# SHEDDING LIGHT ON INDUSTRIAL DESIGN. EDUCATING PRODUCT DEVELOPERS FOR A SUSTAINABLE FUTURE IN DESIGN AND ENGINEERING EDUCATION

**Martin LUCCARELLI**

School of Textiles & Design, Reutlingen University, Germany

## ABSTRACT

A premise guaranteeing the successful interdisciplinary teamwork in product design is a mutual understanding of both professional and academic communities of the different design expertise and the role they play in the process. It appears that the open compound word *industrial design* is open to interpretation in European education. This ambiguity had a negative impact on the labour policies of some European countries, which have labelled some professions with incorrect names. Therefore, this terminological inconsistency urges for clarification within the design community. This work analyses the term *industrial design*, it presents historical developments in European industrial design education, in particular in Germany and in the Netherlands, and discusses how the education to the industrial design profession was positioned towards product development. This paper suggests that the causes for the observed lack of clarity about the meaning of the term *industrial design* are of an etymological and disciplinary kind. In order to act as a bridge between the professional and academic communities, universities should create the premises for interdisciplinary collaboration between designers and engineers through standardized communication, ultimately contributing for a sustainable future in both design and engineering education.

*Keywords: Industrial design education, product development process, interdisciplinary collaboration*

## 1    INTRODUCTION

In the field of product design, the quality of the final product depends on the correct integration of the activities of each domain involved [1]. Since product development requires integrating different domains to accomplish a common goal, it is key to study product design as an interdisciplinary subject [2]. In this paper, interdisciplinarity in product design is intended as the approach focusing on how interactions among disciplines can be enhanced to share information right from the beginning throughout the process, ultimately synthesizing and harmonizing links between disciplines into a coordinated and coherent whole [3]. A premise guaranteeing the successful interdisciplinary teamwork in product design is a mutual understanding of both professional and academic communities of the different design expertise and the role they play in the process.

In today´s European universities an ambiguity in classifying industrial design can be observed. While the term *design* has risen to new levels of centrality at universities shifting from the level of departments and faculties to whole institutions [4], industrial design is both offered as art- and science-oriented degree within the same countries. In Germany, for example, the Stuttgart State Academy of Art and Design offers an MA programme in industrial design, and the Technical University of Munich offered an MSc programme with the same name until 2021. Moreover, a variety of MA curricula in European countries are labelled as product design curricula. An example may be the Royal College of Art that offers an MA programme called Design Products or the ESAD College of Art and Design that offers both a BA and an MA called Product Design. At the same time, other universities currently use open compound words containing the term *industrial design* to imply that what is been taught is different from purely industrial design. An example may be the Elisava School of Design and Engineering that offers both a bachelor's and master's degree called Industrial Design Engineering.

The ambiguous way in which European study courses are catalogued and the recurrent habit of using the terms *product design* and *industrial design* as synonyms ultimately had a negative impact on some

countries' labour policy. Being the latter unable to find cohesion on the role of industrial design from design education, professions are labelled with names that have little to do with the designated activities. In Germany, as example, the name Technical Product Designer has been coined for a profession that is actually intended to be that of a technical draftsman [5]. So, what is it then that we are all referring to when we mean industrial design in the first place?

The aim of this paper is to clarify this terminological inconsistency within the design and engineering community. To do so, the terms *design*, *industrial design* and *product design* are analysed and compared to each other. Moreover, historical developments in European industrial design education, in particular in Germany and in the Netherlands, are presented to discuss how the education to the industrial design profession was positioned towards product development.

This work is expected to shed light on industrial design, thus providing a better understanding on how industrial design relates to product design education. This contribution is relevant for all universities involved in design and engineering education, including art and engineering schools. It is meant to promote the standardization of key terms in product development to ultimately improve the communication between designers and engineers involved in this process.

The remainder of the paper is structured as follows. In the following chapter, this terminological inconsistency is explored from an etymological perspective, while chapter three explores it from an historical one. Finally, chapter four presents the conclusions along with recommendations for design and engineering education.

## 2 DESIGN, INDUSTRIAL DESIGN AND PRODUCT DESIGN: ETYMOLOGICAL ISSUES

The word *design* is derived from the Latin words *de*, i.e., "about" or "coming from" and *signum*, i.e., "sign", "image" or "figure". In English, *design* as a verb may refer to as the act of making or drawing plans for something, while the noun as the drawing or set of drawings showing how something is to be made, how it will work and look. As neither the process nor the output is clearly specified by the term itself, this denomination is used in different fields when referring to development actions or results. Consequently, a designer, i.e., a person who imagines how something could be made and draws plans for it, could potentially have a background of any kind. When *design* is specifically used as term referring to a particular domain, it is generally assigned to the applied arts. This designation was first used to differentiate those arts that apply to everyday objects from those that generate results with no practical use, i.e., fine arts [6]. To the applied arts does belong industrial design.

In English, the open compound word *industrial design* may refer to the process of designing the shape, features, etc. of manufactured products. The modifying adjective *industrial* clarifies two issues that are left open to interpretation when the term *design* is used alone. It stresses out the importance of the action (i.e., as a verb) rather than the topic (i.e., as a noun). Moreover, it clarifies the context in which the design action takes place. It may refer to as something related to industry or having a lot of industry and factories. However, the output of this design activity is not clearly defined since something industrial may refer to a product as well as to a landscape or even a nation. The birth of *industrial design* as term in the mid-1800s coincides with the growth of industrialisation and mechanisation, which in turn had started one century before in Great Britain with the Industrial Revolution [7]. The increase in design complexity in the eighteenth century that culminated with the Industrial Revolution meant an increasing specialisation, which in turn meant more division of labour [8]. This division of labour is linked with the term *industrial design* itself. Indeed, the difference between industrial design and the previously known craft-based approaches was the sudden separation between ideation and creation since product form was no longer determined by the creator of that product at the time of its making [9].

The open compound word *product design* may refer to as the process of creating or improving a product by learning what consumers want and examining similar products that are already available. The modifying adjective *product* clarifies one issue that is left open to interpretation when *industrial* is used as alternative term. It specifies the output of the implied action, since a *product* may refer to as something that is made to be sold, usually something that is produced by an industrial process or, less commonly, something that is grown or obtained through farming.

In literature, the perspective that the term *product design* is a synonym for *product development*, or at least refers to an embedded process in product development, is supported by a number of authors [2,10-12]. According to this view, developing a product produced by an industrial process involves several domains [10]. Mention engineering design, industrial design, ergonomics, marketing and innovation

management as the domains that are nearly always involved in product design. Moreover, the required skills may be linked to the specific product typology to be designed. When taking an electro-mechanical product of modest complexity as example, [11] list industrial designers, mechanical designers, electronics designers, purchasing specialists, manufacturing engineers and marketing professionals. According to [2], product design is an arena in which two domains actively engage in design practice, while others are only involved in the process. To the former group do belong engineering design, being responsible for designing internal parts and the resulting layout design (usually related to mechanical design as products are based on mechanical components), and industrial design, being in charge of designing the outside of a product resulting in an outside form and the related user facing interfaces; to the latter group do belong marketing people that support design activity by providing market and consumer data, purchasing specialists and manufacturing engineers that mainly work in the manufacturing process to focus on the realization of already-determined product forms and functions [2]. Also [12] presents two domains as those actively engaging in design practice within the product development process named as technical design and industrial design. The former is responsible for addressing functionality (i.e., product must work, be safe and economical) and usability (i.e., product must be easy to understand and use); the latter shares the topic of product usability with technical design and addresses product personality, i.e., its appearance, to target customer satisfaction (i.e., product must be life-enhancing) [12]. Hence, while the etymology of the open compound word *industrial design* may explain why industrial design is sometimes confused with product design, industrial design does actually engage in design within product design.

## 3 HISTORICAL DEVELOPMENTS IN INDUSTRIAL DESIGN EDUCATION: DISCIPLINARY ISSUES

The division of labour mentioned in the previous chapter meant also separating the applied arts from the intellectual and the fine arts, leaving them without an intellectual foundation of their own [13]. With the Industrial Enlightenment, which in turn had been set by "scientific method, scientific mentality, and scientific culture" [14] of the scientific revolution of the seventeenth century, the Industrial Revolution initiated the shift from design professions to design disciplines that forged their own independent paths. In this regard, the notions of *profession* and *discipline* are of specific interest for this paper.

A *profession* refers to a vocation founded upon specialized knowledge and skills of great social value that sets it apart from other kinds of employment [15]. The linking of this term to a specialized background implies the belonging to an exclusive occupational group that acquired the abilities necessary to supply objective counsel and service for a direct and definite compensation [16]. To evolve from occupation to profession, the ability to take responsibility is needed to turn fully dependent work into a high degree of independent action. Moreover, skill and knowledge are a premise needed to become a vocation that goes beyond compensation based on production.

A *discipline* refers to the subdivision of knowledge characterised by substantive content in one academic field of study that reflects a specific social behaviour [17]. The linking of this term to an academic background implies the existence of a body of theories, concepts, methods and fundamental aims that a given discipline has to feature in order to be named as such [18]. To evolve from domain to discipline, hypotheses and theories are needed to turn mere representation into clarification of phenomena. Moreover, methodological rigor is a premise needed to become a science that goes beyond observation.

### 3.1 How industrial design did not become a discipline: the German influence

The emergence of industrial design as profession took place in the 20th century in Europe under the influence of the British Arts and Crafts movement first (1870-1920) and under that of the Bauhaus later (1919-1933). While the former still displayed a hard-fought relationship with machinery [19], the German movement foresaw a harmonic coexistence with them. The Staatliche Bauhaus in Weimar had been conceptualized as a state university of arts on par with other universities. Walter Gropius formulated the Bauhaus (literally "building house") programme with the goal of providing students an equal command of technology and form for the design of ornament-free, functional products intended for mass production [20]. Once closed, one attempt to continue the roots of the Bauhaus took place in Chicago in 1937 through Mohly-Nagy [21], and Germany saw the establishment of the HfG School in Ulm in 1953 through Inge Aicher-Scholl, Otl Aicher, Max Bill and others. Both schools explored the possibility to add science to art and technology, the latter two being drawn from the original Bauhaus curriculum. To do so, the HfG in Ulm included disciplines such as ergonomics, mathematical

techniques, economics, physics, politics, psychology, semiotics and sociology [22]. While it is argued in literature if the attempt to articulate and legitimize designing by framing a methodology that drew from science and mathematics was successful [13,22], the impact of this school on industrial design vocabulary was immense.

In 1967 the state parliament of Baden-Württemberg demanded the affiliation of the HfG to the Ingenieurschule (literally "engineering school"), the forerunner of the German Fachhochschule (i.e., university of applied sciences) [23]. The background to this new typology of university was the German economic miracle in the 1950s and 60s, which required more well-trained, technically savvy and specialized specialists. The term *Fachhochschule* refers to a form of university that was introduced in Germany, Austria and Switzerland to provide teaching and research with an application-oriented focus on a scientific basis and that does not have the right to award doctorates [24]. Because of this orientation, teaching at universities of applied sciences is more practical than at other universities. This recategorization within German education system had a negative impact on the further evolution of HfG school typology, which lost its identity. While the term *Gestaltung* was explicitly chosen to include the whole subject area of design, thus avoiding the colloquial narrowing association of design in the sense of purely form-giving, today this term is used in Germany to name different school typologies. For instance, the HfG in Offenbach is ranked as a state university of arts on par with other universities granting doctorates, while the HfG in Schwäbisch-Gmünd is ranked as university of applied sciences focussing on design practice only. Even more importantly, this recategorization led to strengthen the industrial design profession and, at the same time, contributed to annihilate the scientific spirit that had distinguished the curriculum of the HfG Ulm and that could have fostered the definition of an industrial design discipline. Germany, a country that had historically pioneered the search for a balance between mass production and artistic individuality ever since the establishment of the German Werkbund in 1907 [22], suddenly lost its historically gained ground.

### 3.2  How engineering design and industrial design lost boundaries: the Dutch influence

While industrial design remained a profession, other domains managed to evolve into a discipline and explored design as research topic. [25] made an extensive historical review of design research and many disciplines out of the arena of applied arts have shown interest in it throughout history. On the engineering side, engineering design, which in turn was introduced in the sixties [26,27], approached design from the eighties as design science, i.e., a theoretical scientific approach to engineering design methods [28,29]. Engineering design became part of that design community that proved to be highly capable of consolidating the foundation of design research whilst simultaneously expanding to new disciplinary areas through integration, which in turn favoured the entry of new subdisciplines into the frame of design research [4]. This may explain how the new open compound word *industrial design engineering* came into existence.

An important role for the establishment of this term in design research and education was played by the establishment of the Faculty of Industrial Design Engineering in 1986, which had started as an industrial design programme for the Architecture Faculty at the Delft University of Technology in 1962. Literature provides no definition to clarify to what exactly *industrial design engineering* should refer to, how exactly industrial design engineering should differentiate form industrial design and why. Even considering the three most cited papers addressing this domain according to Google Scholar [30-32], the meaning of *industrial design engineering* is neither explained nor are references provided to the reader. This peculiarity is very rare in academic literature and is therefore worth mentioning. The TU Delft leaves as institution this topic open to interpretation as well, stating that the original aim of the university was to make "industrial design a broadly oriented degree programme" and to produce "integral design engineers; that is to say, engineers with an understanding of the technical, commercial, ergonomic and design-related aspects of product design" [33]. While analysing the roots or evaluating the disciplinary model behind industrial design engineering is out of the scope of this paper, its impact on the common understanding of industrial design education is undeniable. For instance, the Delft University of Technology has lately been acknowledged for being the most active institute regarding total publication in the field of industrial design [34] although no chair of industrial design is currently occupied in this institution. Currently, curricula in industrial design engineering are offered in Holland also by the University of Twente, Fontys and The Hague University of Applied Sciences. The appropriation of the term *industrial design* by the engineering domain may partly explain why papers

recently published on highly ranked journals such as [4] misclassify industrial design as domain belonging to engineering.

## 4   CONCLUSIONS

The aim of this paper was to clarify the terminological inconsistency when referring to *industrial design* within the design and engineering community. The ambiguity in classifying industrial design by today´s European universities has been explored from an etymological and disciplinary perspective.

As far as the former is concerned, the verb *design* fails to frame a specific field in which the development action is meant to take place, while the modifying adjective *industrial* fails to specify the output of the implied process. For these reasons, the open compound word *product design* is often used as synonym when referring to industrial design. This is however incorrect, as industrial design operates within product design, which in turn refers to the whole development process.

The disciplinary perspective is far more complex, and it involves historical developments in European industrial design education. In this regard, German education developments favoured the persistence of industrial design as applied art profession. While being acknowledged for developing the educational philosophy that underpins industrial design profession since the early 1920's through the Bauhaus School, Germany is also partly responsible for cutting off the evolution of industrial design into a discipline by closing the concept of the HfG school that had started in Ulm. Consequently, this applied art did not enter the arena of design research. At the same time, Dutch education developments helped the engineering domain consolidating its foundation of design research in engineering design whilst simultaneously expanding to the area of industrial design through integration. Being acknowledged as one of the most active institutes regarding total publication in the field of industrial design, the Delft University of Technology has also contributed in creating a major confusion about it by suggesting that two types of industrial design domains may exist, i.e., industrial design and industrial design engineering. Despite the failure of industrial design to evolve into a discipline and the growing interest of engineering for this profession, industrial design belongs to the applied arts, while engineering design belongs to engineering.

### 4.1  Implications for design and engineering education

The following recommendations are laid out to universities offering curricula of studies in the field of product design to implement a standardized communication in design and engineering education:

- Art schools should offer study programmes in industrial design. A title different from Industrial Design is advisable only if the curriculum of study focuses on a specific typology of products, e.g., Furniture Design or Car Design. They should avoid labelling any BA or MA programmes with the term *product design*.
- Engineering schools should offer study programmes in engineering design. A title containing the term *product design* is advisable for MSc programmes addressing it as complex and multiple disciplinary subjects, e.g., Integrated Product Design or Interdisciplinary Product Design. They should avoid labelling any BEng, BSc, MEng or MSc programmes with or containing the term *industrial design*.

### REFERENCES

[1] Kim K. M. and Lee K. P. Collaborative product design processes of industrial design and engineering design in consumer product companies. *Design Studies,* 2016, 46, 226-260.

[2] Kim K. M. and Lee K. P. Two types of design approaches regarding industrial design and engineering design in product design. In *11th International Design Conference, DESIGN 2010*, Dubrovnik, May 2010, pp.1795-1806 (The Design Society, Glasgow).

[3] Luccarelli M. Interdisciplinarity in product design education. Balancing disciplines to foster creativity. In *4th International Conference on Design Creativity, ICDC*, Atlanta, November 2016 (The Design Society, Glasgow).

[4] Christensen B. T. and Ball L. J. Building a discipline: indicators of expansion, integration and consolidation in design research across four decades. *Design Studies*, 2019, 65, 18-34.

[5] Bundesgesetzblatt. *Verordnung über die Berufsausbildung zum Technischen Produktdesigner und zur Technischen Produktdesignerin sowie zum Technischen Systemplaner und zur Technischen Systemplanerin*. Available:

https://www.bgbl.de/xaver/bgbl/start.xav#__bgbl__%2F%2F*%5B%40attr_id%3D%27bgbl111s1215.pdf%27%5D__16442378965277 [Accessed on 2022, 7 February], (2011) 21 June.

[6] Rosenthal R. and Ratzka H. L. W. *The story of modern applied art*, 1948 (Harper & Brothers, New York).

[7] Heskett J. *Industrial design*, 1980 (Thames and Hudson, London).

[8] Smith A. *The wealth of nations*, 2007 (Harriman House Limited, Petersfield).

[9] De Noblet J. Design in progress. In *Industrial design: Reflections of a century*, 1993, pp.21-25 (Flammarion, Paris).

[10] Roozenburg N. J. M. and Eekels J. *Product design: fundamentals and methods*, 1995 (John Wiley & Sons, Chichester).

[11] Ulrich K. T. and Eppinger S. D. *Product design and development*, 1994 (Mcgraw-Hill College, New York).

[12] Ashby M. F. *Materials and product design*, 2004 (Granta Design, Cambridge).

[13] Buchanan R. and Margolin V. *Discovering design: explorations in design studies*, 1995 (University of Chicago Press, Chicago).

[14] Mokyr J. *The gifts of Athena: historical origins of the knowledge economy*, 2002, pp.36-37 (Princeton University Press, Princeton).

[15] Spencer H. *Principles of Sociology, Volume 3,* 1896 (Appleton, New York).

[16] Abbott A. *The system of professions: an essay on the division of expert labour,* 1988 (University of Chicago Press, Chicago).

[17] Price D. J. Citation measures of hard science, soft science, technology and non-science. In *Communication among scientists and engineers*, 1970 (Heath, Lexington).

[18] Toulmin S. *Human Understanding, Volume 1,* 1972 (Clarendon Press, Oxford).

[19] Crawford A. W. A. S. Benson, Machinery, and the Arts and Crafts Movement in Britain. *The Journal of Decorative and Propaganda Arts*, 2002, 24, 94-117.

[20] Weber N. F. The Bauhaus at 100: Science by design. *Nature*, 2019, 572(7768), 174-175.

[21] Findeli A. Moholy-Nagy's Design Pedagogy in Chicago (1937-46). In *The idea of design: a design issues reader*, 1995, pp. 29-43 (MIT Press, Cambridge).

[22] Bürdek B. E. *Design: history, theory, and practice of product design,* 2005 (Birkhäuser Architecture, Basel).

[23] Spitz R. *Hfg Ulm - the view behind the foreground: the political history of the Ulm School of Design 1953-1968,* 2002 (Edition Axel Menges, Stuttgart).

[24] Pahl J. P. *Fachhochschule: Von der Fachschule zur Hochschule für angewandte Wissenschaften,* 2018 (WBV Publikation, Bielefeld).

[25] Bayazit N. Investigating design: A review of forty years of design research. *Design Issues, 2004,* 20(1), 16-29.

[26] Asimow M. *Introduction to design,* 1962 (Prentice-Hall Inc, Englewood Cliffs).

[27] Woodson T. T. *Introduction to engineering design,* 1966 (McGraw-Hill, New York).

[28] Hubka V. and Eder E. A scientific approach to engineering design s. *Design Studies*, 1987, 8(3), 123-137.

[29] Hubka V. and Eder E. *Design science,* 1996 (Springer Verlag, London).

[30] Christiaans H. H. C. M. and Dorst K. H. Cognitive models in industrial design engineering: a protocol study. *Design Theory and Methodology,* 1992, 42(1), 131-140.

[31] Boks C. and Diehl J. C. Integration of sustainability in regular courses: experiences in industrial design engineering. *Journal of Cleaner Production,* 2006, 14(9-11), 932-939.

[32] Horváth I. On the differences between research in design context and design inclusive research in the domain of industrial design engineering. *Journal of Design Research,* 2008, 7(1), 61-83.

[33] TU Delft. *Delft design history: 50 years of industrial design engineering*. Available: https://www.tudelft.nl/en/ide/about-ide/delft-design-history [Accessed on 2022, 7 February].

[34] Abedini A. et al. The 100 Most Cited Papers in "Industrial Design": A Bibliometric Analysis. *Exacta – Engenharia de Produção,* 2017, 15(3), 369-374.