Innovations

Toward a harmonized definition of the complex multidimensional concept of innovation

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Abstract

Problem: *Now a days it is commonly admitted that innovation is instrumental for the growth of organizations and nations. Nevertheless, the concept is still poorly understood and innovation became a hot universal buzzword used in several ways, which is causing confusion on its proper meaning. This warranted the need to develop a harmonized definition that can be shared across disciplines and uniformly reflect the concept.* ***Design/Methodology/Approach****: We carried out an empirical study based upon a comprehensive review of the literature focused on a search on the commonalities and discrepancies of the current definitions of the innovation, which* ***Findings:*** *We highlighted the high degree of complexity associated with the concept of innovation. We demonstrated that the perception of this concept is contingent across a variety of disciplines. We also showed that the term "innovation" is associated with five key elements namely, process, output, implementation, novelty and value creation.* ***Conclusion****: We lifted the ambiguity surrounding innovation, and proposed a new integrative definition of innovation to harmonize the perception of this multidimensional and multifaceted concept and to ultimately disseminate a working global view of the concept of "innovation" and it across all fields*

Keywords: *1.Innovation, 2.Innovation Definition, 3.Innovation Models, 4.Innovation Complexity, 5.Innovation Types, 6.Innovation Elements*

I. Introduction

As a result of globalization, the fourth industrial revolution, and the rapid developments in communication technologies, the economic system has transformed over the past two decades (Al-Jawareen, 2016). This transformation has increasingly made innovation a main driver of competition (Miniaoui and Schilirò, 2017) for organizations (Betz, 2011; Lin and Chen, 2016; Tidd and Bessant, 2009; and Luecke and Katz, 2003; Carayannis et al., 2017; Prange and Schlegelmilch, 2018) and nations (World Bank, 2010; Carvalho et al., 2018).

In tracing back the historical terminology that is foundational to the underpinnings, defining "Innovation" demonstrates that it is an ancient term, originating from the Latin "innovare" meaning "to change or alter things that already exist" (Zhu, 2016). The innovation theory, on the other hand, isa modern philosophy, founded by Joseph Schumpeter, the godfather of innovation, in 1934 (Puolitaival and Kestle, 2016). Schumpeter was one the first to define innovation as "the ability to create economic value from new ideas" (Gao et al, 2017).

Building on Schumpeter's definition, research within the innovation field has evolved rapidly (Chen, 2017a).It has been an important topic of study across a number of diverse disciplines, including economics, business, engineering, science, and sociology (Chen et al, 2018).

Despite this growing interest on innovation across a variety of field, the term is still poorly understood (Kuratko et al., 2014; Prange and Schlegelmilch, 2018; Kahn, 2018). One idea being that this confusion could be due to its complex, multidimensional, uncertain nature (Wolfe, 1994; Morris, 2011; Claudino et al., 2017; Carayannis et al., 2017; Mumford and McIntosh, 2017; Borrás and Edquist, 2013; Ritala et al., 2016; Kline and Rosenberg, 2010).

Another reason is that the term "innovation" has become a hot buzzword (Obryan, 2015) to the extent that it has become the most overused word in America (O'Bryan, 2013). Hence, the fundamental definition clouded by mis-representation via media, advertisement, politics and other sectors of the society (Acosta et al., 2016).

Therefore, as a call to, this paper aims to establish a consensual understanding and a common working definition of innovation in its purest form to be able to reap its benefits. Through exploring insights from extant literature, the current definitions of the term "innovation" is critically and systematically reviewed, the definitional confusion is analyzed, and the complex multidimensional nature of innovation is explored across various lenses. Through the reviewed literature, the key elements associated with the term "innovation" are further explored to generate a congruent definition of the term "innovation" with a new proposed dynamic, iterative and systematic model.

II. Understanding innovation

"Give me six hours to chop down a tree and I will spend the first four sharpening the axe". This often-quoted phrase by Abraham Lincoln refers to the value of proper preparation, planning and definition of projects, plans and even phrases.

Throughout history, philosophers have been interested in worldviews (Gupta, 2008) as they are powerful tools that provide a common understanding of a word or subject (Whitfield, 2012).

The term innovation specifically requires further discourse since its application among academia, business and government differs vastly thus creating confusion about its foundational ideology (Acosta et al., 2016). In addition, there is confusion regarding innovation and particularly in distinguishing "creativity" and "invention".

2.1 Definitional Confusion

Before discussing the definitional debate, it is useful to trace back the historical roots that are foundational to the term "innovation". As per Zhu (2016), the origin of the word 'innovate' comes from Latin '*innovare*' meaning 'to change or alter things that already exist".

In exploring this debate, it was Schumpeter, the "godfather" of innovation, whoinitially differentiated between the terms: "invention" and "innovation". Throughout this clarification, he further stated that "*invention is an act of intellectual creativity undertaken without any thought given to its possible economic import, while innovation happens when firms figure out how to craft inventions into constructive changes in their business model"* (Abrams et al., 2016).

Another definition of innovation by Schumpeter states that innovation is *"the launching of a new product or of new form of organization, the accomplishment of a merger or the opening of new markets"* (Schumpeter, 1939, cited in Flichy, 2007).

A recent distinction between the terms "innovation" and "creativity", on the other hand, was clarified by Anderson et al. (2014) who states "*creativity and innovation at work are the process, outcomes, and products of attempts to develop and introduce new and improved ways of doing things. The creativity stage of this process refers to idea generation, and innovation to the subsequent stage of implementing ideas toward better procedures, practices, or products. Creativity and innovation will invariably result in identifiable benefits."*

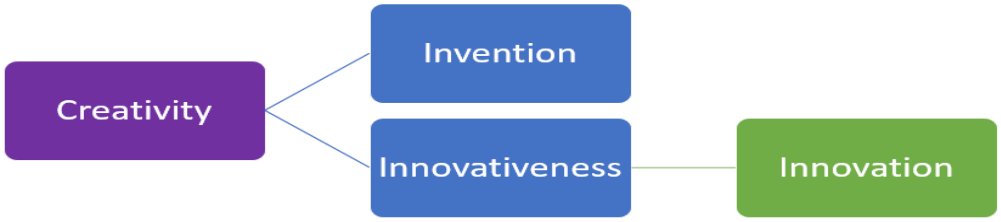
Finally, it is important to differentiate between two terms that are often used interchangeably: "innovation" and "innovativeness". Innovativeness refers to the ability of producing innovative attributes (Shams et al. 2015) whereas innovation is the innovative solution which creates value. According to Clayton Christensen, 80% of the newly introduced innovative products fail (Media Relations Agency, 2017). Hence, not every innovative offering is an

innovation, however, innovation always happens as a result of an introducing an innovative solution.

To further clarify these findings, creativity is the process of generating novel ideas, invention is the implementation of these ideas and innovativeness is the ability to turn an offering into an innovation. Compared to innovation which is the successful diffusion of novel ideas, whether they are inventions or not, and most ultimately result in value creation.

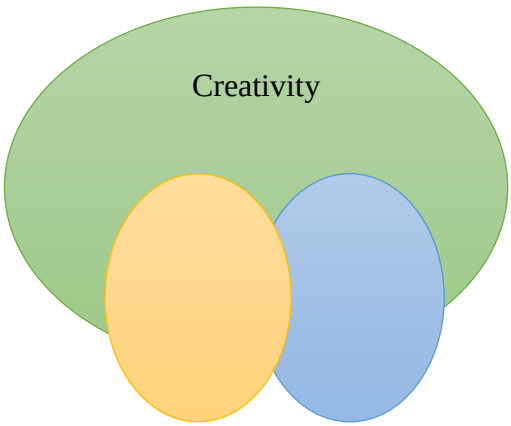
As illustrated in figure 1 below, creative ideas have innovative capabilities and, in this case, can turn into innovation. Also, some creative ideas may become inventions. Nevertheless, not every invention has innovative capabilities, yet, the ones which do may turn into innovation after being presented in the market and capturing value.

Figure 1 Creating Innovation as a result of Creativity, Innovativeness and Invention



Furthermore, figure 2 shows that invention and innovation both require creativity, whereas not every invention is an innovation and vice versa.

Figure 2 Differentiating Creativity from Invention andInnovation



2.2 Review of Innovation Definitions

Considering that the definitional debate is yet to be resolved, it is very important to continue reviewing other viewpoints and worldviews surrounding innovation. According to Drucker (1957), the father of modern management, innovation is defined as "*a systematic organized leap into the unknown*." This is a very general definition of innovation as it overlooks some important dimensions such as novelty, successful implementation and value creation.

Other notable definitions were proposed by the Oslo Manual, a leading source of guidelines related to data on innovation activities, developed by the European Communities and the Organisation for Economic Co-operation and Development (OECD). The Oslo's definitions are adopted in many studies such as (Veselica, 2019; Wikhamn, 2019; Sivam et.al., 2019). They are also adopted in distinguished innovation reports such as the Global Innovation Index (GII).

OSLO's original definition states that innovation is "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations"* (OECD and Eurostat, 2005). This definition reflects the various forms and degrees of novelty associated with innovation. Nevertheless, it does not stress enough on the value creation.

In 2018, the Oslo Manual slightly updated its definition to be as follows: "a*n innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)".* The updated definition demonstrates a broader notion of innovation in a simpler matter. Just like the previously suggested definition, it covers all the important key words except for value creation.

The OECD (2002) had also proposed another definition of innovation in the Frascati Manual which focuses on statistics about research and development. The definition states that innovation is *"the transformation of an idea into a marketable product or service, a new or improved operational manufacturing or distribution procedure, or a new method of providing a social service".*

Moreover, in the latest version of *ISO* Standards 56000, innovation can be defined as *"new or changed entity, realizing or redistributing value".* This is a great definition of innovation as it captures the novelty and value-creation elements. Also, the implementation element is indirectly highlighted through the keyword "entity".

Furthermore, another definition of innovation described by Anthony (2011) states that *"innovation is something different that has a measurable impact".* Obviously, this is a very generic definition; however, it stresses an important factor, which is the ability to measure the value created by innovation.

Also, according to Budden and Murray (2019), innovation can be interpreted as the *"process of taking ideas from inception to impact"*. This is a very short yet precise definition as the selection of its phrases indicate that innovation has to be implemented to ultimately add value. The definition missed reflecting the novelty element though.

Another brief definition is proposed by Bolton (2019), Forbes Council Member. His definition states that *"innovation is something different that creates value"*. Although this definition is simple and easily understood, it excludes the implementation element that needs to be considered in innovation definitions.

The definition that was proposed by Ramalingam et al. (2009) whom states "*innovation is dynamic processes which focus on the creation and implementation of new or improved products and services, processes, positions and paradigms. Successful innovations are those that result in improvements in efficiency, effectiveness, quality or social outcomes/impacts*" is particularly useful because it supports the studies by (Davila et al., 2013; Tidd and Bessant, 2009; Ramalingam et al., 2009) which look at innovation not as a one-time-event, but rather as a process that needs to be managed. It also mentions other important elements of innovation including the implementation, output, degree of novelty and value creation.

The above confirms that the suggested "innovation" definitions vary tremendously. However, despite the huge variation, there are definitely some underlying themes among the definitions reviewed in this section. Specifically, there has been five key concepts replicating in the various definitions, these are: newness, forms, process, implementation/creation and usefulness/ value creation.

Table 1 analyzes the repetitive terms. The table shows that most experts focused on reflecting three elements in their definitions, these are the form/output, novelty and value creation. There also seems to be agreement about highlighting the need for implementation among the different definitions. Authors with management and social backgrounds both see innovation as a dynamic process as well as an output that has different forms. The most comprehensive definition is the ones proposed by Ramalingam et al. (2009) who come from the social services stream. This is because their definition properly reflects all the key concepts mentioned by the other experts.

Table I Summary of Reviewed Innovation Definitions by Experts' Background

Background	**Expert**	**Key Word**				
		Process	**Form/Output**	**Novelty**	**Implementation**	**Value Creation**
Business & Management	Drucker (1957)	✓		✓		
	Budden and Murray (2019)	✓	✓		✓	✓

Background	Expert	Key Word				
		Process	Form/Output	Novelty	Implementation	Value Creation
	ISO Standards 56000		✓		✓	✓
	Bolton (2019)		✓	✓		✓
Literature	Anthony (2011)		✓	✓		✓
Economics	Schumpeter cited in (Flichy, 2007; Gao et al, 2017)		✓	✓	✓	✓
	Frascati Manual (2002)		✓	✓	✓	✓
	OECD and Eurostat (2005)		✓	✓	✓	✓ e
	OECD and Eurostat (2018)		✓	✓	✓	✓
Social Services	Ramalingam et al. (2009)	✓	✓	✓	✓	✓

III. The complexity of innovation

According to Kuckertz and Berger (2016) there are four main challenges associated with complex concepts such as innovation. The first challenge is that they lack control due to the high level of uncertainty. Another challenge faced by researchers is that such concepts have non-linear dynamics. Moreover, complex phenomena are context dependent meaning that they greatlydepend on the context they occur in. Finally, it is hard to observe some of the outputsproduced by complex processes for certain inputs. Sections 3.1 and 3.2 below highlight those challenges through some studies on innovation.

3.1 Innovation Models

Throughout history, the perception of the innovation process has evolved depending on the needs and circumstances of the time and age. Rothwell's (1994) study is seen as a standard (Barbieri and Álvares, 2016), it captures the evolvement of innovation generations from the 1950s up to the 1990s.Rothwell's (1994) research traced back the chronological development

of the different innovation models which have transformed from simple linear models to increasingly complex interactive ones as discussed next.

According to God in (2006), the first and second generational approaches suggest that innovation is a linear, sequential process. The first generation (technology push) sees innovation as an internal process, beginning with scientific discovery and ending with marketing and sales. The second linear model of innovation (demand pull) on the other hand, believes that innovation is derived from market needs and demands (God in, 2006). The main shortfall with these models is that they neglect to demonstrate any interaction between the push and the pull, which is critical in innovation.

Therefore, according to Dodgson et al (2008) the third generation (the coupling model) has introduced and suggested implementation of interaction and feedback loops between different phases. The Fourth (the parallel lines model) showed innovation as a parallel process, with integration within the organization, upstream with key suppliers and downstream with the most important customers (Dodgson et al, 2008), thus factoring in customer value proposition (CVP).

Finally, the fifth generation defines innovation as a highly integrated complex process with extensive interaction, flexibility and feedback (Carayannis et al., 2017).This generation is supported by Russell and Smorodinskaya (2018), since 2000s, innovations arerarely singularly producer-led or user-driven; instead, they are co-created by actors of interactive networks. Individuals, institutes, regions and nations are more involved in the creation of network partnerships to create new values collectively.

Another distinguished study is the one conducted by Marinova and Phillimore (2003), which viewed the evolution of innovation models from the 1930s to the 2000s in six (6) sequential generations. Marinova and Phillimore's (2003) work greatly followed Rothwell's (1994), demonstrating the evolvement of innovation models from simple linear forms focusing mainly on input metrics to increasingly complex interactive ones with a more holistic view of innovation.

There were minor differences though, as the first generation of Marinova and Phillimore's (2003) work, "black box" referring to the invisibility associated with innovation activities, was not captured by Rothwell (1994).Neither was the sixth generation, known as the "innovation milieu" which started in the 2000s, this is probably because Marinova and Phillimore's (2003) work is more recent. The sixth generation is the one we currently live in and looks at theories of growth of regional clusters of innovation and high technology and the importance of geographical location for knowledge generation.

According to Rothwell (1994), these models merely act as a simplified representation of best practices in a complex process. The evolvement of generations does not imply substitution as models may exist side-by-side (Rothwell, 1994). Thru the development of these generations,

different resources and participants are required and hence, different practices (Hao et al., 2017).

3.2 Innovation Process

Numerous models describe the innovation process. Tidd and Bessant's (2009) linear model for instance consists of four core phases, these are: searching for opportunities and ideas, filtering and selecting the best ideas that were generated in the first phase, implementing the selected ideas into reality, and then finally capturing the benefits.

Another example of an innovation process is the one presented by (PDMA, 2015). It is a sequential process that consists of three phases. The first phase is discovering and scanning for opportunities, second phase is developing the offering, and the third phase is delivering the offering. PDMA (2015) concentrate that in the delivery phase, the offering should not only be presented but also be put to a purposeful usage.

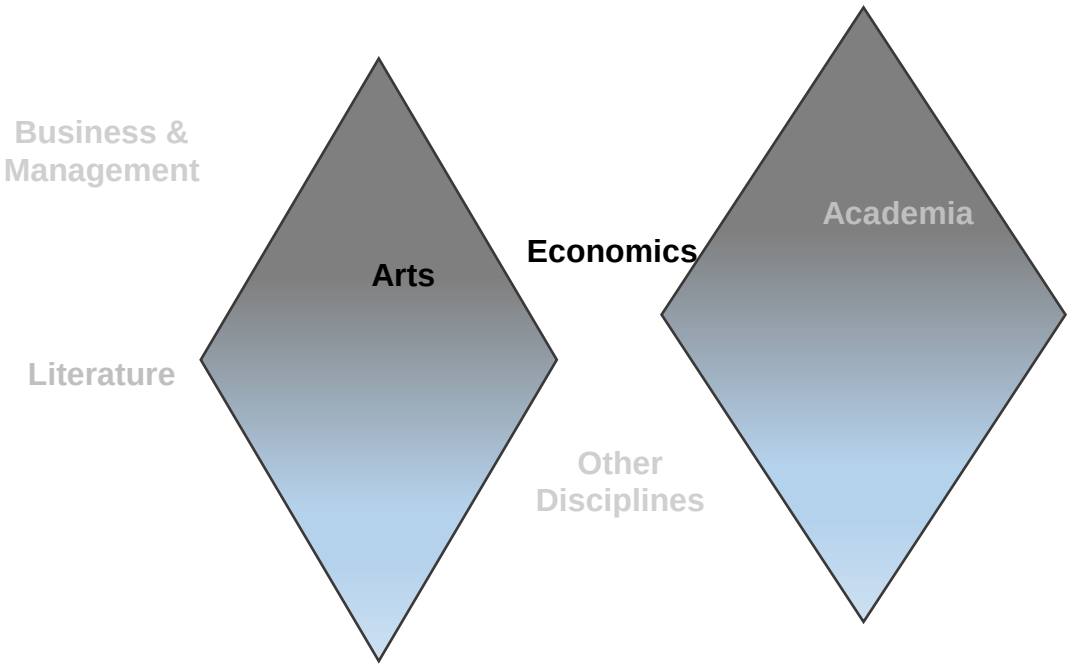
Mulgan and Albury's (2003) model is also sequential yet circular illustrating the complex and non-linear nature of the innovation process. Furthermore, suggesting that the innovation process has four phases starting with generating possibilities (how to encourage new ideas?), incubating and prototyping (how to develop ideas and manage risks?), replicating and scaling up (the promotion and marketing of a successful innovation?) and finally analyzing and learning (evaluating, learning and improving?).

The model suggested by Tidd and Bessant (2009) displays innovation as a linear sequential process, this is to simplify the complexity of the innovation process. The models presented by PDMA (2015) and Mulgan and Albury (2003), on the other hand, were circular reflecting the iterative nature of the innovation process supported by (Rothwell, 1986; Pérez-Bustamante, 1999 and McCulloch et al, 2009).Thomas Edison also supported the iterative fashion of the innovation process by stating "None of my inventions came by accident. I see a worthwhile need to be met and I make trial after trial until it comes. What it boils down to is one percent inspiration and ninety-nine percent perspiration."

IV. The multidimensional, multifaceted nature of innovation

Innovation, like a perfectly cut jewel, has many forms and facets (GDN, 2018). It is a multifaceted concept incorporating varied meanings from the standpoint across different disciplines, including economics, management, arts, literature, academia and social servicesas previously demonstrated in Table 1.

Figure 3 Facets of Innovation



Numerous authors have tried to establish contingent innovation classifications. Nevertheless, innovation represents a multidimensional concept (Caraballo and McLaughlin, 2012) that has numerous typeswhich are hard to distinguish in a meaningful way (Prange and Schlegelmilch, 2018). Table 2below shows that innovation is not only technological, it can also be non-technological, commercial, social, incremental and radical.

Table II Classifications of Innovation

Classification	Authors	Types	Meaning
Novelty	(Azar and Ciabuschi, 2017); (Dohse, and Niebuhr, 2018); (Kobarg et al., 2018; Tidd and Bessant, 2009)	Incremental	Includes significantly enhanced products and services. Less risky.
		Radical	Has a disruptive radical nature. Higher uncertainties.
Form	Tidd and Bessant (2009)	Product	Introducing a new or improved products and services.
		Process	Presenting a new or significantly improved part of process.
		Position	Repositions a product/service in the market.

Classification	Authors	Types	Meaning
		Paradigm	Where major shifts in thinking cause change.
	OECD and Eurostat (2005)	Technological	Which include product and process
		Non-technological	Which include organizational (new organizational method in the firm's business practices, organization or external relations) and marketing (implementing a new marketing method).
Value	Schramm (2018)	Commercial	Connected to commercialization and the marketplace.
		Non-Commercial	Have little or no connection to the marketplace (organizational, social).

V. The key elements of defining innovation

In light of the definitions reviewed above and according to the current literature, there are five (5) key elements associated with the term "innovation. Table 3below lists the studies supporting each key element.

Table III Summary of Studies Supporting the Elements of Innovation

Element	Expert
Novelty	Azar and Ciabuschi, 2017; Dohse and Niebuhr, 2018; Kobarg et al., 2018; Tidd and Bessant, 2009; Jorge Barba*
Process	Davila et al., 2013; Tidd and Bessant, 2009; Ramalingam, Scriven and Foley, 2009;PDMA, 2015; Mulgan and Albury, 2003.
Output	Prange and Schlegelmilch, 2018; Tidd and Bessant, 2009; OECD and Eurostat, 2005; Schramm, 2018; Gijs van Wulfen*; Kevin McFarthing*
Implementation	Sarooghi (2015); Anderson et al., 2014; OECD and Eurostat, 2005; Ramalingam et al., 2009; Paul Sloane*; David Burkus*; Pete Foley*
Value Creation	Osborne, 2010; Ramalingam et al., 2009; Nick Skillicorn*; Kevin McFarthing*; Paul Hobcraft*; Mike Shipulski*; Jeffrey Baumgartner*; Michael Graber*; Drew Boyd*; Jorge Barba*

** According to (Skillicorn, 2016)*

5.1 Innovation is Novel yet Varies in the Degree of Radicality

Innovation varies in the degree of "radicality" or in the extent to which innovations are ground breaking and disruptive (Azar and Ciabuschi, 2017). Although some individuals believe that innovation should have a disruptive radical nature, literature confirms that innovation also includes significantly enhanced products and services "incremental innovation" (Dohse, and Niebuhr, 2018) which is less risky, and contains lower levels of uncertainties compared with radical or disruptive innovation (Kobarg et al., 2018).

5.2 Innovation is a Process

Literature confirms that innovation is an iterative process (Rothwell, 1986; Pérez-Bustamante, 1999; Mulgan and Albury, 2003); McCulloch et al, 2009; PDMA, 2015), not a just a one-time event (Davila, Epstein, and Shelton, 2013; Tidd and Bessant, 2009; Ramalingam, Scriven and Foley, 2009). There are numerous models describing innovation as a process, similar to aforementioned models in Section 3.2.

5.3 Innovation is an Output

In addition to being a process, literature confirms that innovation is an output that can be classified into different types ranging from technological to social as shown in table 3.

5.4 Innovation must be Implemented

As elaborated in the definitional misunderstanding section, implementation is the main component that differentiates innovation from creativity. According to Sarooghi (2015), creativity involves the generation of novel and useful ideas, while innovation entails the implementation of these ideas into new products and processes.

5.5 Innovation Creates Value

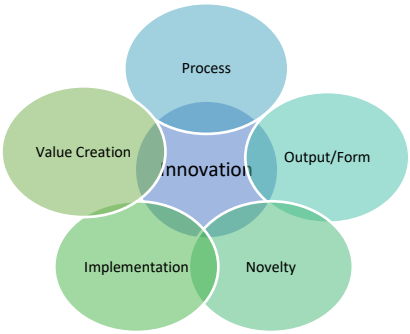
According to Van de Ven (1988) cited in Osborne (2010) "*new ideas that are not useful are not normally called innovations; they are usually called mistakes*". According to Schramm (2018), the value created by innovation can be either commercial or non-commercial.

VI. Harmonizing the concept of innovation

Having identified the five key elements associated with the term innovation, and recognizing specific gaps in the knowledge, this section aims at exploring and socializing a new consensual definition for the term "innovation" integrating thesekey elements,a new terminology for innovation is further demonstrated in figure 4 below. The proposed definition is as follows:

"*The complex, iterative and dynamic process that results in implementing and diffusing new or significantly improved offerings, in the form of products, processes, positions and paradigms, resulting in economic or non-economic value creation*".

Figure 4 Key Elements of the Term "Innovation"



Ix. Conclusion

Innovation is imperative for the survival and growth of organizations and nations. Nevertheless, the complex, multidimensional, uncertain nature of innovation led to poor understanding of its actual meaning. Moreover, lately, the term "innovation" has turned intoa universal buzz word resulting in overusing it. To harmonize the meaning of the term, it is important to understand that it is associated with five key elements these are: outcome, process, novelty degree, implementation and value creation.

This means that there should be an understanding that innovation is both a process and an outcome, where outcomes arise from the implementation of the continuous innovation process resulting in value creation. Furthermore, innovation is not limited to radical breakthrough offerings, but comes in varying degrees ranging from incremental to radical/disruptive.

Having identified the key elements associated with the term, we generated the following new consensual definition for the term "innovation" : "Innovation is *the complex, iterative and dynamic process that results in implementing and diffusing new or significantly improved offerings, in the form of products, processes, positions and paradigms, resulting in economic or non-economic value creation*". Such keen understanding of the term "innovation" outlines the necessary elements, and considerations associated with it. This helps making the proper meaning of the term harmonized; thus, minimizing the ambiguity surrounding it.

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