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International Master of Science on Cyber Physical Systems

Sustainability Plan *D5.7*

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1 Introduction

1.1 Abstract

The purpose of this document is to describe the strategy that assures the sustainability of the outcomes of the MS@CPS project after its lifetime. It includes information on the project outcomes and conditions, recommendations and guidelines for using the developed project products. This document is designed to structure the development process of the sustainability plan at each partner organization. It should be used as a base for planning the future development of the activities after the end of the period of eligibility of MS@CPS project.

Currently, the report is a final version of the sustainability plan which was due at month 36. Writing of this version of the plan is drafted at month 27 of the project. However, we consider the sustainability of the project is of a great importance and therefore we started working on it from the very early stages of the project. As the major outcome of the project will be a higher education study program, we should consider all threats that might encounter this academic program. The master program is designed to be a long-lasting program; furthermore, the master program should be dynamic to respond to the trending technologies. We summarize the threats might face the program and prepare a protection and mitigation plan to keep the program sustainable.

During the second year, the program was launched at most partner universities which will provide valuable feedback for the sustainability plan. There are two tracks that we work on for sustainability, namely they are: sustainability of the program and international visibility and impact. Impact and sustainability are achieved through a variety of activities to support dissemination of the project outcomes, to support continuation of MS@CPS practices and techniques within the partner institutions and beyond the consortium after the project lifetime, and to expand the results among additional HEIs in partner countries and in Europe.

1.2 The scope of the document

The scope of this deliverable is to set up the sustainability plan. This document analyses the threats that might face the program and introduces a protection and mitigation plan to keep the program sustainable. The document presents an overall sustainability plan developed by the consortium within the lifetime of the MS@CPS project. The given plan helps to identify what resources are necessary to sustain project, encourage the development of partnerships and support collaboration, and help define progress and the necessary action steps needed to ensure long-term success after the Erasmus+ MS@CPS project ends.

1.3 Definition of sustainability

Sustainability is the capacity of the project to continue its existence and functioning beyond its end. The project results are used and exploited continuously. Sustainability of results implies use and exploitation of results in the long term. A project can be considered as sustainable if its outcomes or parts of these continue after the end of the funded project duration.

Sustainability may not concern all the aspects of a project. In each project some results may be maintained, while others may not be required to be maintained. A project can therefore be considered as sustainable if relevant results are pursued and products are maintained or developed after the end of the EU funding.

1.4 Objective

The main objective of the project is to establish a higher education academic program in the field of cyber-physical systems which is considered as a computer engineering branch with focus on expert systems and embedded systems topics. In this context, the objective of the sustainability plan of the MS@CPS project is to ensure that this academic program will keep running after the end of the project and the program will leave an impact at the local society of each partner country and as well on the participating universities. Moreover, it aims to evaluate the project progress to provide a long-term perspective and practical steps to ensure project sustainability.

This document is aimed at presenting an overall sustainability plan developed by the consortium within the project of MS@CPS. Sustainability for each organization depends on a specific internal and external environment and this necessitate to have a plan for the sustainable life of the MS@CPS project.

PTC, who is responsible for its coordination, has developed a basic draft of the sustainability plan. However, all project partners will transfer results for impact, especially in their own countries and in their own communities. It will be reviewed throughout the project in order to assess the effectiveness of different sustainability measures.

1.5 Terminology

CPS: Cyber Physical Systems

DEP: Dissemination and the Exploitation Plan

Partner Countries: Countries where the program to be implemented (Palestine, Tunisia, Jordan)

Program Countries: EU partners (Germany, Sweden, UK)

Program: The master program (CPS) to be implemented.

SharePoint: a commercial web-based collaborative platform offered by Microsoft company.

ICM: International Credit Mobility

AQU: Al-Quds University

PTC: Palestine Technical College

GJU: German Jordanian University

TTU: Tafila Technical University

CU: Carthage University

USF: University of Sfax

ISIMS: Higher Institute of Computer Science and Multimedia of Sfax

ISSATM: Higher Institute of applied Sciences and Technologies of Mateur

1.6 MS@CPS Stakeholders

MS@CPS targets a wide community including:

- Graduates in computer engineering, electronic engineering, mechatronics, information technology and computer science or other related by fields.
- Academic staff and scientific community in the aforementioned fields.
- Industry mainly computer companies in hardware or software.

Reaching and communicating with stakeholder was described in the dissemination and exploitation plan. Listed here important activities to reach stakeholders:

- Presentations at the Scientific Council, Faculty Councils;
- Update of information about MS@CPS activities at the official websites;
- Meetings and consultations with staff, students, representatives of ministries of higher education and representatives of industry;
- Leaflets, printing products and other promotional materials;
- Promotion at social media networks;
- Strategic Partnerships.

1.7 Relation to other deliverables

The deliverable relies mainly on the good implementation of the project and therefore D5.1, D5.2, D5.3 and D5.4 are related to this deliverable.

D5.3: Formal establishment of MS@CPS program, D5.7 the core of sustainability plan after the launch of the MS@CPS in September 2020 by all partners is to keep the program active.

1.8 Relation to other work packages

The sustainability relies on the success of the implementation of all work packages activities to be able to sustain all outcomes. The exploitation activity of accreditation is dependent on work package two (WP2) as it needs a study plan of all courses for accreditation.

2 Sustainability of the program

2.1 Strategy and action measures for ensuring sustainability

Sustainability is a challenge that has no specific answer. The sustainability plan provides a road-map to guide project partners and it can also strengthen to keep the Master program operating and improving. A sustainability plan can help identify what resources are necessary to sustain project, encourage the development of partnerships and support collaboration, and help define progress and the necessary action steps needed to ensure long-term success after the Erasmus+ MS@CPS project ends. The project sustainability is assured by the following actions and measures that the consortium undertakes within and after the lifetime of the project:

2.1.1 Targeting audience and disseminating project's results

It is necessary for a sustainable work to keep project stakeholders and beneficiaries informed about project results. The following measures achieve this goal within the life time of the project and after:

- Spread project results along with the gained experience within the project consortium and outside the project consortium to potential universities and industrial stockholders.
- Organize informative sessions, such as open house days at partner universities to acquire future potential students and academic staff with the project.
- Continuous contact with local industry by all partners in the corresponding partner countries.
- Established local pages and local social media outlets at each partner university should run by each partner independently.
- The main project website and social pages outlets refers followers to local pages at each partner.
- After the end of the project social media pages will be kept active for covering joint activities and announcements and PTC will keep administering them.

- Creation of the project physical drive: in order to avoid any loss of data and information, the coordinator dumped all the project deliverables and course material on an external drive and provided to the project partners to be stored at the respective partner universities. This helps the sustainability of the project, as the access to the shared platform might expire or the password of the person, who has access to the files can be lost.

2.1.2 Keeping connections and cooperation with industry

Regarding the project's stakeholders, due to their invaluable role, each partner was asked to define a list of industrial stakeholders that are working in companies related to the program objectives and field, therefore, an Industrial Advisor Board (IAB) has been established for each partner country. The IAB plays a vital role in providing feedback and advices on how to make the program more successful and industry oriented. Furthermore, the IAB was consulted to evaluate the program courses and provide constructive feedback on how to make it more practical. Moreover, the IAB will be involved in the students' master thesis, projects, and will be invited to participate in giving seminars and workshops to the program prospective students.

Another important industrial partner is the Institute of Electrical and Electronic Engineering (IEEE)-Jordan section (JS). The IEEE JS is a large technical society that aims at advancing science and technology, it is also responsible for standardizing many technologies that are related to the MS program. The role of IEEE JS will be important in providing a vision for the industrial technological trends and direct both the faculty members and students toward exploring the state-of-art technologies. The Palestinian Information Sciences and Technology Syndicate signed a memorandum of Understanding (MOU) with Palestinian partner universities to promote the program among its members and networks.

The partner countries have established links with the industry explaining to them the project idea and asking for their continues support. Several companies have shown a great interest to support the project in various ways such as:

- Joint projects between the academia and the industry
- Joint master thesis where the conducted research can solve an industrial challenge
- Provide funding to support master students
- Making cooperation agreements with the industry for offering internships to the master students.

2.1.3 Keeping cooperation among the consortium partners

The partner HEIs of the project prepared within the life time of the project an MoU and it was signed by university rectors that includes the following points:

- Joint supervision of master theses
- Academic staff and student exchange between the partner countries
- Joint applications for International Credit Mobility and following Erasmus+ programs (e.g., PhD program in CPSs)
- Joint lectures, talks and seminars
- External examiners for theses
- Holding international scientific conferences jointly (e.g., international conference on promising electronic technologies)
- Joint access to specific set of resources (e.g., servers, robots).

2.1.4 Paying attention to people with fewer opportunities and to least developed areas

Gender Attention:

Female participation in engineering fields is not wide in many countries. Therefore, the project focuses on increasing female participation in the master program by dedicating a task at its preparation work package that aims to identify the needs of females in the host partner countries to enable them to complete the program requirements. It was noticeable after the launch of the program that female admission rate is high in most partners. For example, at the university of Carthage in Tunisia the participation of women is remarkable in the master and it reached 80% of those enrolled were females. However, in Jordan around 60% of the applicants are male students. In Palestine, we observe almost equal ratio for the gender of the applicants. Due this, the minority will be different in different partner countries.

In order to achieve the goal and motivate the minority to grow in terms of ratio, we will implement the following strategies:

- The partner countries will consider two separate admission priorities and admit the students taking into account the closest result to a balanced gender division.
- In case of funding, two separate lists will be defined to achieve the closest result to a balanced gender division.

Attention to less developed areas in Palestine:

In Palestine, it should be noted that Al-Quds University is the only available Palestinian university in Jerusalem area, where there is a high Palestinian population density mainly in the Eastern part of Jerusalem. Due to the difficulty of access to universities in the West Bank, Al-Quds university plays important role in offering higher education services for Palestinians in that area. Similarly for Palestine Technical College, PTC is located in a least developed area in the Gaza Strip which is the middle region in the Gaza Strip. The MS@CPS program serves the central and southern region in the Gaza Strip which are areas of high population density that lack universities, unlike Gaza City where most universities are concentrated in. Thus, through the project it became possible to provide higher education in areas considered to be rural, and this was one of the objectives of the project. The project took advanced steps towards achieving this goal through a partnership agreement between Al-Aqsa University and Palestine College to establish this program and cooperate in offering it in the Gaza Strip.

- In order to tackle this issue, the partner universities already offer courses and provide the possibility of doing the thesis and using the labs during the weekend in addition to the weekdays. In addition, students can visit the university and the courses after 3 pm, in order to be able to work in the morning.
- In order to support the student with difficult financial situation, students can pay the tuition in multiple instalments.

Attention to less developed areas in Jordan:

The project is launched in Jordan in two different universities that are located in two different regions. The first university is the German Jordanian University, which is located close to Madaba province, and the second university is Tafila Technical university which is located in Tafila province and it is less developed area in the southern regions of Jordan. Both provinces have a great potential for development and improvement. People living in these provinces are looking toward learning new technologies that are addressed in this program. Therefore, launching the program particularly in these two universities will contribute toward the development of Jordan in its different regions and areas.

- In order to tackle this issue, the partner universities already offer courses and provide

the possibility of doing the thesis and using the labs during the weekend in addition to the weekdays. In addition, students can visit the university and the courses after 5 pm, in order to be able to work in the morning.

- In order to support the student with difficult financial situation, students can pay the tuition in multiple instalments (only at TTU). At GJU, recently the university is launching scholarship programs for graduated students, for which the students can apply.

Attention to less developed areas in Tunisia:

The project is launched in Tunisia in two different partner universities that are located in two different regions. The first partner is the higher institute of computer science and multimedia of Sfax (ISIMS) – University of Sfax which is the only university in the south of Tunisia that provides such curricula and it is involved several stockholders including Technopark managers, companies and digital research center of Sfax. Moreover, USF gave special attention to young students who are less skilled in practical and social activities to be part of the organization of several social and cultural events (i.e. Open-door days, Industry 4.0 webinars) as well as meeting with stakeholders. USF involved young students in the ISIMS and techno park events and training.

The second partner in Tunisia is the higher Institute of applied sciences and technologies of Mateur (ISSATM) which is part of Carthage University (CU). It is located in the region of Mateur in the north of Tunisia (60 km from Tunis) which is a part of the governorate of Bizerte (30 km from Bizerte). Mateur is in a geographical area that needs this academic program since it is located in a business incubator (wiring, automotive). Therefore, the master's program improves the employability chances of its graduates.

- In order to tackle this issue, the partner universities already offer courses and provide the possibility of doing the thesis and using the labs during the weekend in addition to the weekdays. In addition, students can visit the university and the courses after 3 pm, in order to be able to work in the morning.
- The higher education in Tunisia is almost free of charge, thus no action is needed.

2.1.5 Keeping the developed curricula dynamic and attractive and following ICT trends

To ensure MS@CPS outputs and outcomes sustainability and impact, the following main factors regarding curricula were taken into account:

- curricula and courses were selected based on deep assessment of the needs of the target groups for new skills and analysing the long-term labour market trends to keep the curricula attractive;
- involvement of all partners in course development;
- involvement of future students in questioners on the master program;
- institutional sustainability is guaranteed by accreditation of the master study programs by local accreditation commissions;
- holding training sessions on CPS topic and teaching methodologies;
- careful selection of equipment to respond to each partner needs;
- The project results that are sustainable are the curricula and courses, laboratories equipped with proper equipment, project webpage and local webpages at each partner.

It might be a challenge to keep the program active and attractive for graduate students to apply for it in a fast-growing technology age. Therefore, the master study plan should be updated regularly with new courses that pace with trending technologies and as well contents of courses should be revised regularly to match the market needs.

The project is fully in harmony with ICT development because Cyber-Physical Systems (CPS) science is categorized under computer engineering and information technology and indeed the ICT sector has a

great impact on other sectors such as the health and climate change. In fact, CPS comprise interacting digital, analogue, physical, and human components engineered for function through integrated physics and logic. These systems form the basis of emerging and future smart services, and improve our quality of life in many areas. In regard to public health, CPS will bring advances in personalized health care. The project activities will provide opportunities to expand the developed digital health and industry 4.0 Networks. When studying the lectures contents and objectives, three use cases direction are maintained: Industry 4.0, Digital health technologies and smart cities. The concepts behind this Master program are to be able to develop and build smart services and equipment's that can foster innovation in digital healthcare and mainly (PPP medicine), industry and smart cities with respect to environment.

2.1.6 Keeping the developed labs upgraded and maintained

Within the lifetime of the project, in order to keep equipment usable for a long time, the following measures were taken:

- Careful selection of equipment to respond to each partner needs;
- Laboratories are equipped with proper equipment that serve several courses;
- Preparing "How to use" guideline; in order to avoid any misuse or action which damages the lab equipment.
- Supporting letter from the university administration for the sustainability of the labs.

After the end of the project, to keep the equipment upgraded and maintained, the following measures agreed upon among partners to be taken:

- Revising labs annually for needed equipment in the labs within the university's allowed budget
- Deploy the cooperation with industry in joint projects to upgrade the labs
- Deploy the cooperation with partners towards:
 - Participating in further research or academic development projects that are in the field of CPS and seize this chance to upgrade the equipment
 - Exchange of knowledge including practical knowledge between partners e.g., under academic staff exchange (signed MoU) to transfer knowledge regarding equipment and their use.

2.1.7 Staff and sustainability at each HEI

Within the life time of the project several members from each partner HEI got involved in the training and management meetings. They got excellent experience in the CPS topics through such involvement.

After the end of the life time of the project, those experienced staff will keep working in the master program as they are permanent staff members at the participating HEIs. It should be noted that teaching staff the master program receive higher incentives in comparison with the undergraduate programs. Moreover, each participating HEI will hire new faculty members according to their needs.

2.1.8 Adhering to the policy development of the Ministry of HE at partner countries

In Palestine

Al-Quds University, Palestine Technical College and Al-Aqsa University offer a master program in cyber-physical systems, which is in line with the vision of the national strategy in bridging the digital divide and transforming into a knowledge society and digital citizenship to build a developed national economy and provide a stimulating investment environment for the digital industry to improve the quality of life of the citizen of the State of Palestine. The project meets the call of the Ministry of Higher Education and Scientific Research for Palestinian universities and colleges to move away from classical academic programs and focus on artificial intelligence, supercomputing and data science programs to keep pace with the fourth industrial revolution and benefit from student exchange programs. Al-Quds

University and Palestine Technical College see their participation in the MS@CPS project as an opportunity to benefit from European and regional experiences to develop such qualitative programs, especially since the cyber-physical systems are equivalent for the fourth Industrial Revolution.

In Jordan

Indeed, the program is aligned with the country vision for creating a new digital economy. To achieve that, the ministry is now calling the universities to improve the curricula of the various study programs in order to tailor it toward the up-to-date technologies such as: The internet of things, big data, cloud computing, computer networks, security, entrepreneurship, etc. All these subjects and others will be covered by the MSCPS program thus actualizing the government vision toward creating a digital economy and enhancing the country ICT infrastructure.

The offered Cyber Physical Systems master program covers topics and subjects that are aligned with the Jordanian Higher Educational ministry, which is urging all Jordanian universities to teach the students for new subjects that are much needed by the industry such as: Artificial Intelligence, Internet of Things, big data and cloud computing, entrepreneurship, etc. These topics are all covered in the MSCPS program and will meet the ministry expectations and plans. Furthermore, recently, the ministry of Communication and Information Technology in Jordan has changed its name to be the ministry of digital economy and entrepreneurship. After this fundamental change in the ministry name, the mission and vision of the ministry have been also changed to include several new objectives such as supporting entrepreneurships and start-up companies to build up the country economy. Furthermore, the ministry is working toward supporting the spread and adoption of new digital technologies that are aligned with the aims of the launched MSCPS program.

In Tunisia

University of Sfax is always considering the national priorities, the labour market needs and sustainable development goal when approving new curricula. The master program in cyber-physical systems, which is in phase with the vision of the national strategy towards a knowledge society, start-up creation and digitalization with respect to the environment will help build a developed national economy and provide a stimulating investment environment for the industry 4.0 and digital health technologies. We notice that the project contributes even in the regional priorities since Sfax has been labelled as the Tunisian capital of Digital health and industry 4.0 and several networks are under establishment to be a hub between both academic and industrial partners to foster start-up creation.

The project meets the call of the Ministry of Higher Education and Scientific Research for Tunisian universities to focus on innovation and interdisciplinarity of the academic programs to enable start-up creation as well as including artificial intelligence, supercomputing and data science programs. USF and CU consider MS@CPS project as an opportunity to benefit from European and regional experiences to develop such qualitative programs and to cooperate with European and MENA universities and ministries.

2.2 Sustainability of operating the program

Financial sustainability is important for keeping the program operative. There are different sources for financing the CPS master program:

- Governmental support for governmental universities;
- Student fees (covers either partially or totally the expenses);
- Sponsorships from organisations and companies that will employ the future graduates;
- Sponsorships from partner research institutes through joint research programs;
- Sponsorship from university alumni;
- Sponsorship from university's own funds.

2.2.1 Sustainability at PTC and Al-Aqsa University

It should be noted that the PTC and Al-Aqsa university are a non-profit governmental organization that serves society within a future view and provides higher education at the lowest possible cost. The salaries of employees and faculty members are completely covered by the budget of the State of Palestine as it is a governmental higher education institutes affiliated to the Ministry of Higher Education and Scientific Research. Moreover, PTC receives external support from supporting institutions e.g., French Ministry of Foreign Affairs, GTZ, Fund Quality Support (QIF) funded by the World Bank, the European Union, the Erasmus+ Program, and some other supporters. Below is a table shows the economic feasibility of the master program within ten years without relying on any external support, on the assumption all students are retained. Sustainability for Palestine Technical College and Al-Aqsa University is guaranteed by the virtue of being governmental institutes and therefore its financing is placed on the shoulders of the government. Once the students are admitted, the program courses are offered as planned. Risks are minor because the program is offered at reduced price for a per credit hour fees rate, compared to other local universities, as it is able to operate the CPS master program at the lowest costs considering that it enjoys governmental funding which greatly reduces its running costs and operation bill.

2.2.2 Sustainability at AQU

Al-Quds University has a long practical experience in offering many graduate programs and was able, despite the challenges, to ensure the successful operation of these programs and thus there will be no difficulty in implementing and ensuring continuity of success in light of the accumulated experience. This experience led to the creation of a good reputation for the university which guarantees the availability of the minimal enrolled students to inaugurate the CPS master program. The student fees cover the expenses of running the program as it is the case with other academic graduate programs. In particular, the AQU tries to ensure sustainability of its master degree programs in general and the CPS program specially through the following measures:

- Students of the first cohort of CPS are offered 30% fees reduction. This discount will be renewed as needed.
- AQU helps the best students find scholarships for PhD positions at AQU and at other local and international universities.
- AQU covers publication fees and partially cover the cost of conference participation of students and Faculty members.
- The load of teaching credit hour of master classes is considered as 1.5 hours instead of just one.
- AQU lab technicians regularly participate in trainings to enhance their skills in maintaining existing and new lab equipment.

2.2.3 Sustainability at GJU

The established MS@CPS program has been adopted by the computer Engineering department, where several faculty members have the needed expertise to teach the new introduced courses, and supervise the students on their projects and master thesis. In order to ensure the project sustainability, the following measures will be taken by the university and the department:

- The university is actively announcing for the available programs, especially the newly established ones. This I achieved using several media outlets such as the university social media pages (e.g., Facebook, twitter) and the official university website.
- Surveys will be collected from the enrolled students and from the new students to receive their feedback and reflect it into the project ongoing activities. Hence, assuring a successful program implementation, which will be positively reflected into the program reputation. This

will urge the enrolled students to advise their colleagues to be enrolled into the program and give positive feedback about the program.

- Several industrial representatives will be invited to participate on giving some lectures, workshops and talks to the student. Furthermore, they will be also invited to participate on co-supervising the students' projects and master thesis. This industrial involvement will enrich the program, improve its reputation among the students and the industry, which will urge the industry to encourage interested students to be enrolled in the program.
- The German Jordanian University is considering this newly established program for scholarships. Therefore, some students will get a scholarship from the university, which will also increase the number of enrolled students.

2.2.4 Sustainability at TTU

The master of science in cyber physical systems is launched in Tafila Technical University, which is located in Tafila province. This city is less developed area in the southern region of Jordan has a great potential for development and improvement. People, who is living in the southern region of Jordan, are looking toward learning new technologies that are addressed in this program. Therefore, pay attention to this region through launching a distinguish program particularly in TTU will contribute toward the development of southern region and Jordan in general. The MS@CPS project is supporting TTU to launch this program successfully as follows: Curriculum development, courses development, essential equipment and software packages, staff training, experience exchange, and program dissemination. We keep the program outcomes sustainable through the following activities:

- Developing and keeping updates of the project webpages (<http://www.ttu.edu.jo/college-of-information-technology-and-communication/departement-of-computer-science/ms-cps/> and <http://www.ttu.edu.jo/ipo/index.php/ms-cps>) and social media page(<https://www.facebook.com/Master-Of-Cyber-Physical-Systems-102535272506541>).
- Continuous issuance of the program newsletter every year. The TTU academic staff and students and our colleagues from the partner and program countries are invited to contribute the newsletter topics.
- Schedule a special issue in the Jordan Journal of Electrical Engineering (JEE:<http://jje.ttu.edu.jo/>) focusing on cyber physical systems applications, challenges, and solutions.
- Hiring faculties in the cyber physical systems domain. In next two years, our plan to employ professors in five academic positions focusing on Internet of Things, Artificial Intelligence, Cyber Security, Mobile Computing, and Data Science. This will assist to support the program competition and to meet the accreditation requirements to increase the number of students who can enroll in the program. Now, the maximum number of students that can we accept is 17 students only.
- Developing the materials and teaching resources of program courses continually to provide the best and newest practices and knowledge in cyber physical systems. Furthermore, the e-learning theme will be considered as a successful tool to encourage people to apply for the program. Another development direction is research and teaching laboratories. Every year, new hardware and software are purchased to keep the laboratories sustainable and developed.
- Conduct incentive training courses for both academic staff and students in variety CPS fields such cyber security, IoT, machine learning, data analytics, and artificial intelligence and robotics through the partnership with National Cybersecurity Center, Computer and IT Center, and Consultation Studies and Training Center. These training courses will provide our staff and students the essential technical skills to follow the new development in CPS domain.

- TTU keeps offering the program at a relatively competitive tuitions and fee compared to other local and regional universities. Also, TTU keeps supporting the students with a range payment options in order to encourage them to apply and continue studying in the program. In addition, students can apply for internal fund to support their research activities, attending conferences, and publication costs.
- There is a noticeable increase in the figures of student's enrollment in the undergraduate-related programs, as the project gave the TTU a huge reputation and credibility. Over 900 students enrolled in seven related-CPS bachelor programs: five new programs (computer science/artificial intelligence and data science, computing of smart devices, cyber security, intelligent systems engineering) and two existing ones (computer information systems, computer engineering) in TTU. Those students are our main target group to join the CPS program. After two years, the first class of those students will graduate. Therefore, we ask them to participate with all program dissemination activities in order to learn about the program and its opportunities for them.
- For the purposes of scholarships to obtain a PhD, all the TTU graduates have a priority according to the comparison table among applicants. Whereas, each TTU graduate has 5 points more comparing to other applicants. This encourages people to join the CPS program in order to have this opportunity to finish their PhD and join the academic staff at TTU.

2.2.5 Sustainability at CU

Sustainability in Higher Institute of applied Sciences and Technologies of Mateur is guaranteed by the virtue of being a governmental institute (public institute) and therefore its financing is placed on the shoulders of the government. Once the students are admitted, the program courses will be offered as planned. There is no Risks because the ISSATM offer the program at reduced price for credit hour, compared to other private universities, as it is able to operate the CPS master program at the lowest costs considering that it enjoys governmental funding which greatly reduces its running costs and operation bill and therefore a student only pays only 100 euro as fees per year. On the other hand, Carthage University has a long practical experience in offering many graduate programs (license, engineering cycle, masters) and was able, despite the challenges, to ensure the successful operation of these programs and thus there will be no difficulty in implementing and ensuring continuity of success in light of the accumulated experience.

2.2.6 Sustainability at USF

Sustainability in Higher institute of computer science and multimedia of Sfax – University of Sfax is guaranteed by the curricula accreditation of the university council and the national accreditation sectorial committee. This latter approved the curricula for Four years and encouraged its creation as it is aligned with the national demand. In fact, the decision of maintaining and creating curricula is achieved each four years through a common national process. After the first-year students' admission to the program, courses are offered as planned. Risks are minor because University of Sfax has a long practical experience in offering many graduate programs/international curricula and was able, despite the challenges, to ensure the successful operation of these programs. Although the leading position of university of Sfax at the national level, and consequent availability of the minimal enrolled students, USF always works at reducing the risk of lack of students' enrolment in the long term. The higher institute of computer sciences and multimedia will make profit of the four-year evaluation by updating the curricula to keep it in phase with the labor market needs.

3 Visibility and impact

Impact is the effect that the activity carried out and its results have on people, practices, organisations and systems. Dissemination and exploitation of results plans can help to maximize the effect of the activities being developed so that they will impact on the immediate participants and partners for years to come. Benefits to other stakeholders should also be considered in order to make a bigger

difference and get the most from the project. In order to evaluate the impact of the project after the project lifetime at the national level, this has been discussed in several consortium meetings.

3.1 International Impact

Indicator-based, self-assessment system for internationalization will be used after the project ends. It will have a long-lasting impact on the internationalization process in partner Universities.

Number	Impact	Indicator
1	Graduates of the program will be prepared for international PhD programs	Number of graduate's enrolment for international PhDs
2	The MS@CPS Program fosters practical and collaborative works including teachers and students from different countries, which creates a basement for international publications. Students can impact at the international level by scientific contribution in the conferences, journals and communication with the society.	Number of international publications
3	Graduates have better opportunity to be employed at the international companies. In addition, to engage in international entrepreneurship.	Percentage of graduates receive job opportunities at international companies and number of established business startups.
4	The resulting consortium network can serve as a baseline for the future project collaborations with higher international impact.	Number of international projects and collaborations

The WP5 leader prepared and proposed a dissemination and exploitation plan along with this sustainability plan and shared them with all the partners to be considered and carried out. The project

partners will continue to have future collaborations and connections with other EU partners. This is important in order to keep the already established link with the international program partners and to enrich the cooperation which will be achieved by taking the following actions:

- Co-supervision of master students for their master thesis projects;
- Apply for mobility funding and grants that can be provided by local partners as well as by other Erasmus+ programs such as International Credit Mobility (ICM);
- Adopting English language as teaching language for the internationalization of the program.

In Jordan, Tunis and Palestine, the project visibility is facilitated by targeting several audience groups. In the HEIs, the project was presented to top management for endorsement of the project efforts. Information on the project is presented on the colleges' websites and updates are periodically distributed to staff members and students through institutional newsletters. Internal meetings and seminars were held in all the colleges to present MSCPS to faculty and to encourage them to take active part in it. Currently, before the pilot, specific information on the developed online-international courses is delivered to students from different departments in the HEIs.

3.2 Impact at the national level

On the national level, the project was presented to the Board of public academic HEIs in partner countries, including the Presidents, VPs and GMs. The project was also presented in an Open Info Day Event organized by the consortium, with the participation of all HEIs and their local students.

Number	Impact	Indicator
1	Graduates of the program will be prepared for PhD programs	Number of graduates enrolment for PhDs
2	The MS@CPS Program fosters practical and collaborative works including teachers and students from the partner country which creates a basement for international publications. Students can impact at the international level by scientific contribution in the conferences, journals and communication with the society.	Number of national publications
3	Graduates have better opportunity to be employed at the national companies. In this way, the program will increase the employability of the graduated student.	Percentage of graduates receive job opportunities at national companies

4	The resulting consortium network can serve as a baseline for the future project collaborations with higher national impact.	Number of national projects and collaborations
5	Taking into account the offered entrepreneurship skills by the program, graduates have a higher chance to establish new businesses and start-ups	Number of “proof of concepts”, prototypes and Minimum Viable Products. In addition, the number of established start-ups.

3.2.1 Impact at Palestine

There are three participating institutes from Palestine: Al-Quds University (AQU), Palestine Technical College (PTC) and Al-Aqsa University (AAU) and they are located in geographical areas that is in need of this master's program as it appeared from the preparation work conducted under needs assessment task in the project. The master program improves employability chances for its graduates as appeared from the surveys conducted in preparation work in the project. The consortium of the project selected its courses and developed them to respond to market needs and requirements at each country. Moreover, the master program will have a positive impact on the Palestinian economic situation, since it will increase the number of established start-ups by the graduate from this program.

3.2.2 Impact at Jordan

There are two participating institutes from Jordan: Tafila Technical University (TTU) and German Jordan University (GJU), and both need this master's program as it appeared from the preparation work conducted under the need's assessment task in the project. The master program improves employability chances for its graduates as appeared from the surveys conducted in preparation work in the project. The consortium of the project selected its courses and developed them to respond to market needs and requirements in each country.

Moreover, the project will have a positive impact on the country economic situation, since it will increase the employability for the students who will graduate from this program. This is because the program covers several technologies and subjects that are needed by the local and global industry.

3.2.3 Impact at Tunisia

There are two participating university from Tunisia: University of Sfax and university of Carthage, and both are located in north and south of Tunisia to serves an important number of students, companies and society. The master program improves employability chances for its graduates as appeared from the surveys conducted in preparation work in the project. The consortium of the project selected its

courses and developed them to respond to market needs and requirements at each country and region.

USF and the Techno park of Sfax plays a prominent role as a hub between both academic and industrial partners and regularly host international events/ conference. USF emphasis there that the Technopark is creating the industry 4.0 center encouraged by the creation of this curricula established in the neighboring higher institute of computer sciences and multimedia of Sfax. The objective is always improving employability and students' skills as well as providing dynamic demonstrators to serve smart industrial process and smart digital health solutions.

The project took advanced steps towards achieving the planned goal through a signed partnership agreement between Technopark of Sfax and Higher institute of Computer sciences and multimedia of Sfax-University of Sfax. Through dissemination events, several companies have shown their interests in cyber physical systems curricula and we think that most of these companies seeks for CPS students to hire. Additionally, the synergy between public and private institution provides effective eco-systems for investment and start-up.

3.3 Impact at the institutional level

3.3.1 Impact at GJU

The German Jordanian University (GJU) is established to give the students an international dimension, where several institutes from Germany have signed a partnership agreement with the university. Utilizing these agreements, students are allowed to participate in several international activities that take place in Germany. Establishing the MS@CPS program will encourage other universities in Germany to collaborate with students and faculty members, since the new established program addresses many up-to-date courses and technologies. As a result, GJU will have a strong position in front of its partner universities, which will open up more opportunities for establishing joint projects in the field of cyber physical systems. Furthermore, the program graduates will have a better opportunity for pursuing a PhD degree in one of this partner university, or on other universities who have similar research track to the cyber physical systems track.

3.3.2 Impact at TTU

Tafila Technical University is the first technical university in Jordan. The university is offered rare and unique majors of its kind in engineering and sciences in Jordan and the region. Tafila Technical University mediates the southern region and connects all southern governorates. Therefore, the university plays an important role in attracting students from all governorates due to its intermediate location and for providing rare specialties. Also, the TTU has attracted many Ph.D. degree holders in various distinct disciplines and several fields.

For Tafila Technical University, the program added a new specialization to the list of offered master programs. It gave the TTU a big push by opening a new horizon in the field of offering novel and unique programs. Now, a growing demand was observed for IT programs due to the new life requirements the growth of the technology. The project and the program opened the door for more academic cooperation between Jordanian universities in many fields, especially in e-learning. On the other side, there was a noticeable increase in the figures of those enrolled in the undergraduate-related programs, as the project gave the TTU a huge reputation and credibility, which was reflected in the students' enrollments and demands. A significant increase in introducing new teaching courses and research activities of TTU academic staff was also observed as a result of their participation in the project.

3.3.3 Impact at PTC and AAU

The project gave the PTC a big push by opening a new horizon in the field of offering a graduate study in cooperation with Al-Aqsa University. Also, there was a noticeable increase in the figures of those

enrolled in the undergraduate related programs, as the project gave the PTC a huge reputation and credibility, which was reflected in the students' demand. A significant increase in introducing new teaching courses and research activities of PTC academic staff was also observed as a result of their participation in the project. Moreover, unemployment rate of PTC graduates in computer engineering is low compared to their counterparts in other universities in the region. The program is offered through a cooperation agreement between PTC and Al-Aqsa University in Gaza and both are classified as governmental institutes. This new cooperation might lead to the merge of PTC into Al-Aqsa University or to promote the PTC as a technical university to realize its vision as a leading technical university in the Gaza Strip.

3.3.4 Impact at AQU

For Al-Quds University, the program added a new specialization to the list of offered master programs. The program's output of graduates constitutes certainly an important support for the information technology PhD program offered by Al-Quds university. It is also observed a growing demand for all programs related to computer systems and information technology. The project opened the door for more academic cooperation between Palestinian universities, considering that the two Palestinian partners in the project agreed to offer the program in partnership, as well as to cooperate in e-learning. In addition, both partners cooperate in organizing an international scientific conference in the field of computer engineering and information technology, which is internationally accredited by the IEEE society.

3.3.5 Impact at USF

In harmony to previous successful projects (i.e., Tempus SAGE, PDTH), the MSCPS project raised the higher Institute of computer science and multimedia reputation, credibility and openness to the international horizon, which was reflected in the students' enrolment (more than 80 applications on the first year). A significant increase is witnessed in introducing new teaching courses and research activities of ISIMS academic staff as well as collaboration with industrial. Moreover, unemployment rate of ISIMS graduates in computer engineering is low compared to their counterparts in other universities in Tunisia. Making profit of the existing curricula at higher institute of computer sciences and multimedia of Sfax – university of Sfax, the program added a new specialization to the list of offered master programs. The program's output of graduates constitutes certainly an important support for the information technology PhD program offered by university of Sfax and the research laboratory MIRACL located at ISIMS. The project opened the door for more academic cooperation between Tunisian universities, considering that the two Tunisian partners in the project agreed to offer the program in partnership and to exchange and share teaching staff as well as the star-tup creation by finding the structured ecosystems.

3.3.6 Impact at CU

Launching the master's program has given the ISSATM a great development in the field of graduate studies at the University of Carthage. This research master's is the first at ISSATM, since previously it only has professional master's degrees. In addition, there was an increase in the number of students enrolled in undergraduate related programs as the master program gave ISSATM huge reputation and credibility which was reflected in the enrolled students. There was also a significant increase in the introduction of new teaching courses (machine learning, human machines, ...) and research activities of academic staff of ISSATM was also observed following their participation to the project. The master also enabled the ISSATM to open positions to recruit other university lecturers, since the available number became insufficient. In addition, the unemployment rate of ISSATM computer engineering graduates will be low in the future. this project has improved ISSATM chances of being accepted in other projects. The program has added a new specialization to the list of master's programs offered at the university of Carthage (CPS). There is also a growing demand for all computer systems and information technology programs. We received students from other institutions of the University of

Carthage and even other universities besides Carthage. The project opened the door to increase academic cooperation between Tunisian universities, given that the two Tunisian project partners (ISSATM (CU) and ISIMS (USF)) agreed to offer the program in partnership, thus to cooperate in the field of online and face-to-face learning. In addition, the two partners cooperate to organize scientific events in the field of computer engineering and information technology. The project also made it possible to sign partnerships with companies, non-governmental organizations and associations.