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THE COMPLEXITY BEHIND THE INCORPORATION OF THE ISO 14006 STANDARD INTO THE PROJECT'S DESIGN STAGES WITHIN MICRO, SMALL AND MEDIUM SIZE INDUSTRIES FROM MEXICO CITY AND METROPOLITAN AREA

LA COMPLEJIDAD AL INCORPORAR LA NORMA ISO 14006 EN LA ETAPA DE DISEÑO DE PROYECTOS EN MICRO, PEQUEÑA Y MEDIANA INDUSTRIA DE LA CIUDAD DE MÉXICO Y ZONA CONURBADA

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ABSTRACT

The efficient and effective incorporation of the sustainable element within product design and manufacturing companies has proven to be a competitive tool to attract new markets and at the same time, a complex challenge. The ISO 14006 Standard regulates the incorporation of the so-called "eco-design" in the creative stage of a project, but within the Mexican context, its integration inside micro, small and medium-sized companies has proven to be complex, because the vision which it contemplates comes from an Eurocentric context, where it is assumed that all companies have the necessary resources to incorporate better technologies, but within the Mexican reality, in which these small companies incorporate semi-artisanal processes, the effective and efficient implementation of such Standard results almost impossible to integrate and it is necessary to analyze viable alternatives to help them achieve it. Through a diagnostic questionnaire and an in-depth interview conducted to a panel of experts formed up by academics, industry leaders, and designers, focusing on the reality experienced by Mexican product companies and the challenges they face when addressing the integration of the environmental element to their projects, such is the case of the ISO 14006 standard. Amongst the findings there is a list of the challenges faced by small companies when incorporating the Standard, a description of the design processes within them and the contribution of a new design profile, capable of addressing complex projects, facilitating the transition of companies towards a more sustainable ones, closing

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with a discussion focused on the scope, challenges, and limitations of incorporating said change.

RESUMEN

Palabras clave:
ISO 14006, diseño, fabricación, productos.

La incorporación eficiente y eficaz del elemento sustentable dentro de empresas de diseño y fabricación de objetos ha demostrado, por un lado, ser una herramienta competitiva para atraer nuevos mercados, y a la vez, un reto complejo. La Norma ISO 14006 regula la incorporación de llamado "eco-diseño" en las etapas creativas de un proyecto, pero dentro del contexto mexicano, su integración en micro, pequeñas y medianas impresas ha demostrado ser compleja, porque la visión de la cual parte contempla un contexto eurocéntrica, en donde se asume que todas las empresas tienen los recursos necesarios para incorporar mejor tecnología, pero la realidad mexicana, donde estas pequeñas empresas cuentan con procesos de producción semi artesanales, la implementación eficaz y eficiente de la Norma, resulta difícil de incorporar y donde resulta necesario analizar alternativas viables para lograrlo. Mediante un cuestionario diagnóstico y una entrevista a profundidad realizada a un panel de expertos conformado por académicos, líderes de industria y diseñadores, se sondeó la realidad que viven las empresas mexicanas de productos y los retos que enfrentan al abordar la integración del elemento ambiental, como lo es la ISO 14006 en sus proyectos. Entre los hallazgos se enumeran los retos que enfrentan las pequeñas empresas al incorporar la Norma, una descripción de los procesos de diseño dentro de éstas y la aportación de un nuevo perfil de diseño capaz de abordar proyectos complejos, facilitando la transición de las empresas hacia unas más sustentables, cerrando con una discusión centrada en los alcances, retos y limitaciones al incorporar dicho cambio.

Introduction

Sustainability has become an increasingly important objective for companies seeking to respond to the demands of a society that is increasingly interested and active in the pursuit of nature conservation. The leaders of organizations have had to incorporate in their agenda, strategies and ways to achieve sustainability, which implies not only a change in their processes, but also in their culture and values (Martínez and Ibarra, 2015), and must start with the idea that sustainability is a strategic achievement necessary for companies and all stakeholders (Aguayo, 2013; Ceschin, 2016; Chávez and Ibarra, 2016).

The great challenge today is to meet emission reduction targets to mitigate the risk of global warming and the resulting severe climate change; time is pressing and it is necessary to reduce global temperature by 1.5°C to 2°C, seeking to return to pre-industrial levels (Berners-Lee, 2016; Chiotis, 2019; Raftery, Zimmer, Frierson, Startz, & Liu, 2017; O'Brien, 2018; UNEP, 2017).

Looking at the sustainable challenge from an industrial perspective, it is possible to understand the objectives that must be addressed from a production and consumption system perspective, reducing the speed at which they consume natural resources; by 2030, if they fail to reach a point of stability, it will be necessary to have a planetary system of resource regeneration and waste absorption equivalent to two planets, just to maintain the current trend (Chiotis, 2019; Crutzen and Stoermer, 2000; UN, 2016).

The challenge presented by climate change has been considered technical, falling on the practical side of transformation systems and their structuring schemes, seeking to facilitate or restrict responses within the productive system, necessary for a global transformation (Ehrenfeld, 2015; O'Brien, 2018).

Within this productive system, there is an actor who plays an important role in the decision making process that generates this impact: the industrial designer, a professional who shapes the material world and who makes the critical decisions that affect ecosystems and planetary health; because everything that exists in the modern world is the result of an act of design, every decision made in the product development process comes from such activity and the role played by the designer marks him as the main responsible (Davidová, 2019; García and Vezzoli, 2021; León and Rosa, 2015; McDonough and Braungart, 2002; Thomson, 2000). This makes the designer responsible for developing his work in an ethical, effective and efficient manner, if he seeks to reduce the impact derived from his work, and therefore a radical change is needed in the contributions made by design within production systems, where the sustainable approach represents a change from product design thinking to one of design systems, opening the door to new models of business organization (Ceschin and Gaziulusoy, 2020; García and Vezzoli, 2021; Papanek, 2005).

Industrial design is responsible for the material transformation of the world, implying also the consequences derived from its work, giving rise to the consideration that no other activity causes greater damage than the way in which we design the material world (Papanek, 2005; Wahl, 2008), marking design as one of the activities with greater environmental, social and moral responsibility, whose obligation should be to generate healthy products for the planet, ethical, socially responsible and incorporate efficient technologies that avoid the degradation of natural systems, instead it has led us to problems such as: resource scarcity, environmental pollution, health problems in the population, as well as social and cultural imbalance, putting at risk the quality of life of future generations, caused by an inability to generate lasting values, becoming obsolete, dangerous and unsustainable (Norman, 1999; Papanek, 2005).

It is known that more than 80% of environmental decisions are made during the conceptual and project stages of the design process, therefore, it is said that the sustainability problem is a design problem. (Thackara, 2005). And although there are strategies aimed at minimizing the damage produced by design practices (e.g. green design, eco-design, bio-inspired design), they are inefficient and insufficient to achieve the objectives of sustainable development (Alsamawi et al. 2017; McDonough and Braungart, 2002; Stegall, 2006) or, rather, of sustainable design development, assuming that design has the ability to develop products that consider environmental factors, transforming the professional practice of design (Ehrenfeld, 2015). The cited authors assume that the designer has the skills to implement the necessary change and face accountability for their actions and redirect the design efforts should help transform the system that determines that it should be designed (Boehnert, 2018).

The concept of eco-design is one that appears constantly in the bibliography consulted, as well as its great weakness: an industrial-economic perspective rooted within the guidelines of neoliberal policies, where the important element is the economic aspect, but not the environmental one, explaining its limitations as a strategy that allows achieving true sustainability, since it addresses only some elements of the industrial cycle or provides subsequent solutions and it is concluded that most of such approaches start from waste reduction and resource optimization (Berners-Lee, 2019; Gaziulusoy, 2015; Papanek, 2005).

Even the whole system concept that characterizes a Life Cycle Assessment (LCA) is limited in terms of aspects related to the human element and the impact on decision making (Bhamra, Lilley and Tang, 2011; Ceschin, 2020), completely discarding aesthetic, symbolic and spiritual issues that characterize holistic thinking (Gaziulusoy, 2020).

In Mexico, facing the challenge that sustainability presents to industries is not an easy one to achieve. There are several factors that combine social, political, cultural, technological and, above all, economic elements that make the task of seeking a sustainable future a difficult one to overcome.

According to the panel of experts, Mexico has not been able to successfully implement an environmental agenda due to several factors, but mainly because the industry does not have support for development, preventing micro, small and medium industries, incorporate clean technologies in their processes, but also because the industry in Mexico is an uninformed industry, with little real knowledge of cause in relation to the environmental crisis, climate change and the role that industries play within it, mainly due to two factors: poor dissemination on the subject and a deficient eco-centric training of workers, designers and managers alike; and at the center of it all, is the industrial designer, whose job is to provide a service through the design and development of products that satisfy in an integral way, the requirements requested by a client. The designer, as mentioned above, plays an important role, since much of the responsibility for reducing the environmental impact of industrial products lies in his or her hands.

Victor Papanek (2005) indicates that more than 70% of the impact derived from industrial products is decided during the early stages of product conceptualization, and it is the industrial designer who makes these decisions. And here is the central problem for the present research: if the designer is the crucial actor to reduce the environmental impact from the early stages of the design process, it is he who should be provided with all the possible tools to perform his work, in the most efficient way possible, appealing to the environmental element.

The irresponsibility of some actors within the industry has forced the search for new strategies that resonate within a context of environmental care and sensible management of our resources, and it is this need that has led man to develop new and

different ways of doing things, among them, the incorporation of the ISO 14006 Standard, which, at the industrial level, governs the incorporation of the so-called eco-design, an alternative proposed to reduce the environmental impact within the industry (Arana and Heras, 2010; Maderas, Pérez and Rubio, 2013).

The ISO 14006 Standard finds its origin within the Spanish standard UNE 150301, published on July 15, 2011, called "Environmental management of the design and development process: Ecodesign", a standard developed by the legal body responsible for Spanish technical standards, AENOR (Spanish Association for Standardization and Certification). The Spanish standard indicates that the design stage determines most of the impact of a product, and that is why it is necessary to incorporate the environmental component in the early stages of the design process, thus preventing more than half of the environmental impacts of products or services (Arana and Heras, 2010).

The ISO 14006 standard pursues the same objective: to reduce the environmental impact of products or services throughout their life cycle: from the design stage, through manufacturing, distribution, use, maintenance and recovery at the end of their useful life. The standard allows demonstrating compliance with existing legislative requirements and is incorporated through a life cycle analysis process, which leads to the identification of three important aspects of products and services: inputs, life cycle and outputs.

According to the panel of experts, incorporating the objectives of ISO 14006 in Mexico is a real challenge for companies that lack sufficient resources to implement this strategy, and in addition to this, the Mexican industrial context differs too much from that of developed countries, for which this standard was developed; mexican companies that generate consumer products must also propose social inclusion, interaction with users, differentiation of products and services and dynamization of the economy through innovation ecosystems that apply design as part of their strategy to boost the competitiveness of Mexican companies and sustainable development. Design generates jobs, opens new channels for citizen participation and helps to address environmental problems. When design is understood from this perspective, we can say that it is sustainable and, therefore, citizens, public administration, research centers and companies benefit from applying and consuming it (Ferruzca, M. and Rodriguez, J., 2011). Mexico City is the state with the most economic units in specialized design, followed by the State of Mexico, Jalisco, Guanajuato and Nuevo León. (Ferruzca et al., 2010).

In relation to the economic impact of design firms, one of the main challenges is the absence of studies on the supply and demand of design services, and the few documents that exist do not delve into the economic impact of design as an activity, but there is a high presence of cultural agents of design in Mexico City -universities, design schools, specialized publishing houses and research centers in technology, culture and the arts-.these are agents that can enhance the activities and functions of the system, either directly or indirectly, so that designers can play a more important role in improving productivity and in product design (Ferruzca et al., 2010).

In Mexico the so-called "PyMes" (small and medium enterprises) represent between 90 and 99% of the economic units, promoters of activity and employment, according to INEGI statistics of 2018, and there are at least 2811 factories within the manufacturing industry focused on the transformation of materials into consumer goods and many of their environmental efforts are channeled towards the recycling of stationery, waste separation for subsequent recycling (which is rarely done within the company) and some basic strategies for the use of raw materials.

The average design firm in Mexico apparently lacks an efficient environmental management program for its activities, and despite this, the virtual directory www.homify.es lists around 680 design firms with a sustainable approach, mainly in the

area of architecture and space design, as well as the so-called "eco-fashion" and small independent brands, demonstrating that in Mexico there is interest in sustainable design. Mexican designer Mario Ballesteros, in an interview during the Abierto Mexicano de Diseño 2018 commented that design must think about the post-industrial era and propose critical resolutions to face the socio-environmental emergency, implying that design within companies, a growing activity in Mexico, must manage and regulate its impact from the industry.

In general terms, we can identify three important aspects of proper design project management: 1) Search for the appropriate designer and the method that companies use to search for suitable profiles; 2) Drafting of project requirements, which refers to the method in which the company transmits to the design team the information necessary to perform its work, and it is in this communication where the key to the success of the projects is found; 3) evaluation of the design process and the feasibility of adapting ISO 14006 to the Mexican context in which small industries are developed (Bruce et al, 1999).

The great challenge of incorporating standards, such as ISO 14006, is that it is designed to address the specific needs of developed countries, countries whose production levels are in the billions, speaking of true industrial production, while the majority of Mexican companies that generate consumer goods reproduce their parts in the thousands; another factor to consider is that developed countries have state-of-the-art technology and the necessary means to invest in the transformation of their companies, while in Mexico, experts agree that the industry has a disjointed model that depends to a large extent on manual labor, artisanal processes and the outsourcing of many of its processes because it lacks the means to implement its own technology, in addition to not having the support to pay the high costs involved in incorporating new technologies, requested after the incorporation of the standard and much less to integrate the recommended measures; a possible solution is to use the guidelines proposed in the standard and adapt them to the Mexican reality.

Method

The results presented here are part of the body of a doctoral thesis, whose focus was to understand the industrial dynamics around environmental considerations, the crucial role played by the industrial designer and how to propose methodological alternatives, based on ISO 14006.

In order to structure the methodological proposal, we resorted to a non-experimental research of a mixed descriptive-explanatory type that incorporated very different scientific activities, both qualitative and quantitative, whose main objective was to generate a methodological support proposal, through the application of an analytical-synthetic method for data collection, analysis and treatment of the information obtained. This research sought to identify, document and relate the different actions and decision making, which lead to a cause and effect relationship between what the designer does and its effects on environmental damage; on the other hand, it seeks to understand what factors affect the way in which the designer makes decisions, determining the indirect variables (positions with decision making, manufacturing requirements, customer requests, etc.), as well as those direct variables (training, knowledge, professional development, etc.) that permeate their activity within the company.

By means of an exploratory questionnaire, a diagnosis was made to a group of designers working in different industrial companies; this was parameterized and quantified as far as possible, seeking to understand the characteristics of such broad and

ambiguous items as the type of environmental management in companies, the implementation of eco-design strategies, environmental performance, responsibility based on the position according to the organizational chart and the objectives pursued by companies that hire industrial designers in Mexico City and the suburban area; This information was nurtured and corroborated by means of an extensive work of bibliographic consultation and various sources of information, as well as a series of in-depth interviews with a panel of experts, thus helping to define quantifiable indicators and concepts as parameters.

This instrument was applied to 103 people who met the ideal profile, which was that of industrial designers or similar, who have worked professionally for at least two years in a company or industrial company that has a design department. The questionnaire did not include open-ended questions, only Likert-type rating scale questions, binary true or false questions, and concept recognition lists, which were later interpreted as graphs for visualization; due to the exploratory characteristics of the questionnaire and the nature of the questions, most of which were to identify multiple concepts, it was not possible to adequately run a validation using Cronbach's coefficient, since only three items out of 38 could be analyzed in this way. The diagnostic questionnaire allowed the drafting of the questions asked during the first portion of the in-depth interviews, the result of which made it possible to identify those concepts that should be included in this one.

The questionnaire was validated with the help of the teaching and research staff working in the Industrial Design Postgraduate Program at the National Autonomous University of Mexico, and its effectiveness was subsequently tested by means of pilot runs before being officially applied. The questionnaire was applied during the first half of the year 2021; due to the restrictions imposed by the COVID pandemic, the format was implemented remotely, using the *Google Surveys* platform and whose main objective was to diagnose and understand the different business dynamics in relation to environmental issues, knowledge about sustainable issues and the incorporation of environmental strategies, as well as knowledge about the ISO 14006 Standard, its existence, scope and implications.

The *Google Surveys* tool performed the categorization, validation and integration of results and generated the corresponding diagrams that can be observed in their entirety within the body of this document.

Prior to the development of the proposed methodology, an exhaustive review of bibliographic sources was required, validated and complemented by interviewing the panel of experts, a process that allowed the development of the diagnostic stage, and to correlate the information with the data obtained during the diagnostic questionnaire. Specifically, the purpose of the questionnaire was to understand the work situation in which they work, identify areas of opportunity, as well as the factors that are directly related to environmental performance within companies, and to identify which concepts related to environmental issues are part of their knowledge and which practical tools, such as eco-design, they apply in their professional work. The questionnaire was applied to three profiles: 1) recently graduated industrial designers, 2) designers who already have considerable experience in the field, and 3) professionals who meet the profile proposed in the research methodology.

The in-depth interview conducted with a panel of experts was the qualitative tool selected to seek to respond to several of the specific objectives, highlighting the delimitation of the professional profile of the industrial designer; the professional environment, as well as its current challenges, limitations and scope; the competencies that every industrial designer must develop and the role played by academic training;

definition of the historical, socio-political and cultural context of the design profession in Mexico; the factors within and outside the industry that affect professional performance and finally, to define the role of the industrial designer as a responsible and change agent, as well as the ideal profile that can address all the problems identified by the industry around the concept of sustainable development. The first part of the interviews was of vital importance to outline the concepts to be covered in the diagnostic questionnaire.

The panel of experts was divided according to the information to be obtained and the professional profile of the specialists, which is why the group of experts was categorized as: theoreticians and historians, academics and design teachers, directors of design schools, and finally, leaders of industries that hire industrial designers in Mexico City and the surrounding area. The in-depth interview was adapted to the content to be obtained, and was based on a series of basic questions, which, using the "*laddering*" strategy, were deepened until rich and detailed information was obtained about the topics to be investigated.

As with the questionnaire, due to health restrictions implemented because of the pandemic, the interviews had to be conducted remotely. The "zoom" video conferencing tool was used for its implementation.

The interviews were categorized based on the subject matter and the objective to be covered, transcribed and subsequently, the various items to be inquired about were identified. From coincidences, concepts that were repeated, different perspectives with respect to certain topics, and even contradictions, the different contents and final objectives of this thesis were built, to completely delineate the contextual framework within which the Mexican industrial designer has been formed and the industrial designer was exhaustively profiled, covering his professional training, the type of workplace in which he works, his practical, theoretical and cognitive tools, including a description of his competencies, limitations, scopes and challenges of his profession.

The panel of specialists made up of professors and academics focused on discussing the evolution of the discipline, curricula, graduate profiles and the incorporation of the environmental factor in training exercises, which helped to identify the role that university studies have played in generating professionals capable of using and integrating, in the workplace, the concepts learned during their training.

A second group of specialists was formed by some of the main historians and theorists of design in Mexico; they provided information about the emergence of the industrial designer and the role he or she has played in different economic, socio-political and cultural aspects, as well as its current importance and the reason why it has become such a popular discipline. These experts also provided a contextual framework for understanding the evolution of the discipline over time and the adaptations it has had to undergo to arrive at today's designer and the challenges he or she faces.

Expert designers who have developed their own industries formed a third panel, and the interviews they were given revolved around the challenges they have had to face as entrepreneurs, how they have adapted to new contexts and new visions, but, above all, how they have addressed, if at all, the issue of sustainability and the advantage, both sustainable and competitive, that this has given them.

Finally, a group composed of industry leaders complemented the vision of the previous group, defining in even greater detail the challenges faced by the industry that hires industrial designers every day. These specialists also delimited in depth the work with clients and how difficult it can be to work with them, as well as the relationship with suppliers, competition with other companies and the great challenge that has been to incorporate environmentally sound practices, often at the expense of what the environment and the client request. These businessmen were asked about the profile

they are looking for when hiring industrial designers, and how, according to them, the ideal profile would be to work in their companies and address the complexities derived from the current situation.

Once the documentary information and the results of the questionnaire and interviews were obtained and analyzed, the data were triangulated to meet the objectives of the research, which were: to define the industrial design activity in Mexico; to understand the industrial dynamics around the environmental issue; to propose a new profile of environmentally responsible designer and finally, the development of a proposal for a preventive methodology of practical use to be used by any designer seeking to reduce its impact, regardless of the size of the project at the door and that had as a starting point, the points proposed within the ISO 14006 Standard and its adaptation to the Mexican context

Results

The applied questionnaire yielded statistical information that helped to give context to the current situation of design firms in Mexico City and its suburbs and serve as a basis for the development of the in-depth interview. Among the most relevant results derived from the diagnostic questionnaire applied to industrial designers working in "MiPyMes" and "PyMes" companies in Mexico City and its suburbs, we find: 1) Figure 1 shows that 50.5% of respondents know little about climate change; Figure 2 shows that 54.3% know little about the environmental crisis, and despite knowing little about the subject, as shown in Figure 3, 87.6% of designers are convinced that what they design affects the environment. 2) An important fact is that 78.09% of the designers surveyed believe that the decision on materials and raw materials generates an impact and 79.05% say that the selection of the process also causes environmental damage; likewise, 61.9% affirm that the final finishes are related to the problem, these processes are selected by the designers themselves, demonstrating that there is inference in their decision making.

Figure 1

Knowledge of climate change, causes and consequences

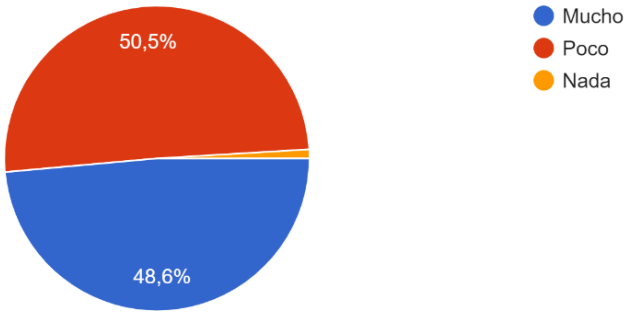


Figure 2
Knowledge of climate change, causes and consequences

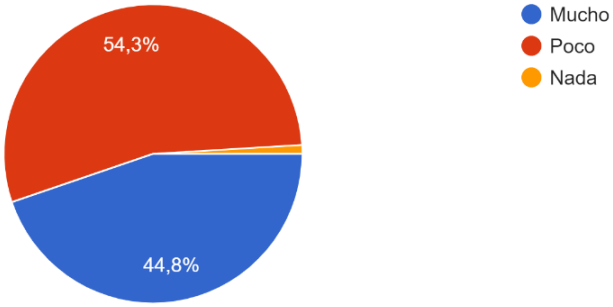
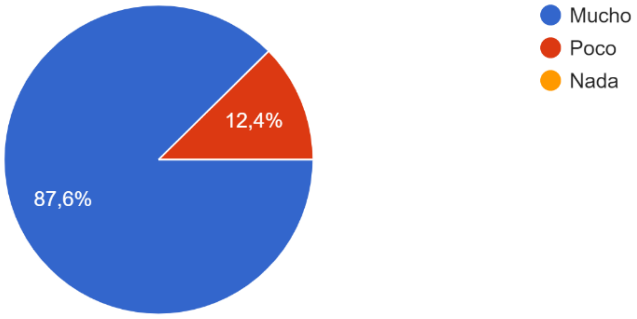
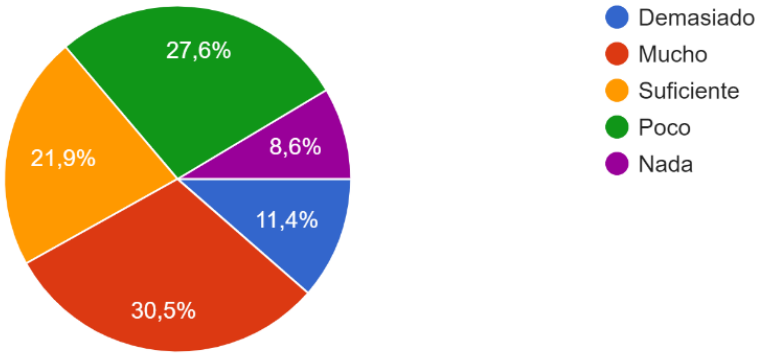


Figure 3
Belief that environmental problems derive from human practices and acts



The final part of the questionnaire focused on the implementation of environmental standards in their workplace, knowledge about them and the freedom they have when making design decisions related to environmental issues within the companies. The most important results were as follows: 1) 78.1% lack knowledge about ISO 14006 and its content; 2) 30.5% state that decisions made during the design process directly affect the environmental crisis and climate change (Figure 4) and 27.6% believe that the environmental element is very important within the work environment (Figure 5). 3) 40.7% of the designers state that the final decision on materials and processes is made by area heads and managers (Figure 6). In direct relation to knowledge of the Standard, 77.8% were unaware of its existence, procedures and strategies (Figure 7).

Figure 4
To what extent is the environmental factor considered in corporate decision-making.



Source: own elaboration, survey with *Google Surveys*, February-March 2021.

Figure 5
Degree of importance of the environmental element in the work environment

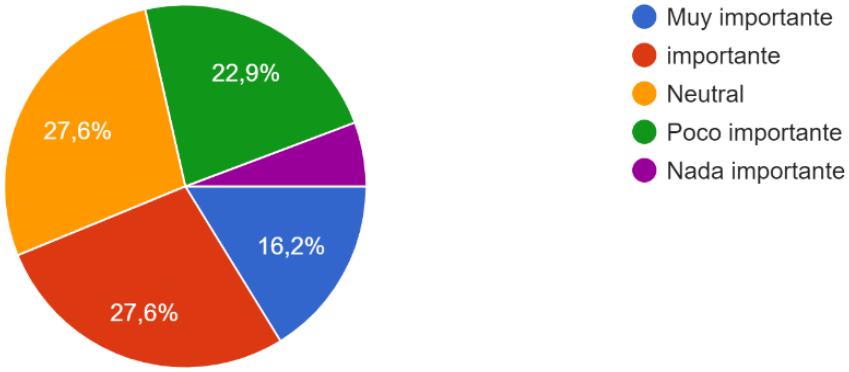


Figure 6

Person who makes the final decisions on the critical aspects of a project.

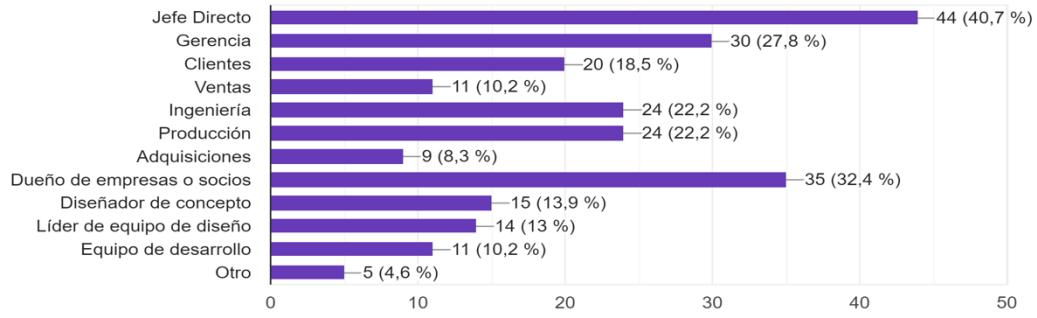
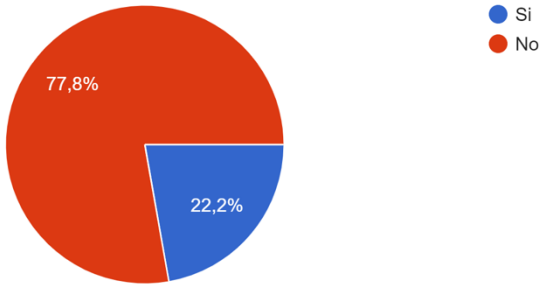


Figure 7

Index on awareness of the existence of the ISO 14006 standard.



Among the preliminary conclusions we find that industrial designers are aware that there are factors that affect the environment within their practice and recognize that they generate an impact, but they are not informed as to which of these processes are the most environmentally risky and much less, how to address these issues. At least half of the designers surveyed, many of them with an average of 9 years of professional work, claim to have no knowledge of the environmental crisis.

When talking about critical decisions related to the environmental crisis is that, in effect, the industrial designer working as an employee, has little or no freedom of decision making and must adhere to the decisions made by the managers under whom they work, 40.95% confirmed that their bosses made such decisions.

In general, designers within the industry have minimal knowledge of environmental strategies and issues, and those who do have knowledge of them either do not know how to implement them or are handicapped in making a real positive impact due to a number of constraints and limitations within the company in terms of decision-making on processes, strategies and materials. The designer must work invisibly and within the established limits, focusing his efforts to perform his work announcing the economic advantages and not the environmental ones, if he wants to achieve the consent of his employers.

The interviews took shape from the concerns derived from the diagnostic stage and the bibliography consulted; these interviews helped to delineate the profile of the Mexican industrial designer, understand the scope of their work, understand the complexity of the challenges they face daily within the industry, find areas of opportunity,

define in detail the techniques and methods they incorporate in their professional work and, above all, the important role they play as an agent of change.

The following are some of the results obtained from the interviews and the consensus among the members of the expert panel:

In Mexico, production runs are well below the truly industrial levels of developed countries, in addition to incorporating the extensive use of artisanal processes and manual labor. The Mexican industrial designer generates products, of any kind, from medium and hybrid technology, not very expensive and where he himself can manipulate and control the processes. Focusing on point-of-sale design, furnishings, unsophisticated products and decoration, whose production levels are low and whose manufacturing lines are easily adaptable to a wide range of objects and small runs.

The business landscape of the designer in Mexico has evolved differently from other countries, and has been forced to renew itself by necessity, diversifying its contribution, and where the name "industrial" is becoming more and more irrelevant every day and the panel of experts made up of industry leaders mentioned that the business and industrial environment presents designers with a much greater challenge; in Mexico, designers who decide to work within a company live governed by the needs posed by the national industry and the economic model that governs it.

Two types of designers are recognized in Mexico, the first is the renowned designer, a professional who has been able to position himself as a brand and who can freely choose what to design and to whom he provides his services, designers who are not subject to the needs of a traditional company and it is these design professionals who have the greatest opportunity to become agents of change: but the majority, designers who exercise the traditional practice, are obliged to respond to the needs of the predominant economic system and with little or no decision-making power.

There are several challenges facing the industry, but from the point of view of the incorporation of ISO 14006, designers have a deficient training, derived from the lack of a structured methodological discipline and the necessary knowledge to address complex issues, such as sustainability.

Another important challenge to overcome is the lack of control that the designer has when making decisions on projects: he has no control over the assigned budget, or the target price, nor does he have control over the information, both qualitative and quantitative, that a client provides, nor over those indirect variables that affect the industry, macroeconomic factors such as devaluations, pandemics, policies, legislation on processes and materials, among others.

A designer who considers making a change from within the industry must have two very important elements, the first, a boss or client with enough openness to change the course of projects or to want to make real innovation and the second, the ability to sell themselves, and for this, you need a solid foundation to convey the economic benefit of their ideas, since it is the only way a designer could implement a change within your company.

Mexican companies that hire designers face various challenges to stay within the changing labor environment, overcoming economic, environmental, cultural, social and political challenges, being the most important factor, the client and his needs, a variant that can make a company grow or make it disappear: among the challenges that clients bring are to provide the best possible service at competitive prices, which force design firms and industries to reduce their profits, and this is a factor that impacts on the environmental aspects of a project, where the objective to be covered is not a strategic one, but to achieve a target price.

When a client seeks to invest as little as possible, it prevents the designer from doing his job well: firstly, the response times requested are minimal, and without adequate time, an in-depth investigation cannot be carried out to consider all factors, including environmental, and in turn hindering the performance of tests and trials, or the selection of suppliers that are aligned with the objectives covered by ISO 14006.

Specialists agree that talking about environmental issues within the Mexican industry is an unfounded factor and that the industry is not prepared to achieve it, and in the race for the best cost, that which is not sustainable is usually the cheapest option.

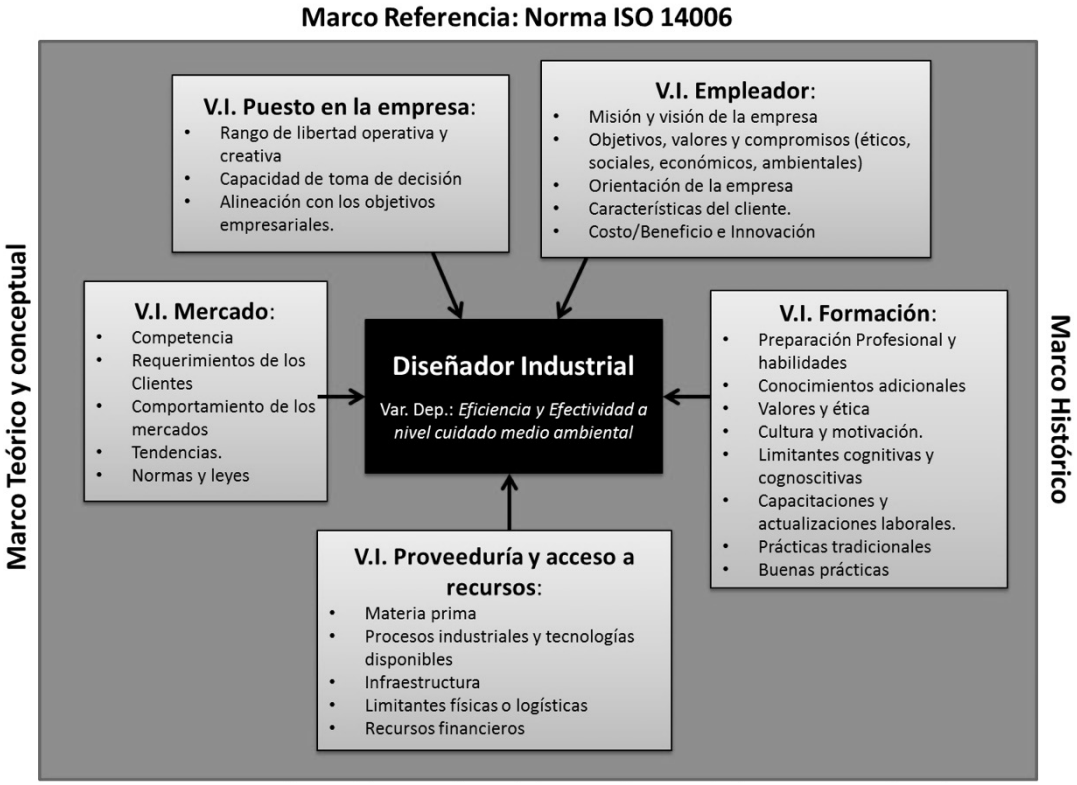
The panel of experts also mentioned that another major constraint for companies is the lack of government support for the acquisition of clean technologies, or incentives for companies seeking this change, and the lack of awareness programs at the industrial and training levels.

Finally, the external variables, those over which there is no control, and which the designer must find a way to deal with: economic crisis, changes in legislation, restrictions imposed on processes and materials, the parity with international currencies, the prevailing political regime and, of course, pandemics and other health crises, as well as other natural catastrophes.

The diagram in Figure 8 shows, by way of summary, all those factors that must be considered and overcome in professional design work if the objectives of ISO 14006 are to be achieved.

Figure 8

Diagram of factors affecting the industrial designer's job performance



Discussion and conclusions

It is necessary to accept the limitations of Mexican companies when they want to incorporate strategies such as those proposed by ISO 14006, starting from the fact that many work with reduced budgets, especially due to the lack of support from clients in their race to get the cheapest prices, punishing the growth of design companies, so without responsible clients and without government support, these businesses, factories and offices will have to find another way to become responsible, since being able to perform a life cycle audit or implement better technologies is completely out of their reach; these factors are sufficient to understand why incorporating a standard developed for advanced countries to the letter is also a complex, but perhaps not impossible, task.

In Mexico, the vision for a sustainable industry must arise from the needs of a semi-craft industry that does not produce in the quantities that first world countries do, adjusting the creation of products and services within the parameters and context of the real needs of the population; the engine that moves the incorporation of new methodological tools must be the context of a complex society, where everyone is involved in the development of products or services that need to be generated, and the need to integrate a disjointed industry, within local contexts, under a regime of care, respect and regeneration of resources, as well as a responsible management of those non-renewable resources, and that under this new scheme, more tools arise to nurture the work of the transformers of the artificial world, from the perspective of a developing country, and that truly takes into consideration the dynamics that are created between industry, planet and society, developing and incorporating every day more, new and better strategies that respond to the needs of production and economic development of the country.

The question now is: how could the ISO 14006 standard be incorporated into projects at the design stage?if it is indeed the case mentioned by several authors, that most of the environmental damage comes from the design stages of a product, I think it is from there that should be operated; the problem: the lack of the necessary means to perform an environmental audit and a subsequent technological update, but the standard can serve as a starting point for the implementation of good practices from the design, and why the need to provide it with practical tools to guide the process, without the need to have deep knowledge, you can simply take the proposed stages and go from there. This was corroborated by the panel of experts, industry leaders, who commented that there are elements that have been taken from the Standard, to be adapted by the design teams, who could be given prior preparation to incorporate into their work the most important aspects of eco-design, as indicated in the Standard.

The Mexican consulting firm on the incorporation of ISO 14006, *CSR Consulting*, during a recent interview commented that the standard focuses on the environmental management of product design and development, providing guidelines to achieve the incorporation of various environmental considerations in all stages of the product life cycle, when asked about what the industry leaders stated during the interviews, they corroborated that, in effect, most design companies are unaware of the existence of the Standard, or that they apply it in a flexible manner, adapting it to their needs and capabilities, mainly due to three factors: 1) lack of awareness, 2) limited resources and 3) the belief that a more flexible adaptation better suits the conditions of the work they perform.

Jesús Octavio Gámez, an intern with the firm, stated:

> In response to your question as to whether standard 14006 can be applied in Mexican industry, it is important to consider that its applicability may vary

> according to the circumstances of each company. Although the standard is designed to be adaptable, lack of knowledge and resources can be an obstacle. It is essential to assess whether companies can benefit from implementing the standard, whether it fits their operations and whether they are willing to invest in improving their design and manufacturing practices. In summary, while 14006 provides valuable guidelines for ecodesign and sustainability in the consumer products industry, its application in Mexican industry may require an approach that is tailored and mindful of the limitations of SMEs and microenterprises. Awareness, training and the perception of tangible benefits could influence the effective adoption of the standard" (Gamez, J, telephone communication, August 12, 2023).

This data confirms the statements of the panel of experts, it is possible to take relevant aspects and adapt them to the needs and context of each company, with their respective limitations, which would also limit the scope of the strategies, their efficiency and their effectiveness.

ISO 14006 refers to seven stages: project organization, product selection, establishment of ecodesign strategies, idea generation, concept detailing, communication and launching, and finally, product follow-up; of these stages, strategy selection and design detailing are the two critical stages, from the designer's point of view. Once the product to be developed has been selected, the designer should be informed about the alternatives available to implement an eco-design strategy, and without the need to master these issues, the development of a methodological tool containing the necessary information, such as applying an environmental assessment to existing products accompanied by a rubric, can help to identify the problems and where each new design challenge offers an opportunity for feedback from good practices previously learned, nurturing the design work, by performing such an exercise, sharing the results with colleagues, and generating a database with these good practices.

During the detailed design phase, it would be necessary that this same methodological guide, help the designer to evaluate his project, which could be through a checklist that allows to contemplate the selection of suitable materials, the appropriate process and issues such as packaging design, a valuation matrix can evaluate the alternatives, and through a numerical result obtained later, go to a table where solutions are listed, something similar to a matrix of contradictions, where the possible design problems and environmental challenges are listed in order to confront them with different solutions, showing possible ways to reduce the impact, and this does not require more than a trained person to develop these tools and teach designers to use them, but above all, to implement and develop them from the experience of each project, and this could serve as a first step to seek that design projects in these small companies can contribute from their own limits, seeking to permeate little by little, all procedures within them.

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