

PROJECT FINAL REPORT

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4.1 Final publishable summary report

4.1.1 Executive summary

The SIMTISYS Simulator is a Software (SW) Tool whose functionality is a Simulation of Maritime Surveillance Performance from SBRs on a PC Workstation as related to the Radar Problem: “Spaceborne GMTI in Sea Clutter.” Notwithstanding the formidable radar difficulties, the SIMTISYS project was entirely animated by Merrill Skolnik’s wisdom:” ...*whether or not there is perfection. Engineers often have to work with compromise solutions that give usable results, if not absolute accuracy.*”

The main project results are reported in the bullets sketched hereafter:

- Although current SAR imagery from LEO spacecrafts has a well-defined, mature, and flight proven non-real time system engineering framework with an operative Swath vs Resolution trade-off, MTI techniques are manifold and, for SBRs, are still experimental in terms of both statistical detection assessments and operative temporal responsiveness.
- Sustainability Studies allowed outlining a roadmap where, for the time being, mathematical analysis and computer stochastic simulation appear as the cornerstone for addressing this low-TRL engineering-framework and eventually for simplifying algorithms and operative solutions while key space-qualified enabling-technologies evolve (namely phased array antennas, onboard processing & storage capabilities, downlink telecom infrastructures) with a tremendous impact on possible signal processing techniques to be adopted.
- The SIMTISYS project supports mathematical analysis with stochastic simulation by exploiting the processing & storage capabilities of modern multi-core PC workstations, modern programming languages, COTS and aerospace development tools. Moreover the SIMTISYS project interprets and inevitably frames the possible "responsiveness" concept for SBR MTI with respect to original ground-based MTI heritages where pop-up targets must be faced with a quick procedural cascade made of "detection-tracking" spanning an amount of time on the order of seconds.
- The SW infrastructure complies to standard policies of system design & development i.e. Flexibility, Modularity, Interoperability, and Efficiency. The Efficacy relies on the core engineering issue which has not been faced completely by the scientific and technical community especially for the technological capabilities of SBRs, the thorough applicability of SBR-GMTI techniques to the marine environment, as well as sea clutter modeling.
- The off-line MTI performance Characterization database represents an important aspect of the SIMTISYS project. In summary such a database is a preliminary version based on classic approaches based on DPCA, ATI, STAP and stochastic assumptions (e.g. Gaussian distributions for Interference and Swerling 0 Targets) whereas current heuristic combinations or ad-hoc extensions of the aforementioned techniques (e.g. taking as a reference EUSAR 2012 proceedings on Radarsat2 MODEX GMTI results and techniques) have not been considered.
- A post-detection autofocus technique has been investigated over a sub-region of the SAR image. It has been based on the 2-Dimension Product-High-order-Ambiguity-Function (2D-PHAF) for estimating the coefficients related to induced moving-target-scattering-centers phase-modulation and range-migration modeled as a superposition of 3rd order 2D Polynomial Phased Signals (PPS).
- The current SIMTISYS project focused on Space-Time Techniques for Multichannel SAR solely (i.e. without RAR KA MIMO STAP approaches). Limited resources, constrained times, prudent engineering design, partial and non-exhaustive availability of public results of spaceborne test campaigns still do not allow SAR system engineers to design Spaceborne SAR Payloads according to a “consolidated moving target detection performance” in the maritime domain for moderate to large sea states in terms of statistical detection assessments.
- Significant steps have been made forward for an improved awareness of the current limits. Accordingly the Reference Study Case adopted during the Validation Phase has been adopted as similar to the MODEX mode experimental payload incidence angles and confirmed the de-facto experimental evidence of current difficulties in single-channel SAR image interpretation for scenarios comprising small vessels in high sea states. Exploiting multi-channel SAR configurations, the Reference Study Case has also highlighted the correct matching obtained from CFAR Detector visual

telemetries, and the order of magnitude of related Estimated Detection Probabilities. Finally the Spaceborne GMTI Performance Analysis applied to the Reference Study Case has pinpointed the significant impact on GMTI performance of the statistical clutter amplitude distributions and related temporal correlations as well as the adopted multichannel baselines physical extent, the SAR noise Equivalent Sigma Zero, and the RCS-related parameters associated to target vessels scattering centers models. The impact of ambiguities (in terms of AASR and RASR) on the Spaceborne GMTI Performance Analysis has been neglected.

- Further investigations and matching of experimental data (e.g. taking as a reference Radarsat2 MODEX MTI results and techniques) appear of paramount importance.
- So far dissemination activities have led to 8 technical papers published/submitted as reported hereafter whereas a 9th paper will be submitted to the 2014 EUSAR Conference.

4.1.2 Summary Description of the Project

In the Maritime Security domain several GMES projects efforts have striven identifying and demonstrating space-based Services for Appointed Authorities – at National and Regional level – by relying on the existing satellite and in-situ capabilities. A general concern has been raised by the User Community: how can Users rely on GMES services if their performance is hardly assessed against operational scenarios? The critical nature of the information needs reported by the Users – e.g., early warning capabilities for implementing an effective response to illegal actions at sea such as illegal migration, asymmetric terrorism threats, and piracy attacks – does not allow a clear answer. In the latest five-ten years the number of demonstrated space-based services for Maritime Surveillance has already achieved a sufficient maturity for drawing conclusions. One of the latest LIMES demonstration trials has recorded an astonishing number of missed space data acquisitions during the ship route in the Somali area. Neglecting the contextual causes for the recorded Service Quality Level (data acquisition conflicts, space data quality, processing bugs or low service priority), it is straightforward to admit that space-based capabilities are requested to rapidly evolve and adapt in order to comply with Maritime Security Users' needs. In such demonstration conditions the User-driven assessment of GMES Services might lead to erroneous conclusions. A reply to the abovementioned issues can be derived by relying on Modelling & Simulation (M&S) techniques. A Simulator is the computer-based representation of the addressed application composed by (i) threats scenario, (ii) background, (iii) sensing systems, and (iv) information management chain. The Model to be developed in this project will cover all the aspects that have a role in determining the overall Service Quality Level, including the observation geometry, the radar sensor, the communication channel, the sea state, the processing approach, etc. Simulation should focus on complex threats scenarios, which are the ones that require the User capabilities improvement the community is searching for. The basic goal of SIMTISYS is to define and develop a system simulator able to emulate different realistic scenarios, as defined by the end users, and alternative data collection mechanisms from formation-flying satellites. The simulator will incorporate alternative innovative processing schemes, such as MIMO GMTI, for example, with the aim of assessing the overall system performance and identifying the most appropriate scheme to detect and track objects of interest, within a realistic scenario.

4.1.3 S&T results/foreground

See attached file “RPT-ECS-SMTI-0017-TASI”

4.1.3.1 Project Foreground

See “RPT-ECS-SMTI-0005-TASI”

4.1.4 Impacts

European strategies for the homeland protection are aimed at extending national policies, laws, operations, and technical capabilities within the framework of a harmonized i.e. coherently standardized transnational management. For the time being such a strategy is still intertwined to non-optimal tactics in terms of fragmented policies or duplicated efforts thus resulting in an inefficient use of resources.

Promoted by major European institutions such as European Commission, European Space Agency and European Defence Agency (EDA), several programs and projects are being issued encompassing further developments of existing EU systems as well as enabling technologies and related techniques. Copernicus constellation represents a clear step towards such enhanced European capabilities whereas significant advances towards a true European political integration can definitely speed up such a process. More specifically such a program (comprising satellites, ground stations, airborne and ground based ancillary support data, data standardizations...) is aimed at providing services based solely on Monitoring & Forecasting capabilities related to six remote sensing thematic areas:

- Marine Services (ship routes, state of the oceans, oil spill pollution, ice monitoring...);
- Land Services (soil sealing, water quality and availability, spatial planning, forest monitoring and global food security...);
- Atmosphere Services (carbon dioxide, methane, carbon monoxide, ultraviolet radiation, ozone layer...);
- Emergency Services (floods, fires, natural disasters, accidents, humanitarian aid...);
- Climate Change Services (historical data comparison, heat transport...);
- Security Services (monitoring illegal activities, border control, nuclear capabilities and infrastructures, critical assets...).

Additionally Space Borne Radars for real-time surveillance is still a technical challenge in terms of required economical budget for the analysis, design, development and testing. Nevertheless there are gaps between governmental needs and low-TRL resources to overcome such technical challenges.

It is in this framework that SIMTISYS was performed, trying to answer the important question: in which circumstances the Space component can undoubtedly and actively support the emergency response? In which circumstances the Space component has limits?

Several parallel activities during SIMTISYS duration were conducted in Europe on this topic, in some cases also experiments were successfully performed, demonstrating the efficacy of the contribution to early warning the monitoring and controlling authorities by means of Change Detection method, duly performed by the state of the art Space constellations (both commercial and Dual-Use). SIMTISYS's mandate was relative to the investigation of the limits of the actual Space capabilities to indicate the way to proceed for the future Space constellation constellations.

SIMTISYS obtained the expected results having elaborated a simulator of the techniques and technologies performances required to comply with the user requests. Moreover SIMTISYS elaborated a tool targeting the Research Community for the further technical investigation requested in a pre-operational service for the processing of the received images and, in parallel, in a first phase of future constellation design to improve limiting parameter of the actual constellation.

4.1.5 Project website and relevant contacts

www.simitys.eu

4.2 Use and dissemination of foreground

During the project development a dissemination plan was elaborated by the consortium. Specifically during the Project coordination Board the list of the planned annual conferences, symposia and workshop were identified and reported in the D13.1 - PSC Report (ref. n° "RPT-ECS-SMTI-0005-TASI")

SIMTISYS activity concerned high technical and innovative content then a deepest investigation on the performed activities, before the exploitation on the Market is necessary. Moreover, SIMTISYS have demonstrated the feasibility, the terms and conditions for the application of the MTI concepts to Space environment, paving the way to the future configuration design approach of instruments and constellation.

Concerning the performed dissemination of intermediate research's outcomes, the following articles were submitted and published on public frameworks.

E. Makhoul, Y. Zhan, F. Ceba, A. Broquetas, A. Beaton, F. Letterio, S. Tonetti, S. Barbarossa, P. Di Lorenzo, M. Maffei, **"Fast Simulation Performance Evaluation of Spaceborne SAR-GMTI Missions for Maritime Applications,"** 10th European Conference on Synthetic Aperture Radar (EUSAR 2014), Berlin, Germany, June 2014.

M. Maffei, R. Venturini, **"A SW Simulator Paradigm for Spaceborne GMTI Performance Analysis in Sea Clutter,"** 2013 European Space Agency Living Planet Symposium, Edimburgh, UK, September 2013.

F. Letterio, S. Tonetti, F. Ceba, E. Makhoul, A. Broquetas, M. Maffei, S. Barbarossa, P. Di Lorenzo, A. Beaton, **"Satellite Convoy Scenario for Spaceborne MTI in Sea Clutter"** 1st International Earth Observation Convoy and Constellation Concepts Workshop, Noordwijk, The Netherlands, October 2013.

E. Makhoul, A. Broquetas, O. González, **"Evaluation of State-of-the-Art GMTI techniques for Future Spaceborne SAR Systems - Simulation Validation"**, Proceedings European Conference on Synthetic Aperture Radar EUSAR2012, Germany, April 2012.

E. Makhoul, A. Broquetas, J. Ruiz Rodón, **"Ground Moving Target Indication using Multi-Channel SAR with Non-Uniform Displaced Phase Centers"**, Proceedings IEEE International Geoscience and Remote Sensing Symposium IGARSS'12, Germany, July 2012.

F. Verzegnassi, **"Patrolling the Sea from Space,"** Research Media International Innovation, October 2013.

F. Verzegnassi, **"Effectively building Spacebased data access tools"** Research Media International Innovation, September 2012.

P. Di Lorenzo, S. Barbarossa, L. Borgarelli, **"Optimal Beamforming for Range-Doppler Ambiguity Minimization in Squinted SAR"**, IEEE Transactions on Aerospace and Electronic Systems, Jan. 2013.

P. Di Lorenzo, S. Barbarossa, **"Optimal Beamforming for Range-Doppler Ambiguity Suppression in Squinted SAR Systems"**, IEEE Int. Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP), Dec. 2011.

S. Barbarossa, P. Di Lorenzo, P. Vecchiarelli, A. Silvi, and A. Bruner, "**Parameter Estimation of 2D Polynomial Phase Signals: An Application to Moving Target Imaging with SAR**," Proc. IEEE ICASSP 2013, Vancouver, May 2013.

S. Barbarossa, P. Vecchiarelli, P. Di Lorenzo, "**Parameter Estimation of 2D Polynomial Phase Signals based on 2D Product of High Order Ambiguity Function: An Application to Moving Target Imaging with SAR**" to be submitted to IEEE Transactions on Signal Processing.

List of dissemination activities

NO	Type of activities	Main leader	Title	Date/Period	Place	Size of audience
1	Periodical Meeting	Involved Projects	Project Steering Board	Twice per year	Brussels	Limited
2	Periodical Meeting	European Commission	MARSUR	Twice per year	Brussels	Limited
3	Workshop	Italian Space Agency	Workshop on GMES	June 2012	Rome	>50
4	Conf.	European Commission	Let's Embrace Space 2012	November 2012	Cypro	>80
5	Conf.	Ministry of Maritime Transports and European Commission	European Maritime Day 2013	May 2013	Malta	>80

4.3 Report on societal implications

A General Information (completed automatically when <i>Grant Agreement number</i> is entered).	
Grant Agreement Number:	263268
Title of Project:	Simulator for MTI SYStem (SIMTISYS)
Name and Title of Coordinator:	Fulvia Verzeznassi – Project manager
B Ethics	
<p>1. Did your project undergo an Ethics Review (and/or Screening)?</p> <ul style="list-style-type: none"> • If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports? <p>Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 'Work Progress and Achievements'</p>	<i>0No</i>
2. Please indicate whether your project involved any of the following issues (tick box) :	YES
RESEARCH ON HUMANS	
• Did the project involve children?	NO
• Did the project involve patients?	NO
• Did the project involve persons not able to give consent?	NO
• Did the project involve adult healthy volunteers?	NO
• Did the project involve Human genetic material?	NO
• Did the project involve Human biological samples?	NO
• Did the project involve Human data collection?	NO
RESEARCH ON HUMAN EMBRYO/FOETUS	
• Did the project involve Human Embryos?	NO
• Did the project involve Human Foetal Tissue / Cells?	NO
• Did the project involve Human Embryonic Stem Cells (hESCs)?	NO
• Did the project on human Embryonic Stem Cells involve cells in culture?	NO
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	NO
PRIVACY	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	NO
• Did the project involve tracking the location or observation of people?	NO

RESEARCH ON ANIMALS		
• Did the project involve research on animals?	NO	
• Were those animals transgenic small laboratory animals?	NO	
• Were those animals transgenic farm animals?	NO	
• Were those animals cloned farm animals?	NO	
• Were those animals non-human primates?	NO	
RESEARCH INVOLVING DEVELOPING COUNTRIES		
• Did the project involve the use of local resources (genetic, animal, plant etc)?	NO	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	NO	
DUAL USE		
• Research having direct military use	NO	
• Research having the potential for terrorist abuse	NO	
C Workforce Statistics		
3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).		
Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	1
Work package leaders	0	6
Experienced researchers (i.e. PhD holders)	0	2
PhD Students	0	0
Other		
4. How many additional researchers (in companies and universities) were recruited specifically for this project?		
Of which, indicate the number of men:		1

D Gender Aspects		
5. Did you carry out specific Gender Equality Actions under the project?	<input type="radio"/> <input checked="" type="checkbox"/>	Yes No
6. Which of the following actions did you carry out and how effective were they?		
	Not at all effective	Very effectiv e
<input type="checkbox"/> Design and implement an equal opportunity policy	<input checked="" type="checkbox"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
<input type="checkbox"/> Set targets to achieve a gender balance in the workforce	<input checked="" type="checkbox"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
<input type="checkbox"/> Organise conferences and workshops on gender	<input checked="" type="checkbox"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
<input type="checkbox"/> Actions to improve work-life balance	<input checked="" type="checkbox"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>	<input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/>
<input type="radio"/> Other: <input style="width: 200px; height: 20px;" type="text"/>		
7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?		
<input type="radio"/> Yes- please specify <input style="width: 150px; height: 20px;" type="text"/>		
<input checked="" type="checkbox"/> No		
E Synergies with Science Education		
8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?		
<input type="radio"/> Yes- please specify <input style="width: 150px; height: 20px;" type="text"/>		
<input checked="" type="checkbox"/> No		
9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?		
<input type="radio"/> Yes- please specify <input style="width: 150px; height: 20px;" type="text"/>		
<input checked="" type="checkbox"/> No		
F Interdisciplinarity		
10. Which disciplines (see list below) are involved in your project?		
<input checked="" type="checkbox"/> Main discipline ¹ : 1.2		
<input checked="" type="checkbox"/> Associated discipline ¹ : 2.3	<input type="radio"/>	Associated discipline ¹ :
G Engaging with Civil society and policy makers		
11a Did your project engage with societal actors beyond the research community? <i>(if 'No', go to Question 14)</i>	<input type="radio"/> <input checked="" type="checkbox"/>	Yes No
11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?		
<input type="radio"/> No		
<input type="radio"/> Yes- in determining what research should be performed		
<input type="radio"/> Yes - in implementing the research		

¹ Insert number from list below (Frascati Manual).

<input type="radio"/> Yes, in communicating /disseminating / using the results of the project			
11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?		<input type="radio"/> <input type="radio"/>	Yes No
12. Did you engage with government / public bodies or policy makers (including international organisations)			
<input type="radio"/> No <input type="radio"/> Yes- in framing the research agenda <input type="radio"/> Yes - in implementing the research agenda <input type="radio"/> Yes, in communicating /disseminating / using the results of the project			
13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?			
<input type="radio"/> Yes – as a primary objective (please indicate areas below- multiple answers possible) <input type="radio"/> Yes – as a secondary objective (please indicate areas below - multiple answer possible) <input type="radio"/> No			
13b If Yes, in which fields?			
Agriculture Audiovisual and Media Budget Competition Consumers Culture Customs Development Economic and Monetary Affairs Education, Training, Youth Employment and Social Affairs	Energy Enlargement Enterprise Environment External Relations External Trade Fisheries and Maritime Affairs Food Safety Foreign and Security Policy Fraud Humanitarian aid	Human rights Information Society Institutional affairs Internal Market Justice, freedom and security Public Health Regional Policy Research and Innovation Space Taxation Transport	

13c If Yes, at which level?		
<input type="radio"/> Local / regional levels <input type="radio"/> National level <input type="radio"/> European level <input type="radio"/> International level		
H Use and dissemination		
14. How many Articles were published/accepted for publication in peer-reviewed journals?		2
To how many of these is open access² provided?		2
How many of these are published in open access journals?		2
How many of these are published in open repositories?		2
To how many of these is open access not provided?		0
Please check all applicable reasons for not providing open access:		
<input type="checkbox"/> publisher's licensing agreement would not permit publishing in a repository <input type="checkbox"/> no suitable repository available <input type="checkbox"/> no suitable open access journal available <input type="checkbox"/> no funds available to publish in an open access journal <input type="checkbox"/> lack of time and resources <input type="checkbox"/> lack of information on open access <input type="checkbox"/> other ³ :		
15. How many new patent applications ('priority filings') have been made? <i>("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).</i>		0
16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	Trademark	0
	Registered design	0
	Other	0
17. How many spin-off companies were created / are planned as a direct result of the project?		0
<i>Indicate the approximate number of additional jobs in these companies:</i>		
18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:		
<input type="checkbox"/> Increase in employment, or <input type="checkbox"/> Safeguard employment, or <input type="checkbox"/> Decrease in employment, <input type="checkbox"/> Difficult to estimate / not possible to quantify	<input type="checkbox"/> In small & medium-sized enterprises <input type="checkbox"/> In large companies <input checked="" type="checkbox"/> None of the above / not relevant to the project	
19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:		<i>Indicate figure:</i>

² Open Access is defined as free of charge access for anyone via Internet.

³ For instance: classification for security project.

Difficult to estimate / not possible to quantify	<input checked="" type="checkbox"/>
I Media and Communication to the general public	
20. As part of the project, were any of the beneficiaries professionals in communication or media relations?	
<input type="radio"/> Yes	<input checked="" type="checkbox"/> No
21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?	
<input type="radio"/> Yes	<input checked="" type="checkbox"/> No
22 Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?	
<input type="checkbox"/> Press Release	<input type="checkbox"/> Coverage in specialist press
<input type="checkbox"/> Media briefing	<input type="checkbox"/> Coverage in general (non-specialist) press
<input type="checkbox"/> TV coverage / report	<input type="checkbox"/> Coverage in national press
<input type="checkbox"/> Radio coverage / report	<input type="checkbox"/> Coverage in international press
<input checked="" type="checkbox"/> Brochures /posters / flyers	<input checked="" type="checkbox"/> Website for the general public / internet
<input type="checkbox"/> DVD /Film /Multimedia	<input checked="" type="checkbox"/> Event targeting general public (festival, conference, exhibition, science café)
23 In which languages are the information products for the general public produced?	
<input type="checkbox"/> Language of the coordinator	<input checked="" type="checkbox"/> English
<input type="checkbox"/> Other language(s)	

Question F-10: Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

FIELDS OF SCIENCE AND TECHNOLOGY

1. NATURAL SCIENCES

- 1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
- 1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
- 1.3 Chemical sciences (chemistry, other allied subjects)
- 1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
- 1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

2. ENGINEERING AND TECHNOLOGY

- 2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
- 2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]

- 2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

3. MEDICAL SCIENCES

- 3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immunohaematology, clinical chemistry, clinical microbiology, pathology)
- 3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
- 3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)

4. AGRICULTURAL SCIENCES

- 4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
- 4.2 Veterinary medicine

5. SOCIAL SCIENCES

- 5.1 Psychology
- 5.2 Economics
- 5.3 Educational sciences (education and training and other allied subjects)
- 5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

- 6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
- 6.2 Languages and literature (ancient and modern)
- 6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]

5 FINAL REPORT ON THE DISTRIBUTION OF THE EUROPEAN UNION FINANCIAL CONTRIBUTION

Report on the distribution of the European Union financial contribution between beneficiaries

Name of beneficiary	Final amount of EU contribution per beneficiary in Euros
TASI	€ 255.223,99
DIET	€ 179.959,34
UPC	€ 172.365,70
DEIMOS	€ 211.423,25
Sistematica	€ 300.446,03
VEGA	€ 202.969,74
DAPPO	€ 253.820,06
TOTAL	€ 1.576.208,11