H2020 5Growth Project
Grant No. 856709

D5.4: Report on WP5 Progress and Update of CoDEP

Abstract

This document presents the progress and activities of the 5Growth project during Y1 and Y2. All the results are classified according to the Communication, Dissemination, and Exploitation Plan (CoDEP), and taking as reference the initial and updated plan in D5.1 and D5.2, respectively. To recall, communication includes all the activities related with the promotion of the project, including a non-specialist audience, i.e., society at large. Dissemination includes activities on peer-reviewed publications in academic conferences and journals, collaboration with other projects, and it also includes participation and organization of technical events. Exploitation includes the activities aiming at using the results from the 5Growth project in various ways, including developing, creating, and marketing products or processes, or provisioning a service. Project results will as well be exploited through the standardization activities. In addition, the document introduces an update and a plan for the CoDEP, as the project is transiting from the presentation of results phase (Y2) to integrated experimental demonstrations phase.

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Document responsible	Carlos Guimarães (UC3M)
Document editor	Carlos Guimarães (UC3M)
Authors	Carlos Guimarães (UC3M), Antonio de la Oliva (UC3M), Carlos J. Bernardos (UC3M), Paola Iovanna (TEI), Giulio Bottari (TEI), Álvaro Gomes (ALB), Antonio Manzalini (TIM), Annachiara Pagano (TIM), Óscar Pereira (ITAV), Rui Aguiar (ITAV), Daniel Corujo (ITAV), Vitor Cunha (ITAV), João Fonseca (ITAV), João Alegria (ITAV), Giada Landi (NXW), Juan Brenes (NXW), Hugo Martins (EFACEC_E), Jorge Baranda (CTTC), Engin Zeydan (CTTC), Ricardo Martínez (CTTC), Josep Mangues-Bafalluy (CTTC), Ramon Casellas (CTTC), Lorenza Giupponi (CTTC), Raül Muñoz (CTTC), Luca Valcarenghi (SSSA), Lorenzo De Marinis (SSSA), Piero Castoldi (SSSA), Simone Panicucci (COMAU), Lina Magoula (NKUA), Chia-Yu Chang (NBL), Tezcan Cogalan (IDCC), Alain Mourad (IDCC), Xi Li (NEC), Andres Garcia Saavedra (NEC), Aitor Zabala (TELCA)
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Disclaimer

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List of Acronyms

3GPP	Third Generation Partnership Project
5G NR	5G New Radio
5G PPP	5G Public Private Partnership
AI	Artificial Intelligence
API	Application Programming Interface
BSS	Business Support System
CDN	Content Delivery Network
CMM	Coordinate Measuring Machine
CoDEP	Communication, Dissemination, and Exploitation Plan
DLT	Distributed Ledger Technology
DMM	Distributed Mobility Management
E2E	End-to-end
eMBB	Enhanced Mobile Broadband
ESB	Extern Stakeholders Board
ETSI	European Telecommunications Standards Institute
EVIAB	External Vertical Industries Advisory Board
GSMA	Global System for Mobile Communications
HTC	Human Type Communication
ICT	Information and Communication Technology
IEEE	Institute of Electronics and Electrical Engineering
IETF	Internet Engineering Task Force
IoT	Internet of Things
IP	Internet Protocol
IPR	Intellectual Property Rights
IRTF	Internet Research Task Force
ITU-T	International Telecommunications Union – Telecommunications
KPI	Key Performance Indicator
LV	Low Voltage
MANO	Management and Orchestration
MEC	Multi-Access Edge Computing
ML	Machine Learning
MNO	Mobile Network Operator
MTC	Machine Type Communication
MV	Medium Voltage
NFV	Network Functions Virtualization
NFVI	NFV Infrastructure
NMRG	Network Management Research Group
NSaaS	Network Slice as a Service
ONOS	Open Network Operating System
OPNFV	Open Platform for NFV
O-RAN	Operator Defined Next Generation RAN
OS	Operating System
OSM	Open-Source MANO

OSS	Operations Support System
QoS	Quality of Service
RAN	Radio Access Network
RL	Reinforcement Learning
RNC	Radio Network Controller
ROS	Robot Operating System
SAC	Standard Advisory Committee
SDN	Software Defined Networks
SDO	Standard Development Organization
SLA	Service Level Agreement
SME	Small and Medium-Sized Enterprise
TB	Technology Board
URLLC	Ultra-Reliable Low Latency Communication
VNF	Virtual Network Function
WG	Working Group
Y1	Year 1
Y2	Year 2
ZDM	Zero Defect Manufacturing

Executive Summary and Key Contributions

This document presents the progress (achievements and activities) of the 5Growth project, covering year 1 (Y1) and year 2 (Y2), on WP5 activities according to the Communication, Dissemination, and Exploitation Plan (CoDEP). Furthermore, the document presents a plan and an update of the CoDEP for the remaining 9 months of the project duration.

To recall, and according to common practice [1][2], *Communication* includes all the activities related with the actions targeting a wide audience, i.e., society at large. *Dissemination* focuses on the actions with a research audience working in the same technical field, including the interaction with other EU and international projects. *Exploitation* deals with the actions that extend the results of the project beyond the project duration aiming at having a long-lasting impact in the form of new products and services, standardization efforts, open-source code, and their integration in future projects.

First, the document reports all activities and events undertaken during Y1 and Y2 of the project. Similarly to D5.2 [6], these achievements are presented following the same order of classification of the CoDEP, which offers a systematic way of checking the results of its execution.

We list below some key achievements of the project related to the work reported in this deliverable:

- A noticeable presence at and organization of virtual events, such as the presence on several 5G PPP Technology Board (TB) workshops and the organization of online workshop at Layer123, among others.
- An active communication through 18 videos, more than 10 press releases and more than 55 collaborations with other projects.
- A high number of scientific peer-reviewed publications with 45 published or accepted for publication in reputed scientific journals/magazines and conference/workshop proceedings.
- Technology demonstration of the project concepts in 19 events, conferences, among others.
- A significant number of contributions submitted to standardization groups, with 22 contributions approved, agreed, or adopted.
- Contribution to the Innovation Radar where 4 innovations were selected considering the level of innovation with respect to state of the art, the maturity of deployment reached in the project and the potential impact on products and services.
- Software developments in the project prototypes emerge as important assets for all the partners and for the community given that they are published as open-source software.

Finally, the document presents an update of CoDEP, which is basically following what has been introduced in D5.2, expanded to consider the additional 3-months project extension.

The communication plan will continuously be monitoring whether any adaptation is needed, with more focus being put on press release activities.

The dissemination plan for the remaining 9 months will follow the same plan as defined in D5.2.

As indicated earlier, we separated the exploitation plan and the standardization plan, to better show the standardization activities, and clearly highlight the relation between the standard contributions

and the corresponding activities in 5Growth. The Exploitation plan for the remaining 9 months extends the plan reported in D5.2 and refines the potential impact on the products and services of the partners. For the last 9 months of the project, the focus and effort will be dedicated to completing and consolidating all key innovations developed in the first two years of activities and to outline the relevant potential for exploitation in the last period and beyond the project lifetime. Most of the activities in the next months will be dedicated to test beds and pilot trials, which will drive setting out the exploitation directions for the future.

Regarding the standardization plan, it is elaborated according to the Standard Advisory Committee (SAC), which continues ensuring that 5Growth Standardization efforts clearly reflect specific outcomes from the various activities during the last 9 months of the project.

1. Introduction

During progress and activities of the 5Growth project within year 1 (Y1) and year 2 (Y2), no major deviations have been observed in communication, dissemination, and exploitation plan (CoDEP) presented in the initial plans. During these two years, multiple communication, dissemination, and exploitation activities were carried out in line complying with the initial plan.

Although the COVID-19 pandemic had an impact on several face-to-face activities especially within Y2 of the project, these constraints have not led to major deviations with respect to the participation of several virtual activities performed. Communication, dissemination, and exploitation activities were all performed successfully within the first two reporting years of the project, including:

1. event organizations.
2. communication articles.
3. academic paper publications (journals, conferences).
4. talks within various events.
5. public demonstrations at various events and conferences.
6. open-source and standardization contributions.
7. the presentation of videos highlighting the main outcomes of the project in 5Growth social media channels.
8. the development of the pilots (e.g., 5Growth pilots and 5Growth interaction with ICT-17 platforms).

The exploitation plans after the end of the project are also being supported with key innovations, commercial grade products, services, novel solutions, and patents that are contributed by different partners (vertical industries, operators, vendors) during the first two years of activities in the project. This deliverable also explains those exploitation activities that are going to be performed after the project ends to maximize the impact of 5Growth. The outcome of the standardization contributions, following the roadmap defined by the Standardization Advisory Committee (SAC), is also presented in this document.

The document is structured into two parts. First, we describe the work progress of WP5 in Section 2. And second, we present an update on the 5Growth CoDEP achievements in Section 3. Both parts are structured into four sub-sections, namely communication, dissemination, exploitation, and standardization. Section 3 also presents the exploitation plans after the project ends and contribution of the project to 5G-related standards.

2. Work Progress of WP5

5Growth created, from the early stages of the project, a basic set of necessary presentation materials targeted for various audience types: a **communication package** that is used as the core communication measure to promote the project as summarized in the following section.

2.1. Communication

The 5Growth communication activities are devoted to outreach academia, industry, and society at large and to highlight the major achievements of the 5Growth project, vision, concept, objectives, and results among the various stakeholders. All 5Growth partners promote the 5Growth project to the general public, and through different kinds of activities. In the following subsections, we report all the activities, such as the Web, social media and project communication material, leaflet and poster, video, press releases and news, articles, presentation/lectures.

2.1.1. Overall Achievements

In this section, we report the Y2 achievements of the project related to communication activities with respect to the targets planned in the initial plan. Overall, the project overcame its targets despite the challenging situations due to COVID-19 pandemic, as reported in Table 1.

TABLE 1: COMMUNICATION ACTIVITIES ACHIEVEMENTS AND TARGETS

Type	Achieved	Target (per year)	Achieved/Target
Press Releases and News	10	2	5
Communications Presentations	1	1	1

In addition, to the actions reported in Table 1, three additional courses in which 5Growth-related concepts were included have been activated in Y2 by academic member of the consortium.

2.1.2. Web, Social Media, and Project Communication Achievements

The project website, reachable at https://5growth.eu/, received many visits. In particular, the website "365 days" statistics at the end of May 2021 showed a number of visits summing up to more than 55000 visits, as shown in Figure 1, with a decrease with respect to the almost 90000 reached at the end Y1. The reason of this decrease is that the project has built its reputation during Y1 and during the Y2 most of the attention has been shifted towards other social media channels such as YouTube, LinkedIn, and Twitter.

	Visitors	Visits	Visitors	Visits
Today:	15	20	58	97
Yesterday:	26	88	103	368
Last 7 Days:	465	1,168	562	1,241
Last 30 Days:	1,725	5,441	1,948	4,476
Last 365 Days:	20,054	89,552	20,148	55,059
Total:	20,054	89,552	40,290	144,998
	Y1 stats		**Y2 stats**	

FIGURE 1: OVERALL WEBPAGE HITS FOR Y1 AND Y2

In detail, as shown in Figure 2, the most popular subpages in Y1 were the ones related to the consortium events and to project deliverables.

Top Pages

ID	Title	Link	Visits
1	Home Page	/	23,656
2	Deliverables	/deliverables/	2,057
3	Consortium	/project/consortium/	1,136
4	5GROWTH in Torino, Italy	/2019/09/17/5growth-in-torino-italy/	1,083
5	5GROWTH's presence during the 24th Science Week in Catalonia	/2019/11/18/510/	938
6	Plenary Meeting in Pisa	/2019/09/03/plenary-meeting-in-pisa/	864
7	Consortium	/project/consortium	838
8	Project	/project	750
9	Project	/project/	721
10	Home Page	/index.php	708

FIGURE 2: DETAILS OF THE VISITED WEBSITE PAGES FOR Y1

Similarly, in Y2, as shown in Figure 3, the home page and the deliverable subpage are among the five most visited ones. It is also interesting to note that the "Contacts" subpage is the second most visited one in Y2, showing the increased interaction of the project with external stakeholders.

ID	Title	Link	Visits
1	Home Page	/	15,660
2	Contacts	/contacts/	2,144
3	Deliverables	/deliverables/	1,574
4	Home Page	/blog/	998
5	Project	/project/	734

FIGURE 3: DETAILS OF THE VISITED WEBSITE PAGES FOR Y2

The project has been very active in other social media such as LinkedIn and Twitter. As depicted in Figure 4 and Figure 5, the number of LinkedIn profile[1] views are constant, on average, in Y2 and the number of connections is steadily increasing. This behavior highlights the capabilities of the project of raising interest in the scientific communication but also in the general public. For what concerns Twitter[2], the profile visits increased sensibly in Y2 as depicted in Figure 6. Thus, despite the COVID-19 pandemic, 5Growth social media were active and attracted a lot of attention. 5Growth was active also in Instagram attracting a lot of attention. Indeed, the data depicted in Figure 7 show a steady increase in the Instagram[3] followers.

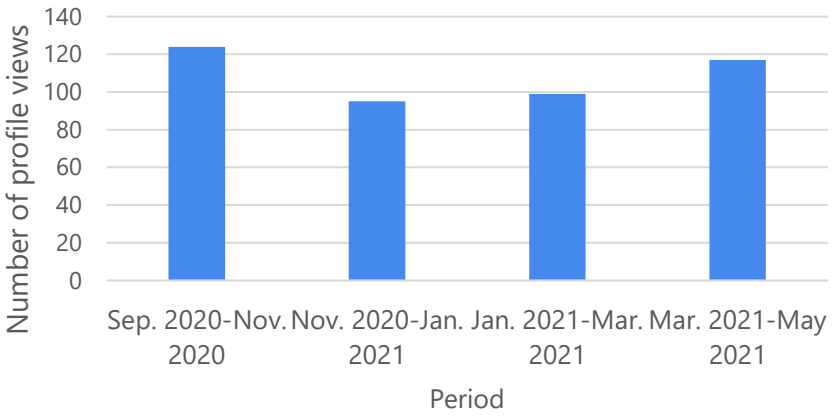


FIGURE 4: 5GROWTH LINKEDIN PROFILE VIEWERS

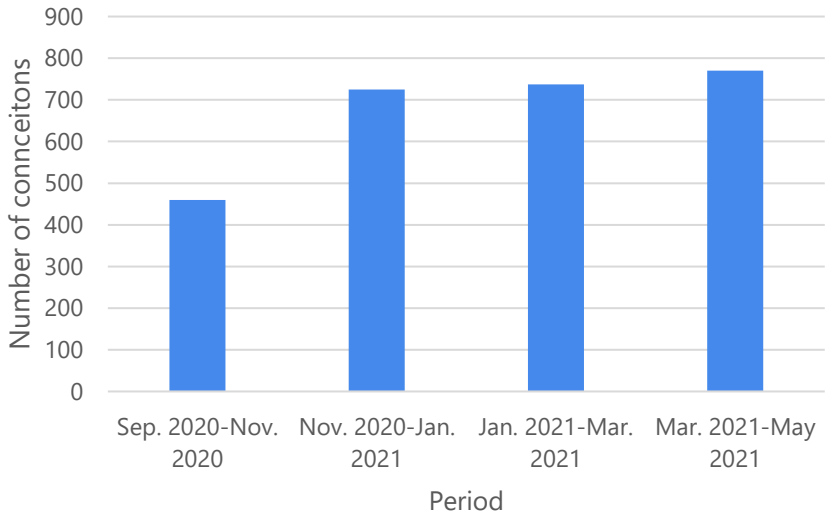


FIGURE 5: 5GROWTH LINKEDIN PROFILE CONNECTIONS

[1] www.linkedin.com/in/5growth-project
[2] https://twitter.com/5growth_eu
[3] https://www.instagram.com/5growth_h2020/

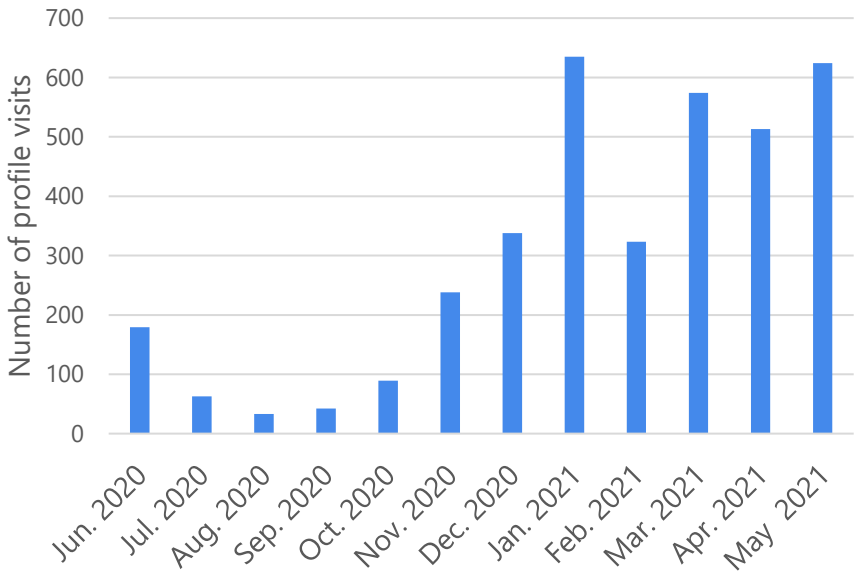


FIGURE 6: TWITTER PROFILE VISITS

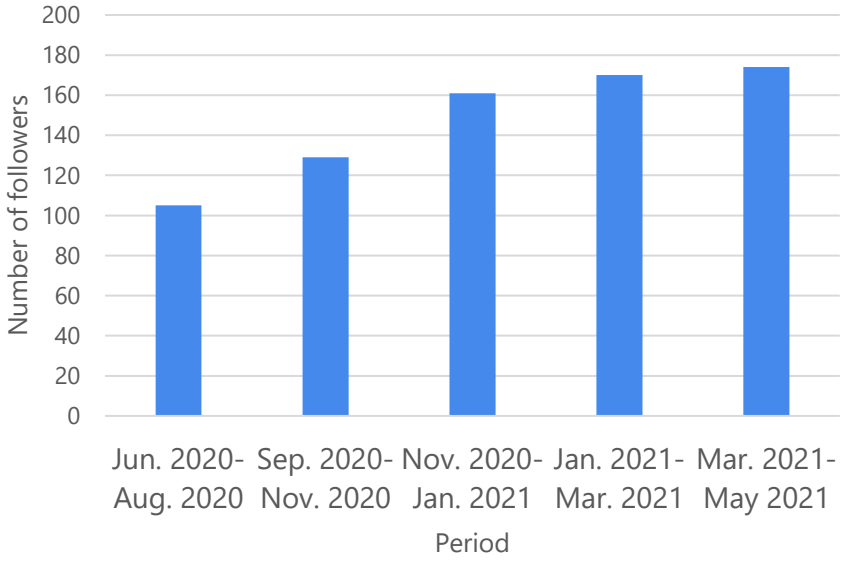


FIGURE 7: 5GROWTH INSTAGRAM FOLLOWERS

Due to COVID-19 pandemic many communication activities resorted to Internet. It is worthy to mention that during Y2 the 5Growth YouTube channel[4] visits increased sharply because of the release of several videos related to the ongoing vertical pilot experimentation and project innovations as shown in Figure 8. In Y2, 5Growth YouTube channel received more than three thousand visits with almost one hundred and fifty hours of watch time.

[4] https://www.youtube.com/5Growth

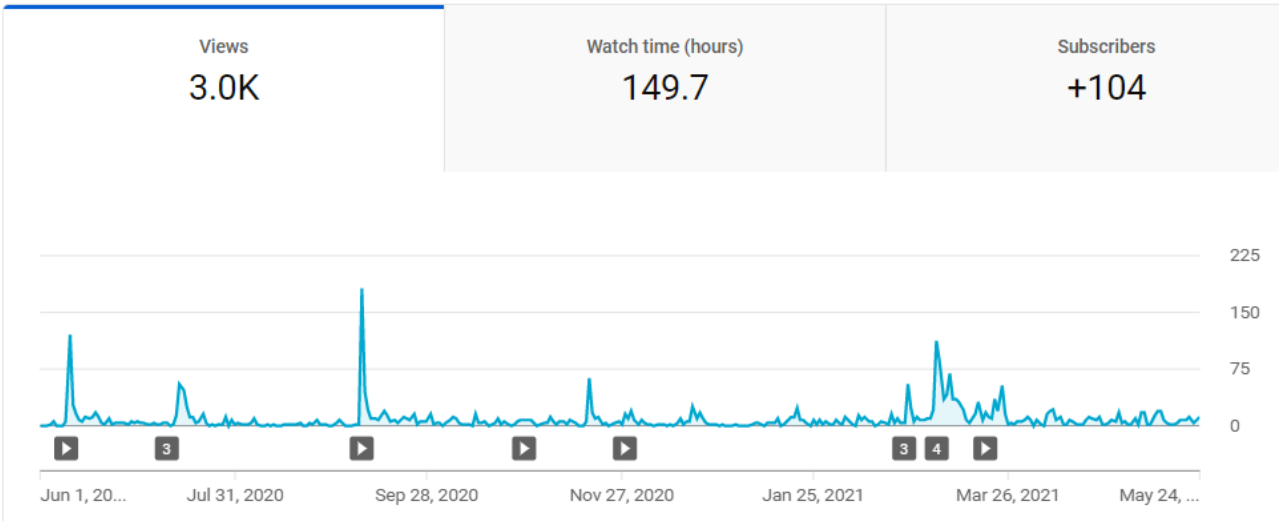


FIGURE 8: 5GROWTH YOUTUBE CHANNEL VIEWS IN Y2

2.1.3. Communication Talks and Other Actions

Despite the COVID-19 pandemic, the project has made extensive effort to deliver talks and other communication related actions. They were mainly delivered through online events. For example, Table 2 and Table 3 present the communication videos delivered during Y1 and Y2 of the project, respectively.

TABLE 2: 5GROWTH COMMUNICATION VIDEOS IN Y1

Date	Item	Channel
2019-07-04	5GROWTH presentation during ICT-19 call at EuCNC 2019	https://youtu.be/73tJLtfZfgg
2020-03-23	An introduction to 5Growth	https://youtu.be/wPt5v9V52f4
2020-05-12	First meeting del 5Growth External Vertical Industries Advisory Board (EVIAB)	https://youtu.be/7uC0SN0F79g

TABLE 3: 5GROWTH COMMUNICATION VIDEOS IN Y2

Date	Item	Channel
2020-06-10	5G end-to-end experimentation by verticals in EU projects Online Workshop	https://youtu.be/YMn5WMIaEV8
2020-07-10	Online Workshop – Layer123/5Growth: Powering 5G in Industry	https://youtu.be/AsrpwH6zudM
2020-07-13	5Growth: 5G-enabled Growth in Vertical Industries	https://youtu.be/A6otrNNL_bY
2020-07-13	Demo: vrAIn Proof-of-Concept. A Deep Learning Approach for Virtualized RAN Resource Control	https://youtu.be/1I8mcnHQcW8
2020-09-08	5G for Industry 4.0: COMAU pilot, Video Describing COMAU Pilot	https://youtu.be/tlyQBmRbNf0
2020-10-28	Transportation Pilot during the Aveiro Tech Week	https://youtu.be/IH5PIs6Qbvl

2020-11-28	Second meeting del 5Growth External Vertical Industries Advisory Board (EVIAB)	https://youtu.be/7AioiT_qeGQ
2021-02-23	ML-Driven Scaling of Digital Twin Service in 5Growth (short version)	https://youtu.be/7V3AKSrWzzY
2021-02-23	ML-Driven Scaling of Digital Twin Service in 5Growth (detailed description - long version)	https://youtu.be/K5GyrAD7h_Q
2021-02-23	Performance Isolation for 5G Network Slicing	https://youtu.be/DSGHUBFuvYs
2021-03-04	Advanced Monitoring and Maintenance Support for the Secondary MV/LV Distribution Substation	https://youtu.be/JcLEF3T5nLg
2021-03-04	COMAU Pilot. Digital Twin Apps Use Case	https://youtu.be/rY6ZH75agOk
2021-03-04	5Growth Interaction with ICT-17 Platforms	https://youtu.be/6CRYAwSlMZo
2021-03-11	EFACEC_S pilot. 5G to Support Railway Signaling Operations.	https://youtu.be/XP7E_txgmzY
2021-03-19	INNOVALIA Pilot. Connected Worker Remote Operation of Quality Equipment	https://youtu.be/EBLm0l32iTQ

Two communication articles were delivered by CTTC and EFACEC_S related, respectively, "5Growth Pilots" and "Project 5Growth".

Finally, academic partners of the consortium added to the portfolio of the courses that deliver content related to 5Growth topics, namely three additional courses dedicated to Ph.D. students. They are listed in Table 4 and Table 5.

TABLE 4: LECTURES AND COURSES IN Y1

#	Title	Host organization
1	Master in NFV and SDN for 5G networks	UC3M Telematics Department[5]
2	Advanced Communication Networks	NKUA Dept. of Informatics and Telecommunications[6]
3	Intelligence at the Edge of 5G for enabling 5G services	TIM Academy on 5G and Edge Computing[7]
4	Cloud Computing (Master Course)	Politecnico di Torino[8]
5	Software networking (Master Course)	Politecnico di Torino[9]

[5] https://www.uc3m.es/master/NFV-SDN-5g-networks#program
[6] https://www.di.uoa.gr/en
[7] https://www.telecomitalia.com/tit/en/sustainability/actions-dialogue/our-people/training-development.html
[8] https://didattica.polito.it/portal/pls/portal/gap.pkg_guide.viewGap?p_cod_ins=01TYDOV&p_a_acc=2020&p_header=S&p_lang=EN
[9] https://didattica.polito.it/portal/pls/portal/gap.pkg_guide.viewGap?p_cod_ins=01SQPOV&p_a_acc=2020&p_header=S&p_lang=EN

TABLE 5: LECTURES AND COURSES IN Y2

#	Title	Host organization
1	Laboratory of Teletraffic Engineering	SSSA[10]
2	Laboratory of Network Software	SSSA[10]
3	Communication Networks and Security	SSSA[10]

2.2. Dissemination

This section presents the overall progress of the project during Y1 and Y2, regarding the dissemination activities, which follow the plan described in D5.2 [6]. The dissemination activities are grouped as publications and technical dissemination, synergies with other projects, event organization, technology demonstrations, research/technical skill development and standardization.

Before reporting the overall dissemination activities in detail, Table 6 summarizes the dissemination plan target metrics described in D5.2 for the lifetime of the project and, whenever mentioned, for the Y2 of the project, along with the achieved metrics. The targeted and achieved metrics for Y1 can be found in D5.2.

TABLE 6: TARGETED METRICS VERSUS ACHIEVED METRICS IN Y2 OR LIFETIME OF THE PROJECT

Activity	Targeted Metric	Achieved Metric
Submission of scientific articles	At least 10 conference/journal in Y2	A total of 29 in Y2 (Conference = 12) (Journal = 17)
Submission of standardization contributions	At least 10 contributions to SDOs such as 3GPP, IETF, ETSI, IEEE, ITU during the lifetime of the project	A total of 55 contributions (Agreed/accepted = 22)
Submission of joint publications with other EU and international research projects	At least 2 joint documents in Y2	A total of 15 in Y2
Demonstration of project-related prototypes/solutions	At least 1 in a flagship event; and at least 1 in a vertical-oriented event in Y2	A total of 11 demonstrations in Y2[11]
Organization of events	At least 1 research- or industry-oriented workshop in Y2	A total of 8 in Y2 (Research-oriented = 7) (Industry-oriented = 1)
Participation to events	At least 1 research- or industry-oriented workshop in Y2	A total of 22 in Y2 (Research-oriented = 18)

[10] https://www.santannapisa.it/sites/default/files/programmazione_e_orari_phd_final_xxxvi_ciclo2020_21_final_3.pdf

[11] Due to the COVID-19 pandemic, planned vertical-oriented events (such as, InnoTrans) were either cancelled or postponed. As an alternative, we opt for dissemination through virtual events, workshops and demo videos.

		(Industry-oriented = 4)
Participation to open-source projects	At least 1 during the lifetime of the project	A total of 7 participations
Filing of patent applications	At least 5 during the lifetime of the project	A total of 2 filed patents
Research skill development	No specific target	A total of 14 students (Master = 7) (PhD = 7)

2.2.1. Publications and Technical Dissemination

Table 7 and Table 8 present all 5Growth peer-reviewed articles in scientific journals and studies/demos/posters in scientific conferences in Y1 and Y2, respectively.

TABLE 7: PUBLICATIONS IN SCIENTIFIC JOURNALS AND CONFERENCES IN Y1

Type	Title	Publication/Conference
journal	Beyond 5G Evolution (Guest editorship)	MDPI Electronics
journal	Service Shifting: A Paradigm for Service Resilience in 5G	IEEE Communications Magazine
journal	Reducing Service Deployment Cost Through VNF Sharing	IEEE/ACM Transactions on Networking
journal	DeepCog: Optimizing Resource Provisioning in Network Slicing with AI-based Capacity Forecasting	IEEE JSAC
journal	Is OpenCL Driven Reconfigurable Hardware Suitable for Virtualising 5G Infrastructure?	IEEE Transactions on Network and Service Management
journal	An Edge-based Framework for Enhanced Road Safety of Connected Cars	IEEE Access
journal	On the integration of NFV and MEC technologies: architecture analysis and benefits for edge robotics	Elsevier Computer Networks
conference	vrAIn: A Deep Learning Approach Tailoring Computing and Radio Resources in Virtualized RANs	ACM Mobicom 2019
conference	SliMANO: An Expandable Framework for the Management and Orchestration of End-to-end Network Slices	IEEE CloudNet 2019
conference	PI2forP4: AnActive Queue Management Scheme for Programmable Data Planes	ACM Conext 2019
conference	A Q-learning strategy for federation of 5G services	IEEE ICC 2020
conference	OKpi: All-KPI Network Slicing Through Efficient Resource Allocation	INFOCOM 2020
conference	Handover Prediction Integrated with Service Migration in 5G Systems	IEEE ICC 2020
conference	Orchestrating Edge- and Cloud-based Predictive Analytics Services	EuCNC 2020

conference	5Growth: AI-driven 5G for Automation in Vertical Industries	EuCNC 2020
conference	Information Exchange to Support Multi-Domain Slice Service Provision for 5G/NFV	IFIP Networking 2020

TABLE 8: PUBLICATIONS IN SCIENTIFIC JOURNALS AND CONFERENCES IN Y2

Type	Title	Publication/Conference
journal	TOTP Moving Target Defense for sensitive network services	Elsevier Pervasive and Mobile Computing
journal	Optical transport for industry 4.0	OSA Journal of Optical Communications and Networking
journal	RISMA: Reconfigurable Intelligent Surfaces Enabling Beamforming for IoT Massive Access	IEEE JSAC
journal	Overview of Architectural Alternatives for the Integration of ETSI MEC Environments from Different Administrative Domains	MDPI Electronics
journal	LACO: A Latency-driven Network Slicing Orchestration in Beyond-5G Networks	IEEE Transactions on Wireless Communications
journal	Decomposing SLAs for Network Slicing	IEEE Communications Letters
journal	Modeling MTC and HTC Radio Access in a Sliced 5G Base Station	IEEE Transactions on Network and Service Management
journal	5Growth: An End-to-End Service Platform for Automated Deployment and Management of Vertical Services over 5G Networks	IEEE Communications Magazine
journal	Optimal Deployment Framework for Multi-Cloud Virtualized Radio Access Networks	IEEE Transactions on Wireless Communications
journal	vrAIn: Deep Learning based Orchestration forComputing and Radio Resources in vRANs	IEEE Transactions on Mobile Computing
journal	Delay and reliability-constrained VNF placement on mobile and volatile 5G infrastructure	IEEE Transactions on Mobile Computing
journal	Monitoring in fog computing: state-of-the-art and research challenges	Inderscience International Journal of Ad Hoc and Ubiquitous Computing (IJAHUC)
journal	Architecture for integrating vertical customer programmability control of network functions and connectivity in a slice-as-a service schema	EURASIP Journal on Wireless Communications and Networking Journal

journal	Public and Non-Public Network Integration for 5Growth Industry 4.0 Use Cases	IEEE Communications Magazine
journal	Support for Availability Attributes in Network Slices in GANSO	Wiley Internet Technology Letters
journal	Towards Intelligent Cyber-Physical Systems: Digital Twin meets Artificial Intelligence	IEEE Communications Magazine
journal	A Genetic Algorithm Approach for Service Function Chain Placement in 5G and Beyond, Virtualized Edge Networks	Elsevier Compute Networks
conference	DLT federation for Edge robotics	IEEE NFV-SDN 2020
conference	An Intelligent Edge-based Digital Twin for Robotics	IEEE GlobeCom 2020
conference	GANSO: Automate Network Slicing at the Transport Network Interconnecting the Edge	IEEE NFV-SDN 2020
conference	On the Integration of AI/ML-based scaling operations in the 5Growth platform	IEEE NFV-SDN 2020
conference	Experimental Validation of Compute and Network Resource Abstraction and Allocation Mechanisms within an NFV Infrastructure	IEEE IM 2021
conference	Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs	IEEE INFOCOM 2021
conference	An RL Approach to Radio Resource Management in Heterogeneous Virtual RANs	IEEE WONS 2021
conference	Serving HTC and Critical MTC in a RAN Slice	IEEE WOWMOM 2021
conference	5Growth Data-Driven AI-Based Scaling	EuCNC 2021
conference	5Growth: Secure and Reliable Network Slicing for Verticals	EuCNC 2021
conference	On Slice Isolation Options in the Transport Network and Associated Feasibility Indicators	IEEE NetSoft 2021
conference	Efficiency Gains due to Network Function Sharing in CDN-as-a-Service Slicing Scenarios	IEEE NetSoft 2021

Table 9 and Table 10 present 5Growth consortium talks at scientific conferences, seminars, and forums, with the goal of raising awareness on the 5Growth project during Y1 and Y2, respectively.

TABLE 9: 5GROWTH TALKS IN SCIENTIFIC CONFERENCES AND TECHNOLOGY FORUMS IN Y1

Date	Venue	Description
2019-05-22	IEEE ICC 2019	Panelist at IEEE ICC 2019 Workshop: 5G-Trials – From 5G Experiments to Business Validation called Challenges in 5G Trials
2019-05-27	Dagstuhl Seminar 19222 "Control of Networked Cyber-Physical Systems"	Impulsive presentation of 5Growth ("5G Service Automation")
2019-06-20	EuCNC 2019	Presentation of 5Growth in ICT-19 Session at EUCNC 2019

2019-07-23	EuCNC 2019	Presentation of 5Growth in EMPOWER-PAWR workshop: EuCNC.
2019-07-03	FUSECO FORUM	Presentation of 5Growth (results and WIP) at FUSECO Forum[12]
2019-09-03	ICT-19 session by 5G-EVE	5G-EVE organized a session devoted to discussing collaboration with ICT-19 projects (i.e., 5Growth)
2019-10-08	5G PPP TB Workshop	5G-enabled Growth in Vertical Industries
2019-11-27	2nd Visions for Future Communications Summit	Slicing with non-public networks – another orchestration challenges for the next decade.
2020-01-13	Nokia Bell Labs (Paris-Saclay, France)	Reinforcement Learning for Slice Resource Allocation
2020-01-13	NYU Tandon School of Engineering	Reinforcement Learning for Slice Resource Allocation
2020-03-09	"Jornadas Electrotécnicas 2020" at Instituto Superior de Engenharia do Porto	Presentation of 5Growth project under the Seminar "Research for beyond the Early 5G Network – EU and PT"
2020-05-12	First meeting of 5Growth External Vertical Industries Advisory Board (EVIAB).	Presentation of the 5Growth project. Available at: https://youtu.be/7uC0SN0F79g
2020-05-19	"The role of computing in the post 5G-era: Architectures and enabling technologies", workshop, co-located with ONDM'20 (WS)	Evolutionary trends in operators' networks for beyond 5G
2020-05-19	5th IEEE International Workshop on Orchestration for Software Defined Infrastructures (O4SDI), co-located with the 2020 IEEE/IFIP NOMS	Towards a standardized transport slicing architecture in operator networks
2020-05-26	5G PPP TB eWorkshop (Session on Collaboration among infrastructure and vertical validation trials projects)	An exemplary view from an ICT-19 project: 5Growth – Link with 5G-EVE and 5G VINNI
2020-05-26	5G PPP TB eWorkshop (Session on Business Model Validation)	5Growth business validation

[12] https://www.fokus.fraunhofer.de/ngni/events/fuseco_forum_2019

2020-05-26	5G PPP TB eWorkshop (AIML session)	A Deep Learning Approach for vRAN Resource Orchestration
2020-05-26	5G PPP TB eWorkshop (Session on Validation and KPIs)	5G PPP TMV TF on vertical KPIs Industry 4.0

TABLE 10: 5GROWTH TALKS IN SCIENTIFIC CONFERENCES AND TECHNOLOGY FORUMS IN Y2

Date	Venue	Description
2020-06-09	5G End-to-end Experimentation by Verticals in EU projects workshop	Intervention at Introductory Panel called: "Key challenges and requirements for 5G experiments with verticals" and at Concluding Panel called: "End to end 5G experimentation across multiple EU projects"
2020-09-11	5G From Theory to Practice (5GToP) Workshop, in conjunction with IEEE 5G World Forum	Presentation overviewing 5Growth project: "Validating 5G in vertical industries: the 5Growth project"
2020-10-14	5G Workshop on "5G Experimentation Facilities and Vertical Trials: Current Status and Future Perspectives" organized by 5GENESIS/NCSR "DEMOKRITOS"	Presentation called "Validating 5G in vertical industries: the 5Growth project"
2020-09-29	CTIF Global Capsule "23rd Strategic Workshop", theme "Sustainable Green Environments"	Presentation called "5G-enhanced verticals: contributions of the 5Growth project into the railways and energy sectors"
2020-09-23	Event organized (Panel) by 5G Solutions project in collaboration with the IEEE ComSoc EMEA region	Presentation called "The Operator Point of View on Transport Network, Not just phone calls and messages where new telecommunication technologies (5G) are hiding?"
2020-10-02	Talk organized by IEEE ComSoc EMEA	Presentation called "Get Smart – The Challenges in Data-Driven Network Management"
2020-11-11	Keynote at IEEE NFV SDN 2020	Keynote called "Serious science and serious engineering - The way of software-based network experimentation"
2020-11-09	Keynote at MOBISLICE III workshop co-located with the IEEE NFV-SDN 2020	Keynote called "Network slicing in practice through service federation"
2020-11-19	Talk at MDPI webinar called "Beyond 5G Webinar"	Talk called "5Growth Network Architectures for 5G and beyond"
2020-12-09	5G PPP TB eWorkshop (industry 4.0 session)	5Growth - Industry 4.0 Low Latency services on a shared Transport Network

2020-12-09	5G PPP TB eWorkshop (Testing: Methodologies and Setup session)	5G EVE & 5Growth: Dealing with App validation, in practice
2020-12-09	5G PPP TB eWorkshop (Integrating Public and Private Networks session)	On the operation of Non-Public Networks – An MNO's perspective
2020-12-09	5G PPP TB eWorkshop (Working on verticals session)	5Growth - E2E Solutions for experimenting 5G vertical services across multiple Platforms and Sites
2020-12-09	Keynote at SBRC 2020	Scaling and Sharing Network Slices in 5G Networks and Beyond
2020-12-11	Talk at the 5G PPP Architecture WG Meeting	5Growth Architecture Design & Innovations
2021-01-11	Presentation at the 5G-VINNI ESB (External Stakeholders Board)	Presentation of the objectives, status and future plans concerning the 5Growth 5G infrastructure and Transportation and Energy use cases.
2021-03-10	Keynote at R2T2: Robotics Research for Tomorrow's Technology 2021	Supporting Industry 4.0 in Next-generation Cellular: The Digital Twin Use Case
2021-03-25	Presentation at the Metromeet'21 conference: "Intelligent Metrology for a Sustainable And Efficient Digital Factory"	5Growth: 5G Metrology for a 5G Industry
2021-03-04	Presentation at 1st SLICES workshop: Next Generation ICT Research Infrastructures	Twinning Networks: On the Use and Challenges of Network Digital Twins
2021-04-08	2nd 5G EVE Learn and Drive	Panelist in the slot on "A great chance for SMEs and startups to boost 5G applications"
2021-04-13	Presentation at Layer123 Europe 2021 Event	Data flow aggregation for smarter network security
2021-04-27	NGIoT Thematic workshop series on IoT and Edge Computing (Session: Part I Industrial IoT and Edge Node Use Cases)	Towards an Autonomous Zero-X manufacturing 4.0: Human-Centred Tactile Manufacturing Intelligence (Talk in panel)

2.2.2. Synergies with Other Projects

Table 11 and Table 12 report collaborative activities with other EU and international research projects (e.g., through 5G PPP working groups, or working groups of other platforms) towards a coordinated action inside the 5G PPP. Additionally, project partners regularly attend meetings and participate in the activities of the 5G PPP working groups, including the steering board and technical board, Pre-Standardization, Vision and Societal Challenges, 5G Architecture, Trials, SME 5G PPP, Software Networks, Security, and Test, Measurements and KPI Validation.

TABLE 11: COLLABORATIVE ACTIVITIES WITH EU AND INTERNATIONAL RESEARCH PROJECTS IN Y1

Item	Explanation
Joint Paper with project 5G-TRANSFORMER @ IEEE Communications Magazine	Service Shifting: A Paradigm for Service Resilience in 5G
Joint Paper with projects: 5G-TRANSFORMER, 5G-MoNArch, 5G-TOURS @ ACM Mobicom 2019	vrAIn: A Deep Learning Approach Tailoring Computing and Radio Resources in Virtualized RANs
Joint Demo with projects: 5G-TRANSFORMER, 5G-MoNArch, 5G-TOURS @ ACM Mobicom 2019	vrAIn Proof-of-Concept — A Deep Learning Approach for Virtualized RAN Resource Control
5G PPP Technology Board meeting	Report 5Growth interaction with ICT-17 platforms
5G PPP Software Network WG virtual meeting	Discussion about our future plan/actions of the WG for 2019-2020
Joint Paper submitted with 5G-TRANSFORMER project @ IEEE ICC 2020	A Q-learning strategy for federation of 5G services
First technology roadmap for advanced wireless, EMPOWER	Roadmap
Joint Paper with project 5G-TRANSFORMER and 5G-Tours project @ IEEE JSAC SI ("Advances in Artificial Intelligence and Machine Learning for Networking")	DeepCog: Optimizing Resource Provisioning in Network Slicing with AI-based Capacity Forecasting
Joint Demo with project 5G MISE Trial in Bari and Matera	Remote Control of a Robot Rover Combining 5G, AI, and GPU Image Processing at the Edge
EuCNC 2020 white paper on verticals. Joint white paper on verticals (5GT + 5Growth + other projects) to be presented during EuCNC 2020.	Empowering Verticals industries through 5G Networks – Current Status and Future Trends
Presentation of the 5Growth project to 5G PPP SN WG	Interaction with other projects of the H2020 5G Infrastructure PPP, 5G PPP SNWG meeting
Brochure for MWC 2020 from 5G PPP Software Network Working Group	Participation of 5Growth project in the MWC'20 brochure of SN WG called: Cloud Native and 5G Verticals' services
Joint demo: 5Growth (ICT-19 project), 5G-CLARITY (ICT-20 project), and 5G-DIVE (EU-Taiwan ICT-23 project) at EuCNC 2020 Booth	"Hybrid eMBB-URLLC network slicing for I4.0"
Joint demo with project 5G-TRANSFORMER at INFOCOM 2020	NFV Service Federation: enabling Multi-Provider eHealth Emergency Services
Joint demo with project 5G-TRANSFORMER at INFOCOM 2020	Arbitrating Network Services in 5GNetworks for Automotive Vertical Industry
5G PPP White paper on edge computing	Contribution on Edge Computing in 5Growth

5G PPP White paper on 5G architecture (consolidated version)	Capturing novel trends and key technological enablers for the realization of the 5G architecture
Joint paper with 5G-TRANSFORMER and 5G-CORAL projects at Elsevier Computer Networks	On the integration of NFV and MEC technologies: architecture analysis and benefits for edge robotics
Joint workshop with 5G-DIVE, co-located with Globecom 2020	Intelligent Fog and Edge Infrastructures for Future Wireless Systems
5G PPP TB eWorkshop (Business model validation session)	Participation in the discussion on business validation with the 5Growth business validation

TABLE 12: COLLABORATIVE ACTIVITIES WITH EU AND INTERNATIONAL RESEARCH PROJECTS IN Y2

Item	Explanation
Joint Demo with project 5G-TOURS @ 5G End-to-end experimentation by verticals in EU projects Workshop	Demo called: "vrAIn: AI-driven orchestation of vRAN resources"
Contribution to 5G IA white paper called "Business Validation in 5G PPP vertical use cases", from "Vision and Societal Challenges Working Group / Business Validation, Models, and Ecosystems Sub-Group"	White paper
Publication of white paper: Empowering Verticals industries through 5G Networks - Current Status and Future Trends	White paper
Joint paper with 5G-DIVE project at MDPI Electronics journal	Paper called: Overview of Architectural Alternatives for the Integration of ETSI MEC Environments from Different Administrative Domains
Participation in the report of 5G PPP Pre-Standardisation Work Group	Report called: "5G PPP Projects Impact on SDO Technical Report"
Participation in the 5GPP TMV working group White Paper on ICT-19 Performance KPIs	White paper name: "Service performance measurement methods over 5G experimental networks"
Joint paper with 5G-DIVE project at IEEE NFV-SDN'20	Paper called: DLT federation for Edge robotics
Joint paper with 5G-DIVE at IEEE Globecom 2020 WS AT5G+	Paper called: An Intelligent Edge-based Digital Twin for Robotics
Joint paper with 5G-DIVE at IEEE NFV-SDN 2020 WS MOBISLICE III	Paper called: "GANSO: Automate Network Slicing at the Transport Network Interconnecting the Edge
Joint paper with MonB5G Project at Transaction on Wireless Communications	Paper called: LACO: A Latency-driven Network Slicing Orchestration in Beyond-5G Networks
EC H2020 5G Infrastructure PPP - PPP T&Ps Summary Table - PPP T&Ps Brochure n°2 - PPP Verticals Cartography	Participation with the pilot called: "5Growth: Industry 4.0 Low Latency use cases on shared Network"
5G PPP projects' brochure to be released early next year.	Phase 3 projects brochure

Joint workshop with 5G-DIVE and Empower	Beyond 5G Evolution
5G PPP White paper	"Delivery to 5G Services to Indoors"
5G PPP White paper	"AI/ML for future networks"
5G PPP TB eWorkshop (Industry 4.0 session)	5Growth - Industry 4.0 Low Latency services on a shared Transport Network
5G PPP TB eWorkshop (Testing: Methodologies and Setup session)	5G EVE & 5Growth: Dealing with App validation, in practice
5G PPP TB eWorkshop (Integrating Public and Private Networks session)	5Growth - "Slice Capability Exposure as an Enabler for NSaaS
5G PPP TB eWorkshop (Working on verticals session)	5Growth - E2E Solutions for experimenting 5G vertical services across multiple Platforms and Sites
5G PPP TB eWorkshop (Integrating Public and Private Networks Session)	On the operation of Non-Public Networks – An MNO's perspective
ETSI ENI PoC #9	ETSI ENI PoC #9: Autonomous Network Slice Management for 5G Vertical Services
Joint webinar with 5G-DIVE	5Growth and 5G-DIVE Research Projects: diferentes acercamientos para el Edge (in Spanish)
Joint webinar with 5G-DIVE	Projetos de pesquisas 5Growth e 5G-DIVE: diferentes abordagens para Edge (in Portuguese)
Joint journal with 5G-DIVE at IEEE Transactions on Mobile Computing	Journal called: Delay and reliability-constrained VNF placement on mobile and volatile 5G infrastructure
Participation in the 5G-VINNI ESB (Extern Stakeholders Board) meeting	The objective, status and future plans concerning the 5Growth 5G infrastructure and Transportation and Energy use cases.
Joint Demo paper with 5G-DIVE at IEEE INFOCOM'21	Demo paper called: "Demo: AIML-as-a-Service for SLA management of a Digital Twin Virtual Network Service"
Joint Demo paper with DAEMON at IEEE INFOCOM'21	Demo paper called: "Demonstrating a Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs"
Joint journal article with 5G-DIVE at Inderscience	Journal called: Monitoring in fog computing: state-of-the-art and research challenges
Joint journal article with 5G-DIVE at Eurasip JWCN	Journal called: Architecture for integrating vertical customer programmability control of network functions and connectivity in a slice-as-a service schema
Joint conference paper with 5G-DIVE and 5G-VINNI projects	Conference paper called: On Slice Isolation Options in the Transport Network and Associated Feasibility Indicators
Joint journal article with 5G-EVE project at IEEE Communications Magazine	Journal called: Public and Non-Public Network Integration for 5Growth Industry 4.0 Use Cases
Joint journal article with 5G-DIVE at Wiley Internet Technology Letters (Special Issue:	Journal called: "Support for Availability Attributes in Network Slices in GANSO"

Mobility support in Slice-Based Network Control for Heterogeneous Environment)	
5G PPP White Paper	"Service performance measurement methods over 5G experimental networks" White paper – ICT-19 performance KPIs
5G PPP White Paper	"Understanding the Numbers Contextualization and Impact Factors of 5G Performance Results"
Joint journal article with 5G-DIVE at IEEE Communications Magazine (Special Issue: Networks for Cyber-Physical Systems and Industry 4.0)	Journal called: "Towards Intelligent Cyber-Physical Systems: Digital Twin meets Artificial Intelligence"

2.2.3. Events Organization

Table 13 reports on the participation of the 5Growth consortium in the organization of dissemination events, which realization happen already during the Y2 of the project.

TABLE 13: 5GROWTH ORGANIZED EVENTS

Date	Item	Explanation
2020-06-09	Joint half-day online workshop with 5Growth, 5G-DIVE, 5G-EVE, 5G-VINNI, and 5G-TOURS	Open virtual workshop in which 5G projects will present their latest results, including demonstrations.
2020-07-09	Powering 5G in industry	Periodical webinar with Layer123
2020-09-10	5G from Theory to Practice (5GToP) Workshop	Co-located with IEEE 5G World Forum 2020, Bangalore, India[13]
2020-11-10	IEEE NFV-SDN 2020	November 10-12, 2020
2020-11-10	Mobislice 2020	Co-located with IEEE NFVSDN 2020
2020-11-19	Beyond 5G Evolution	MDPI Webinar 2020 ()[14]
2020-12-07	Intelligent Fog and Edge Infrastructures for Future Wireless Systems	Co-located with IEEE Globecom 2020
2021-01-12	Webinar called "5Growth and 5G-DIVE Research Projects: diferentes acercamientos para el Edge"	Telesemana Webinar[15]
2021-01-14	Webinar called "Projetos de pesquisas 5Growth e 5G-DIVE: diferentes abordagens para Edge"	Telecom Webinar[16]

[13] https://ieee-wf-5g.org/5g-from-theory-to-practice-5gtop-workshop/
[14] https://electronics-2.sciforum.net/
[15] https://www.telesemana.com/blog/webinar/5growth-and-5g-dive-research-projects-different-approaches-to-the-edge/
[16] https://telecomwebinar.com/webinar/projetos-de-pesquisas-5growth-e-5g-dive-diferentes-abordagens-para-edge/

2021-03-05	Ericsson internal event	Outside-insight program: Factories of the Future

2.2.4. Exhibitions and Technology Demonstrations

Table 14 and Table 15 gather the exhibitions and technology demonstrations performed in different dissemination events in Y1 and Y2, respectively.

TABLE 14: EXHIBITIONS AND TECHNOLOGY DEMONSTRATIONS IN DISSEMINATION EVENTS IN Y1

Date	Venue	Description
2019-10-21	ACM Mobicom 2019	vrAIn Proof-of-Concept — A Deep Learning Approach for Virtualized RAN Resource Control
2020-03-08	OFC 2020	Remote Control of a Robot Rover Combining 5G, AI, and GPU Image Processing at the Edge
2020-06-09	Online workshop with 5G-DIVE, 5G-EVE, 5G-VINNI, 5G-TOURS	vrAIn: AI-driven orchestration of vRAN resources
2020-07-06	INFOCOM 2020	NFV Service Federation: enabling Multi-Provider eHealth Emergency Services
2020-07-06	INFOCOM 2020	Arbitrating Network Services in 5GNetworks for Automotive Vertical Industry

Note that the InnoTrans event was planned to be held the 23rd of September 2020, but it has been first converted to a virtual event postponed to April 2021 due to COVID-19 restrictions, and later cancelled.

TABLE 15: EXHIBITIONS AND TECHNOLOGY DEMONSTRATIONS IN DISSEMINATION EVENTS IN Y2

Date	Venue	Description
2020-07-09	Online webinar Layer123 on Powering 5G in Industry	vrAIn: AI-driven orchestration of vRAN resources
2020-10-12	ACM MobiHoc 2020	Demo: Scaling Composite NFV-Network Services
2020-12-18	ETSI ENI PoC#9	ETSI ENI PoC #9: Autonomous Network Slice Management for 5G Vertical Services
2021-03-10	ETSI ENI PoC#9	ETSI ENI PoC #9: Autonomous Network Slice Management for 5G Vertical Services
2021-03-10	OSM Ecosystem Day	Demo: Vertical's intent evolution at service runtime driving vCDN automated scaling
2021-05-12	INFOCOM 2021	Scaling Federated Network Services: Managing SLAs in Multi-Provider Industry 4.0 Scenarios
2021-05-12	INFOCOM 2021	Demo: AIML-as-a-Service for SLA management of a Digital Twin Virtual Network Service

2021-05-12	INFOCOM 2021	Demonstrating a Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs
2021-06-29	IEEE NetSoft 2021	Slice Isolation for 5G Transport Networks

2.2.5. Bachelor, Master, PhD Theses and Internships

The following table reports bachelor, master, and PhD theses as well as internships on matters related to 5Growth.

TABLE 16: 5GROWTH-RELATED BACHELOR, MASTER AND PHD THESES, AND INTERNSHIPS

Type (PhD/Master/Int.)	State	Title
Internship	Finished	P4 Programmable Traffic Management
PhD	Finished	Development and Performance Evaluation of Network Function Virtualization Services in 5G Multi-Access Edge Computing infrastructure
Master	Finished	AI-based algorithms and experimental evaluation for beyond 5G
Master	Finished	A Machine-learning Approach for Video Streaming Provisioning at the Network Edge
Master	Finished	Machine Learning for 5G/6G Mobile Networks
PhD	Ongoing	AI/ML-enabled Software Defined Smart Networks on Distributed and Next generation Architectures
PhD	Ongoing	Smart Networks and IoT
PhD	Ongoing	Artificial Intelligence Driven Next Generation Networking
PhD	Ongoing	Offloading of 5G functions in accelerated edge data centres
PhD	Ongoing	Virtualized Mobile Services at the edge of the network
Master	Ongoing	A new SDN application providing Quality of Service (QoS) for network slicing
Master	Ongoing	Machine learning techniques for anomaly detection in vertical industries
Master	Ongoing	Machine learning techniques for anomaly detection and resource management in 5G networks
Master	Ongoing	Performance evaluation and design of ML-based solutions for the support of mobile services in 5G systems

2.2.6. Standardization Dissemination

The dissemination achievements related to standardization are listed below:

- Forming a SAC with 5 Standard Development Organizations (SDOs) and 7 open-source Projects.
- Disseminating insights from each SDO and open-source project and identifying relevant Working Groups (WGs) that map with 5Growth Innovations.
- Coordinating standard and open-source activities relevant to 5Growth project.
- Delivering Dissemination plan.
- Delivering standards plan and timeline.
- Delivering open-source plan and timeline.

Details of 5Growth contributions to open-source projects and standardization are provided in Section 2.3.4 and Section 2.3.3, respectively.

2.3. Exploitation

2.3.1. Innovation Radar

The exploitation process is going on according to the plan initially defined. Y1 has been devoted to identifying the innovations from technology carried out in the project and to map them on the products/services previously identified as potential target for exploitation. In D5.2 [6], the mapping of the activity is reported. During the Y2, more concrete activities have been done for the exploitation. In this phase, continuous iteration between technology selection and mapping on product/services has been done based on results carried out in the project. Figure 9 shows the exploitation process.

FIGURE 9: EXPLOITATION PROCESS

Among the innovations described in D6.2 [7], four innovations have been selected for Innovation Radar[17]. They have been selected considering the level of innovation with respect to state of the art, the maturity of deployment reached in the project and the potential impact on products and services. Table 15 reports the list of selected innovations, showing in the column "Partner" the driver of the exploitation (first one), and the other partners who also contributed to the design and deployment of the innovation in 5Growth project.

TABLE 17: INNOVATIONS SELECTED FOR INNOVATION RADAR

N°	Innovation title	Innovation detail	Commercial product platform	Partner
1	IIOT platform (Ingrid) running on an MNO cloud	Intelligent and automatic management of production line	Operations Support Systems in production lines. Ingrid platform[18]	Comau (Vertical) TEI (Vendor) TIM (Operator)
2	RAN Transport aware slicing	Enhanced Network slicing solution Innovation (1)	Ericsson IOT Accelerator[19] Ericsson NFVI[20]	TEI (Vendor) NXW (SME) CTTC (Academia)
3	5G-based solution for remote operation of optical scanning equipment	IoT solution for Public and Non-Public Network interworking	Ericsson IOT Accelerator[21] Cloud Packet Core[22]	ERC (Vendor) CTTC (Academia) UC3M (Academia)
4	Next generation RAN Innovation supporting of virtualized RAN Orchestration	Impacting Vertical Slicer, Service Orchestrator, Resource Layer	NEC O-RAN product portfolio[23]	NEC (Vendor)

2.3.2. Exploitation Activities

In the following, a list of exploitation activities carried out during Y2 is reported for each partner in Table 18.

[17] https://www.innoradar.eu/resultbykeyword/5Growth
[18] https://www.comau.com/en/innovation-and-digital-transformation/ingrid
[19] https://www.ericsson.com/ourportfolio/iot-solutions/iot-accelerator?nav=offeringarea613
[20] https://www.ericsson.com/ourportfolio/digital-services-solution-areas/nfvi?nav=fgb_101_0363
[21] https://www.ericsson.com/ourportfolio/iot-solutions/iot-accelerator?nav=offeringarea613
[22] https://www.ericsson.com/ourportfolio/cloud-core/cloud-packet-core
[23] https://www.nec.com/en/global/solutions/5g/O-RAN_Compliant_5G_Radio_Unit.html

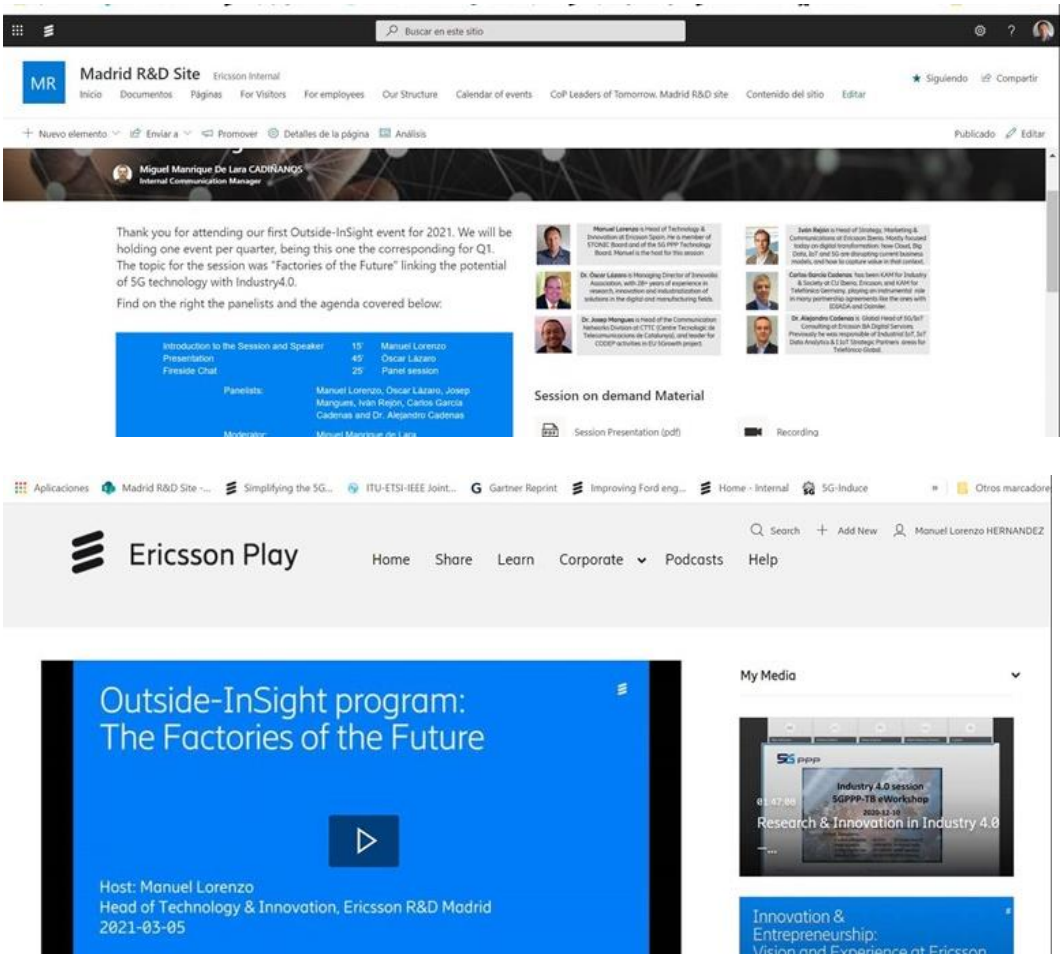
TABLE 18: EXPLOITATION ACTIVITIES IN Y2

Partner	Exploitation Activities
ALB	ALB is expanding SONATA monitoring to verticals integrating monitoring probes into EFACEC_S and EFACEC_E equipment's which can provide closer view and control of the provided 5G QoS. In this second year, ALB also increased its awareness concerning orchestration and management of 5G infrastructures mainly focused on SONATA platform. Moreover, the KPIs collected so far on the context of EFACEC_S and EFACEC_E use cases, as well experience with SONATA platform, reached a very good level, that will enable the next phase of exploitation. It is expected that this technology will give to ALB an important contribution for the design of a new generation of ALB OSSs.
COMAU	For all the three use cases, exploitation activity is going on with Ericsson and TIM. A first concrete result from use case 2 (Monitoring and Telemetry): it has formalized a commercial collaboration between TIM and COMAU about the IIOT monitoring platform. https://www.comau.com/en/innovation-and-digital-transformation/ingrid.
EFACEC_E	The first phase of Energy pilot is in place at IT Aveiro Lab, comprehending Use Case 1 "Advanced Monitoring and Maintenance Support for Secondary Substation Medium Voltage (MV)/ Low Voltage (LV) distribution substation". Preliminary measurements took place to assess the requirements of the 5G communications, and the results obtained so far are on the right track to confirm the feasibility and potential of the proposed use case. Taking this into account, EFACEC_E is considering the development in the short/medium term of a business case including the 5G connectivity service as part of the next generation solutions in its portfolio for the supervision and control of the secondary distribution substations.
EFACEC_S	EFACEC_S is considering improving its portfolio by having a Level Crossing Solution supported by 5G technology. In this context of activities, EFACEC_S and Administração do Porto de Aveiro (Aveiro Harbour) signed a cooperation protocol to assure the implementation and the exploitation of the Transportation Pilot. This opportunity will allow to validate the Pilot in the scope of 5Growth project but also will be a great chance to show and to demonstrate the solution to other Ports and to other infrastructure owners such as IP (Infrastructure of Portugal). The new Level Crossing solution is called XSAFE 3.0. The participation of EFACEC_S in the project is being disseminated internally and externally with specific partners. An internal meeting focused on "Transportation" has been held with a dedicated time slot for the 5Growth activities. The meeting hosted around 150 attendees. Moreover, the goals and achievements of the 5Growth project have been presented and discussed with R&D audience to be included in the R&D project reviews.

INNOVALIA

In this second year, Innovalia developed plans to improve its portfolio by introducing a new capability of remote control of quality control equipment and edge/cloud computing leveraging 5G technology and the 5Growth architecture. Indeed, the development at Innovalia Pilot is aligned with other innovation projects within Innovalia Metrology, such as Boost 4.0. The goal is to obtain a smarter, more connected, more flexible, faster, and automated metrological process with a holistic conception of metrology as a key component of the Zero Defect Manufacturing Process. As a direct output from 5Growth, Innovalia intends to commercialize an improved version of its comprehensive metrological devices and services as an expanded 5G capability for remote control, especially focused to SMEs. In this year, the first 5G powered metrological measurement worldwide was demonstrated, proving the feasibility of the innovation and providing results in line with commercial expectation. This development undergone allows two different types of deployments. A first one, where the 5Growth architecture is used for 5G connection but all the calculations are done within a standardized, secure device, the M3Box, connected in-site between the 5G NW and the PLC controller of the CMM. A second type of deployment eliminates the need of the aforementioned edge device by leveraging the 5G Core capabilities, with virtualized applications in charge of the processing of dimensional data additionally to the 5G connection. These different deployments will allow for a better adaptation to different specificities of manufacturing companies (priority on security, speed, cost reduction, modularity, data sovereignty, etc.). Moreover,

	the virtualization and standardization of the communication and processing opens the door to mere comprehensive, holistic, ZDM strategies. A formal collaboration with Telefonica and Ericsson is being explored for the deployment of these innovations. Finally, the participation of Innovalia Metrology in the project is being disseminated internally and externally (Metromeet 2021, workshops, Advanced Factories, EuCNC 2021 conference). The Innovalia Pilot UC1 is incorporated as one of the continuous innovation features of the M3 SMART CYBER PHYSICAL METROLOGY 4.0 SYSTEM, which has been selected as a 2021 Advanced Factory Finalist for Best industrial equipment for the factory of the future (on the 9th of June the winner will be announced: https://www.advancedfactories.com/awards/premiados-factories-of-the-future-awards/).
NEC	NEC is considering vrAIn solution (the Innovation designed within WP2 for the next generation RAN Innovation supporting of virtualized RAN Orchestration) to be integrated into its O-RAN product portfolio. To this end, several meetings with internal business units have taken place during the last fiscal year. In addition, during Y2 this innovation has been demonstrated in several public conference and workshop events such as ACM Mobicom 2019.
ERC	Ericsson has benefited from testing 4.0 industrial operations over a shared 5G network during Y2 to improve its product portfolio. Ericsson 5G Core products of both Non-Stand Alone and Stand Alone options have been validated, as well as 5G RAN New Radio products such as DOT 4479. The benefits and conclusions of using this testing environment have been shared with key people within Ericsson to be used in the strategic decisions towards the 4.0 industrial services and deployments, in an internal workshop. The workshop, organized by the Head of Technology and Innovation, Ericsson R&D, (Manuel Lorenzo, has been hold on 2021-03-05. Below some details about the event: • Internal event organized by Manuel Lorenzo (Head of Technology and Innovation, Ericsson R&D, Madrid). • Speaker: Óscar Lázaro (INNO). • Guest speaker: Josep Mangues (CTTC) • Panelists (ERC): Iván Rejón (VP Strategy for Iberia), Carlos García Cadenas (Head of Private 5G Solutions for Iberia), Alejandro Cadenas (Head of IoT/5G Consulting) • Audience: Ericsson personnel (of Business Areas: Networks and Digital Services) • Around 70 attendees.



TEI	Ericsson (TEI) expects to benefit from the active participation of Ericsson in 5Growth through the in-field experience gained in the project and thanks to the tight collaboration established with many project partners. The key benefits related to the activity carried out in Y2, identified by Ericsson (TEI) are the following: • Having deployed a concrete pilot in the COMAU vertical premises, in cooperation with the key Ericsson's customer TIM, TEI had the opportunity to test 5G operations in a "private network" setup. Private networks are expected to increase their market value in the Ericsson portfolio as 5G will be deployed in the industrial segment. • In this respect, the functionality of RAN Slicing has been deployed and tested in the COMAU premises to demonstrate a new function in managing vertical use cases that exploit the 5G radio platform. Many of the innovations released in the first project period (Release 1) such as "Support of Radio Access in Network Slices", "Smart Orchestration and Resource Control Algorithms", "Vertical-oriented Monitoring System" are relevant for the realization of the Ericsson NFVI solutions. Innovations provides new inputs for consideration in strategy and portfolio decision processes, for improving our positioning in the market with new added-value features, solutions and services, as well as a broader ecosystem of partners.

	To consolidate learnings and explore opportunities, Ericsson (TEI), COMAU, and TIM has identified three key areas to be further debated in specific thematic seminars and workshops: • The first area relates to the awareness of transport in slicing deployment and operations which attains the specific innovation I1 "Support of Radio Access in Network Slices" identified in 5Growth. To explore this topic, both research and business departments of Ericsson have been involved in an internal seminar, propaedeutic for a specific workshop with partners. This allowed to present the main results of 5Growth project to some customers as technical leadership activity. • A second area relates to the use of the Industrial IOT platform (COMAU's Ingrid) in the operator's cloud. This scenario, that has been deployed in the second use case of the pilot, will be discussed in a specific workshop as it provides promising commercial opportunities for all the partners. • Finally, TEI is organizing an internal seminar, involving both research and market areas, on the topic of transport for low-latency applications. This technological area has been deeply investigated and demonstrated in the pilot and provides significant opportunities especially in scenarios in which a shared transport network shall ensure an adequate latency level providing a tradeoff between required delay thresholds and network cost. As concrete activity on the exploitation internal meeting have been organized to present the main results on the previous topics with the market and business areas of Ericsson and presentation to customers have been done to present high level of technical leadership on the areas. Moreover, on-going activity is devoted for internal workshop with relevant partner for exploitation on product and solutions that are TIM and COMAU as described in Section 3.
IDCC	Through its participation in 5Growth, InterDigital targets the validation through trials of some of its 5G, Video and Sensors technology innovations. These trials conducted in integrated setups with 5G technologies from several partners, including noticeably partners involved in 5G EVE and 5G-VINNI projects, and for use cases and test environments defined by the vertical industry represented in 5Growth, are envisioned to bring valuable technological and business insights that will pave the way for tangible exploitation of InterDigital's innovations.
NBL	NBL is exploiting and extending the concept of slice isolation innovation over P4 programmable switch in some product prototypes internally. And thus, a number of internal meetings within Nokia Bell Labs and with different Nokia Business Units are carried out.
TIM	TIM innovation department offers experience gained in 5Growth internally to engineering, operation departments. Meetings, webinars, training courses are organized internally and for subsidiaries and participates. Yearly meetings and project updates are dedicated to management and stakeholders.
TID	One of the main outputs that TID is focusing for exploitation refers the Data Aggregator. The Data Aggregator supports metadata-based description of data sources and consumers, combined with model-based orchestration of data flows.

	TID has shared the Data Aggregator concept and design with the team working on the internal TID project named "NOM", and held a first coordination workshop. A more in-depth, hands-on workshop is planned for Q3 of this year, including the proposal of a further proof-of-concept to evaluate Data Aggregator integration in NOM.
TELCA	Participating in the development of 5Growth stack and the validation of industry 4.0 pilots has allowed TELCA to gain experience in 5G technology experimentation platforms and benchmarking. This experience has allowed TELCA to expand its 5G services portfolio to include 5G experimentation and benchmarking services. Moreover, a Ph.D. thesis has been defended.
MIRANTIS	The exploitation activity is related to Mirantis OpenStack for Kubernetes and k0s. It has been recently running a webinar on Mirantis OpenStack for Kubernetes[24]. Mirantis introduced Mirantis OpenStack for Kubernetes, which hosts containerized OpenStack, using Kubernetes as a substrate. Traditionally fragile OpenStack components are now containerized services, managed and kept alive by Kubernetes native orchestration — with the cluster state continually re-converged to optimum by Kubernetes operators. Benefits are immediate and substantial: • Simple upgrade processes for every layer of the stack — bare metal host OS, Kubernetes, and OpenStack — that do not interrupt running workloads. Continuous updates delivered by Mirantis are now easily and non-disruptively applicable, keeping your infrastructure more secure and letting you benefit from the latest features and improved performance from upstream. • Greater stability and reliability with reduced OpenStack complexity: replacing complex, layered clustering technologies with native Kubernetes services, deployments, replicasets, and other objects provides much greater reliability and self-healing. Operators continually converge the cluster towards its optimal state, healing around failed services and nodes. • Simple OpenStack cluster scaling: commission or decommission worker and manager nodes in minutes. • Radically reduced administrative overhead due to the inclusion of extensive out-of-the-box automation. • Future-proofing through a long-term Roadmap that includes OpenStack reference architectures for NFV, Edge, and other use-cases as well as intelligent automation.
NXW	The exploitation activities carried out from the project, referred several areas as reported in the following: (i) knowledge transfer to production unit about vertical service modelling, container-based virtualization and orchestration; (ii) integration of re-engineered Vertical Slicer functions in Symphony product to automate its deployment; (iii) knowledge transfer production unit about requirements and orchestration of vertical services in Industry 4.0 context. Moreover, the results of

[24] https://info.mirantis.com/l/530892/2021-04-22/nlfmgn

	the project allow the participation in standardization body (ETSI ENI) presenting PoC about network slicing automation.
UC3M	The syllabus of the 2019/2020 and 2020/2021 editions of the Master on NFV/SDN for 5G networks have been updated to cover the latest updates on 5G technology, benefiting from the activities carried out in 5Growth. Several BSc (4x), MSc (2x) and PhD (2x) theses have been already defended or close to completion, plus some others have recently started. The activities performed in 5Growth in 5TONIC have generated new potential collaborations with other 5TONIC partners for future projects. Exploitation has also been carried out through code developed for the 5Growth platform (available in the 5Growth GitHub repository) and the collaboration in the design of innovations selected for the Innovation Radar.
CTTC	The exploitation activities of CTTC related with 5Growth revolve around the architectural concepts conceived in the various activities carried out (particularly, service orchestration, AIML integration in MANO stacks, improvements on data analysis, scaling, the placement algorithms, path restoration, integration of RAN segments). Their exploitation has been carried out through the code developed (available as open source in the 5Growth github repository), the realization of PhD and master theses, the collaboration in the design of innovations selected for the innovation radar, and more generically, the use of the 5Growth work to generate further collaborations that may materialize in future projects that further extend this work.
NKUA	Several 5Growth's concepts and enablers are already included in the Bachelor course "Software Development for Networks and Telecommunications" and the Master course "Advanced Communication Networks" in the Department of Informatics and Telecommunications of NKUA. Moreover, related to the research activities, all the algorithmic solutions designed and developed under WP2 for the Innovations 8 "Smart Orchestration and Resource Control" and 9 "Anomaly Detection Algorithms", as well as their preliminary results available by M18 are exploited in NKUA's ongoing research activities towards exploiting 5G and beyond principles.
POLITO	The measurement methodology in the COMAU testbed has allowed POLITO to gain great experience in the testing of 5G technology, which will be applied to contracts with industrial subjects from the Torino Wireless ICT Hub. Additionally, POLITO has expanded its portfolio of competences on AI/ML thanks to the activity in 5Growth**.**
SSSA	The activities performed in 5Growth have generated new potential collaborations with many national and international partners for future projects. Moreover, several Master and Ph.D. theses have been already defended or close to completion.
ITAV	The researchers involved in 5Growth have included aspects related to the challenges of verticals' integration into 5G-enabled ecosystems, into their repertoire of training and consultation services. Several aspects discussed within 5Growth have generated new lines of thought with the ability to contribute and define new avenues of research. Some of those concepts are taking shape in the

	form of new research proposals. Some of the concepts researched within scope of the 5Growth project have been addressed in PhD and Master classes.

2.3.3. Patents and Licensing

The 5Growth project addresses an area which provides significant opportunities for patent creation also leveraging on a strong previous background from partners related to 5Growth topics in the form of patents filed by partners before joining the project.

According to the objectives of the project, for the moment, partners have filed two patents, which are listed in Table 19, that may lead to subsequent licensing opportunities, depending on the specific exploitation strategies of the corresponding partners.

TABLE 19: LIST OF PATENT APPLICATIONS REPORTED AT THE END OF Y2

#	Patent Application Title	Partner
1	"A method for anomaly detection of cloud services based on mining time-evolving graphs"	NEC
2	Patent in the area of "Application-aware congestion control"	NBL

More patent applications are currently under preparation.

2.3.4. Open-Source

To maximize the impact of the results, the project released open-source code for each of the building blocks of the 5Growth architecture (i.e., Vertical Slicer, Service Orchestrator, Resource Layer, Vertical-oriented Monitoring System, AI/ML platform, Forecasting Functional Block). Most of the building blocks are released under the Apache 2.0 license, which substantially eases code reuse in other projects. Details are reported in the relevant 5Growth deliverables (e.g., D2.3 [3], D2.4 [4]). The code is available for download at 5Growth GitHub repository[25].

It is worth to notice that SME partners, in synergy with all the other project members, have had a crucial role in developing code and to practically use such deployments in the proofs-of-concept and pilots of the project, which is particularly relevant in the 5Gr-VS and 5Gr-VoMS. Furthermore, there is also a relevant vertical-oriented open-source projects in the domain of industry 4.0 that is led by COMAU.

In addition to the development and open-source publication of the core building blocks, the concepts analyzed in 5Growth have also resulted in multiple contributions to relevant open-source projects, as presented in Table 20.

[25] https://github.com/5growth

TABLE 20: LIST OF CONTRIBUTIONS TO RELEVANT OPEN-SOURCE PROJECTS

#	Item	Explanation
1	e.DO	E.DO is a manipulator created by COMAU S.p.A.. The robot is composed by six joints, the first three for the arm and the lasts for the wrist. Externally, e.DO can be enhanced with user-developed accessories and configurations. Internally, e.DO is ROS-native, open-source control logic gives users complete freedom to create and execute their own programs and applications. To support open-source community around the e.DO platform, Comau has created following web resources for the e.do platform: a) Forum: https://edo.cloud/forums b) Android app: https://edo.cloud/apps c) Source code and binaries: https://edo.cloud/github d) Documents and Datasheets: https://edo.cloud/documents
2	Contribution to networkx graph library	Development needed to use multigraphs. Enhancement of the behaviour of a function retrieving simple paths. The pull request has been recently merged into networkx master branch: • https://github.com/networkx/networkx/pull/3358
3	Contribution to ONOS Repository	Rest Interface for VPLS application (https://gerrit.onosproject.org/#/c/23406/). This extension implements a REST APIs interface for the VPLS app (the one creating the notion of slices in ONOS) that is used for receiving the commands coming from the southbound interface 5Gr-RL.
4	Contribution to ONOS Repository	Improvement of rest Interface for VPLS application (https://gerrit.onosproject.org/#/c/23479/). This extension implements a REST APIs interface for the VPLS app (the one creating the notion of slices in ONOS) that is used for receiving the commands coming from the southbound interface 5Gr-RL
5	Contribution to OpenStack Victoria Release	Multiple commits: • https://www.stackalytics.com/?release=victoria&company=mirantis&metric=commits
6	Contribution to Docker Repository	Multiple commits: • https://www.stackalytics.com/unaffiliated?project_type=docker-group&company=mirantis&date=180
7	Contribution to OSM Repository	Fixing dependencies in Common, NBI and devops gits of OSM project: • https://osm.etsi.org/gitweb/?p=osm/common.git;a=commit;h=4ce854c2cfcdddf4d049ee312182c65832b3f5d4 • https://osm.etsi.org/gitweb/?p=osm/NBI.git;a=commit;h=c3ee9cb2997aa717529e3e8936370084defcfde0 • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=1850e4abd7b58d749443ddc5ca5c2cdbb2d067ca • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=40f63682b2ebda7b6415069e67a00919e9230232 • https://osm.etsi.org/gitweb/?p=osm/NBI.git;a=commit;h=59793fe76a0ee8ac94f120230faaa3b60466458e • https://osm.etsi.org/gitweb/?p=osm/MON.git;a=commit;h=ff4b9f2d85abb98ed7f90833b777a5e91590039e

8	Contribution to OSM Repository	Fixing some dependencies and updating versions: • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=988b7868af92877714dab49ff9d877f55569d39e • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=1563cd24eb1aabf5489054a3c79eb11dd16aa91a • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=c57bb17a62755c240a6d54d21fba4775c1b88c6f • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=ffee4d15520a33596f4653013652a8382d1b02f0 • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=4a64a900816abbd5ebd4d14360b5e153a5959025 • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=845aa5264f928851618f07b6dcc1b28a41069bb6 • https://osm.etsi.org/gitweb/?p=osm/devops.git;a=commit;h=da0e40f9a97f7517c1f4a49d6759f4063078f52

This work has even resulted in public recognition (outstanding technical contribution) of the OpenSource MANO community to 5Growth researchers.

2.4. Standardization

The target for the 5Growth project is 10 adopted[26] contributions to SDOs, such as 3GPP, IETF, ETSI, IEEE, ITU over the lifetime of the project. In the first two years of the project, the project has reported a total of 55 standard contributions where 22 out of 55 contributions are adopted. Regarding ITU, the 5Growth project has contributed with 2 ITU-T white papers. The spread of contributions among the remaining SDOs is as follows:

- 3GPP → Total: 18; Adopted: 14; Overall contribution ratio: 32.7%
- IETF/IRTF → Total: 14; Adopted: 3; Overall contribution ratio: 25.5%
- ETSI → Total: 7; Adopted: 5; Overall contribution ratio: 12.7%
- IEEE → Total: 16; Adopted: 0[27]; Overall contribution ratio: 29.1%

Table 21 and Table 22 provides more details on the status of the standardization effort in 5Growth in both Y1 and Y2, respectively.

TABLE 21: CURRENT SDO ACTIVITIES AND CANDIDATE CONTRIBUTIONS IN Y1

Date	Target SDO	Item/Activity	Status	Explanation
2019-09-16	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-1642-00-00bc-constraints-of-ocb-transmission.pdf	Submitted	This contribution is an analysis of the use of OCB (out of the Context of a BSS) for data frame transmission in .11bc. Does not have a direct matching to a 5Growth task but was needed for .11bc.

[26] adopted/agreed/approved/accepted are used based on the use of SDO-specific terminology.
[27] The adoption process in IEEE takes longer time period compared to adoption process of other SDOs.

2019-09-17	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-1665-00-0rcm-rcm-rogue-containment-use-case.docx	Submitted	Use case presented for the RCM study group on Randomization of MAC addresses. This use case studies the effects of randomization of MAC addresses in rogue AP containment environments. This mechanism may be used in controlled scenarios, such as the I4.0 in order to avoid user created APs to be used in an area with controlled interference.
2019-11-09	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-1978-00-00bc-service-discovery-on-ebcs-info-frame.pptx	Submitted	This contribution proposes a mechanism for service advertisement coupled with group security. The AP is broadcasting a set of eBCS services. Each service is secured by a key. This key is used to proof origin authentication. The proposed mechanism enhances the eBCS Info frame (in charge of distributing the keys to the eBCS clients, so that each Info frame can carry more than one service and more than one key. This technology is relevant for the I4.0 use cases, where different sensors or machines can receive broadcast instructions or software updates, for example, which are authenticated using this contribution.
2019-11-11	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-1978-01-00bc-service-discovery-on-ebcs-info-frame.pptx	Submitted	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically deals with the authentication of the origin of the broadcast, and therefore can be used in critical systems such as the railway scenario.
2019-11-11	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-2017-00-00bc-service-discovery-advertisement.pptx	Submitted	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically handles the way the services being broadcasted in the area are advertised.
2019-11-12	IEEE 802.1CQ	cq-aoliva-statemachineexplanation-1119-v1.pdf	Submitted	Update to IEEE 802.1CQ
2019-11-12	IEEE 802.1CQ	http://www.ieee802.org/1/files/public/docs2019/cq-aoliva-statemachine-1119-v1.pdf	Submitted	Update to IEEE 802.1CQ
2019-11-13	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-2069-01-00bc-update-on-proposed-sfd-text-for-r3-5-3.docx	Submitted	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios.

2019-11-13	IEEE 802.11	https://mentor.ieee.org/802.11/dcn/19/11-19-2069-00-00bc-update-on-proposed-sfd-text-for-r3-5-3.docx	Submitted	Above
2019-11-13	IEEE 802.1CQ	http://www.ieee802.org/1/files/public/docs2019/cq-aoliva-PALMAPAD-1119-v1.pdf	Submitted	This contribution forms part of IEEE 802.1CQ. This standard defines a mechanism to assigning multicast and unicast local MAC addresses to end stations. This is relevant as a way of reducing the cost of sensors which do not need to have a hardwired MAC address. This will potentially impact any scenario using sensors.
2019-11-13	IEEE 802.1CQ	cq-Marks-Oliva-update-2019-11-13-1119.pdf	Submitted	Update to IEEE 802.1CQ
2020-01-08	IETF	https://datatracker.ietf.org/doc/draft-bernardos-raw-use-cases/	Submitted	Relevant to 5Growth due to the inclusion of the I4.0 use case -> This document describes different use cases of interest for reliable and available wireless networks, which is basically deterministic networking for wireless. This is extremely relevant for 5Growth use cases, especially Industry 4.0. This use case is reflected in the document. It is an individual contribution, recently adopted as WG document.
2020-01-08	IETF	https://datatracker.ietf.org/doc/draft-mcbride-edge-data-discovery-overview/	Submitted	This document describes some issues and challenges of discovery data and resources at the edge of the network. This is relevant for 5Growth, as some of the applications considered in our pilots (such as Industry 4.0) might benefit from these mechanisms to optimize the overall performance in automation scenarios.
2020-02-13	IEEE 802.11bc	https://mentor.ieee.org/802.11/dcn/20/11-20-0135-00-00bc-sfd-text-for-section-9-6-33.docx	Submitted	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically handles the way the services being broadcasted in the area are advertised.
2020-03-07	IETF	https://datatracker.ietf.org/doc/draft-ietf-dhc-slap-quadrant/	Adopted	It is relevant for I4.0 use cases, where a massive number of devices need connectivity and might benefit from the local addressing assignment mechanisms described in the draft -> This document describes extensions to DHCP to allow a requester (client or hypervisor) indicate the preference of the type of local address to obtain. This is applicable to 5Growth scenarios, e.g. in Industry 4.0. It is an adopted WG document at the very end of the publication process as RFC.

2020-03-09	3GPP SA5	S5-201596 Rel-16 Study Item "study on non-public networks management"	Accepted	Relevant contribution for 5Growth network slicing mechanisms as means of NPN provisioning in industrial 4.0 scenarios. This is related to D3.1, because the contribution treats the use of slicing (following a NSaaS model) to provisioning public network integrated with NPNs, emphasising the public-private integration. In this sense, it is related with Section 3.4 of D3.1 ("Initial study on ICT-17 integration with 5Growth").
2020-03-09	IETF	https://datatracker.ietf.org/doc/draft-bernardos-dmm-sfc-mobility/	Submitted	In some scenarios, distributed SFC control might be useful to provide extra resilience. This document describes Mobile Ipv6 extensions to enable function migration in distributed SFC scenarios. It is an individual submission.
2020-03-09	IETF	https://datatracker.ietf.org/doc/draft-bernardos-sfc-nsh-distributed-control/	Submitted	This document specifies several NSH extensions to provide in-band SFC control signaling to enable distributed SFC control solutions. This might be applied to some of the 5Growth use cases, to enable extra resilience by supporting distributed control. It is an individual submission.
2020-03-09	IETF	https://datatracker.ietf.org/doc/draft-bernardos-sfc-distributed-control-operation/	Submitted	In some scenarios, distributed SFC control might be useful to provide extra resilience. This document describes a general framework for distributed SFC operation. It is an individual submission.
2020-04-28	IEEE 802.11bc	https://mentor.ieee.org/802.11/dcn/20/11-20-0322-01-00bc-discovery-sta-service-consumption.pdf	Submitted	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically handles the way the services being broadcasted in the area are advertised.

TABLE 22: CURRENT SDO ACTIVITIES AND CANDIDATE CONTRIBUTIONS IN Y2

Date	Target SDO	Item/Activity	Status	Explanation
2020-07-01	IEEE 802.1CQ	Private draft (only voting members)	Submitted	IEEE 802.1CQ draft standard.
2020-07-14	IRTF NMRG	https://datatracker.ietf.org/doc/draft-contreras-nmrg-interconnection-intents/	Submitted	This contribution aims to become one of the use cases of the NMRG for intent-based systems. Its applicability within 5Growth would be related to, on one hand, how verticals can express through intents their slice needs, on another hand, how service providers can express interconnection intents among themselves for achieving those services.
2020-07-20	IETF OPSAWG	https://datatracker.ietf.org/doc/draft-claise-opsawg-service-assurance-architecture/	Submitted	This document addresses the combination of different measurement sources by means of a semantics-aware data aggregator, proposed to be integrated in the IETF SAIN architecture.

2020-07-20	IRTF COINRG	https://datatracker.ietf.org/doc/draft-mcbride-edge-data-discovery-overview/	Submitted	This document focuses on the problem of actually locating data, throughout a network of data servers, in a standardized way. This is again related to 5Growth, due to its potential applicability to the pilot use cases.
2020-09-07	ETSI NFV TST	https://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=58429	Submitted	Support to these work-items as targets for measurement techniques and tools, data aggregation, and the communication of pilot results as proofs-of-concept to ETSI NFV.
2020-09-07	IEEE 802.11bc	https://mentor.ieee.org/802.11/dcn/20/11-20-1418-00-00bc-802-11bc-cc31-resolution-for-cids-assigned-to-antonio.docx	Reviewed	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically removes the use of the Service Advertisement Frame since its use has been added to the eBCS Info frame.
2020-09-07	IEEE 802.11bc	https://mentor.ieee.org/802.11/dcn/20/11-20-1419-04-00bc-802-11bc-cc31-resolution-for-cid-355.docx	Reviewed	This is a contribution to IEEE 802.11bc. We believe IEEE 802.11bc can be used within the I4.0 and Railway scenarios since it can be used to connect low complexity sensors used in both scenarios. This contribution specifically solves a security issue when the AP was advertising no throttling characteristics for eBCS UL traffic.
2020-09-15	ETSI ZSM	https://portal.etsi.org/webapp/WorkProgram/Report_WorkItem.asp?WKI_ID=59231	Accepted	Report of the capabilities provided by OSM, as reference orchestrator for the integration of project innovations at 5TONIC, to support multi-domain closed-loop operations
2020-09-15	3GPP SA5	S5-204463 Rel-17 work item "Management of non-public networks (OAM_NPN)"	Accepted	The interconnection of vertical and ICT-17 facilities is allowing the project to analyze the implications of the integration of non-public networks (NPNs) and public network services to address industrial environment requirements. This is one in a series of contributions related to the concepts and results available.
2020-09-15	3GPP SA5	S5-204465 Rel-17 work item "Management of non-public networks (OAM_NPN)"	Accepted	The interconnection of vertical and ICT-17 facilities is allowing the project to analyze the implications of the integration of non-public networks (NPNs) and public network services to address industrial environment requirements. This is one in a series of contributions related to the concepts and results available.
2020-07-01	ETSI MEC	MEC(20)000258 (must be a member of ETSI)	Accepted	This contribution outlined the E2E architecture framework for an intelligent edge and far edge integrated with an E2E 5G system.
2020-07-01	ETSI MEC	MEC(20)000259 (must be a member of ETSI)	Accepted	This provided a description of the 5Growth I4.0 use case on zero defect manufacturing and the role of edge in supporting this use case.

2020-07-01	ETSI MEC	MEC(20)000261 (must be a member of ETSI)	Accepted	This provided a description of the 5Growth I4.0 use cases involving robots/AGVs and the role of edge in supporting this use case.
2020-11-09	IETF TEAS WG	https://datatracker.ietf.org/doc/draft-llc-teas-dc-aware-topo-model/	Submitted	The relation with the project is to facilitate the joint topological view of both networking and computing resources available. This can be useful for assisting on orchestration decisions in the provider side both single- and multi-domain scenarios.
2020-10-18	3GPP SA2	S2-2005788	Accepted	This provides a solution for low latency switching of user plane functions between MNOs for edge deployments.
2020-10-18	3GPP SA2	S2-2005942	Accepted	This provides service continuity when it is necessary to switch between a private and public network temporarily.
2020-10-18	3GPP SA2	S2-2006257	Accepted	This provides terminal inputs of quality of experience to the data analytics enhancements to improve network performance.
2020-11-15	3GPP SA1	S1-204435	Accepted	This provides a description of switching terminal connections from terminal to terminal to local network via a gateway.
2020-11-15	3GPP SA1	S1-204436	Accepted	This provides a description of switching hosting environments via a gateway.
2020-12-03	IETF	RFC 8948 (https://datatracker.ietf.org/doc/rfc8948/)	Accepted	It is relevant for I4.0 use cases, where a massive number of devices need connectivity and might benefit from the local addressing assignment mechanisms described in the draft. This document describes extensions to DHCP to allow a requester (client or hypervisor) indicate the preference of the type of local address to obtain. This is applicable to 5Growth scenarios, e.g., in Industry 4.0. It is an adopted WG document at the very end of the publication process as RFC.
2020-12-18	ETSI ENI	ETSI ENI PoC #9	Accepted	The PoC will embed algorithms, strategies, and procedures for the composition, sharing and auto-scaling of network slice subnets to build and dynamically adjust the entire set of end-to-end network slices following a closed-loop approach (Task 2.4) to meet service-level requirements, while optimizing the usage of the underlying 5G infrastructure, jointly considering access, core, edge, cloud resources. Such strategies will be fed and assisted by the ENI system, based on short-term and long-term profiles related to resource availability, service and network slice performance, service demands, etc.
2021-02-03	3GPP SA5	S5-211479	Accepted	CAG is a 3GPP mechanism that allows for UE access control in PNI-NPN scenarios. This is relevant for 5Growth use cases.

2021-02-04	3GPP RAN2	R2-2102087	Submitted	This Contributions discussion ultra-reliable communications in a controlled environment like factories using cellular unlicensed spectrum.
2021-02-04	3GPP RAN2	R2-2101509	Submitted	This Contributions discussion ultra-reliable communications with more enhanced QoS requirements like those needed for Industry 4.0 applications.
2021-02-22	IETF	https://datatracker.ietf.org/doc/draft-bernardos-raw-joint-selection-raw-mec/	Submitted	This contribution discusses mechanisms to allow a terminal influencing the selection of a MEC host for instantiation of the terminal-targeted MEC applications and functions, and (re)configuring the RAW network lying in between the terminal and the selected MEC host, filling a gap that would allow to enhance the applicability of MEC technologies in Industry 4.0 scenarios as the ones addressed by 5Growth (in WP3).
2021-03-01	3GPP SA1	S1-210483	Submitted	This contribution applies to the interconnecting of two non-public factory networks (equivalent to residential networks) for minimum user interaction with the gateways.
2021-03-01	3GPP SA1	S1-210484	Submitted	This contribution applies to the interconnecting of two non-public factory networks (equivalent to residential networks) for seamless access between them.
2021-05-13	ETSI	ETSI TR 103 761 V0.0.5 (2021-04)	Draft	The challenges, approaches, methodologies, and tools produced by 5Growth project in WP4 adoption, design and execution of validation activities allows producing guidelines and recommendations for piloting vertical activities beyond the 5G PPP ecosystem.
2021-05-19	IETF	https://datatracker.ietf.org/doc/draft-ietf-detnet-oam-framework/	Submitted	This contribution applies OAM mechanisms for deterministic or quasi-deterministic (reliable and available) operation in wired networks, which is particularly relevant to the Industry 4.0, but also to the other verticals.
2021-05-24	IETF	https://datatracker.ietf.org/doc/draft-ietf-raw-oam-support/	Submitted	This contribution applies OAM mechanisms for deterministic or quasi-deterministic (reliable and available) operation in wireless networks, which is particularly relevant to the Industry 4.0, but also to the other verticals.

3. Update of the CoDEP for the Remaining Period of the Project

Figure 10 illustrates the Communication, Dissemination and Exploitation Plan (CoDEP) of 5Growth, updated to cope with the 3-months project extension. The original CoDEP can be found in D5.2 [6].

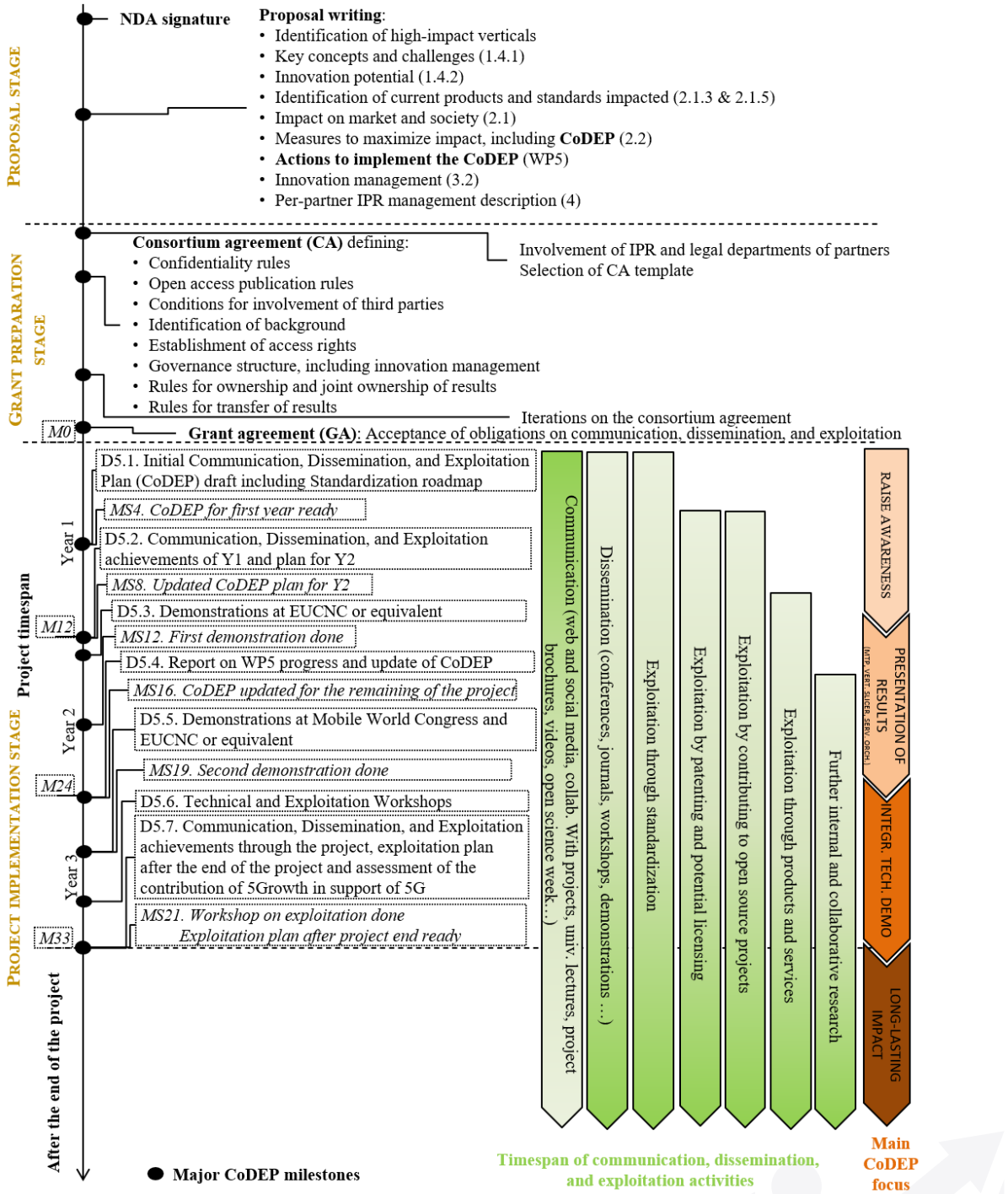


FIGURE 10: UPDATED ILLUSTRATION OF THE COMMUNICATION, DISSEMINATION AND EXPLOITATION PLAN (CODEP) OF 5GROWTH

3.1. Communication

5Growth will continue to target the communication activities detailed in D5.2. Based on the effectiveness of the countermeasures adopted by National and European authorities to reduce the impact of COVID-19 outbreak, 5Growth aims at exploiting live events to communicate the projects results to the general public and to the vertical sectors. However, a hybrid (i.e., online, and live) approach will be followed because of two main reasons: a) the effectiveness of the online approach in reaching a larger audience; and b) the reopening of live events that will likely have a lot of success after such a long lockdown situation.

3.2. Dissemination

This section follows the dissemination plan described in D5.2. For the remaining 9 months of the project, the dissemination activities will be steered towards generating impact through peer-reviewed publications, presentations, talks, demonstrations, panels, workshops, and events (both organization and participation of events targeting particularly verticals). The table below summarizes the targeted metrics for the remaining 9 months of the project. Similar tables have already been provided for Y1 in D5.1 and Y2 in D5.2. In Table 23, the target audience, activity details and timing are kept the same as those in tables D5.1 and D5.2, but the targeted metrics are modified to consider the remaining duration of the project.

TABLE 23: 5GROWTH DISSEMINATION PLAN FOR THE REMAINING 9 MONTHS OF THE PROJECT

Audience	Activity	Timing	Target Metric
Academic and industrial research	5Growth aims at **publishing its work in selected, high-impact-factor journals** and magazines on **communications/networking** (e.g., IEEE Communication Magazine, IEEE JSAC), and reputed international conferences (e.g., ICC, PIMRC, Globecom, CoNext, EuCNC) as well as smaller-scale but highly targeted, including **vertical**-oriented ones (e.g., FIWARE Summit, International Conference on Electricity Distribution – CIRED)). An appropriate balance between academic and industrial awareness will be sought.	Continuous	Average of 5 papers in the last six months.
Other research projects	**Collaboration with other EU and international research projects** (e.g., through 5G PPP working groups, or working groups of other platforms, such as networld2020) will also be key towards a coordinated action inside the 5G PPP and with other H2020 projects related with the vertical industry involved in the project	5G PPP WGs & ad hoc bi-lateral collaboration	Num. of meetings attended (target: at least 1 in the last six months of the project). Num. of joint documents generated (target: at least 1 in the last six months of the project).

Mostly academia, but also industry	**Organization, presentations, and participation in the organization of events** (e.g., panels, targeted workshops, workshops co-located with relevant conferences, special sessions) and participation in these same kinds of sessions as keynote speaker, panelist, etc., thanks to important vendors, technology providers and operators, high-tech SMEs, and reputed academic organizations within the consortium.	Approx. once every six months. One workshop organized	Organization of one 30-people workshop co-located with a major conference (e.g., EuCNC, IEEE WCNC, ICC, INFOCOM) with 70% satisfaction in the workshop quality poll for attendees. Participation in workshops: we measure the number of events (target: at least one for the remaining 9 months of the project), we will measure the metrics (web access, cites) of work presented to measure its impact.
Industry	**Exploitation workshop.** Chaired by the innovation manager and specifically devoted to maximizing the exploitation outcomes of the project in terms of standardization, patenting/licensing, and products and services. Experts on innovation from the various companies representing all industrial sectors already in the project (verticals, operators, vendors, and SMEs and external experts acting as advisors on maximizing the exploitation outcome of the project.	One workshop org. before M30	One 30-people exploitation workshop before the end of the project with 70% satisfaction in the poll for attendees.
Mostly industry, & also academia	**Technology demonstration**. The project team believes that the realization of proofs-of-concept is the key to maximize innovation potential. 5Growth will participate in demonstrations of key project components in exhibition booths in fairs, such as those of EuCNC, or industrial events, such as Mobile World Congress (MWC), where some of the partners have regularly exhibited.	Approx. every 6 months	Technology demonstration in at least 1 event during the last six months of the project. One demonstration deliverable is planned during the project. More demonstrations in several events are targeted.
Vertical industry	**Vertical-oriented demonstration.** 5Growth will participate in vertical-oriented events (e.g., InnoTrans, European Utility Week, CIRED, Int'l Machine Tool exhibition). It will present how the 5Growth platform offers a simple interface that allows verticals to focus on their specific business parameters when requesting service and forget about the underlying deployment process.	Approx. every year	Vertical demonstrations in at least 1 event. One demonstration deliverable is planned during the project, which will include vertical-oriented demonstrations.
Industry	Though being part of exploitation activities, the **participation in standardization** efforts of 5Growth also offers an **indirect way to disseminate the results** of the project to the industrial community. Nevertheless, there are other **non-traditional ways of standardizing (e.g., OPNFV, OpenStack)**, such as	Continuous meetings	Participation in at least 1 open-source project.

	contributing and **publishing open-source software** (part of 5Growth exploitation plan), which may become a de-facto standard.		

3.3. Exploitation plan

3.3.1. Products and Services

The exploitation plan is reported for partner category: verticals, vendors and service providers, network operators, small and medium enterprises (SME), academia and research centers. It is conceived in three main phases, namely short, medium, and long term, as initially reported in D5.1 [5] and D5.2 [6].

Specifically, such exploitation plan will have a concrete impact on products and services for verticals, vendors, and SMEs. The following sections report the target activities for each timeframe, for each type of partner, and also present a table with a specific discussion on exploitation for each partner.

3.3.1.1. Verticals

The 5Growth project is vertical-centric, providing 5G sites and testbeds where verticals can deploy their pilots, experiment, and validate through trials. Three timeframes were originally defined:

- **Short term:** verticals will exploit 5Growth results such as telemetry and monitoring applications; the creation of internal skills inside their companies, to integrate their systems into ICT-17 platforms.
- **Medium term:** verticals will exploit developing augmented worker applications and strengthening their portfolio of solutions.
- **Long term:** verticals with the technology and products developed will expand to new more competitive and demanding markets.

TABLE 24: VERTICAL'S EXPLOITATION PLANS

Partner	Brief Exploitation Plan
COMAU	COMAU aims to test within the project timeline their telemetry and monitoring applications, with a target impact for deployment in 2020, with augmented worker applications for 2021 and with 5G digital twin applications for 2022.
EFACEC_E	The deployment of the pilot carried out in 5Growth will have a strong impact on the future strategy of Medium Voltage (MV) and Low Voltage (LV) power network management, since the use case URLLC and eMBB provide the means to extend the power network real-time supervision and control to the Secondary Substations. The enhancements made in LVS3 (three-phase low voltage sensor) and GSmart (distribution transformer controller) prototypes along the 5Growth project to support the pilot use cases are an important contribution to the technological roadmap of EFACEC's smart grid products and solutions. After the project finishes, these prototypes will be further explored and enhanced in other strategic projects

	and will ultimately result in first series of new generation products for the LV smart grid.
EFACEC_S	The achievements of the Transportation Pilot carried out in the 5Growth project is leveraging a strategy to develop new signaling systems products, positioning EFACEC_S for the new commercial windows over the market of next generation of signaling systems that are under the standardization and digitalization efforts resulted from of the EULYNX consortium project. EFACEC_S intends to certify the new solution with the new protocols (Safe Ethernet). After the project, EFACEC_S will have a certified solution to be used with IP (Cable) or wireless. Therefore, EFACEC_S will replace the analog solution by a certified digital solution.
INNOVALIA	The pilot implementation carried out in 5Growth project is a relevant contribution to the innovative capabilities of Innovalia Metrology's Smart Connected Quality (SCQ) business model proposal. After the project, the pilot will be further developed in other innovation projects publicly and privately funded, resulting in the (likely) first ever commercial Quality Control Equipment with 5G capabilities. This will be a key selling point within the SCQ and M3 Experience environment, enabling for a remote 5G-Connected, quality control service for better human-machine-information interaction and ZDM strategies. This will be further explored at the exploitation Workshop of the Innovalia Pilot.

3.3.1.2. Vendors and Service Providers

Vendors and service providers participating in 5Growth are set to lead the future market of 5G facilities and services by developing novel hardware, software platforms and services. Three timeframes were defined:

- **Short term:** opportunity to get their R&D efforts into focus and evolve their current product portfolio with vertical requirements as input.
- **Medium term:** use findings to understand verticals requirements and needs related to the various vertical markets present on the project, and to identify gaps in 5G End-to-End connectivity platforms in order to develop innovative, flexible solutions that could suit most of the categories of verticals in the consortium.
- **Long term:** exploitation of results by further integrating innovations in their products by interaction with business units and product lines that are in charge of defining product features and related roadmaps.

TABLE 25: VENDORS AND SERVICE PROVIDERS' EXPLOITATION PLANS

Partner	Brief Exploitation Plan
NEC	5Gr-Resource Layer´s (RL) traffic management schemes, being developed in the scope of WP2, are inspiring new features to enhance the performance isolation to support slicing in iPASOLINK VR products and iPASOLINK EX products. Moreover, 5Gr-RL´s abstractions on the transport side have steered the evolution of WizHaul product family. The solutions carried out on Vertical Slicer of 5Growth is being integrated into the NEC RAN slicing product portfolio and being further enhanced to support virtualized RANs. In addition, the innovation of vrAIn for the next generation RAN

	developed in 5Growth WP2 will have an impact on the integration of O-RAN-like interfaces for the virtualized RANs support and exploited in NEC O-RAN product portfolio (vRANs).
ERC	5Growth will carry on being an excellent environment to test RAN and Core products and features such as slicing along with computing edge solutions, contributing to the enhancement of the products by our Product Development Units. The improved products and features will ultimately be used in commercial deployments that will meet verticals and telecommunication operators requirements. The further work on monitoring and automation will be valuable for standardization work groups and new research.
TEI	In this landscape, TEI intends to exploit 5Growth results to further validate and evolve the 5G portfolio and the IoT solutions (IoT Accelerator) by leveraging on the experience gained in the field-trials that are in the scope of the project. In particular, validation of the 5G technology potential performances and features (including slicing) in the realistic environments foreseen by 5Growth will be an important asset for TEI to be advertised towards customers to demonstrate the potential for take-up in the selected vertical applications. Ericsson Customer Units will also be involved to convey project outcomes towards customers. 5Growth has also been an excellent testing environment to validate the integration of radio and transport for the specific needs of vertical services. This is particularly significant for TEI as the research on transport, and the related product R&D, is in the Italian sites of Ericsson. This provides a smooth pathway for feeding project results in a possible product enhancement. Finally, it worth to notice that 5Growth has provided the opportunity to put in operation software modules dedicated to the orchestration of radio, transport, and cloud thus providing a unified orchestration framework supporting services and resources through their lifecycle, from planning to closed-loop automation. This paradigm is particularly interesting for the Ericsson Orchestrator commercial platform which main goal is it to provide End-to-end service orchestration for both network operators and enterprise environments. Here the exploitation opportunity is to convey specific functionalities inside the product dimension starting from the in-field demonstrations deployed in 5Growth.
IDCC	The exploitation routes foreseen by InterDigital include but are not restricted to (i) identify new study items/use cases and contribute to the global standards development organizations namely 3GPP, ETSI and IETF; and (ii) enhance/extend the already available pre-commercial proof-of-concepts to lead to commercial products. 5Growth has been and will be used to enhance technology solutions/features to provide vertical-specific and mobile network operator-specific requirements. InterDigital plans to continue to 5Growth integrated setup to exploit/showcase real-world trials and demonstrations in live networks with commercial equipment available on the market.
NBL	Nokia plans to exploit its participation in 5Growth in multiple dimensions: • Nokia will use the results of the 5Growth project, with patented innovations and pre-commercial proof-of-concepts, to evolve the current end-to-end product portfolio on: (i) mobile, fixed and converged broadband access (AirScale C-RAN, Airframe, Altiplano, Lightspan); (ii) orchestration solutions (e.g., CloudBand Network Director, Digital Operations Suite), towards automated service life-cycle

	management solutions facilitating network slicing in multi-vendor / multi-operator environments, fully supporting the requirements as set out by the verticals. • The end-to-end testbed that is based on the proof-of-concepts developed in the project has proven to be successful in some NBL's internal projects. Therefore, it has been re-deployed in more than one NBL sites to facilitate the research and development of NBL. • The core idea of programmable user-plane traffic management is planned to be introduced into NOKIA's RAN segment product portfolio. • Nokia will share insights of 5Growth with telecom operators who already use the Nokia ecosystem for current end-to-end life-cycle management of 5G services, with regards to orchestration and programmable forwarding plane solutions. • Nokia might contribute certain project outputs to the relevant industry communities focused on network programmability, in the form of source code to the open-source projects like P4. The plan is to continue to use the end-to-end testbed that is based on the proof-of-concepts developed in 5Growth within some NBL's internal projects, and re-deployed in more than one NBL sites to facilitate the research and development of NBL. The core idea of programmable user-plane traffic management is planned to be introduced into NOKIA's RAN segment product portfolio. Further on, Nokia will further disseminate the project results through its involvement in global standards development organizations, such as IETF, ETSI, 3GPP, etc.

3.3.1.3. Network Operator

Network operators will evaluate how to best fulfill the requirements and offer service to various vertical industries over their network, as well as how to shape their relationship with them. Three timeframes were defined:

- **Short term:** foresee a direct enhancement of their 5G experimentation and demonstration facilities, extending them to meet vertical requirements, ultimately consolidating their position as a global reference for the evolution of 5G.
- **Medium term:** operators will gather the know-how for the planning and design of future 5G networks.
- **Long term:** operators will apply the experience gained during the validation of 5Growth scenarios to contribute to the definition of 5G services for their industrial.

TABLE 26: NETWORK OPERATORS' EXPLOITATION PLANS

Partner	Brief Exploitation Plan
TIM	The experience gained in 5Growth Pilots will allow TIM to evaluate the possibility of providing 5G services of Operation Support Systems for monitoring and diagnostics of industrial production machinery – even remotely – and improving maintenance and assistance needs using preventative and predictive systems. Specifically, the use cases developed and experimented in 5Growth will target the innovative networking platform to provide such services. The use of 5G and the Edge cloud will allow the interconnection and remote management of industrial plants, ensuring greater efficiency, reliability and

	security than with traditional networks. Moreover, TIM will exploit 5Growth innovations to create vertically integrated platforms according to national development strategies accelerating the adoption of Internet of Things-based solutions. Additionally, TIM plans to exploit 5Growth to create vertically integrated lab platforms to showcase business opportunities related to 5Growth innovations for new potential collaborations with other partners for future projects or with beta customers. Finally, the participation in the project will allow TIM to follow more effectively the activities of the standardization bodies addressing service models, functional architectures, and interfaces (e.g., ETSI, ITU, 3GPP, GSMA).
TID	TID planned to exploit the Data Aggregator concept and design. As follow up of a first workshop already held, it has defined for more focused workshop to be held in Q3 of 2021. Moreover, the plan is realizing a further proof-of-concept to evaluate Data Aggregator integration in the internal TID project "New Operating Model" (NOM).
ALB	The network management solution developed in 5Growth is shaping the requirements and architecture of City Catalyst project. Demonstrators to validate City Catalyst solutions in the fields of energy, mobility and governance will be implemented in 5 Portuguese cities: Porto, Aveiro, Guimarães, Famalicão and Cascais. These decisions are taken in ALB internal meetings (weekly) that have the objective to better address exploitation activity by sharing projects results, plan and criticality with the relevant organizations.

3.3.1.4. Small and Medium Enterprises

SMEs plan to evolve their products in their specific fields of interest. Two timeframes were defined:

- **Short term:** SMEs will exploit from the technology created from 5Growth in contributing to open-source projects and training courses on SDN, NFV, MEC architectures and cloud platforms.
- **Short/Medium term:** SMEs could design novel concepts, inspired by 5Growth results to feed-back their product portfolio, which will foresee in the long term an increase in their competitiveness for consultancy services.

TABLE 27: SMALL AND MEDIUM ENTERPRISES' EXPLOITATION PLANS

Partner	Brief Exploitation Plan
MIRANTIS	The activity carried out in 5Growth is expected to have a relevant impact on the new generation of the product - MOSK - Mirantis OpenStack on Kubernetes. This could potentially improve the platform reliability and time to market index, and it can simplify the management. Moreover, the activity will impact on k0s platform.
NXW	Based on on-going exploitation activity on Symphony components, some components have been virtualized and deployed in containers. Moreover, using as baseline the 5Gr-VS carried out in 5Growth the plan is to automate the orchestration of these Symphony software modules within eMBB and URLLC network slices, dedicated to the video-surveillance, media and A/V services, and to domotics services respectively. Leveraging the experience built in 5Growth activities on Industry 4.0 pilots, the company is also extending the Symphony platform for its deployment in smart factory contexts. The original training courses have been extended to cover new technical areas specifically related to 5G networks, orchestration solutions specialized

	for edge computing and AI/ML technologies applied to closed-loop network automation.
TELCA	Telcaria foresees to exploit from 5Growth project, the experience of developing some key components in 5Growth, to acquire the know-how of integrating components from different domains into a common platform, to monitor and configure pilots end-to-end. In the short term, Telcaria expects to exploit 5Growth monitoring platform and performance isolation innovations by integrating similar solutions into its product portfolio, required by the increasing necessity of gaining better insights, guaranteeing quality of service, and improving the decision-making mechanisms. Moreover, in the medium term, the experience gained from the 5G pilots is of significant value for strategic consulting and trials for new services that Telcaria could offer. Finally, in the wake of the 5Growth project success, Telcaria has hired new employees, and also motivated current employees to develop their professional careers by pursuing a Ph.D., which impacts directly in the quality of the products and services Telcaria offers to its clients worldwide.

3.3.1.5. Academia and Research Centers

The Universities and R&D centers participating in the 5Growth consortium are interested in building on and further developing existing research strength in the networking research community. Two timeframes were defined:

- **Short/Medium term:** academia will improve the knowledge in 5G, multi-domain orchestration and slicing, transferring it to the industry.
- **Medium/Long term:** the patent and license rewards will help to undertake future European and international research, which will contribute towards further collaborative research possibilities with the project partners and others.

TABLE 28: ACADEMIA AND RESEARCH CENTERS' EXPLOITATION PLANS

Partner	Brief Exploitation Plan
UC3M	UC3M plans to exploit 5Growth to transfer the technology to large industrial partners and SMEs, with particular emphasis on companies located in the technical business park "Parque Científico Leganés Tecnológico". In addition, UC3M forms part of the 5TONIC laboratory and plans to use the results of this project in order to find exploitation opportunities for spin-offs in collaboration with other 5TONIC. The activities performed in 5Growth in 5TONIC have generated new potential collaborations with other 5TONIC partners for future projects.
CTTC	As a non-profit research institution with strong ties to both academia as well as industry, CTTC will extend its academic activities and transfer knowledge to larger communities, specifically the ones directly involved in topics related to the 5Growth project. More specifically, as a main developer of the open-source Service Orchestrator, CTTC has contributed to the open-source community by creating two repositories CTTC MESCAL and ELECTRA. At the same, the CTTC is also involved in AI/ML platform development that will be exploited in other projects. CTTC also plans to exploit the activities performed within 5Growth in future research and industrial-oriented projects with large

	industrial partners, SMEs, and universities within the 5G and their vertical-oriented ecosystem. The research activities performed in 5Growth generated new potential collaborations with other partners for future projects related to 5G, AI/ML and vertical integrations. CTTC is also planning to exploit the development and vertical integration activities to extend their research activities, build new experimentation platforms for both AI/ML enabled and 5G and beyond activities. In addition, CTTC's plans are also focused on enhancing its Ph.D. training program using project results, to transfer the acquired knowledge to the industry, after the completion of the students' theses.
ITAV	As a public-private entity with strong ties to both academia as well as industry, ITAV will extend its portfolio under the context of consultation services offered by its researchers, specifically the ones directly involved in the 5Growth project. Such activities involve training and consultation services, which can be provided to partners, industrial and other types of entities, involving the concepts developed and progressed within 5Growth. ITAV will capitalize on the knowledge gained within the 5Growth project, both in regard to the technical innovations made over the base 5G ecosystem as well as in the vertical integration within these environments, to pursue research funding initiatives and projects.
NKUA	NKUA will extend the relevant Bachelor and Master courses by including several 5Growth's concepts and enablers, as well as algorithmic solutions developed by NKUA under WP2 to exploit evaluation results. NKUA will exploit 5Growth's results by combining the outcomes of the development, in which NKUA is actively involved or leading, with its ongoing research developments.
POLITO	POLITO will actively seek to exploit the expertise acquired in 5Growth by partnering with local SMEs with the support of the Torino Wireless ICT hub. Creation of new companies that can benefit from the 5Growth experience will be fostered through I3P, the Innovative Enterprise Incubator of POLITO
SSSA	SSSA plans to exploit 5Growth to transfer the technology to large industrial partners and SMEs. In addition, SSSA is planning to exploit part of the knowledge developed during 5Growth within national and regional projects. Finally, SSSA is planning to leverage the acquired knowledge to seek funding through regional, national and European calls. An example is the recent submission of proposal to the national call of National Interest Project (PRIN) issues by the Ministry of University and Research.

3.3.1.6. Exploitation Plan of Products and Platforms for Vendors, SMEs and Verticals

In the following table, a detailed description of the platform and products for vendors, SMEs and verticals according to the exploitation plan, is reported.

TABLE 29: EXPLOITATION PLANS OF PRODUCTS AND PLATFORMS FOR VENDORS, SMES AND VERTICALS

Short Name	Platform/ product	Description of impact on platform/product	5Growth component
ALB	Operations Support Systems portfolio	This portfolio is currently in the process of evolution to a new generation of OSS systems, which will benefit from lessons learned about orchestration and management of	Vertical Slicer/ Service Orchestrator

		5G infrastructure through the development and evaluation of the EFACEC use cases.[28]	
COMAU	Operations Support Systems in production lines	5Growth 5G Pilots will allow COMAU to evaluate the evolution of its Operation Support Systems in production lines towards 5G. Specifically, use cases developed and experimented in 5Growth will target the innovative networking platform.[29]	5G Pilot
EFACEC_E	ScateX# ADMS, GSmart & LVS3	A current main concern to EFACEC is the competitiveness of its products and systems. The 5Growth project results will allow EFACEC to strengthen its portfolio of solutions for Smart Grids by adding innovative communications features to the products' configuration options. The major benefits will impact on EFACEC's portfolio for Smart Grids' applications integration and deployment, a set of solutions designed to implement flexible management and monitoring over an entire smart electrical infrastructure, including high-level platforms with management software and web user interfaces, smart meters and sensors, data concentrators and distributed controllers, or any other type of IP capable device.[30]	5G Pilot Vertical Slicer/ Service Orchestrator
EFACEC_S	DigiXSafe	The outputs carried out in the project related the development of new signaling system products will open new commercial windows over the market of next generation of signaling systems that are under the standardization and digitalization efforts resulted from of the EULYNX consortium project[16] and Shift to Rail Join Undertaking.	5G Pilot
INNOVALIA	Metrology Software M3	The participation of INNOVALIA in the 5Growth Project will allow the extension of its portfolio of products and services offering not only the remote control of its Quality Control Equipment but also a decision support system based on the Augmented Reality to achieve the strategy of Zero Defect Manufacturing (ZDM) using the MEC to reduce the processing time of the captured data. The impact will be directly located in the Metrology Software M3 offered by Innovalia Metrology.[31]	5G Pilot
ERC and TEI (Ericsson)	IOT Accelerator	Ericsson IoT Accelerator is a platform to develop market and manage secure IoT solutions. IoT Accelerator can benefit from the experience gained in 5Growth in relation to the IoT pilots and relevant use cases and possibly can	Vertical Slicer, Service Orchestrator, Resource Layer

[28] http://www.alticelabs.com/en/operations_support_systems.html
[29] https://www.comau.com/en/innovation-and-digital-transformation/ingrid
[30] https://www.efacec.pt/en/automation/
[31] https://www.innovalia-metrology.com/metrology-products/metrology-software/

		incorporate functionalities that could emerge from the vertical partners in the consortium.[32]	
	Cloud Packet Core	Especially driven by the expected verticals cooperation's and experimentation in the 5Growth project pilots, the Cloud Packet Core platform can be enhanced especially in relation to Massive IoT support (Introducing network slices for massive IoT with a decoupled lifecycle from consumer eMBB service) and support of enterprise with dedicated instances for critical enterprise deployments, like manufacturing sites.[33]	Service Orchestrator, Resource Layer 5G Pilot
	Ericsson NFVI	Ericsson NFVI solution consists of software and hardware products as well as support and system integration services forming a complete solution for telecom operators. 5Growth can bring important elements to the platform, both in the resource layer aspects, being hardware products part of the NFVI solution, and in orchestration and virtualization functionalities. RAN-Transport solutions under definition in 5Growth projects, are under discussion internally to Ericsson for analyzing possible impact on product. Now, it is necessary a more consolidated assessment in PoC and experimentation, but the joint cooperation with Telefonica and TIM are considered as valuable feedback for future deployment in products.[34]	Vertical Slicer, Service Orchestrator, Resource Layer
IDCC	360-Degrees Adaptive Viewport Video Streaming over 5Growth	The platform showcases the concept of microservices-based design by distributing several computing tasks necessary to deliver a high-resolution 360 video streaming service to terminals with different resources and capabilities. This platform will be enhanced in 5Growth by incorporating 5Growth vertical slicer and resource layer, with the goal of demonstrating the impact of these two key components in terms of latency reduction and advanced scalability.	Vertical Slicer, Resource Layer
MIRANTIS	Mirantis OpenStack on Kubernetes (MOSK)	MOSK - Mirantis OpenStack on Kubernetes. This product leverages on the container isolation, state enforcement, and declarative definition of resources provided by Kubernetes to deploy and manage OpenStack clusters.	Resource Layer, 5G Pilot
	K0s, which is, Mirantis Open-Source product.	k0s is the simple, solid & certified Kubernetes distribution that works on any infrastructure: public & private clouds, on-premises, edge & hybrid. It is 100% open source & free.	
NEC	iPASOLINK VR Family	NEC iPASOLINK VR family (microwave backhaul): The iPASOLINK VR delivers enhanced wireless signal processing performance. The design of Resource Layer abstractions	Resource Layer

[32] https://www.ericsson.com/ourportfolio/iot-solutions/iot-accelerator?nav=offeringarea613
[33] https://www.ericsson.com/ourportfolio/cloud-core/cloud-packet-core
[34] https://www.ericsson.com/ourportfolio/digital-services-solution-areas/nfvi?nav=fgb_101_0363

		and interfaces with data-plane equipment will directly impact the potential evolutions of this product family.[35]	
	NEC iPASOLINK EX family	In a lightweight, compact 23cm squared enclosure, iPASOLINK EX Advanced realizes industry-leading 10Gbps single link capacity features. The design of Resource Layer abstractions and interfaces with data-plane equipment will directly impact the potential evolutions of this product family.[36]	Resource Layer
	WizHaul (Transport resource management)	SDN/NFV-based centralized resource management orchestrator for mobile transport domains. 5Growth novel orchestration algorithms for monitoring and prediction and automated closed-loop resource management will have a potential impact on the evolution of this product.	Service Orchestrator, Resource Layer
	OVNES (Network slice broker)	The 5G Network slice broker is a piece of software integrated on a network controller or orchestrator. It acts as a mediator between tenants' slice requests and physical network resources availability. 5Growth novel orchestration solutions for SLA monitoring and management and automated network slice management will have a potential impact on the evolution of this product.	Vertical Slicer, Service Orchestrator
	Net2Vec	Net2Vec is a flexible high-performance platform that allows the execution of deep learning algorithms in the communication network. The monitoring platform of 5Growth and its interfaces with high-speed data processing platforms can have an impact on the evolutions of this product.	Monitoring platform
	NEC O-RAN product portfolio (vRANs)	Next generation RAN Innovation supporting of virtualized RAN Orchestration.	Vertical Slicer, Service Orchestrator, Resource Layer
NBL	Mobile, fixed and converged broadband access	The outcome of 5Growth is also expected to impact significantly NOKIA's software-defined access solutions on mobile and fixed access networks. It is foreseen the potential adoption of suggested 5Growth enhancements on programmable traffic management schemes, in NOKIA access nodes. A domain-specific language such as P4 will be adopted for this purpose and extended appropriately to allow programmability independently of the access technology employed, thus impacting NOKIA's entire mobile and fixed access product portfolio.	5G Pilot, WP2 innovations
	AirScale Cloud RAN	The AirScale Cloud RAN solution consists of the AirScale Cloud Base Station Server and the Nokia AirScale Radio Network Controller (RNC). The 5Growth innovation on	Vertical Slicer, 5G Pilot

[35] http://www.nec.com/en/global/prod/nw/pasolink/products/ipasolink_VR4.html
[36] http://www.nec.com/en/event/mwc/leaflet/pdf_2017/i_pasolink_ex_advanced.pdf

		programmable traffic management at the RAN is expected to complement the innovations for this product suite.[37]	
	Cloud and Edge Computing Nokia AirFrame DC	The Nokia AirFrame Data Center solution offers a flexible range of data center infrastructure portfolio. 5Growth research on tools for closed-loop control, such as programmable traffic management schemes, can be potentially adopted to improve future offerings in the Nokia AirFrame Data Center.[38]	Vertical Slicer
	Digital Operations Suite	The DO Suite provides and agile and modular orchestration for managing service orchestration across virtualized and hybrid networks. It is expected that 5Growth enhancements to the Vertical Slicer and Service Orchestrator (e.g., algorithms for arbitration across coexisting services, service utilization demand forecasting for appropriate vertical service dimensioning, service decomposition etc.) can steer DO innovation.[39]	Vertical Slicer, Service Orchestrator
	CloudBand Network Director	CloudBand Network Director is an NFV resource and network service orchestrator, built for OpenStack and VMware. It provides two main functions. As a network service orchestrator, the system onboards network services, automates their lifecycles, and provides monitoring and troubleshooting tools. As a resource orchestrator, it administers, monitors and optimizes NFV infrastructure resources across geographically distributed NFV infrastructure) nodes. 5Growth innovations pertaining to SLA-driven service management automation, resource allocation algorithms, automated optimization and self-* properties, etc., are expected to impact the (future) list of features of the CloudBand Network Director.[40]	Service Orchestrator Resource Layer
NXW	Symphony	Symphony is an integrated and open platform for smart buildings, including domotics, media services, A/V communications, video-surveillance, energy management, etc. The adoption of the resource virtualization combined with Vertical Slicer will allow evolving Symphony towards an integrated set of virtualized and distributed services able to exploit 5G technologies to improve the scalability and simplify the automated deployment and customization of the system in wider environments, towards smart city solutions.[41]	Vertical Slicer

[37] https://networks.nokia.com/solutions/airscale-cloud-ran
[38] https://networks.nokia.com/solutions/airframe-data-center-solution
[39] https://networks.nokia.com/portfolio/service-orchestration
[40] https://networks.nokia.com/products/cloudband
[41] http://www.nextworks.it/en/products/brands/symphony

TELCA	Alviu	Alviu is a flexible and resilient control system that enables the integration of cloud and network services through a centralized and dynamic administration. On top of this, it reduces equipment expenses and offers a wider range of White Box Switches to enterprises. The innovations of 5Growth vertical slicer and service orchestration will impact directly on how Alviu slices and manages network infrastructure.[42]	Service Orchestrator, Vertical Slicer

3.3.2. Patents and Licensing

The 5Growth project addresses an area that provides significant opportunities for standard essential patents. All partners are committed to producing European IPR as an important channel for exploiting project outcomes. Partners have declared a strong background of over 40 patents related to the 5Growth area. At least 5 patents are expected to be filed during the project lifetime, out of which two have already been filed (see Section 2.3.3).

It has to be considered that, after submitting a patent application, it typically takes about one to three years to get a grant, sometimes significantly longer. It is also common to file additional divisional/continuing applications several years after the original filing. This means it can take several years before the final protection scope is known, and the time may vary significantly.

Manufacturers can also use patented systems or patented methods in products of their portfolio. In this case, the patent department inside the company typically activates continuous monitoring of possible infringement typically targeting main competitors operated on the same market segment. Infringement detection and the relevant legal contention can also bring to additional revenues from the invention.

Finally, patents may lead to subsequent licensing, depending on the interests of the partners in exploiting their inventions for their products/solutions or by selling the license to third parties leveraging on licensing revenues. The licensing options is also possible for patents filed by academic institutions in the consortium.

3.3.3. Plan for Exploitation Workshops and Other Activities

According to the plan, the next 9 months will be devoted at completing the last phase of the exploitation process that aims at promoting the innovations to the various stakeholders.

Each owner of the innovations must define a plan for an internal workshop with relevant stakeholders (e.g., marketing/business department) to present the main outputs of the project and to discuss concrete actions that enables exploitation.

[42] https://www.telcaria.com/#serviceModal1

In addition, a workshop is planned to provide some concrete and public results about exploitations of the main outputs carried out in the project. It will be organized jointly with 5G-DIVE project[43] before November 2021.

According to the initial plan, the planning of the exploitation workshops will be concluded in November 2021.

Pilot / Partner	Description
COMAU PILOT (TEI, TIM, COMAU)	As reported in Section 2.3.2, TEI, jointly with TIM and COMAU, identified three main areas for innovations and is organizing internal workshops. The plan agreed to hold the workshops in June with possible follow up. Such workshops will involve all the business and market department from the main stakeholders of the pilot (TIM, COMAU, TEI) that shared a business model perspective as reported in WP1.
INNOVALIA PILOT	Upon completion of the validation, on Innovalia premises, of the several use cases involved in the Innovalia pilot, expected by November 2021, a dedicated workshop involving all participant partners shall be held, analyzing the main conclusions of the experimentation and the status of maturity achieved and exploitability potential of the major involved building blocks (technologies, products and services) after the project. Also, this collective meeting is expected to spawn in-depth bi- and multi- lateral meetings for fostering further lines of cooperation in and beyond the original scope of the project.
EFACEC_E PILOT	EFACEC_E, ALB and ITAV jointly planned two workshops to be held in November 2021. The proposed structure for these workshops follows below: 1. The first workshop will be hold on November 2021, as Online, and is organized for the Technology departments at Efacec Energia and Altice Labs. The objective of the workshop is to showcase the technological contributions and achievements of integrating key 5G mechanisms into solutions belonging to the Energy Sector. 5G has brought an extensive set of new tools, going beyond just incremental performance increases, that are able to readily benefit and improve vertical users at different degrees. Some of those verticals, need to take an extra step in transitioning from closed or dedicated communication technologies, and move into the capital and operational benefits of flexible mobile network 5G deployments. This workshop presents, explores, and discusses different viewpoints on the technical capabilities made possible by integrating 5G mechanisms in existing technological solutions of the Energy Sector. Challenges, lessons learnt, and performance improvements are showcased in different levels, considering both 5G link and cloud virtualization perspectives. 2. The second workshop, planned for November 2021, has as target audience the Business Development departments at Efacec Energia and

[43] https://5g-dive.eu/

	Altice Labs. The objective is to analyze how the performance and flexible capabilities of 5G can produce and sustain new business opportunities. This workshop will illustrate how 5G can deliver as an underlying tool for generating new use case scenarios, allowing for a broader reachability of Energy Sector solutions and products. Discussions involving technological service providers and verticals of different sectors will be held, presenting proof-of-concept realizations of new experimental use cases of the Energy Sector, based in 5G, as well as lift the veil on further possibilities.
EFACEC_S PILOT	EFACEC_S planned a workshop to be held in the end of November 2021 in the Aveiro Harbor facilities, the place where the Transportation Pilot is being deployed. This solution allows to invite not only the partners of this project but also other Port entities and relevant stakeholders from Railways and Metro business.
TID	TID planned to organize a workshop for Q3 of 2021, to better address the exploitation related to the Data Aggregator.

3.4. Standardization

This section is based on the standardization plan described in D5.2, and in particular, in accordance with the three objectives set for the standardization activities by the Standard Advisory Committee (SAC). For convenience, these three objectives are listed below.

1. Create and maintain a project standardization activity roadmap. This roadmap will capture the standardization activities that may influence or get influenced by the project's technological innovations. It will keep track of existing or upcoming industry specifications or recommendations that may affect the project's technological choices and identify opportunities for the project to contribute its proposed solutions to present and future standardization groups.
2. Disseminate the project into the standardization forums to raise awareness and help create an opportunity for standardization exploitation.
3. Contribute through the partners (individually or jointly) with project-related technology proposals into the relevant standardization forums.

During the first two years, the project has achieved an outstanding dissemination outcome to the identified SDOs and groups namely 3GPP, ETSI MEC, IETF and IEEE, as outlined in Section 2.4. Although 5Growth has already met the target and objectives in terms of standardization commitments, the partners as well as the SAC leadership are committed to maintain a strong participation in the noted key SDOs in order to disseminate:

i. the key development area of the project to the identified standardization groups shown in Table 20 in D5.2.
ii. the use cases of the project to the identified standardization working groups shown in Table 21 in D5.2.

The SAC will continue ensuring that 5Growth standardization efforts clearly reflect specific outcomes from the various activities to be completed during the next 9 months. To this end, the SAC will continue coordinating Standardization activities within the project, either through planned conference calls or direct one on one discussions with the Project Standardization leads who are also integral part of the SAC. The following activities are planned for the remaining 9 months of the project, to keep a significant level of participation and overall impact of 5Growth into key SDOs, where a target of at least 2 additional contributions be approved/agreed/accepted:

1. Identify which new capabilities of the current 5Growth feature set may address objectives outlined in relevant Study Items and Work items from key SDOs described above or whether New Studies should be proposed.
2. Analyze possibilities to continuing our thrust on existing topics that the project partners are already participating e.g., Industry 4.0/Vertical private networks and use cases (IEEE, ETSI MEC/ETSI NFV, 3GPP), Network Intelligence (ETSI ZSM/ETSI MEC/ETSI ENI, 3GPP), Network Slice Management (ETSI MEC/ESTI NFV, 3GPP), Service Orchestration in multi-domains (IETF).
3. Determine the need and periodicity of SAC meetings, considering SDOs release cycles and deadlines and remaining time available to bring contributions.

4. References

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[4]. H2020 5Growth deliverable D2.4 "Final implementation of 5G End-to-End Service Platform", May 2021, available at https://5growth.eu/wp-content/uploads/2021/05/D2.4-Final_implementation_of_5G_End-to-End_Service_Platform.pdf

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[6]. H2020 5Growth deliverable D5.2 "Communication, Dissemination, and Exploitation achievements of Y1 and plan for Y2", May. 2020, available at https://5growth.eu/wp-content/uploads/2020/05/D5.2-Communication-Dissemination-and-Exploitation-achievements-of-Y1-and-plan-for-Y2.pdf

[7]. H2020 5Growth deliverable D6.2 "First periodic report of the project", Nov. 2020, available at https://5growth.eu/wp-content/uploads/2019/06/D6.2-First_periodic_report_of_the_project.pdf

5. Annex I. Survey of Overall Satisfaction of Attendees to Events (co-)organized by 5Growth

This annex provides the overall satisfaction from not yet reported events (co-)organized by 5Growth. Satisfaction results of previous events organized during the Y1 were already reported in D5.2 [6]. Note that, the statistical information with respect to the participation in events organized by third-party entities (e.g., IEEE and Layer123) is not included in this annex.

MDPI Webinar Beyond 5G Evolution: There were about 40 online participants to the MDPI Webinar Beyond 5G Evolution. The survey circulated to attendees that followed the demonstration showed very positive results in terms of attendee satisfaction with the program of the workshop, as shown in Figure 11.

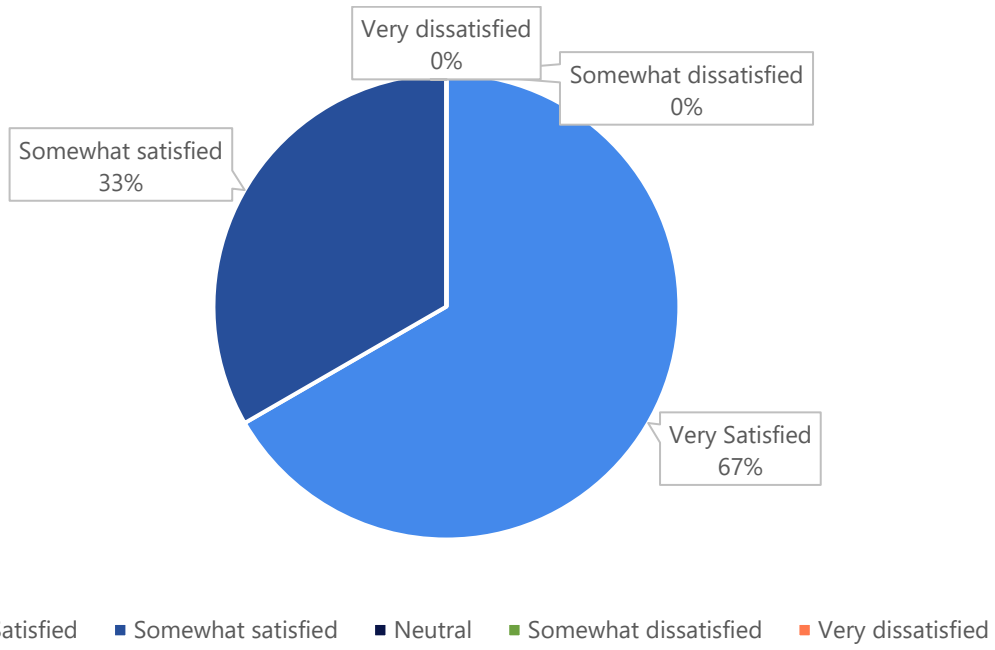

FIGURE 11: RESULTS OF THE ATTENDEE SATISFACTION POLL OF THE "MDPI WEBINAR BEYOND 5G EVOLUTION" SURVEY

2020 Mobislice workshop: There were about 22 online participants to the 2020 Mobislice workshop. The survey circulated to attendees that followed the demonstration showed very positive results in terms of attendee satisfaction with the program of the workshop, as shown in Figure 12.

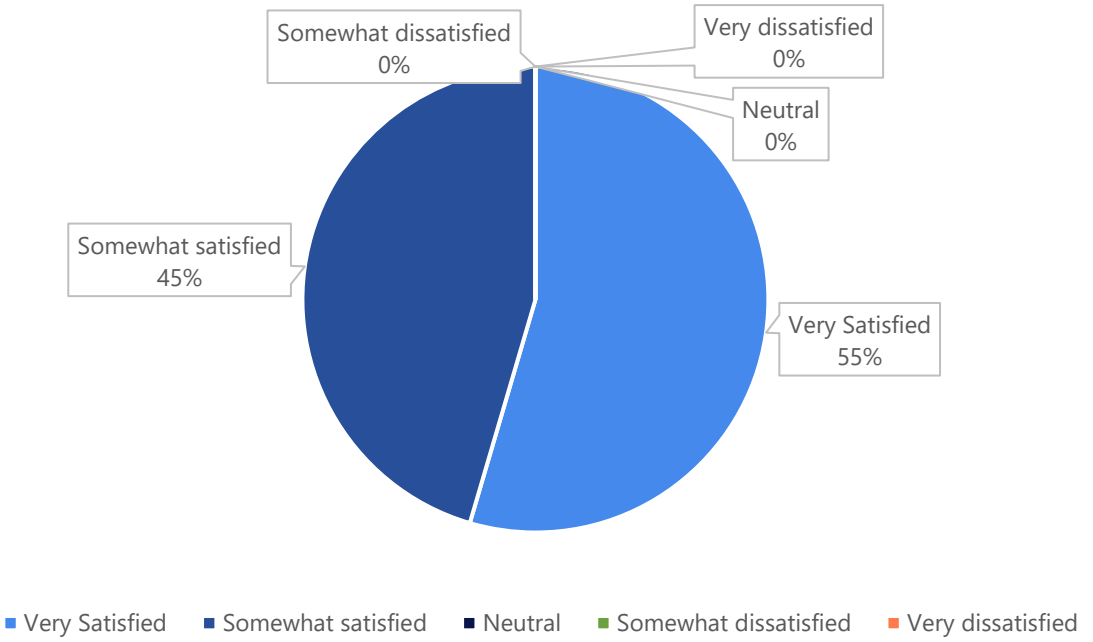

FIGURE 12: RESULTS OF THE ATTENDEE SATISFACTION POLL OF THE "2020 MOBISLICE WORKSHOP" SURVEY