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The Impact of Design Thinking on Innovation

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Abstract

In a world that gets harder and tougher every day, companies need creative and multifaceted solutions for facing their challenges, which simultaneously enables them to win over their rivals. Such a need leads to a method, called Design Thinking, the process of creating new and innovative ideas to solve a particular problem. The aim of this paper is to show how design thinking affects Product, Process and Organizational Innovation. The objective of design thinking is to involve consumers, designers and businesspeople in an integrative process which can be applied to product, service or even business design. Based on the information and literature, the conceptual framework of the research was designed and hypotheses were developed. Data from 95 organizations in science park of Tehran, Iran provided empirical evidence for this survey. Partial Least Squares Structural Equation Modelling (PLS-SEM) using Smart PLS 3.0 computer software was used to analyze the data. The results of this study suggested that: Design thinking could be applicable to Product, Process and Organizational Innovation. Using the various Design Thinking tools, techniques and templates, organizations can apply them to make their innovations come true.

Keyword

Design Thinking, Product Innovation, Process Innovation, Organizational Innovation

Introduction

Innovation is the mechanism by which organizations produce new products, processes, and systems, required for their adaptation to the changing markets, technologies, and modes of competition (Lawson & Samson, 2001). Technological innovations, business model changes and shifting consumer habits are increasingly producing turbulence in and around organizations. To successfully respond to these dynamics, managers not only require innovative problem-solving practices but also need to turn from a traditional decision-making attitude for example selecting among predetermined alternatives, toward a design-creating attitude i.e. creating new options (Schumacher & Mayer, 2018).

This rapid and accelerating market shift towards integrated products and services has spurred significant changes in how companies invest in innovation, train their employees and engage with their customers. Among these, one of the most visible and arguably, strongest trend is a board-based investment in design thinking (Roberts et al., 2016). Design thinking, as a concept, has been slowly evolving and coalescing over the past decade. One popular definition is that design thinking means thinking like a designer. More concretely, Tim Brown of IDEO has written that design thinking is *a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity* (Martin, 2009).

Design thinking is promoted as a user-centered approach to innovation, it has been introduced as a management approach that brings creativity and user-centeredness to organizations as a new way of working (Brown, 2008). It has also started to receive increased attention in business settings. This is because the design of products and services is a major component of business competitiveness, to the extent that many known companies have committed themselves to become design leaders (Razzouk & Shute, 2012). A review of the literature on design thinking suggests that it is a management practice deserving increased attention from scholars. An examination of both theoretical work and actual management practice reveals a process that is not only internally consistent and coherent, but also capable of constituting a distinctive practice (Liedtka, 2014). The authors believe that design thinking is a remarkably under-used tool for achieving strategic business initiatives, increasingly driven by the need for innovation (Lockwood, 2009).

This paper aims to consider how applying design thinking behaviors allows one to focus on the problem, the issue and the user, letting him/her find the means for solutions. For many, this approach combines different viewpoints and customer-centric concepts, increasing their innovation speed. This study investigates the nature of the relation between design thinking and innovation, particularly with the purpose of examining the relation between design thinking and product, process and organizational innovation. It starts with the background as well as the issues of design thinking, then to propose the research hypotheses. Afterwards, having discussed the methodology, it presents the results of data analysis, followed by a conclusion of its given points.

Background

To understand every concept, one needs to find out its origin and roots. In this regard, early glimpses and attempts at design thinking goes back to the 50s and 60s. However, most of these views in the context of architecture and engineering were fighting the rapidly changing environment of those times. In the book, titled *Sciences of the Artificial* (1969), Herbert A. Simon was the first how defined design as a science or way of thinking. After Simon, Nigel Cross discussed the nature of designers' problem-solving in his paper *designerly ways of knowing* in 1982. The he compared designers' problem solving methods to non-design-related problem solutions people encounter in their everyday lives.

The concept of *Design Thinking* was first introduced by Peter Rowe in 1987, but has been oversimplified in many industry realms ever since, leaving behind a trail of design thinking experts along with a frustrated design research community (Mosley et al., 2018).

In 1991 IDEO was formed and widely accepted as one of the first companies that introduced Design Thinking. One year later, Richard Buchanan published his article, *Wicked Problems in Design Thinking* which focused on the origins of design thinking and discussed that Design Thinking was formed as a means of integrating highly-specialized fields of knowledge so that they could be jointly applied to new problems people face.

Since 2005, Design Thinking has been taught at the Stanford School of Design. At present there is a growing awareness that the collection of concepts and processes, associated with design thinking, can be strikingly effective to resolve complex problems, especially the ones that require imagination, creativity and innovation (Diethelm, 2019).

The notion of design thinking is broad, thus considered quite confusing. There are many debates over what exactly is meant by the term and how it differs from creativity, innovation or system thinking (Hassi & Laakso, 2011). Over the past decade, the definition of design thinking has shifted from *the interior situational logic and decision-making processes of designers in action*, including the *theoretical dimensions* that both account for and inform this kind of undertaking towards a highly contested, contemporary understanding which is predominately conceptualized in a specific way for the use of non-designers to evaluate and synthesize problems through design methods (Mosley et al., 2018).

Applying a design approach to management is suitable as it could enable innovation, organizational change and growth (Johansson & Woodilla, 2009). Design thinking has been increasingly associated with the practice of problem solving in case of complex and ill-defined problems, also known as *wicked* problems (Carlgren, 2013). Another defining aspect with design thinking is that it is believed to provide value through a customer, hence allowing the businesses to interact and involve their customers in a different way and gain insight from them in ways that can be both meaningful and rewarding. Liedtka argued that the process of deriving and using these insights result in competitive advantages. According to her *Translating these needs into design criteria provides the underpinning for the ideation stage and its belief that users' unarticulated needs and desires are the foundation of differentiated value propositions* (Liedtka, 2014).

1. *Problem-Solving in Design Thinking*

Design Thinking is a method of understanding problems and producing innovative and compelling solutions (Thienen et al., 2014). It is seen to inherently include questions concerning the way the problem is represented (Boland & Collopy, 2004), looking beyond the immediate boundaries of the problem to ensure that the right question is being addressed (Drews, 2009), thus it goes beyond what is obviously stated to see what lies behind the problem (Zaccai in Lockwood, 2010). Identifying, framing and reframing the problem to be solved are regarded as equally important as solving the problem or finding an appropriate solution (Beckman & Barry, 2007). The process of challenging the original problem is not limited to the beginning of the process, but is ongoing, incorporating the findings already gained to re-phrase the problem (Drews, 2009).

There are problems that require creativity in order to find multiple workable solutions. *Wicked Problems* is a common phrase and many papers have been return in this regard. According to Kimbell (2011), design thinking is appropriated for a variety of professions e.g. business and sciences, to solve disciplinary problems in seemingly new ways. In the same context, Piotrowski explains that businesses are seeing that the process of design can bring innovative thinking to problem-solving within the corporate environment, a methodology which is known as design thinking (Piotrowski, 2011). Muratovski goes on to propose that design has developed from a purely stylistic trade, centered around creating beautiful objects into an industry with complex problem-solving at its core (Muratovski, 2015).

In *Wicked Problems in Design Thinking*, Buchanan (1992) posed the idea that designers frequently encounter complex, wicked problems. The skill of developing multiple varied solutions in an effective way that is at the heart of design thinking. In addition, Buchanan suggested that designers' thought process allowed them to deal with complex, multi-faceted wicked problems.

Hypothesis Development

The term *design thinking* is often used as a unique approach to solve problems in innovative ways. Researchers from various disciplines use the principles of design to solve problems. Tim Brown in his book *Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation* (2009) has explored design thinking. Accordingly, design thinking, based on the same principles used by designers to produce innovative solutions for engineering problems, is considered by Brown to be the paradigm for solving complex problems regardless of the field of activity. Also, he adds that: *Design thinking has its origins in the training and the professional practice of designers, but these are principles that can be practiced by everyone and extended to every field of activity* (Brown, 2008).

Insights into real users' needs have been perceived to help innovation teams go beyond their usual problem and solution frame. Studies show that design thinking has been used in the area of incremental innovation or continuous improvement. The central promise in the literature is the contribution of design thinking to innovation (Brown, 2008; Martin, 2009). However, while the view on innovation ultimately affects how design thinking is evaluated, innovation as a term is usually not problematized and is discussed mainly as short-term gains for instants creativity boost or a way to come up with great ideas i.e., invention rather than innovation (Cruickshank, 2010). Another dimension is innovativeness or innovation output what is brought to market even though some effects on the innovation capability side have been considered in discussions of design thinking, like the benefits of collectively addressing wicked problems (Hobday et al., 2012). Design thinking should be thought of as a form of experimental thinking that is solution focused and may be implemented to produce creative solutions to wicked problems (Pusca & Northwood, 2018), with few works addressing long-term effects (e.g. Simons et al., 2011).

Innovation, a critical factor in business competition, is a complex concept, far more than principles, rules and procedures. This process would be most effective, when imbued with attitudes and ways of thinking that have evolved over generations within the community of those who routinely practice creative invention and synthesis. Thinking appropriately in the field of design is called *Design Thinking* (Owen, 2006). Design Thinking is an innovation process, which offers a set of techniques that seem to reduce the cognitive bias of innovation teams, stimulate their creative confidence and improve their learning. The mechanisms are all likely to improve a firm's innovation and performance (Veflen Olsen, 2015).

Asserting that innovation tasks are carried out by diverse, multifunctional teams, design thinking mitigates the effects of projection, egocentric empathy, focusing and hot/cold biases (Liedtka, 2014). Design thinking could assist innovation process, by providing a safe space for diverse perspectives to be openly shared, for new insights to emerge and knowledge to be created, while empowering participants in the co-creation of shared visions (Docherty, 2017). Design thinking is incorporated into the innovation process to develop specific solutions to address complex issues. The current revival of interest for this creative discipline is justified by its effective method to create concrete solutions to address organizations' new needs and requirements in terms of innovation (Pavie & Cathy, 2015).

Design methods are orderly, inclusive and innovative. Taking advantage of design thinking can help business leaders make their intentions real by clearly defining goals, deeply understanding customers and getting their internal teams aligned to deliver results (Lockwood, 2009). Design thinking has numerous benefits, such as its ability to articulate itself around and adapt to the organization's innovation process. It has five main objectives, consisting of;

1. Opening of the innovation process to include customers, stakeholders, and experts capable of providing guidance with regards to potential impacts

2. Improved understanding of customers' needs and expectations by involving them throughout the process

3. Full use and management of new distribution channels through the cross-disciplinary work

4. Reduction of the risks posed by innovations via making an impact monitoring system central to the innovation process

5. Redefining organizations' role as actors to shape the future of the society actively

Based on this idea, the following hypotheses are proposed;

1. Design thinking has a positive and significant impact on product innovation

2. Design thinking has a significant and positive impact on process innovation

3. Design thinking has a significant and positive impact on organizational innovation

Methodology

1. *Survey Development and Sample*

To test the research questions, a survey instrument was developed. The design process for the questionnaire involved two stages. In the first, an extensive literature review was conducted, which got further assisted through identification of model's constructs. Afterwards, the items associated with each of the constructs got directly adopted or slightly modified. Since the questionnaires were administered in Iran, two scholars were asked to translate the initial English questionnaire into Persian. The Persian version was then back-translated into English by two other scholars and both English versions were checked for any discrepancies to ensure consistency. Ultimately the Persian questionnaire was employed. In the second stage, three academics with relevant working experience in Iran reviewed the draft questionnaire and identified any awkward or inapplicable items. Further revisions and refinements were made, based on their feedbacks, to ensure that the survey would be highly understandable and relevant to the practices in Iran. An internet survey was administered and targeted at companies located in the science parks of Tehran, Iran. The questionnaires were emailed to the members of top management in each company with a cover letter that explained the purpose of the survey and provided an assurance of confidentiality. Previous researches suggested that members of top management are more familiar with ideas and values within organizations, putting them in the best position to respond to the questionnaire (Hambrick & Mason, 1984). Out of the 250 invitations, emailed to the respondents, as many as 95 usable output was received, representing a response rate of approximately 24%.

2. *Constructs in the Model*

Table 1 gives the variables, used in this study. The respondents were requested to indicate the level of agreement on each of the statements from 1: strongly disagree to 5: strongly agree. The items for the design thinking came from Blizzard et al. (2015) and Brown (2008). The respondents were asked to answer the expressions. The items for product, process and organizational innovation were derived from Jimenez-Jimenez et al. (2008). Respondents were asked to rate the level of each of the items, using a five-level response format with 1: strongly below competitors up to 5: strongly above competitors.

Table 1. *Constructs measurements*

Constructs	Item Description	Reference
Design Thinking	1. I seek input from those with a different perspective from me.	Blizzard et al., (2015); Brown, (2008)
	2. I seek feedback and suggestions for personal improvement.	
	3. I analyze projects broadly to find a solution that will have the most significant impact.	
	4. When problem-solving, I focus on the relationships between issues	
	5. I hope to gain general knowledge across multiple fields.	
Product innovation	1. Number of new products/ services introduced	Jimenez et al., (2008)
	2. Efforts on innovation in terms of hours/ persons, teams and training involved in innovation	
	3. Number of new products/ services introduced	
	Scale: 5= Strongly above competitors…1= Strongly below competitors	
Process innovation	1. Number of changes in the process introduced	
	2. Pioneer disposition to introduce the new process	
	3. Quick response to the introduction of competitors new process	
	Scale: 5= Strongly above competitors…1= Strongly below competitors	
Organizational innovation	1. The novelty of the management systems	
	2. The search for new management systems	
	3. Pioneer disposition to introduce new management	
	Scale: 5= Strongly above competitors…1= Strongly below competitors	

Results

1. *Validation of the Measurement Instrument*

This section examines the reliability and validity of the constructs. Based on the results in Table 1, the measurement model met all general requirements. Firstly, the outer loading factor was calculated by determining the correlation rate of the indicators of a construct with the construct itself. Hulland (1999) believed that if this value was equal to or greater than 0.4, then the variance between the construct and its indicators surpassed the variance of the construct measurement model error, causing the measurement model reliability acceptable. All outer loadings were above 0.722 and significant at the 0.001 level. Secondly, Cronbach's alpha is a measure of internal consistency, i.e., how closely related a set of items are as a group. From Table 2, it can be seen that all values of Cronbach's alpha were greater than 0.70, suggesting acceptable reliability. Thirdly, CR is proportionate with the variance between the construct and its indicators to the variance between the construct and its indicators plus the variance of the measurement model error. If the CR value goes beyond 0.4 for each construct (Nunnally, 1978), it means that measurement models have acceptable interior consistencies, whereas a value below 0.6 signifies lack of reliability (Davari & Rezazadeh, 2015). Results show that all the aspects of the model had acceptable reliability. The fourth column of Table 2 represents AVE, the correlation rate of the construct with its indicators; the more correlation leads to greater fit (Barclay et al., 1995). Fornell & Larcker (1981) introduced AVE for the assessment of the convergent validity, specifying that the critical value for AVE is 0.5, meaning that AVE values above 0.5 indicate an acceptable convergent validity (Davari & Rezazadeh, 2015). Here, all AVE results were acceptable.

Table 2. *Convergent validity and reliability*

Constructs	Outer Loadings	α	CR	AVE
Design Thinking	0.762	0.868	0.904	0.652
	0.782			
	0.853			
	0.831			
	0.808			
Product Innovation	0.891	0.865	0.917	0.786
	0.908			
	0.860			
Process Innovation	0.901	0.806	0.870	0.692
	0.861			
	0.722			
Organizational Innovation	0.830	0.874	0.914	0.780
	0.950			
	0.866			

Note: α= Cronbach's Alpha; CR= Composite Reliability; AVE= Average Variance Extracted

Furthermore, discriminant validity was tested. This scale showed the correlation rate of the model with its indicators, in comparison to the correlation rate with other models. As such, acceptable discriminant validity of a model suggests that a construct in a model has more interaction with its parameter rather than other constructs. The results can be interpreted in this way that if the value of the square root of AVE of the latent variables located in the cells of the main diameter of the matrix surpasses the correlation value of the lower cells as well as leftward cells of the matrix, then it can be stated that the constructs — latent variable— in the model have more interaction with their parameter than other constructs. Table 3 presents the convergent Fornell-Larcker scale results, showing an acceptable discriminant validity. Finally, the HTMT (Heterotrait-Monotrait) ratio was tested. HTMT measures the multiplicity of observed variables on their single attribute. The acceptable value of this ratio, as Henseler et al. (2015) suggested, is below 0.9. Table 4 represents HTMT validity.

Table 3. *Discriminant validity test*

Design Thinking	0.808			
Organizational Innovation	0.380	0.883		
Product Innovation	0.739	0.443	0.887	
Process Innovation	0.523	0.457	0.817	0.832

Table 4. *Heterotrait-Monotrait ratio*

Design Thinking				
Organizational Innovation	0.359			
Product Innovation	0.831	0.438		
Process Innovation	0.514	0.530	0.872	

2. *Structural Model Assessment*

In order to assess the structural model, three scales have been checked. First of all, R^2 is an index to connect the measurement section and structural section with structural equations modelling and shows the effect of an endogenous variable along with an exogenous one (Davari & Rezazadeh, 2015). Three values of 0.19, 0.33 and 0.67 as the criteria values for weak, average and strong R squared has been proposed by Chin (1998), respectively. The values of R^2 for the endogenous constructs stood above the adequate level. Based on the results, the values of R^2 of the product innovation (0.546) were moderate, whereas process innovation (0.274) and organizational innovation (0.144) were rather weak.

Second, the Q^2 scale, proposed by Stone (1974) and Geisser (1975), determines the prediction power of the model. This index must be calculated for all exogenous constructs of the model. Hensler et al. (2009) set the values of 0.02, 0.15 and 0.35 for weak, average and strong prediction power of the exogenous constructs, respectively. Using the blindfolding procedure, the Q^2 value of product innovation (0.391) was strong, while for process innovation (0.149) and organizational innovation (0.067), it was approximately weak.

3. *Testing the Hypothesis*

The current study used a resampling bootstrap method with 200 samples, with each bootstrap sample containing the same number of observations as the original sample so as to generate standard errors and t-values (Chin, 1988). The study valuates estimated path relations among the latent variables in the model through the sign and magnitude of path coefficients. Considering the results in Table 5, in case the t-value of each route was greater than 1.96 and path coefficient stayed between 0 and +1, it could be concluded that there was a positive and direct effect between the two variables.

Table 5. *Significant testing results of the structural model*

Structural path		Path coefficient	T-values	P-values	conclusion
Independent variable	**Dependent variable**				
Design Thinking	*Product Innovation*	0.739	14.018*	0.000	H1 supported
Design Thinking	*Process Innovation*	0.523	10.674*	0.000	H2 supported
Design Thinking	*Organizational Innovation*	0.380	4.822*	0.000	H3 supported
Note: |t|>1.96 at p=0.05 level; *|t|>3.29 at p=0.001 level.					

Discussion and Conclusion

The concept of design thinking and innovation has received increasing attention during recent years. Several papers and books have addressed the power of design thinking. Moreover, the term innovation has been used to cover any improvement in a product, process and organization.

In the journey of design thinking to innovation, the present paper began with organizational objectives, moving through innovation in products, processes and organizational levels, then eventually ending with the desired outcomes. Based on conduced researches, design thinking offers a structured framework to understand and pursue innovation in ways that contribute to organic growth and add real value to the customers. The cycle of design thinking involves observation to discover unmet needs within the context and constraints of a particular situation, framing the opportunity and scope of innovation, generating

creative ideas, testing and refining solutions. The management-related literature presents design thinking as a cure to nearly every challenge in business, and today as Kimbell points out, *in management practice, it seems, everyone should be a design thinker* (Hassi & Laakso, 2011). David Burney (2006) calls design *an innovative problem-solving methodology that is fast becoming an imperative business strategy*. He also believes that design thinking is *a way of thinking that produces transformative innovation* and *open source, at its heart, is a design thinking process* (Best, 2011).

In general, a large part of the literature, including Yoo et al. (2006), Brown (2008), Martin (2009), Lockwood (2010), Brown and Wyatt (2010), Cross (2000), Johansson and Woodilla (2009, 2011), Hassi & Laakso (2011), Simons et al. (2011), Wattanasupachoke (2012), Acklin (2013), Carlgren (2014), Mootee (2013), Collins (2013), Seidel and Fixson (2013) and Liedtka (2014) examined the capability of design thinking on innovation and problem solving. Results from these studies indicate that design thinking has a positive and significant impact on product and process innovation as well as organizational innovation.

These findings indicate that design thinking is suited to the contexts of product, process and organizational innovation. Results from this research could lead to more informed investigations on how firms organize innovation and in what ways design thinking can contribute. Several organizations claim to have integrated design thinking as a culture or a set of principles to guide employees, putting more emphasis on mindset. It would be interesting to compare different approaches of using design thinking and studying the implications for innovation in the long-term. The findings of a successful fit of design thinking with a numbers-driven culture open doors for more research into different ways of integrating design thinking in innovation work and combining design thinking with other management concepts, currently used in organizations. A few points deserve specific attention: First, there seems to be a need for better understanding of design thinking to enable studies of the concept in organizational contexts. The majority of literature on design thinking assumes a positive influence on innovation, NPD, organizations or individuals. However, this positive attitude raises the question of challenges or adverse effects, ignored by the literature so far, thus provoking a good starting point for further research.

Design thinking comprises an approach to problem-solving that uses tools, traditionally utilized by designers of commercial products, processes and environments e.g. designing a new car or the layout of a new airport. While design thinking was initially introduced as an approach that would work best when infused into the culture of an organization, earliest studies of design thinking focused on identification of specific tools and methods that might be used to solve management problems (Kimberly, 2018).

Organizational cultures influenced — both positively and negatively— the use of design thinking tools (Kimberly & Stigliani, 2018). However, design thinking in organizations provides new insight into the value of this increasingly popular approach to problem-solving. In general, it suggests that the use of design thinking tools in organizations trigger an experiential learning process, which ultimately supports the development of organizational cultures defined by a user-centric focus, collaboration, risk-taking and learning, in turn supporting the further use of design thinking tools. More importantly, the physical artefacts and emotional experiences, which resulted from the use of design thinking tools, provided sources of reflection that help organizations to build such cultures (Kimberly & Stigliani, 2018).

What is missing from design thinking literature includes some aspects like the feeling of democratization or more social issues of companies for being more open to different personalities, how this concept helps people connect with like-minded individuals, affects the norms and culture, and reduces unhealthy cultural elements that can hinder design and innovation (Carlgren et al., 2014). These insights suggest that future research may continue to explore the mediating role of organizational culture on the relation between design thinking and innovation.

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