of Studies, followed by review and approval from the Faculty Board for Teaching and Learning. Once these two committees sign off, the modules will be sent to Academic Council for final review and approval.	SSUET MUET LUMHS SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	
T2.8	Pilot Implementation of Revised BME Curricula and Short Courses and	This task aims to implement the revised BME curricula for both UG and PG programme through a pilot testing phase. Partner HEIs will	SSUET	COO	

Feedback	ensure delivery of the modules in their respective programme.	MUET	BEN	
		LUMHS	BEN	
	The effectiveness of the updated and new modules will be assessed via teachers and students feedback.	SHU	BEN	
		ZIAU	BEN	
	Teachers' feedback will help to evaluate structure and organisation of modules, teaching methods and materials for facilitating enhanced learning by students, challenges experienced during modules delivery and general comments on practical implementation of pilot phase.	UETL	BEN	
		BUET UETT	BEN	
		TUCN	BEN	
		DCU PEC	BEN	
	Students' feedback will help to assess quality of teaching materials in terms of student's learning needs and expectations, challenges encountered, and overall learning experience.		BEN	
			BEN	
	The feedback received from both lecturers and students will provide a comprehensive and well- rounded evaluation of the revised curricula and help to ensure that it is effective and relevant to improve overall knowledge of students in I4.0/5.0 technologies in biomedical engineering and healthcare sectors. Based on the strengths and weaknesses of the revised curricula, the areas for improvements in teaching contents, delivery style and assessment plans will be identified and the modules will be updated accordingly.			
	The results from feedback studies will be published in peer reviewed engineering education journals (e.g. Journal of Engineering Education (JEE), Wiley, Computers and Education, Elsevier etc.).			

Milestones and deliverables (outputs/outcomes)

Milestone No (continuous numbering not linked to WP)	Milestone Name	Work Package No	Lead Beneficiary	Description	Due Date (month number)	Means of Verification
MS3	PEOs and LOs revised to incorporate I4.0/5.0 in BME curricula	2	SSUET	The revision and update of PEOs and LOs for PG and UG programme are completed to introduce I4.0/5.0 technologies in new and existing modules.	M2	Structured map of PEOs and LOs matching the proposed changes and updated curricula is available.
MS4	New modules developed and approved by PEC for UG and PG programme	2	SSUET	Module descriptors, teaching contents and assessment plans are developed and modules are approved by PEC for inclusion in BME curricula.	M18	New modules are added into programme guide in partner HEIs
MS5	Selected existing modules are revised and ready for delivery	2	SSUET	Module descriptors, teaching contents and assessment plans are updated with incorporation of I4.0/5.0 technologies and available for delivery in UG and PG BME programme	M18	Delivery of updated modules in partner country HEIs
MS6	Completion of development of life-long learning Open Online Courses (OOC) on digital transformation and I4.0/5.0 in biomedical engineering and healthcare	2	MUET	Course descriptors, teaching contents and assessment plans are developed and approved by partner HEIs' statutory bodies	M18	Availability of the developed OOC on MOOC
MS7	Successful pilot implementation of updated and revised BME Curricula and short courses with positive feedback	2	SSUET	Updated curricula implemented in UG and PG BME programme in partner country HEIs	M36	WP2 deliverables submitted. Engineering students equipped with essential skills to lead digital transformation using Industry 4.0/5.0 technologies
Deliverable No (continuous	Deliverable Name	Work Package	Lead	Type Disseminat	Due Date (month	Description

numbering linked to WP)		No	Beneficiary		ion Level	number)	(including format and language)
D2.1	Resolutions of Curriculum Update and Revision Committee on Revised PEOs and LOs	2	SSUET	[R — Document, report]	[SEN — Sensitive]	M2	The report will provide detailed information on revised PEOs and LOs for incorporating digital transformation enabling I4.0/5.0 technologies. These revisions will be made on the basis of discussions between subject matter experts, IAB members and students and it will be aligned with needs assessment made at the proposal preparation stage of BIOMED5.0. Format: Electronic Report, approx. 10 pages Language: English
D2.2	Report on incorporation of I4.0/5.0 technologies in BME curricula via new and updated modules	2	SSUET	[R — Document, report]	[SEN — Sensitive]	M18	The report will provide detailed information on how the updated PEOs and LOs are matched by introducing new modules and update of existing modules in UG and PG BME programme. Format: Electronic Report, approx. 15 pages Language: English
D2.3	Report on Open Online Courses developed for biomedical and healthcare professionals	2	MUET	[R — Document, report]	[SEN — Sensitive]	M18	A detailed report on OOC developed for working and open to work professionals to improve digital literacy in biomedical and healthcare industries. Format: Electronic Report, approx. 20 pages Language: English

| D2.4 | Report on feedback survey results from BME students | 2 | MUET | [R — Document, report] | [SEN — Sensitive] | M36 | This report will summarise the finding of the survey and how the results were used to improve the teaching contents, delivery style and assessment modes for UG and PG BME programme.

Format: Electronic Report, approx. 30 pages

Language: English |

Work Package 3

Work Package 3: Capacity Building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions			
Duration:	M1 - M36	Lead Beneficiary:	UETL

Objectives

503.1: to enhance BME UG and PG students competencies, skills and employability potential by providing hands-on training on state-of-the-art laboratory facilities

503.2: to develop VR and AR based lab training sessions for diagnostic and therapeutic biomedical engineering devices

503.3: to upgrade engineering teaching laboratories with the purchase of modern equipment required for incorporating digital transformation enabling I4.0/5.0 technologies

Activities and division of work (WP description)

Task No (continuous numbering linked to WP)	Task Name	Description	Participants		In-kind Contributions and Subcontracting (Yes/No and which)
			Name	Role (COO, BEN,	

				AE, AP, OTHER)	
T3.1	Establishment of BIOMED5.0 Labs working group		UETL	COO	No
		For a structured and organised work, a working group BIOMED5.0 Labs will be established to work on the upgradation of BME lab facilities and development and implementation of VR/AR labs. One subject matter expert from each partner HEI and one lead VR/AR expert from DCU, TUC, ZIAU, and UETL will be the members of this working group. BIOMED5.0 Labs will share and develop best pedagogical practice on design, development and implementation of I4.0/5.0 technology labs across the partner HEIs in UG and PG BME programme. The Group will be scheduled to meet once per quarter. However, more frequent meetings will be held as the need arises. Briefly, BIOMED5.0 Labs work group will be responsible for the following activities: 1. Capture, monitor and review the tools required to incorporate I4.0/5.0 technologies in BME lab sessions through revision and update of BME PEOs and LOs 2. Provide guidelines, directions and recommendations for development and integration of VR/AR lab resources within practical laboratory modules at UG and PG programme levels 3. To share examples of good practices for integrating and demonstrating the benefits of Virtual Laboratory components within partner HEI programs and modules 4. To regularly review and evaluate the VR/AR sessions development, gather feedback from students and update the sessions accordingly	MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	

		5. To procure state-of-the-art lab equipment to upgrade existing facilities			
T3.2	Revision of PEOs and LOs to update teaching laboratory sessions in UG and PG programmes	The first meeting of BIOMED5.0 Labs will be convened with kick-off meeting. This meeting will focus on revision of PEOs and LOs and review the structure proposed in the BIOMED5.0 application and get feedback from industry members and students. A detailed framework will be developed mapping the PEOs and LOs with the proposed VR, AR and in-lab sessions for BME bachelor and master programmes.	UETL MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN AP	No

T3.3	Designing of new lab manuals	Based on outcomes of T3.2, lab manuals for VR and AR lab sessions for therapeutic and diagnostic modalities will be developed for the following modules: • Biomedical Engineering System (UG level) • Medical Imaging (UG level) • Human Anatomy (UG level) • Biomedical Engineering Design (PG level) • Cardiopulmonary Resuscitation (CPR) Training (UG & PG levels)	UETL MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T3.4	Procurement of equipment for upgradation of lab facilities	The following equipment will be purchased to upgrade the lab facilities and develop and run the lab sessions described in T3.2 and T3.3: 1. Virtual Reality Headsets 2. Workstations for the development of Virtual Reality and Augmented Reality sessions (for ZIAU, SSUET, & UETL) 3. 360° video cameras for recording medical equipment at ZIAU for VR development 4. AR Glasses for testing of developed sessions at UETL 5. Polymer 3D printers 6. 3D Scanners 7. IoT based sensor trainer boards 8. Robots, actuators and microcontrollers (educational robotic kit) Lab equipment will be procured by each partner country HEI according to their	UETL MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

		requirements and involvement in different tasks as indicated in the list above. VR headsets, 3D printers and scanners, IoT trainer boards and robotic kits will be purchased by all partners.			
T3.5	Reinforcement learning of digital transformation technologies via laboratory sessions	Based on recommendations from T3.2, following laboratory based training sessions will be introduced in 2nd, 3rd and 4th year modules: Medical Device Prototyping: Lab sessions will composed of hands on experience in medical device product design via Computer Aided Design (CAD) and additive manufacturing (3D printing). Internet of Things in Healthcare: Lab sessions will introduce Internet of Things devices and sensors that are used in healthcare industry. Medical Robotics: Lab sessions will demonstrate the use and control of robots and actuators by programming microcontrollers and drivers to cover concepts and working of surgical, industrial and collaborative robots.	UETL MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

T3.6	Development of VR lab sessions	VR lab sessions for the following biomedical engineering modalities will be developed by different partner HEIs as described below:
		Diagnostic Modalities:
		    1. Computed Tomography (CT) Scan (SSUET)
		    2. Magnetic Resonance Imaging (MRI) (ZIAU)
		    3. Angiography System (UETL) Therapeutic Modalities:
			UETL
			MUET
			SSUET
			LUMHS
			SHU
			ZIAU
				COO
				BEN
				BEN
				BEN
				BEN
				BEN
					No

		1. Medical Linear Accelerator (LINAC) for cancer treatment (UETL) 2. Lithotripter system for treating stones in kidney and ureter (ZIAU) All these equipment are available in a partner country HEI, Ziauddin University and Hospital Karachi (ZIAU). The VR sessions will be developed in following steps: • 360 videos of these modalities will be captured, stitched and converted into virtual world using open source software GStreamer. Required adjustments will be made to create fully immersive, seamless VR experience. • BIOMED5.0 will use open source software including A-Frame, Unity, and Babylon.js to develop VR sessions. These software will allow to add: a) different functionalities and scripts, b) interactions with medical devices and their corresponding responses, c) labelling and tagging, d) instructions on standard operating procedures and e) detailed explanation on working principles of different device components (such as X-ray generation and detection in CT Scan, creating magnetic fields and capturing resonance signals in MRI and dose creation and delivery in LINAC etc.). • The VR sessions Unity projects will be build for Oculus headsets which are cost effective and easy to use.	BUET UETT TUCN DCU PEC	BEN BEN BEN BEN BEN	
T3.7	Development of AR/MR lab sessions	The following three AR/MR lab sessions will be developed in this task by UETL: 1. Human Anatomy Learning System using Augmented Reality Open source software Blender will be used to create 3D models of human organs. ARToolKit software will be used to integrate human organ models and creation of tracking	UETL MUET SSUET LUMHS SHU	COO BEN BEN BEN BEN	No

				ZIAU BUET UETT TUCN DCU	BEN	
			images of lab table for augmented reality experience. Interactive elements such as hide and display of different organs and system, pop-up information boxes and quizzes will be added. 2. Augmented Reality based IoT Sensor Board Training Vuforia will be used to create image tracking of physical IoT sensor board, augmented display of sensor data and data communication. The IoT sensor board will be connected with Vuforia API via local Wi-Fi connection and the sensor data will be displayed in real time on a variety of devices (smart phones and tablets) as AR experience. 3. Cardiopulmonary resuscitation (CPR) training using Mixed Reality (MR) For CPR training, 3D models of human torso and heart will be created in Blender and integrated into the ARToolKit. Tracking image for torso and recognition and tracking of hand movements will be incorporated. Step-by-step training instructions for CPR will be provided. Realtime feedback on accuracy of hand placement, location and movements will be provided for effective and easy training. AR based CPR training will be used to train students from other departments and faculties in partner country HEIs.	PEC	BEN BEN BEN BEN BEN	

T3.8	Approvals, pilot implementation and students feedback		UETL	COO	No
		The developed lab sessions will be passed through approval for laboratory teaching by Department Board of Studies, Board of Faulty for Teaching and Learning and Academic Council. The developed lab sessions will be implemented in respective modules as pilot programme and assess the effectiveness of use of digital technologies as innovative pedagogy and enhanced student experience. The evaluation of new and updated lab sessions will be performed via student and staff feedback to asses the effectiveness and impact of introducing new lab sessions. Survey questionnaire will be developed which will cover the key aspects of teaching and training contents, level of interactivity, comfort of use and accessibility and overall experience. The feedback from the questionnaire will be analysed and a report will be prepared on suggestions and recommendations. The necessary improvements will be implemented to further enhance students experience and knowledge in digital transformation enabling technologies.	MUET SSUET LUMHS SHU ZIAU BUET UETT TUCN DCU PEC	BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	

Milestones and deliverables (outputs/outcomes)						
Milestone No (continuous numbering not linked to WP)	Milestone Name	Work Package No	Lead Beneficiary	Description	Due Date (month number)	Means of Verification
MS8	Inception of BIOMED5.0 Labs Working Group	3	UETL	BIOMED5.0 Lab working group is established and responsibilities are assigned to group members.	M2	Report on terms of reference and responsibilities of the group
MS9	PEOs and LOs revision	3	UETL	Revision and update of PEOs and LOs completed for capacity building in BME teaching laboratories	M2	Report on mapping PEOs and LOs with

	completed for upgrading lab sessions			and lab equipment upgradation requirements are identified.		proposed new lab sessions
MS10	Procurement of lab equipment completed	3	SHU	Lab equipment procured and laboratory facilities upgraded in the partner country HEIs. Hardware required for development and delivery of VR and AR sessions procured by partner country HEIs.	M9	Lab staff training completed on procured equipment.
MS11	VR, AR and physical practical sessions developed, implemented and improved	3	UETL	Lab sessions for VR, AR and Industry 4.0/5.0 technologies developed and implemented in UG and PG BME programmes and improved on the basis	M36	Number of students trained and educated using the developed lab sessions.

Deliverable No (continuous numbering linked to WP)	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month number)	Description (including format and language)
D3.1	Report on establishment of BIOMED5.0 Labs Working Group and revised LOs for lab sessions	3	UETL	[R — Document, report]	[SEN — Sensitive]	M2	This report will provide detailed information on goals and objectives of the working group and planned activities and responsibilities. The report will provide a comprehensive map and framework between the PEOs and LOs matched with the proposed new lab sessions. Format: Electronic report, approx. 20 pages. Language: English
D3.2	Report on procurement of lab equipment and corresponding lab designs in partner HEIs	3	SHU	[R — Document, report]	[SEN — Sensitive]	M12	The report will provide detailed information on capacity building, lab facility upgradation and staff training on purchased equipment in each partner country HEI. Report will provide detailed information on the designed lab manuals. Format: Electronic report, approx. 30 pages plus lab manuals as annexures

							Language: English
D3.3	VR, AR and MR based lab sessions	3	UETL	[DEM —Demonstrator]	[SEN — Sensitive]	M18	Executable files for installation of developed VR/AR/MR applications on headsets and electronic devices (smartphones). Format: VR/AR executable files

Work Package 4

Work Package 4: Centre of Excellence in Biomedical Engineering			
Duration:	M1 - M36	Lead Beneficiary:	SHU
Objectives			
504.1: to establish Centre of Excellence in Biomedical Engineering to promote digital transformation in education, research, and industry and facilitate collaboration among knowledge triangle players			
504.2: to build capacity of partner HEIs through training in Industry 4.0/5.0 technologies, transformative skills and mental well-being to academic and lab staff, students and entrepreneurs			
504.3: to create a technology incubation hub to drive innovation and support entrepreneurship in biomedical engineering and healthcare through providing access to fabrication labs and mentorship programmes			

Activities and division of work (WP description)

Task No (continuous numbering linked to WP)	Task Name	Description	Participants		In-kind Contributions and Subcontracting (Yes/No and which)
			Name	Role (COO, BEN, AE, AP, OTHER)	

T4.1	Establishment of Centre of Excellence in Biomedical Engineering	Following sub-tasks will be performed for the establishment of the centre: Formation of Steering Committee (SC) The SC will be formed bringing key stakeholders from academia (biomedical engineering, digital technology, entrepreneurship, and professional & personal (mental health and well-being) experts), Pakistan Engineering Council, and industry (healthcare and biomedical engineering). The SC will develop the centre's mission and vision, oversee the development of the centre and ensure that the centre activities aligns with the needs and goals of digital transformation in academia and industry. Acquiring Physical Space and Location MUET has offered a large designated space to set up the centre and run activities. MUET will provide necessary infrastructure and resources to support the centre activities. Securing Additional Funds for Centre Sustainability The SC will be responsible for securing additional funds from different sources to support centre's activities beyond the BIOMED5.0 project life. SC will target the following funding schemes: HEC Pakistan, Erasmus+ and philanthropist donations.	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	In-kind contribution from MUET in the form of office space and furniture for the establishment of the centre.
T4.2	Pan-Institutional Biomedical Engineering Digital Fabrication Laboratory (Fab Lab)	This "Fab Lab", spread across the partner HEIs, will serve as a technology incubator, driving innovation and development through the uptake of I4.0/5.0 technologies in innovative products and solutions for biomedical engineering and healthcare industries. The laboratory will provide platform for young entrepreneurs, business start-ups, and technology developers to use their theoretical knowledge into practical applications. For each partner country HEI, a budget of €18700 is requested to purchase the following equipment to facilitate users in technology development: - 5 Axis lab scale hybrid 3D printer and CNC mill machine (€8000) - FDM Desktop polymer 3D printer (€2500) - Handheld 3D scanner (€700) - CNC laser cutter and engraver (€3500)	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	In kind contributions from Pakistani HEIs in the form of designated space for Fab Labs.

		- Screen printer for sensors and flexible electronics components (€1500) - High-end computing workstations with NVIDIA® GeForce® RTX 3060 graphic card (€2500) - Tower Form Factor, Ryzen 9 5000 series processor (5900x) for image processing using deep learning (€4000; requested by UETT)			
T4.3	Entrepreneur Mentorship Programme	A structured entrepreneur mentorship programme will be developed. DCU has already developed a similar programme with EIT HEI Initiative Project "SMART- 2M". The mentorship programme will match programme participants with technology and business experts who will offer support and guidance in specific areas of biomedical engineering, Industry 4.0/5.0, product and process development, and business strategy. The programme will act as a catalyst in helping and facilitating students, start-ups and businesses towards technology development and innovation. Annual entrepreneurship and start-up weeks will be organised to promote business ideas and enable participants to create new networks and have access to potential investors.	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T4.4	Academic staff training in Innovative Pedagogies	DCU Teaching Enhancement Unit will organise a five day training and workshop on innovative pedagogies in engineering higher education programmes. The training will consist of two days online lectures, two days in-person workshop at DCU and one day followup online session. The first two days online session will be focused on the use of project-based, problem based and challenge based learning. The participants will learn about use of "Design Thinking" principles in engineering education to encourage students in creative thinking and finding outside the box solutions. DCU team will share experiences on the innovative transformative technology project based module which is focused on collaborative and experimental learning, generating resilience in impossible to solve tasks. The participants will learn about the use of VR/AR in creating immersive learning experiences for engineering students. Followed by the online session, a two day in-person workshop will be organised at	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

		DCU in which participants will work in small groups to develop and present an action plan for implementation of innovative pedagogies in their modules. Feedback will be provided to the participants from trainers and peers at the end of the workshop. An online follow-up session will be organised to ensure that the participants have successfully implemented innovative pedagogies in their teaching practices. Participants: Two participants from each partner country HEI will attend this training.				
T4.5	Academic staff training in Industry 4.0 technologies	DCU team will organise a comprehensive three-day training program for academic staff members of partner country HEIs which will be focused on the utilisation of additive manufacturing technologies in biomedical engineering product development and optimisation. DCU applicant team is composed of additive manufacturing experts who will provide hands-on training in the use of cutting-edge 3D printing technologies. DCU boasts an impressive range of 3D printing facilities, including a metal Laser Powder Bed Fusion system, a Polyjet polymer printer, Micro-Stereolithography, Fused Deposition Modelling 3D printer, two-photon lithography system for nanoscale 3D printing, and screen printers for flexible electronics and sensors fabrication. Participants in the training program will have the opportunity to get first hand experience with these state-of-the-art facilities and gain practical experience in using them for product design and optimization. This training will be designed to provide a comprehensive understanding of the additive manufacturing processes mentioned above, as well as their benefits and limitations. Moreover, participants will learn about the design and optimization of products for biomedical engineering applications, including the use of computer-aided design and modelling software. The training participants will be equipped with the skills and knowledge necessary to effectively apply these technologies in their own teaching and research. Participants: Two participants from each partner country HEI will attend this training.	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No	

T4.6	Academic staff training in TUCN	A five day training session will be organised by TUCN which will be focused on the following topics: - Smart Manufacturing in Medical Engineering - Product Design and Development using Industry 4.0/5.0 - Advanced Industrial Internet of Things and Applications in Biomedical Engineering - Big Data Analysis and Applications in Healthcare - Virtual and Augmented Reality in Biomedical Engineering Participants: Two participants from each partner country HEI will attend this training.	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T4.7	Promoting wider impact and human resource development in Pakistani HEIs through reciprocal training programs	This task aims to promote knowledge transfer and capacity building of Pakistani HEIs staff members through reciprocal training programmes. The academic staff members who would complete training programmes in T4.4, T4.5 and T4.6 will organise design and deliver similar training programmes to their colleagues in their respective HEIs. Following trainings will be offered at university level at each Pakistani HEI so that faculty members from other departments can attend: Innovative Pedagogies (2 days) All department and faculties will be invited. Design for Additive Manufacturing (2 days) Participants from Biomedical, Mechanical, Industrial and Materials Engineering will be invited to attend this training. This training will summarise the topics from training in DCU. Digital Transformation and Industry 4.0/5.0 (one week) Participants from Engineering departments of all Pakistani HEIs (including non-participating HEIs) will be invited to attend this training session. This will be an extensive week long training programme covering all aspects of digital transformation and Industry 4.0/5.0 technologies with a focus on bridging the digital gap in engineering programmes.	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T4.8	Laboratory staff trainings	Each partner HEI will organise laboratory staff	SHU	COO	No

		trainings on the newly procured state-of-the-art equipment for upgraded teaching labs and Fab Labs so that they can profoundly assist students in the use of these equipment. Each year, training sessions for lab staff will be organised at each participating Pakistani HEI focusing on raising the awareness about the opportunities brought by digital transformation and basic understanding of enabling Industry4.0/5.0 technologies.	MUET SSUET LUMHS ZIAU UETL BUET UETT	BEN BEN BEN BEN BEN BEN BEN	
T4.9	Students training on Industry 4.0/5.0 technologies	One day online training sessions will be organised by DCU, CUT, SHU, ZIAU and UETL on the following topics: 1. Digital transformation and Industry 4.0/5.0 in Biomedical Engineering (DCU and CUT) 2. Physiological Modelling in Open Cell Software (SHU) 3. Implementing cryptographic techniques in electronic health record systems (SHU) 4. Design for Additive Manufacturing (DCU and MUET) 5. CPR training using Augmented Reality (UETL)	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T4.10	Students training on transformative skills	SSUET and DCU will organise online transformative skills trainings for students on the following topics: 1. New Value Creation (DCU) This training will explain the use of innovation and risk management, critical thinking, open mindset, agility, collaboration and adaptability for new value creation 2. Reconciling tensions and dilemmas for digital transformation (SSUET) This training session will teach participant how to use cognitive flexibility, perspective-taking skills, conflict resolution, empathy and respect, problem solving skills, resilience and tolerance	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

		for complexity and ambiguity skills for digital transformation 3. Taking responsibility to drive innovation and leading digital transformation (SSUET) This training will be focused on locus of control, integrity, compassion and respect, critical thinking, self-awareness, self-regulation, reflective thinking and building trust			
T 4.11	Student training on mental health and well-being	Psychology experts from LUMHS and SSUET will organise in-person seminars "Mental Health and Well-Being for professional and personal development". These in-person seminars will be organised separately at each partner HEI. The seminar will cover the following topics: - Understanding the basics of mental health and well-being for academic success - Identification and management of stress and anxiety during university life - Building healthy habits for self-care and stress management - Navigating challenging experiences and building resilience Mental health and well being impact on personal and professional relationships	SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T 4.12	Development of digital platform for Mental Health and Well-Being	The Centre of Excellence in Biomedical Engineering together with psychology experts from SSUET and LUMS will develop a website based digital platform using a combination of standard psychological screening tools DAS 21 and Rosenburg Self-Esteem scale to guide students towards their psychological well-being. SHU MUET SSUET LUMHS ZIAU UETL BUET UETT TUCN DCU PEC		COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	SSUET will provide web-space to host the digital platform during and beyond the BIOMED5.0 project lifetime.
T4.13	Industry 4.0/5.0 Technology Hackathons	Considering the geographical spread of the country, MUET, SSUET, UETL, BUET and UETT will separately organise I4.0/5.0 Technology Hackathons for engineering students in multidisciplinary teams to bring innovative solutions for real-world problems in healthcare industry. The Hackathons will challenge	SHU MUET SSUET LUMHS ZIAU UETL	COO BEN BEN BEN BEN BEN	No

| | | | students to develop innovative solutions using Industry 4.0/5.0 technologies, such as 3D printing, AI, IoT and big data analysis. The Hackathon will focus on promotion of hands-on experience, critical thinking and problem solving skills. Possible challenges could include: robotic prostheses for disabled persons, developing novel wearable solutions for continuous patient monitoring, use of IoT for telemedicine and healthcare access, data driven personalised medicine for patient outcome improvement etc. | BUET UETT TUCN DCU PEC | BEN BEN BEN BEN BEN |

Milestones and deliverables (outputs/outcomes)

Milestone No (continuous numbering not linked to WP)	Milestone Name	Work Package No	Lead Beneficiary	Description	Due Date (month number)	Means of Verification
MS12	Centre of Excellence established at MUET	4	MUET	Steering Committee of Centre of Excellence is formed and its mission and vision statements are prepared. Terms of reference and responsibility and duties are assigned to committee members.	M12	Vision and mission statements, meeting minutes of SC.
MS13	Establishment of Fab Lab at partner HEIs	4	SHU	Equipment procured and installed and training of lab staff is completed.	M12	Fab lab facilities are available to use by academics, students and entrepreneurs
MS14	Staff and students training events and hackathon successfully completed.	4	SHU	Staff trainings at DCU and CUT are completed.	M36	Staff training reports

Deliverable No (continuous numbering linked to WP)	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month number)	Description (including format and language)
D4.1	Project Interim Report 4		MUET	[R — Document, [SEN —		M18	These interim report will provide progress and

				report]	Sensitive]		Status of project: No.8Format Electronic Report, approx. 20 pages Language: English
D4.2	Report on staff and student training	4	SHU	[R — Document, report]	[SEN — Sensitive]	M24	This report will provide comprehensive information on the events organised for staff and students training, hackathons and seminars. Format: Electronic Report, approx. 20 pages Language: English

Work Package 5

Work Package 5: Project Impact and Outreach: Dissemination, Communication and Exploitation				
Duration:	M1 – M36	Lead Beneficiary:		LUMHS
Objectives				
505.1: to develop and implement a comprehensive dissemination, communication and exploitation plan to maximise the BIOMED5.0 impact and outcomes 505.2: to increase awareness and adoption of digital transformation and BIOMED5.0 outcomes through efforts of a Societal Impact Champion 505.3: to utilise digital media, organise annual conferences and participate in relevant international events engaging key stakeholders and promoting BIOMED5.0 benefits and outcomes				
Activities and division of work (WP description)				
Task No (continuous numbering linked to WP)	Task Name	Description	Participants	In-kind Contributions and Subcontracting (Yes/No and which)
			Name	Role (COO, BEN, AE, AP,	

				OTHER)	
T5.1	Dissemination, Communication and Exploitation Plan	In order to maximise and multiply the impact of the project results during its implementation and beyond the project life, a comprehensive Dissemination Communication and Exploitation plan will be developed, targeting the key stakeholders students, academic staff, higher education sector, government agencies and industries. This plan will be directly supervised by the BIOMED5.0 Executive Committee (Task 1.1). A general plan is developed with planned activities as listed in this WP5. This plan will be continuously monitored and updated throughout the project lifetime.	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T5.2	Copyright policy and intellectual property management	BIOMED 5.0 project outcomes primarily composed of teaching and learning materials in the form of lectures, videos and software. Therefore a comprehensive copyright policy will be developed and agreed upon between the partners for effective management of intellectual property and prevent conflict. It has been decided among the BIOMED 5.0 partners to make the generated materials freely available to use under Creative Commons license.	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T5.3	Dissemination and Communication	The following digital media will be used to disseminate and communicate BIOMED5.0	LUMHS	COO	No

		using Digital Media	project outcomes: Project website will be developed and regularly updated with project activities, deliverables, outcomes, and reports available for public dissemination. BIOMED5.0 Social Media Accounts will be created to reach a wider audience. For these accounts, infographics and project activities videos will be created. Bi-annual newsletter will be published and distributed to subscribers, keeping them informed about the project activities and outcomes.	MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	
T5.4		Digital transformation Societal Impact Champion for Education And Public Engagement (EPE) activities	A full time Societal Impact Champion will be appointed to carry out EPE activities and promote the societal impact of BIOMED5.0 to the identified key stakeholders (students, educators, biomedical engineers, healthcare professionals and general public). The champion will monitor and evaluate the impact of BIOMED5.0 using relevant indicators and metrics and translate this information into understandable terms for general public, government agencies and industry representatives. The champion will organise a number of events and workshops and use digital media to create a dialogue about digital transformation and its impact on the society and economy. A major responsibility of the champion will be to train the academics to effectively communicate scientific progress to non-technical audience and general public.	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No
T5.5		BIOMED5.0 Annual Conference and Stakeholder Engagement	BIOMED5.0 project will host an annual conference with a focus on promotion of innovative pedagogies, enhancing capacity	LUMHS MUET	COO BEN	No

		building in biomedical engineering higher education, and highlighting the impact of digital transformation and Industry 4.0/5.0. These conferences will be organised in LUMHS (Year 1), UETL (Year 2), and SHU (Year 3). These events will serve as a platform to showcase BIOMED5.0 project outcomes and achievements, facilitate networking opportunities with academic professionals, and engagement with key stakeholders.	SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	BEN BEN BEN BEN BEN BEN BEN BEN BEN	
T5.6	Organisation of Master Classes in Industry 4.0/5.0 and Digital Transformation	BIOMED5.0 will organise online master classes with the objective of attracting enrolments to Open Online Courses (OOCs) for lifelong learning, developed in task T2.6. These master classes will specifically target working and unemployed professionals looking to upskill and seeking new knowledge for better job opportunities and individuals interested in latest technological developments. These classes will offer participants a preview of the full OOCs, providing a glimpse into the comprehensive teaching contents of the courses. The classes will serve as a gateway for participants to enrol in full courses and ensure high participation number in BIOMED5.0 OOCs.	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	

T5.7	Participation in International Conferences	Each partner HEI will participate in at least two International Conferences on engineering education (such as International Symposium of Engineering Education (ISEE)) to present BIOMED5.0 project outcomes to a global audience, gain new knowledge on engineering education development by the international community and learn about innovative teaching methods.	LUMHS	COO	No
			MUET	BEN	
			SSUET	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	
			TUCN	BEN	
			DCU	BEN	
			PEC	BEN	
T5.8	STEM outreach programme	Each HEI will perform the following four activities as part of STEM outreach programme in close collaboration with the Societal Impact Champion: 1. Secondary and High Secondary school visits: BIOMED5.0 team members will give presentations on importance of STEM education and how digital transformation and STEM subjects will shape their future. 2. 3D printing demonstrations: The partner HEIs will organise 3D printing demonstration sessions in schools to engage students with hand-on experience of 3D printing technology and how it is influencing the designing of products. 3. Fab Lab visits: Schools will be invited to Fab Labs at partner HEIs and experience VR/AR sessions, igniting interest in STEM education 4. Women in STEM: Girls school visits in	LUMHS	COO	No
			MUET	BEN	
			SSUET	BEN	
			SHU	BEN	
			ZIAU	BEN	
			UETL	BEN	
			BUET	BEN	
			UETT	BEN	

		disadvantaged and remote areas will be organised to inspire and encourage more women to pursue careers in STEM and demonstrate the potential for digital transformation to create a more diverse and inclusive future.			
T5.9	Impact Assessment and Case Studies	The Societal Impact Champion, together with academic staff members from partner HEIs will participate in BIOMED5.0 impact assessment and conduct the following six case studies: 1. The impact of updated and revised biomedical engineering curricula on student knowledge in digital transformation and potential increment in employability rates. 2. The benefits of virtual reality sessions in enhancing hands-on learning experiences and skills development. 3. The effectiveness of modernized teaching lab facilities in promoting hands-on learning and experimental design 4. The success of the Centre of Excellence in Biomedical Engineering in attracting new partnerships, funding, and research collaborations. 5. The impact of capacity building efforts on faculty development and improved teaching practices 6. The overall impact of the project on the biomedical engineering education and industry in Pakistan using periodic surveys and focus group discussions. This case study will provide ongoing insights into the effectiveness and impact of the project and facilitate revisions, corrections and modifications based on feedback	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

			received.			
T5.10	Sustainability Plan		A detailed sustainability plan will be devised to ensure the longevity of the project outcomes beyond the project life. Majority of the project outcomes such as teaching contents including lectures, videos, lab manuals and VR/AR sessions are naturally sustainable beyond the project lifetime. The infrastructure developed for virtual labs (high-end computing workstations) would remain available beyond project life, however further funding would be required for human resources to convert more lab practical sessions into VR/AR environment. Future funding would be required to run the activities of Centre of Excellence and Fab Labs beyond the BIOMED5.0 project life. A number of funding sources have been identified to secure future funding for sustaining the BIOMED5.0 project outcomes beyond the project lifetime.	LUMHS MUET SSUET SHU ZIAU UETL BUET UETT TUCN DCU PEC	COO BEN BEN BEN BEN BEN BEN BEN BEN BEN BEN	No

Milestones and deliverables (outputs/outcomes)

Milestone No (continuous numbering not linked to WP)	Milestone Name	Work Package No	Lead Beneficiary	Description	Due Date (month number)	Means of Verification
MS15	Dissemination, communication and exploitation plan developed	5	LUMHS	The action plan for dissemination communication and exploitation is ready for implementation.	M3	Project website is ready and planned WP5 activities are updated on the website.
MS16	Copyright policy and intellectual property management plan approved	5	BUET	The copyright policy is developed and agreed by the partner HEIs. Intellectual property management plan is approved.	M2	Digital platform is made available (e.g. in the form of Google drive) to share the teaching contents.
MS17	Societal Impact Champion is appointed	5	LUMHS	The societal impact champion recruitment process is completed and stakeholder engagement plan is made available to start WP5 activities.	M2	On-boarding of the Digital Transformation Societal Impact Champion for Education And Public Engagement (EPE)

							activities
MS18	EPE, stakeholder engagement activities and annual conferences are organised	5	LUMHS	Completion and implementation of the digital transformation societal impact strategy for education and public engagement, development of key metrics and indicators for monitoring and evaluation, and establishment of partnerships and collaborations with relevant stakeholders.		M36	Planned activities are performed in timely manner.

Deliverable No (continuous numbering linked to WP)	Deliverable Name	Work Package No	Lead Beneficiary	Type	Dissemination Level	Due Date (month number)	Description (including format and language)
D5.1	Report on project assessment	5	LUHMS	[R — Document, report]	[SEN — Sensitive]	M36	This report will provide a comprehensive evaluation of the BIOMED5.0 project's impact on biomedical engineering education in Pakistan, specifically focusing on the modernisation of curricula, implementation of virtual reality sessions, improvement of teaching lab facilities, establishment of a Centre of Excellence, and capacity building efforts. The report will present the findings from the six case studies conducted to assess the BIOMED5.0 project's overall impact and achievements. Format: Electronic report, approx. 40 pages Language: English

Staff effort (n/a for Lump Sum Grants)

Staff effort per work package

Fill in the summary on work package information and effort per work package.

Work Package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Start Month	End Month	Person-Months
1	Project Management and Coordination	1	MUET	M1	M36	169
2	Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula	2	SSUET	M1	M36	208
3	Capacity Building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions	3	UETL	M1	M36	392
4	Centre of Excellence in Biomedical Engineering	4	SHU	M1	M36	198
5	Project Impact and Outreach: Dissemination, Communication and Exploitation	5	LUMHS	M1	M36	119
					Total Person-Months	1086

Staff effort per participant

Fill in the effort per work package and Beneficiary/Affiliated Entity.

Please indicate the number of person/months over the whole duration of the planned work.

Identify the work-package leader for each work package by showing the relevant person/month figure in bold.

Participant	WP1	WP2	WP3	WP4	WP5	Total Person-Months
Mehran University of Engineering and Technology	78	72	96	36	24	306
Sir Syed University of	9	36	11	6	6	68

Engineering and Technology						
Liaquat University of Medical and Health Sciences Jamshoro	16	36	30	6	40	128
Salim Habib University	36	12	36	72	6	162
Ziauddin University	3	12	69	10	6	100
University of Engineering and Technology, Lahore	6	6	93	3	3	111
The Baluchistan University of Engineering and Technology	3	18	18	12	18	69
University of Engineering and Technology, Taxila	6	7	31	42	10	96
Universitatea Technica CLUJ - NAPOCA	3	2	1	3	2	11
Dublin City University	6	6	6	5	3	26
Pakistan Engineering Council	3	1	1	3	1	9
Total Person-Months	169	208	392	198	119	1086

Subcontracting (n/a for prefixed Lump Sum Grants)

Subcontracting

Give details on subcontracted project tasks (if any) and explain the reasons why (as opposed to direct implementation by the Beneficiaries/Affiliated Entities).

Subcontracting — Subcontracting means the implementation of 'action tasks', i.e. specific tasks which are part of the EU grant and are described in Annex 1 of the Grant Agreement.

Note: Subcontracting concerns the outsourcing of a part of the project to a party outside the consortium. It is not simply about purchasing goods or services. We normally expect that the participants to have sufficient operational capacity to implement the project activities themselves. Subcontracting should therefore be exceptional.

Include only subcontracts that comply with the rules (i.e. best value for money and no conflict of interest; no subcontracting of project coordination tasks).

Work Package No	Subcontract No (continuous numbering linked to WP)	Subcontract Name (subcontracted action tasks)	Description (including task number and BEN/AE to which it is linked)	Estimated Costs (EUR)	Justification (why is subcontracting necessary?)	Best-Value-for-Money (how do you intend to ensure it?)
	S1.1					
	S1.2					

Other issues: If subcontracting for the project goes beyond 30% of the total eligible costs, give specific reasons.	Insert text

Events meetings and mobility

Events meetings and mobility

This table is to be completed for events meetings and mobility that have been mentioned as part of the activities in the work packages above Give more details on the type, location, number of persons attending, etc.

Event No (continuous number ing linked to WP)	Participant	Description					Attendees
		Name	Type	Area	Location	Duration (days)	Number
E1.1	[All Partners]	Kick-off Meeting	Meeting	Management	Jamshoro, Pakistan	2	30
E1.2	[All Partners]	Executive Committee Meeting	Meeting	Management	Online [3 times annually]	1	30
E1.3	[All Partners]	Executive Committee Meeting	Meeting	Management	Karachi, Pakistan	1	30
E1.4	[All Partners]	Executive Committee Meeting	Meeting	Management	Karachi, Pakistan	1	30
E1.5	[All Partners]	Executive Committee Meeting	Meeting	Management	Karachi, Pakistan	1	30
E1.6	[All Partners]	Project Closeout Meeting	Meeting	Management	Jamshoro, Pakistan	1	30
E2.1	[All Partners]	Curriculum Revision Meeting	Meeting	Course Development	Jamshoro, Pakistan	2	30
E2.2	[All Partners]	Curriculum Revision Meeting	Meeting	Course Development	Online (3 times annually)	1	30

E3.1	[All Partners]	BIOMED5.0 Labs Working Group Meeting	Meeting	Course Development	Jamshoro, Pakistan	2	30
E3.2	[All Partners]	BIOMED5.0 Labs Working Group Meeting	Meeting	Course Development	Online (3 times annually)	1	30
E4.1	[All Partners]	Centre of Excellence in Biomedical Engineering Steering Group Meeting	Meeting	Management	Online (3 times annually)	1	20
E4.2	[All Partners]	Academic staff training in Innovative Pedagogies	Training	Skill Development	Dublin, Ireland	2	20
E4.3	[All Partners]	Academic staff training in Industry 4.0 technologies	Training	Skill Development	Dublin, Ireland	3	20
E4.4	[All Partners]	Academic staff training on Smart Manufacturing for Biomedical Engineering	Training	Skill Development	Cluj-Napoca, Romania	5	20
E4.5	[All Partners]	Innovative Pedagogies	Training	Skill Development	Each Pakistani HEI will organise	2	400
E4.6	[All Partners]	Design for Additive Manufacturing	Training	Skill Development	Each Pakistani HEI will organise	2	400
E4.7	[All Partners]	Digital Transformation and Industry 4.0/5.0	Training	Skill Development	Each Pakistani HEI will organise	5	400
E4.8	All HEIs	Digital transformation and Industry 4.0/5.0 in Biomedical Engineering	Training	Skill Development	Online	1	300 x 8 =2400
E4.9	All HEIs	Physiological Modelling in Open Cell Software	Training	Skill Development	Online	1	300 x 8 =2400
E4.10	All HEIs	Implementing cryptographic techniques in electronic health record systems	Training	Skill Development	Online	1	300 x 8 =2400
E4.11	All HEIs	Design for Additive Manufacturing	Training	Skill Development	Online	1	300 x 8 =2400
E4.12	All HEIs	CPR training using Augmented Reality	Training	Skill Development	Online	1	300 x 8 =2400
E4.13	All HEIs	New Value Creation	Training	Skill Development	Online	1	300 x 8 =2400
E4.14	All HEIs	Reconciling tensions and dilemmas for digital transformation	Training	Skill Development	Online	1	300 x 8 =2400
E4.15	All HEIs	Taking responsibility to drive innovation and leading digital transformation	Training	Skill Development	Online	1	300 x 8 =2400
E4.16	All HEIs	Mental Health and Well-Being for professional and personal development	Seminar	Seminar	Organised in all partner HEIs	1	300 x 8 =2400
E4.17	All HEIs	Industry 4.0/5.0 Technology Hackathons	Hackath on	Skill Development	Karachi, Pakistan	1	400
E4.18	All HEIs	Industry 4.0/5.0 Technology Hackathons	Hackath on	Skill Development	Lahore, Pakistan	1	400
E4.19	All HEIs	Industry 4.0/5.0 Technology Hackathons	Hackath on	Skill Development	Taxila, Pakistan	1	400
E4.20	All HEIs	Industry 4.0/5.0 Technology Hackathons	Hackath on	Skill Development	Khuzdar, Pakistan	1	400
E.4.21	All HEIs	Laboratory Staff Training	Training	Training	Each Pakistani HEI will organise	2	10x8
E5.1	All Partners	BIOMED5.0 Annual Conference	Confere nce	Dissemination and Communication	Jamshoro, Pakistan	2	250
E5.3	All Partners	BIOMED5.0 Annual Conference	Confere nce	Dissemination and Communication	Lahore, Pakistan	2	250
E5.4	All Partners	BIOMED5.0 Annual Conference	Confere nce	Dissemination and Communication	Karachi, Pakistan	2	250

E5.5	All Partners	Master Classes in Industry 4.0/5.0 and Digital Transformation	Master Class	Outreach	Online	1	150 x 5 = 750
E5.6	All Partners will attend two international conferences	Participation in International Conferences	Confere nce	Stakeholder Engagement	International Locations	3	16
E5.7	All Pakistani HEIs	Secondary and High Secondary school visits	Visit	Education and Public Engagement	Organised in five cities of Pakistan (Jamshoro, Karachi, Lahore, Taxila, and Khuzdar)	1	100x10 = 1000
E5.8	All Pakistani HEIs	3D printing demonstrations	Visit	Education and Public Engagement	Organised in five cities of Pakistan (Jamshoro, Karachi, Lahore, Taxila, and Khuzdar)	1	100x10 = 1000
E5.9	All Pakistani HEIs	Fab Lab visits	Visit	Education and Public Engagement	Organised at each Pakistani HEIs	1	100x10 = 1000
E5.10	All Pakistani HEIs	Women in STEM	Visit	Education and Public Engagement	Organised in five cities of Pakistan (Jamshoro, Karachi, Lahore, Taxila, and Khuzdar)	1	100x10 = 1000

Timetable

Timetable (projects of more than 2 years)
Fill in cells in beige to show the duration of activities. Repeat lines/columns as necessary.
Note: Use actual calendar years and quarters. In the timeline you should indicate the timing of each activity per WP. You may add additional columns if your project is longer than 6 years.

ACTIVITY	YEAR 1				YEAR 2				YEAR 3			
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
T1.1 Kick-off meeting and establishment of BIOMED5.0 Project Executive Committee												
T1.2 Quality Assurance Plan preparation and execution												
T1.3 Collaboration with Quality Enhancement Cells in Pakistani HEIs												
T1.4 Risk Assessment and Mitigation Planning and Execution												
T1.5 Project Data Management Plan												
T1.6 Managing project budgets and finances												
T1.7 Conduct of Financial Audit												
T1.8 Preparation of a Project Completion Report												
T1.9 Closing out the project and conducting a post-project review.												

Task
T2.1 Development and revision of Programme Educational Objectives (PEOs) and Learning Outcomes (LOs) of BME UG and PG curricula in line with Industry 4.0/5.0 needs assessment
T2.2 Development of new modules on I4.0/5.0 technologies for bachelor in BME programme
T2.3 Development of new modules on I4.0/5.0 technologies for masters in BME programme
T2.4 Incorporating Industry 4.0 and 5.0 Technologies into existing modules in undergraduate BME programme
T2.5 Incorporating Industry 4.0 and 5.0 Technologies into existing modules in postgraduate BME programme
T2.6 Improving digital literacy by development of life long learning Open Online Courses for biomedical and healthcare professionals
T2.7 Approval of new and updated modules through PEC and relevant bodies at HEI.
T2.8 Pilot Implementation of Revised BME Curricula and Short Courses and Feedback
T3.1 Establishment of BIOMED5.0 Labs Working Group
T3.2 Revision of LOs to update teaching laboratory sessions in UG and PG programmes
T3.3 Designing of new lab manuals
T3.4 Procurement of equipment for upgradation of lab facilities
T3.5 Reinforcement learning of digital transformation technologies via laboratory sessions
T3.6 Development of VR lab sessions
T3.7 Development of AR/MR lab sessions
T3.8 Approvals, pilot implementation and students feedback
T4.1 Establishment of Centre of Excellence in Biomedical Engineering
T4.2 Pan-Institutional Biomedical Engineering Digital Fabrication Laboratory (Fab Lab)
T4.3 Entrepreneur Mentorship Programme
T4.4 Academic staff training in Innovative Pedagogies
T4.5 Academic staff training in Industry 4.0 technologies
T4.6 Academic staff training in TUCN
T4.7 Promoting wider impact and human resource development in Pakistani HEIs through reciprocal training programs

T4.8 Laboratory staff trainings								
T4.9 Students training on Industry 4.0/5.0 technologies								
T4.10 Students training on transformative skills								
T 4.11 Student training on mental health and well-being								
T 4.12 Development of digital platform for Mental Health and Well-Being								
T4.13 Industry 4.0/5.0 Technology Hackathons								
T5.1 Dissemination, Communication and Exploitation Plan								
T5.2 Copyright policy and intellectual property management								
T5.3 Dissemination and Communication using Digital Media								
T5.4 Digital transformation Societal Impact Champion for Education And Public Engagement (EPE) activities								
T5.5 BIOMED5.0 Annual Conference and Stakeholder Engagement								
T5.6 Organisation of Master Classes in Industry 4.0/5.0 and Digital Transformation								
T5.7 Participation in International Conferences								
T5.8 STEM outreach programme								
T5.9 Impact Assessment and Case Studies								
T5.10 Sustainability Plan								

RK-PLA-WP§#

#@ETH-ICS-EI@#

5. OTHER

5.1 Ethics

Ethics (if applicable)

If the Call document/Programme Guide contains a section on ethics, describe ethics issues that may arise during the project implementation and the measures you intend to take to solve/avoid them.

Describe how you will ensure gender mainstreaming and children's rights in the project activities.

Not applicable

Programme guide for this call does not contains a section on ethics.

The applicant team does not anticipate any ethical issues during the implementation of the

project.

#§ETH-ICS-EI§# #@SEC-URI-SU@#

5.2 Security

Security

Not applicable.

#§SEC-URI-SU§# #@DEC-LAR-DL@#

6. DECLARATIONS

Double funding	
Information concerning other EU grants for this project Please note that there is a strict prohibition of double funding from the EU budget (except under EU Synergies actions).	YES/NO
We confirm that to our best knowledge neither the project as a whole nor any parts of it have benefitted from any other EU grant (including EU funding managed by authorities in EU Member States or other funding bodies, e.g. Erasmus, EU Regional Funds, EU Agricultural Funds, etc). If NO, explain and provide details.	Yes
We confirm that to our best knowledge neither the project as a whole nor any parts of it are (nor will be) submitted for any other EU grant (including EU funding managed by authorities in EU Member States or other funding bodies, e.g. Erasmus, EU Regional Funds, EU Agricultural Funds, etc). If NO, explain and provide details.	Yes

Financial support to third parties (if applicable)
If your project requires a higher maximum amount per third party than the threshold amount set in the Call document/Programme Guide, justify and explain why this is necessary in order to fulfil your project's objectives. Not applicable – no financial support to third parties is requested in the budget.

Seal of Excellence (if applicable)

If provided in the Call document, proposals that pass the evaluation but are below the budget threshold (i.e. pass the minimum thresholds but are not ranked high enough to receive funding) will be awarded a Seal of Excellence.

In this context we may share information about your proposal with other EU or national funding bodies through the Erasmus+ National Agencies.

Do you agree that your proposal (including proposal data and documentation) is shared with other EU and national funding bodies to find funding under other schemes?	[YES]

#§DEC-LAR-DL§#

#§DEC-LAR-DL§#

ANNEXES

LIST OF ANNEXES

Standard

Detailed budget table/Calculator (annex 1 to Part B) — mandatory for certain Lump Sum Grants (see Portal Reference Documents)
CVs (annex 2 to Part B) — mandatory, if required in the Call document/Programme Guide
Annual activity reports (annex 3 to Part B) — not applicable
List of previous projects (annex 4 to Part B) — mandatory, if required in the Call document/Programme Guide

Special

Other annexes — mandatory, if required in the Call document/Programme Guide

LIST OF PREVIOUS PROJECTS

List of previous projects					
Please provide a list of your previous projects for the last 4 years.					
Participant	Project Reference No and Title, Funding programme	Period (start and end date)	Role (COO, BEN, AE, OTHER)	Amount (EUR)	Website (if any)
[name]					
[name]					

HISTORY OF CHANGES

VERSION	PUBLICATION DATE	CHANGE
1.0	25.02.2021	Initial version (new MFF).
2.0	01.06.2022	Consolidation, formatting and layout changes. Tags added.
3.0	24.11.2023	D1.1, D1.2 of initial version are clubbed into a new deliverable D1.1: A consolidated report on Project Quality Assurance and Communication Strategy. D1.3 and D1.4 are changed to a new deliverable D1.2: Accreditation of modernized curricula by the Academic Councils at HEIs
		D2.1 updated with "Resolutions of Curriculum Review and Update Committee on revised PEOs and Los"
		D3.4 cancelled
		D4.1, D4.2 and D4.3 clubbed in to two new deliverables D4.1: Project Interim Report and D4.2: Report on staff and student training
		D5.1,D5.2 and D5.3 clubbed in one deliverable D5.1: "Report on Project Assessment"
		A symbolic effort of 1 added to all beneficiaries in work packages, where there was no task assigned to a beneficiary but a budget was allocated.
		Timelines updated in Deliverable 3.2 from M3 to M12.
		Dissemination level changed to SEN for all deliverables, if not already.
		Typing error in the name of WP3 rectified
		Timelines corrected for MS10, MS12, MS13 and MS15
		Tables named as "Staff effort per WP and "Staff effort per participant" updated
		A summary of project added

ANNEX 2

ESTIMATED BUDGET (LUMP SUM BREAKDOWN) FOR THE ACTION

Forms of funding	Estimated EU contribution					Maximum grant amount[1]
	Estimated eligible lump sum contributions (per work package)					
	WP1 Project Management and Quality Assurance	**WP2 Modernising Pakistani HEIs by revision and update of Biomedical Engineering curricula**	**WP3 Capacity building of partner HEIs by upgrading teaching lab facilities and implementing virtual reality sessions**	**WP4 Centre of Excellence in Biomedical Engineering**	**WP5 Project Impact and Outreach: Dissemination, Communication and Exploitation**	
	Lump sum contribution	Lump sum contribution	Lump sum contribution	Lump sum contribution	Lump sum contribution	
	a	b	c	d	e	f = a + b + c + d + e
1 - MUET	16 689.00	14 089.00	21 668.00	32 953.00	15 350.00	100 749.00
2 - SSUET	3 833.00	7 636.00	29 160.00	36 152.00	8 474.00	85 255.00
3 - LUMHS	2 725.00	7 155.00	14 955.00	27 175.00	16 179.00	68 189.00
4 - SHU	8 888.00	2 533.00	9 948.00	37 865.00	8 474.00	67 708.00
5 - ZU	800.00	1 377.00	50 297.00	27 464.00	8 474.00	88 412.00
6 - UETL	2 215.00	1 926.00	49 836.00	26 309.00	8 474.00	88 760.00
7 - BUETK	3 659.00	4 237.00	10 497.00	28 331.00	10 786.00	57 510.00
8 - UETT	2 215.00	2 264.00	12 697.00	33 190.00	9 871.00	60 237.00
9 - UTC	13 906.00	5 778.00	3 852.00	9 630.00	8 301.00	41 467.00
10 - DCU	29 635.00	25 186.00	25 185.00	33 508.00	16 254.00	129 768.00
11 - PEC	799.00	4 006.00	1 686.00	2 985.00	2 157.00	11 633.00
Σ consortium	85 364.00	76 187.00	229 781.00	295 562.00	112 794.00	799 688.00

[1] The 'maximum grant amount' is the maximum grant amount fixed in the grant agreement (on the basis of the sum of the beneficiaries' lump sum shares for the work packages).

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

SIR SYED UNIVERSITY OF ENGINEERINGAND TECHNOLOGY (SSUET), PIC 915845289, established in MAIN UNIVERSITY ROAD BLOCK 5 GULSHAN E IQBAL, KARACHI 75300, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

LIAQUAT UNIVERSITY OF MEDICAL AND HEALTH SCIENCES JAMSHORO (LUMHS),
PIC 883413630, established in SINDH 75300, JAMSHORO 76090, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

SALIM HABIB UNIVERSITY (SHU), PIC 883629746, established in NC-24 DEH DIH KORANGI CREEK, KARACHI 74900, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

ZIAUDDIN UNIVERSITY (ZU), PIC 891803354, established in 4B SHAHRAH-E-GHALIB RD BLOCK 6 CLIFTON, KARACHI 75600, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITY OF ENGINEERING AND TECHNOLOGY LAHORE (UETL), PIC 881141696, established in GT ROAD LAHORE, Lahore 54890, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

THE BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR (BUETK), PIC 887803074, established in BALOCHISTAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY KHUZDAR, KHUZDAR 89100, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITY OF ENGINEERING AND TECHNOLOGY TAXILA (UETT), PIC 884685882, established in TEHSIL, TAXILA, UET, TAXILA 47050, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

UNIVERSITATEA TEHNICA CLUJ-NAPOCA (UTC), PIC 999897244, established in STR MEMORANDUMULUI 28, CLUJ NAPOCA 400114, Romania,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

DUBLIN CITY UNIVERSITY (DCU), PIC 999892588, established in Glasnevin, DUBLIN 9, Ireland,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 3

ACCESSION FORM FOR BENEFICIARIES

PAKISTAN ENGINEERING COUNCIL (PEC), PIC 881020640, established in ATTATURK AVENUE (EAST) G-5/2, ISLAMABAD 44000, Pakistan,

hereby agrees

to become beneficiary

in Agreement No 101129077 — BIOMED5.0 ('the Agreement')

between MEHRAN UNIVERSITY OF ENGINEERING &TECHNOLOGY (MUET) **and** the **European Education and Culture Executive Agency (EACEA)** ('EU executive agency' or 'granting authority'), under the powers delegated by the European Commission ('European Commission'),

and mandates

the coordinator to submit and sign in its name and on its behalf any **amendments** to the Agreement, in accordance with Article 39.

By signing this accession form, the beneficiary accepts the grant and agrees to implement it in accordance with the Agreement, with all the obligations and terms and conditions it sets out.

SIGNATURE

For the beneficiary

ANNEX 4 XXX LUMP SUM MGA — MULTI & MONO

FINANCIAL STATEMENT FOR THE ACTION FOR REPORTING PERIOD [NUMBER]

	EU contribution											Requested EU contribution
	Eligible lump sum contributions (per work package)											
	WP1 [name]	WP2 [name]	WP3 [name]	WP4 [name]	WP5 [name]	WP6 [name]	WP7 [name]	WP8 [name]	WP9 [name]	WP10 [name]	WP [XX]	
Forms of funding	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	[Lump sum contribution]/[Financing not linked to costs]	
Status of completion	COMPLETED	COMPLETED	COMPLETED	COMPLETED	COMPLETED	COMPLETED	COMPLETED	PARTIALLY COMPLETED	PARTIALLY COMPLETED	COMPLETED	NOT COMPLETED	
	a	b	c	d	e	f	g	h	i	j	k	l = a + b+ c + d+ e+ f+ g+ h+ i+ j+ k
1 – [short name beneficiary]												
1.1 – [short name affiliated entity]												
2 – [short name beneficiary]												
2.1 – [short name affiliated entity]												
X – [short name associated partner]												
Total consortium												

The consortium hereby confirms that:
The information provided is complete, reliable and true.
The lump sum contributions declared are eligible (in particular, the work packages have been completed and the work has been properly implemented and/or the results were achieved; see Article 6).
The proper implementation of the action/achievement of the results can be substantiated by adequate records and supporting documentation that will be produced upon request or in the context of checks, reviews, audits and investigations (see Articles 19, 21 and 25).

<div align="right">**ANNEX 5**</div>

<div align="center">**SPECIFIC RULES**</div>

INTELLECTUAL PROPERTY RIGHTS (IPR) — BACKGROUND AND RESULTS — ACCESS RIGHTS AND RIGHTS OF USE (— ARTICLE 16)

Rights of use of the granting authority on results for information, communication, publicity and dissemination purposes

The granting authority also has the right to exploit non-sensitive results of the action for information, communication, dissemination and publicity purposes, using any of the following modes:

- **use for its own purposes** (in particular, making them available to persons working for the granting authority or any other EU service (including institutions, bodies, offices, agencies, etc.) or EU Member State institution or body; copying or reproducing them in whole or in part, in unlimited numbers; and communication through press information services)

- **distribution to the public** in hard copies, in electronic or digital format, on the internet including social networks, as a downloadable or non-downloadable file

- **editing** or **redrafting** (including shortening, summarising, changing, correcting, cutting, inserting elements (e.g. meta-data, legends or other graphic, visual, audio or text elements extracting parts (e.g. audio or video files), dividing into parts or use in a compilation

- **translation** (including inserting subtitles/dubbing) in all official languages of EU

- **storage** in paper, electronic or other form

- **archiving** in line with applicable document-management rules

- the right to authorise **third parties** to act on its behalf or sub-license to third parties, including if there is licensed background, any of the rights or modes of exploitation set out in this provision

- **processing**, analysing, aggregating the results and **producing derivative works**

- **disseminating** the results in widely accessible databases or indexes (such as through 'open access' or 'open data' portals or similar repositories, whether free of charge or not.

The beneficiaries must ensure these rights of use for the whole duration they are protected by industrial or intellectual property rights.

If results are subject to moral rights or third party rights (including intellectual property rights or rights of natural persons on their image and voice), the beneficiaries must ensure that they

comply with their obligations under this Agreement (in particular, by obtaining the necessary licences and authorisations from the rights holders concerned).

Access rights for the granting authority, EU institutions, bodies, offices or agencies and national authorities to results for policy purposes

The beneficiaries must grant access to their results — on a royalty-free basis — to the granting authority, other EU institutions, bodies, offices or agencies, for developing, implementing and monitoring EU policies or programmes.

Such access rights are limited to non-commercial and non-competitive use.

The access rights also extend to national authorities of EU Member States or associated countries, for developing, implementing and monitoring their policies or programmes in this area. In this case, access is subject to a bilateral agreement to define specific conditions ensuring that:

- the access will be used only for the intended purpose and

- appropriate confidentiality obligations are in place.

Moreover, the requesting national authority or EU institution, body, office or agency (including the granting authority) must inform all other national authorities of such a request.

Access rights for third parties to ensure continuity and interoperability

Where the call conditions impose continuity or interoperability obligations, the beneficiaries must make the materials, documents and information and results produced in the framework of the action available to the public (freely accessible on the Internet under open licences or open source licences).

COMMUNICATION, DISSEMINATION AND VISIBILITY (— ARTICLE 17)

Additional communication and dissemination activities

The beneficiaries must engage in the following additional communication and dissemination activities:

- **present the project** (including project summary, coordinator contact details, list of participants, European flag and funding statement and project results) on the beneficiaries' **websites** or **social media accounts**

- for actions involving public **events**, display signs and posters mentioning the action and the European flag and funding statement

- upload the public **project results** to the Erasmus+ Project Results platform, available through the Funding & Tenders Portal.

SPECIFIC RULES FOR CARRYING OUT THE ACTION (— ARTICLE 18)

EU restrictive measures

The beneficiaries must ensure that the EU grant does not benefit any affiliated entities, associated partners, subcontractors or recipients of financial support to third parties that are

subject to restrictive measures adopted under Article 29 of the Treaty on the European Union or Article 215 of the Treaty on the Functioning of the EU (TFEU).
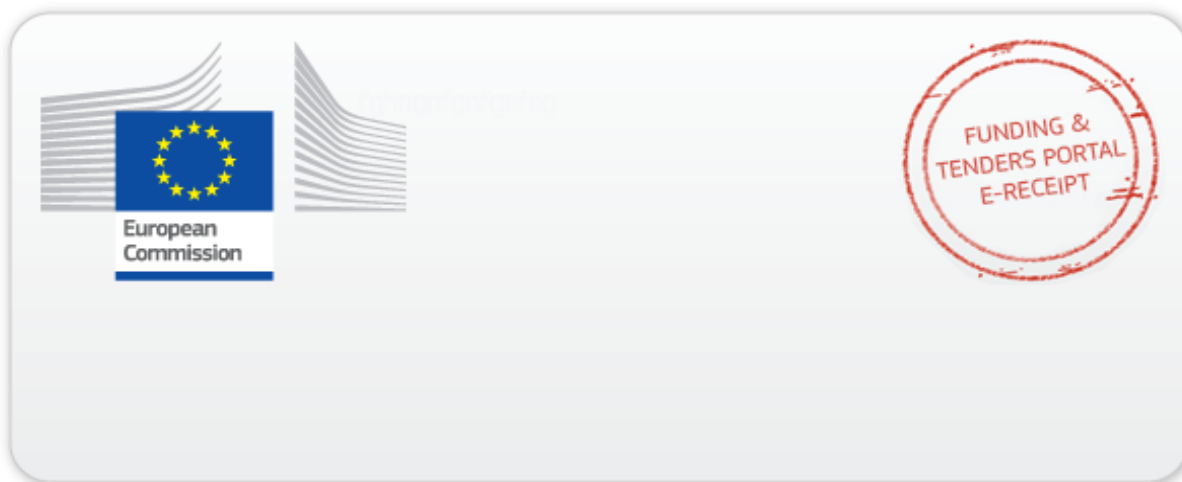
This electronic receipt is a digitally signed version of the document submitted by your organisation. Both the content of the document and a set of metadata have been digitally sealed.

This digital signature mechanism, using a public-private key pair mechanism, uniquely binds this eReceipt to the modules of the Funding & Tenders Portal of the European Commission, to the transaction for which it was generated and ensures its full integrity. Therefore a complete digitally signed trail of the transaction is available both for your organisation and for the issuer of the eReceipt.

Any attempt to modify the content will lead to a break of the integrity of the electronic signature, which can be verified at any time by clicking on the eReceipt validation symbol.

More info about eReceipts can be found in the FAQ page of the Funding & Tenders Portal.

(https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/support/faq)