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BOOSTING INNOVATION AND GROWTH THROUGH THE USE OF DESIGN

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Abstract. The question underpinning this study is: would the incorporation of design throughout every dimension of a company's business pursuing innovation result in higher levels of growth and competitiveness? The paper begins with a brief theoretical approach to the concepts of creativity, design and innovation and identifies some of the traditional company growth strategies. This paper provides, in the context of design management, a first empirical analysis on the relationship between company growth and the investments in design along the value chain, stressing the importance of the phase in which design gets applied for the first time ("momentum"). The empirical analysis was based on data captured from an online questionnaire on the Portuguese manufacturing industry. The multivariate data analysis focused on the analysis of variance and factor analysis. The paper has the merit to conclude that the companies growing more sharply apply design from generating ideas to processes and production and extending into the marketing phase.

Keywords: design, creativity, innovation, growth strategies, data analysis, design management, phases of design use.

JEL Classification: O32, O33, L6.

Introduction

The main goal of this paper is to shed light on the contribution of design within the context of the relationship established with creativity and innovation to boost company turnover (performance). We begin with a brief theoretical approach to the main concepts – creativity, design and innovation (section 1) – as well as detailing some traditional company growth strategies (section 2). We then move onto analysis and discussion of the results of an online survey, sent to 1,084 Portuguese manufacturing

companies with a total of 99 respondents (section 3). Firstly, we will reflect on the concepts of "design" as well as "design management" in this Introduction.

Should we agree with the Walsh definition of a designer as "*someone (that) makes a series of decisions that result in a product of a particular function, cost and appearance, any of which may contribute to its commercial success (...)*" and that design *"is therefore an important activity for manufacturing firms and an important topic for economic and sociological analysis while the management of design is a vital aspect of corporate strategy*" (Walsh 2000: 75), we correspondingly recognize how deploying effective design requires companies develop wide-ranging capabilities in this field. Design involves creating concepts, plans and instructions, usually in response to a brief provided by a firm or client, which enable the making of a two or three dimensional object that did not exist previously.

The concept of design management relates to those specific management activities, methods and skills applied in order to optimize and manage design processes and spanning the complex and systemic nature of design processes. As a professional field, design management focuses not only on the multitude of visual manifestations of companies, brands and products but also on non-visual aspects relating to the design process such as processes targeting product development, production, distribution, sales, delivery or services.

Design is one of the most important "non-price" based source of competitiveness (Bryson, Rusten 2011; Hertenstein *et al.* 2013). The term design draws on fields ranging from engineering, product and industrial design to fashion and textiles, graphics and communications, interiors, exhibitions and architecture (Johansson-Sköldberg *et al.* 2013; D'Ippolito 2014).

Design management also aims at leveraging synergies between the creative field and business environments that usually tend to operate with their own specific dynamics, cultures and values (Gardien, Gilsing 2013). For a company, creativity is the generation of ideas, design is the "formatting" of ideas and innovation is placing those forms in new and/or different contexts. Design may generate value at different levels of the value chain (Mozota 2002) and needs perceiving as a facilitator, differentiator, integrator and communicator (Hayes 1990).

Moreover, design and innovation are inextricably linked and as Kootstra (2009: 9) points out: *(...) design management is a competence that falls under the umbrella of innovation management (...)".* In fact, companies investing in design are more likely to prove more innovative and lucrative and develop more rapidly than companies failing to do so. A series of recent studies demonstrate that design-driven companies (that approached design as a strategy at an earlier stage than other firms) perform better in the field of innovation than others.

1. Creativity, design and innovation

To become more competitive, companies must raise their level of successful innovation not only in terms of technology and R&D, but also in their market relationships. Thus, creative processes may be perceived as complete circles and overcoming the gap

between vision and reality (Ciprian, Degouzon 2007). As stated by Keller (2004), innovation should not be conceived of as some mere combination of invention, design and final product transaction. In reality, to companies, innovation is not only coming up with something new or improved but, essentially, a process adding value to customers (Razeghi 2012). Furthermore, whilst creativity is about generating ideas, design endows a face and shapes those ideas just as innovation places the face and shapes those ideas in new and/or different contexts (Fleming, Lynch 2006). Thus, design lies between creation, production and consumption (Walsh 2000), and designers can use mental shapes and forms and recombine them in meaningful and even creative ways in an activity that is most relevant to designing (Goldschmidt, Smolkov 2006).

As pointed out by Hollanders and Van Cruysen (2009), creativity and design may be linked to innovation as the former contributes to the expansion of applicable ideas while the latter raises the feasibility of those ideas attaining commercial success. The concept of design overlaps that of innovation especially when the designer cooperates with the management team on innovative approaches to all the (substantial) business processes (DDC 2003; Battistella *et al.* 2012), or when the designer reaches beyond creativity by not only producing new and promising ideas but also by appropriately implementing those ideas inside the organizations (Amabile 2006). As Cross (2006) observed, expert designers take a "*broad system approach*" to the problem rather than accepting narrow problem criteria.

In summary, despite recognition of the holistic importance of design – understood as the conceptual side to the expression and the expressive side to the concept, – there remains a certain degree of confusion over how best to implement design within companies (Fernández-Mesa *et al.* 2013).

2. Innovation and growth

We have already mentioned the relationship existing between design and business performance also identified by several authors and academics. Other studies conclude similarly, for example clearly pointing out the correlation existing between recourse to design and growth in terms of national employment (Christiaans, Almendra 2010) along with growth in both turnover and profitability (DDC 2003; Moultrie, Livesey 2014).

Renewal and innovation are two important means of attaining continuous company growth (Chakravarthy, Lorange 2008). Renewal is achieved by continuous improvements to production and marketing processes and innovation interrelates with entering new markets and serving those markets through the deployment of new competences. This, consequently, involves companies investing in new future businesses and not only in the short term as generally happens with renewal, and there is no reason to suppose that cooperation modifies the nature of the basic cognitive activities and operations implemented in design (Visser 2009). Renewal provides a protective strategy and helps extend the company's business while innovation represents more of a strategy for transformation (Chakravarthy, Lorange 2008).

Bridging is another growth strategy approaching the passage from renewal to innovation. This approach may ensure the company advances its new product design capa-

bilities and distribution competences appropriate to market diversity. Hence, leveraging new segments typically generates the creation of new competences (Chakravarthy, Lorange 2008).

Summing up, there are two recognized paths enabling the growth of companies: one through renewal, which requires a type of creativity backed by improving that already known, and another approach drawing on innovation in which companies enter into new fields of business thereby creating new competences for these new markets. In both cases, design plays a significant role especially in the connection established between creativity and implementation in companies be this in the short term through renewal or in the long term through innovation or alternatively through implementing bridging strategies between renewal and innovation.

We shall now consider how relationships between growth (either through renewal and/or through innovation) and design actually take place inside firms in accordance with the results of the survey sent to 1,084 Portuguese manufacturing companies (Romão *et al.* 2007; Barata 2012, 2013).

3. Experiment design and results

3.1. The DeSID survey

The online survey sample (n = 1084) was representative of the population under study. The sample was stratified by size and sector of activity categories. The questionnaire created contained six sections. The final number of respondents totalled 99 companies and constituting the basis for the respective analysis. The questionnaire requested information detailing the activities of design and their role in the company business. The responses are circumscribed to those activities taking place between 2005 and 2007. Best estimates were also accepted in the absence of precise figures for those years.

As regards the geographic location of respondent companies, we do acknowledge that the majority are located in the North of Portugal with over a third operating in regions with an industrial tradition. The vast majority are Portuguese owned with a very significant percentage of the companies (41%) launched in the period between 1974 (the Portuguese Revolution) and the late 1980s.

The business sectors of Non Metallic Minerals, Metallic Products, Furniture and Food and Beverages account for around half of the respondents (49%). About 80% of the companies employ fewer than 250 members of staff with the single most statistically relevant category being “50 to 99 employees” (26%). The level of turnover that proves slightly more expressive is “1 to 5 million Euros” bracket (25%) whilst 21% of companies report annual sales of over 25 million Euros.

We may consider that the overall set of respondent companies are export orientated, with around 27% exporting over 75% of their production even while 21% of companies do not export at all.

The intensity of design across this sample of the Portuguese manufacturing industry (total value spent on design activities as a percentage of net sales) was 0.69% (2007).

This analysis was tested through a dozen "case studies" carried out by the DeSID project (DeSID 2011). The relationship between design and innovation is also relevant as the majority of firms report the first mental association with design being precisely "Innovation" (Brown 2009; Verganti 2009). The main drivers for recourse to design in companies are "image/reputation" followed by "innovation ability".

In general terms, one may also conclude that economic-financial aspects were most likely to be identified as "barriers". Nevertheless, when assessing the impact of design, the responding firms held aspects of an intangible nature in high regard (firm image/ reputation, customer satisfaction, etc.).

3.2. Design management, innovation and growth strategies: key results

The empirical component of this paper is two-fold. Firstly, we will classify the companies according to the moments or phases when design is implemented and its relationship with growth in turnover (Analysis I); secondly, we focus on the combination of design use typologies in effect alongside the respective company growth strategies (Analysis II). In total, two analytical approaches and six concepts were addressed in order to explain growth in company turnover as detailed in Table 1.

Table 1. Experimental design: analysis, phases and strategies

Analysis	Variables
Analysis I	Phase 1: Design applied in the ideas creation phase
	Phase 2: Design applied in the post-creation phase and before market launch: process and production.
	Phase 3: Design applied in the final market associated phase: marketing
Analysis II	Renewal strategy
	Innovation strategy
	Bridging strategy

Source: authors' construction.

3.2.1. Analysis I: design phases

In Analysis I, we considered three conceptual phases characterizing companies in terms of their relationships with design. This was achieved through the questions contained in the questionnaire drafted in accordance with a vast literature review and including several studies (Walsh 2000; NZIER 2003; Design Council 2004; DESIGNIUM 2005). The majority of these questions belong to two of the six questionnaire chapters: 2. Perception of the Importance of Design use; and 4. Management Attitude and Action towards Design (namely, "Disciplinary and organizational design borders" and "Context of design in companies").

The question answers were analysed and ranked according to the three Analysis I phases and resulting, logically, in eight company characterization categories ("solutions") (Fig. 1 and Table 2).

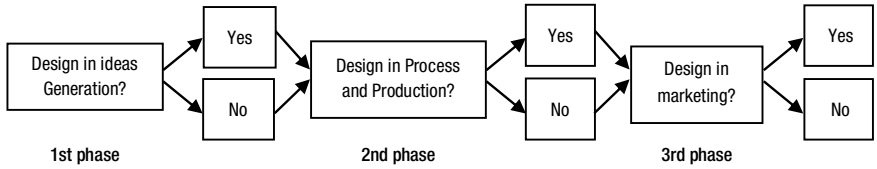

Fig. 1. Decision tree – the three phases of analysis I
Source: authors' construction.

The eight possible solutions resulting from this decision tree establish the options the company faces in terms of applying design along with the three phases presented in Table 2.

Table 2. Eight decision solutions for companies in terms of the three analysis I phases (yes and/or no)

Solution 1	NNN	Solution 5	YNN
Solution 2	NNY	Solution 6	YNY
Solution 3	NYN	Solution 7	YYN
Solution 4	NYY	Solution 8	YYY

Among the various multivariate statistical methods applied in survey data analysis, we selected, firstly, factorial analysis (principal component analysis) with the objective of summarizing the information gathered and identifying the main dimensions underlying the utilization of design according to the aforementioned three phases. Following the appropriate selection of the core variables and carrying out testing procedures, we obtained the factorial analysis model featured in Table 3.

The first component (C1) clearly approaches the dimensions belonging to production and process management (Phase 2), highlighting, for example, the design activities "associated with the production department" (coefficient = 0.811). The second component (C2) interrelates with the application of design in the ideas creation and development activities ongoing in companies (Phase 1). Finally, the third component (C3) represents Phase 3 – design applied to those activities globally understood as "marketing".

Based on this model, we obtained factorial scores (standardized) both for each company and for each one of the three dimensions. Whether or not a company applies design in one or more of the study phases reflects in the value obtained in the respective score. The criterion was defined as follows: the company applies design in phase I (I = 1 to 3) whenever the score value returned for that phase proved positive (>0). Our key results are summarized in Table 4. For 21 companies (99–78), due to a lack of information in some variables (procedure: missing *listwise*), we proceeded with the definition of a "solution" type (from 1 to 8) on a case by case basis. Taking into account the 99 respondent companies in accordance with the eight solutions defined for Analysis I, we attained the results presented in Tables 5, 6 and 7.

Table 3. The phases of design use – descriptive statistics and rotated component matrix

Items/questions from questionnaire	Mean	Std. deviation	N	Components		
				C1 (19.3%) Phase 2 – process/ production	C2 (17.0%) Phase 1 – ideas development	C3 (16.7%) Phase 3 – marketing
Major associations with design: product development*	2.29	2.127	78	–0.022	0.454	–0.478
Major associations with design: marketing*	1.23	1.879	78	–0.067	–0.725	0.224
Major associations with design: process*	0.12	0.581	78	0.690	0.118	–0.212
"Coming up with new ideas": designers **	0.33	0.474	78	–0.316	0.364	0.230
Design activities are associated with: the production department?**	0.17	0.375	78	0.811	–0.139	0.015
Design activities are associated with: the marketing department?**	0.40	0.493	78	–0.067	–0.055	0.760
Staff working most directly on design: product development staff?**	0.51	0.503	78	–0.121	0.647	0.147
Staff working most directly on design: production process development staff, including technological specialists?**	0.33	0.474	78	0.580	0.475	0.121
Staff working most directly on design: marketing and sales, including after sales service, staff?**	0.46	0.502	78	–0.066	0.167	0.822
Design takes place in which phase: concept, development, detailing, pre-production, post-production?**	4.18	1.102	78	–0.579	0.352	0.013
Extraction method: Principal Component Analysis. Rotation method: Varimax with Kaiser Normalization.						

Notes: * Selected from a list of items (1 = minimum; 5 = maximum); ** Selected from a list of items; Kaiser-Meyer-Olkin = 0.589; Bartlett's Test of Sphericity Approx. χ^2 (Pearson) = 100.781; df = 45; Sig. = 0.000.

Source: authors computation based on DeSID (2011).

Table 4. Phase 1 (ideas development), phase 2 (process/product), phase 3 (marketing) – cross tabulation

Phase 1_ideas development			Phase 3_marketing		Total
			(No) 0	(Yes) 1	
(No) 0	Phase 2_process/product	(No) 0	23 (NNN)	19 (NNY)	42
		(Yes) 1	6 (NYN)	4 (NYY)	10
(Yes) 1	Phase 2_process/product	(No) 0	17 (YNN)	11 (YNY)	28
		(Yes) 1	11 (YYN)	8 (YYY)	19
					99

As detailed in Table 4, the most statistically significant solutions were: NNN; NNY and YNN. However, we should express one important reservation at this point: the large number of defined "solutions" and, fundamentally, the very small scale of the number of observations analysed (99) severely restrict the scope of empirical analysis.

Following the segmentation undertaken in Table 4, we are furthermore able to identify other facets with both strategic and operational relevance (Tables 5 and 6). In brief summary, the Table 5 reveals the weighting of the "ideas creation and development" phase as a key point in design "entering into action" in companies, that is, the first time use (n = 47). The table 6 shows that, independently of the design solution adopted, 47 companies make recourse to design in Phase 1, 29 in Phase 2 and 42 in Phase 3. In general terms, there are 23 companies that make no recourse to design (solution NNN).

Table 5. Point in time of recourse to design

	Frequency	Percent
No Design	**23**	23.2
Momentum Y1_ideas development	**47**	47.5
Momentum Y2_process_production	**10**	10.1
Momentum Y3_marketing	**19**	19.2
Total	99	100.0

Table 6. Design usage across the respective phases

Y/N in Phase 1		
	Frequency	Percent
No	52	52.5
Yes	47	47.5
Total	99	100.0
Y/N in Phase 2		
	Frequency	Percent
No	70	70.7
Yes	29	29.3
Total	99	100.0
Y/N in Phase 3		
	Frequency	Percent
No	57	57.6
Yes	42	42.4
Total	99	100.0

Finally, we proceeded to test some of the hypotheses posited about the relationship between design management solutions and the performance (turnover) of companies and their respective trends. We applied the Kruskal-Wallis non-parametric test (to the mean differences) – Table 8.

Study of Table 8 provides three fundamental results. The first interrelates with the breakdown of the data (cases) hindering the obtaining of statistically significant results – the case of the "Design Use Solutions (1–8)"; furthermore, stemming from this situation, all of the testing with other "solution" typologies (double consecutive "YY", "NN" or the YYY solution *versus* XXX, etcetera) failed to return any statistical relevance.

The second approaches the recourse to design in the marketing phase (Phase 3) – irrespective of engaging in design in the other two phases – as a means of differentiating between different (higher) levels of turnover. This analytical outcome is corroborated also by means of one-way Anova (Sig. F = 0.021).

The third and most specific result points to the overall importance of the point in time (phase) in which design gets applied for the first time to the value chain ("momentum"), at least in terms of average level of turnover, with solutions involving design entering into the final phase (marketing) returning the highest levels of sales, 29 million Euros on average, followed by entrance in the first phase (ideas generation and development), with an average of 20 million Euros (data from Table 7); whilst the solutions involving design in the process/production (second phase) report the highest levels of average growth, with first phase design (ideas generation development – YNN, YNY, YYN and YYY) ranked in second place (data from Table 7, DeSID data).

Furthermore, we would highlight that the variable for business turnover (more exactly, reported sales) also returns significant relationships with other variables collected within the scope of our survey. Hence, the level of turnover (mean) differs statistically significantly depending on the categories, for example, by:

- "Amount spent on design undertaken externally" (2005 to 2007) (Kruskal-Wallis test: Sig. = 0.00);
- "Amount spent on design undertaken internally" (2005 to 2007) (Kruskal-Wallis test: Sig. = 0.00);
- "Intensity of design (expenditure on design in the period from 2005 to 2007 as a percentage of sales in the same period) (Kruskal-Wallis test: Sig. = 0.01).

In overall terms, the analysis above renders the difficulty in explaining, in any statistically significant fashion, the behaviour of growth in turnover. We would state that the only variable demonstrating some capacity to reveal differences in the turnover growth dynamics (Growth of Turnover) was that of "Levels of Differentiation" (differentiation only in product development *versus* using, additionally, industrial property instruments: licensing, trademarks and patents) (with Kruskal-Wallis test: Sig. = 0.067).

Table 7. Employees, turnover and company growth (in the three years indicated), by design use solution (analysis I)

Typology of design use solutions (1–8)		N	Mean	Std. deviation	Minimum	Maximum
Employees in service average (2005–2007)	**1-NNN**	23	**153.77**	244.59	2.00	1 030.33
	2-NNY	18	**174.43**	177.54	2.00	611.67
	3-NYN	6	**32.67**	59.94	3.00	154.33
	4-NYY	4	**103.08**	42.94	44.33	146.67
	5-YNN	16	**253.63**	490.42	16.33	2 025.67
	6-YNY	11	**207.12**	225.57	15.00	849.33
	7-YYN	11	**137.64**	129.76	26.33	377.33
	8-YYY	8	**258.00**	288.46	40.33	766.67
	Total	**97**	**177.31**	271.48	2.00	2 025.67
Average turnover (2005–2007) (Thousands Euros)	**1-NNN**	19	**10 573.53**	17 477.69	41.30	69 666.21
	2-NNY	18	**32 967.01**	48 148.13	18.00	175 333.33
	3-NYN	6	**3 592.54**	5 023.73	5.00	11 272.36
	4-NYY	3	**6 655.12**	5 743.98	2 632.03	13 233.33
	5-YNN	16	**15 657.96**	20 545.96	421.70	74 617.33
	6-YNY	10	**13 263.18**	13 676.32	1 271.00	49 374.00
	7-YYN	10	**12 240.72**	16 376.92	800.00	49 783.36
	8-YYY	7	**53 556.66**	86 638.38	1 197.01	240 943.97
	Total	**89**	**19 284.12**	36 404.60	5.00	240 943.97
Growth in turnover (2005–2007) (%)	**1-NNN**	18	**13.92**	22.55	–29.29	63.60
	2-NNY	18	**11.59**	20.93	–21.98	66.17
	3-NYN	5	**44.52**	104.94	–21.65	231.00
	4-NYY	3	**64.74**	140.95	–34.97	226.00
	5-YNN	16	**25.70**	34.60	–14.39	123.00
	6-YNY	10	**9.03**	25.98	–24.50	61.79
	7-YYN	10	**25.46**	36.93	–22.12	96.68
	8-YYY	7	**37.42**	83.59	–41.39	214.00
	Total	**87**	**21.77**	47.36	–41.39	231.00

Table 8. Turnover and design use phases – Kruskal-Wallis test (independent samples)

Null hypothesis	Sig.	Decision
The distribution of "Turnover (2005–2007 average)" *is the same* across categories of "Design Solution Typologies (1–8)" (Table 4)	0.200	Retain the null hypothesis
The distribution of "Growth of Turnover (2005–2007)" *is the same* across categories of "Design Solution Typologies (1–8)" (Table 4)	0.909	Retain the null hypothesis
The distribution of "Turnover (2005–2007 average)" *is the same* across "The momentum of the first design intervention in the company" category (Table 5)	0.021	Reject the null hypothesis
The distribution of "Growth in Turnover (2005–2007)" *is the same* across "The momentum of the first design intervention in the company" category (Table 5)	0.797	Retain the null hypothesis
The distribution of "Turnover (2005–2007 average)" *is the same* across categories of "Yes/No in Phase 1" (Table 6)	0.092*	Retain the null hypothesis
The distribution of "Growth of Turnover (2005–2007)" *is the same* across categories of "Yes/No in Phase 1" (Table 6)	0.355	Retain the null hypothesis
The distribution of "Turnover (2005–2007 average)" *is the same* across categories of "Yes/No in Phase 2" (Table 6)	0.601	Retain the null hypothesis
The distribution of "Growth of Turnover (2005–2007)" *is the same* across categories of "Yes/No in Phase 2" (Table 6)	0.888	Retain the null hypothesis
The distribution of "Turnover (2005–2007 average)" *is the same* across categories of "Yes/No in Phase 3" (Table 6)	0.044	Reject the null hypothesis
The distribution of "Growth of Turnover (2005–2007)" *is the same* across categories of "Yes/No in Phase 3" (Table 6)	0.091*	Retain the null hypothesis

3.2.2. Analysis II: business strategies

As regards Analysis II, and as previously stated, this approaches any eventual relationship established between design use typologies (Analysis I) and company growth strategies (Analysis II). The basis for classifying the company growth strategy as belonging to the renewal, innovation or bridging categories stemmed from the information gathered by some of the questions answered in the questionnaire based upon a critical review of the literature. The majority of these questions belong to the following questionnaire chapters: 2. Perception of the Importance of Design use ("Design ladder"); 3. Identification of the Design's Drivers and Enablers ("Design, product and production" and "Innovation dynamics"); 4. Management Attitude and Action towards Design ("Design human resources" and "Design spending"); and 5. Company's Evaluation on the Design Results.

In order to carry out this second empirical study, we broadly applied the same statistical techniques as in Analysis I. Thus, based on the most relevant variables from the DeSID questionnaire, we undertook factorial analysis (principal components analysis) in order to define the dimensions underlying company recourse to renewal, bridging or innovation strategies. The results returned are set out in Table 9 (Cronbach's $\alpha = 0.60$).

Table 9. Company growth strategies – descriptive statistics and rotated component matrix

Items/questions from questionnaire	Mean	Std. deviation	N	Components		
				C1 (32.7%) Innovation strategy	C2 (20.9%) Bridging strategy	C3 (18.4%) Renewal strategy
Innovation in the introduction of new products: 2007 (Y/N)	0.70	0.460	61	0.863	0.185	0.048
Innovation in the introduction of new processes: 2007 (Y/N)	0.59	0.496	61	0.888	0.116	–0.059
Innovation in the improvement of existing processes: 2007 (Y/N)	0.54	0.502	61	0.823	0.134	–0.033
Innovation in the improvement of existing products: 2007 (Y/N)	0.61	0.493	61	0.898	0.206	–0.084
Graduate degree in design*	1.85	0.749	61	0.318	0.792	0.091
Graduate and post-graduate designers as a percentage of design allocated members of staff (%)	37.74	38.565	61	0.098	0.904	0.023
Graduates and post-graduates with design backgrounds as a percentage of total staff with design backgrounds (%)	51.50	43.163	61	0.187	0.926	0.019
Levels of differentiation (4 levels)**	1.66	1.167	61	0.663	0.255	0.207
Design ladder (4 levels)***	2.93	0.680	61	0.555	–0.023	0.450
Evaluation of impact of applying design: increase in market share****	3.25	1.274	61	0.090	0.064	0.799
Evaluation of impact of applying design: increase in number of new clients****	3.51	1.164	61	–0.041	0.152	0.813
Evaluation of impact of applying design: higher client retention and loyalty rates****	3.62	1.128	61	–0.016	–0.080	0.798
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.						

Notes: *1 = 0 designers; 2 = 1 to 2 designers; 3 = more than 2 designers; **Only for product development (=1) versus additionally including the industrial property instruments: licensing, trademarks and patents (=2, =3, =4); ***1 = no design; 2 = design as styling; 3 = design as process; and 4 = design as innovation; **** 1 = minimum; 5 = maximum; Kaiser-Meyer-Olkin = .772; Bartlett's Test of Sphericity Approx. χ^2 (Pearson) = 426.132; Df = 66; Sig. = 0. 000).

Clearly, the first main component (C1) reflects the dynamics of innovation (I); while the second (C2) approaches the bridging strategy (B) supported especially in terms of competences and skills; with the third (C3) reporting on factors of ongoing improvements in companies and their respective market positioning: renewal (R).

As in the previous analysis, we obtained factorial scores for each company and for each one of the three growth strategies. The criterion defined was the following: a company is classified as following one of the three strategies in accordance with the highest value returned for the respective three scores (*Max*. score). Based on this procedure, we were able to automatically classify only 61 companies, the final number incorporated into the study. Table 10 combines the respective different solutions from Analysis I with the different options returned by Analysis II.

Brief analysis of Table 10 soon encounters the difficulty in drawing clear conclusions on the phenomena under study given the low number of observations for each item. The results of the χ^2 (Pearson) test for this table return a (2-sided) level of significance of 0.818.

By applying the factorial scores (cases) reporting the different design phases – Ideas development, Process/production and Marketing (interval variables) (Analysis I), – in accordance with the three categories of the variable "growth strategies", we arrive at

Table 10. Design use solution typologies (1–8) versus strategy type – cross tabulation

Design use solution typologies (1–8)	Strategy type			Total
	Renewal strategy	Bridging strategy	Innovation strategy	
1 – NNN	4	3	1	8
	50.0%	37.5%	12.5%	100.0%
2 – NNY	3	6	3	12
	25.0%	50.0%	25.0%	100.0%
3 – NYN	1	0	0	1
	100.0%	0.0%	0.0%	100.0%
4 – NYY	1	1	2	4
	25.0%	25.0%	50.0%	100.0%
5 – YNN	4	4	4	12
	33.3%	33.3%	33.3%	100.0%
6 – YNY	2	4	3	9
	22.2%	44.4%	33.3%	100.0%
7 – YYN	5	1	4	10
	50.0%	10.0%	40.0%	100.0%
8 – YYY	1	2	2	5
	20.0%	40.0%	40.0%	100.0%
Total	21	21	19	61

Table 11. Through this, we may verify a "lack of sensitivity" of the scores returned by the "Phase 2-Process/production" factor as regards the growth strategies in effect. Moreover, in contingency tables produced, we find that companies characteristic of Phase 1 are intensively engaged in "innovation" (in contrast to the two remaining strategies) with those of Phase 3 weighted towards both and with similar result levels, the bridging and innovation strategies.

Table 11. Design use phases and growth strategies – Kruskal-Wallis test (independent samples)

Null hypothesis	Sig.	Decision
The distribution of "Phase 1-ideas development" *is the same* across the "Growth strategy" categories	0.008	Reject the null hypothesis
The distribution of "Phase 2-process/production" *is the same* across the "Growth strategy" categories	0.562	Retain the null hypothesis
The distribution of "Phase 3-marketing" *is the same* across the "Growth strategy" categories	0.009	Reject the null hypothesis

Furthermore, and similar to the case of Analysis I, we made recourse to other economic and business variables contained in the questionnaire. By way of an example, the higher levels of differentiation and academic qualifications broadly correspond with the innovation and bridging strategies. This pattern is already present in the factorial analysis undertaken (Table 9).

4. Discussion. Implications and limitations

Directly interpreting the tables of results, and having withdrawn the NYN and NYY "solutions" due to the limited number of cases, we would firstly note that, in general, the majority of companies reporting Phase 1 design based solutions return higher rates of growth in turnover. In particular, the results demonstrate the YYY group of companies achieve the highest growth rate, with an average of 37%, and hence the group turning in the most satisfactory growth rates by incorporating design throughout the value chain, i.e., the three defined phases of design process. However, this situation requires corroboration with further specific testing and within the context of a larger scale sample. Another relevant issue refers to the many companies that predominantly apply design in Phase 3, i.e. design primarily gets associated with marketing. That confirms theories associating design overwhelmingly with the commercialization of products and hence particularly branding, packaging and communication.

Regarding the second analysis (growth strategies) the most striking finding comes with the companies applying design throughout the value chain (YYY) also displaying a greater tendency to implement growth strategies through innovation and bridging. In descriptive terms, firms applying design in more than one phase display a significantly higher tendency to pursue growth strategies incorporating either innovation or bridging. We may therefore conclude that design is effectively an innovation facilitator especially when integrated into the largest number of business activities ongoing inside firms.

In terms of economics implications for companies and investors, companies that compete through differentiation, quick lifecycles of products, processes and businesses are naturally related with a creative process of innovation and design. Companies that compete through volume strategies and have concerns about cost and price are relocating their main activities to areas of the world with cheaper inputs and resources. That is why there is a high relocation of industries to countries in Asia and Middle East, especially with regard to the process and production. It might be thought that in this type of activity the role of design would be limited because those industries are associated to slower lifecycles and because of that they does not require rapid changes and innovations. Today we know that is not true. Europe and North America, for example, have staked much on innovation, notably through the creation of patents, the conquest of new markets, the creation of new forms of demand and the development of new competences.

In this sense, knowledge is of vital importance for the competitiveness and sustainability of firms and it is increasingly becoming a strategic tool for decision making. As we have seen, knowledge necessarily emerge in the early stages of any creative process where the design has its relevant space.

There are fewer businesses with slow lifecycles. So, complex factors of competitiveness as is the design, are practical contributions for the investments and investors. Effectively, we know that design and designers use as input for its actions the state of the art of concepts, products and processes of businesses and industries in the market, and have innovation at the heart of its DNA.

Last but not least, one of the key limitations to this study derives from that fact that less than 10% of the companies in the defined sample actually responded to the (online) questionnaire, which inherently undermines any extrapolation of our results. Further and more systematic exploration of these results opens up interesting lines of future research.

Conclusions and recommendations

In descriptive terms, we conclude that the companies growing more sharply in average terms apply design across the three phases from generating ideas and creativity to processes and production and extending into the marketing phase.

We must stress also the importance of the phase in which design gets applied for the first time to the value chain ("momentum"). We find out that companies characteristic of Phase 1 (ideas development) are intensively engaged in "innovation" (in contrast to the two remaining strategies). On the other hand, 53% of respondent companies do not make any recourse to design in the first phase and this behaviour continues with generalized non-usage of design, namely, in the second phase, that of process and production. Finally, comparing and contrasting the two analytical approaches (Analyses I and II) also enables us to conclude that design represents a strong driver behind companies adopting either innovation or bridging strategies. This especially occurs whenever companies apply design either throughout the value chain or at least in the majority of their ongoing activities.

The relatively low level of design education affects and undermines the ways in which firms acknowledge design and its potential role in business (Hardin *et al.* 2014). An upgrade in employee qualifications might represent one important step to boosting design inside firms as a more efficacious resource and similar to practices prevalent in Northern European countries. Firms valued the development and introduction of new and better products in the prevailing context of global competition with such approaches deemed instrumental to future design and innovation.

A motivation for future studies is the relationship between different industries and its application of design on each one of the three stages defined. Although not tested it seems evident that the sectors of mass consumption as food and beverages, for example, have a tendency to apply the design especially in the third stage, the commercialization and marketing. And at this stage firms emphasize more the design of communication and the design of brands. Also, firms working in the business to business market have a higher probability to apply the design at an early stage. It is a mere suggestion for future studies.

A second suggestion raised by this research has to do with the relationship between industries and strategies. As mentioned, the innovation strategy differs from the strategy of renewal. Both favor the growth of business and economies, but innovation has a higher growth performance. It would therefore be interesting to study which industries are more conducive to the adoption of one or another and which is the role of design in the value chain of these different industries.

One last suggestion has to do with the fact that investors often cannot clearly visualize the contribution of design for the performance or improvement of a company's performance. In this sense, many times it lacks the formulation of conditions or indicators that help companies to measure the impact of design on businesses. A study on this subject can work as a facilitator for the increasingly intervention of design early in the creative development process, in the process and production and in the commercialization and marketing processes.

In sum, we confirm the complex and interactive character of the design process that, to be successful, requires considerable levels of organization, training, and the capture and circulation of information inside the firm and in its relationship with the business environment, with design representing a fundamental driver of innovation and growth dynamics.

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