



**Final evaluation of the
NETWORK University
Cooperation in Cuba
(coordinated by UCLV)**

Glossary of Acronyms and Terms

AI	Artificial Intelligence
ARES	Ares Charitable Foundation (United States, Europe and Asia)
CENED	National Center for Long Distance Learning
CIH	International Center of Havana
CINTRO	Universidad de Oriente Enterprise for the commerce of its products and services.
CITMA	Ministry of Science Technology and Environment
ETI	Enterprise for TICS at Biocuba Farma
FP	Focal point
GIAT	Higher Business Management Organization for Terrestrial Water Management
INDER	National Institute of Sports
ICT	Information and Communication Technologies
IP	Intellectual Property
IR	International Relations
IUC	VLIR-UOS Institutional University Cooperation
JSC	Joint Steering Committee
KTTO	Knowledge and Technology Transfer Office
LLC	Limited Liability Company
MES	Ministry of Higher Education
MINSAP	Ministry of Public Health
OECD-DAC	OECD-Development Assistance Committee
ONEI	National Office of Statistics and Information
PL	Project Leaders
Professor	In Cuba, a professor of higher education to be considered as such, must have academic rank ¹
UCI	University of Informatics Sciences
UC	University of Camagüey
UPR	University of Pinar del Río
UHO	University of Holguín
UO	Universidad de Oriente
US	United States of America
UCLV	Universidad Central de Las Villas
UNAIC	National Association of Engineers and Architects of Cuba
VR	Vice-rector

¹ According to *Ministerio de Educación Superior* (Ministry of Higher Education, 2016). Resolución 85 (Resolution 85), professors can get the following ranks: full, associate, assistant, instructor, technical teaching assistant, emeritus, visiting and consultant. The universities and the Ministry of Higher Education are the authorities in charge of authorizing the candidates.

Executive Summary

Subject and objective of the evaluation

Subject of this end of term evaluation is the Network programme, phase II, implemented in partnership between the Universidad Central de Las Villas (UCLV), Universidad de las Ciencias Informáticas (UCI), Universidad de Pinar del Río (UPR), Universidad de Holguín (UHO) Universidad de Camagüey (UC) and the following higher educational institutions in Flanders: Universiteit Gent (UGent), Vrije Universiteit Brussel (VUB), and Universiteit Hasselt (UHasselt).

This programme consisted of 3 projects:

1. Strengthening the research on ICT and its knowledge transfer to Cuban society (RESICT)
2. Open ICT Systems and Management (ICTSYS)
3. ICT supporting the educational processes and the knowledge management in higher education (ELINF)

The objective of this end evaluation was to assess the performance of the Network programme, with a particular focus on its effectiveness, impact and sustainability.

Context

VLIR-UOS supported a 10-year partnership between Cuban and Flemish universities. Within this context, we evaluated the second phase of the Network programme, which aimed “to strengthen the role of ICT for development through 5 Cuban universities and partner organizations”. Following an IUC field visit to the University of Oriente (UO), which participated in various ICT-related activities organized within the context of this Network programme, the evaluators carried out a 5-day investigative field mission in Villa Clara and Havana provinces. We considered the complicated circumstances Cuba faces with the US blockade, the derived crisis the country has suffered for decades, and recent legislative changes with regard to property and decentralized spaces of production. Notwithstanding both logistical challenges and the limitations of minimal number of working days for the evaluation, the evaluation team answered the evaluation questions linked to of the 6 DAC evaluation criteria; while applying the evaluation methodology, including analysis of available documentation / data, conducting field visits and integrated analysis and triangulation of all information obtained.

Methodological approach

This evaluation is part of a more comprehensive evaluation of 5 IUC programmes and 3 Network programmes, including 1 IUC and 1 Network programme in Cuba. It is based on a shared evaluation framework that looks at the 5 OECD-DAC criteria and applies a shared methodological approach which starts with self-assessments completed by network stakeholders. This approach also entails attention to collaborative performance, changes in institutional capacity, learning questions and analysis of a particular impact case.

The evaluation of collaborative processes was based on a spiderweb tool to assess key factors that can explain the success/failures in the collaborative process and visualizes collaborative processes on 6 dimensions or axis of the spider web. The stakeholders’ scoring for this tool was prepared between August and the field visit in October 2023.

To analyze findings related to the learning questions and the impact case, the evaluators collected data in audio recordings, photographs, 14 interviews and 45 documents were reviewed during the field mission.

Evaluation process

The evaluation was prepared by online key-informant interviews, desktop study and design of the methodological approach for the impact case. The impact claim was related to water management, reviewing it required a closer look into one of the most significant country-wide projects carried out by university professors and researchers. A variety of related entities were studied as a chain of providers and clients, considering all contributors, from a small private company to the National Institute of Hydraulic Resources (the entity in charge of providing potable water as a public service).

The 5-day field visit was marked by a large participation of university staff and faculty members, and encounters with people involved in new and developing spaces for economic production. The evaluators conducted 14 individual interviews, 2 focus group discussions, and organized additional spontaneous interviews and visits. Three restitution meetings (with the Network, MES and VLIR-UOS) concluded the phase of data-collection and sense-making.

Main findings and conclusions

The collaborative process was considered to be strong with competent representation in the network structure, leadership and process. Six criteria with different questions were answered at programme and project level. Evaluators consider that the results obtained are/have, at programme and project level:

Relevant: as the most important topics are already generalized in all the universities of the country, becoming part of MES policies in the topic.

Coherent: as all projects learned how to work interconnected, transcending disciplines, and complemented with other foreign actors in the years to come.

Effective: as the outputs were achieved at an outstanding level, solving problems in public services like health using last generation technology, overcoming the inhibiting factors and actors, and taking advantage from every facilitating opportunity.

Efficient: as the services and products which came out of the programme are protected by law and commercialized, or in the way to do it.

Impact: as the evaluators could detect the changes, and assess if they were positive, intended or not. Even the intended changes were considered good, as the complementarity with the private sector was a surprise after so many years debating the topic for a socialist system. There were negative changes too, Covid 19 delayed several tasks for months, some of the staff even abandoned the country, as well as some of the students supported by VLIR.

Sustainability: as the evaluators could see the network of enterprises in charge of commercializing the products and services obtained thanks to the programme, and the contracts derived, benefitting higher education from the professor to the Ministry level. The current and future contracts can ensure income for the next few years, as there are country level problems that could be solved.

The impact case related to water management was not hard to find, the evaluators quickly consulted with the focal point, as there was a clear network of clients all across the country, and among the university professors as providers. Innovation was perceived all the way, with impact in the prevention of natural disasters, environment protection and better service quality at providing water for the population. Six major

achievements were described, all technology related, with sustainability guaranteed for several years through contracts already signed, and others in review. The case accomplished every goal that the programme stood for: know-how transfer obtained through training, prestigious publications, PhD and MSc. students formation, awards among other. Lastly, the findings on the 3 learning questions made the evaluators reflect and make recommendations on gender and uptake of research results. In essence, high complex tech problems could be solved in less time, which translated into better decisions, with free access to high tech resources for specialists all over the country.

The evaluators conclude, after assessing all the materials consulted and the results from the field visit, that the network programme got an excellent evaluation. The goal 'to strengthen the role of ICT in Cuban universities for the development of the society' was considered accomplished.

Overview of recommendations

For Cuban and Flemish universities:

- To align PhD requirements between Cuba and Flemish universities, especially with respect to number of publications required.

For Cuban universities:

- To consolidate programme generated products and services for the Cuban export portfolio, directed to the Ministry of Foreign Trade, Cuban Medical Services S.A., the Ministry of Tourism and other institutions
- To expedite commercialization through the university interface company or other enterprises, to guarantee sustainability, motivating professors and researchers with (profit-driven) incentives and guarantee continuity in further projects.

For VLIR-UOS

- To enhance the principle of gender equity by ensuring that the programme stakeholders apply a country-specific approach based on the country's perceived needs and official statistics for a better balance, and by giving attention to other aspects of diversity such as individuals with special needs and geographical origin in the selection process of Ph.D. candidates. This could be conceived as an opportunity to further integrate the social sciences into projects, especially if the network programme has a strong STEM component.

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1 Introduction

1.1 Background

VLIR-UOS supported a 10-year partnership between Cuban universities and universities in Flanders (Belgium), collaborating in a network programme to foster innovative responses to global and local challenges. Prior to this, an IUC programme was implemented at UCLV, from 2003 to 2013, and the experiences obtained were leveraged for the design of the Network programme that started in 2013 and was just concluded in 2023. The purpose of this end-term evaluation of this network programme included assessing the empowerment of the different universities working within the network and evaluating the outcomes of their role as a development actor in society.

In 2023, the second (4-year) phase of the Network programme was concluded, but due to COVID-19 it was extended for an additional year. A key component of the final evaluation process was a field visit that 2 external evaluators conducted in conjunction with the key programme actors and focal points involved. This was preceded by the study of the closure documents of both the programme and the network partners. During the field visit, interviews were conducted with academics and practitioners, totalling more than 25 hours of recorded interviews, as well as focus groups; furthermore 157 pictures and videos were taken to better document the objectives accomplished. Additional individual interviews and conversations were held with the (vice) rectors of UCLV and Universidad de Ciencias Informáticas (UCI), representatives of the Minister of Higher Education and the Ambassador of Belgium in Cuba.

Phase	Project title	Objective/s
1-2	Strengthening the research on ICT and its knowledge transference to the Cuban society (RESICT)	To prepare more and better qualified ICT human resources to strengthen different Cuban sectors, and to contribute more from ICT R-D-i to the Cuban economy
1-2	Open ICT Systems and Management (ICTSYS)	To strengthen institutional practices regarding the administration, development and implementation of state-of-the-art ICT services, systems and applications by using free software, and upgrade practices for collaboration within the HE system and with external partners (industries, communities) in view of societal uptake
1-2	ICT supporting the educational processes and the knowledge management in higher education (ELINF)	To integrate education and science processes into an open approach, and to improve the use of concrete realizations of open education and science approach in society

Table 1. Projects

1.2 Context

1.2.1 Key social, political, economic, demographic contextual factors in the country

Cuba is at once a Latin American and Caribbean country that has a unique political system shaped by internal dynamics which in turn respond to geopolitical tensions. Its proximity to the United States, and the political and military tensions between the two nations for more than 100 years, has also affected the contours of its socio-economic and political development. The people of Cuba have borne the longest blockade in modern history from one country (United States) to the other. The blockade affects every sector

and its 11,089,511 citizens, with nearly a 50-50 proportion between men and women, with approximately 77% of that population living in urban areas². The island has had a decreasing birth rate since 1970, while the population aged 60 and more has been gradually increasing during the same period³. Parallel to this, the population between 15 and 59 years of age has been gradually decreasing, so there are (and have been) more elderly and infants than working people⁴. Since 1990, the external migration rate has been negative, except for the years 2013- 2014 and 2021-2022⁵. The first 2 cases took place right after migration policy change⁶, and in the last 2, COVID-19 had an impact as borders were closed.

Despite the US blockade⁷, the government of Cuba has prioritized two areas of socio-economic development with a proven track record of increasing public investment even during times of dire economic turmoil; these being Health and Education. In both sectors, Cuban citizens are exempted from any fees related to these services provided by the State. Science and technological development aimed at improving quality of life, economic production and preparation for climate change were two additional concerns manifested in almost all research endeavours. Central to the country's technological development and scientific production is the concept of *technological sovereignty*, whereby advancement falls in line with the technological and digital needs of the country and, where possible, contribute to import substitution. During the Covid-19 pandemic, Cuba was capable of producing 5 vaccine variants, two of which have been marketed and used internationally⁸.

Constitutional adjustments and legislative changes since 2019 have allowed for the recognition of new forms of property and more decentralized spaces of economic production⁹. Among these are laws and ministerial decrees regulating interface companies that operate between universities and industries for the patenting and trade of technological products.

Since the COVID-19 pandemic, other crises have overlapped, including energy and scarcity of fuel, inflation, and food distribution. In 2021, the country implemented economic organization measures called 'Tarea Ordenamiento', by increasing wages, suppressing the convertible Cuban peso as one of the currencies, and change in the exchange rates¹⁰. None of these have been enough to control the basic scarcities that the US blockade imposes and those produced by large military conflicts such as the Ukraine-Russia war which have led to higher prices of many vital products, internationally.

² Oficina Nacional de Estadística e Información (2022). Table 3.1- Población residente por sexo, tasa anual de crecimiento y relación de masculinidad, Havana, ONEI.

³ Oficina Nacional de Estadística e Información (2022). 3.12 - Evolución de la estructura por edades de la población de Cuba, Havana, ONEI.

⁴ Oficina Nacional de Estadística e Información (2022). Table 7.1 - Población económicamente activa, Havana, ONEI.

⁵ Oficina Nacional de Estadística e Información (2022). Table 3.21 - Saldos migratorios y tasas de migración interna y externa, por provincias (1985-2022). Havana, ONEI.

⁶ According to Law Decree 302 of 2012, which modified Law 1312 on Migration of 1976, an emigrated person is a Cuban citizen who travels abroad for particular issues for more than 2 uninterrupted years, Gaceta Oficial de la República de Cuba Extraordinaria Nr. 41 of 2015. Before 2012, the amount of time to be considered an emigrated was 11 months.

⁷ Iturriaga Bartuste, M., Barrera Rodríguez, S. (2023). Sanciones de EEUU a Cuba (1950-2021) y Derecho Internacional Público, Études Caribéennes, 54.

⁸ Gorry, C. (2022). Vaccines and Public Trust: Containing COVID-19 in Cuba, MEDICC Rev, 24 (1): 9-13.

⁹ Asamblea Nacional del Poder Popular (2019). Constitución de la República de Cuba, Gaceta Oficial Extraordinaria 5.

¹⁰ Ministerio de Economía y Planificación. Tarea Ordenamiento, in <https://www.mep.gob.cu/es/tarea-ordenamiento> (consulted 2nd December, 2023).

1.2.2 Higher Education and Scientific Research

Except for the study of Medical Sciences, the Ministry of Higher Education (MES) is the country's highest authority of the sector and governing 50 universities, with more than 52 thousand professors, and more than 285 thousand students in 2022¹¹. All HEIs are financed by the State. Each university has its own research centres and/or institutes, where professors are encouraged to work in a multidisciplinary environment. MES designs the policies and controls the performance of the entire system. Degrees provided in the Cuban system of higher education are undergraduate and graduate, from this latter there are doctorate students, plus certificates in training provided by faculties and research centres. The Ministry of Science Technology and Environment (CITMA), established in 1994, also has regulatory functions on scientific production and provides a support system for research institutes.

Accreditation is governed by the National Board of Accreditation (JAN) which is empowered to qualify and classify HEIs and academic programmes. JAN also provides Awards of Excellence to programmes and theses. Furthermore, the University Association of Ibero-American Postgraduate Studies (AUIP) is an important regional body, which is referenced in Cuba for quality assurance, best practices and accreditation or recognition.

There are also university-linked enterprises across the country, and one foundation in Havana, which operate as interface entities between their respective universities and private sector and other entities. Regulated by Council of Ministers Decree No.363 of 2019, these enterprises help to market some of the products and services created by university faculty members and researchers, helping them to obtain an extra source of income, and/or to receive donations and equipment to improve their working conditions, thus sustaining higher education in general. The absolute majority of professors and faculty members (61.9% in course 2021/22) and students (65.7% in course 2021/22) in Cuba's system of higher education are women¹².

1.2.3 University level

There are 3 types of higher education institutions (HEIs) in Cuba: universities, schools of medicine and a broad category 'other organisms'¹³. All of them follow the methodological instructions from MES, in terms of professor categorization, graduate programmes or examination commissions. However, while universities are directly subordinated to MES, schools of medicine are subordinated to MINSAP, and the others are subordinated to different organisms depending on their level of specialization, such as the Universidad de las Artes is subordinated to the Ministry of Culture.

In Cuba there is a singular criterion for PhD evaluation followed by all universities, emulating graduate schools in other countries. It uses a system of cumulative credits; adding a series of exams the students must take, including one to demonstrate the skill to use a foreign language and an analyses of science problems in all the programmes; the publication of articles in indexed reviews; and a demanding procedure before 3 different examination commissions: one for the project, another for pre-defence and a last one for

¹¹ Oficina Nacional de Estadística e Información (2022). Tables 18.5 - Escuelas por tipo de educación; 18.6 - Personal docente por tipo de educación; 18.9 - Matrícula inicial por tipo de educación, Havana, ONEI; Oficina Nacional de Estadística e Información (2022). Tables 18.5 - Escuelas por tipo de educación; 18.6 - Personal docente por tipo de educación; 18.9 - Matrícula inicial por tipo de educación, Havana, ONEI.

¹² 18.9 - Matrícula inicial por tipo de educación; 18.10 - Matrícula inicial (mujeres) por tipo de educación, Havana, ONEI.

¹³ Oficina Nacional de Estadística e Información (2022). Table 18.5 - Escuelas por tipo de educación, Havana, ONEI.

defense¹⁴. Postdoc research opportunities are provided for doctoral graduates who wish to continue their academic work.

1.3 Evaluation methodology and process

1.3.1 Evaluation framework

This evaluation is part of a more comprehensive evaluation of 5 IUC programmes and 3 Network programmes, including 1 IUC and 1 Network programme in Cuba. It is based on a shared evaluation framework that looks at the 5 OECD-DAC criteria and applies a shared methodological approach which starts with self-assessments completed by network stakeholders. This approach also entails attention to collaborative performance, changes in institutional capacity, learning questions and analysis of a particular impact case.

The evaluation of collaborative processes was based on a spiderweb tool to assess key factors that can explain the success/failures in the collaborative process and visualizes collaborative processes on 6 dimensions or axis of the spider web. The stakeholders' scoring for this tool was prepared between August and the field visit in October 2023. To analyse findings related to the learning questions and the impact case, the evaluators collected data in audio recordings, photographs, 14 interviews and 45 documents reviewed during the field mission, while assessing strength of evidence for the project-level self-evaluations.

Criterion	Evaluation Question	Judgement criteria
1. Relevance	EQ1. To what extent are the objectives of the programme/project consistent with beneficiaries' requirements, country needs, global priorities and partners' and donors' policies?	1.2. What is the relevance (<i>ex ante</i>) of the formulated outcome(s) and objectives?
		1.2. Extent to which changes in the external context or within the organization influenced the relevance of the intervention, and how this was handled?
2. Coherence	EQ2. To which extent is the partnership programme coherent internally and externally? What is the level of synergy and complementarity with other relevant (Belgian) actors?	2.1. Internal coherence
		2.2. External coherence
3. Efficiency	EQ3. To which extent are resources/inputs (funds, expertise, time, etc.) converted to results in an economic manner?	3.1. The cost-effectiveness (the usage of resources in relation to the achievement of objectives)
		3.2. The extent to which organizational management and structures of the programme/project are conducive for efficient implementation.
4. Effectiveness	EQ4. To what extent are the programmes objectives (expected to be) achieved, taking into account their relative importance?	4.1. The extent to which the programme outputs and outcomes have been achieved and the likelihood that the predetermined outcomes will be achieved by the end of the implementation period.

¹⁴ Dirección de Educación de Posgrado (2020). Instrucción 1, Manual para la Gestión del Posgrado, Havana, MES.

Criterion	Evaluation Question	Judgement criteria
		4.2. Inhibiting and facilitating factors and actors
		4.3. Scientific quality
5. Impact	EQ5. To what extent are (potential) positive and negative, primary and secondary long-term effects generated by the programme, directly or indirectly, intended or unintended?	5.1. Changes (intended and unintended, positive and negative) in stakeholders' lives and contexts contributed to by the programme
		5.2. Fostering 'collective impact'
6. Sustainability	EQ6. To what extent will the programme results continue after the programme is completed?	6.1. Level of institutional sustainability
		6.2. Level of financial sustainability
		6.3. Level of academic sustainability

Table 2. Evaluation framework¹⁵

The data collection methods were the following:

- Desk study (self-assessments, documents of the programme, documents from the university);
- Interviews (in group or individual, with project leaders, focal points, stakeholders from the universities involved, and others);
- Focus group discussions with beneficiaries;
- Workshop to analyse and discuss evolution in collaborative processes;
- Workshop to share findings.

To analyse findings, the evaluators processed all the material described above in point 1.3.1

For the learning questions, the evaluators looked at the measures that were put in place by the network partners. Then, for each measure the evaluators inquired after the effect/change of that measure, they assessed the strength of the evidence for that measure, noted what elements in the measure contributed to the effect and what other factors influenced. For the impact case, a similar systematic approach was used (see 1.4).

¹⁵ For more information about the evaluation framework, the inception report of the framework assignment can be requested for consultation at the level of VLIR-UOS.

1.3.2 Evaluation process and activities

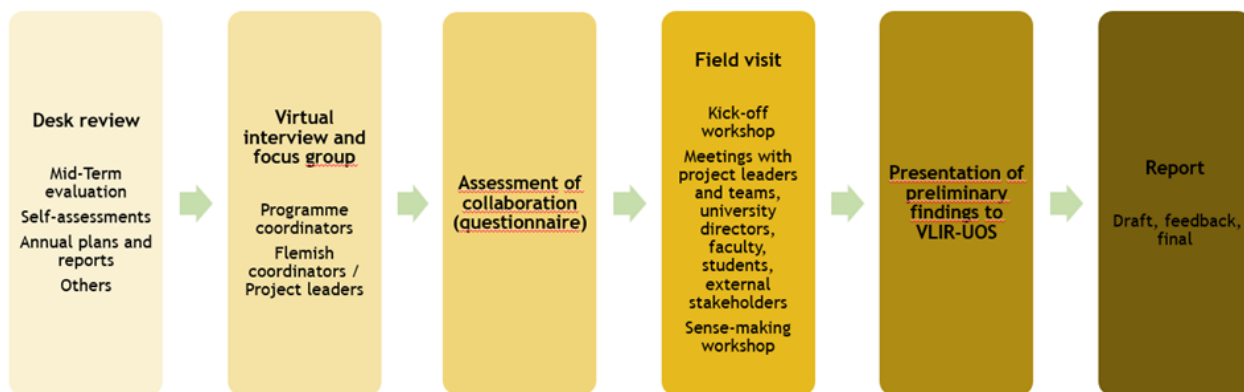


Figure 1. Evaluation process (Network)

Activities

Prior to the field mission: The evaluation team organized meetings with the local coordinator to develop the impact case, requested information about other rival projects, sent the spider web collaborative processes tool to be completed in all 5 universities with the help of the focal points, and studied the self-assessments to identify points to validate during the field mission.

During the field mission: The field mission started with the presentation of the spider web collaborative processes consolidated, delivered before via e-mail by the focal points from the partner universities. There was a workshop on the spider web collaborative processes, introduced and attended by the university leadership, the network stakeholders (online) and representatives of the faculties and administrative units of the university related to the programme.

The workshop was organized as follows: the evaluators presented the spider web consolidated, followed by brainstorming on the general results. The evaluators used the results to obtain an average and to make a visual when drafting the report (see Annex 4). See Annex 2 for the rest of the field visit programme.

After the field mission: A presentation of findings was organized for the network coordinator, project team leaders and VLIR-UOS.

1.3.3 Limitations

The evaluators had to deal with the intermittent lack of internet connectivity, energy and transportation due to the broad crisis the country is suffering caused in great part by the blockade. Nevertheless, great efforts were made by all the teams at the universities visited, including help from the rector, which gave maximum priority to the evaluation-related activities during the week, and put their limited resources at the evaluators' disposal. However, as some beneficiaries were located too far away or inaccessible by public or private transportation, they could not be visited. Visits were indeed limited to university campuses, organizations, stakeholders and enterprises in the vicinities of Santa Clara and Havana province.

1.4 Selection of impact case and description of impact claim

Name of programme: Strengthening the role of ICT in Cuban universities for societal development
Impact claim: The university contributed to the renovation of water management as a public service, using innovative tools and new technologies.

Performance story: Professors from different disciplines gathered to promote innovation for the rehabilitation of automatic hydrometric stations in the provinces of Villa Clara, Matanzas, Artemisa, Havana and Sancti Spiritus. At this moment, it involves a network that starts at *Empresa de Aprovechamiento Hidráulico* (Hydraulic Utility Company) of Villa Clara, and involves the National Institute of Hydraulic Resources (*Instituto Nacional de Recursos Hidráulicos*) and the Enterprise Organization for the Comprehensive Management of Terrestrial Waters (*Grupo empresarial Nacional para la Gestión Integral de las Aguas Terrestres*, GIAT) as clients, while a private LLC guarantees the import of some of the tools and electronic components needed in order to provide part of the scientific services. The innovations and good practices generated through the project are expected to be extended across the country, which may generate fundamental developmental impact as water resource management is a key element in the socio-economic situation of Cuba, given its importance for agriculture and other industries, and general consumption among the population.

Prior to the project, there were no reliable measurements of precipitation, quality, flow, and dam water level in the tropical country affected by hurricanes, heavy rains, and then drought. The result was overexploitation and therefore waste of such an important natural resource. Advanced technologies such as the Internet of Things (IoT) and cloud computing services were designed to address such wastages. The regions involved (Villa Clara, Matanzas, Artemisa, Havana and Sancti Spiritus) possess national priority hydrographic basins such as Zaza, the biggest of the country. Due to their impact, these works have been supported by important contracts through mediation of the interface company of science and technology which belongs to UCLV, the Society of Architects and Engineers and the mentioned LLC.

Data collection: Data collection was organized through visits combined with interviews to the beneficiaries and professors involved, and study of documents provided (presentations with data on the results, pictures showing the field work repairing the hydrometric stations, impact case proposal among others).

Mechanisms that can lead to change (more detailed in the table in “chapter 4. Impact case”):

- Projects involved: P1, P2 and P3
- Universities (collaborating mechanism): UCLV network programme, especially with VUB and UGent; UCLV- Universidad Tecnológica Metropolitana, Chile; UCLV-Universidad Federal de Paraná, Brazil; UCLV-Universidad del Bio Chile; UCLV- Université de la Sorbonne, France
- Other programmes and related interventions: 3 in total

Nr.	Title	Promoter	Local partner	Financier
1	HPC VLIR-UOS JOINT project	UGent	UCLV	VLIR

2	Evaluation of Civil Engineering Structures based on Vibrations	KU Leuven	UCLV	VLIR
3	Digital Transformation of Education in Engineering.	Francophone University Agency	UCLV	AUF
4	Sanitation and Rain Drainage Solutions for Eastern Havana.	Sanitation and Rain Drainage Solutions	FC	OPEP

- Contextual factors: Cuba has a complicated socio-economic situation, due to the blockade and its unpredictable impact, which have been present since the Revolution in 1959. All economic areas are affected by it, so every other crisis overlaps, like the pandemic and the energy and fuel crisis. In 2021, the country implemented economic organization measures called 'Tarea Ordenamiento', by increasing wages, suppressing the convertible Cuban peso as one of the currencies, changing the exchange rates among other. None of them have been enough to control the monetary inflation, taking on account that it is also a global phenomenon.

1.5 Structure of the evaluation report

The report follows with an analysis on the findings at programme level, focusing on the criteria to be evaluated, according to the structure of the evaluation framework. This is followed by a brief description of the projects, based on the self-assessments, the information compiled during the field work, the analysis and conclusions related to the impact case, and the material collected on the learning questions. The conclusions are based on the analysis at programme level combined with the institutional analysis, impact case and learning questions. Recommendations follow at the end and address the different actors involved (VLIR-UOS, Cuban and Flemish universities).

2 Analysis and findings at programme level

2.1 Overview performance scores (6 DAC evaluation criteria)

Criterion	Excellent (4)	Good (3)	Weak (2)	Poor (1)
Relevance	4			
Coherence	4-			
Effectiveness		3+		
Efficiency	4			
Impact	4			
Sustainability	4-			

2.2 Relevance

As explained below, the Network programme is highly relevant for priorities at country level, for the partner universities themselves and for their stakeholders.

For the country

The main goal of the programme was to strengthen the ICT role in Cuban Universities for societal development.

It adapted its goals to the country's priorities, following MES strategic planning and consequently UCLV's and the rest of the network members. Therefore, doctoral theses and research projects focused towards two strategic axes that were transversal: **infrastructure & human potential**, and **science, technology & innovation** defined in PNDES 2030¹⁶, emphasizing on closed-loop and technology transfer of results. In this sense, the different projects obtained relevant results which reached technological sovereignty and developed endogenous technology with some of their products, which saved resources and substituted imports. SDGs 3, 4, 6, 9, 11 and 12 were all implied in the Network ambitions and operations.

For the universities

The new devices, procedures and software applications developed are now part of different subjects at university level, improving higher education. The number of PhD. and MSc. students involved in those research endeavours, their publications and how after graduation they have taken over new responsibilities to continue the legacy of university processes, was relevant to the perception and performances of the partnering universities as a real actor and driver of change. At the same time, the novel changes improved the quality of work and study for professors and students, by automating many bureaucratic processes. It also improved the speed and quality of management, as decisions related to those processes could be taken in less time, using the information collected. The results were handled with full support of all the universities directives, and government officials from the Ministry of Higher Education involved.

¹⁶ Partido Comunista de Cuba (2016). *Plan Nacional de Desarrollo Económico y social hasta 2030: Propuesta de Visión de la Nación, Ejes y Sectores Estratégicos (PNDES, National Plan of Socio-Economic Development until 2030: Proposal of Vision of the Nation, Axes and Strategic Sectors)*.

For the stakeholders

The innovations envisaged were also aligned with government policies¹⁷, as they met the needs and benefitted the population from the centre and western provinces as they got faster and more accurate diagnoses, interacted with the different educational digital platforms to enrich their knowledge, managed energy in a more efficient way among other. The list of external stakeholders participating in the programme, many of them national industries and social institutions of strategic sectors such as health and education, showed the relevance and pertinence reached. Among them, the evaluators had the opportunity to visit important stakeholders as a hospital, UCI (a university very linked to production) and ETI enterprise from Biocubafarma, which are vitals as users-producers of massive medical services, software and metadata processing. Thanks to the programme, the network with universities such as UCI, UC, UHo and UPR was strengthened, in topics such as the use of data centres, English training or information management.

2.3 Coherence

Internal: All projects worked in an interconnected manner ensuring each result also benefits the rest. For example, at the repositories: RESICT developed research using advanced computer science techniques for data acquisition and processing, while ICTSYS provided the infrastructure for data storage. ELINF processed all of this, put it on the repositories and made it available for everyone. To achieve this goal actors involved could count on last generation data centers available for all researchers, along with training and tech transfers to some of the main Cuban soft and high technology companies.

Synergy with the IUC programme of UO. This was materialized through a VLIRUOS JOINT project and the doctoral training at UCLV, following one of the objectives of the NETWORK programme: the creation of thematic subnetworks. In this regard, 6 projects were developed: 2 with ELINF on quality control, monitoring of scientific research and research data management, where one was related to University of Pinar del Rio; 3 with RESICT on Model-Driven Software Engineering, food production, social welfare, afforestation and avoidance of deforestation, all of them with other universities (Holguín, Camagüey and Havana); 1 with ICTSYS on silico modelling through scientific computing.

External: the programme advised that MES incorporate Cuba as an ARES eligible country for the development of collaboration projects; this has already been materialized in the fields of biotechnology and agricultural production. There were cross-project actions with the network programme of Jimma University in Ethiopia, with specialists from the Cuban network programme providing technical expertise and training to Ethiopian researchers on HPC, and on the set-up of an HPC ecosystem in Jimma university. Also, FOURIER (connecting knowledge regarding renewable energy sources) and the EUBBC-Digital project have become active collaborators. The level of synergy and complementarity with other relevant (Belgian) actors was also evident in the collaboration with other VLIR projects such as the TEAM-VIBRAS project. The Flemish universities have expressed their satisfaction with the programme results and the desire to continue working together in further cooperation, through various interviews conducted by the evaluators.

2.4 Effectiveness

Overall, across the programme, the targeted **outputs and outcomes** were achieved at an outstanding level, this is for example well illustrated in the impact case reviewed below (cf. chapter 3). The collaborative context according to the questionnaire was strong among the network members. The interests of all

¹⁷ *Partido Comunista de Cuba (2021). Lineamientos De La Política Económica Y Social Del Partido Y La Revolución Para El Período 2021-2026 (Guidelines for Economical and Social Policy of the Party and the Revolution for the period 2021-2026).*

stakeholders in the network/process were thoroughly addressed. The programme implementation demonstrated a good combination of donated and purchased inputs, whereby the use of second-hand and new equipment, selected by Cuban specialists in conjunction with their Flemish colleagues, has successfully avoided the typical hurdles other programmes and the country are confronted to because of the US blockade. All the beneficiaries took advantage from the distribution of new infrastructure. Thanks to this, virtual meetings grew in quality, which meant better management of the programme as a whole. The programme's effectiveness benefited from: stable project leaders, collective decision making between the Cuban and Flemish project leaders, and excellent communication between focal points and stakeholders, with an overall average of 3.6 in a 0 to 4 scale and the highest score achieved in the questionnaire (refer to Annexes - §7.4).

The below examples illustrate the excellent overall effectiveness of the Network programme. All of them have been implemented during the programme.

- The Technical reference model proposed by P.3 (ELINF project for knowledge management and academic and scientific information) was adopted by all Cuban universities, along with the tools for the implementation of Virtual Learning Environments (something that was essential for the continuity of studies during COVID-19, for example). This involved the system of institutional repositories (which has positioned many Cuban universities in the web ranking of repositories); library management systems; metadata management; control of authorities and authorship; research relationships among academics; and interoperability between all these systems. It is worth highlighting the open science and open education policy promoted by the programme for its adoption in partner universities and the ministry of higher education.
- Access to the information supported by the infrastructure and services was created at the datacenters of the partner universities, for all Cuban universities and the community-at-large. The main software repositories in the country are hosted in the NETWORK data centers, with an upstream traffic of more than 3 Gbps. Prior to this it was 2 Mbps for the whole university, equivalent to the traffic in an average private home. External users can use it through REDCUBA WAN access. This shared information contains data obtained by the scientific computing services (HPC and Big Data) that are offered for free to all Cuban researchers, inside and outside Cuba. The HPC-Cuba network was integrated into the Ibero-American high-performance computing network (RICAP), which offers extra possibilities to Cuban researchers, allowing them to use other supercomputing resources. The creation of thematic networks in the field of Artificial Intelligence, information repositories and supercomputing has promoted the network that integrates all universities under MES (REDUNIV), as a candidate for joining RedClara, the advanced network that links the main academic networks and research centers in Latin America.
- The creation of a spin off, as a public provider of IT added-value services in Cuba, is ongoing. It could take the form of a public LLC, with the university as the owner. UCLV is waiting for the final approval from the Ministry of Communications. This could help to develop conditions for the realization of a smart city.
- The participation of the NETWORK programme with the Institute of Tropical Medicine in Antwerp, the Cuban Institute Pedro Kourí and the Finlay Institute of Vaccines in local projects to develop an evaluation tool to measure the health impact of the Cuban pneumococcal vaccine, and other issues related to Arboviruses. This was operating until the start of the COVID-19 pandemic.
- Within the framework of the ELINF project, close academic collaboration and work with experts has prevailed to monitor the services offered and the training of Cuban specialists with organizations such as UNESCO, FAO, CEPAL and the office of the British Council in Cuba.

- The application of advanced artificial intelligence and Web semantic techniques using ontology and thesaurus, with the joint contributions of RESICT and ELINF projects. At the same time, all the systems used by ELINF with interoperability solutions (repositories, virtual learning environments, research information system) are developed and hosted on the infrastructure developed by ICTSYS (P2).

By the end of the implementation period, all expected key outcomes were achieved. The metadata used by the different information management platforms were standardized. The evaluators observed how the students could effectively access research profiles and academic networks with one of the best connections in the country, and how the generation of content came from training and research results. At the same time, the creation of services in the platforms based on the global network data encouraged an accountability culture in order to mitigate risks related to staff changes or loss of intangible assets (software). The evaluation process confirmed the positive evolution and sustained development of the software tools, systems and applications, in the automation of university processes, such as the different reports generated with the information uploaded by the professors (articles, awards, books, presentations etc.). All of this was possible thanks to the competent representation in the network structure/process, with an overall average of 3.4, according to the opinions of the focal points, professors, PhD. and MSc. students among others.

Inhibiting factors and actors. Interoperability among the different IT systems is still an unresolved issue, open to scientific research. This is also a more generic problem, all kinds of actors are thus involved: private and public universities, governments, and companies among other entities. In the programme some solutions were developed with the resources available at the virtual learning environments, available in the institutional repository. Staff changes also occurred, but the use of GIT repositories (virtual storages containing the code and the history of changes in a project) for well-documented version control and backups made it possible to mitigate risks of intangible asset loss.

Facilitating factors and actors: the foundation established by the previous IUC programme at UCLV was very positive, as the experiences and good practices of that programme became part of consecutive Network programme (subject of this end term evaluation). Also, the support from MES was significant as they indicated to the evaluators that this Network programme was the most important programme they have had for the past 10 years. To add, the interaction with the industry for applying research and tech transfer has allowed this Network programme to achieve the expected impact on society. The synergy developed with the other 4 universities members of the network allowed the generation of new products and services. The commercialization of these results has also been a positive factor, and will be dealt with in the sustainability criterion, and more specifically in the impact case, with all the actors involved: CIH, professors, UNAIC among others.

2.5 Efficiency

Overall, the programme implementation demonstrated an excellent level of efficiency. The extent to which organizational management and structures of the programme were conducive for efficient implementation, could be seen through the following measures and achievements:

- During a meeting with the steering committee (made up of the local coordinator, programme manager, some of the local project leaders and other representatives of the NETWORK programme in 2 partner universities) the evaluators were informed on how this committee contributed to the efficiency of the programme implementation. They meet quarterly (although extraordinary sessions were called if necessary) to discuss and approve the activities to be carried out in the programme, budget issues, and needed modifications to achieve a better implementation. These meetings are generally held by videoconference, and Flemish partners / VLIR-UOS is invited, thanks to the good infrastructure created

by the programme. Decisions and agreements were collectively made between the Flemish and the Cuban teams. The joint steering committee (JSC) did meet live at least once a year.

- Both the project leaders and the representatives of the partner universities kept up with a systematic participation in all meetings held, most of them online. The stability of the project leaders has been essential to achieve good understanding, teamwork and synergy between the different projects that make up the programme. There is good communication and information flow between the parties.
- Generally, the budget has been fully executed, spent for successful programme activities and according to the manual. However, during COVID-19 it was necessary to realign the budget. With approval by VLIR, 10% of the budget will be shifted for a phase out year, as some of the objectives were still pending.
- The **cost-effectiveness** in the evaluators' opinion was also beneficial. Cuba is famous for the intensive use of its resources, especially in massive services such as health and education; the programme was no exception, as it had a strong presence in both areas according to its objectives.
- The annual planning was done the previous year, and then followed up by the JSC afterwards.
- For the scholarship grants process, selection committees are made up with the participation of Cuban and Flemish experts, and project level focal points from every partner university. In the case of Joint PhD scholarships, the Flemish and Cuban coordinators also participated, not only in the selection process but also in the follow-up.
- As there wasn't such a big budget to guarantee all ICT infrastructure needs in each partner university, the programme carried out a strategy to benefit from donations. The purchases were done through the Flemish universities which have significant discounts from their suppliers. The annual shipment of a container to Cuba brings all the acquired goods and materials. For example, the value of the data centres built in all partner universities could more than duplicate the total budget of the programme, which demonstrates the efficiency in the use of financial resources.
- Most key results were (or are in the process of being) converted economically, as explained in §2.8 on the sustainability criterion.

2.6 Impact

Informing on the baseline situation, before the start of the network programme, stakeholders explained that the collaboration with other universities was not that strong, except for UCI in Havana. The stakeholders explained to the evaluators how the network programme managed to avoid competition by enabling collaboration between all partners involved. As we could see in matters of health, the IUC programme at UO and the network programme just decided to divide the Cuban regions in order to develop and support the implementation of different software applications to process images for patient diagnosis, and constantly exchanged when any of the developers encountered difficulties. Those were the reasons for the 3.4 overall average at the questionnaire about embracing diversity, as an expression of tolerance when facing multiple views on the same topic.

The evaluators found that all of the **changes** were **positive**. Among the **intended impact**, the following achievements are worth mentioning specifically.

- The partnerships with Flemish universities, and also among the focal points helped to make faster and better decisions. The collaborative structure created reached a high 3.5 overall average when applying the questionnaire on collaborative performance. The NETWORK programme concluded with a significant level of institutionalized ICT related science capacities, radiating in part to the entire higher

education system in Cuba, as well as to several strategic sectors of Cuban society. This is the case of the repositories available for all researchers.

- The network infrastructure and servers (data centers in each partner university) provide fundamental support for the development of science and institutional processes carried out in the partner universities. This made it possible to significantly speed up user access to academic and scientific information (using REDUNIV, the backbone network that interconnects all Cuban universities), while offering data storage as well as processing capacities. Among the most used academic services today is the virtual learning environment, used by all Cuban universities. Also, those e-learning platforms were key to guaranteeing teaching during the COVID-19 period. On the other hand, the development of institutional repositories for scientific (or technical) production publication/dissemination brought improvement to the positioning of partner universities in the web ranking of repositories. Today an "open science and open education" policy proposed by the NETWORK Programme has been adopted by MES.
- The ICT infrastructure developed by the NETWORK Programme, allowed the creation of an academic supercomputing network (HPC-Cuba). This network offers scientific computing services (HPC and BigData) to the entire academic and scientific community of Cuba and the Region. Here we can highlight the membership of the HPC-Cuba network to the Ibero-American High Performance Computing Network (RICAP). The development of thematic academic networks, such as the artificial intelligence and the high-performance computing networks, has aroused sufficient interest for the incorporation of REDUNIV into RedCLARA membership (ongoing process). The latter is an advanced network that connects the main research centres and university networks in Latin America.
- The training of human resources through internships and PhD studies has given new results, especially in its application in the industry. The successful interaction with the industry sector stems from the creation of tech-transfer companies in all partner universities. They facilitated the transfer of scientific and technical results to the industry through contracts with companies like BioCubaFarma (ETI), the National Institute of Hydraulic Resources (INRH) and other hydraulic exploitation enterprises, the electronics industry among others.
- A more comprehensive impact that would include small and medium-sized companies, both from the state and private sector, is expected after the UCLV Datacentre obtains its authorization to be a public IT provider (as a result of an already ongoing procedure). This will make it possible to impact society through cloud computing services, including housing, hosting, 'Infrastructure as Services' (IaaS), 'Platforms as Services' (PaaS) and 'Software as Services' (SaaS). There is a strong interest of the Cuban telecommunications operator (ETECSA) in using the storage services of this datacentre as backup for national sensitive information and for offering small and medium-sized companies IT services in the cloud. Today the datacentres of the partner universities host the main repositories of software, antivirus and media information in the country. It is expected that once authorized to be a public provider, they will be able to offer IT development environments and Gitlab services for software developers and IT entrepreneurs. Note that today they cannot access public cloud computing services like Amazon Web Services, Microsoft Azure or Google Cloud due to the US blockade against Cuba. Today the network partners offer High-performance computing capabilities, Big Data, Internet of Things and application of artificial intelligence techniques for industry IT applications. This surely contributes to uptake the smart city paradigm in Cuba.

As described above and also in §2.4 related to effectiveness, the outputs and outcomes of the Network programme have generated and continue to generate positive impact for actors involved and for the Cuban citizens in the sectors of health and water management. The latter is further explained in chapter 4 with respect to the corresponding impact case reviewed by the evaluators.

Among the **unintended changes**, the evaluators found an unexpected complementarity and synergy with the private sector. Private sector companies, in the form of a limited liability company or LLCL, were reintroduced as an economic actor in 2021¹⁸. While Cuban private companies were regulated before in the Code of Commerce, the legislation at that time was very disadvantageous compared to anonymous companies, in fact the only companies effectively present were the foreign companies doing business in Cuba. The evaluators could visit one of these private LLCs newly established by the partnering universities, named TECISS Interfaz SURL, with only one partner. As neither SICTE nor UNAIC have access to bank accounts abroad, with hard currency ready to use, and right now nearly all the foreign providers demand their payments abroad, this enterprise can guarantee the import of some of the tools and electronic components needed in order to provide part of the scientific services. It will also hire some of the professors to provide some services as experts in their spare time, which will mean another source of income for them. This could become another motivation for them to stay at the university without needing to migrate (completely) to the private sector.

2.7 Sustainability

2.7.1 Institutional sustainability

Cooperation with VLIR UOS has been acknowledged by the Ministry of Higher Education (MES) as one of the most stable and influential, and the Network Programme has consolidated that status. The document “Recommendations and Strategy for Open Science and Open Education in the Cuban Ministry of Higher Education”, shared deep experiences related to courses, workshops, and diagnostics developed for each university. MES used this proposal to draft their policy on the topic for the rest of the country. For their part, UCI has had a striking influence, since the programme has greatly contributed to both postgraduate and undergraduate education, with several capacity-building actions carried out with numerous researchers, software developers, faculty, and ICT staff involved as beneficiaries. Most importantly, UCI has had a strong impact on the research management culture of the organization, since people have a better idea now about how to work for a replicable and transparent model of research, which is linked from the very beginning to the industry, so that commercialization is much more consolidated.

Seven project initiatives are already taking place to continue with the collaboration after the programme closes, such as JOINT, SI or Strategic partner. To add, participation with other European Union projects such as FOURIER and EUBBC-Digital have increased. The programme results have been taken up by institutional policies and procedures for the rest of the universities, just as it happened with ELINF (P3) as we mentioned in §2.2 on the relevance criterion. There are still some ongoing initiatives regarding applied research and ICT developments, but those will be taken care of in the ‘phase out’ during the following months.

UCLV is currently considered a Strategic Partner of VUB, and they celebrated 25 years of collaboration, to which the NETWORK programme provided very important contributions. Although the other four Flemish universities were also very much involved in different actions and activities, the Flemish leadership contribution has been naturally distributed among the three universities where their respective project leaders reside. For example, research has been coordinated from VUB; while actions related to ICT infrastructure and Datacenter management were supported mostly by UGent, and knowledge and information management by UHasselt. On the Cuban side, only one project has been led by colleagues outside UCLV (ELINF is led by UCI).

¹⁸ Consejo de Estado Decreto (2021). Decreto-Ley 46. Sobre las micro, pequeñas y medianas empresas, Gaceta Oficial Ordinaria 94.

Networks and scientific groups are associated within the topics of AI, pattern recognition, bioinformatics, big data among others. This also favoured institutional integration, as more than 50% of the high-impact publications produced within the programme resulted from collaboration with researchers from institutions outside UCLV.

2.7.2 Financial sustainability

The first step towards enhanced financial sustainability was the creation of SICTE S.A., a company that belongs to UCLV, with the mission to trade with the research results created by its employees. CIH, UNAIC and TECISS Interfaz SURL, have also been used as ways to commercialize some of the products and services. In this regard, about 38 contracts or agreements were signed and some of them have been already executed with several Cuban clients, such as important research centres from Biocuba Farma (Finlay Institute of Vaccines and the Information Technology Enterprise), INRH, Cienfuegos Harbour, the cement company among others. The programme supported this process through workshops and seminars between academia and industry. Today the results have been materialized and the intention is to create an LLC also belonging to UCLV, to offer value-added public IT services as pilot experience. This pilot experience could be generalized in the future for the other partner universities with their respective data centres. Improved work conditions, better wages and new jobs will help to increase the retention of staff. The main client so far would be ETECSA, which is negotiating with UCLV the terms, with the university LLC as a public provider of IT value-added services. There are actions fostering scientific production with theoretical results obtained in the framework of the programme in Africa. Specialists also formed within the programme are in that continent, helping other VLIR-UOS programme participants with the training of the staff and assembling their data centres.

New projects have started: the Scientific and Technological Observatory with Intensive Use of Computational Technologies, proposing the ELINF Ecosystem as one of its fundamental sources of information; and the scientific Information Management System, focusing on the personalization, deployment and interoperability of a CRIS (DSpaceCRIS). The profits could be reinvested on infrastructure for the data centres, new laptops, printers among others.

2.7.3 Academic sustainability

The document drafted within the ELINF project “Recommendations and Strategy for Open Science and Open Education in the Cuban Ministry of Higher Education”, is the result of long and consistent teamwork. Deep experiences related to courses, workshops, and diagnostics were developed for each university and shared with others for increasing impact in Open Science and Open Education in Cuba. The draft is now the basis of the policy that will be extended all across the country on the topic.

To understand the partnering universities promote staff retention and better wages by not competing but to collaborating with the private sector, the evaluators visited some of the initiatives that can guarantee an early transfer knowledge dynamic, where specialists or PhD students remain connected and contribute to master programme formation at partner universities. Those were the cases of TECISS Interfaz SURL and Xetid (a State-owned tech company), where some of the students and professors work part-time, in a good environment. This system also allows the detection of young talents that could continue to work at the university and at these companies at the same time, in a virtuous circle. The talent plan is organized by the Ministry of Education (MINED), already at secondary high schools to identify them before they start at the university. The programme contributed to that, by finding spots for these talents to develop their ideas, with

access to resources such as the data centres or high-performance computers. University professors and faculty members from the programme offer participants lectures and trainings; they then become their supervisors and also members of the examination commissions where they discuss their dissertations, and finally turn into co-authors in articles, events and work with them as part of the teams that share the profits when the projects generate income.

Other local follow-up activities also take place, through scientific seminars which allow the professors to track the PhD students' progress, and also transfer knowledge to master students who continue to be involved as members of the research pool at partner universities. These factors allow a solid group of professors and specialists, with an excellent background and expertise, to remain active in both academic work and its private sector application. After the programme, the key Cuban partners expect a continued increase in scientific production and technological development at partner universities, with the comparable budget per year becoming available.

In the area of English, teaching and assessment relationships have been outstanding. Key related outcomes contributing to academic sustainability were the creation of a real community of practice and the Cuban Language Assessment Network (CLAN), with representatives of every institution in the country. The ELINF project set up an excellent communication system, each team has been able to maintain the exchange through Telegram groups and share training from the project's Moodle platform. UCI coordinates the ABCD and DSpace development teams, as well as the coordination of the PETICT (Professional English Training for ICT) group. To add, UCLV pays special attention to the results of the network and the two joint doctoral programmes. Several of the university's top managers are members of the project and are demonstrating important scientific results.

2.8 Scientific quality

Compared to the initial baselines in phase 2, the results were very good, in terms of articles published, PhD theses defended or presentations in events. The selection process of candidates for short training or PhD scholarships was developed adhering to the procedure (management manual) accepted by all partner universities. This process has been enriched with the online participation of Flemish experts and project leaders, taking advantage of the existing video conference facilities. The evaluators could use this infrastructure during an online collective interview with several beneficiaries. This has allowed partner universities to participate and lead 18 projects from national programme, and 8 from branch and enterprise programmes, funded by the Cuban government.

The scientific quality was also reflected in the (increasing) number of professors, faculty members and scientists from Cuban partner universities that participate as experts in important national commissions, such as the Cuban Academy of Sciences and the National Innovation Committee. Here, they contribute directly to the elaboration of policies on innovation, science and technology, and advise important decision makers, such as the President of the Republic.

All academic and scientific development achieved by partner universities during the NETWORK programme have consolidated the vanguard position of the partner universities on ICT related sciences and technologies. In synergy with a VLIR-UOS JOINT project, the NETWORK programme founded the Cuban academic supercomputing network, made up by three nodes in UCLV, UO and the state -owned enterprise ETI, from Biocuba Farma, strengthening the university-industry linkage.

The Summer and PhD schools aroused the interest of a broad audience and attracted international students and specialists from industry, some of them from Colombia. Nevertheless, the impact of COVID-19 limited international mobility, so UCLV it's starting to open this market again.

2.9 Brief assessment per project

It should first of all be noted that the scope of this end term evaluation only allowed an external evaluation of the Network programme as a whole; it did not include a full-fledged evaluation of each of the three projects implemented within this programme. Nonetheless a brief assessment per project provides additional foundation for the findings and conclusions at programme level. Doing so, it was difficult to evaluate the projects separately, because of the connections between the 3 of them. P1 usually does the research, while P2 collaborates with infrastructure (platforms & connections) and software. P3 creates capacities for P1-P2 to better communicate their research, collect and process the information, making it available for all. Therefore, in every achievement, product or service, the evaluators perceived that the 3 projects were present, contributing at different scales.

Finally, the evaluators started from the self-assessment reports and the scoring from the spider web (which complements the assessment based on the OECD DAC criteria). Where they wanted to nuance the self-assessment score, the evaluators indicate so in the text. The evaluators preferred to illustrate the criteria with the facts found during the evaluation.

Table 2 presents the scores as provided in the self-assessment per project. The evaluators consider that the quality and reliability of the self-assessment was good. The evaluators however consider that the score of P1 related to Finance/Economic Sustainability is rather low and that the actors involved were too severe on themselves, when considering the 38 contracts, some of them with their service fees already collected, trading with some of the scientific results. Some of these contracts were real from the first day, as usually the client comes with the problem, and the professors form a team in order to solve it. Sometimes they did a demonstration first, to show what they could do, like leaving a fully functioning device.

Table 2. Scores by project based on self-assessments (applying a scale of 1 to 4)

Programme	Network UCLV		
	P1	P2	P3
Sustainability (Q3)			
Finance/Economic Sustainability	3	4	3
Level of Ownership	4	4	4
Results will continue	4	3	4
Partnership (Q3)			
Quality of communication within project/programme	4	4	3
Academic interest and commitment	3	4	4
Project management (Q5)			
Value for money	3	4	3

Programme	Network UCLV		
	P1	P2	P3
Working relations with PSU	4	4	3
Active involvement	4	4	4
Mutual trust and joint decision making	4	4	4

Source: Self-assessments by projects

2.9.1 Project 1. Strengthening the research on ICT and its knowledge transference to the Cuban society (RESICT)

Relevance: RESICT and ELINF projects worked interconnected on a project for the development of an infrastructure for information management, which resulted of interest to several entities such as the Ministry of Energy and Mines and the Fishing Industry Research Centre and was supported in a contract processed by the UCLV interface company.

Six other projects were established with other VLIR-UOS funded projects, like the “Play for food!”: Improvement of food production and social welfare in the province of Camagüey. The first three were developed in an area of great relevance for Cuba such as food production and were coordinated by the University of Camagüey. The Resict project also supported them with human resources necessary to apply ICT in solving the problems addressed; including the enrolment in the doctoral programme of the members of these projects. The last one was coordinated by University of Hasselt and UCLV, with the participation of other universities involved in the Network ICT programme.

Efficiency: Transfer of ICT innovation and knowledge was increased, in comparison with the intermediate assessment. The legal infrastructure to do it was created, like the scientific-technological park at UCI. These new offices facilitate the transfer of knowledge, allowing the universities to trade with their scientific results. The incomes can be transferred to the research groups, faculties and students involved in the consultancy. The transfer of knowledge in the field of ICT was supported by holding various workshops with the participation of specialists from universities, software industry companies (such as Desoft, Datys and Xetid). Also, RESICT supported the participation in fairs of computer products and ICT services.

The development of a digital TV receiver prototype within the project, should go into production in 2023/24, so this will mean important profits derived from know-how transfer at country level. It will also save resources currently imported from China. The water resources management is another good example of transfer that will be detailed in the impact case. Other contracts are in process, to develop infrastructure for institutions information management, in ontologies and interoperability models with linked data, with clients such as the Ministry of Energy and Mines, the Pasture Station Indio Hatuey, and the Fishing Industry Research Centre. Joint tasks have been developed with companies such as Citmatel, who have funded applied research when introducing results.

New applications have been developed for the health sector, related to Covid19 and ataxia, where training have been done to prepare professionals to process signals and images, such as ray-X and other types of data, improving diagnosis. Other client sectors have been tourism and transportation: with opinion mining

techniques for tourist orientation and recommendation systems, or heuristic search methods for transport logistics.

Effectiveness: by the end of the implementation period, the expected outputs and outcomes were achieved with good quality. The main action was doctoral training, through 3 PhD schools, with scholarships for Cuban doctoral students at Flemish universities and joint PhDs, as well as postdoctoral scholarships. This allowed them to have access to new approaches, levels of development and introduction techniques for the results. It also became a continuous source for systematic exchange with Flemish experts.

Several workshops were held, with the participation of specialists from universities and from other productive and services institutions, in the field of ICT. They aimed at knowing the demands and offers in this field, promoting mutual knowledge and work relations, as well as disseminating scientific results. Within the framework of scientific conventions in the country, such as the Informatics Convention, workshops were held to promote the R-D-i cycle in the field of ICT, as well as workshops to discuss the integration between universities and other companies in the territories.

Important exchanges were held with experts from research groups in other countries, like the collaboration with the research lab on Artificial Intelligence of VUB (Prof. Dr. Ann Nowe, Belgium) and with the Universidad de Granada (Prof. Dr. Francisco Herrera, Spain), we got information about the elaboration of the strategy to develop AI in those countries. From there, members of the project prepared a proposal for Cuba, within the framework of a national research project called “The development of a Cuban AI strategy”, approved in 2021 by the Ministry of Communications.

The performance indicators referring to publications and papers presented at international scientific events are better than planned. The number of awards obtained was also significant.

The evaluators agree with the concept held by the project members, when they said that today scientific results are being introduced to solve socio-economic problems, as the academic sector can get profits from these projects.

The development of the ICT Network programme positively impacted the formation of English language skills, thanks to joint work with the ELINF project. This was a great help for the exchange between specialists, but also for the writing of articles and projects.

Inhibiting factors and actors: The COVID19 pandemic clearly had negative impact on the programme by complicating the already difficult economic situation in which the country found itself. An increase in the severity of restrictions imposed by the blockade on Cuba made it difficult to make money transfers, and to ship containers to Cuba. This created a more devastating impact on living and working conditions, provoking a wave of emigration, mainly of young and highly skilled people. Thanks to the ICT technologies provided by the project, virtual exchanges were however carried out.

Facilitating factors and actors: the governmental interest in Cuba in promoting digital transformation, foreseeing the use of information and communication technologies as a main driver of socio-economic development of the country. A system of national, sectorial and territorial programmes was created to promote scientific work and innovation. New structures were created, such as scientific-technological parks and interface companies between universities and clients. Also, the interest in promoting the informatization of the society encouraged the establishment of agreements and contracts between universities and companies.

Scientific quality: The PhD programmes in Computing at UCLV and (UCI) are both accredited as excellent by the National Board for Programmes and Institutions Evaluation in Cuba (JAN , Spanish acronym), and

hold the Award for quality given by the Ibero-American Association for Postgraduate Studies (AUIP in Spanish). The master programmes on ICT in all universities of the network have been accredited.

Impact: The **changes** detected were **positive**. Among the **intended**, we found the following:

- Human resources were improved through the doctoral, winter, summer schools and scholarships related to doctoral training. The development of joint PhDs and research training of Cuban PhD students at Flemish universities, as well as research trainings for members of the staff of doctoral programmes has strongly improved the skills of many Cuban researchers and collaborators. During the second phase, the project supported five Joint PhDs, four of which are expected to defend by the end of 2023 or beginning of 2024. RESICT supported other 6 scholarships for Cuban PhD students, who had the opportunity to work in laboratories with Flemish universities for two months. This increased their possibilities of accessing up-to-date scientific information, participating in seminars and benefitting from different exchanges with professors and other PhD students. Six professors from the staff of the doctoral programmes developed research training in the Flemish institutions. Three schools prepared specialists in novel topics in the field of ICT, with the presence of Flemish and Cuban experts (University of Pinar del Rio, 2019; University of Camagüey, 2020 and UCLV, 2022).
- Professors participated in six international scientific conferences, publishing scientific results and acquiring new knowledge. This activity also supported the acquisition of necessary credits for doctoral and master's degree programmes. The programme also supported scientific conventions of great importance in Cuba, at UCI for example, by giving key lectures, developing panels and workshops, disseminating the results of the project.
- Most of the publications came from P1, in collaboration with the other 2 projects, as stated 1.4. Analysis and findings at programme level.
- Members of the project have become advisers for politicians, helping to design the policies behind ICT.

Unintended changes: the complement with the private sector explained at programme level.

No negative changes detected.

Sustainability: all the levels achieved are considered high.

Institutional sustainability: The commercialization of academic results helps to retain the staff, and there is full support at this moment for that principle at different levels, starting at the presidency of the Republic, and ending at the universities. However, some of the former staff members went to work for new economic actors in the country, or for foreign institutions, and the vast majority of them maintains excellent working relations with their group of origin, facilitating the establishment of new cooperative relationships for joint work. This already happened with TECISS Interfaz SURL, in the impact case.

There was a strong support at all 5 universities for the development of the activities that the project has planned for their benefit. The evaluators could also witness the active participation of the decision makers of these institutions in the activities and monitoring the development of the project. They also contributed with additional funds and logistics, for the implementation of the planned project activities at their site.

Financial sustainability: The scientific results in topics such as the Internet of Things, Data Science, Artificial Intelligence and High Performance Computing, facilitate the generation of products and services that are attractive to different socio-economic agents in the country, establishing cooperation agreements and contracts. The acquisition of new knowledge and the infrastructure created allowed the establishment of new attractive academic offers for specialists both at national and at international level. Also, doctoral students from abroad enrolled in the doctoral programmes.

The establishment of new international cooperation projects also contributes to sustainability. For example, a project was approved to develop a joint doctoral programme in Artificial Intelligence financed by AUIP, where participating institutions include the University of Granada (Spain), and Cuban universities UCI, UCLV, and Technological University of Havana (Cujae).

Academic sustainability: a good quality sign was that more students than the quota assigned to each university participated in activities such as doctoral, winter or summer schools. More students are waiting to be chosen. There are durable contracts with specialists from other institutions, for them to participate as professors in those schools.

The results of the project improved the country's digital transformation policy since it allowed the formation of more qualified human resources and the generation and assimilation of useful knowledge for Cuban society. It also contributed to the strategy of government management based on science, in which information technologies, due to their transversal nature, play an important role.

2.9.2 Project 2. Open ICT Systems and Management

Relevance: The main goal was to create the technical capabilities and staff knowledge to keep running a stable and secure computer network with services to support the teaching and administrative processes within the member universities and for other associated companies. This was aligned with the country's government strategy for the informatization of society and digital transformation. In a country like Cuba that does not have access to many markets due to the US blockade among other reasons, having networks with high quality standards, data centres with high computing and storage capacity, people trained to manage and expand that knowledge represents a huge strength and saves critical resources. The infrastructure donated/purchased by the project has been used by the other two with excellent results.

Efficiency (including partnership and project management): The evaluators could see a stable and performant network infrastructure at university campus level, and during the virtual meetings they could perceive how good it was in partner universities, except for UCI, which they visited. These intra and extra-nets enabled collaboration, resource sharing, and access to external information and services among the network participants. The number of users on the network has increased and there has been a shift of users from the wired to the wireless network. It opened up the possibility of offering new services and applications that took advantage of the mobility and flexibility of the wireless network.

One of the project's objectives was to improve the preparation and work performance of the area's employees. To this end, a series of training, support and recognition actions were designed and implemented. As a result, members of the project offer a range of services such as training, consultancy, research, networking, dissemination and evaluation, which are tailored to the specific needs and objectives of each client. The services are provided by a team of qualified and experienced professionals who have extensive knowledge and experience in their respective fields. They are part of the teams that signed the contracts described in P1 and also the impact case. Other contracts will be analysed in the **Sustainability** criterion.

Effectiveness: outputs and outcomes were achieved by the end of the implementation period with good quality. The universities that are members of the project today have almost all the systems that are used running on platforms based on free software. The work with the other projects also helped to achieve software migration: for example, the platforms selected for project 3 fulfil with the requirements of project 2. These policies and practices have been periodically shared with the rest of the universities, with other companies in the country and with the growing private sector.

Inhibiting factors and actors: countrywide shortfall in power generation, causing blackouts. This affects the stable operation of servers, which can suffer interruptions, loss of information or irreparable damage.

Some proprietary systems remain almost entirely located in the areas of economics and finance, such as ASSET. These legacy systems are used at country level and their change does not depend on the universities.

Facilitating factors and actors: To avoid damages caused by blackouts, energy saving techniques have been applied to allow a more rational use of energy and reduce the environmental impact: optimizing the design and location of servers, implementing efficient cooling systems and monitoring server consumption

and performance. The use of modern equipment has also allowed a greater concentration of services and a smaller number of servers.

Scientific quality: The dissemination of practices to implement free software was successful through events, workshops and forums. It allowed the universities involved to influence the decisions made by these entities. The support by sharing resources and access with these sectors was important for the computerization of their processes, improving work quality for professors and directives, by saving time, labor and being able to take decisions in less time. This set an example and influenced the use of best practices at country level. The improvement of the infrastructure of the networks has been higher than expected in some cases thanks to the donations received from the University of Ghent.

Impact: The **changes** detected were **positive**. Among the **intended** we found the following:

- Integration with other universities during the isolation by COVID when the online work was necessary and possible thanks to the infrastructure available purchased/donated by the project.
- Joint work with other foreign projects such as “Strengthening Universities and Research Centres with Renewable and Efficient Energy” financed by the European Union, and VUB as counterpart, or “Strengthening Research Practice in Biopharmaceutical In Silico Modelling through Scientific Computing Programme of Institutional University Cooperation (IUC)”, with the Flemish Interuniversity Council, with Universidad de Oriente.
- Contracts with state-owned enterprises and an institute related respectively to health and water as a public service, permitted to improve the quality of both services at country level.

Unintended changes: the complementarity with the private sector explained at programme level.

One negative change was also detected: Staff retention became a bigger problem after the trainings and workshops. After spending time and effort building capacity for some members of the project, they decided to migrate to the private sector or abroad. This made continuity and team cohesion difficult, so git repositories became an option to keep track on the apps they designed, or the services they rendered. At the same time, if the former employees keep in good terms their relationship with the university, cutting ties it's not an option anymore, but an opportunity to explore and consolidate new and maybe more profitable joint work.

Sustainability:

Institutional sustainability: The Direction of ICT is attended by one of the vice-rectors in all 5 Cuban universities, allowing to take decisions faster and with a more direct impact. The project can keep the infrastructure purchased/ donated for 3 years without big investments thanks to the high-quality devices acquired through the project. It will be difficult to increase services and coverage, but current services are guaranteed.

Financial sustainability: 5 contracts and agreements have been signed with several Cuban companies, for \$1,638,016 cuban pesos. The clients were ETI, Instituto Finlay de Vacunas and Cubahidráulica, and the intermediaries were CIH, UNAIC and SICTE S.A, in a win-win cycle were project members, UCLV, an NGO, MES and other actors are benefited. It also represents an inflow of capital for the sustainability of the equipment and an improvement in the salaries of workers.

Academic sustainability: ICT systems and infrastructure are today the main tasks in the daily work in all partner universities of the programme. It also plays an important role in the evaluation process made by MES every year. Services, know-how and procedures will be easy to keep unless the staff decides to migrate, and even so, measures were taken in order to ensure continuity, as described in the **Impact** criterion. The project achieved a high level of communication among its participants and with other related projects. The project leaders coordinated their actions through videoconferences and visited each university at least once a year, with the exception of the isolation imposed during COVID. The project has become an example of good practices within and outside the Ministry of Higher Education.

2.9.3 Project 3. ICT supporting the educational processes and the knowledge management in higher education

Relevance: The project drafted recommendations for MES in infrastructure and academic research for management information. There were synergies with another VLIR-UOS projects and another network with Ecuador, Peru and the University of Havana (UH). Ecuador and Peru helped to acquire IT software for authority control, while the project provided IT support for publishing, education and research management, as well as policies proposals for those processes. There were other synergies with projects of CITMA, the British Council in Cuba and the UNESCO Office in Havana. With CITMA they participated in discussions and workshops on R+D+i projects and exchanged information about open science. They used ELINF metadata models and recommendations for open science implementation. ELINF designed a new project for MES with BC funds in the topic of English assessment and learning in Cuban higher education context, which is in force until today. ELINF also used UNESCO's network to do synergies with other LATAM initiatives related to open education, and their recommendations for open educational resources development, which they applied for Cuban universities.

Efficiency (including partnership and project management): all of the results transformed in 29 IT services offered to non-partner institutions, such as the National Institute for Sports (INDER in Spanish) or the Centro de Investigación del Petróleo y Minero Metalúrgico (Center for the Research of Petroleum and Mine Metallurgical), along with 31 software installations and 56 specialists trained about solutions to support an integrated approach on open education and open science in higher education institutions. This meant 4 contracts with profits for the professors involved in the amount of \$342899.9 pesos, from year 2021 to 2023, using SICTE as intermediary.

Effectiveness: outputs and outcomes were achieved **by the end of the implementation period** with good quality, by creating and implementing a system of technological platforms in all partner universities to support open science and open education. This included English teaching.

Inhibiting factors and actors: the impact of COVID-19 pandemic mainly in the software development process.

Facilitating factors and actors: the university authorities designed specific workshops within the international conventions of the partner universities, along with fairs and events, related with open science and open education, or made it part of the discussion topics. During COVID-19 pandemic, several workshops and training were developed in online and hybrid formats to open education and research at universities, increasing the impact in society.

The adoption of open science and open education approach was traversed by the consultation, study and exchange of scientific information. The results could be perceived during the registration and active participation in international communities, not only for software development, but also for educators and researchers, using English as work language, thanks to the training given by the professors, specialized in academia. The latter also trained teachers from a long list of beneficiaries outside the Network. At the same time, to support such training they developed virtual courses over Moodle, and a lot of educational resources.

During Covid19, the government adopted some decisions related to cost free use of Internet access for teaching and academic purposes using Moodle platform. Access to repositories (Dspace-based) were also free of cost and the same happened to Moodle.

Scientific quality: all partner universities have an updated and standardized version of Moodle as a Virtual Learning Environment, Dspace as a digital repository, and ABCD as a Library Management System. A group of applications was also included as support: 'Authoritas' as authority system and VIVO for research and researchers management. The first edition of the International Seminar "Open and Linked Information Framework for Education and Research" (OLINFER), explored linked data, interoperability, open science and open education. After that, the project concentrated in the mapping of the metadata models of all the applications, the development of links among the data and the workflows of the applications, the openness

of the processes of education and research, and the training of English professors and project members about how to consume and socialize technical information related with those topics when interacting with international experts and communities of software developers. Links were made between all the platforms through software source code, so it was easier to get the information for the students and the staff.

Several workshops, courses and trainings took place, spreading the results into the Cuban society, such as the stakeholders and beneficiaries of the Network.

Impact: *The changes detected were positive. Among the intended, we found the following:*

- Several trainings, internships, conference attendance, IT services, educational modules and resources were developed, for the partner universities, other collaborators and clients. New software features, architectural models, patterns and metadata framework were created to support the links among the software within the ELINF Technological Ecosystem (Cuban Virtual University). Members of the project did eight presentations, with their correspondent publication in 4 international conferences related with the interoperability to support open science and open education.
- 11 virtual courses and educational resources were developed by the project teammates at all partner universities, to train software developers, open science and open education practitioners, and specialists from inside and outside of the project. A Technical Webinar Series took place in 2021, about Distributed Software Engineering (DSE), Free and Open Source Software (FOSS) approach. That became a response to the pandemic impact when all activities were moved into a virtual format.
- The shift in the conception of education and research made by higher education authorities at MES and partner universities.
- The group integrated by English teachers and experts in all partner universities, made possible a methodology and a framework for the assessment of English skills development, implemented in all Cuban universities). They developed virtual courses and educational resources for English training and autonomous learning, implemented workshops to socialize and spread the knowledge acquired within the project. They also collaborated with foreign universities and international organizations, executed trainings in Cuba for project members, stakeholders and beneficiaries about Academic English for Professional Purposes (AEPP).

Unintended and also positive **change:** recognition by the authorities of MES of the outputs and contributions from the project to the embracement of the open science and open education approach.

No negative changes were detected.

Sustainability

Institutional sustainability: The English professors lead the national group of experts at MES who worked on the Cuban Methodology for English knowledge certification and assessment supported by ICT, which is nowadays nationally adopted. The university authorities have kept and improved the mechanisms to promote open education and open science. For example, all of the events have hybrid format taking advantage of the infrastructure provided by the project, and the sessions are recorded and available for everyone.

Financial sustainability: good synergies and connections were made with other VLIR-UOS projects and networks, as well as foreign institutions, regional and international organizations, and associations to support further scientific and financial sustainability with new initiatives related with open science and open education. More contracts than the ones mentioned in **Efficiency** are intended to be signed with the same clients and others, for follow up, maintenance and new services. The conception of consultancy and advisory services related to recommendations and strategies for open science and open education approach implementation, its diagnosis; policies definition and implementation; installation and management of education and research platforms; staff training in those topics among other. One of the contracts mentioned in the **Efficiency** criterion, about Open Science Ecosystem in universities of MES, is expected to bring \$463,208.31 pesos from year 2024 to 2026, just for the professors involved in the service as providers.

Academic sustainability: IT changes will be present because software functionalities need updating. Also, the group integrated by English teachers promoted new projects and initiatives in Cuba, with MES and foreign funds, for further sustainability of the project achievements. 10 members of the project did internships in Germany and Belgium with specialists and experts in English assessment and learning. Professors from the language centres of the University of Bremen (Germany) and the Hasselt University (Flanders) also visited Cuba several times to train larger groups (including stakeholders and beneficiaries from outside the Network), and to follow-up the implementation of the project achievements. A new project coordinated and financed by the University of Bremen, the British Council in Cuba and MES, is running since 2022. The first 2 co-financed workshops, trainings and attendance of four project members to International Conferences related to English learning. As a result, the partner universities became local hosts for training and consultation about English teaching.

On the part of Scientific information specialists, the training in Cuba was accompanied by a set of Internships in Belgium; 16 members of the project visited Flemish universities to be trained in topics of DSE, FOSS, policies and public management on open science and open education. This impacted the finalization and dissertation of four undergraduate term papers and three master studies. There are synergies with another VLIR-UOS project and a Network in Bolivia and Peru, with the participation of an expert of MES.

3 Impact case

Impact claim: The University contributed to the renovation of water management as a public service, using innovative tools and new technologies

Effect/change that is observed/ noted	Appreciation effect / change ¹⁹	Significance of the changes with regards to the overall objectives of the Network programme	Contribution of the project/Network programme: what mechanisms have played a role (from the programme and from the university) – only when moderate and strong evidence for occurrence and contribution of the mechanism	Other mechanisms: rival and context (only when moderate and strong evidence for occurrence and contribution of the mechanism)
Installation of cloud computing services	strong	The clients were GIAT and INRH, so the services comprehended and benefitted water management in all provinces. 2 contracts were signed, one in 2018 and another one in 2019, for \$344,155.38 pesos in total. Part of the income stayed at UCLV, part of it went to MES, CIH as intermediary and the professors who provided the service. In all cases, the profits supported higher education, and involved professors received an extra source of income. They also saved resources for the country: as free software was used there was no need to pay for licenses, nor was it necessary to hire specialists from abroad	Project mechanisms: Training and stages to acquire knowledge in Belgium on cloud computing services, software customization, development, installation and customization of Internet of Things (IoT) platforms and also the exchanges with the specialists who came to Cuba, were applied in the scientific services given. In these cases, the collaborative mechanisms designed for PhD training between the programme and the universities played a significant role: 10 students are linked to the results with their theses, 7 Cuban and 3 from Belgium, 3 of them with double qualification in Flemish	Rival mechanisms: UNDP programmes; project with Universidad Tecnológica Metropolitana and Universidad del Bio, both from Chile; Universidad Federal de Paraná in Brasil and Université de la

¹⁹ Appreciation strength of evidence for effect/change by evaluator (none, weak, moderate, strong) + description of evidence

Effect/change that is observed/ noted	Appreciation effect / change ¹⁹	Significance of the changes with regards to the overall objectives of the Network programme	Contribution of the project/Network programme: what mechanisms have played a role (from the programme and from the university) – only when moderate and strong evidence for occurrence and contribution of the mechanism	Other mechanisms: rival and context (only when moderate and strong evidence for occurrence and contribution of the mechanism)
Rehabilitation of hydrometric stations using FORSAT (SEBA technology) and Caribe HYCOS (OTT technology)	strong	Starting with UNDP programmes with high impact in society, through the monitoring and responding to emergency situations more quickly and effectively, and improving public safety. It also impacted agriculture, specifically rice production. The clients are INRH, GIAT and 2 other enterprises in Villa Clara, Santi Spiritus, Artemisa and Matanzas provinces. 2 contracts were signed, one in 2021 and another one in 2022, for \$1,658,000.00 pesos in total. In this case, SICTE and UNAIC were the intermediaries.	universities and Cuba. 6 other students doing their MSc. degrees are also related to water management. The students and professors joined in field missions to collect data on progress (PhD research) and to give access to some inputs to the staff in charge of measuring (new devices, software installation, testing). Multiple Feedback meetings to assess utility of products and services helped to design and adjust them according to the client's needs. Hydraulic Utility Company of Villa Clara as demonstration becomes the lab to test devices, software and platform, to be then generalized for the rest of the country. The skills developed in English by the programme were also used, as programming is in that language, and also that's the common tongue in free software.	Sorbonne Paris, France
Software customization to SOFREL technology hydrometric stations for its integrations into SGIA information system	strong	The clients are INRH, GIAT and 2 other enterprises in Havana. There is a contract under review		

Effect/change that is observed/ noted	Appreciation effect / change ¹⁹	Significance of the changes with regards to the overall objectives of the Network programme	Contribution of the project/Network programme: what mechanisms have played a role (from the programme and from the university) – only when moderate and strong evidence for occurrence and contribution of the mechanism	Other mechanisms: rival and context (only when moderate and strong evidence for occurrence and contribution of the mechanism)
Design and implementation of new automatic hydrometric stations into SGIA information system	strong	The clients are INRH and 2 other enterprises in Villa Clara and Sancti Spiritus, with one contract using the private LLC TECISS, and the other one with UNAIC, for \$ 685,000 pesos. There is another contract signed for \$ 363,000 pesos, invoiced to the EAH of Villa Clara. The innovative station helps reach technological sovereignty, where the knowledge behind VLIR-UOS and UCLV formed. The devices created impact agriculture, livestock and create new capabilities for the early warning system of natural disaster. Lives and resources will be saved, because there will be more time for evacuation and securing property	communities, where exchanges happen all the time. The possibility of publishing 11 articles and presentations, all of them in English and in high impact reviews and events, increased the visibility and the reach of the research results obtained. The latter was also possible thanks to the programme funds in hard currency, which could be used to pay for publications in prestigious reviews. 5 awards were obtained, including the National Award from the Cuban Academy of Sciences in 2017, and the Best PHD Thesis in Telecommunications in 2015	
Development, installation and customization of an Internet of Things (IoT) platform for hydrometric stations	strong	The client is INRH for the entire country. The contract is the same as the first case. It impacts society by automating processes and connecting devices, leading to increased efficiency and the veracity of hydrometeorological information for water	Collaborative mechanisms: Client budget for supporting field work of all PhD students; Network programme budget for professors and PhD students to acquire the necessary knowledge that was later used in the apps and devices; PNUD funding part of the	

Effect/change that is observed/ noted	Appreciation effect / change ¹⁹	Significance of the changes with regards to the overall objectives of the Network programme	Contribution of the project/Network programme: what mechanisms have played a role (from the programme and from the university) – only when moderate and strong evidence for occurrence and contribution of the mechanism	Other mechanisms: rival and context (only when moderate and strong evidence for occurrence and contribution of the mechanism)
Achievement of technological convergence for different technologies in hydrometric station (OTT, SEBA and SOFREL) that interact through the IoT platform to report information to the SGIA information system.	strong	management. At the environmental level, it reduces waste and conserves energy by optimizing resource utilization	devices and electronic components for hydrometric stations. Contextual elements: Students and professors from UCLV have capacity to create and implement innovations. In the case of the professors, they also have strong national and international experience in development of software applications and devices. The programme provided some of the equipment used to develop the prototypes. As by now they are well known in the industry, they are well networked at country level: INRH and GIAT as State entities want them to provide their services and products to the rest of the provinces.	

Conclusions: The change in terms of significantly improved water management was the result of a combination of project mechanisms such as PhD training, collaborative mechanisms such as network programme budget for professors and PhD students to acquire the necessary knowledge, and contextual elements like a favourable policy from State entities, which are also clients, to support water management to save resources, substitute imports, and care for the environment. The outcomes for water management generated by the programme are linked to six major, technology related, and achievements with sustainability guaranteed for several years through contracts already signed, and others in review.

The partners involved in this impact case accomplished every goal that the programme stood for: know-how transfer obtained through training, prestigious publications, PhD and MSc. students graduating, awards among others.

No export for these services or devices is foreseen so far, yet related opportunities could be leveraged (refer also to the corresponding general recommendation provided at the end of the report).

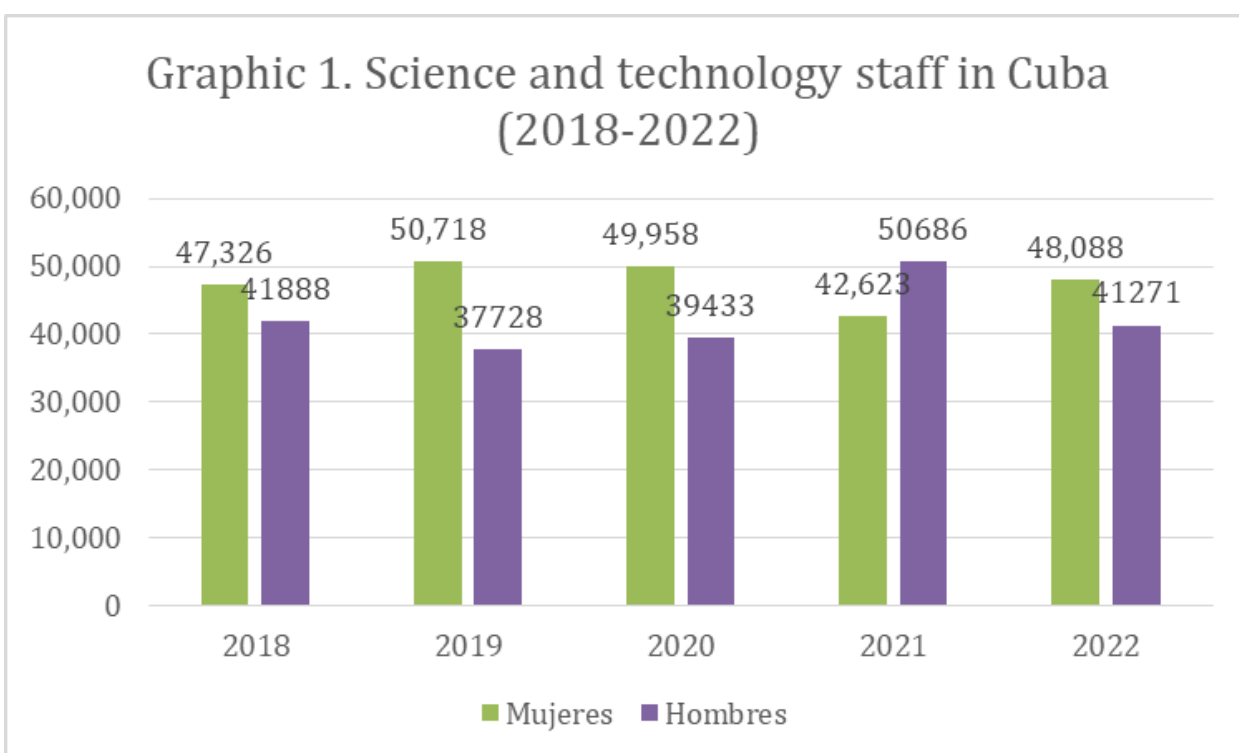
This project qualifies as an outstanding success story (and business card: university professors rehabilitate one hydrometric station looking to provide their services in one company in their province and end up providing a package of improved and newly designed software, devices and procedures nationally, with impact among the general population and industries receiving water through the national distribution system).

4 Findings on the learning questions

4.1 How to support PhD trajectories, with a focus on optimizing diversity/inclusivity (gender and Leave No One Behind)?

The programme directly supported 9 PhD students: 5 men and 4 women.

A review of official statistics, for the last 5 years, shows that more than 53% of staff in science and technology were female, except for year 2021, where only 45.7% were female. The next graphic shows the figures.



Source: elaborated by the evaluators on ONEI figures

These figures include directives, technicians, administrators, operators and services workers.²⁰ In the opinion of the evaluators, the selection of the students counteracted the tendency, and we find it correct, because although the difference was not that big, choosing more men when there is a majority of women in the science sector is one of the ways to keep the balance. Also, as the selection process of candidates was developed adhering to the procedure (management manual) accepted by all partner universities, this meant that gender was not a bias, at least not in the way the evaluators have just synthesized. The Joint PhD scholarships and the scholarships for Cuban PhD students were based on a selection process, which considered the level of preparation of the candidates, the definition of the research work to be carried out, their skill in the English language, and their previous link built with Flemish researchers.

²⁰ Oficina Nacional de Estadística e Información (2022). Table 16.2 - Trabajadores físicos en la actividad de ciencia y tecnología según categoría ocupacional, Havana, ONEI.

The Cuban Federation of Women, has done much work over the years to bring equality for women²¹, so in important areas such as science, law or the Parliament, they are a majority. The local coordinator at UCLV, Hector Cruz Enriquez, informed us that when choosing the students, they tried to keep a proportion in gender, but not taking on account the statistics at country level. For this reason, one of the recommendations goes in that direction.

With regards to 'Leave No One Behind', all of the students finished their studies with the support of their respective institutions. In Cuba, according to the Labor Code, workers have the right to study under the principle of using their free time, except for cases of special State interest.²² Based on that, university authorities exempted PhD students, who were also professors, from teaching and other bureaucratic processes, such as group guide or control inventories. Thanks to those measures, **the doctoral students could focus only on research, and also felt stimulated to stay in the higher education sector**, thus providing a support that is hard to find in the private sector. At the same time, they could see sooner how their results were introduced through publications, events, and even get additional revenue for providing scientific services through collaborations with the private sector.

4.2 What factors and measures, at VLIR/IUC level and/or at partner institute level, support effective programme coordination?

At VLIR level: the evaluators could see the deep level of understanding of the Cuban reality that VLIR representatives achieved. Many trips to Cuba, with constant exchange with partner universities through multiple field visits can bear witness to the amount of effort which has been put in. The results are clear, for example the creativity when evading the US blockade when shipping containers to Cuba, with all the equipment donated/purchased, or when transferring money every year.

VLIR was also flexible when the pandemic began, as they gave an extension for the network programme to finish pending tasks, which also made it possible to achieve the good results the evaluators perceived. All the interviewed focal points talked about this topic, also remarking their thankfulness in general.

When filling out the spider web tool for the network's collaborative performance, the evaluators reflected on the answers and found that it offered a good picture on how strong the collaborative process with Flemish universities and VLIR was. The same was true between the focal points and the rest of the beneficiaries. During the field mission, every site visited was filled with a feeling of people ready to give as much information as they could, the evaluators found highly committed teams ready to proudly show their research results at the highest scientific level.

At partner institute level: there was a clear priority given by MES, which considered the programme the most important they had for the past 10 years. No wonder the field visit started and ended there, the only reason the Minister himself was not at the meetings was because he was traveling to China, but nevertheless, he left instructions to ensure that all the specialists who worked with the programme at MES level were available for any information or consultation the evaluators could need. Governmental support is therefore a very important factor.

²¹ Álvarez Suárez, M. (2022). *Igualdad de Género en el Sector Público en Cuba. Informe de sistematización de experiencias* [Gender equality in the Public Sector in Cuba. Report on experiences systematization]. La Habana, Centro de Estudios de la Mujer; Díaz Medina, Y., Álvarez Suárez, M. (2021). *Mujeres en Cuba. Una revolución en marcha*, La Habana, Centro de Estudios de la Mujer.

²² Ibidem; Oficina Nacional de Estadística e Información (2022). Table 4.1 Proporción de mujeres juezas en instituciones del Poder Judicial; Table 4.4 Proporción de mujeres fiscales; Table 4.3 Proporción de escaños ocupados por mujeres en el Parlamento Nacional. Havana, ONEI.

We must also highlight the focus on forming a good team. As described in the Effectiveness criterion at programme level, the focal points and other coordinators were stable, some of them even came from the former IUC programme, so this was also important, as there was less time needed to train the new staff, which could focus directly on the pending tasks and the new goals for the network.

Another important factor was how university integration deepened with the programme, as many inter- and transdisciplinary teams had to be formed in order to solve the problems. The impact case is a good example demonstrating how the 3 projects were integrated to better manage water as a public service at a national level.

Last but not least, the evaluators witnessed good engagement with the local governments of Villa Clara and Havana during the field visit. With so many crises creating scarcity in basic needs, critical resources such as fuel were centralized. Since the evaluation was a priority, everything was guaranteed. For example, without the help of the local government, use of the public train to get in and out of UCLV campus from the city centre would not be possible, and today it's the main source of transportation for students and professors there.

4.3 How to ensure uptake of research results or new educational practices by political and societal actors and end-users?

In Cuba there was already an awareness among the authorities at all levels about new educational practices, that's why the recommendations coming from the programme, concerning open science and open education, were generalized by MES at the national level. The leadership knows this broadens the reach of education, and at the same time saves resources in hard currency by circumventing the need for certain imports.

The desired sustainability of services and production resulting from the programme are yet to be evaluated, but the ways to achieve it have also broadened, both in the public as well as in the private sector. Just 2 years ago it would have been impossible to think about the private sector as an active actor in university processes, and the evaluators see it as a positive sign of changes in the country, with an impact in the programme. At the university, there are processes that naturally need to be maintained, such as training, the updating of repositories and know-how transfers.

Sustainability is a key factor in acquiring new equipment due to programmed obsolescence, and this must also be well planned financially, in order for the accountancy departments to create mechanisms, such as creating special sub-accounts for the most complicated and expensive items, such as the servers for the data centres.

The updating of the created software applications and devices must be well protected by intellectual property, so the existing alliances with the Law Department through a monitoring system, which allows entities and persons to start the paperwork from the moment a new product or service is envisaged, to avoid delays in future commercialization is also paramount. This could be inserted into future projects of collaboration. Also, the socialization of good practices at places linked to production like UCI, would also be recommended.

Increasing the enrolment in advisory committees, at the country level where educational policies are made, is the last measure the evaluators conceive to ensure the uptake of research results or new educational practices. Following the 2011 National Guidelines for Social and Economic Policy, the Cuban government has increased the use of academics in temporary work groups where policies are made. This ensures that at least part of the content of the policies has a scientific background, as the experts recruited in these groups usually use their own research when conducting specific research required by legislators.

5 Conclusions

Following a successful IUC programme at UCLV, VLIR-UOS continued to support an additional decade of partnership between Cuban and Belgian universities, through the network programme evaluated in this report. Under the given circumstances, the collaborative process was considered to be strong with competent representation in the network structure, leadership and process. The embracing of diversity and sustainability has been duly noted, and the common efforts and positive attitude allowed for all parties involved to mutually benefit from the venture.

The six evaluation criteria (cf. DAC-OECD evaluation guidelines) with corresponding evaluation questions were assessed at programme level, supported by project level self-evaluations. The evaluators consider that the programme's performance is outstanding.

Relevance: The programme's excellent relevance is evident as the most important results and outcomes are already adopted and generalized in all the universities of the country, becoming part of MES policies in the topic, such as the environment created for open science and open education.

Coherent: all projects and their teams worked in an interconnected manner, transcending disciplines, and in synergy with other foreign actors; this is expected to continue in the years to come.

Effective: as the outputs were achieved at an outstanding level, solving problems in public services like health using last generation technology, overcoming the inhibiting factors and actors, and taking advantage from every facilitating opportunity.

Efficient: as the services and products which came out of the programme are protected by law and commercialized, or in the way to do it.

Impact: as the evaluators could detect the changes, and assess if they were positive, intended or not. Even the unintended changes were considered good, as the complementarity with the private sector was a surprise after so many years debating the topic for a socialist system.

Nonetheless, the programme needed to cope with negative evolutions in the context too. Covid 19 delayed several tasks for months, some of the staff even abandoned the country, as well as some of the students supported by VLIR. Nevertheless, good lessons and perspective changes took place, like consolidating ties with emigrant professors who wish to continue collaborating with the university.

Sustainability: as the evaluators could confirm the potential of the network of enterprises in charge of commercializing the products and services obtained thanks to the programme, and the contracts derived, benefitting higher education from the professor to the Ministry level. The current and future contracts can ensure income for the next few years, as there are country level problems that could be solved. These will need constant updating, maintenance and training for the specialists in charge of the equipment at the client's offices.

The **impact case** related to water management demonstrated a solid impact claim. The evaluators consulted with the focal point and appreciated a clear network of clients all across the country, and among the university professors as providers. Existing and potential impact resulting from innovation in water management was perceived all the way, with impact for the prevention of natural disasters, environment protection and better service quality at providing water for the population. Six major achievements were described, all technology related, with sustainability guaranteed for several years through contracts already signed, and others in review. The case accomplished every goal that the programme stood for: know-how transfer obtained through training, prestigious publications, graduation of PhD and MSc. students, awards among other.

Lastly, the findings on the 3 **learning questions** made the evaluators reflect and make recommendations on gender and uptake of research results. In essence, high complex tech problems could be solved in less time, which translated into better decisions, with free access to high tech resources for specialists all over the country.

The evaluators conclude, after assessing all the available materials and processing the results from the field visit, that the design and implementation of this network programme were excellent. The goal 'to strengthen the role of ICT in Cuban universities for the development of the society' is considered accomplished.

6 Recommendations

For Cuban and Flemish universities jointly:

- To align PhD requirements between Cuba and Flemish universities in articulated agreements in Joint PhD programmes (e.g., required number of articles to be published in order to defend a thesis).

For the Cuban universities:

- To consolidate products and services for the Cuban export portfolio, directed to the Ministry of Foreign Trade, Cuban Medical Services S.A., the Ministry of Tourism among other institutions, for the services and products obtained with the support of the programme.
- To enhance the agility of commercialization through the university Interface Company or other enterprises, to guarantee sustainability, motivate more the professors with a share in the generated revenues, and guarantee continuance in further projects.

For VLIR-UOS

- With respect to gender, diversity and inclusion, there is a need for policies, guidelines and approaches, to be adopted in agreement with partnering universities, which effectively take into consideration particular country/local contexts in order to set goals and targets which connect to specific contextualised needs.
 - Proactively promoting gender equity in one country or programme might mean targeting an increase in the number of female PhD candidates, while in another country / programme the reverse might be needed to reach a gender balance, due to a prevailing underrepresentation of men.
 - Other areas of consideration could be maternity leave or co-parenting obligations which may call for corresponding 'reasonable accommodation' responding to specific types of stakeholders (e.g. among a broader group of potential PhD candidates).
 - Related guidance can be included in the management manual and the universities should go through the exercise of designing their locally informed gender balance targets and other markers for equal opportunities and diversity; including considering geographical origin, rural-urban participation, etc. This is about stimulating the development and adoption of locally informed strategies to deal with Gender, Special Needs, Diversity and Reasonable Accommodation, etc.
 - A clear VLIR-UOS posture acknowledging country/context-specific conditions will encourage participating institutions to find innovative ways of embracing diversity.

7 Annexes

7.1 List of documents consulted

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7.2 Field visit programme

Day	Activities
1.	Welcome from the UCLV management and institutional presentation highlighting the impacts of the ICT-NETWORK programme at UCLV. Presentations of the ICT NETWORK programme by the coordinator and project leaders. Workshop on spider web collaborative processes. Interviews with team members of the ICT NETWORK programme at UCLV. Presentation of impacts at the institutional level in terms of infrastructure and network services, Data Centre, scientific computing/HPC and BigData, digitalization of university processes and Internet of Things technologies (applications)
2.	Visit to the installations of the UCLV Scientific-Technical Information Centre (CDICT). Presentation of scientific results in open sciences and open education, research data management, Moodle, DSPACE, vivo and English learning. Presentation of scientific results in applications based on ontology, Artificial Intelligence and applications, signal and image processing and digital television setup box. Focus group with ELINF (project 3) stakeholders (UCF, ASCUBIVC, UMCC, INDER, INIVIT, Indio Hatuey). Visit to enterprise XETID and the University-Industry enterprise SICTE S.A. Visit to the branch of the National Union of Architects and Engineers of Cuba in Villa Clara
3.	Visit to the hydraulic exploitation company in Villa Clara. Visit to MiPyMe TECISS. Visit to Health institutions beneficiaries of the project. Partial conclusions at UCLV
4.	Welcome from the UCI management and institutional presentation highlighting the impacts of the ICT-NETWORK programme at UCI. Presentations by projects' focal points at the UCI. Visits to CENED and CENID. Visit to data centres. Impacts on ICT infrastructure. Presentation of scientific results from research labs: IA-RP., scientific computing and the projects "Platform for the analysis of large volumes of data and its application to strategic sectors" and "Lisa as a smart and sustainable city". Exhibition on Systems developed by Project ELINF - ABCD, RepXos, Arkeia, DspaceCRIS, Interactive Virtual Catalog and Technological Observatory. Visit to Havana Tech-Transfer technological park
5.	Visit to the Information Technology Enterprise (ETI) of Biocubafarma. Visit to selected UCI stakeholders and institutions in Havana: MINED ICT department, MINSAP (National Centre for Minimum Access Surgery), National Institute of Hydraulic Resources (INRH). Conclusions of the evaluation mission at the International Affairs Direction of MES

7.3 List of people consulted/interviewed

Prior to the visit

Nr.	Name	University	Position	Date
1.	Ann Nowe	Brussels	NETWORK Coordinator	14 September
3.	Dieter Roefs	Gent	NETWORK advisor	19 September
4.	Marc Goevaerts	Hasselt	NETWORK advisor	20 September
5.	Paul Cos	Antwerpen	NETWORK advisor	20 September
6.	Ann Cuypers	Hasselt	NETWORK advisor	21 September
8.	María Victoria Villavicencio Plasencia	-	Head of International Affairs, Ministry of Higher Education, Cuba	22 September
9.	Raúl Hernández	-	Adviser, Ministry of Higher Education, Cuba	22 September
10.	Philippe Meers	Antwerpen	NETWORK advisor	24 October
11.	Kris Steenhaut	VUB	NETWORK advisor	23 October

Field visit

Kick-off workshop

Nr.	Names	University/other	Position	Date
1.	Peter De Lannoy	VLIR-UOS	Global Partnerships Coordinator (IUC, TEAM&SI)	28 June
2.	Joshua Eykens	VLIR-UOS	Coordinator	28 June
3.	Patrick Stoop	C-lever	Consultant - general managing partner	28 June
4.	Teresa Orberá Ratón	UO	local coordinator	28 June
5.	Hector Cruz Enriquez	UCLV	local coordinator	28 June
6.	Antonio Carmona Báez	San Martín	Evaluator	28 June
7.	Seida Barrera Rodríguez	Havana	Evaluator	28 June

*online

On campus

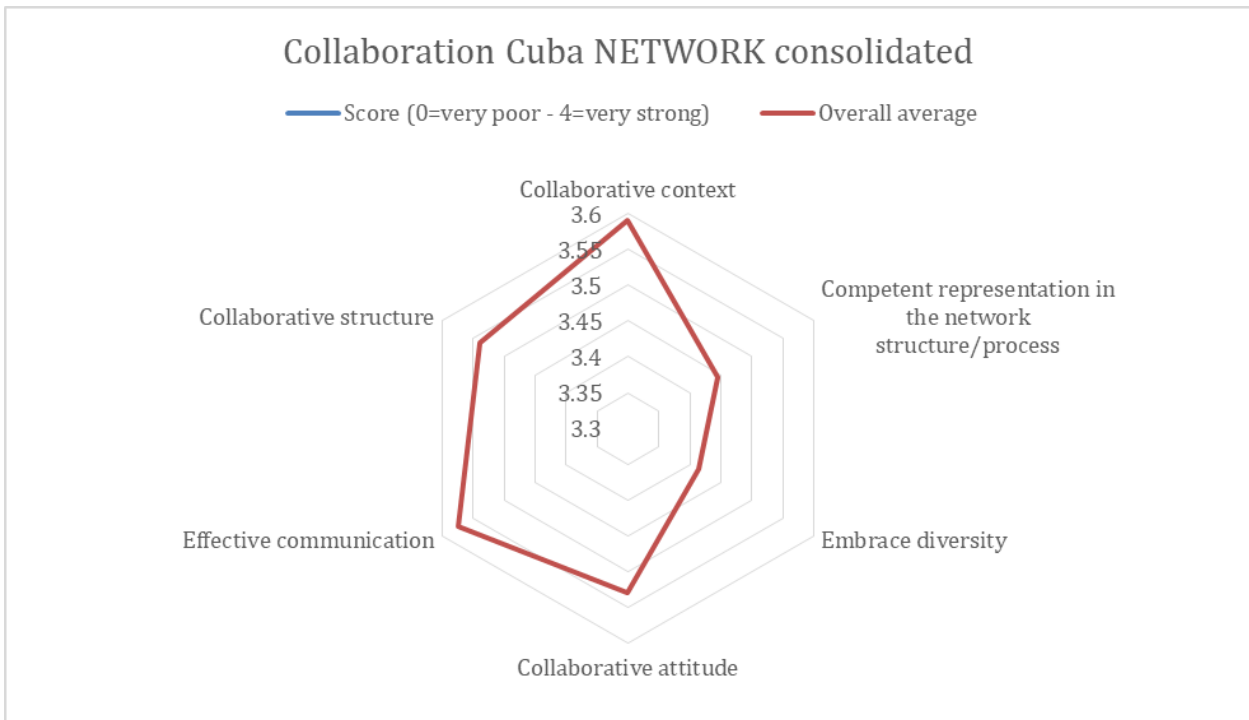
Nr.	Name	University/Stakeholder	Position	Date
1.	Hector Cruz Enriquez	UCLV	local coordinator	multiple
2.	Yoan Martínez Márquez	UCLV	Focal point	3 oct
3.	Gilberto Quevedo Sotolongo	SICTE S.A.	President	3 oct
4.	Manuel Oliver Domínguez	UCLV	Project leader	3 oct
5.	Grizly Meneses Placeres	UCLV	Project leader	3 Oct
6.	Rafael Bello Perez	UCLV	Project leader	3 Oct
7.	Jorge de la Torre Linares	<i>Aprovechamiento Hidráulico, Empresa de Acueducto y Alcantarillado de Villa Clara</i>	Director	6 Oct
8.	Omar Correa Madrigal	UCI	Focal point	9 Oct
9.	Yadier Perdomo Cuevas	UCI	Focal point	9 Oct
10.	Lidia Ruiz Ortiz	UCI	Vice rector of research and graduate education	9 Oct
11.	Rafael Torres Peña	<i>Centro Nacional de Cirugía de Mínimo Acceso</i>	Full profesor and Vicedirector	11 Oct
12.	Jean –Jacques Bastien	Embassy of the Kingdom of Belgium	Ambassador	11 oct
13.	Odalys Alonso Leal	MES	Specialist	11 oct
14.	Maiky Díaz Pérez	MES	Head of Multilateral Affairs Department	11 oct

Focus groups

Name	University/other	Position	Date
Stakeholders and beneficiaries*	UCLV	Focal points, professors, researchers at partner universities, stakeholders representatives	3 Oct
Hector Cruz Enriquez, Omar Correa Madrigal, Grizly Meneses Placeres, Rafael Bello Perez	UCLV	Local coordinator and project leaders	3 Oct

*online

7.4 Overall scores for the assessment of the collaborative process/ overview of scores of analysis of institutional capacity



VLIR-UOS supports partnerships
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