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Article

Project management competences and sustainable development in higher education: case studies from two Spanish public universities

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Abstract: The paradigm that assumes the autonomous management of universities involves them in the redefinition of their policies and processes and the training of their staff, designing new formulas that allow them to adapt to a changing environment. In this context, research and sustainable universities can link with society to solve its problems and influence a responsible and sustainable development. Through a Delphi panel, importance to acquire and improve project management (PM) competences by teaching and research staff (TRS) into innovating education and research projects is measured, from the standard of individual competences (ICB4) of the International Project Management Association (IPMA). Also, internal data sources from the flexible structures of two Spanish universities (the University of Cadiz (UCA) and the Technical University of Madrid (UPM)), are investigated, in order to analyze how they are organized. Thanks to the study of cases, an increasing tendency to work by projects is observed, empowering teams, managing properly stakeholders and facilitating their functions towards society. Likewise, after two rounds of experts' consultation, consensus is reached with an acceptable and stable level of responses, resulting in confirmation that there is alignment between IPMA competences and TRS' needs for sustained success in education and research, contributing to universities' development, improvement and sustainability.

Keywords: project management; sustainable development; projects; competences; sustained success; sustainability; research university; sustainable university

1. Introduction

In the university context, the TRS develops projects of different nature (research, educational innovation, contracts with companies, etc.) according to the objectives that are presented, whose approaches can be assimilated to projects, programs or portfolios [1]. These projects, in their different modalities, are formulated and directed by the teachers and researchers themselves, mainly forming part of Research Groups or Centers and/or Educational Innovation Groups, as organizational structures inside the University that offer their knowledge and methodologies for solve problems and needs of society and companies from specific projects, as instruments of linking with society, administrating resources (public and private ones), involving stakeholders (internal and external), generating and transferring knowledge to society.

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First, there are research projects of a local, regional, national or international nature. There is a wide variety of calls, whose administrative and documentary complexity is proportional to their scope (while for own University plans is usually quite simple, for international projects, high-level alliances are needed to make successful proposals). Next, projects that arise from companies' needs, developed as contracts and agreements, must be added, and those derived from industrial doctoral theses. Then, it is necessary to include of educational innovation projects, in which the main objective is the improvement of resources' use to promote results in students and teachers training. In fact, this type of projects is already considered necessary (and essential) for the development of competences in the TRS, as it is one of the parameters to measure their quality in accreditation by the majority of national members of the International Network for Quality Assurance Agencies in Higher Education (INQAAHE).

Finally, although it is not yet explicitly included in INQAAHE criteria, it is necessary to outline university management itself, in which projects such as the design and development of internal management systems, creation of research and/or innovation groups, organization and administration of departments and the implementation of first, second and third cycle degree programmes, as well as those related to the improvement of deadlines in educational plans, establishment of budgetary management models and attention to calls for fundraising and/or talent retention. All these actions require the adaptation of needs raised to specific requirements, in order to be carried out within a planned time and budget, with limited resources and diverse stakeholders (both internal and external) and considering risk management, based on the clarity that they are projects and not processes, either seeking the acquisition of competences based on educational models of higher education, developing basic or applied scientific research, or applying continuous improvement at the University, as suggested in the international standard ISO 9001 [2]. In summary, these are some of the projects that are developed in the university context:

- Educational projects
  - Innovation projects
  - Improvements projects
- Research projects
  - University plans projects
  - Regional projects
  - National projects
  - International projects
- Contracts and agreements with companies and entities
- Doctoral thesis programs in industries (industrial doctorates)
- Grade and master subjects
- PhD's programs
- Internal university management projects
  - Implementation of internal management systems
  - Creation of research groups
  - Creation of departments and knowledge areas
  - Implementation of specific degrees
  - Improvement of teaching planning deadlines
  - Establishment of budgetary management models
  - Attention to calls for funding
  - Attention to calls for talent retention

Research Groups and Educational Innovation Groups are autonomous organizations, inserted within the University, but that have their own strategy (with mission, vision and objectives from their lines of teaching and/or research), governance, interests, culture and own values. Although the University supports the direction of the projects, these ones have to be managed by the groups, which have to acquire and improve the necessary competences to link with society, working by projects, being more effective and generating impact in society. Consequently, the development of individual competences in PM can be a critical factor to achieve success in them.

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The international standard ISO 17024 (Conformity assessment - General requirements for bodies operating certification of persons) defines a competence as "the demonstrated ability to apply knowledge or skills and, where appropriate, personal attributes" [3]. In the same line, the standard ICB4 of IPMA defines it as "the application of knowledge, skills and abilities in order to achieve the desired results" [4], and the standard PMCDF3 of PMI as "the demonstrated ability to perform activities within a project environment that lead to expected outcomes based on defined and accepted standards" [5]. These competences can be grouped into three areas: technical-practical competences (such as cost, term, quality or risks) that deal with the management of the projects in which the Groups work, intra- and interpersonal competences (such as leadership, communication, motivation or commitment), which deal with personal relationships between the TRS and other people and entities (external to Groups) and contextual competences (such as strategy, governance, power or culture), which deal with the interaction of the Group within the context of the projects and with the University, Administrations, companies, etc.

TRS are professionals who have been selected through a purely educational and research process, so they have to promote a range of competences in different areas, if they want to properly manage the projects in which they are involved, as directors or members of the team. In the university context, there are people with a high level of involvement who are in charge of a portfolio of projects, others on a lower level with a program, and others who lead a project or are part of it. In all three cases, building PM competences may be a critical factor in achieving success in them. For universities, if a formal process to recognize the competences of their TRS is culminated, involving the issuance by an authorized institution of an accreditation of the competence possessed [6] and granting them a recognition (that implies a process of formation and another of evaluation), it would acquire a great value deeply related to the TRS adaptability, facilitating their transferability in different contexts [7].

2. Objectives

Universities are interested in projects as a means to implement their strategies, requiring a management system that responds to the demands of adaptability, flexibility and availability, and constituting as devices of change, adaptation and learning, highlighting their potentiality to align with their objectives [8].

In an educational context, projects can be managed with the tools offered by the "project manager" profession, so that a correct competences application will promote success in achieving objectives, providing value and generating synergies among institution members, as well as with other universities, companies and social agents.

The main objective of this research is to establish the importance and influence in the TRS of PM competences in the university context, determining those that need to be considered and defining a series of indicators that help to correctly acquire these competences and apply them to the success of the projects to be undertaken. If the means are put in place to facilitate achieving sustained success, developing and improving PM practices and incorporating sustainability principles (which are not fundamental but foundational in current society), then it is closer to universities contributing efficiently, effectively and sustainably to SD.

As shown in the Figure 1, the framework of this research marks a path that tries to relate PM to SD in the university context. Innovation society needs the transfer of new ideas into the market, so that universities become an essential economic driver and play a crucial role in its construction, in terms of wealth and prosperity. From the concepts of "research university" (which advocates relevant teaching and pioneer research that links with society) and "sustainable university" (which promulgates a sustainable education, research and offer sustainable internal operations, outreaches, and external services), it is intended to reach the "21st century university" as a fusion of both concepts. These universities address these challenges through the use of projects, highlighting those to improve the quality and sustainability of teaching and research. In summary, the successful management of projects has a considerable importance in current society, being PM an important way for integrating SD principles [9].

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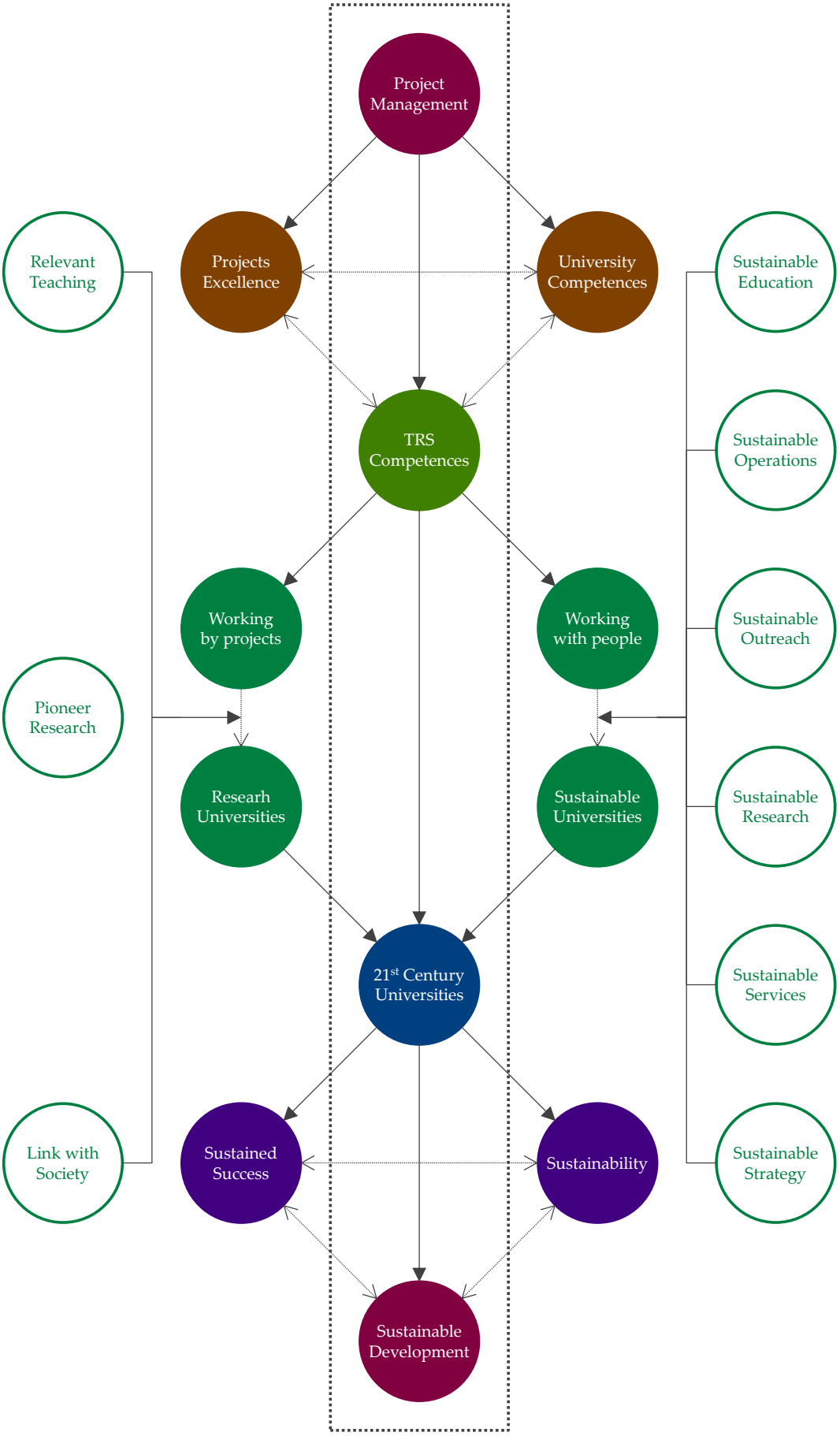
148 **Figure 1**. Framework of the research



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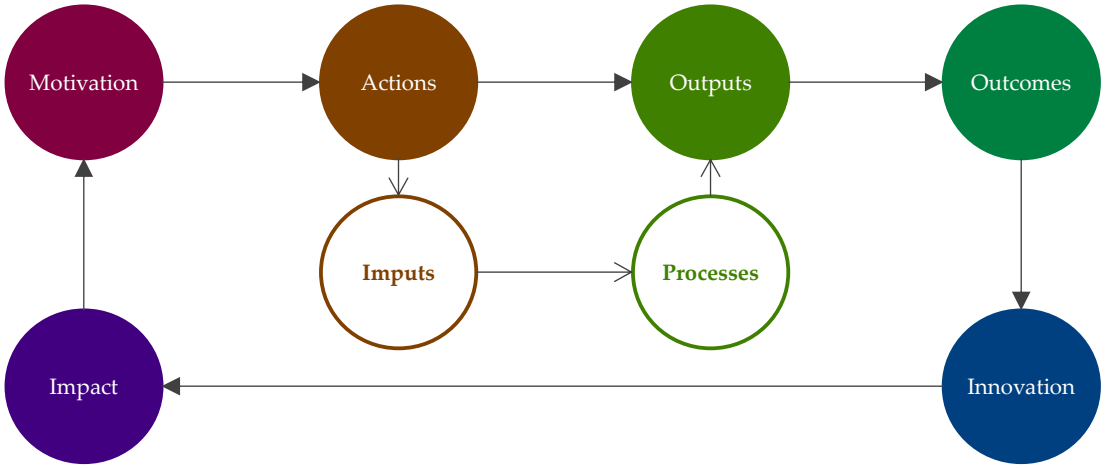
3. Background

3.1. Knowledge society

The role of universities in stimulating innovation has long been accepted, transferring new ideas into the market and being an essential economic driver. From this point of view, entrepreneurial universities are the center of the knowledge society, as presented in Figure 2, in which how knowledge use for decision-making processes is related [10]. Likewise, universities play a crucial role in the construction of advanced societies, in terms of wealth and prosperity [11].

Figure 2. The knowledge society. Based on [10]



Being:

Inputs: Efforts

Outputs: Discoveries, inventions, human capital

Outcomes: Patents, social knowledge

Impact: Economic growth, productivity growth, environmental improvement, public appreciation

Knowledge adds value through its contribution to products, processes and people. Knowledge management (KM) can be defined as the generation, representation, storage, transfer, processing, application, rooting, and protection of the organizational knowledge (including universities, entities and public administrations). Six most quoted KM elements in searches can be proposed, as shown in Figure 3:

- Knowledge creation: it's geared towards generating and developing new knowledge [12]. Hence, the effective creation of knowledge has become a top priority in a SC (Wu, 2008). Similar appellations are also used such as knowledge production [13], knowledge discovery [14] and knowledge building [15]
- Knowledge acquisition: it begins with identifying knowledge in an organization's external environment and concludes with transforming that knowledge into a representation that can be used by the organization [16]. Authors use related words such as knowledge extraction [17] and knowledge capture [18]
- Knowledge sharing: lack of knowledge sharing between PM members may affect the overall project performance [19]. Otherwise, information sharing enhances firms agility while improving the stability and performance of the whole project [20]. It's commonly also cited as knowledge exchange [21] and knowledge transmission [22]
- Knowledge capitalization: capitalize company's knowledge is to identify its critical knowledge, preserve and perpetuate them while ensuring that they are shared and used by the largest number of actors [23]. Other terms are used in this field such as knowledge hoarding [24], knowledge integration [25], knowledge protection [26], knowledge storage [27]

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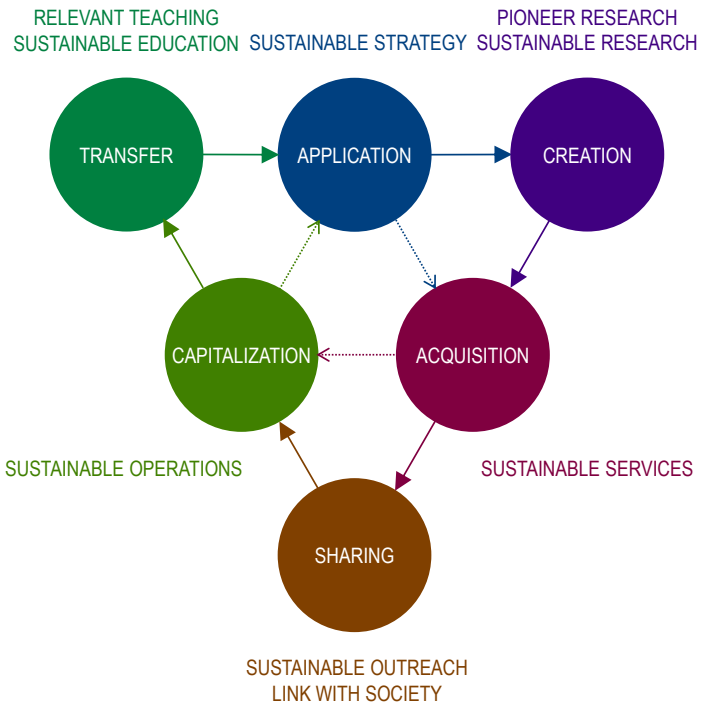
- Knowledge transfer: it's a process which gathers PM members to exchange ideas, proofs and expertise and add some value to the latter [28]. For example, mobile technologies used for knowledge transfer by employees allow user autonomy through their ability to select solutions that they find convenient, use of preferred platforms, personalize applications and utilize devices and software in various environments [29]. For the same meaning, some researchers use the word dissemination [30]
- Knowledge application: [31] believe that the combined effect of proper knowledge acquisition and efficient knowledge application is a key to maximizing the performance of the organizations. It is also referred to as knowledge exploitation [32] and knowledge use [33]

Figure 3. Knowledge management processes



3.1.1. Research universities

In the knowledge society, research universities are key institutions for social and economic development, being characterized by their global mission, research intensity, TRS roles, diversified funding, worldwide recruitment, increasing complexity, relationship with public administrations and industry and global collaboration with other universities, achieving it through focusing on the discovery of new knowledge and the development of the next generation of scholars, decision makers and entrepreneurs [34]. The qualification and achievement possibilities which graduates from research universities benefit from, the prestige associated with the publications presented by their members and the effectiveness and transferability of knowledge which they provide both the public and private sectors, demonstrate that research universities are an educational model which interacts at different levels within the global market [35,36].

The success of research universities depends on the TRS potential, funds in order to run, a flexible that allows them to be placed in different cultural and political contexts without sacrificing their academic and financial autonomy as well as their organizational vision and resources to unfold experimentation [34,36]. As summarized in Figure 4, the research university can be defined by these intrinsic characteristics [37]:

- Pioneer research, inspiring TRS to transmit the new knowledge in a creative and useful way for students and society, as a driving force that connects industry and university, generating incomes, achieving financial stability and avoiding a decrease in quality

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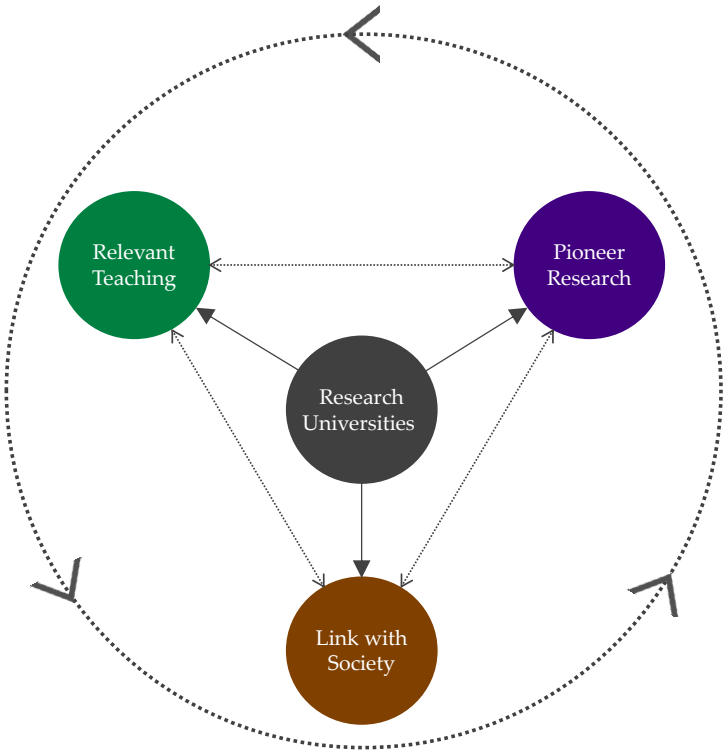
- Relevant teaching, as a pillar for learning and transferring knowledge, being international and not isolated, reflecting, in order to develop and requiring to be current, suitable and connected to the society that it will serve in the future
- Link with society, researching topics requested by the society they serve (creating useful knowledge for society), being relevant to create substantial incomes in order to operate, and meeting social needs, at the forefront of progress, research and innovation

Figure 4. Intrinsic characteristics of research universities



Research universities serve the progress of society, and this one (its companies, associations and/or administrations) goes to universities before problems, opportunities or needs [38], which are challenged to become the engine of transformation of society [39], solving the problems of the surrounding environment through the generation and dissemination of new knowledge, recovering the original concept of the university as a guardian institution, generator and disseminator of knowledge [40]. International rankings such as ARWU, SCI, CWUR, URAP or Webometrics consider these aforementioned characteristics, as shown in Table 1. If these ones are developed, then universities can lead to an improved position in rankings [41].

Table 1. Weight in international rankings of universities. Extracted from [42–46]

Weight	ARWU	SCI	CWUR	URAP	Webometrics
Relevant teaching	10%	30%	25%	10%	10,00%
Pioneer research	50%	40%	50%	60%	40,00%
Link with society	40%	30%	25%	30%	50,00%
Nº of universities	>1.300	5.250	1.000	2.500	>27.000

Being:

ARWU: Academic Ranking of World Universities

SCI: Scimago Institutions Rankings

CWUR: Center for World Global Universities Ranking

URAP: University Ranking by Academic Performance

Webometrics: Ranking Web of Universities

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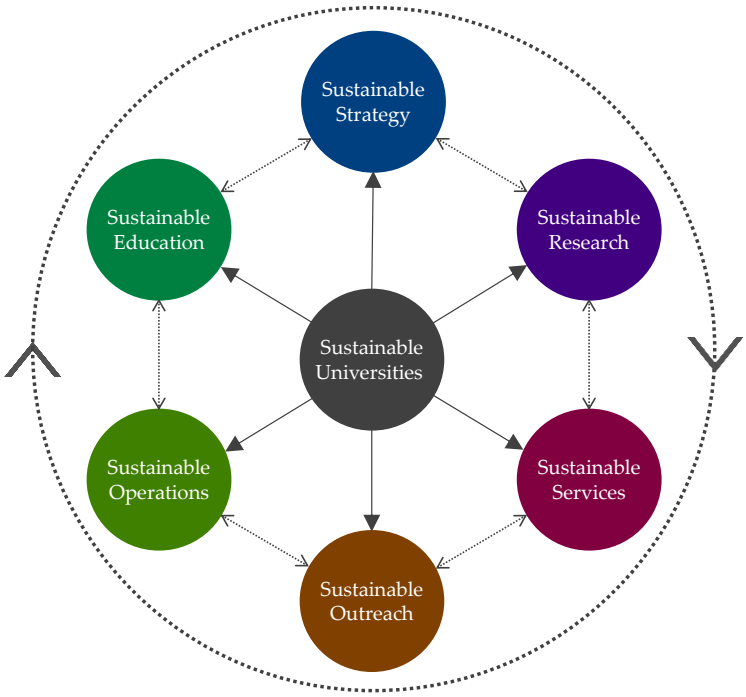
3.1.2. Sustainable universities

Universities can contribute to the solutions of increasing environmental and socio-economic crises, inequalities of income and wealth and political instabilities by integrating the holistic concept of SD in research and by educating future decision makers [47], extending their support to interdisciplinary scientific research and ensuring the appropriate evolution of the means by which they themselves are managed [48]. Likewise, universities are including an organizational change management approach to embedding sustainability into their organisational structures [49], assessing strategies and insights from behavioural change [50], accepting their responsibility, assuming their role and contributing to SD with their three core functions (research, teaching and linking with society) positioning themselves within society [51], using these six areas of action [47], as drawn in Figure 5:

- Sustainable strategy, models and organizational basis, documenting clear SD objectives and strengthening their identification and ethics
- Sustainable research, providing the possibility at disciplinary, interdisciplinary, and transdisciplinary levels to develop the innovative technologies and the system-oriented know-how necessary to shape SD
- Sustainable education, providing people with knowledge and skills to enable them shaping a future that is economically, ecologically, and socially sustainable
- Sustainable services, being shaped and optimized for sustainability within legal, financial and administrative frameworks, considering economic, ecological and social aspects in internal decisions and business processes
- Sustainable operations, applying knowledge of sustainability related problems and solutions to their own institutions
- Sustainable outreaches, assuming responsibility not just for the local SD, but also at a national and international level

Figure 5. Intrinsic characteristics of sustainable universities



Universities contribute sustainable solutions to the challenges of the 21st century through basic and applied research and by generating knowledge and suitable responses to complex interrelationships [47]. In this context, universities have a unique role and responsibility towards economy, society and environment, thanks to their position and legacy in society and their significant capacity for innovation and the honest brokerage of knowledge at the boundaries of science, policy and politics [52].

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Sustainable universities are "higher educational institutions, as a whole or as a part, that address, involve and promote, on a regional or global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil their functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable life-styles" [53]. Sustainable universities should include these goals and objectives [54]:

- Clearly defined mission and vision statements which express their philosophies and future commitments
- Degree programs including the concept of sustainability, adding it to their curricula
- Campus activities and operations environmental friendly
- Rewarded researches about sustainability
- Local and global partnerships supported by sustainability
- Concepts of sustainability implemented into all levels of decision-making
- Attention to personal and social sustainability of university members

Assessment systems enable universities to systematically use their potential for action for SD by initiating, evaluating, and accelerating the sustainability process [47]. These sustainability assessment systems are widely accepted to assess institutions of higher education and can be used to evaluate SD implementation at early stages:

- Sustainability Assessment Questionnaire (SAQ), to self-assess their contribution in curricula, research and scholarship, operations, faculty and staff development and rewards, outreach and service, student opportunities and institutional mission, structure and planning
- Auditing Instrument for Sustainability in Higher Education (AISHE), to rate their identity, operations, education, research and society
- Sustainability Tracking Assessment & Rating System (STARS), to audit education, research, operations, planning, administration, engagement and innovation
- Alternative University Appraisal (AUA), to review governance, education, research and outreach

3.2. PM competences

Competences in PM can be defined as "the abilities to mobilize, integrate and transfer knowledge, skills and resources to reach or surpass the configured performance in work assignments, adding economic and social value to the organization and the individual" [55] and as "a combination of personal attributes (capabilities, motivations, personality, image, aptitudes, attitudes, personal values, etc.) that complement and integrate, in conjunction with other elements that are related to work contexts (knowledge, abilities, skills, behaviours , actions, expertise, experience, etc.)" [56].

Almost all the PM standards are oriented on procedures and processes (as PRINCE2 and MSP by Axelos, PMBoK by PMI or PM2 by EU). On the contrary, very few standards are competency-based and specify the competences needed for good performance of people in project environments[57]. While process-oriented standards usually prescribe procedures and methods, ensuring organizations have an universal approach in managing projects, competence-oriented standards present a wide spectrum of knowledge, skills and abilities that organizations need for a successful performance, holding people to perform tasks in projects [57], being very important in project success [58].

The most veterans and extended PM associations worldwide, both the IPMA [4,59,60], with its humanistic vision and the Project Management Institute (PMI) [5,61,62], with its education, training and development programs, in addition to the international standard ISO 21500 [63] and to the European Union (EU) PM² methodology [64], as represented in Figure 6, guide their foundational standards, bodies of knowledge, methodologies, practical guides, baselines and frameworks focused on three points of view:

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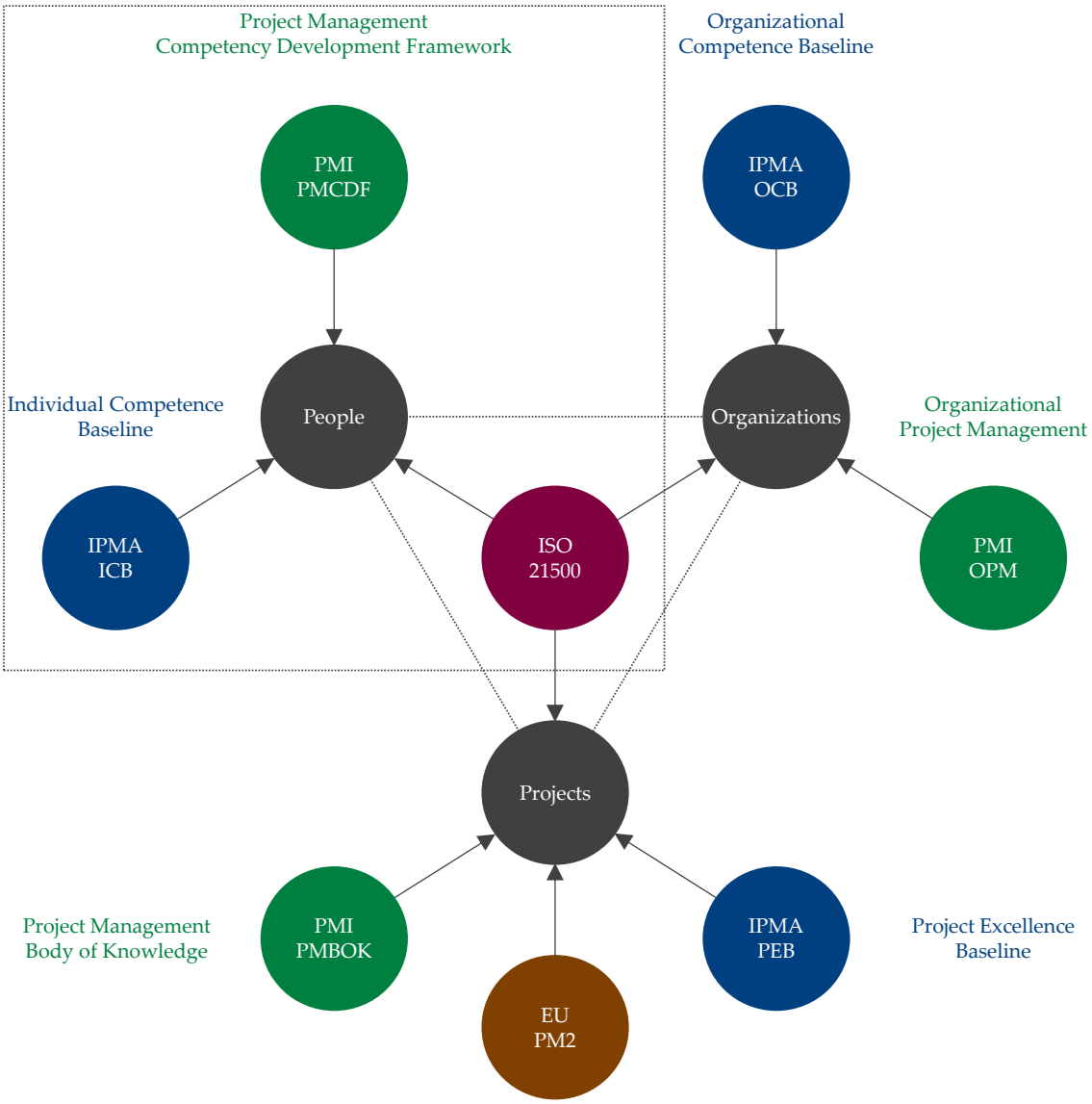
- Project: Knowledge and practices to manage individual projects
- Organization: Knowledge and practices to manage projects, programs and portfolios
- People: Development, counselling, registration and certification

Figure 6. EU, IPMA, ISO and PMI project management approaches



To survive in a competitive environment, organizations including universities look for a competitive advantage, emphasizing the availability of competent personnel, for which they make a remarkable effort, increasing their competence [56]. Likewise, the understanding and application of knowledge and techniques recognized as good practices are not enough for effectively managing projects [62], as specific skills and general capacities are also required, combination of personal attributes (personality, image, interests, aptitude, attitude and values) that complement and integrate with other elements related to work contexts (knowledge, abilities, behaviour, experience and expertise). For IPMA, ISO and PMI, these competences are grouped into three blocks:

- For [4] IPMA ICB 4: Perspective, practice and people
- For [63] ISO 21500: Contextual, technical and behavioural
- For [62] PMI PMBOK 6: Strategic-business, technical and leadership
- For [5] PMI PMCDF 3: Knowledge, performance and personal

This way of classifying PM competences is not only carried out by professional associations and international organizations, but also by many researchers do it analogously:

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- For [65]: Occupational, understanding and attitudinal
- For [66]: Social, functional and cognitive
- For [67]: Living in the world, tools for working and ways of thinking
- For [68]: Compliance, professional and behavioural
- For [69]: Contextual, job and person

3.2.1. Competences for PM practitioners and professionals

The development of the competence of people allows to achieve a better project performance, thanks to a growing motivation, a better self-organization and a reduced need for centralized control [70]. However, there are different ways of acquiring and improving individual competences, depending on the organizational structure and its integrated management model, as well as on the individual particularities and functions that are to be found in the structural organization chart in which they are located. In order to learn and train PM competences, the IPMA ICB 4 model proposes a series of approaches for individual development, highlighting self-study, through study and experimentation, peer-to-peer development, education and training, coaching and mentoring, and simulation and games. In Table 2, PM competences of the IPMA ICB 4 model are contrasted against the PM competences and skills of the PMI PMCDF 3 and PMI PMBOK 6 models.

Table 2. Comparative between IPMA and PMI approaches. Extracted from [4,5]

PMI PMCDF 3 and PMBOK 6 Competences	IPMA ICB 4 Competences	Code
Strategic and business management:	**Perspective:**	
Strategy	Strategy	C01
Mission	Governance, structures and processes	C02
Goals and objectives	Compliance, standards and regulations	C03
Priority	Power and interest	C04
Tactics	Culture and values	C05
Products and services	**People:**	
Operations	Self-reflection and self-management	B01
Market conditions	Personal integrity and reliability	B02
Competition	Personal communication	B03
Financial implications	Relations and engagement	B04
Economic viability	Leadership	B05
Business value	Teamwork	B06
Benefits realization	Conflict and crisis	B07
Personal:	Resourcefulness	B08
Communicating	Negotiation	B09
Leading	Result orientation	B10
Managing	**Practice:**	
Cognitive ability	Design	T01
Effectiveness	Requirements, objectives and benefits	T02
Professionalism	Scope	T03
Technical:	Time	T04
Integration	Organisation and information	T05
Scope	Quality	T06
Time	Finance	T07
Cost	Resources	T08
Quality	Procurement and partnership	T09
Human resources	Plan and control	T10
Communication	Risk and opportunities	T11
Risks	Stakeholders	T12
Procurement	Change and transformation	T13
Stakeholders	Select and balance	T14

In order to map PM competences, these steps can be applied in a sequential mode [55]:

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- Description of competence and performance criteria
- Assessment process
- Diagnosis of the current proficiency level
- Identification of competence levels that differentiate professional categories
- Establishment of expected profiles
- Gap analysis
- Association between experience and competence development

Once PM competences are being acquired by the TRS, then universities can use the standard IPMA OCB1 [59]to support their research proposals, perform practice-based teaching using results of assessment or benchmarking activities, extract data and validate changes against baseline data for trend analysis and continuous improvement, to identify good practices as well as innovation, enabling new research activities in the field of PM.

3.2.2. Competences for pre- and university students

Training PM competences can be introduced in education through proposals which are included on theoretical educational frameworks (defining, designing and managing projects and setting goals, besides balancing, evaluating, executing, interacting, monitoring, organizing, planning, prioritizing and other actions intrinsically related to leading projects in an educational context). In EU and Latin America, these approaches cover the main educational stages [71]:

- During the pre-university stage, the Definition and Selection of Competencies (DeSeCo) Project by the Organisation for Economic Co-operation and Development (OECD) tries to instill that students assert rights and duties, communicate, conduct plans and projects, construct alliances, cooperate, empathize, make decisions, negotiate, recognize merits, resolve conflicts, be self-aware, suggest alternatives, support others, and take responsibility, among other skills
- At the university stage, the European Higher Education Area (EHEA) and the Latin America Academic Training (ALFA) Tuning Projects ensure that future graduates analyze, appreciate diversity, are competitive, be creative and critical, commit, communicate, lead, learn, make decisions, motivate, solve problems, synthesize, take initiative, and work as a team

The DeSeCo project [72], which includes the Program for International Student Assessment (PISA) reports, defines competence as "the knowledge and ability to cope with complex demands by putting into action, in specific situations, psychological resources, skills, attitudes, and helps young people and adults develop as individuals and professionals in training projects that will last a lifetime. Key competences shown in Table 3, as OECD remarks [37], are not determined by arbitrary decisions about what personal qualities and cognitive skills are desirable, but by a careful consideration of the factors required for a successful life and a well-functioning society.

The Tuning project [73,74], from EU to Latin America, defines competence, from an integrated perspective, as "the capacity to execute, the degree of preparation, sufficiency and/or responsibility to perform a task"; and control its action thanks to:

- Generic and specific competences of each subject
- Role of ECTS (European credit transfer system), as an accumulation system
- Role of learning, teaching, assessment and performance, to ensure quality

To understand the competences shown in Table 3, it is necessary to include knowing how to understand (theoretical knowledge of an academic field), act (practical and operational application of knowledge to certain situations) and be (values as an integral element of the way of living in a social context) into the university stage. Certain competences cannot be taught if, previously, they are not possessed by teachers.

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Table 3. Comparative among DeSeCo Project and Tuning Project elements of competence. Extracted from [72–74]

OECD DeSeCo Project Competences	ALFA & EHEA Tuning Project Competences
Use tools interactively:	**Instrumental:**
Use communication skills effectively	Analysis and synthesis
Access adequate information sources	Organization and planning
Evaluate the value of information	Basic general knowledge
Organize knowledge and information	Communication
Use technology	Elementary computing
Interact in heterogeneous groups:	Information management
Be empathetic	Problem solving
Manage emotions	Decision making
Present ideas and listen to others	**Interpersonal:**
Understand of debate	Criticism and self-criticism
Construct tactical alliances	Teamwork
Negotiate	Interaction with technical experts
Make decisions	Working in heterogeneous teams
Analyze issues and interests	Appreciation of diversity
Identify areas of agreement	Working in international context
Reframe the problem	Ethical commitment
Prioritize needs and goals	Motivation
Act autonomously:	Cooperation
Understand patterns	**Systemic:**
Have an idea of the system	Applying knowledge in practice
Identify action consequences	Research
Choose among available options	Learning
Define projects and set goals	Adaptation to new situations
Evaluate necessary resources	Creativity
Balance resources to meet goals	Leadership
Learn from past actions	Judgement of cultures and customs
Monitor progress	Working autonomously
Understand own interests	Project design and management
Know rules and principles	Initiative and entrepreneurial spirit
Construct arguments	Concern for quality
Suggest alternative solutions	Will to succeed

3.3. Sustainability and SD

Sustainability is a way of asserting the value of longevity and intergenerational justice, while recognizing morality and finitude [75], and has been moved decisively towards being a core value of the global community, for economic, environmental, and social progress [76]. In fact, after the last global crisis (2018-2013), sustainability has become the single most important issue for policy makers and public managers [77], whose three imperatives are [78]:

- Society, providing social and governance systems that sustain values wished to live by
- Economy, ensuring and maintaining adequate standards of living
- Environment, staying within the planet's biophysical capacity

In summary, sustainability is about balancing or harmonizing social, environmental and economic interests, with both short term and long term orientation , both local and global, consuming incomes and not capital, under principles of transparency and accountability, with strong personal values and a strict ethics code [79]. For its part, the international standard ISO 26000 [80], about social responsibility, mentions as principles of sustainability:

- Accountability
- Transparency
- Ethical behavior
- Respect for

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- Stakeholders' interests
- Rule of law
- International norms of behavior
- Human rights

SD is a development that can meet the needs of the present without compromising the ability of future generations to meet their own needs [81], for what it requires not depleting natural, knowledge, produced and human capital available to society over time [82], improving the human condition in such a manner that these improvements can be maintained [83], and needs the commitment of actors from different spheres and scales, in order to be able to enhance economic development, social inclusion and environmental protection in a mutually reinforcing manner [84].

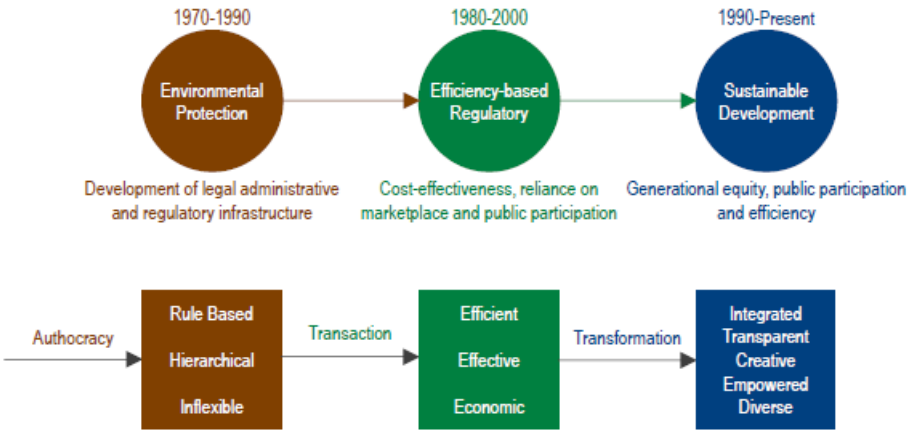
Broad-based SD requires a healthy, growing economy undergoing structural transformation and leading to a higher standard of living, in which the benefits are equitably shared and distributed, a protection of human rights, civil society, and democratic participation, and that of sustainability, wherein the environment is not destroyed and descendants of current people enjoy the same or a higher standard of living [85]. Into a holistic point of view, goals of SD can be synthesized in [86]:

- Biological
  - Genetic diversity
  - Resilience
  - Biological productivity
- Economic
  - Efficiency
  - Equity
  - Social welfare
- Social
  - Citizen participation
  - Social justice

3.3.1. SD and public administrations

Efficiency, effectiveness, social equity and sustainability can be identified [86] as the pillars of public administrations (PA). The transformation from traditional PA to sustainable ones can be sketched in the Figure 7:

Figure 7. Epochs into the role of PA in sustainability. Based on [87,88]



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Global challenges have been affecting all areas of human development in the recent decades, calling for a response from PA bodies around the world, which have to adopt new sustainability policies in an attempt to improve their impact and the quality of life for its citizens [89], sustaining each of environmental, economic and political/social systems on its own while maintaining an appropriate balance among them [90], transforming their public services and developing their capacity to deliver critical essential services equitable and effectively [88]. PA feature the roles [91]:

- Having a proper system
- Mandating to the realization of goals through policy instruments
- Embedding and framing goals in governance

SD afford administrators an opportunity to integrate intergenerational equity, environmental preservation and economic efficiency as complementary values rather than competing values [86], embracing instruments to accelerate regulatory reform, empowering communities to govern in cooperation, becoming a successful tool, as a key component of it [92] and proposing educators the outstanding undertaking of bringing up to date programs to supply knowledge and expertise in industry, government and society [116]. Furthermore, SD may be targeted at different levels [77]:

- Sustainability of organizational operations
- Sustainability of public policies and services
- Sustainability of impact on all stakeholders

Universities play a vital role in regional development of countries, pursuing sustainability and becoming society's cornerstone [54] and developing tomorrow's decision makers, professionals and citizens [48]. However, the effects of implementing SD at institutions of higher education are far from satisfactory, being necessary to take actions, sensitive to local and global levels, to support initiatives promoting science and learning, capacity development, transparency and the continuous enhancement of activities [48]. Besides, universities have to be instrumental in discussions regarding the social circumstances where human development is feasible and the economic circumstances that influence both environmental and social results [93]. The integration of principles and practices associated with sustainability into the whole portfolio of universities' activities is an opportunity to prepare the university community to be better prepared to make decisions for a future that becomes more complex, dynamic and uncertain [94].

3.3.2. SD and PM

SD means to prosper without compromising the life of future generations, looking for a long term among economic, environmental, human and social issues, changing by projects shaped by sustainability criteria [95]. As a new management paradigm, whose principles can be operationalized and used to improve how practitioners and professionals of all skill levels manage the complexity and dynamics of organizations and projects [96], SD has to be linked to organizations performance, being necessary its integration into their core processes and functions to receive performance benefits, but distinguishing content processes, project results, decision and management processes [96].

Sustainability is relevant to projects and PM, stretching its system boundaries if integrated and, at the same time, projects make a contribution to the sustainable change of organizations [79]. From this point of view, a set of six capability areas are the key to manage PM [97]:

- Strategic alignment is the continual tight linkage of business process management to organizational priorities and processes, enabling achievement of business goals
- Governance establishes relevant and transparent accountability and decision-making processes to align rewards and guide actions in PM.
- Methods are the approaches and techniques that support and enable consistent business PM actions and outcomes
- Information Technology is the software, hardware, and information management systems that enable and support business process management activities

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- People are the individuals and groups who continually enhance and apply their PM-related expertise and knowledge
- Culture is the collective values and beliefs that shape management-related attitudes and behaviors

PM leaders have a responsibility to ensure that the impact of the project from a sustainability perspective is recognized and actively managed to deliver sustainable outcomes [60]. Optimal decisions cannot be taken in isolation from the environment, ethics and social responsibility play an important role in all decisions and to understand the widest possible environment and the long-term view is a challenge. In practice, leaders of excellent projects:

- Behave in a socially responsible way, taking care of stakeholders with limited power who are impacted by the project
- Understand the key elements of the project environment, including, but not limited to, the natural environment, social systems and the economy
- Whenever applicable, recognise environmental bodies and organisations as project stakeholders and cooperate with them

The need for sustainability is a crucial factor for PM and project success, as a key skill needed to develop, execute and guide projects in a sustainable way [98]. In addition to the value created, the benefits and competitive advantages of sustainability management in projects include [9]:

- Continuous improvement and competitive advantage
- Development of a collaborative, system approach to sustainable projects
- Improved project controls
- Benchmarking and assessing sustainability performance with respect to international laws, norms, codes, performance standards and voluntary initiatives
- Demonstrating how the organisation influences and is influenced by the expectations about sustainable development
- Comparing performance within an organization and between different organisations over time

In order to relate sustainability and PM, it's necessary to consider [99] that strategy is the driver to evolve from traditional to sustainable PM, as indicated in Table 4, linking stakeholders management with sustainable practices, profiting by innovation drivers and needing the intensive use of metrics. If sustainable innovations drivers (aggregated in four domains: strategy, management, integration and performance measurement) are added to traditional PM, then it is possible to promote the necessary changes to achieve the sustainable PM [79] .

Table 4. Contrast between traditional and sustainable PM concepts. Based on [100]

Traditional PM	Sustainable PM
Short term orientation	Long term orientation
Interest of stakeholders	Interest of current and future generations
Deliverables orientation	Life cycle orientation
Scope (and quality), time and budget	People, planet and profits
Reduced complexity	Increasing complexity

PM processes and knowledge fall short of committing to a sustainable approach [101], with a series of leverage points that cover the whole life cycle of projects, including:

- Contribution to business strategy
- Business justification
- Procurement strategy
- Readiness for service
- Benefits evaluation

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PM standards fail to address the role of project managers to realize SD, lacking the competences to consider the sustainability aspects of their projects, but being crucial to close this gap [102]. The lack of a common structure and language for analyzing sustainability in projects as well as the absence of specific tools mean the lack of a framework that can be useful and applicable to projects [98]. From this base a theoretical framework of sustainability aspects, constructs and variables for PM is shown in Table 5:

Table 5. Principles and constructs of sustainability dimensions. Based on [103]

Economic dimension	Enviromental dimension	Social dimension
Financial performance	Natural resources	Labour practices
Financial benefits	Energy	Relationship with communities
Good practices	Water	Engagement of stakeholders
Cost management (resources)	Biodiversity	Social actions
Business ethics	Enviromental policies	Competition and pricing policies
Relationship with users	Impact on environment	Anti-corruption practices
Innovation management	Eco-efficiency	Social justice
Economic performance	Environmental justice	Relationship with suppliers
Organizational culture	Enviromental education	Health and safety
Economics	Environmental training	Responsibility
Environmental accounting	Risks	Respect and privacy
Management of intangibles	Climate strategy	Human rights
Internacionalization	Governance	Disciplinary procedures
Investment and improvement	Enviromental reports	Social reports

By contrast, a set of competences for sustainability can be developed, which are required in order to realize a proper role in sustainable PM [11,104]:

- Anticipation, forward-looking in analysis and evaluation of developments
- Cooperation, planning together with others and take action
- Dealing with incomplete and overly complicated information, recognizing risks, dangers and uncertainties and being able to evaluate them
- Dealing with individual decision-making dilemmas, handling conflicting goals when reflecting on action strategies
- Independent action, being able to independently plan and act
- Interdisciplinary knowledge, acquiring and acting on it
- Interpersonal and facilitating sustainability research and problem solving
- Moral action, using ideas of justice as a basis for making decisions and taking action
- Motivation, being able to motivate one's self and others to take action
- Normative, understanding justice, equity, integrity and ethics
- Participation, taking part in collective decision-making processes
- Perspective-taking, open-minding and creating knowledge from new perspectives
- Reflecting on goals, being able to reflect on one's own goals and those of others
- Strategic, designing and implementing interventions and governance strategies
- Supporting others, showing empathy towards others
- Systems thinking, understand the cause of complex problems

If analyzing PM standards values, IPMA ICB 4 [4] makes a stronger statement compared with PMI PMBOK 6 [62] and Axelos PRINCE2 [105], including ethics, openness, social sensitivity, fairness, integrity, transparency, respect, and efficiency, among others [96]. Although sustainability concepts are poorer included in PMI PMBOK 6 [62], in which twice are included [95], and in PMI PMCDF 3 [5], in which no mention is referred them but in four example plans, into IPMA ICB 4 [4], are included conversely in the perspective (strategy, compliance, standards and regulations, cultures and values), people (personal integrity and reliability and negotiation) and practice (scope, procurement and change and transformation) competence domains.

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The development of training units for the implementation of the IPMA ICB 4 standard [4] can be used to shape its sustainability approach, dealing with several methods and tools like balanced scorecards, critical success factors (CSF), key performance indicators (KPI), dependency analysis and development of roles and responsibilities combining perspectives of sustainability and project management [95]. As shown in Table 6, a strong focus on sustainability in PM is found [95], with a significant improvement in proposals [99].

Table 6. Sustainability in perspective, practice and people domains of competence. Based on [99]

Competence	Definition	Knowledge	Skills
Strategy	Correlation with organizational sustainability	-	Sustainable thinking
Compliance, standards and regulations	Tracing of guidelines and rules on SD	Sustainable principles	-
Culture and values	Supporting organizational SD, including social responsibility	Corporate social responsibility Green PM	-
Scope	Appropiate scope mangement Avoiding scope creep	-	-
Procurement	Selection of commodities and suppliers	-	-
Change and transformation	Avoiding falling back	-	-
Integrity and reliability	Focusing on solutions endurance Consideration of long-term outcomes and effects of behaviour	Sustainability	Personal integrity and reliability
Negotiation	Achievement of sustainable agreements	-	Negotiation
Result orientation	-	Integration of social, environmental and technical facets	Result orientation

4. Methodology

Two methodologies are used in this investigation:

- The Delphi Technique
- The Study of Cases

On the one hand, the first of them tries to highlight those essential competences for the development of the projects undertaken in the university context. On the other hand, the second analyzes two real cases trying to situate the activities developed in education, research and sustainability.

The Delphi technique is a prospective method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problems [106], to acquire the most reliable consensus of a group of experts' opinion by series of intensive questionnaires combined with controlled opinion feedback [107]. At the same time, Delphi technique is a research approach to gain consensus using a series of questionnaires and the provision of feedback to participants who have expertise in key areas, especially useful to collect ideas from isolated experts on a specific topic and establish agreement to discover the underlying assumptions or perspectives among the experts, trying not to lack its theoretical framework [108].

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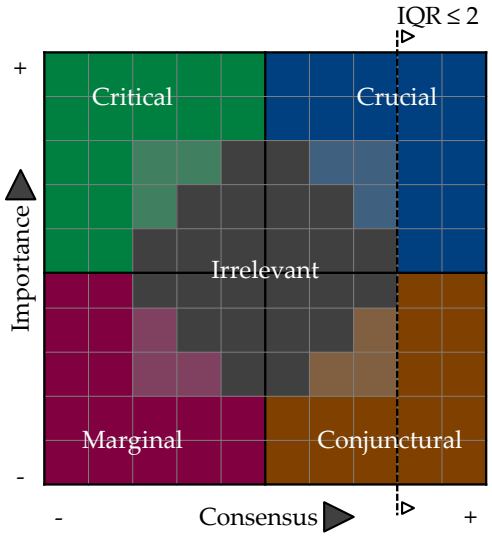
The most important requirements for the use of Delphi are [109–111]:

- Need for experts' judgment (experienced and capable ones)
- Use of a formal and structured questionnaire
- Dispersion of experts
- Group consensus to achieve the results
- Anonymity in data collection
- Complex, multidimensional, and interdisciplinary problem
- No time limitation
- Use of quantitative and/or qualitative scales
- Process consisting of two or more rounds
- Feedback from each round through statistical feedback and optional text information
- Iteration until consensus is reached (determined by the moderator)

The Delphi technique allows to determine the points of agreement, their level of consensus and the hierarchy of their transcendence. The results of this technique can be distributed and categorized into five blocks, for the same factor, depending on their importance (much or little) and their consensus (majority or scarce) [112]. These categories are distributed in a double entry table, as shown in Figure 8. According to it, crucial factors are those that have a high consensus and importance, so they must be the focus of attention for the acquisition, development and improvement of competences in PM by the TRS.

Figure 8. Problems' categorization according to importance and consensus. Based on [112]



Crucial:	Importance Δ	Consensus Δ
Critical:	Importance Δ	Consensus ∇
Irrelevant:	Importance ~	Consensus ~
Conjunctural:	Importance ∇	Consensus Δ
Marginal:	Importance ∇	Consensus ∇

The second methodology used, the study of Cases, consists in the detailed description and analysis of a series of social units or unique entities, studying their particularities and complexities, in order to get to understand their activities in specific circumstances. Likewise, it presents a series of advantages, among which it is worth mentioning that it:

- Does not separate the phenomenon from its context [113], starting from a preliminary theoretical model to build a theory and reach a more complete explanatory model [114]
- Allows to create new theoretical frameworks, verifying its practical application [115]
- Analyzes in depth the complexity of the phenomenon under study [116]
- Considers the points of view of all people and entities involved [117]

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5. Delphi panel

Delphi panel is done with the participation of individuals who have the knowledge and expertise of the study subject [108]. In order to avoid partiality, diversity in the number of universities and areas of knowledge represented has been an imput when sending invitations. All candidates possess experience managing national and international research projects, experience in administrative roles in universities (department directors, directors of educational innovation and/or research groups, directors of technical schools, deans of faculties, etc.), accredited teaching experience (at least ten years) and have carried out relevant research at an international level (at least other ten years), so they can be considered as potential respondents in order to form part of the panel.

A total of twenty respondents have finally participated (all of them meeting the established requirements, as indicated previously), from 25th January 2018 to 25th March 2018, being their charecteristics briefed in Table 7. For most event statements, final-round interquartile range is smaller than into the initial one, being convergence of responses more common than divergence over a number of rounds. Likewise, uncertainty increases as the median forecast date of the event moves further into the future, having near-term forecasts a smaller interquartile range than distant forecasts [106].

This group of experts is formed of members of the international academic community, belonging to twelve universities (both technical and generalist ones and both public and private ones) across Spain and Latin America (Peru and Ecuador) and sixteen knowledge areas (from education and business organization to environmental technology and project engineering). The size of the group is considered suitable as it falls within the optimum size of between six and thirty experts recommended by [118].

Table 7. Experience and participation in teaching and research projects

Experts	Teaching experience (in years)	Number of teaching projects	Research experience (in years)	Number of research projects
20	23,80	8,55	20,40	24,60

The Delphi panel is designed so that experts can score the elements of competence of the IPMA ICB 4 standard. The research question is formulated in the following terms:

> *"On a scale of 0 to 10, being 0 trivial and 10 essential, indicate the degree of importance (influence, criticality) that you grant to the acquisition and improvement of the following competences, by the teaching and research staff (TRS), in the university context, in order to carry out the projects in which they participate, both for the practice of a relevant and sustainable teaching (T), especially in educational innovation projects, and for developing their research (R), from R+D+i projects."*

The second stage involves sending the questionnaires to each of the experts. A scoring scale of 0 to 10 is proposed, in which 0 indicates superficiality and 10 indispensability. Consensus and stability are reached after two rounds of consultation, as can be checked in Tables 8 and 9 (including mean, standard deviation, first quartile, second and third ones, interquartile range and relative interquartile range), both for teaching and research projects.

Finally, the Delphi panel is completed in a third stage in which the responses sent by the experts are included and scoring is carried out. In order to achieve consensus and stability, two conditions are imposed [119–121]:

- Consensus is scored through the interquartile range (IQR), defined as the difference between the 3rd quartile (Q3) and the 1st one (Q1), with variations of equal or less than 20% being aceptable
- Stability is calculated using the relative interquartile range (RIR), defined as the IQR divided into the 2nd quartile (Q2), and being obtained when the results are within the 25% of the value range

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680 *5.1. Competences for teaching*

681 **Table 8.** Results of Delphi panel for Teaching

Code	1st Round (N=20)							2nd Round (N=15+5)						
	Distribution		Quartiles			Consensus		Distribution		Quartiles			Consensus	
	Mean	SD	Q1	Q2	Q3	IQR	RIR	Mean	SD	Q1	Q2	Q3	IQR	RIR
C01	8,10	1,25	8	8	9	1	0,13	8,30	0,98	8	8	9	1	0,13
C02	7,10	2,05	6	7	8,75	2,75	0,39	7,60	1,35	7	7,5	8,75	1,75	0,23
C03	7,90	1,68	7	8	9	2	0,25	7,90	1,68	7	8	9	2	0,25
C04	7,25	1,89	6,25	7,5	8	1,75	0,23	7,40	1,43	6,25	7,5	8	1,75	0,23
C05	7,85	1,95	7	8	9	2	0,25	8,05	1,70	7,25	8	9	1,75	0,22
B01	7,85	2,30	7	8,5	9	2	0,24	8,00	2,05	7	8,5	9	2	0,24
B02	8,80	1,20	8	9	10	2	0,22	8,80	1,20	8	9	10	2	0,22
B03	9,05	0,89	8,25	9	10	1,75	0,19	9,05	0,89	8,25	9	10	1,75	0,19
B04	7,80	1,51	7	8	9	2	0,25	7,80	1,51	7	8	9	2	0,25
B05	7,75	1,59	7	8	8,75	1,75	0,22	7,75	1,59	7	8	8,75	1,75	0,22
B06	8,25	1,25	7	8,5	9	2	0,24	8,25	1,25	7	8,5	9	2	0,24
B07	7,90	1,45	7	8	9	2	0,25	7,90	1,45	7	8	9	2	0,25
B08	8,60	1,35	8	9	9	1	0,11	8,80	0,83	8	9	9	1	0,11
B09	7,35	1,39	7	7	8,75	1,75	0,25	7,35	1,39	7	7	8,75	1,75	0,25
B10	8,60	1,14	8	9	9,75	1,75	0,19	8,60	1,14	8	9	9,75	1,75	0,19
T01	8,40	0,99	8	8	9	1	0,13	8,55	0,89	8	8,5	9	1	0,12
T02	8,75	1,45	8,25	9	10	1,75	0,19	8,85	1,23	8,25	9	10	1,75	0,19
T03	7,35	1,53	6,25	7,5	8	1,75	0,23	7,50	1,47	7	8	8	1	0,13
T04	7,75	1,71	7	8	8,75	1,75	0,22	7,90	1,68	7	8	9	2	0,25
T05	7,35	1,31	6,25	7,5	8	1,75	0,23	7,50	1,19	7	8	8	1	0,13
T06	7,25	1,80	7	7,5	8	1	0,13	7,50	1,43	7	7,5	8	1	0,13
T07	7,00	1,78	6	6,5	8,75	2,75	0,42	7,45	1,19	6,25	7	8	1,75	0,25
T08	7,00	1,56	6	7	8	2	0,29	7,35	1,09	6,25	7	8	1,75	0,25
T09	5,70	2,30	5	6	7	2	0,33	6,20	0,77	6	6	7	1	0,17
T10	7,60	2,26	6	8	9,75	3,75	0,47	8,00	1,65	7	8	9	2	0,25
T11	6,75	1,62	6	7	8	2	0,29	6,65	1,31	6	7	7,75	1,75	0,25
T12	8,15	1,53	7	8	9,75	2,75	0,34	8,25	1,21	7	8	9	2	0,25
T13	7,35	1,84	6,25	7	9	2,75	0,39	7,60	0,99	7	7	8,75	1,75	0,25
T14	7,80	0,95	7,25	8	8	0,75	0,09	7,70	0,92	7	8	8	1	0,13
Average	**7,74**	**1,72**			(1st Round)			**7,88**	**1,44**			(2nd Round)		

682 Being:

683 SD: standard deviation

684 Q1: 1st Quartile (25th percentile)

685 Q2: 2nd Quartile (50th percentile)

686 Q3: 3rd Quartile (75th percentile)

687 IQR: Interquartile Range IQR = (Q3-Q1) ≤ 2 for consensus

688 RIR: Relative Interquartile Range RIR = (Q3-Q1)/Q2 ≤ 0,25 for stability

689 For teaching projects, only six of the twenty-nine elements of competence did not reach
690 consensus in the first round (brown colour) by the twenty experts. However, fifteen experts
691 modified their opinions not only in those ones but in other fourteen items in the second round (blue
692 -increasing their importance- and magenta -decreasing it- colours), increasing their respective
693 consensus and promoting a significant level of importance.

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5.2. Competences for research

Table 9. Results of Delphi panel for Research

Code	1st Round							2nd Round						
	Distribution		Quartiles			Consensus		Distribution		Quartiles			Consensus	
	Mean	SD	Q1	Q2	Q3	IQR	RIR	Mean	SD	Q1	Q2	Q3	IQR	RIR
C01	9,10	0,85	9	10	10	1	0,11	9,15	0,81	9	9	10	1	0,11
C02	7,70	1,78	7	8	8,75	1,75	0,22	7,95	1,19	7	8	8,75	1,75	0,22
C03	8,60	1,14	8	9	9,75	1,75	0,19	8,60	1,14	8	9	9,75	1,75	0,19
C04	7,65	1,84	7	8	8,75	1,75	0,22	7,85	1,39	7	8	8,75	1,75	0,22
C05	8,10	1,74	7	8,5	9,75	2,75	0,32	8,25	1,29	7	8,5	9	2	0,24
B01	7,75	1,68	7	8	9	2	0,25	7,90	1,33	7	8	9	2	0,25
B02	8,95	1,00	8	9	10	2	0,22	8,95	1,00	8	9	10	2	0,22
B03	8,80	0,95	8	9	9,75	1,75	0,19	8,80	0,95	8	9	9,75	1,75	0,19
B04	8,20	1,28	7	8	9	2	0,25	8,20	1,28	7	8	9	2	0,25
B05	8,70	1,03	8	9	9,75	1,75	0,19	8,90	0,97	8	9	10	2	0,22
B06	9,00	0,92	9	9	10	1	0,11	9,05	0,94	9	9	10	1	0,11
B07	8,45	1,15	7,25	8	9,75	2,5	0,31	8,45	1,05	8	8	9	1	0,13
B08	8,90	0,79	8	9	9,75	1,75	0,19	8,90	0,79	8	9	9,75	1,75	0,19
B09	7,60	1,43	7	8	9	2	0,25	7,80	1,06	7	8	9	2	0,25
B10	8,85	1,04	8	9	10	2	0,22	8,85	1,04	8	9	10	2	0,22
T01	9,05	0,89	8,25	9	10	1,75	0,19	9,20	0,77	9	9	10	1	0,11
T02	8,90	1,33	8,25	9	10	1,75	0,19	9,05	1,10	8,25	9	10	1,75	0,19
T03	8,25	1,48	8	8	9	1	0,13	8,45	1,19	8	8	9	1	0,13
T04	8,45	1,36	8	8,5	9,75	1,75	0,21	8,45	1,36	8	8,5	9,75	1,75	0,21
T05	8,25	1,16	8	8	9	1	0,13	8,30	1,13	8	8	9	1	0,13
T06	7,90	1,68	7,25	8	9	1,75	0,22	8,15	1,14	7,25	8	9	1,75	0,22
T07	8,70	1,22	8	9	9,75	1,75	0,19	8,70	1,08	8	9	9	1	0,11
T08	7,95	1,67	7,25	8	9	1,75	0,22	8,20	1,06	7,25	8	9	1,75	0,22
T09	7,00	1,81	6,25	7	8	1,75	0,25	7,10	1,02	6,25	7	8	1,75	0,25
T10	8,15	1,95	7,25	8	10	2,75	0,34	8,50	1,36	8	8,5	10	2	0,24
T11	7,80	1,64	7	8	9	2	0,25	7,80	1,11	7	8	8,75	1,75	0,22
T12	8,15	1,60	7,25	8	9	1,75	0,22	8,45	1,05	8	8,5	9	1	0,12
T13	7,65	1,60	6,25	8	9	2,75	0,34	7,90	1,17	7	8	9	2	0,25
T14	8,20	0,77	8	8	9	1	0,13	8,20	0,89	8	8	9	1	0,13
Average	**8,30**	**1,45**						**8,42**	**1,18**					

For research projects, only three elements of competence did not reach consensus in the first round (brown colour) by the twenty experts. However, fifteen experts modified their opinions not only in those ones but in other twelve items in the second round (blue -increasing their importance- colour), increasing their respective consensus and promoting a significant level of importance.

5.3. Analysis of results

After the results provided by the experts have been presented for both teaching and research projects, it should be noted that only one element of competence (procurement) of the IPMA ICB 4 model does not reach seven points out of ten, and another eleven ones are between seven and eight points out of ten. The remaining seventeen are over eight points out of ten. Then, a prioritized list of competences is extracted, in order to focus on the most crucial ones (those that reach a greater value of importance and generate a greater consensus). As shown in Table 10, between the most valued competence and the eighth one, there is the same difference as between the eighth and the ninth, so it can be affirmed that these eight competences (shaded in grey colour) that make up the first gap.

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Table 10. Prioritization of elements of competence according to results

Code	Teaching		Research		Average		
	Mean	Ranking	Mean	Ranking	Mean	Ranking	Position
C01	**8,3**	**7**	**9,15**	**2**	**8,73**	**4,5**	**5**
C02	7,6	19	7,95	23	7,78	21	22
C03	7,9	13	8,6	11	8,25	12	12
C04	7,4	25	7,85	26	7,63	25,5	26
C05	8,05	10	8,25	18	8,15	14	15
B01	8	11	7,9	24	7,95	17,5	19
B02	**8,8**	**3**	**8,95**	**5**	**8,88**	**4**	**3**
B03	**9,05**	**1**	**8,8**	**9**	**8,93**	**5**	**4**
B04	7,8	16	8,2	19	8,00	17,5	18
B05	7,75	17	8,9	6	8,33	11,5	10
B06	**8,25**	**8**	**9,05**	**3**	**8,65**	**5,5**	**7**
B07	7,9	13	8,45	13	8,18	13	13
B08	**8,8**	**3**	**8,9**	**6**	**8,85**	**4,5**	**6**
B09	7,35	26	7,8	27	7,58	26,5	27
B10	**8,6**	**5**	**8,85**	**8**	**8,73**	**6,5**	**8**
T01	**8,55**	**6**	**9,2**	**1**	**8,88**	**3,5**	**2**
T02	**8,85**	**2**	**9,05**	**3**	**8,95**	**2,5**	**1**
T03	7,5	21	8,45	13	7,98	17	17
T04	7,9	13	8,45	13	8,18	13	14
T05	7,5	21	8,3	17	7,90	19	21
T06	7,5	21	8,15	22	7,83	21,5	23
T07	7,45	24	8,7	10	8,08	17	16
T08	7,35	26	8,2	19	7,78	22,5	25
T09	6,2	29	7,1	29	6,65	29	29
T10	8	11	8,5	12	8,25	11,5	11
T11	6,65	28	7,8	27	7,23	27,5	28
T12	8,25	8	8,45	13	8,35	10,5	9
T13	7,6	19	7,9	24	7,75	21,5	24
T14	7,7	18	8,2	19	7,95	18,5	20
Average	**7,88**		**8,42**		**8,15**		

The most critical and essential elements of competence for the TRS to address with greater guarantees the challenges posed by both educational innovation and research projects result, without any kind of priorization but according to their domain, strategy (as a perspective competence), design, requirements, objectives and benefits (as practical competences), personal integrity and reliability, personal communication, teamwork, resourcefulness and result orientation (as interpersonal competences).

In practical project situations, elements of competence cannot be considered as individual elements, being related to each other, so they should not be assessed only by the value of their importance. These relationships contribute considerably to perform other competences [4]. In Table 11 relationships among eight most relevant competences are compiled. These relationships are multi-lateral, but being important enough for providers and receivers (strong relations) or only for one of them (medium relations).

Likewise, according to their relationships, as shown in Figure 9, result orientation (in relation to all the remaining competences) and resourcefulness are the centre of the net of crucial elements of competence.

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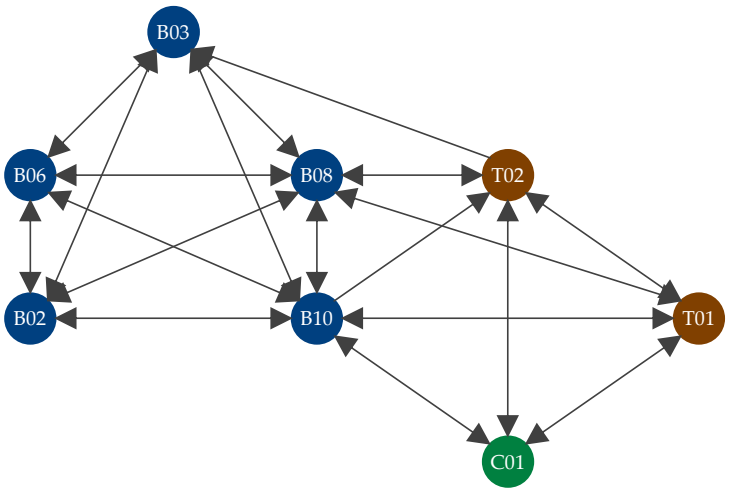
727 **Table 11.** Relationships among crucial elements of competence

Code	C01	B02	B03	B06	B08	B10	T01	T02	
C01	-								Strategy
B02		-							Integrity and reliability
B03			-						Communication
B06				-					Teamwork
B08					-				Resourcefulness
B10						-			Result orientation
T01							-		Design
T02								-	Requirements, objectives and benefits

Weak Medium Strong

728 **Figure 9**. Net of crucial elements of competence



729 *5.4. Basis for a gap plan*

730 Once the most crucial elements of competence (due to the importance and consensus achieved)
731 are identified, it is necessary to lay the groundwork for the acquisition, development and
732 improvement by TRS, so that the following indicators are described for their implementation,
733 according to the guidelines of the IPMA ICB 4 [4]. A brief description of elements is also included:

734 • The competence T02 (requirements, objectives and benefits) deals with the relationship
735 between what stakeholders want to achieve and what projects will achieve, regarding
736 objectives, benefits, deliverables, requirements and outcomes and how they relate to
737 each other. Key indicators (KCIs) are:
738 ○ Defining and developing projects goals hierarchy
739 ○ Identifying and analyzing projects stakeholders needs and requirements
740 ○ Prioritizing and deciding on requirements and acceptance criteria
741 • The competence T01 (design) integrates demands, desires and influences of all
742 stakeholders, drafting how resources, funds, benefits, risks and opportunities,
743 deliveries, priorities and urgencies are considered and deriving the proper approach to
744 guarantee projects success. KCIs are:

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    - Acknowledging, prioritizing and reviewing success criteria
    - Reviewing, applying and exchanging lessons learned
    - Determining complexity and its consequences for the approach
    - Selecting and reviewing the overall PM approach
- The competence B02 (integrity and reliability) enables to make consistent decisions, take consistent actions and behave consistently, building integrity, reliability and responsibility from ethics, commitment and trust. KCIs are:
    - Acknowledging and applying ethical values to all decisions and actions
    - Promoting the sustainability of outputs and outcomes
    - Taking responsibility for own decisions and actions
    - Acting, taking decisions and communicating in a consistent way
    - Completing tasks thoroughly in order to build confidence with others
- The competence B03 (communication) describes the essential aspects of efficient and effective communication, both content and mean, exchanging adequate information and delivering it with precision and coherence to the relevant parties. KCIs are:
    - Providing clear and structured information and verifying their understanding
    - Facilitating and promoting open communication
    - Choosing communication styles and channels to meet audience needs
    - Communicating effectively with virtual teams
    - Employing humour and sense of perspective when appropriate
- The competence C01 (strategy) encompasses the formal justification of projects objectives and the establishment of long-term goals, ensuring it is highly correlated with the mission and sustainability of organizations. KCIs are:
    - Aligning with organizational mission and vision
    - Identifying and exploit opportunities to influence organizational strategy
    - Developing and ensuring the ongoing validity of the organizational justification
    - Determining, assessing and reviewing critical success factors
    - Determining, assessing and reviewing key performance indicators
- The competence B08 (resourcefulness) facilitates to apply ways of thinking to defining, analyzing, prioritizing, finding alternatives for, dealing with and solving challenges and problems, in order to manage better and more effective approaches. KCIs are:
    - Stimulating and supporting an open and creative environment
    - Applying conceptual thinking to define situations and strategies
    - Applying analytic techniques to analyzing situations, data and trends
    - Promoting and applying creative techniques to find alternatives and solutions
    - Promoting a holistic view of context to improve decision-making
- The competence B06 (teamwork) brings people together to realize common goals, building a productive team by forming (selecting right members), supporting (promoting orientation) and leading (managing the team effectively). KCIs are:
    - Selecting and building the team
    - Promoting cooperation and networking between team members
    - Supporting, facilitating and reviewing the development of members team
    - Empowering teams by delegating tasks and responsibilities
    - Recognizing errors to facilitate learning from mistakes
- The competence B10 (result orientation) prioritizes resources to overcome problems, challenges and obstacles in order to obtain optimum outcomes for all stakeholders, focusing on productivity, as a combination of effectiveness and efficiency. KCIs are:
    - Evaluating all decisions against their impact on success and objectives
    - Balancing needs and means to optimize outcomes and success
    - Creating and maintaining a healthy, safe and productive working environment
    - Promoting projects, their processes and outcomes
    - Delivering results and getting acceptance

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6. Case studies

The proper cases selection allows exogenous variables to be controlled, results limits obtained to be defined, concepts to be refined, theoretical models to be developed and findings to be analyzed in depth. The universities selected, in spite of being at different stages of research and sustainability implementation, have a series of similar characteristics:

- From Spain, what means they are in the same legal context
- Public institutions, what implies they face the same financing system
- Broad offer, what enables they recruit undergraduate, master's and doctoral students

Two cases are selected in this research. On the one hand, the Technical University of Madrid (UPM), of an eminently technical nature, and, on the other hand, the University of Cadiz (UCA), of a more transversal and generalist nature. For the case study, first the presentation of both universities is carried out. Next, an extensive comparison is analyzed, based on a series of parameters and indicators, related to education and research (linking with society) and sustainability. Finally, these results are put into value by contextualizing them with those of other universities through international rankings.

6.1. Presentation of case studies

The Technical university of Madrid (UPM) is funded in 1971, although some of its schools come from the 18th century and for years they were the only ones in Spain linked to architecture and engineering teaching, both civil and militar. As set out in its statutes, UPM has, among its objectives, the creation, development, transmission and criticism of science, technology and culture, working from its faculties, technical schools, institutes and research centres, assimilating the changes taking place in the society and maintaining its vocation for excellence, which is why it has both national and international recognitions, as the Campus of International Excellence, distinction that refers to the quality of its research and teaching activities [122].

The University of Cadiz (UCA) is funded in 1979, marking the culmination of a long process in the demand for a university institution that would recover the fruitful tradition of higher education studies initiated and developed with the support of maritime and commercial activities in modern and contemporary times [123]. UCA wants to be recognized for its human capabilities, its efficient organization and its results, as well as for its willingness to work, together with its stakeholders, in the creation of economic, cultural and social value.

Main challenges UCA is facing are related to [123]:

- New legislative frameworks
- Establishment and consolidation of students despite demographic reduction
- Activation of new financing programmes
- Emergence and adaptation of new information and communication technologies
- Permanent collaboration with socioeconomic sectors to support their development

UPM has de the mission of educating their students, preparing them for professional practice and inculcating them with ethical values, responsibility and sensitivity for social problems and the challenges of humanity through the promotion, transfer and dissemination of scientific research, technological development and artistic creation, with a view to create a just and safe society, and improve the welfare of people and following generations [124]. In a similar story line, UCA has the mission of generating, diffusing and transferring of knowledge and culture as well as to the integral formation, throughout the whole life, of people and professionals [125].

UPM is structured in four university campuses (Universitary City, Madrid City, Montegancedo and South) [126], all in the city of Madrid, within a distance of no more than ten kilometers. For its part, UCA is structured in four university campuses too (Cadiz, Puerto Real, Jerez de la Frontera and Algeciras Bay) [127], all in the province of Cadiz but in four different cities, within a distance of more than one hundred kilometers.

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In addition to central services of their rectorships, these two Spanish public universities are structured into departments, housing faculties, higher technical schools, university schools and research institutes and centers, with the support of business chairs and university offices, as shown in Table 12:

Table 12. UPM and UCA structures. Extracted from [126–133]

Centers	UPM		UCA	
	N	Relative %	N	Relative %
Faculties	1	8,33	11	91,67
High Technical Schools	17	80,95	4	19,05
University Schools	0	0,00	2	100,00
Research Centers	3	75,00	1	25,00
Institutes	6	46,15	7	53,85
Departments	60	56,60	46	43,40
Business Chairs	75	84,27	14	15,73
University Offices	16	80,00	4	20,00
Total	178	66,67	89	33,33

First resource (and the most important one) of an organization is its human capital [134,135]. UPM and UCA, as public universities (also public administrations), besides to be organized into proper structures, depend on the contribution of their staff to achieve the proposed objectives, especially to develop the teaching and research tasks. The composition and amount of their personnel is presented in Table 13:

Table 13. Staff in UPM and UCA for the 2016-2017 course. Extracted from [136,137]

Type of titles		UPM		UCA	
		N	Relative %	N	Relative %
TRS		2.976	66,91	1.472	33,09
ASS		1.890	72,94	701	27,06
RTS		634	78,18	177	21,82
	Technicians	145		42	
	RST	278		86	
	Graduates	75		37	
	PHD and MD	136		12	
Total		**5.500**	**70,06**	**2.350**	**29,94**

Being:

TRS: Teaching and research staff

ASS: Administration and services staff

RTS: Research and technical staff

RST: Research staff in training

PHD: Doctor of philosophy

MD: Doctor of medicine

If the number of university structures and TRS from both universities are checked, it can be verified that the size of UPM is double that of UCA, so, for future comparisons, this ratio 2/3-1/3 will be taken as a measure for compare teaching, research, link with society and sustainability, as well as their national and international rankings position. According to this baseline, the number of ASS (giving support in management to the TRS) and RTS (collaborating in research with the TRS) in UCA is lower than the ratio, which would imply an increase in staff (especially for research) of four hundred people.

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On the other hand, if UPM and UCA budgets for the year 2017 are revised, as summarized in Tables 14 and 15, there is a difference of four percentage points (coming from taxes, rates and public prices), which would mean, maintaining the UPM budget and adjusting the UCA one, twenty-nine million euros, equivalent for UCA to seventeen times the incomes from private companies.

Table 14. UPM and UCA incomes budget for 2017. Extracted from [138,139]

	Items	UPM		UCA	
		N	Relative %	N	Relative %
3	Rates and public prices	96.289.638,47	81,27	22.197.300,00	18,73
4	Current transfers	200.698.758,14	63,56	115.071.163,29	36,44
(49)	From private companies	(3.530.600,00)	67,50	(1.699.548,00)	32,50
5	Heritage incomes	2.433.000,00	93,36	173.000,00	6,64
7	Capital transfers	39.396.097,73	83,59	7.736.140,00	16,41
8	Financial assets	10.302.365,78	97,29	286.858,00	2,71
	Total	**349.119.860,12**	**70,59**	**145.464.461,29**	**29,41**

Table 15. UPM and UCA expenditures budget for 2017. Extracted from [138,139]

	Items	UPM		UCA	
		N	Relative %	N	Relative %
1	Staff expenses	207.567.393,72	67,51	99.912.397,00	32,49
2	Goods and services	44.339.151,49	66,80	22.035.483,00	33,20
3	Financial expenses	1.278.468,42	83,72	248.518,00	16,28
4	Current transfers	12.313.536,50	66,67	6.157.157,29	33,33
6	Investments	77.312.698,06	82,13	16.824.048,00	17,87
7	Capital transfers	190.000,00	100,00	0,00	0,00
8	Financial assets	245.261,60	55,08	200.000,00	44,92
9	Financial liabilities	5.873.350,33	98,54	86.858,00	1,46
	Total	**349.119.860,12**	**70,59**	**145.464.461,29**	**29,41**

6.2. Comparison of UPM and UCA in terms of teaching

Below is a comparison between both universities, UPM and UCA, in terms of academic offer (Table 16), number of students by level (Table 17) and implementation of educational innovation projects (Table 18). According to the number of titles offered, a parity is observed, which indicates that, due to its smaller size, in order to achieve such diversification, it is probably necessary for UCA to make a greater effort than UPM. On the contrary, the number of students is very close to the ratio, with a higher proportion of second and third cycle students in the case of UPM.

Table 16. Academic offer in UPM and UCA. 2016-2017 course. Extracted from [140,141]

Type of titles		UPM		UCA	
		N	Relative %	N	Relative %
Grades		52	45,22	63	54,78
	Simple	46		44	
	Double	6		19	
Official masters		93	65,03	50	34,97
Doctorate		44	33,59	87	66,41
Own titles		245	56,45	189	43,55
	Continuous	105		116	
	Specialist	43		3	
	Expert	35		49	
	Master	62		21	
Total		**434**	**52,73**	**389**	**47,27**

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Table 17. Students in UPM and UCA. 2016-2017 course. Extracted from [142,143]

Type of students	UPM		UCA	
	N	Relative %	N	Relative %
Grades	31.387	64,63	17.180	35,37
Masters	4.816	79,30	1.257	20,70
Doctorate	2.108	62,66	1.256	37,34
Total	**38.311**	**66,05**	**19.693**	**33,95**

With the implementation of the Tuning project [73,74] and as a means of adapting to the Bologna process [144], UPM creates a novel structure of educational innovation groups, in a similar way of research groups, in order to join efforts and coordinate initiatives, that currently holds one hundred twenty-four groups and two thousand eight hundred and eight members.

Table 18. Evolution of educational/teaching projects from 2005 to 2017. Extracted from [145,146]

Course	UPM		UCA			
	N	Relative %	N1	N2	N3	Relative %
2005-2006	40	-	-	-	-	-
2006-2007	97	-	-	-	-	-
2007-2008	118	-	-	-	-	-
2008-2009	105	-	-	-	-	-
2009-2010	108	-	-	-	-	-
2010-2011	209	-	-	-	-	-
2005-2011	**677**	**-**	**-**	**-**	**-**	**-**
2011-2012	244	60,70	82	76	158	39,30
2012-2013	222	50,80	50	71	121	49,20
2013-2014			77	22	99	
2014-2015	257	64,90	72	67	139	
2015-2016	82	21,47	90	55	145	78,53
2016-2017			99	56	155	
2011-2017	**805**	**49,63**	**470**	**347**	**817**	**50,37**

Being:

N: Number of educational innovation projects in UPM

N1: Number of teaching innovation projects in UCA

N2: Number of teaching improvement projects in UCA

N3: Number of teaching innovation and improvement projects (N1+N2) in UCA

As reported in Table 18, UPM begins to develop educational innovation projects since the 2005-2006 course. However, UCA takes six more years to create the necessary structures beginning to face tasks and challenges of the TRS in the field of their training, teaching innovation and improvement and the use of new technologies. Although the number of educational/teaching innovation and improvement projects in both universities is similar from the 2011-2012 course, which may lead to more significant results in UCA, due to its smaller size (but with individual responsibilities), the establishment of a better organization in the UPM allows it to obtain deeper results, with less duplicities.

Another way of prospecting on the efficiency, effectiveness and quality of learning is the study of student satisfaction surveys, conducted to all students who attend class, throughout the academic year, as summarized in Table 19. The difference in the results obtained, throughout the courses 2012-2013 to 2016-2017 (last five complete courses), is clamorous in favor of UCA (something more than twenty-five percentage points) and remains relatively constant over the years. However, the use of two different scales (up to ten in UPM and up to five in UCA) induces a bias that should not be forgotten when establishing results.

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Table 19. Evolution of the students satisfaction survey from 2012-2013 to 2016-2017. Extracted from [147,148]

Items	UPM		UCA	
	N1	Average %	N2	Average %
2012-2013	5,03	50,3	4,0	79,7
Methodologies	6,32	63,2	4,0	80,0
Occupational guidance	3,70	37,0	4,4	88,0
Learning evaluation	5,78	57,8	3,8	76,0
Suggestions	4,01	40,1	3,9	78,0
Resources and services	5,57	55,7	3,9	78,0
Students support	4,80	48,0	3,9	78,0
2013-2014	5,33	53,3	4,0	79,7
Methodologies	5,59	55,9	3,9	78,0
Occupational guidance	4,26	42,6	4,4	88,0
Learning evaluation	6,27	62,7	3,8	76,0
Suggestions	4,49	44,9	3,9	78,0
Resources and services	5,96	59,6	4,0	80,0
Students support	5,38	53,8	3,9	78,0
2014-2015	5,54	55,4	4,0	80,3
Methodologies	5,76	57,6	4,0	80,0
Occupational guidance	4,81	48,1	4,5	90,0
Learning evaluation	6,19	61,9	3,8	76,0
Suggestions	4,69	46,9	3,9	78,0
Resources and services	6,17	61,7	4,0	80,0
Students support	5,64	56,4	3,9	78,0
2015-2016	5,65	56,5	4,1	81,3
Methodologies	5,67	56,7	4,0	80,0
Occupational guidance	5,08	50,8	4,5	90,0
Learning evaluation	6,09	60,9	3,8	76,0
Suggestions	4,83	48,3	4,1	82,0
Resources and services	6,45	64,5	4,0	80,0
Students support	5,76	57,6	4,0	80,0
2016-2017	5,68	56,8	4,2	83,0
Methodologies	5,63	56,3	4,1	82,0
Occupational guidance	5,36	53,6	4,7	94,0
Learning evaluation	6,15	61,5	4,0	80,0
Suggestions	4,69	46,9	4,1	82,0
Resources and services	6,64	66,4	4,0	80,0
Students support	5,60	56,0	4,0	80,0
2012-2017 Average	**5,44**	**54,4**	**4,04**	**80,8**

Being:

N1: Value on a scale of ten points

N2: Value on a scale of five points

6.3. Comparison of UPM and UCA in terms of research

Main objective for a research is to publish it in the scientific and technical literature, linking with other research universities, organizations and society in general [149–151], but it is not the unique way to do it and there is to do it carefully, selecting the means to spread it [152,153]. In Table 20 are compiled the documents by UPM and UCA indexed in Scopus, the largest abstract and citation database of peer-reviewed literature [154], thanks to its objective system of evaluation and validation, which includes journals, conference papers, reviews, books, chapters and even patents.

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923 **Table 20**. UPM and UCA documents indexed in Scopus until 30th September 2017 by type

Document types	UPM		UCA	
	N	Relative %	N	Relative %
Articles	19.842	73,24	7.251	26,76
Conference papers	10.695	90,79	1.085	9,21
Reviews	682	64,71	372	35,29
Book chapters	510	81,99	112	18,01
Editorials	362	85,99	59	14,01
Articles in press	218	68,99	98	31,01
Notes	72	62,61	43	37,39
Erratum	59	72,84	22	27,16
Letters	52	46,43	60	53,57
Books	41	87,23	6	12,77
Short surveys	30	68,18	14	31,82
Total	**32.563**	**78,12**	**9.122**	**21,88**

924 Table 21 classifies the information contained in the previous table by knowledge areas, showing
925 the diversity of research topics produced by both universities, UPM and UCA.

926 **Table 21**. UPM and UCA documents indexed in Scopus until 30th September 2017 by knowledge area

Knowledge areas	UPM		UCA	
	N	Relative %	N	Relative %
Agriculture and Biology	3.403	70,65	1.414	29,35
Arts and Humanities	485	53,59	420	46,41
Biochemistry and Genetics	1.829	61,60	1.140	38,40
Business and Management	476	67,71	227	32,29
Chemical Engineering	951	58,20	683	41,80
Chemistry	1.579	50,87	1.525	49,13
Computer Science	9.086	92,70	715	7,30
Decision Sciences	595	77,37	174	22,63
Dentistry	3	37,50	5	62,50
Earth and Planetary Sciences	1.625	68,71	740	31,29
Economics and Finance	202	61,40	127	38,60
Energy	1.864	90,09	205	9,91
Engineering	12.654	92,24	1.065	7,76
Environmental Science	2.208	66,23	1.126	33,77
Health Professions	503	85,40	86	14,60
Immunology and Microbiology	372	69,27	165	30,73
Materials Science	4.103	81,54	929	18,46
Mathematics	4.955	83,73	963	16,27
Medicine	1.979	56,62	1.516	43,38
Multidisciplinary	207	87,34	30	12,66
Neuroscience	336	64,99	181	35,01
Nursing	237	69,30	105	30,70
Pharmacology and Toxicology	70	15,73	375	84,27
Physics and Astronomy	6.601	86,55	1.026	13,45
Psychology	213	58,20	153	41,80
Social Sciences	1.931	73,37	701	26,63
Undefined	12	66,67	6	33,33
Veterinary	132	89,80	15	10,20
Total	**32.563**	**78,12**	**9.122**	**21,88**
(Authors)	(7.115)	(71,36)	(2.856)	(28,64)

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After reviewing Tables 22 and 23, it is observed that UCA publications are below the comparison ratio. To achieve this, they would have to index in Scopus a little more than seven thousand documents, which would mean an increase for UCA of almost eighty percent, which clearly indicates that the scientific production activity is quite superior in UPM (with a ratio of almost five documents per author compared to just over three documents for UCA authors).

However, it is necessary to discriminate articles indexed from the rest of documents, as it is extracted in Table 22. Once this has been done, it can be seen that the gap is considerably reduced, although UCA is still below the ratio. To be leveled, there should be published a little more than two thousand five hundred articles by UCA, which would mean an increase of almost thirty-seven percent (well below the eighty percent indicated above). Also, if the trend of the last five years (2013-2017) is analyzed, this gap is being reduced more and more, so the ratio could be reached in another three years.

Table 22. UPM and UCA articles indexed in Scopus until 30th September 2017 by their publication year

Year	UPM		UCA	
	N	Relative %	N	Relative %
< 2005	4.608	68,02	2.166	31,98
2005	540	71,15	219	28,85
2006	638	70,73	264	29,27
2007	709	72,72	266	27,28
2008	764	71,20	309	28,80
2009	964	75,31	316	24,69
2010	1.033	74,75	349	25,25
2011	1.277	78,58	348	21,42
2012	1.381	77,24	407	22,76
2013	1.565	78,05	440	21,95
2014	1.679	77,27	494	22,73
2015	1.638	75,24	539	24,76
2016	1.673	73,60	600	26,40
2017	1.361	72,01	529	27,99
2018	12	70,59	5	29,41
Total	**19.842**	**73,24**	**7.251**	**26,76**

Table 23. UPM and UCA patents registered until 30th September 2017 by their registration year. Extracted from [155]

Year	UPM		UCA	
	N	Relative %	N	Relative %
< 2005	115	71,43	46	28,57
2005	17	65,38	9	34,62
2006	30	61,22	19	38,78
2007	46	70,77	19	29,23
2008	56	77,78	16	22,22
2009	81	80,20	20	19,80
2010	98	81,67	22	18,33
2011	71	78,02	20	21,98
2012	72	69,23	32	30,77
2013	70	71,43	28	28,57
2014	79	74,53	27	25,47
2015	58	68,24	27	31,76
2016	42	87,50	6	12,50
2017	8	88,89	1	11,11
Total	**843**	**74,27**	**292**	**25,73**

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Other way to monitor the research of UPM and UCA is the register of patents, as shown in Table 23, which can be considered as tools for the sustainable development, mechanisms that stimulate the interest of researchers in continuing their research. According to these results, it can be contrasted that the number of UCA patents is below the ratio with those of UPM, and this trend is not reducing the gap (in fact, in order to place the ratio, UCA would have to have registered forty-five percent more patents).

All these scientific activities of UPM and UCA, through the planning and execution of research projects, which leads to the publication of scientific documents (mainly articles) and patent registration referred to above, are carried out through research groups, autonomous management units that, with the direction of a responsible researcher, they have to manage the resources available to them, including the formulation of the projects. UPM has two hundred and six groups (206) and UCA with one hundred and ninety seven (197). If TRS and RTS of both universities are added, there are three thousand six hundred and ten "potential" researchers in UPM and only one thousand six hundred and forty nine ones in UCA, which implies that each research group is composed of an average of almost eighteen people in UPM and almost nine people in UCA (twice as many people per group in UPM than in UCA). Likewise, UPM has an R+D+i project management office (unlike UCA), similar to PMOs in private organizations [59,61], which helps research groups with:

- Support on PM
- Review and consultancy of project budgets
- Advice in negotiation phases (contracts with the Commission and the Consortium)
- Management of economic reports
- Coordination of project and institutional audits
- Resolution of problems with the European Commission and the Consortium

Once research activities of both universities have been treated, it is the time to place them in national and international contexts, as summarized in Table 24, including the relative position of UPM and UCA with respect to other national universities and worldwide. University rankings have arisen as a result of widespread growth of higher education, competition between universities and the commercialization of tertiary education at a global level [37,156]. Nonetheless, these international rankings should be taken only from a qualitative and guiding point of view, as evaluation tools, whose results should not be considered as an objective in itself [41].

Table 24. UPM and UCA ranking in CWUR, URAP and Webometrics at 30th September 2017. Extracted from [42–46]

Academic Ranking of World Universities (ARWU)

University	World
UPM	600-700
UCA	900-1.000

Scimago Institutions Rankings (SCI)

University	Country	World
UPM	16	420
UCA	43	582

Center for World Global Universities Ranking (CWUR)

University	Country	World	Education	Employ	Facilities	Publish	Influence	Citations	Impact	Patents
UPM	15	501	235	267	240+	459	696	576	728	132
UCA	33	869	383+	616+	240+	843	885	709	936	266

University Ranking by Academic Performance (URAP)

University	Country	World	Category	Article	Citation	Document	AIT	CIT	Concert	Total
UPM	16	455	A	69,61	65,69	32,11	57,29	45,61	48,78	319,10
UCA	38	891	B++	64,30	63,68	30,42	54,61	45,15	45,70	303,86

Webometrics

University	Country	World	Presence	Impact	Openness	Excellence
UPM	9	335	233	270	742	406
UCA	37	926	575	1.264	1.202	1.036

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Next, in Table 25, the ranking Webometrics is analyzed in depth, being able to verify that in terms of excellence, UCA is in agreement to the ratio with UPM, but not in terms of presence and openness. Likewise, the impact variable, with a weight of fifty percent is quite heterogeneous. However, due to the smaller size of UCA and therefore less availability of human and economic resources, this is penalized in absolute terms against UPM.

Table 25. Breakdown of UPM and UCA ranking in Webometrics at 30th September 2017. Based on [46]

Breakdown Ranking		UPM		UCA	
		N	Relative %	N	Relative %
Impact					
	Trust flow	63	54,78	52	45,22
	Citation flow	52	51,49	49	48,51
	Referring domains	1k-10k	-	1k-10k	-
	External backlinks	1.709.691	53,49	1.486.766	46,51
	Majestic million	3.301	14,20	19.947	85,80
	Indexed URLs	54.986	61,33	34.674	38,67
Presence					
	Sites	547.000	75,34	179.000	24,66
Openness					
	Documents	49.700	78,76	13.400	21,24
Excellence					
	10% Top articles	224	65,69	117	34,31

6.4. Comparison of UPM and UCA in terms of sustainability

Sustainability is present in UPM from its own mission, in which through their TRS, tries to emphasize the transmission to their students of ethical values, responsibility and sensitivity for social problems, creation of a just an safe society and improvement of the welfare of following generations [124]. But in terms of sustainability, UPM activities are incipient. In fact, UPM starts preparing its strategic sustainability plan in 2017, based on these five cornerstones:

- Energy and emissions
- Water
- Sustainable mobility
- Circular economy and waste management
- Healthy campus

Likewise, other initiatives are being developed. On one hand, and with the intention of advancing in the process of improving sustainability, UPM is committed to involve students in the process by launching a series of calls for scholarships for the completion of the final degree/master projects in the field of improving the sustainability of the university. On the other hand, from the Innovation and Technology for Development Centre of UPM, they are researching with the aim to consolidate the crucial role that science and technology play in meeting the SD objectives [157]:

- Redesigning the means of productions, reorienting individual and social objectives to the general welfare
- Supplying goods and services with sustainability criteria
- Developing new technologies for sustainability, promoting social innovation
- Participating in the development of responses adapted to their reality
- Promoting multi-stakeholder alliances, aligning themselves in the new concepts of public-private-people
- Accessing to energy in a scalable way, designing and implementing models of participation, business, adaptation, production, maintenance and expansion, so that the solution adopted is really appropriate and sustainable over time
- Visualizing needs and devising responses, involving multiple actors

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Finally, among the numerous individual initiatives (from research groups), one in particular stands out, due to its relationship with PM and SD. This is the initiative working with people (projects to be developed by the people and not for the people) of Gesplan group [158], consisting of the integration of resilience in SD projects, introducing the concept of social learning and focusing on their three dimensions:

- Technical-entrepreneurial
- Ethical-social
- Political-contextual

For its part, UCA frames its trajectory in terms of sustainability in its environmental policy statement of 2006 (eleven years before than UPM), in which UCA, in accordance with its commitment to sustainability in the search for environmental quality, social justice and a viable and equitable economy, believes that it is an ethical imperative to generate a culture that contributes to an integral human development and environmentally sustainable [159].

- Contribute to SD of UCA by applying the necessary actions following a responsibility model, in order to respond to the expectations of the community
- Promote and operate coordinated strategies to prevent, solve or mitigate the impacts and environmental problems generated in campuses and their surrounding areas, as well as in the natural areas supervised by UCA
- Implement an educational communication strategy among the university students and the users of its services, to favor and enhance their involvement in environmental management and sustainability
- Establish criteria to protect the natural resources that are included in the university campuses of UCA
- Offer the community an example of reflection and intervention of good environmental practices, to induce initiatives that improve their quality of life
- Evaluate physical infrastructures, in order to optimize their operations from a sustainability perspective, promoting sustainable mobility
- Encourage responsible participation in university campuses in actions that improve the sustainability of the educational center and its environment
- Sensitize the university community (TRS, ASS, RTS and students) of the environmental and social problems of their closest university environment
- Improve knowledge and understanding of environmental and social problems by the university community
- Complement the training of the students for the exercise and development of a specific professional activity, expanding the teaching that is taught, in order to develop the knowledge and skills of students in a more sustainable environment

This involvement by UCA is solid, which can be endorsed by consulting the sustainability projects that have been carried out (nine) and are currently being carried out (another thirteen), as well as thanks to collaborations with other public administrations. All these efforts are made in UCA in a coordinated way (unlike UPM), through the Sustainability Office, supporting the community in these topics [160]. Likewise, the Sustainability Office is in cooperation of the publication of bulletins like RedEA, GEOBIO, Ecodes and Rediam, which are specialized in news, calls and environmental education and participation projects, besides communication and dissemination of work and actions in the field of Geodiversity and Biodiversity, collecting news of interest about its conservation. It is also necessary to emphasize that UCA is in the middle of the process of implementing a certified management system based on the ISO 14001 standard.

However, in terms of sustainability, neither UPM nor UCA are yet engaged in international rankings like the UI GreenMetric [161] (weighting infrastructures, energy and climate change, waste, water and transportation education), for regarding condition and policies related to green campuses and sustainability in universities all over the world. UI GreenMetric currently holds the participation of more than six hundred universities in the world and almost thirty ones in Spain.

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7. Discussion

In a scenario in which the production of knowledge results from scientific research, its transmission takes place through education and training, its dissemination thanks to information and communication technologies and its exploitation by technological innovation, universities can be postulated as the engine of social and economic change. In this context, research and sustainable universities, working by projects and with people into relevant teaching, pioneering research and sustainable outreaches, operations, services and strategies, can link with society to solve its problems and influence a responsible and sustainable development. All these objectives, once they have been formulated, lead to a series of processes, activities and tasks, of a unique, concrete and temporary nature, not always technical but managerial ones. In short, a series of projects. Consequently, projects are essential for the contribution of universities to SD.

Among all the projects that the TRS have to face, two of them stand out: educational innovation projects and research ones. But they do not do it alone but through flexible structures (research groups, innovation groups, corporate-sponsored (business) chairs, support offices, etc.) of universities. Therefore, the TRS not only have to deal with the technical and management processes of the projects in which they are involved, but they also have to organize, coordinate, collaborate and cooperate as a team. Although projects can be undertaken in an unstructured way, PM helps to improve their results in a sustained manner.

Results from the Delphi panel show that the acquisition and improvement of PM competences by the TRS are crucial in order to carry out the projects in which they participate (from the formulation of objectives until the achievement of results). Among the twenty-nine competences of the IPMA ICB 4 standard, eight have been outstanding, both in consensus, stability and importance, which can be considered as the nucleus for the TRS to undertake projects in the University community (reaching a score of almost nine points out of ten): strategy from the contextual (perspective) domain, design and requirements, objectives and benefits from the technical (practice) domain and integrity and reliability, communication, teamwork, resourcefulness and result orientation from the behavioural (people) domain. In fact, these eight competences reach the predefined consensus in the first round. Definitely, it can be affirmed that the experts consulted agree that competences in PM help the TRS to address their teaching and research, leading to a successful conclusion of all their projects, based on a sustainable formulation of objectives. However, it is necessary to point out that the values reached by the competences of the IPMA ICB 4 model are greater to develop research projects (almost eight points and a half out of ten) than to do it in educational innovation projects (almost eight points out of ten).

Case studies of UPM and UCA, both in terms of education, research and sustainability, have allowed an extensive, broad and deep analysis of their structures, policies and particularities, being able to draw some conclusions:

- Business chairs, as instruments to carry out the stable collaboration between the University, companies and institutions, are significantly more present in UPM than in UCA, with a ratio of 85/15, clearly superior to the adopted standard ratio 2/3-1/3
- There is a higher number of RTS (staff directly linked to (research) projects) in UPM than in UCA, with a ratio 80/20, clearly superior to the 2/3-1/3 one
- UPM largest budget (from rates and public prices and not from private companies), allows it to invest in initiatives that contribute to improve teaching and research results
- The academic offer is similar in both universities, which indicates that in UCA there are degrees with a lower number of students than in UPM, which implies greater attention and personalization (same grades, half of students)
- There is a higher ratio (almost 75/25) of 2nd and 3rd cycle students in UPM versus UCA
- Scientific production, both in indexed articles and in patents, is higher in UPM than in UCA, with a ratio 75/25
- International rankings punish UCA against UPM not only for their lower scientific contributions, but also for their smaller size (they are not goals themselves, but an external evaluation of universities' evolution and development)

Now, it is the place to propose a series of suggestions, based on the observations made. For UPM, the creation of an Office for Sustainability is suggested, similar to the one existing in UCA. Also, for UCA, the adoption of a series of proposals would be desirable:

- Create an Office for project management, supporting the TRS (especially for international and/or complex projects), similar to the one existing in UPM
- Increase the research activity of the TRS, acquiring critical mass in research groups and studying the possibility of merging those with common interests and needs
- Create a structure of educational innovation groups, coordinating strategies, joining forces and sharing resources, in a similar way of other universities like UPM

Besides, for both UPM and UCA, it would be interesting the participation in international rankings of sustainability in universities, increasing their commitment and stimulating the appearance and use of new opportunities.

In order to finalize and as a continuation of this research and future line of action, to check the degree of maturity in PM of the TRS that intervenes in educational innovation and research projects is recommended, through the use of the KCIs, and propose a customized breeding plan accordingly, as a first step to develop and improve the TRS competences and, therefore, of the universities themselves.

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