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Gestión de proyectos de diseño sustentable en planteles educativos de educación superior

Sustainable Design Project Management in Schools of Higher Education

Gestão de projetos de design sustentável em escolas de ensino superior

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Resumen

Debido a la importancia actual de los problemas sociales, de deterioro ambiental y económicos en los centros de estudios superiores, el presente trabajo tiene como objetivo analizar e identificar las competencias generales y específicas requeridas para gestionar proyectos de diseño sustentable. Esto a partir de los diferentes factores que favorecen la toma de decisiones, así como de elementos teóricos de apoyo para su implementación en los planteles educativos de nivel superior. La metodología se centró en técnicas observacionales. A través de un estudio de transversalidad entre las distintas competencias de sustentabilidad, diseño, administración y de liderazgo, se partió de la valoración de cada uno de los elementos que integran esta actividad. Aunado a lo anterior, se aplicó un cuestionario, con base en los conceptos y criterios resultantes, a gestores investigadores de la Universidad Autónoma del Estado de México, Centro Universitario Valle de Chalco. Para dar fiabilidad a los datos obtenidos, se trabajó con la teoría de la información, y en especial con el procedimiento denominado *distancia de Hamming*. Las capacidades y habilidades relevantes aquí obtenidas

no solo impactarán favorablemente en el planteamiento, desarrollo y cumplimiento de objetivos, sino también en el desarrollo de los planes curriculares en las distintas áreas de aplicación y el ejercicio docente.

Palabras clave: competencias, estrategias de gestión, proyectos, sustentabilidad.

Abstract

Due to the importance of social problems, environmental and economic deterioration in higher education centers, the present work aims to analyze and identify the general and specific competences required to manage sustainable design projects. This based on the different factors that favor decision-making, as well as theoretical elements of support for its implementation in higher education schools. The methodology was focused on observational techniques, through a study of transversality between the different competencies of sustainability, design, administration and leadership, based on the assessment of each of the elements that make up this activity. In addition, a questionnaire was applied based on the concepts and resulting criteria to research managers of the Universidad Autónoma del Estado de México, Centro Universitario Valle de Chalco. In order to give reliability to the obtained data, we worked with the Hamming distance process. As a result of the theoretical analysis and the application of the validation technique, the relevant skills and abilities were presented, which will not only impact favorably on the planning, development and fulfillment of objectives, but also on the development of the curricular plans in the different areas of application and teaching practice.

Keywords: competencies, management strategies, projects, sustainability.

Resumo

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Devido à atual importância dos problemas de deterioração social, ambiental e econômica nos centros de ensino superior, o presente trabalho tem como objetivo analisar e identificar as competências gerais e específicas necessárias para gerenciar projetos de design sustentáveis. Isto é baseado nos diferentes fatores que favorecem a tomada de decisão, bem como elementos de apoio teórico para sua implementação em estabelecimentos de ensino superior. A metodologia focada em técnicas observacionais. Através de um estudo transversal entre as diferentes competências de sustentabilidade, design, administração e liderança, baseou-se na avaliação de cada um dos elementos que compõem essa atividade. Além do exposto, aplicou-se um questionário, baseado nos conceitos e critérios resultantes, para pesquisadores da Universidade Autônoma do Estado do México, Centro Universitário Valle de Chalco. Para dar confiabilidade aos dados obtidos, trabalhamos com teoria da informação e, principalmente, com o procedimento denominado distância de Hamming. As habilidades e habilidades relevantes obtidas aqui terão impacto positivo na abordagem, desenvolvimento e cumprimento de objetivos, mas também no desenvolvimento de planos curriculares nas diferentes áreas de aplicação e ensino.

Palavras-chave: competências, estratégias de gestão, projetos, sustentabilidade.

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Introduction

Current research should focus on addressing situations that are exceeding the limits of the planet (Duarte, 2006). Each country has different environmental policies and actions, depending on its natural resources, productive, cultural or recreational activities. In recent years, interest in caring for the world and the actions of living beings has increased. The Brundtland Report (United Nations Organization [UN], also called Our Common Future, published in 1987, declares, among other things, that in order to achieve sustainable development a production system that respects the obligation to preserve the ecological base is necessary) for the development and a technological procedure that is able to continuously find new solutions, based on the satisfaction of the needs of the present without compromising the needs of future generations.According to Økland (2015), sustainability in

project management has increasing importance, since the problems of pollution and production processes, to mention a couple, are affecting the environment considerably.

It is currently possible to find detailed information on the projects developed. In this regard, one third of the gross world product (sum of the gross national product [GNP] of all countries in the world) is carried out through these developments (Turner, Huemann, Anbari and Bredillet, 2010). However, there is a gap between the methodologies, tools and frameworks presented in academic literature and common practice, as shown by management standards (Ali, Boks and Bey, 2016).

The Organization for Economic Cooperation and Development [OECD] (2012) states that one must work together in the face of global problems such as climate change or the destruction of the ozone layer, which affect any region of the world. The environmental perspective towards 2050, according to the same OECD (2012), is that the world population will go from 7000 million people to more than 9000 million, and predicts that the world economy will grow almost four times and, therefore, demand will increase energy and natural resources. It is also estimated that a 400% higher global economic growth will require 80% more energy. In line with the above, the degradation and erosion of natural environmental capital will present an irreversible risk that could jeopardize two centuries of growth in living standards.

The University Agenda 21, also focused on environmental management, affirms that higher education must form new generations in the integral sustainability model, in which a perfect correspondence between the different academic, administrative and operational processes is presented, in addition to contributing to the generation and application of knowledge, as well as in the behavior of a current society (Marcote and Suárez, 2011).

On the other hand, it is known that there is a crisis in the economic field, whose repercussions are more evident in the structures and characteristics of wage labor, and that international organizations, governments and institutions somehow pursue the idea of contributing to employability, term that has become a valued concept with respect to economic recovery (Formichella and London, 2013). Another manifestation of the crisis is based on the progressive exhaustion of the services that meet the daily needs of people.

Consequently, different conditions arise to reverse the difficulties inside and outside of economic systems.

In response to everything mentioned here, the need to develop skills in sustainability is latent. These competences can be distinguished into two types: a) those (of a technical nature) necessary to perform green tasks typical of a green economy, and b) those of a generic nature, which have to do with behavior as citizens, consumers and professionals. The latter are key to the development of sustainable design projects, since from them it is possible to promote new and improved behaviors to address the problem (Bina, 2013).

In that sense, the academy has eagerly sought to implement sustainable design projects within the industry through various methods and tools. Although Baumann, Boons and Bragd (2002), and more recently Pigosso and Rozenfeld (2011), suggest that the application and development of these instruments are in quantity the same number of sustainable designs implemented in production and daily life (Bey, Hauschild y McAloone, 2013).

So projects with a focus on sustainability have changed product-based systems with systems based on products and services (Manzini, 1999). Johansson (2002) also highlights the need to work with innovation, skills within the company, the relationship with the client and the commitment of managers, which are important factors for these initiatives. Even Brones, de Carvalho and Senzi Zancul (2014) observed that it is necessary to work with an overview of the various methods and techniques in the industry. In addition to managing a holistic approach considering the different approaches of the project as a single system (Fet, Aspen and Ellingsen, 2013) and increasing the complexities in organizations and communication difficulties in the different stages of development of a product with a guidance in ecodesign, putting first the approach, development and termination in the proposals to be developed (Verhulst and Boks, 2012).

Therefore, higher education institutions (HEIs) have a permanent commitment to the innovation of strategic plans for project management, and their participation should not be restricted to the formation of technical and professional resources, but to involve as a mandatory requirement a Social organizations In addition, we must work towards a full understanding of the different elements that determine a project.

According to the Royal Spanish Academy [RAE], the term project is defined, in one of its meanings, as follows: "Plant and arrangement that is formed to make a treaty or an execution of something of importance." Roberts and Wallace (2004) describe it as 1) a single objective, product or result; 2) presents restrictions (time) and scope of objectives; 3) needs various professions, organizations and educational organizations; 4) It is unique, it is not repeated; 5) one of its sections is generally unknown; 6) it is a temporary activity; 7) presents a clearly defined start and end; 8) The entire project is part of an interlaced process, and 9) is relatively complex.

In addition to the above, Roberts and Wallace (2004), the latter research professor at the Center for Strategy Development and Implementation (CSDI), present some definitions of project management:

a) Process of planning and execution of a portion of work from the beginning until the end, aimed at guaranteeing the fulfillment of the objectives, adjusting to the limitations of time and cost, complying with the specified quality standards.

b) Organization, planning, direction, coordination and control of all the resources of a project from beginning to end, with the purpose of achieving the objectives of the project, within the limits of time and cost, respecting the quality standards required (Roberts y Wallace, 2004, p. 8)

The CSDI of the Edinburgh School of Business at Heriot-Watt University works on project management based on four interrelated areas: a) strategic planning; b) strategic risk management; c) how to make strategies work, and d) project management for change (Roberts and Wallace, 2004). From another perspective, the review study of the state of the science of innovation and creativity in organizations conducted by Anderson, Potočnik and Zhou (2014) refers to the models of innovation management within companies, considering that the Different innovative human resources practices can be the transversal axis in project management with respect to their areas of application.

Therefore, HEIs, through their actions, have the capacity to create solutions and new methods to address the transformation that universities, organizations and the population in

general are experiencing, which favors the planning, development and efficient conclusion of projects of sustainable design. For many authors, all educational establishments should be sustainable, considering that they are spaces for the formation of human beings. However, inside, there is a series of practices that are detrimental to the environment and the health of those who develop different academic, administrative or operational activities. An important amount of affectations (saturated constructions of materials, cafeterias that serve in unicel containers, waste of paper, abuse of electricity consumption, etc.) can be an important approach for any manager. For Frías and Hurtado (2014), a sustainable team is primarily responsible for taking care of life, its resources (water, electricity), the generation of garbage, equity and social justice, environments of peace and harmony to favor leaderships that promote environmental content for your educational curriculum. In addition, it generates strategies that seek to involve managers, teachers, students, parents, administrative and administrative staff to plan, operate, evaluate, systematize and disseminate their environmental management practices.

As part of the efforts to develop new sustainable theories in educational establishments of higher education is the one carried out by the Interdisciplinary Group of Rural Technology (GIRA), the Ecosystem Research Center of the National Autonomous University of Mexico (UNAM), the Colegio de la Frontera Sur and the Research Center in Agricultural Sciences of the Autonomous University of the State of Mexico (UAEM). These proposed the project called the MESMIS sustainability evaluation methodology, due to the request of the Rockefeller Foundation to develop a method to evaluate the sustainability of the productive projects developed. The expectation focused on clarifying and reinforcing theoretical aspects on the subject, in addition to promoting technical recommendations in the management of natural resources (Astier, Masera and Galván, 2008). The initiative became an international frame of reference, and has served to train staff with a focus on the multidimensionality of management processes.

However, defining a problem based on project management where different skills are involved, such as planning, evaluating and deciding, among others, is an important challenge, and even more if one considers that in some situations more time is spent planning or determining A problem to solve. Therefore, it was considered important to ask the following

questions: What are the skills for training and professional activity of the sustainable design project manager? and How do the manager's skills interact to professionalize in his work activity? Also, through the investigation, it was necessary to determine specific objectives: 1) Identify and state the capacities that a sustainable design project manager must develop and 2) Develop alternative solutions to access and benefit from the calls regarding the development of Projects.

Objectives

- Study in detail the generic, specific and sustainable skills related to project management.
- Conduct a cross-sectional study of skills to analyze and propose relevant concepts in the approach, development and conclusion of proposals.
- Validate the results of the application of the questionnaire through information theory to present the required capacities.

Method

The research has a quantitative-qualitative approach. It is based on an analysis of data on generic and specific competences related to project management to conduct a cross-sectional study; define concepts and criteria that integrate a questionnaire that will be applied to 20 researchers from the UAEM, Valle de Chalco University Center, in order to submit the results to the theory of information (distance from Hamming) and give reliability to the work. The proposal was developed in the following phases:

- Phase 1. A detailed study of the characteristics and qualities that integrate generic, specific and sustainability competencies to complement and support project management was proposed for the beginning.
- Phase 2. In this part, a descriptive cross-sectional analysis was developed, through observation, comparing and evaluating the data of the different skills in the determined areas, based on the information presented in the documents Reflections and perspectives of the Higher education in Latin America: Final report Latin

America Tuning Project: 2004-2007 and Identification of the most relevant specific competences of the industrial designer: An exercise for curriculum development.

- Phase 3. A questionnaire with preponderant reagents for the management of sustainable design projects was applied to 20 researchers (17 with a doctor's degree and 3 as a teacher) responsible for technical research of different research projects at the Valle de Chalco University Center. The results obtained were validated with the application of information theory (Hamming distance).

Phase 1. General analysis of competences

Many authors have defined the term competence. However, due to the characteristics of the investigation, only the following contributions were considered. According to Badilla (2003), competencies are "abilities that every human being needs to solve, in an effective and autonomous way, life situations (p. 35). Beneitone (2007), meanwhile, defines them as follows:

> Complex integrated capacities, to varying degrees, that education must train in individuals so that they can perform as responsible subjects in different situations and contexts of social and personal life, knowing how to see, do, act and enjoy conveniently, evaluating alternatives, choosing the appropriate strategies and taking care of the decisions made (p. 35).

HEIs seek that all their students develop, from the appropriation of knowledge, problem solving. So new learning strategies should facilitate the diversification of knowledge. To conceptualize management competencies it is important not to forget the social, economic and political characteristics of Latin America. The conditions show the capacities that students must have, that is, they must have a cultural and intellectual preparation to face the challenges of coexistence, family or work. At the World Conference on Higher Education (1998) the following was stated: a) better staff training, skills-based training is necessary; b) the quality of education, research and services, as well as the relevance of curricula, should be improved and preserved, and c) it is necessary to agree on

cooperation and equal access to benefits related to international cooperation. In addition, the missions and functions of higher education were presented:

a) Provide adequate technical skills to contribute to the cultural, social and economic development of societies.

b) Facilitate access to a broad and specialized general education for certain careers, often interdisciplinary, focused on competencies and aptitudes, as both prepare individuals to live in diverse situations and to change activity.

c) Promote the acquisition of practical knowledge, skills and aptitudes for communication, creative and critical analysis, independent reflection and teamwork in multicultural contexts.

d) Ratify and apply regional and international regulatory instruments related to the recognition of studies, including those related to the homologation of knowledge, skills and abilities of graduates, in order to allow students to change course more easily and increase mobility within national systems and between them (Beneitone, 2007, pp. 33-34).

The generic competencies defined in the final report of the Tuning-Latin America 2004-2007 project make it possible to identify the favorable factors that are presented in the mainstreaming exercise between the generic skills and the capacities that are related to the management of sustainable design projects. Table 1 shows the competencies with the greatest impact to modify project management activities.

Tabla 1. Listado de competencias genéricas

Núm.	Competencia
1	Capacidad de abstracción, análisis y síntesis.
2	Capacidad de aplicar los conocimientos en la práctica.
3	Capacidad para organizar y planificar el tiempo.
4	Conocimientos sobre el área de estudio y la profesión.
5	Responsabilidad social y compromiso ciudadano.
6	Capacidad de comunicación oral y escrita.
7	Capacidad de comunicación en un segundo idioma.
8	Habilidades en el uso de las tecnologías de la información y de la comunicación.
9	Capacidad de investigación.
10	Capacidad de aprender y actualizarse permanentemente.
11	Habilidades para buscar, procesar y analizar información procedente de fuentes diversas.
12	Capacidad crítica y autocrítica.
13	Capacidad para actuar en nuevas situaciones.
14	Capacidad creativa.
15	Capacidad para identificar, plantear y resolver problemas.
16	Capacidad para tomar decisiones.
17	Capacidad de trabajo en equipo.
18	Habilidades interpersonales.
19	Capacidad de motivar y conducir hacia metas comunes.
20	Compromiso con la preservación del medio ambiente.
21	Compromiso con su medio sociocultural.
22	Valoración y respeto por la diversidad y multiculturalidad.
23	Habilidad para trabajar en contextos internacionales.
24	Habilidad para trabajar en forma autónoma.
25	Capacidad para formular y gestionar proyectos.
26	Compromiso ético.
27	Compromiso con la calidad.
28	Responsabilidad social y compromiso ciudadano.
29	Compromiso con la preservación del medio ambiente.
30	Compromiso con su medio sociocultural.

Fuente: Beneitone (2007, p. 33)

The last three capacities focus on social responsibility and care for the environment, which indicates that they include sustainable thinking.

The specific skills of the administrative area and their importance of the management activities defined in the aforementioned document were also identified. We worked with 700 graduates, 580 employers and 681 academics. Table 2 shows the specific competencies of the administration area and table 3 contains the results of the relative importance of the stakeholders.

Tabla 2. Listado de competencias específicas para administración de empresas

Núm.	Competencia
1	Desarrollar un planeamiento estratégico, táctico y operativo.
2	Identificar y administrar los riesgos de negocios de las organizaciones.
3	Identificar y optimizar los procesos de negocio de las organizaciones.
4	Administrar un sistema logístico integral.
5	Desarrollar, implementar y gestionar sistemas de control administrativo.
6	Identificar las interrelaciones funcionales de la organización.
7	Evaluar el marco jurídico aplicado a la gestión empresarial.
8	Elaborar, evaluar y administrar proyectos empresariales en diferentes tipos de organizaciones.
9	Interpretar la información contable y la información financiera para la toma de decisiones gerenciales.
10	Usar la información de costos para el planeamiento, el control y la toma de decisiones.
11	Tomar decisiones de inversión, financiamiento y gestión de recursos financieros en la empresa.
12	Ejercer el liderazgo para el logro y consecución de metas en la organización.

Fuente: Beneitone (2007, p. 71)

Tabla 3. Importancia relativa de las competencias específicas para los grupos de empleadores y académicos en el área administrativa

Competencia específica	Media empleadores	Media académicos
Desarrollar un planeamiento estratégico, táctico y operativo.	3719	3787
Tomar decisiones de inversión, financiamiento y gestión de recursos financieros en la empresa.	3590	3643
Identificar y administrar los riesgos de negocios de las organizaciones.	3594	3633
Interpretar la información contable y la información financiera para la toma de decisiones gerenciales.	3644	3631
Administrar y desarrollar el talento humano en la organización.	3635	3621

Fuente: Beneitone (2007, p.73)

The data reveal that academics give greater importance to the competencies of a) strategic planning, b) decision making for investment and c) identify and manage business risks. Employers consider the following more relevant: 1) Interpret information for decision-making, and 2) Manage and develop human talent.

Part of the task was to analyze the most relevant skills for the industrial designer. At different times, design professionals have sought to solve problems related to the environment, production and users. This has generated interest to propose consensus and define the design, as well as its competences. In May of 2018, there was the opportunity to edit the book entitled Identification of the most relevant specific competences of the industrial designer: Exercise for the development of a curriculum plan, thanks to which it was possible to determine 10 specific skills considering the issue of sustainability. The following table shows the results of the investigation.

Tabla 4. Competencias específicas de importancia relativa para el diseñador industrial

Identificación de las competencias específicas más relevantes para el diseñador industrial		
1. Reconocer y analizar los conceptos de la disciplina, así como las formas y estructuras en los conceptos de diseño para aplicar tridimensionalmente los elementos constructivos de la forma.	2. Analizar e interpretar los elementos del estado del arte de las diferentes áreas, sustentabilidad, ergonomía, estética, tecnológicas y de mercado, para integrar los elementos con base en fundamentos de diseño, creatividad, percepción y sensibilización para la elaboración de propuestas de diseño.	3. Interpretar sistémicamente la interrelación entre los factores humanos y otros sistemas a partir de la ergonomía y la antropometría para su evaluación y aplicación en el diseño de artefactos y objetos industriales.
4. Reconocer y aceptar proyectos de diseño industrial que garanticen un desarrollo sostenible y sustentable en lo ambiental, social, cultural y económico.	5. Reconocer y seleccionar la aplicación creativa de los materiales convencionales y los de última generación en problemas específicos de diseño.	6. Reconocer el proceso proyectual como un método de investigación para la configuración de objetos de diseño industrial.
7. Manejar programas de diseño asistido por computadora para la representación gráfica en dos y tres dimensiones de objetos de diseño industrial, empleando formatos electrónicos e impresos.	8. Percibir, concebir y manejar los materiales de transición (papeles, cartones, espumados, laminados plásticos, madera balsa, yeso plastilina, etc.) para la representación tridimensional de objetos a cualquier escala.	9. Manejar los medios y herramientas para realizar las animaciones y simulaciones virtuales de objetos de diseño industrial con *software* especializado.
10. Manejar los medios y herramientas para desarrollar modelos tridimensionales, utilizando impresoras estereolitográficas o centros de maquinados de control numérico asistido por computadora o equipos similares existentes.	11. Desarrollar proyectos de diseño industrial que garanticen un desarrollo sostenible y sustentable en lo ambiental, social, cultural y económico.	

Fuente: Sánchez (2018, p. 74)

In the table presented is the competence that integrates the development of projects considering sustainability theories, which are structured by the following axes of application: 1. Natural resources, 2. Economic sector, 3. Social equity, 4. Political sector and 5. Culture.

With regard to the competences for sustainability, it is known that there is currently a record of the activities carried out by HEIs. For example, universities in Spain, among others, have worked for important changes. The Faculty of Education Sciences at the University of La Coruña implemented a sustainable management system. The groups in charge of the project worked monographically on various administration indicators. In summary, the objectives were:

1. Eliminate or minimize negative environmental impacts in the school or faculty by controlling those activities that involve some kind of risk to the environment.
2. Demand that the university community and companies that have a relationship with the academic, administrative or any other process comply with current environmental legislation.
3. Promote the rational use of natural resources and energy.
4. Promote practices of reuse, recycling and recovery of materials, in order to minimize the production of waste and its impact on the environment.
5. Develop training programs aimed at the entire university community to promote the development of positive attitudes towards sustainable development in the performance of their functions.
6. Make the campus a friendly environment (protection of green spaces, improved access, maximum ease of mobility for people with disabilities, etc.).
7. Develop and improve every two years pro-environmental objectives and goals, ensuring compliance with periodic evaluations, through evaluation systems (Marcote y Suárez, 2011, p. 212).

The Commission on Environmental Quality and Sustainable Development (Cadep), created in 2002 from the Conference of Rectors of Spanish Universities (CRUE), which integrates all HEIs of the Spanish State, ordered to promote sustainability for university studies, promote best practices in natural resource management, sensitize all actors and actively participate in social initiatives. This delegation, made up of more than a dozen

university faculties, studies the curriculum sustainability proposal in order to facilitate the teaching-learning process based on key competencies. The research line consists of three sublines:

1. Diagnosis and increase of instruments through evaluative research on the presence of capacities for sustainability in university degrees (Aznar, Ull, Martínez and Piñero, 2017).
2. An innovative methodological proposal of the training procedures of university students to reinforce the acquisition of key sustainability skills (Melendro, Murga, Novo and Bautista, 2008).
3. Teacher training in the skills necessary to lead pedagogical processes in the framework of education for sustainable development of both initial and ongoing training (Vilches y Pérez, 2012).

Derived from these lines of work, Cadep suggests that four general competencies for sustainability be integrated. Table 5 shows these competencies.

Tabla 5. Competencias clave para la sustentabilidad

Núm.	**Competencia**
1	Competencia en la contextualización crítica del conocimiento estableciendo interrelaciones con la problemática social, económica y ambiental, local y/o global.
2	Competencia en la utilización sustentable de recursos y en la prevención de impactos negativos sobre el medio natural y social.
3	Competencia en la participación en procesos comunitarios que promuevan la sustentabilidad.
4	Competencia en la aplicación de principios éticos relacionados con los valores de la sustentabilidad en los comportamientos personales y profesionales.

Fuente: Cadep (2012)

Phase 2. Cross-sectional study

To define the competencies in project management, the analyzed capacities were taken, as well as those that a director must have. The Project Management Institute (PMI), in its Fundamentals Guide for Project Management [PMBOK Guide] (2013), declares that this activity is a critical strategic discipline, therefore, the leader must understand, generate and apply knowledge , tools and techniques to manage projects efficiently, in addition to having specific area skills and those transversal generic for management.

Crawford (2005), on the other hand, developed an investigation about the perceptions that senior managers have about the competencies that project managers should have. He proposed an integrated model based on the identification of its components considering the knowledge, skills, experience and personal characteristics, as well as the attitudes and behavior of the project managers. Said model together with the competences of relative importance for the administrative and cross-sectional areas will be the basis for conceptualizing management. Table 6 shows the relationship between the concepts.

Tabla 6. Análisis transversal de las áreas para la propuesta de competencias importantes en la gestión de proyectos de diseño sustentable.

Características de los proyectos	**Tipos de competencias para la gestión de proyectos de diseño sustentable**
Un objetivo, producto resultado único	Capacidad para formular y gestionar proyectos. **Co. Genérica//** Desarrollar un planeamiento estratégico, táctico y operativo. **Co**. **Importancia Relativa-Administración//** Reconocer y aceptar proyectos de diseño que garanticen un desarrollo sustentable en lo ambiental, social, cultural y económico. **Co. Diseño//** Compromiso con la preservación del medio ambiente. **Co. Genérica//** Competencia en la aplicación de principios éticos relacionados con los valores de la sustentabilidad en los comportamientos personales y profesionales. **Co. Sustentabilidad//** Perspectiva estratégica. **Co. Liderazgo**// Competencia en la contextualización crítica del conocimiento estableciendo interrelaciones con la problemática social, económica y ambiental, local y/o global. **Co Sustentabilidad//** Perspectiva estratégica. **Co. Liderazgo**.

Restricciones (tiempo)	Capacidad para organizar y planificar el tiempo. **Co.Genérica**
Requerimientos para el alcance de objetivos	Competencia en la utilización sustentable de recursos y en la prevención de impactos negativos sobre el medio natural y social. **Co. Sustentabilidad//** Eficiente gestión de los recursos. **Co. Liderazgo** Resistencia emocional **Co. Liderazgo//** Valoración y respeto por la diversidad y multiculturalidad. **Co.Genérica//** Capacidad de trabajo en equipo. **Co.Genérica**
Requiere de diversas profesiones, organizaciones e instituciones	Capacidad de motivar y conducir hacia metas comunes. **Co. Genérica//** Administrar y desarrollar el talento humano en la organización. **Co. IR-Administración//** Interpretar sistémicamente la interrelación entre los factores humanos y otros sistemas, a través de las áreas requeridas para su evaluación y aplicación en el diseño de proyectos sustentables. **Co. Diseño** Capacidad de aprender y actualizarse permanentemente. **Co. Genérica**
Es único, no se repite	Identificar y Administrar los riesgos del proyecto. **Co IR Administración//** Capacidad de aplicar los conocimientos en la práctica. **Co.Genérica//** Capacidad de investigación. **Co. Genérica** Capacidad para actuar en nuevas situaciones. **Co. Genérica**
Desconocimiento de algunos de sus apartados	Análisis crítico y juicios. **Co. Liderazgo**
Se trata de una actividad temporal	Capacidad para tomar decisiones. **Co. Genérica** Desarrollar un planeamiento estratégico, táctico y operativo. **Co. IR-Administración**
Capacidad para tomar decisiones. **Co. Genérica** Desarrollar un planeamiento estratégico, táctico y operativo	Competencia en la participación en procesos comunitarios que promuevan la sustentabilidad. **Co. Administración**
Todo el proyecto forma parte de un proceso entrelazado	Competencia en la contextualización crítica del conocimiento estableciendo interrelaciones con la problemática social, económica y ambiental, local y/o global. **Co. Administración**
Es relativamente Complejo	Capacidad para identificar, plantear y resolver problemas. **Co.Genérica** Capacidad de abstracción, análisis y síntesis. **Co. Genérica**

Fuente: Elaboración propia

Phase 3. Application of the instrument and validation

The concepts resulting from the mainstreaming study were used to propose an instrument with strategic questions and based on the characteristics of the project and the type of management competence. The purpose of the exercise was to facilitate the recognition and consensus of the competences that compose them. So that HEIs, through their managers, teachers and students involved in the various jobs, accelerate and improve conditions in order to develop new criteria for academic administration.

We worked with a non-probabilistic sample of 20 full-time teachers and researchers in six different degrees (Industrial Design, Accounting, Computer Engineering, Nursing, Law and Administrative Informatics) of the UAEM, Valle de Chalco University Center; eight belong to the National System of Researchers (SNI); All have been responsible for technical research projects with a focus on sustainability. Each of them answered the questions in the following questionnaire.

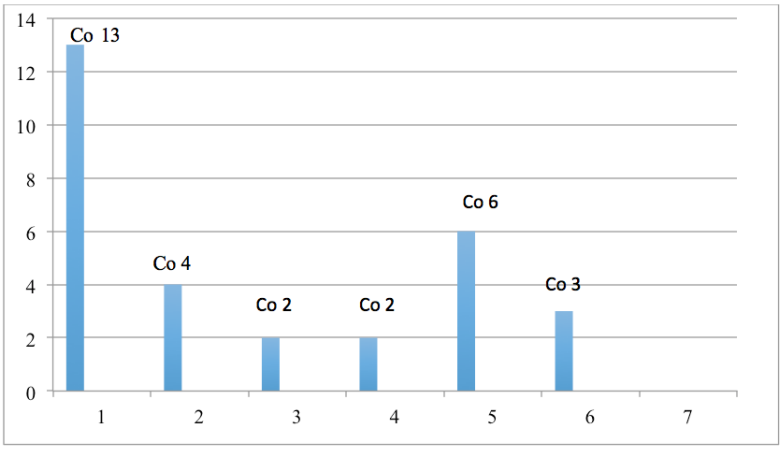
Tabla 7. Descripción (escriba la competencia elegida por nivel de importancia hasta completar 10 de las expuestas en el estudio de transversalidad y desarrolle la información solicitada)

Núm.	**Defina, con base en su experiencia como investigador, la interrelación entre las competencias genéricas, de administración, diseño y sustentabilidad.**	**¿Cómo mejoraría su ejercicio profesional como gestor de proyectos de diseño sustentable en planteles de educación superior, a partir de la implementación de las competencias que se presentan en el ejercicio de transversalidad?**
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Fuente: Elaboración propia

The general analysis of the instrument showed that generic skills are relevant to project management. Therefore, the mainstreaming between general and leadership, administration, sustainability and design skills facilitated the identification of the capacities that a manager must have, know and develop.

Figura 1. Valores obtenidos del análisis general de competencias



13 Co. Genéricas. 6 Co. Liderazgo. 4 Co. Importancia relativa (administración). 3 Co. Sustentabilidad. 2 Co. Diseño. Y 2 Co. Administración.

Fuente: Elaboración propia

In Information Theory, Hamming Distance is called the effectiveness of block codes (techniques used to transform a set of binary data "N" into a somewhat longer "K") and depends on the difference between a code word valid and other. The greater this difference, the lower the possibility that a valid code will be transformed into another valid code by a series of errors. This difference, precisely, is called Hamming distance and is defined as the number of bits that have to be changed to transform a valid code word into another valid code word. If two code words differ by a distance x, x errors are needed to convert one into the other (Hamming, 1950, 90).

The validation technique was done through this theory: branch of mathematical theory and computer science. In the field of information theory, Claude E. Shannon (electronic and mathematical engineer) and Warren Weaver (biologist and computer scientist) published in 1948 the Mathematical Theory of Communication. With the application of this theory it was possible to demonstrate that all sources of information can be measured and that the communication channels (radio, television, telephone or people talking, etc.) have a similar unit of measure, and the speed was determined Maximum transfer or channel capacity.

In this way, Hamming's distance facilitates the validation of the study, since it allows to verify if the distance between the actual estimated value is consistent with the ideal estimated value. Frequency levels and weighting were analyzed on a scale of 0 to 10 for the suggested competencies. In this way, the real frequency level vector was obtained. Subsequently, the following algorithm was applied to define the ideal vector. Hamming distance is defined:

$$\delta\left[\mu_{A\,(x)}, \mu_{B\,(y)}\right] = \frac{1}{n}\sum_{\mathbb{k}=0}^{n} |\, X_k - Y_k|$$

As:

A(x) It is the vector of the real averages at each level of the competencies suggested in the cross-sectional study.

B(y) it is the vector of the estimated averages at each level of the redefined competences.

$\mu A(x)$ define set attributes *A(x)*.

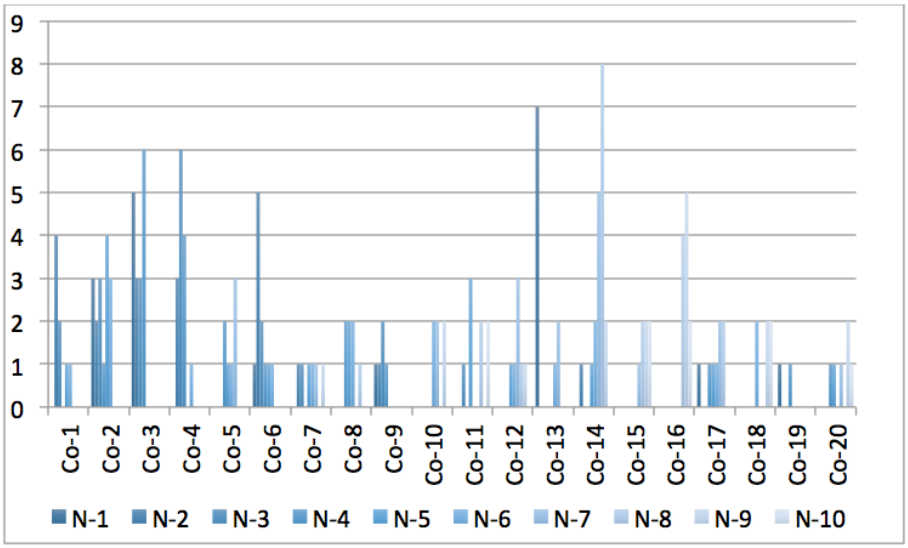
$\mu B\,(y)$ define set attributes *A(y)*.

X_k es the k-ésimo set attribute *A(x)*.

n is the total attributes.

With this technique it was feasible to detect the similarity between the real vectors and the estimated vectors. Therefore, it was possible to define the distance between A (x), vector of the real averages at each level of the competencies suggested in the cross-sectional study, and B (y), vector of the estimated averages at each level of these competencies The following graph describes the frequency analysis.

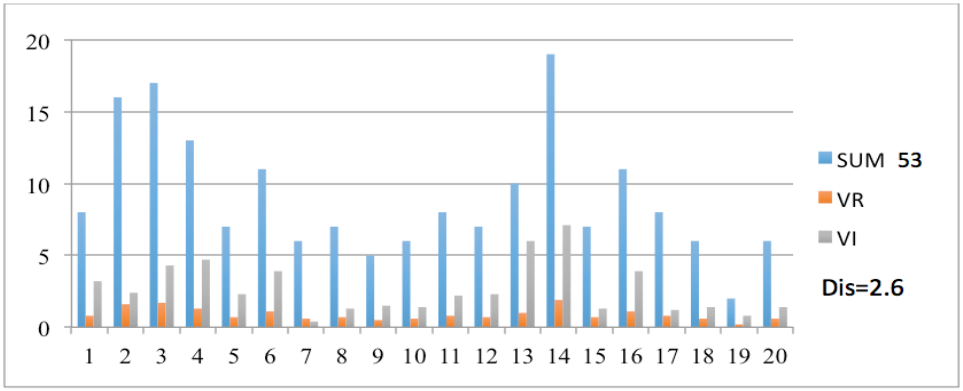
Figura 2. Análisis de frecuencia de las competencias elegidas por los investigadores



Fuente: Elaboración propia

The average distance established between the real state derived from the research exercise applied to the research managers and the ideal state found from the technique used was 2.6. Figure 3 represents it.

Figura 3. Sumatoria vectores reales, vectores ideales y distancia



Fuente: Elaboración propia

Therefore, it can be said that the skills for the management of sustainable design projects have a fairly acceptable degree of reliability. Since on a scale of 0 to 10 of this type, and when talking about the distance of Hamming, the closest to the value 0 is considered a highly satisfactory result, so, to talk about a process of validating the results more robust, this value should not exceed 3.

Results

After the identification, analysis and definition of the different capacities, as well as the application of the questionnaire and the validation of results, the following competencies for the management of sustainable design projects are presented:

- Ability to plan, formulate and manage strategically, tactically and operationally design projects that guarantee a sustainable development in environmental, social, cultural and economic with a strategic perspective.
- Ability to make investment, financing and financial resource management decisions for the development of sustainable design projects through the efficient management of resources with vision and imagination.
- Emotional resistance to motivate and lead towards common goals of administration and development of human talent in the organization, considering the value and respect for diversity.
- Systemically interpret the interrelationship between human factors and other systems through the areas required for evaluation and application in the design of sustainable projects.
- Ability to learn, update and apply knowledge in research practice with regard to project risk management.
- Ability to act in new situations, based on a critical analysis and judgments to identify, plan and solve problems.
- Competence in participation in community processes that promote the critical contextualization of knowledge, establishing interrelations with the social, economic

and environmental, local and / or global problems.

- Capacity for abstraction, analysis and synthesis to organize and plan time.

Discussion

In the investigation, different criteria emerged that can strengthen project entrepreneurship, although the complicated to initiate them is presented in demographic dynamics and political patterns based on bureaucratic processes given in a local, state or federal system. According to Manzini (1996), it is necessary to generate a new way of making products and design, because the artificial environment of man tends to be increasingly disposable, since the initiatives or programs that are developed in a friendly context with The environment only benefits a few.

In addition, it was possible to expose the need to address the incompatibility between current production and consumption models. Despite this, the economic factors exceed the rational use of natural resources, interaction and understanding in the different human activities, as well as the versatility so that the designed objects can continually reconfigure their environment and efficiently use natural resources and raw materials.

Conclusions

It is clear that project management is based on a technical perspective and is directed towards a social perspective, so it is necessary to reconsider our behavior in higher education centers, starting with everyday family activities, circumstantial relationships with other people, habits of consumption, the use of goods and services to the most structured actions and their consequences derived from the ignorance of some subject. Therefore, to generate sustainable design projects in educational establishments it is necessary to jointly address the development of competences based on the theories and criteria of sustainability, management techniques and programs that focus transversely on people's behaviors. In that sense, it is necessary to identify and modify if necessary the pro-environmental behavior presented by managers, researchers, students and the university community. Currently, the academic

bodies or research groups of HEIs in design work towards global production processes, without taking into account the relevant social and cultural factors to counteract those projects that are evaluated as pollutants.

Project management in organizations has used academic elements as research, considered different approaches focused on the execution of tasks, skills management, development of functions and new performance criteria. Despite all this material, a method that guarantees the total success of a project cannot be determined. However, whatever a manager's specialty, it does not prevent him from working towards new ways of thinking. The tools used by those who intend to hegemonize the economy, production and natural resources to their advantage do not reach the ethical and contextualization values required to control the excessive devastation of the planet in which we live. Therefore, new generations, together with experienced professionals, must commit to innovative models for project development and generating knowledge, as well as satisfactory results. Sustainable design projects are tools that should balance the material culture, the technological, economic, educational, political and cultural sectors in favor of the quality of life.

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