Cogito : Intelligo : Efficio : evolution of a method for valuable innovation through the study of the relationship between creativity and innovation

Sathikh Peer Mohideen

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**Evolution of a Method for Valuable Innovation
through the Study of the Relationship between
Creativity and Innovation**

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Cogito : Intelligo : Efficio
Evolution of a Method for Valuable Innovation
through the Study of the Relationship between
Creativity and Innovation

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Doctor of Philosophy

2020

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Abstract

‘Some men see things as they are and say why? I dream things that never were and say why not?’

Robert F. Kennedy

quoting

George Bernard Shaw

Source: forbes.com

Cōgitō, which means ‘I think’ in Latin, is the initial stage of the creative process and has to do with ideas evolving freely.

Intelligō, which means ‘I realise’, is the second stage, referring to the process of selecting and developing ideas which have potential.

Efficiō, which means ‘I accomplish’, is the final stage where the developed ideas are executed to achieve innovation of value.

These three individual states combine to form the relationship between creativity and innovation and lead to what I term ‘valuable innovation’.

This thesis seeks to identify a definable process from idea to innovation, via creativity. This has been approached by analysing the relationship between creativity and innovation in both the arts and sciences, and by investigating the interwoven complexities of difference and complementarity from the mid twentieth century to the present day. A partial autoethnographic approach has also been utilised to draw on the author’s long experience as an industrial designer to realise a synoptic map as a method for understanding valuable innovation and the myriad routes to it.

This research was driven, in particular, by the author’s key questions: “Why and how did I become an innovator from a creative person? What is the difference? What has led to this change? What then is creativity and innovation?” These personal questions were then contextualised within an academic analysis of the journey from ‘creative’ to ‘innovation’, and culminated in the creation of a synoptic map depicting the routes to meaningful innovation for individuals, businesses, communities and / or societies. This synoptic map is tested and validated through five distinct case studies in the area of applied art, in particular industrial design, and exemplified by a showcase from an established creative artist / designer / innovator from Singapore.

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And

Prof K. Chandrasekaran for his gentle pursuit in seeing me complete this journey

Declarations

a) Statement of originality

I certify that all work submitted for this thesis is my original work. I declare that no other person's work has been used without due acknowledgement. Except where it is clearly stated that I have used some of this material elsewhere, this work has not been presented by me for assessment in any other institution or University. I certify that the data collected for this project are authentic and the investigations were conducted in accordance with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice.

Sathikh Peer Mohideen

30 November 2020

Date

Declarations

b) Supervisor declaration statement

I have reviewed the content of this thesis and to the best of my knowledge, it does not contain plagiarised materials. The presentation style is also consistent with what is expected of the degree awarded. To the best of my knowledge, the research and writing are those of the candidate except as acknowledged in the Author Attribution Statement. I confirm that the investigations were conducted in accordance with the ethics policies and integrity standards of Nanyang Technological University and that the research data are presented honestly and without prejudice

Dr Andrea Nanetti

30 November 2020

Date

Declarations

c) Authorship attribution statement

This thesis contains material from six paper published in the following peer-reviewed papers accepted at conferences / book chapter in which I am listed as an author.

Sathikh, P.M. (2010). *Cultivating Innovation: by understanding creativity-innovation relationship*. Proceedings of the National Collegiate Inventors & Innovators Alliance 14th Annual Conference, San Francisco CA. 25-27 March 2010.

Sathikh, P.M. (2011). Transformal Role of Product Design in Singapore's Transition to a Service Economy. In Silva, A. & Simões, R. (Eds.), *Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives*. USA: Business Science Reference.

Sathikh, P.M. (2014). *What are you managing in design? Creativity or Innovation or Both?* Proceedings of the 19th DMI: Academic Design Management Conference, London, UK, 2-4 September 2014.

Sathikh, P.M. (2015). *Understanding Modes of Creativity for Effective Innovation at Grassroots*. Proceedings of the Third International Conference on Creativity and Innovations at Grassroots, Ahmedabad, India, 19 -22 January 2015.

Sathikh, P.M. (2017). *Creative Culture to Innovative Culture: Transformal Operation*. Proceedings of the 19th International Conference on Innovation and Creativity, Paris, France, 18 - 19 April 2017.

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30 November 2020

Date

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1. Introduction

*'Creativity and Innovation are
something you can't
flowchart out'*
Tim Cook
Apple Inc
Source: azquotes.com

Creativity and innovation have become popular words in the everyday vocabulary of people in all walks of life. Not a day goes by without hearing or seeing the words, 'creativity and innovation'. It is not uncommon to hear someone say, "this is creative; that is innovative", etc., or to read about them in the innumerable books, newspaper and magazine articles, blogs and websites, documentaries and shows on television and radio. Over the last three decades or so, several 'gurus' of management and leadership such as Tony Buzan, Edward deBono, Peter Drucker, C.K. Prahalad, Robin Sharma, Tom Kelley and others have been exalting the importance of creativity and innovation in their motivational articles, books, videos, television shows and talks around the world. Each of them has their unique take on the subject and seem to fit them to the end point of their approach to leadership and management. This leaves the audience wondering:

- What is Creativity? And what is innovation?
- Which is more important? Creativity or innovation?
- How can I harness these two to my/organisation's/society's benefit?

Answers to these questions, and more, have been withstanding in many instances in author's opinion, save for a few researchers and practitioners who seem to have grasped the difference between the two and understood ways to harness the strengths of creativity and innovation. With the effect, creativity and innovation are terms being used interchangeably in most instances, without understanding what each represent and is capable of, leading many a time to the notion that investing in creativity is good enough to bring about innovation and vice versa, which could be detrimental to extracting the full potentials of creativity and innovation. To many others, creativity seems to be a means to an end and innovation an end to a means, leaving the readers and the listeners to ponder how did the former end and how did the latter begin.

Theodore Levitt (Harvard Business Review, 2003, p.155), a management guru himself, does not mince his thought or words when he states, "Creativity is often touted as a miraculous road to organizational growth and affluence" and goes on to say further that, "Often the worst thing a company can do, is put innovation into the hands of 'creative

types' ". At this point it is easy for one to wonder, "isn't this supposed to be?" Levitt (Harvard Business Review, 2003, p.157) also urges us to, "... distinguish between the relatively easy process of creative in the abstract and the infinitely more difficult process of being innovationist in the concrete". While the author does not agree with Levitt on the 'creative being relatively easy' part, he does agree with Levitt's contention about creativity being in the abstract and innovation in the concrete. This simple concept will later be expanded as the this thesis draws towards a synoptic representation of the relationship between creativity and innovation.

As a professional industrial designer and a design academic, the author is asked about what he thinks of the relationship between creativity and innovation and how can this relationship be identified, distinguished and harnessed. He is also asked about the philosophy and approach to the design work that the author has done as a professional, and how they relate to his understanding of creativity and innovation as concepts in the abstract and results in the concrete.

These questions stem from the fact that there seems to be two camps to the 'creativity-innovation' relationship, with the creativity dominant camp on one side and the innovation dominant camp on the other. While the creativity dominant camp seems to believe with confidence that they can also lead the process to successful innovation, the innovation centred camp seem to think that creativity is only a minor (but significant) part of the innovation process and there needs to be many other factors for successful innovation. While one forgets to recognise the other factors required for innovation, the other camp assumes that creativity is relatively easy, without acknowledging that useful ideas do not occur at random.

All this brings to the conclusion that a clear understanding of the common elements as well as the critical differences between creativity and innovation is paramount for successful innovation. This leads one to ask further questions:

- Can these common elements and critical differences of creativity and innovation be visually represented?
- Can we derive a synoptic diagram as a visual representation of this relationship, as process flow for everyone to understand?

- How does one go about creating this visual synoptic diagram that represent this relationship and the journey from creativity and innovation?

Answers to these questions are beyond contemplation, and lie in the arena of research that requires a study of creativity and innovation at a much deeper level. In an effort to not get caught in any of the two camps that is described earlier, the author set about turning inwards to himself first, to seek what he may have been subconsciously doing, for the last forty-nine years or so, to realise creative ideas into innovations. For the readers to understand the author's thoughts on creativity and innovation and how a synoptic map of the relationship between creativity and innovation is derived, it is important to have a glimpse of this journey thus far and the personal make-up that has made the author into the creative designer and the innovative entrepreneur that he is today¹. This sets the scene for the motivation to do a doctoral study. With answers to a personal question still forthcoming, the author felt that the path to this study starts inside the person first.

Why look inwards. In order to expound on the author's beliefs and practices into research leading to a theoretical framework, it is important to be the investigator as well as the subject. In setting the scene for self-examination and reflection, it is important to quote George Bernard Shaw:

Things have not happened to me: on the contrary it is I who have happened to them; and all my happenings have taken the form of books and plays. Read them or spectate them; and you have my whole story.

(Wallace et al., 1989, p. 25)

In a chapter titled *Studying the Individual*, Wallace² (Wallace et al., 1989, pp. 25 – 41) says that, “His (Shaw's) life is his work. Through it he has shaped his story. His most valued and best known qualities are those that are unique to him. If therefore, we wish to understand that he did and how, we must study Shaw at work. And so, with every creative person”.

¹ This forms Appendix A of this thesis.

² Doris B. Wallace (Wallace et al., 1989) seems to be one of the key researchers in studying the individual through case study methods for creativity.

By looking inwards and to the life events that have occurred, the author wishes to identify several factors or influencers that have shaped and set him on to the path that he is on today. Through this, the author maps his progress in terms of the level of knowledge, experience and maturity to identify one or more of personal operators that are important in creativity moving forward to innovation. This approach to narrating about one's own self has been termed as 'autoethnography' within the fields of research in humanities³. From such an autoethnographic account, the author derives a narrative to extract key attributes of him as a scholar and practitioner that point to possible ingredients for a person to be creative and innovative. These attributes are then used to check against a framework for a synoptic map of the journey that leads from creativity to innovation. The author's autoethnographic account of Appendix A forms a small, but significant, part of the research to derive a synoptic map. It however is only the beginning of the research in this doctoral study.

Researchers do point out to shortfalls in such 'autobiographical' account⁴ since it could represent only aspects of his/her life that are relevant to the research or issue at hand, neglecting others that make up the whole personality. The author is cognizant of this as he set about writing an autoethnographic account of his journey as a first step in this thesis (Appendix A), and has followed the guidelines set forth by Chang (2007) as paraphrased below:

1. Avoid excessive focus on self without including others
2. Emphasise more on analysis and cultural interpretation rather than on narration
3. Check facts as data when relying on memory
4. Observe ethical standards when writing about others
5. Apply autoethnography appropriately

³ Heewon Chang (Chang, 2007) in an essay titled, "Autoethnography as a Method: Raising Cultural Consciousness of Self and Others", writes, "Autoethnography is an ethnographic inquiry that utilizes the autobiographic materials of the researcher as the primary data. Differing from other self-narrative writings such as autobiography and memoir, autoethnography emphasizes cultural analysis and interpretation of the researcher's behaviors, thoughts, and experiences in relation to others in society. Autoethnography should be ethnographical in its methodological orientation, cultural in its interpretive orientation, and autobiographical in its content orientation".

⁴ Wallace (Wallace et al., 1989) points to other researchers such as Erikson, Koestler, Olney and others. A reading of the chapter titled 'Studying the Individual' could lead one to the details of the researchers' work on this subject.

Further reading on the rigour in autoethnographic research (Le Roux, 2017) helped in keeping the author's account within the boundaries of good practice in autoethnography.

With this as basis, the author sets out **Chapter 2: Motivation** which derives six observations that has motivated the author to do this thesis as well as establishing the human centric nature of the subject of study. A description of the author's life journey through creativity and innovation from **Appendix A: Setting the Scene**, is then used to extract important attributes for **Chapter 3: Analysing the Journey**, to arrive at key elements that make up human engagements in the 'creative-to-innovation' path. Finding the unique attributes, key elements and personal make-ups do not give insights into how and when creative ideas flow into valuable innovation. This forms the impetus to for **Chapters 4 and 5, titled Creativity and Innovation** respectively, which give an overview of the survey of the literature as well as definitions of the subjects from different points of view before identifying the common traits of each. One of the main inference that is taken from the two distinct chapters on creativity and innovation is that creativity is a human quality, while innovation is a process which requires more than creativity. The discovery of, many a times, mixed reference to creativity in art as opposed to creativity in science leads to **Chapter 6: Case for creativity in the arts and sciences**, which describes the spectrum between pure art and pure science and the role of creativities in that spectrum during the journey towards valuable innovation. With the understanding of creativity and innovation, as well as the roots of creativity in the spectrum connecting the arts and sciences, together with the derivation of key elements of the progression of creative ideas to valuable innovation, the thesis moves to the next chapter, **Chapter 7: Making the Connection**, which proposes a synoptic map depicting the relationship between creativity and innovation, revealing three distinctive phases that are essential for the journey. The discovery of *cogito* and *intelligo* together with the naming of the last phase as *efficio* as well as the corresponding *epigenous*, *endogenous* and *exogeneous* occur during this chapter. The proposed synoptic map is then validated through five distinct case studies that reveal the presence of the flow depicted in the synoptic representation in **Chapter 8: Validating the Synoptic Representation**. Returning back to the human centred nature of creativity and innovation as described in Chapters 4 and 5, **Chapter 9:**

Dialogue with an Innovator is a showcase of an acknowledged innovator from Singapore, which reveals the biographical journey of the innovator and allows comparison between the innovator and the author. This thesis is then completed through **Chapter 10: Discussions** and **Chapter 11: Conclusions**.

This thesis is based on qualitative methods in research, since the subject of study is not easily quantifiable, though the result of the process could be measured as increased revenue, percentage increase in market, permeation and absorption of social changes, etc. Personal insight and experience in creativity and innovation revealed a germ of a visual representation that connects creativity and innovation which has been studied further to arrive at a comprehensive synoptic map that the author believes, will contribute to further research as well as application of the model/map. As the doctoral study progressed, an important concept called *Dancing over Ideas* on research in art and design initiated by Nanetti and supported by the author (Nanetti and Sathikh, 2018) culminated into a three-day event which discussed a total knowledge aggregation process termed D.A.N.C.I.N.G, which stands for⁵:

- Definition
- Assumption
- Notion
- Concept
- Interpretation

⁵ In an article titled *Heritage Science: Expanding the thinkable future beyond inherited pasts and the visible presents*, Nanetti (2018) quoting several sources has expanded on the D.A.N.C.I.N.G as follows:

Definition. A statement of the exact meaning of a word, especially in a dictionary, which aggregates the use of the term in a specific language (e.g., dictionary mashup).

Assumption. A statement accepted as true without proof in a disciplinary context seen as a prerequisite for interdisciplinary research. “Disciplinary researchers absorb a host of disciplinary assumptions in the course of their education: epistemological, ethical, ideological, theoretical, and methodological. They may often not be conscious of these assumptions. Yet they interpret what others say through the lens of these assumptions” (Szostak, Gnoli, & López-Huertas, 2016, p. 58).

Notion. A conception of or belief about something, especially in an encyclopaedia that aggregates the knowledge of a cultural group or a disciplinary field (Eco 2014, pp. 3 to 94).

Concept. An abstract belief justified as true; a certain understanding as opposed to opinion; an idea presented as a plan, especially conceived/born in a disciplinary silo (Koselleck & Presner, 2002).

Interpretation. The action of explaining the meaning of something (i.e., a translation of a sign into another system of signs according to the volume 4 of the collected papers by Charles S. Peirce (see Hartshorne & Weiss, 1933, p. 127), who apparently uses ‘translation’ as a synecdoche, i.e., pars pro toto, for ‘interpretation’.

Narrative. A spoken or written account of connected events; a story. Mid 17th century: from Latin narrat- ‘related, told’, from the verb narrare and from gnarus ‘knowing’ (Altman, 2008).

Gamut. The complete range or scope of something (scale of musical notes).

- Narrative
- Gamut

The concept of ‘Dancing over Ideas’ and the notion of a complete research though process where relevance and meanings can be derived in a way that suits the research⁶ helped the author set the directions of this doctoral thesis.

⁶ This idea has been also discussed by Bast (2019) in an article titled “DANCING over Ideas of Research”: Eine zukunftsorientierte Kooperation mit Singapur im Kunst- und Bildungsbereich”

2. Motivation

'You can't connect the dots looking forward; you can connect them looking backwards. So, you have to trust that the dots will somehow connect in your future'

Steve Jobs

Source: news.stanford.edu

The motivation to do this major study started with curiosity from a question that the author posed to himself in 2005, "How did I become an *innovator* from being a *creative designer*?"⁷ This curiosity opened the way for several questions that lead to key observations, which needed a first study into the relationship between creativity and innovation. This first study revealed system level complexities, paving the way to realise that creativity and innovation are human activities. With levels of discovery that needs to be understood, a full study on the topic of creativity and innovation seems to be required before establishing a viable relationship between the two.

The first questions to arise out of self-curiosity were:

What is creativity?

What is innovation?

Are they different? What is the difference?

Which comes first?

To move forward on this inquiry, it is best to establish the commonly accepted definitions for the words, creativity and innovation. The dictionary presents the first level of definition for these two words.

Creativity. Dictionaries⁸ seem to give different statements as to the meaning of creativity as seen in a sample from three of the top English language dictionaries in the world:

Merriam-Webster dictionary defines creativity as, "the ability to make new things or think of new ideas."

The Oxford Dictionaries define the same as, "the use of imagination or original ideas to create something."

Cambridge Dictionary defines creativity (noun) as, "(the ability of) producing or using original and unusual ideas"

Between the three dictionaries, the only common word in describing creativity seems to be 'ideas', which leads to

⁷ Amtek Engineering Ltd., (the company that bought over Inovasia Design, co-founded by the author) recognising that the author's capabilities go beyond industrial design, named him as 'Lead Innovator'. The journey of the author to this stage is depicted in Appendix A of this thesis and is analysed in Chapter 3.

⁸ <http://www.merriam-webster.com>
<http://www.oxforddictionaries.com>
<http://dictionary.cambridge.org>

several questions on the other key words used by the three dictionaries:

- How do you use imagination? What is imagination then?
- Create what thing?
- Is it the ability to make new things? or
- Is it the ability to think of new ideas?
- What are original and unusual ideas?
- How do you produce them?

Innovation. With creativity itself posing questions in its definition, it is the turn of 'innovation' to be defined through the same three dictionaries.

Merriam-Webster dictionary defines innovation as, “the act or process of introducing new ideas, devices, or methods.”

The Oxford Dictionaries defines innovation in two ways,
1 (uncountable) “the introduction of new things, ideas or ways of doing something.”

2 (countable) “a new idea, way of doing something, etc. that has been introduced or discovered.”

Cambridge Dictionary defines innovation as, “(the use of) a new idea or method.”

The immediate questions that these dictionary definitions of innovation pose are:

- Is innovation idea(s) or method/process of introducing ideas?
- How does one know when an innovation has occurred?
- What must be done to turn ideas into innovations?

The larger research question that emerges then, is:

If the introduction or the process of introducing a new idea, device or method is clearly acknowledged as innovation and if these ideas, original and/or unusual, had their starting point in creativity, through what relationship or path did creativity become innovation? Can this relationship be represented visually in some way?

Before proceeding to find answers to these question, it is of relevance to understand how authors, researchers and pundits have defined creativity and innovation in the work they have done (or are doing) that may help in the search to derive the relationship realm of the two.

Creativity definitions - a selection from authors.

Perhaps the most clear and simple definition of creativity was given by Lev Vygotsky as early as in 1925 (Vygotsky, 2004):

Any human act that gives rise to something new is referred to as a creative act, regardless of whether what is created is a physical object or some mental or emotional construct that lives within the person who created it and is known only to him. (Lev Vygotsky, 2004, p.7)

Vygotsky calls it a creative act rather than creativity, but the statement is clear; it gives rise to something new which could be physical or a mental or emotional construct. Other authors have contributed to the definition over the years as follows:

...to bring into existence something genuinely new that is valued to be added to the culture.

(Csikszentmihalyi, 1996, p. 25)

At the simplest level 'creative' means bringing into being something that was not there before... then we ascribe some value to the result, so that the "new" thing must have a value. (De Bono, 1996, p.3)

Creativity is the ability to think about something in a new way, from a different perspective, to come up with unique solutions and ideas. (Ratnakar, 2012, p.19)

Creativity is the production of novel and useful ideas by an individual or small group of individuals working together. (Amabile, 1988, p.126)

I suspect that creativity has to do with the employment of a playfully exploratory rather than a mechanical process of problem solving, by a person who is open and curious and imaginative rather than by a person who is inhibited and conventional, to find solutions or designs that are novel (and yet useful) rather than merely run-of-the-mill.

(Khandwalla, 1984, p.4)

Observation 1. At the outset, it is apparent that creativity at the level of the researchers and experts defies universal definition. The only common theme in these definitions is that at the end of a creative process there is something tangible, a quality which has some impact on the perception of others.

These authors tend to agree with the views of Puccio (2006) that creativity is a multifaceted concept and is the interaction of three facets, namely the **person, process** and the **environment**. This closely matches the definition given by Khandwalla (1984) above. Based on a personal creative path, the author has derived a definition of his own (Sathikh, 2010) which stems from Khandwalla's (1984) in consideration to the definitions of the others.

Innovation definitions – a selection from authors.

Innovation has been defined from different angles, depending on who is approaching innovation and for what purpose. The following are samples of such definitions:

The intersection of invention and insight, leading to the creation of social and economic value.

(Council on Competitiveness, 2004, p. 8)

Any thought, behavior, or a thing that is new because it is qualitatively different from existing forms.

(Barnett, 1953, p. 7)

Something new, which is presented in such a way that the value will be determined by the selectors.

(Jacobs, 2007, p. 30)

Very strictly, innovation occurs when someone uses inventions, ideas, existing tools or technology in a new way, to change the manner in which the world works.

(Ratnakar, 2012, p.86)

Innovation is the creation of a viable new offering.

(Keeley, 2013, p.5)

Through this definition, Keeley brings out four key points:

1. innovation is not an invention though they may involve invention
2. innovations need to return value, i.e., be viable, bringing in returns on the efforts and capital
3. innovations do not have to be new to the world – only to a market or industry
4. innovation should be about more than products and can even be new interactions and forms of engagements between organizations and customers

Observation 2. From the selection of definitions of innovation from the authors, as well from the dictionary, the main aspect of innovation is that it is a process that leads to change of some sorts and presents a value or a system whose success is, perhaps, only realised through implementation.

It emerges from the definitions that, while creativity leads to ideas that are new and novel, innovation takes this idea further and produces tangible value propositions that are measurable through its success (and profitability).

From the definition point of view, the author is more in agreement with Barnett's statement that innovation could be 'thought, behavior or a thing' at the first instance and it leads to 'qualitatively' different forms which leads one to the notion the value of innovation should not be based on quantitative measurement alone since innovation due to a thought or behavior could lead to changes in thinking and behavior at the societal level within communities of people, which may be measured in terms of quality rather than quantity. This also fits if one takes Vygotsky's (2004) definition of creativity as a starting point. The question that emerges from observation 2 is:

Which of the ideas could be taken further to produce tangible value propositions? And how?

To answer this, Keeley (2013, p.6), in supporting his definition of innovation, states, "Innovating requires identifying the problems that matter and moving through them systematically to deliver elegant solutions".

The message embedded in the above statement has five points:

1. know where to innovate (or what idea to innovate)
2. focus on the hardest part of concept (or idea) first
3. be patient and work to create comprehensive solutions
4. it is not innovation till it is delivered to the market and there is returns (value proposition)⁹
5. turn complexity into simplicity so that the solutions are elegant (and more attractive to users/customers)

These five points, derived from Keeley and the definitions of innovation, highlight clearly the level of concerted effort and

⁹ The author does not fully agree with this statement in full since in some forms of innovation such as social innovation, the market is not a measurable quantity with returns but change in society values, etc.

comprehensive process required for a creative idea to be implemented successfully.

Before proceeding further, this may be the right place to introduce the author's observation on how the public views innovation through a sample (personal) collection of images that are shown in Figures 2.1.

Figure 2.1: Every day innovation, a cross section

Source: Author's collection

Presented to the public around the world, innovation comes across as a jargon or a slogan, used for business advantage more than anything else. Where is the innovation in 'Innovation Seeds', 'Innovative Fish Tackle' and 'Innovative Air'? Changing innovation or innovative to 'regal', for example, in these examples, will result in 'Regal Seeds', 'Regal Fish Tackle' and 'Regal Air' respectively. Use of the word innovation, in many instances, seems to be a psychological ploy to convey to the general audience that something

sophisticated is involved in the product or service being offered without any substantiation for the use of the word innovation. Figure 2.2 seems to exhibit an extreme example of this practice, showing the INTERPOL Global Complex for Innovation in Singapore.

Figure 2.2: INTERPOL Global Complex for innovation
Source: Author

The relevant webpage of INTERPOL¹⁰ declares:

The INTERPOL Global Complex for Innovation (IGCI) is a cutting-edge research and development facility for the identification of crimes and criminals, innovative training, operational support and partnerships.

Drilling down to find out what could possibly be the role of innovation in what is principally a police organisation, the website further reveals:

Championing innovation: The Global Complex goes beyond the traditional reactive law enforcement model. This new centre provides proactive research into new areas and latest training techniques. The aim is to give police around the world both the tools and capabilities to confront the increasingly ingenious and sophisticated challenges posed by criminals.

While the author could appreciate that, *'It is crucial for police to stay one step ahead of criminals'*, the question here is, 'will the complex on the whole create new offerings of value to qualify as innovation'? The innovation, in this case, seems to be in their setting up a central complex for, "Digital Security,

¹⁰ <http://www.interpol.int/About-INTERPOL/The-INTERPOL-Global-Complex-for-Innovation>, retrieved on 10 December 2016

Capacity Building and Training and Operational and Investigative Support”, as their website states, and locating it in Singapore.

The example shown in Figure 2.3 is even more interesting in the way the word innovation has been used. Not an expert on medicine, surgery or therapy, the author is left wondering where is the innovation in a subject such as ‘psychopharmacotherapy’. Is the procedure of psychopharmacotherapy innovative by itself?

Figure 2.3: Innovative Psychopharmacotherapy
Source: Amazon.com

The meaning of psychopharmacotherapy according to dictionary.com is:

The use of psychoactive drugs in the symptomatic treatment or control of mental disorders or psychiatric disease.

Again, is the use of these drugs an act of innovation by itself? Or, is there innovation in the way different ways the therapy is administered? Will the person who reads this book become innovative? These two extreme examples, and the earlier

ones, point me to another observation with respect to how innovation could be perceived by the public.

Observation 3. While the specialists and the experts may define creativity and innovation in many complex ways, the public see both in many other different ways.

If the public is confused, what about the key elements of the society such as the governments, international bodies, institutions and companies, who stand to gain by adapting innovation? Even here, creativity and innovation tend to be used interchangeably leading to confusing one for the other. deBes and Kotler (2012) identify this as one of the problems hindering the development of business innovation. They also point out that, "... companies invest heavily in creativity at the expense of innovation", and state that, "... an organisation filled with creative people is not necessarily an innovative organisation". Another case in this point is a definition of creativity by the United Nations as:

‘Creativity’ in this context refers to the formulation of new ideas and to the application of these ideas to produce original works of art and cultural products, functional creations, scientific inventions and technological innovations. (United Nations, 2008, p. 3)

Embedding ‘technological innovations’ into a definition of creativity is a contradiction in itself, and in the author’s opinion, can mislead in the way innovation is managed. If this is an anomaly, researchers studying creativity and innovation many times ignore one or the other. For example, a commissioned paper written by Adams (2005) titled, “The Source of Innovation and Creativity”, discusses elaborately on creativity for almost the entire paper, giving scant mention about innovation. For anyone who is interested in seeking to know the difference, the paper tends to be a disappointment, although discussions on creativity and education are quite apt.

Observation 4. There is a general level of contradiction caused by the way the terms creativity and innovation are used interchangeably by many, including researchers and authors, causing confusion as to what is the difference and between the both.

Star Wars the epic 'space opera' conceived by George Lucas, I think, is a perfect example of innovation in the creative arts. The flow of creativity in all aspects of filmmaking right from story, screen play, character design, costume and set design, special effects, music and overall imagineering brought about a change in the thoughts of the industry as well as the consumers. The commercial success did not follow any preconceived innovation methods and strategies that are so much celebrated by management education and the industry.

Logo image: ncdcr.gov

How do these contradictions and confusions arise? In an article titled, "What are you managing in design? Creativity or innovation or both?", Sathikh (2014) seem to point to the source where, "creativity and innovation was studied and researched upon by academicians and practitioners from wide variety of areas other than design". A look at the cross section of prominent researchers and authors on design reveals that:

Creativity was studied predominantly by psychologists such as Robert J Sternberg (1989), Teresa Amabile (1988, 1996, 1998), Mihaly Csikszentmihalyi (1996) and Marc Runco (2007) amongst others and also by medical doctors such Edward deBono (1970) and journalists such as Arthur Koestler (1989). (Sathikh, 2014).

Adding to this list are archaeologists such as Steven Mithen (1996, 1998) and psychologist/philosopher/computer scientist Margaret Boden (1990). According to Sathikh (2014), innovation, which seems to be at the forefront of economics, has become:

The domain of business management with eminent personalities such as Larry Keeley (2013), C.K.Prahalad (Prahalad and Krishnan, 2008) and major management schools such as Harvard Business School, Wharton School, Stephen M Ross School of Business, Stanford Graduate School of Business and Cambridge Judge Business School and many innumerable academicians, professionals and personalities contributing to the vast source of knowledge available on innovation. (Sathikh, 2014)

Other well-known authors on innovation include Tom Kelley (2001, 2005) who is a business executive at the famous design and innovation consultancy, IDEO and Vijay Kumar (2013), who is a professor at the Institute of Design, IIT Chicago.

While the commentators of creativity and innovation come from different fields, practitioners of creativity, on the other hand, tend to come from 'creative arts', which encompass art, design, literature, music, filmmaking, animation and drama, amongst others. Creative arts' role in innovating or innovation tends to be lot subtler and nuanced and not all the time in line with the business' view of innovation in terms of the value proposition. Innovation in creative arts is realised in many forms and value propositions, and not predicated on

commercial success and monetary value that is often cited in the industry.

Observation 5. Many a times, articles, publications and books on creativity and innovation are written from an observer point of view by authors, who by themselves are not directly involved in creativity and/or innovation. In general, commentators on creativity tend to be academics and researchers, while experts of innovation tend to be from management or business and are either academics or consultants.

Business and arts are not the only domains in which creativity and innovation are important. Another area in which creativity and innovation play important roles is in science and technology. Koestler (1985) in an article titled, “The Three Domains of Creativity”, introduces “artistic originality, scientific discovery and comic inspiration”, and states that, “I believe that all creative activity falls into one or another of these three categories, or more frequently, into some combination of them”. While the author also believes that successful creativity¹¹ tend to be combination of the three, most successful innovations seem to have their roots in artistic originality or scientific discovery.

Rowan Atkinson as Mr. Bean
Example of innovation
originating from ‘comic
Inspiration’ domain of
creativity.
Image: thesun.co.uk

Comic inspiration, which may be considered to be the highest form of creativity, has a lot to do with creativity and innovation that evoke emotional response from the consumer. The British television comedy series, ‘Mr. Bean’ is an example of innovation in entertainment that stems from the comic inspiration domain of creativity. While the viewers of Mr. Bean are drawn to laughter, the humour behind this response is much more emotional, allowing the viewers to empathise with Mr. Bean’s social awkwardness and his knee-jerk reactions to situations in life. The commercial success of Mr. Bean also makes it a business innovation.

With reference to artistic originality and scientific discovery, how can we evaluate the creativity of great artists such as Leonardo da Vinci or Pablo Picasso with the creativity of great scientist such as Sir Isaac Newton or Albert Einstein? According to Briskman (1980), “creativity is something we value, and that the notion of creativity is an evaluative one”.

¹¹ This will be picked up as a topic in Chapter 6, where the author discusses on creativity in art and science and fields in between.

This leads to the question:

*Are artistic creativity and scientific creativity the same?
What is the common denominator and what are the
differences?*

In an earlier paper, Sathikh (2014), has quoted Bruton (2011) who states that, “As usual one of the big problems facing creativity is the inability of language to distinguish between artistic creativity and idea creativity”. According to Sathikh (2014), “the value in artistic creativity can be said to be the creation itself, while the value in idea creativity will be its usefulness as a starting point of innovation”. While Bruton and Sathikh have used idea creativity, it is much likely that idea creativity has more in common with scientific creativity through the writings of researchers such as Dutton and Krauz (1981). This view is also reflected in the article titled *Creativity in Art and Science* by Tang and Leonard (1985). It is becoming more and more apparent that, while innovation seems to get boxed into one category, there is a strong case for the recognition of innovation growing from two important modes of creativity that bring potentiality for value propositions in equal measures, if not in the same metrics, setting the necessary conditions for innovations that are unique. This resonates with the definition of innovation by Barnett (1953) in which he laid out the avenue for innovation to be, “any thought, behavior, or a thing whose value proposition is to be qualitatively different from existing forms”.

Observation 6. There is a need to study the unique characteristics of art creativity and science creativity to determine if and how, each of them influence the direction and the outcome of innovation, which may show a significant difference from where creativity originates.

With these six observations, as summarized in Table 2.1, it is important to turn the attention to the relationship between creativity and innovation and establish how each of the observations could help in the quest to establish a structural relationship between creativity and innovation.

Table 2.1: Summary of Observation

No	Observation	Effect
1	It is apparent that creativity at the level of the researchers and pundits defies a universal definition.	Need to define creativity and its position within innovation visually
2	The main aspect of innovation is that it leads to change of some sorts and presents a value or a system whose success is, perhaps only, realized through implementation.	Value propositions of innovation need to be clearly defined.
3	Specialists and pundits may define creativity and innovation in many complex ways, the public see both in many other different ways (and get confused).	A visual map that explains the relationship between creativity and innovation derived needs to consider understanding by all.
4	There is a general level of contradiction caused by the way creativity and innovation are used interchangeably by many, including researchers and authors, causing confusion as to what is the difference and between the both	Definitions of creativity and Innovation must be made clear in the map of the realm of both
5	Many a times, articles, publications and books on creativity and innovation are written from an observer point of view by authors, who by themselves are not directly involved in creativity and/or innovation by themselves	In establishing the relationship between creativity and innovation, I feel that I will be contributing as a practitioner.
6	There is a need to study the unique characteristics of art creativity and science creativity to determine if and how, each of them influence the outcome.	Opportunity for establishing a more comprehensive and inclusive realm for each of them.

First studies of the relationship. In discussing about creativity and innovation, Barbara Stavich (2010, p. 9) in her doctoral thesis titled ‘Disciplining Creativity: Social Mechanisms and Human Resource Management Practices in Creativity-driven Organizations’ quotes Amabile et al. (1996) as follows:

All innovation begins with creative ideas. We define innovation as the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation; the first is a necessary but not sufficient condition for the second. (Amabile et al., 1996)

This statement by Amabile et al., helps establish a few important concepts.

- Firstly, creativity and innovation are unique by themselves, each distinguishable by their own set of characteristics.
- Secondly, creativity is a necessary starting point for innovation.
- Thirdly it is not sufficient to come up with ideas alone, but it is very important to successfully implement these ideas.

In order to do that, the ideas themselves must be successful and also need to show the potential to become innovations.

West (2002) who proposes that, “creativity and innovation represent two stages in the innovation process and that external demands have quite opposite effects on each of these stages”. Innovation, according to West is, “two components, but essentially a non-linear process, encompassing both creativity and innovation implementation, with creativity dominating at the outset of the process to be superseded later by innovation implementation process”. Interestingly, West’s statement seems contradictory in the sense that while innovation is a non-linear process, it does, however, follow creativity, as a sequence, which is the starting point according to Amabile (1996). However, this does bring forth the idea for any relationship between the two to have a strong starting point in creativity which then becomes valuable as innovation, setting the scene for a ‘concept or idea to realisation’ path. This highlights clearly that creativity, beyond ideas alone, brings quality that enable the process of innovation to derive valuable outcome(s).

Before setting out further on studying the relationship between creativity and innovation at a structural level, perhaps it is important to briefly introduce, at the first instance, some examples of relationship models that have been proposed¹². It is the author's observation that most of the relationship diagrams or models presented in the various literature pertains to business, industry or organisations with an express purpose to be a leader or, at least, profitable. A book with the title, "Unrelenting Innovation: How to build a culture for Market Dominance", by Tellis (2013) affirms to this. The first example is from Amabile (1988), who has derived a model for organisational innovation as shown in Figure 2.4.

Figure 2.4: Amabile's Model of Organisational Innovation

Source: Amabile (1988, p. 152)

(Quality of image as from source)

¹² A more detailed study of other models of the relationship will be presented in Chapter 7.

The backbone of Amabile (1988) model comprises of:

- 1) Motivation to Innovate
- 2) Skills in the Task Domain
- 3) Skills in Creative Thinking

Creativity acquired through 'Individual or small-group creativity' is channelled through this backbone to a five-step innovation process. Lots of iterative possibilities are suggested. As a person who has been pursuing creativity as a profession, and having seen fruits of creativity turn to innovation, the author sees Amabile's (1988) model as complicated with many sub activities and too many dependents which tend to hinder the understanding of innovation.

deBes and Kotler (2012) in their book, "Winning at Innovation", present a "Total Innovation System and A-to-F Model", as shown in Figure 2.5. de Bes and Kotler believe that, "Creativity requires analogical, not sequential thinking, and so does innovation, which is nothing but creativity applied to particular discipline' which, '...is a process that advances, but with much backtracking and detouring".

Figure 2.5: Total Innovation System and A-to-F Model

Source: de Bes and Kotler (2012, p. 19)

The innovation process deBes and Kotler's model is actually, the A-to-F roles of:

- (A)ctivators ; (B)rowsers; (C)reators; (D)evelopers
(E)xecutors and (F)acilitators

going through a process 'soup' called 'creative culture' after 'strategic planning for innovation' to achieve 'results' and reap 'rewards' if they are to able show their innovation capacity at 'innovation metrics'. What the author finds

interesting is the definition for ‘Creators’ by deBes and Kotler (2012), who are said to be, “The people who produce ideas for the rest of the group”. Their function is to ideate for new solutions at any point in the process according to this definition. Creativity here moves from a central position in the initiation of innovation to a utility player in the innovation process in this model.

If Figure 2.5 seemed complex enough, further complications are revealed when the details of the same innovation process is expanded as seen in Figure 2.6

Figure 2.6: Total Innovation System and A-to-F Model: Summary
Source: de Bes and Kotler (2012, p. 212)

The author, looking back at his own experience of having interned at one of the most innovative companies of that time (1990s), Sony Corporation in Tokyo, and subsequently working as a consultant for global corporations such as Black and Decker and HP, thinks that, while a post-mortem of successful innovation may reveal a total innovation system existing within these organisations, he does not believe that a system like this is planned and executed to near perfection as shown in Figure 2.6. In fact, many of the ‘techniques’ employed by each role as depicted in the model are actually routine tasks employed in new product development worldwide as per the author’s extensive experience working as an industrial designer.

Heuristics
involving or serving as an aid
to learning, discovery, or
problem solving by
experimental and especially
trial-and-error methods.
merriam-webster.com

The point emphasised, in the two examples shown in Figures 2.4 to 2.6 is that, most of the models of creativity to innovation process tend to be **heuristic** in nature and seem to feed on our insatiable appetite for recipes for success. While the credentials of the commentators or their sincerity in presenting what they have found through their observations, research or consultancy is not doubted, the author places the commentary on their emphasis on delivering value in terms of profits, business advantage, market dominance, etc.

Poetic
expressing ideas in a very
sensitive way with great
beauty and imagination
macmillandictionary.com

In the attempt to visually represent the relationship between creativity and innovation, it is the wish of the author to present a more **poetic** view of the transformation of ideas that are harvested through creativity into innovation that in turn brings value to a system, be it business, organization, society or nation. A poetic representation, will bring forth a simple, yet elegant depiction of the creativity-to-innovation process that could fit the different manifestations of innovation in various fields.

Motivation. The motivation for this doctoral study stems from the six observations described in this chapter and summarised in Table 1. This clearly shows a gap in the understanding of the true nature of creativity and innovation and the confusion amongst the wider audience as to what is creativity and innovation. This is compounded further by complicated depiction of the creativity-to-innovation process by many of the researchers and authors.

In taking up this study on the relationship between creativity and innovation, the author wishes to:

- a) study creativity and innovation in detail
- b) understand art and science creativities better
- c) look at the various models of creativity-to-innovation proposed/derived by researchers and authors
- d) explore the possibility of depicting the structural relation between creativity and innovation by means of a synoptic diagram
- e) verify this structural synoptic map/diagram through case studies
- f) derive a comprehensive synoptic map which looks at the process and human relationship and management

The aim is to depict the relationship between the two in a poetic manner that is simple, elegant and easy to understand that fits the innovation process in different fields and specialisations.

Creativity and innovation from other angles. Before setting out to explore further on creativity and innovation in order to establish a framework that connects both, it is important to briefly introduce two researchers in creativity and one author on innovation¹³ who have helped the author in looking at creativity and innovation from two different yet related angles, steering the initial thought process which was lateral yet in a linear direction to a more multidimensional mode of thinking. The first researcher that has helped in altering the line of thinking is Margaret Boden, a cognitive scientist and the other is an archaeologist named Steven Mithen. The third, H.G. Barnett, got the author to think about innovation beyond the smaller circle of products and services to a wider society where innovation represents the vehicle for changes of societal value.

Margaret Boden. Margaret Boden (Boden, 1996), in her book, “The Creative Mind: ‘Enormously Enjoyable’ ” and in a chapter titled ‘What is Creativity’ in the book titled, “Creativity in Human Evolution and Prehistory” (Mithen, 1998) introduces several concepts that have set the author thinking about creativity in reference to art as well as science. Boden outlines, “two senses of creativity; **P-creativity** and **H-creativity**”, the former is psychological and the latter is historical. According to Boden:

A valuable idea is P-creative of the person whose mind it arises could not have had it before; it does not matter how many times other people have already had the same idea. By contrast, a valuable idea is H-creative if it is P-creative and no one else, in all human history, had it before. (Boden, 1998, p. 23)

Through this Boden is able to accommodate, what can be termed as, ideas of incremental value that are novel, as well as ideas that are very high in value due to its novelty and originality. Boden also introduces a higher order of thinking on creativity through her, ‘maps of the mind’ and ‘conceptual spaces’, both of which change the way in which creativity and the creative process has been conceived and presented by other researchers.

¹³ This is only an introduction to the authors/researchers with reference to the motivation behind the doctoral study. A more comprehensive literature study/review is presented in Chapters 4 and 5.

Steven Mithen; Mithen's approach to creativity is through, "the archaeological study of human creativity", as he puts it in the book "Creativity in Human Evolution and Prehistory" (Mithen, 1998), where he brings a historical sense to creativity on how human beings had evolved to be creative. Mithen's book titled, "The Prehistory of the Mind: A search for the origins of art, religion and science" (Mithen, 1996), further evoked the author's interest in creativity in art and science. Mithen, through his writings, paints a clear picture of how creativity evolved from the time of the first homids, through to the Neanderthals, till the present human beings. Mithen's historical account of the evolution of creativity through both chance and necessity sets a clear direction on how art creativity and science creativity lead to different value propositions in successful innovation.

H.G. Barnett; Professor Barnett (1953), a civil engineer, philosopher and an anthropologist has written a book titled, "Innovation: The Basis of Cultural Change" which is very relevant to this day. At a time when innovation is skewed towards entrepreneurship, competitive advantage and business profits, Barnett proposes that cultural changes that occur at a societal level happen by innovation¹⁴. He pre-empted the business innovation centric, post-Drucker world, by stating that, "Because man-made objects have an extramental existence, it is deceptively easy to formulate a theory of innovation that will purport to describe this conception". This set the author to realise that innovation is far beyond the man-made, material, business and profit centred panacea for societal growth and the thought that the real challenge lies in "the realm of behaviour, belief and concept" which brought the author to understand what Barnett (1953) meant in his definition of innovation when he states, "any thought, behaviour or a thing that is new because it is *qualitatively* different from existing forms".

Human Activities; The discussions in this chapter point to the notion that creativity and innovation are not just standalone processes to be harnessed to benefit human beings, but they are themselves human activities that have evolved over the hundreds of thousands of years. Edward Wilson, an eminent biologist and naturalist in his book titled, "The Origins of

¹⁴ Panning books and publication on innovation, it comes as a surprise that not many works have been published on innovation and its influence at society level. Lane et al. (2009) have edited a book titled *Complexity Perspectives in Innovation and Social Change* which seems to address this, albeit at a complex level at best.

Creativity” (Wilson, 2017), sets the tone clearly when he states, “It might seem – *feel* is perhaps the better word – that the human suite of intellect and emotions is the only one that could have attained creativity”, and further states, “This diagnostic trait of our species, almost four billion years in the making, might seem to require some unique feature of evolution...”. Wilson states earlier that creativity, “...is the innate quest for originality. The driving force is humanity’s intrinsic love of novelty – the discovery of new entities and processes”. Wilson also says that, “We judge creativity by the magnitude of the emotional response it evokes”. Emotion is a very human trait studied as a part of humanities. How does this relate to introduction of art creativity and science creativity that Mithen (1998) and Boden (1996) mention? Wilson puts forth an argument for this, by stating, “The two great branches of learning, science and the humanities, are complimentary in our pursuit of creativity. They share the same roots of innovative endeavor. The realm of science is everything possible in the universe; the realm of the humanities is everything conceivable to the human mind”. Humans or *Homo sapiens*, by the theory of evolution, have evolved from the earliest line of *Homo* species and have several special features that points to the fact that creativity is a human activity. According to Wilson (2017), the nearest genetic relations to humans, chimpanzees and bonobos, “...although highly intelligent in at least one aspect... score far below humans in others. They live in the here and now. They cannot plan their action even for the next day, whereas humans can construct scenarios thousands of years into the future and millions of miles into the space”. According to Wilson, chimpanzees also, “... fall short in the ability to cooperate or act altruistically”. Wilson puts creativity in the hands of humans in stating, “... the ancestors of our species developed the brain power to connect with other minds and to conceive unlimited time, distance and potential outcomes. This infinite reach of imagination, put quite simply, is what made us great”. This ability to imagine, unique to human beings is a result of millions of years of evolution and has been researched and documented by archaeologist, social scientists. Wilson (2017), as well as others such Mithen (1998)¹⁵ and Boden (1996) point to the fact that humans

¹⁵ Steven Mithen (1998) in his book, “The Prehistory of the Mind”, attributes the development of social intelligence alongside general intelligence, natural history intelligence and technical intelligence that started off with *Homo habilis* as the important milestone in humans evolving as toolmaker and eventually evolving a flexible mind that allowed for cognitive fluidity leading to language, creative ability, etc.

developed their enormous insights and ability to imagine through the development of the mind and ultimately, language in humans. Boden (1996) clearly sets the tone by her statement, "...creativity can sensibly regarded as a mental capacity to be understood in psychological terms, as other mental capacities are"¹⁶.

What about innovation as a human activity? Wilson (2017) puts it as, "The drive for innovation can be viewed as an analogue of genetic evolution". How so? Wilson's answer to this is, "Cultural evolution adapts our species to the inevitable and constantly changing conditions of the environment. Its innovation are the equivalent of mutations in the genome". Mithen (1996) has clearly traced the evolution of social intelligence and flexible mind of human resulting in unique social interactions pointing to the ability to innovate. An example of this is Mithen's description of art as stored information where he describes the findings from Upper Palaeolithic period:

... it is difficult to draw any division between what is a piece of 'art' and what is a 'tool', and such artifacts epitomize the absence of any boundaries between domains of activity. Many of the art objects can indeed be thought of as a brand new type of tool; a tool for storing information and for helping to retrieve information stored in the mind'. (Mithen, 1996, p. 195)

This is a clear sign of innovation as deliberate activity or process that is innate in humans. Jacobs and Roberts (2009) have described in detail about the, "two bursts of human innovation in southern Africa during the Middle Stone Age (that) may be linked to population growth and early migration off the continent", pointing to the ability of human kind to innovate as they evolved to the modern humans of today.

The next stage. The six observations together with the understanding that creativity and innovation are human centred activities brings back the author's question, "How did I become an *innovator* from being a *creative designer*?" Are there qualities in an individual that can be identified and categorised as those which could lead to creative attributes and propel creative ideas into innovation?

¹⁶ While the author agrees that creativity is a mental capacity, he does not fully agree that creativity can be completely understood through psychology alone.

Having been a practicing designer since 1986, there could be a possibility that a personal inquiry into the life of the author will help in identifying traits required to be creative and how such traits turn oneself into an innovator. Once reasonably identified, it may be possible to analyse these traits and attributes to formulate a framework that could be validated at a later stage. What follows in Chapter 3 is the analysis of the traits of a person as he/she transform from the quality of being a creative person to a process oriented innovator.

3. Analysing the journey of the creative

Several researchers and experts on creativity point out to the importance of the socio-historical narrations of individuals that have contributed to an individual's ability to be *nominally*¹⁷ creative. These socio-historical narrations of individual form an important aspect of ethnographic studies and is termed autoethnography. Narration by itself is only a story, unless it can be analysed to extract the essence of the individual and his/her mental make-up that makes in him/her successful. Carolyn Ellis in her contribution as one of the editors of the book titled, "Handbook of Autoethnography" describes autoethnography as:

... autoethnography is not simply a way of knowing about the world; it has become a way of being in the world, one that requires living consciously, emotionally, reflexively. It asks that we not only examine our lives but also consider how and why we think, act, and feel as we do.

Autoethnography requires that we observe ourselves observing, that we interrogate what we think and believe, and that we challenge our own assumptions, asking over and over if we have penetrated as many layers of our own defenses, fears, and insecurities as our project requires. It asks that we rethink and revise our lives, making conscious decisions about who and how we want to be. And in the process, it seeks a story that is hopeful, where authors ultimately write themselves as survivors of the story they are living. (Jones et al., 2015, p. 14)

Dwayne Custer (Custer, 2014) in an article titled, "Autoethnography as a Transformative Research Method", states that:

Autoethnography is a creative process. It is an artistic tool of deep inquiry. It cuts and chisels at the stone of our being in order to reveal a marble statue inside our many layers of coal. It is also an innovative tool because it promotes reevaluation, reinterpretation, and reinvention from the inside out. (Custer, 2014)

¹⁷ Nominally creative, is of higher order to the 'everyday' creativity that some of the researchers and authors use while discussing creativity, which I prefer to use in my discussions.

Custer's (2014) point of view is that, "Autoethnography is a transformative research method because it changes time, requires vulnerability, fosters empathy, embodies creativity and innovation, eliminates boundaries, honors subjectivity, and provides therapeutic benefits". It is within this context that the author has proceeded to narrate his life story from the age of 5 to the present age of 59 which is presented as Appendix A of this thesis. Important traits and attributes from the author's autoethnographic narration is then harvested for analysis. Through this, the author is seeking a transformative research that could lead to forming a structural relationship between creative and innovation.

'There is a deep art that comes with age. I want to attain that.'

Mansai Namura
Kyogen Artist/Performer
in NHK World TV
Programme heard
by the author

Autoethnographic approach to research. Is this self-study a valid proposition in research? An autoethnographic study¹⁸ is not complete unless inferences could be derived from the narration. In studying individuals for their creativity, Wallace (Wallace et al., 1989, pp. 36 – 37) proposes a series of five contextual systems. They are:

- a) Relevant work enterprise (s)
- b) Work as a whole (oeuvre)
- c) Professional milieu
- d) Family and personal life
- e) Sociohistorical period

Relevant work enterprise concerns, "the set of area/field directly relevant to the person"; *work as a whole* represents, "the oeuvre and overall purpose revealed in the network of enterprise pursued by the individual"; *professional milieu* are, "teachers, colleagues, collaborators, critics, etc."; *family and personal life*, "is about the understanding, support, encouragement, praise, etc.", and their support in the individual's creative life and *sociohistorical period* represents the influences from external factors in the life of the individual. It is important to note that Wallace explains:

Enterprise stands for a group of related projects and activities broadly defined so that:

- (1) the enterprise may continue when the creative person finds one path blocked but another open toward the same goal, and

¹⁸ There are several books and many references in autoethnography that provide elaborate description of this method of research. *Handbook of Autoethnography*, written by Jones et al. (2015) and *Autoethnography as Method* written by Heewon Chang (2008) have provided the direction for this study.

(2) when success is achieved, the enterprise does not come to an end but generates new tasks and projects that continue it'. (Wallace et al., 1989, p. 11)

In the author's journey, as outlined in appendix A, the five contextual systems put forth by Wallace have occurred, some concurrently, some overlapping with the others and some in a linear manner, each reinforcing one another. In the author's case, work (b) has allowed him to establish methods and means to pursue projects and goals irrespective of the obstacles, allowing him to produce new opportunities to pursue his goals and family and personal life (d) has played, and continues to play an important role and accounts for a childhood experience that had been unique and which continues to inspire him to be curious and inquisitive. Wallace also places emphasis on the importance of 'psychobiography' to, 'analyse, explain, and interpret the adult's personality as caused by childhood and infantile experiences'. Many researchers also support this notion, with Sandra Ross (2014) being one of the leading exponents of the importance of play; especially pretend play in childhood as a foundation for adult creativity. Real life experience of the author from his education period, through professional to the academic work of today, represents a sociohistorical period (e) that has been influencing him through external factors.

Approach and research. A look at the cross section of acclaimed artists such as Picasso and Andy Warhol or innovators such as James Dyson or Steve Jobs reveal that not all creative people, nor innovators, are alike. Each one of them has their own life experiences, changing environments, interaction with the people around them, education, domain knowledge, etc. Everyone is a complex individual with different traits that combine to form a personality. The only differentiating trait of a creative personality seems to be the ability to be unique, in the way of producing works that are new and novel. Runco (2007, p. 280) corroborates this thinking, quoting a study done in 1998 where it was found that, "Empirical research over the past 45 years makes a rather convincing case that creative people behave consistently over time and situation and in ways that distinguish them from others". What then is the makeup of someone who is unique?

In a chapter titled, “Studying the Individual”, Wallace (Wallace et al., 1989, pp. 25 – 41) introduces three aspects of an individual, namely, **Alpha, Beta and Gamma**. He says that, “any individual is like all in some aspects (Alpha), like some others in some aspects (Beta), and like no others in some respects (Gamma)”. It is easy to ascertain that these three aspects are not mutually exclusive and that one becomes a unique individual when he/she evolves to form a whole personality, which Wallace calls **Delta**. It is this Delta that makes everyone different from each other and unique. The author believes that the Delta of a creative personality has much to do with a larger portion of Beta and a dominant proportion of Gamma. With the narration from Appendix A as reference, the author has embarked on a series of mapping and analysis of key information that may lead to understanding the Delta of the author’s personality that reveals the essential factors of a journey from creativity to innovation.

*To think, it seems to me,
is to hold on an idea long
enough to unlock and
shape its power in the
varied context of shared
human knowledge*
Vera John-Steiner
In Notebooks of the mind
(1997, p.9)

Distilling the details. In taking details from the personal journey of Appendix A, what could be the basis to verify the important attributes that define a creative person first before distilling attributes that corresponds to the author through his life journey. John-Steiner (1997) in his book titled, “Notes of the Mind: Explorations of Thinking”, has taken on the task of interacting with, “... one hundred very different individuals”, whose, “... voices contributed to the shaping of (this) book”. The book is a result of finding an answer to his question, ‘What is thinking?’ According to John-Steiner (1997), “The earliest source that creative individual draws upon are linked to childhood play”. In the chapter titled *Apprenticeships*, he describes through examples how parents offer opportunities and experiences for intellectual development and creativity. Besides the experiences of home, John-Steiner also discusses about ‘memories of schools and teachers’ and the influences of ‘distant teachers’ which includes role models in their field of interest. Here are some key points to take from John-Steiner (1997) about the growth of a creativity personality:

- As a person grows up, cycles of activity, and the internalized knowledge based upon them, are molded by the particular setting in which one is raised.
- The opportunities and content of children’s learning are historically and culturally patterned. These are

further shaped by family interactions, which provide models and motivation for the acquisition of knowledge.

- ... the influences affecting the growth of creative thinkers are not arranged in a neat, chronological order; it is the totality of their experiences that musicians, actors, painters, and scientists bring to bear on their work.
- The past and the present, the historical and existential, are not easily separated in the mind. In most instances, what is learned from others becomes part of a dimly conscious awareness, to be summoned in those moments when an individual is trying to push beyond the edge of his or her talent.
- The earliest sources that creative individuals draw upon are linked to childhood play; to the many long hours that they have spent entranced by nature, by the play of lights, or by a book.
- Many individuals also learn from the legacy of ‘distant teachers’¹⁹. Thus, varied paths through the past as well as the present are pursued before one achieves a distinctive voice, a creative identity.
- Undoubtedly, the fusion of the present and the past is an important aspect of the creative process.
- New work is born out of the playfulness of the young, and the freshness of perception that does not wilt after childhood.
- The first and most powerful sign that an individual is committed to a life of creative endeavour is his or her sense of intensity; the need to see, explore, understand, experience, and to go beyond what is already known.
- The intensity required to go beyond the known is replenished by such encounters with distant teachers. The young person is enriched by the exposure to the lively wrought works of their mentors.

¹⁹ By ‘distant teachers’, the author believes John-Steiner means role models that the individuals read about, idolise or look upto.

- Much of experience which less courageous persons would repress or deny is accepted by creative persons.
- Praise and recognition can help young artists to define their own objectives.
- The creative individual engages in demanding work to prepare him or herself for the future.
- Many sources sustain creative intensity in the lives of artists and scientists. Some of these are internal and may reach back to the person's childhood; others are more clearly linked to the challenges of existence.

To further summarise John-Steiner (1997), the following are important in the life of a creative person:

- People and relationships
- Childhood experience and play
- Praise and recognition
- Past and the present
- Intensity of involvement, preparation and commitment
- Teachers and 'distant teachers'

What do other researchers write about creative person and personality? In a paper titled, "In Search of the Creative Personality", Helsen (1996) starts by stating:

... creative individuals were found to share strong symbolic interests, independence, and high aspirations. Viewing them as self-oriented rather than other-oriented is consistent with the above findings and with their love of work and difficulty in relationships; it points to transcendence of the self as a common moral problem. (Helsen, 1996)

After extensive studies, Helsen concludes the paper with the following findings, "... the creative personality can be conceived quite generally as, a) organised around a symbolic interest pattern, b) in the service of some kind of power motive²⁰ and, c) related to a social identity (artist, scientist)". Helsen further states, "... most creative individuals are especially original in thought process and are interesting as persons..." (Helsen, 1996).

²⁰ The author does not agree with Helsen's conclusion on power motive. The motive of a creative person seems much more of recognition, as John-Steiner points out.

Collins and Cooke (2013) in an article titled, “Creative role models, personality and performance”, set about establishing a research, “... to discover whether there is an interaction between creative personality and a supportive work environment resulting in creative behaviours ’ and to find out, ‘Is a creative personality essential to creative performance?’”

After detailed discussions and presentations of the results of their survey, Collins and Cooke (2013) report their findings as:

The results indicate that the presence of creative supervisors influences subordinate creativity when the subordinate’s creativity-relevant skills are minimal. On the other hand, there were not any significant relationships between the presence of creative co-workers, creativity-relevant personality facets and employee creativity. (Collins & Cooke, 2013)

The article though, seems more informative on other researchers propositions and findings on creativity persons and personalities.

Chau et al. (2018), in a paper aimed at discussing the relationship among “creative personality”, “well-being” “innovation behavior” and the mediation of “well-being”, and between “creative personality” and “individual innovation behavior”, find that there is:

... significant positive effect of R&D personnel’s creative personality on individual innovation behavior, the remarkably positive effect of creative personality on well-being, as well as the mediation effect of well-being between R&D personnel’s creative personality and innovation behavior. (Chau et al., 2018)

Though this study, as in many research studies, has taken the route of questionnaires and surveys and is dependent on the statistical results, the final finding that creative personality has a significant effect on, not only innovation, but also on the general well-being of an individual is interesting.

Runco (2007) in his defining book on creativity has a dedicated chapter titled, “Personality and Motivation”(pp. 279 – 317), which starts with the question, “Do creative individuals have particular traits?”, to which, “The answer seems to be affirmative, and interestingly, these represent both positive and negative traits”. Runco states that:

The creative personality can be described with some combination of the following traits, tendencies, and characteristics:

- Autonomy
- Flexibility
- Preference for complexity
- Openness to experience
- Sensitivity
- Playfulness
- Tolerance of ambiguity
- Risk taking or risk tolerance
- Intrinsic motivation
- Psychological androgyny
- Self-efficacy
- Wide interest and curiosity

(Runco, 2007, Chapter 9)

Runco, further states that, “the creative person also values creativity and intentionally invests time and effort in creativity. They choose to fulfill their creative potentials and choose unconventional and original ideas and careers”.

Runco also wants to emphasise three important points²¹:

- The creative personality varies from domain to domain, and even from person to person.
- There are indicative traits and contraindicated traits.
- Some of the traits that are indicative of creativity are admirable, respectable and socially desirable. Some of them are unattractive and low in social desirability.

(Runco, 2007, Chapter 9)

In view of the discussions above, what are the traits and attributes that constitute the creative personality in the author? In order to distil this, it is pertinent to harvest the main aspects of author’s journey from Appendix A.

²¹ Runco in this chapter also cautions on distinguishing between, “creative behavior and pseudocreative behavior such as self-publicity and self-promotion”.

This could be surmised into seven distinct headings:

- **people** from all walks of life from parents and relations to acquaintance to strangers
- **environment** from house, to neighbours and neighbourhoods, to village, towns and cities, to countries and continents
- **encouragement** from the people and the environment along the journey
- **education** from preschool to tertiary and the influence of the people, environment and the encouragements
- **exposure** to studies, society, faith and socio-politics through people, environment and education
- **experience** through profession and work, as well as the exposure it brings from the people, environment and the engagements and encouragement
- **opportunities** to go beyond exposure and experience to participate in higher levels of profession and society

In the opinion of the author, these seven aspects contributed to taking him from a creative person into an innovator. Each aspect seems to have had its influences and influencers that helped in this journey to becoming an innovator. Drilling down further into the journey of the author several key influencers emerge from Appendix A which have had an influence on the development as a creative, and later, an innovative, personality. These influencers and the corresponding influences as well as the level of complexity in the way it contributes to personal attributes seem to grow with the author, both in chronological and aspirational manner. Could this be visually represented or plotted?

Matrix of influencers and influence. A personal matrix of author's journey thus far, is shown in Table 3.1, taking the influencer and influences from the descriptions given in Appendix A. Age period depicts the period in the author's life that each influencer had influenced. The matrix also shows complexity that follows the human capability to take on ideas and starts with basic level of complexity, progressing through simplex and complex to sophisticated. Table 3.1 also defines attributes to the influence for each of the influencer, as seen from the author's point of view.

Table 3.1: Personal influence matrix of the author

Influencer	Influence (Result/Outcome)	Age Period	Complexity	Attribute
People	Relationships	4 ~ 12 12 ~ 20	Basic Simplex	Behavior (personal)
Physical Environment	Culture and heritage Socio-cultural issues	4 ~ 12 12 ~ 20	Simplex Complex	Socio-cultural
Faith and Culture	Rites and rituals Cultural heritage	4 ~ 12 12 ~ 20 20 ~ 28	Simplex Complex Complex	Socio-cultural
Education Environment	Economic strata Socio-economics	12 ~ 20	Complex	Education/knowledge
Education	Multi-discipline Multi-culture Philosophical	20 ~ 28 28 ~ 36 53 ~	Complex Complex Sophisticated	Education/knowledge/Intellect
Socio-Politics	Dichotomy in policies	4 ~ 12 12 ~ 20 20 ~ 28	Basic Complex Complex	Socio-cultural
Parental Influence	Multi-faceted exposure Appreciation Access to extra knowledge Concept of simplicity and complexity	4 ~ 12 12 ~ 20	Simplex Complex	Socio-cultural
Relations, friends, neighbours	Encouragement Praise Appreciation Inspiration Concept of beauty & grace	4 ~ 12 12 ~ 20 20 ~	Simplex Complex Complex	Socio-cultural
Working for (large) corporations	Decorum in behavior Opportunity to meet important people Discipline	20 ~ 28 28 ~ 36	Complex Complex	Professional
Entrepreneurship	Marketing Tact and Diplomacy Accounts/Finance Economics Business Ethics Good Relationships Business procedure and Documentation	28 ~ 36 36 ~ 44	Complex Sophisticated	Professional Business

Influencer	Influence (Result/Outcome)	Age Period	Complexity	Attribute
Investment Experience	Business documentation Negotiations Higher order of decorum	36 ~ 44 44 ~	Complex Sophisticated	Business
Leadership	Responsibility Representing community Vision and direction Guiding and direction	36 ~ 44 44 ~	Complex Sophisticated	Behavior (organizational)
Teaching Experience	Transfer knowledge Sensitivity individuals needs	44 ~	Complex	Professional (academic)

Table 3.1, in many ways, brings forth how each influencer can contribute to one's growth into a Delta personality. In the author's case, the Gamma (*like no others in some respects*) personality²² probably comes from the unique combination of experiences such as the encouragement from friends and family from an early age, exposure to the Western Hemisphere when young, supportive parents and opportunities, attaining complex skill and knowledge levels and near to sophisticated attainment as a leader and an entrepreneur as I grew into a businessperson. This fits very closely with what Wilson (2017) and John-Steiner (1997) have described as influencers of creative personalities. Table 3.1 is one way to represent the evolution of the Delta of the author as an individual. Is there another method to represent the author's life journey as well? Can the attributes be mapped against the influencers and vice versa? How would that look?

Mapping the attributes. Table 3.2 shows the attribute mapping for the author based on the various influencers starting from ages 4 onwards till 52 based on the author's life journey as depicted in Appendix A. The attribute map shows that from the period from 4 years old till about 20 years, the author has been influenced, progressively in complexity, by people behavior, socio-culture and educations, i.e., gaining domain knowledge in engineering and industrial design. After the age of 20, rather in the mid 20s, the author started

²² From *Studying the Individual* (Wallace et al., 1989, pp. 25 – 41).

grasping the complexity of the profession of Industrial design. From the age of 28 onwards the author was introduced to and grasped the sophistication of business and organisational behavior.

Table 3.2: Personal Attribute Mapping

Personal Attribute Progression Mapping - from 4 to 52 years

Mapping the influencers. There maybe another way of mapping the life journey in terms of complexity. Table 3.3 shows the mapping of the influencers in terms of complexity. Again, as in the case of the attribute mapping, a pattern emerges as the author moves from the age of 4 till 52. From the basic influence of people, influencers move up in terms of complexity to environments, faith, parents, closer people, education environments, to education till the sophisticated influence of business and investment from age 36 to 52. While the author has been influenced by the sophistication of business by the age of 32, it wasn't till the investment opportunities, which arose around the age of 41, that the real sophistication of business becomes apparent.

Table 3.3: Personal mapping of the influencers in terms of complexity

Influencer Mapping - from 4 to 52 years

Where is this leading to. As the author gained confidence and momentum in becoming a designer, the life trajectory as seen in Tables 3.2 and 3.3, show that there has been a move from the ‘basic’ to ‘sophisticated’. Is this cumulative? In moving from a creative person to an innovator, has the author stopped being creative? Or, is the fact that the author is (still) creative that he can be an innovator? Where did the role change occur? Was the author’s moving up in complexity in terms of attributes gained (Tables 3.1 to 3.3) a good answer to why he is called an innovator? Is sophistication an indicator of innovation? What is the relationship between creativity and innovation then?

Evolution of author’s ‘creativity-to-innovation’ journey. To answer this, the author needs to understand the evolution of his journey and the key aspects that he has acquired thus far, as he gained experience. These key aspects in are the following:

1. a sequence of *personal attributes*: basic, simple, complex and sophisticated
2. *mental attributes* that have helped to attain those mental attributes; imagine, study, understand the principles, analyse, who, what, why, when and why
3. a series of *methods* to solve problems creatively; curiosity, game play, pretend play, explore, draw, experiment, stories and narration
4. (*domain*) *expertise* in mechanical engineering, industrial design and applied art and *experience* in all aspect of industrial design, product development, entrepreneurship, enterprise management
5. *coach, mentor and lead* colleagues, interest group, business negotiations; as an academic working with the young design students
6. *focus and discipline*, persevere and pursue, *pride and decorum* in work

These, have been gained through the different environments and the people the author has met and worked with during his journey, earning praise, critique and criticism, with different level of success and an equal share of failures. How does this connect with the aim to form a relationship between creativity and innovation? Can a map of the author’s personal journey reveal something towards this creativity-innovation relationship? Figure 3.1 shows such map done with the intention of understanding creativity and innovation within the author.

Figure 3.1: Representing the progression of the author's journey
Source: Derived by the author for this thesis

The author's journey as seen in Figure 3.1 shows four important paths as he progressed from a child to a mature adult:

1. **Personal Approach**
2. **Mental Approach**
3. **Domain Immersion**
4. **Practice Methods**

There seems to be a correlation in the growth of the author's personal attributes as well, from a basic personality, through a simplex, complex to a person who understands sophistication in its many aspects in life. As the author reaches towards sophistication, the four paths reach towards an equivalent end destination as seen in Figure 3.1, namely:

- Personal Approach → Extract
- Mental Approach → Apply
- Domain Immersion → Entrepreneurship
- Practice Methods → Lead

Does this point to a direction in the relationship between creativity and innovation? While Figure 3.1 shows the varied headings and details, as well as shows the direction of movement, this is a starting point to depicting the relationship between creativity and innovation. Taking this as a first step, a deeper study of creativity and innovation may be needed before a concrete relationship between the two can be established.

Other interesting studies. Has anyone else done studies on creative people, on a biographic basis and map their progression, as this thesis has attempted to do? Margery Franklin (Wallace et al., 1989, pp. 255 – 277) has done such a study on the American artist Melissa Zink (1932 – 2009). In a chapter titled, “A Convergence of Streams: Dramatic Change in the Artistic Work of Melissa”, Franklin studies the development of an artist who decided to commit herself to professional art only when she was forty-one years old and maps her short five-year journey to be an established artist as ‘convergence of streams’. According to Franklin, Melissa Zink, ‘did some drawing and painting (in childhood and adolescence); in college, she majored in art history’. Zink has also worked in drawing, painting and printmaking subsequently and had also become skilled in a variety of crafts. Influenced by her second husband Nelson Zink, who was also an artist, she made a commitment and vowed to be an artist and be recognised. What is more interesting is the revelation from Zink that she felt like she had an ‘enormous suitcase full of magic’ which she was not allowed to open because ‘the things in the suitcases are not worthy of artistic consideration’. Those things were, ‘words, childhood memories, pretend, fantasy, archaeology’. It was in her early forties that Zink opened the ‘suitcase’, allowing her to play with those things.

From Franklin’s chapter on Melissa Zink, and from other Internet references²³, it is clear that, she created different streams of art by rapidly dipping into her memories, hopes and fantasies as well as from the domain knowledge and skill sets that she had acquired up to that point in time. One such stream, according to Franklin, is *imaginative visualisation* where she could work from ‘a prior visualisation of the

²³ <http://www.laterbloomer.com/melissa-zink/> ; http://www.taosnews.com/news/updated-story-artist-melissa-zink-dies-at-inspiration-for-others/article_45035f93-5aa6-53fb-85e6-042b9020a524.html, both retrieved on 05 September 2015.

whole’. Works from this stream Zink relates to the pretend play of her childhood. Franklin writes that, ‘Zink explains that she spent a great time alone as a child²⁴, and that much of time was spent reading stories and playing – in her words, “imagining”’.

Franklin’s map interpreting the ‘phases, streams and metaphors’ in Zink’s work from 1974 to 1979 is reproduced in Figure 3.2. There are two things to note about the map shown in Figure 3.2:

1. It is based on research framework from Franklin’s study and interview with Melissa Zink and it covers a very short time in her 77-year life.
2. The map is structured very close to the first map of the realm of creativity and innovation produced as part of the author’s research journey (Sathikh, 2010)

While there are possibilities of discovering similar biography based maps of creative personalities, the map shown in Figure 34 establishes the relevance of biographic or ethnographic studies as qualitative research of the nature of the study in this thesis.

Figure 3.2: Interpretational map of Melissa Zink’s Work
Source: Wallace et al., (1989, p. 273)

²⁴ Which is diagonally opposite to my experience of being around a lot of people in pretend play and make up stories based on the sketches/drawings that I make alone but many a times with onlookers around.

What follows. With a fair idea of the transformers that take a person from being a creator to an innovator, the next step is to understand creativity and innovation in a structured manner, in order to arrive at a stage where a relationship between creativity and innovation can be proposed in the quest to understand this relationship. Works by Boden (1996), Mithen (1996 & 1998) and Wilson (2017) discussed in Chapter 2 establishes that creativity is a quality of human activity as against innovation which is a process that is driven by many factors including creativity. Hence it is important to conduct an in depth study of creativity and innovation by dedicating a chapter each for creativity (Chapter 4) and innovation (Chapter 5). Through this, the author's intention is to clearly identify for himself the difference between the two and to lead the research and discussions towards building a means to connect creativity and innovation through a visual map. A deeper study into the two will make the intentions of the thesis clear to the readers of this dissertation.

4. Creativity

'Creativity is contagious, pass it on'
Attributed to
Albert Einstein
Source:
quotetab.com

In presenting the motivation for this thesis in Chapter 2, several definitions of creativity have been quoted from leading dictionaries, together with several interpretative definitions of the same from people who have been studying and writing on the subject. In order to discover the relationship between creativity and innovation, it is important to understand creativity across the spectrum of several fields before studying on innovation. With this in view, this chapter is dedicated solely to the study of creativity, taking earlier definition and interpretations of creativity further, to understand better, what each of the areas within the larger boundaries of liberal arts define as creativity, before discussing on some key literature that have helped in framing the approach to this doctoral study. To start with, the author agrees with Carl Hausman, when he states in an article titled, "Criteria of Creativity" (Dutton et al., 1981):

...what is needed at the beginning of a study of creativity is a sober, straightforward structural account – an account that avoids as much as possible, metaphorically couched expressions of praise for what is creative, and which postpones claims to provide immediate 'insight' into the nature of creativity'. (Dutton et al., 1981, pp. 75 – 76)

Hausman goes on to suggest that it is better to, "... lay out a bare conceptual skeleton, leaving for other discussions the attempt to fill out the flesh for the skeleton". This suggestion fits well in the attempt to obtain interpretative definitions of creativity from the different fields in liberal arts, which form the 'flesh and skin' on the basic definition of creativity. In laying out any 'conceptual skeleton' one also must be aware of the fact that creativity holds different meaning to even researchers of creativity. Gaut (1992) in an article titled, "Philosophy of Creativity", alludes to the common qualifying criterion for creativity, which is 'original and valuable' and says that this is not sufficient to define creativity. Gaut gives an example of, "a chimp painting boisterously onto paper: her trainer removes the paper at the point at which it is aesthetically pleasing but left to their own devices chimps will keep adding more paint and simply end up with a mess". What Gaut is emphasising here is that the creative person (creator) must have the evaluative quality to assess and stop at certain point. This means that:

The kinds of actions that are creative are ones that exhibit at least a **relevant purpose** (in not being purely accidental), some **degree of understanding** (not using merely mechanical search procedures), a **degree of judgement** (in how to apply a rule, if a rule is involved) and an **evaluative ability** directed to the task at hand. (Gaut, 1992).

In many cases this is true of creative actions across the spectrum from pure art to pure science. Whereas, the artist may have a purpose that is more emotional and near to his/her heart, the artist in many ways proceeds with a level of understanding, exercising his/her judgement on the process of creation and exercises a level of evaluative ability as to when to stop, the scientist may have a focused purpose, an understanding of the background and the field and is able to make a judgement on the process and evaluate if he/she has attained a specific result that fits the initial purpose.

While creativity, or concepts near to, may have been mentioned in the annals of history, a structured approach to studying creativity probably started since 1950²⁵. According to Taylor and Getzels (1975), “J.P. Guilford’s presidential address at the American Psychological Association meeting in 1950 ‘marked a paradigmatic shift in the field of inquiry’ ”, when Guilford observed that less than 200 studies on creativity had appeared in psychological literature in the preceding quarter century. Since then, creativity has been studied, researched, written and published about from all angles. This doctoral study into creativity, therefore starts from, what can be considered, the post-World War II period. According Sawyer (2006), “modern research into creativity could be divided into three waves”, where the **first wave** from the 1950s to 1960s, “focused on studying the personalities of exceptional creators”. The **second wave** during the 1970s and 1980s shifted the attention to a more cognitive approach where research focused on, “the internal mental process that occur while people are engaged in creative behavior”. The **third wave**, from the 1980s and 1990s was more about sociocultural aspects, shifting to, “an interdisciplinary approach that focused on creative social systems: groups of people in social and cultural context”. Sawyer (2006) also brings about a

²⁵ Unfortunately, the works of the Soviet psychologist Lev Vygotsky probably was not known to Western researchers on creativity at this point in time. As early as the 1920s Vygotsky (2004) has been writing on creativity and, most importantly, on imagination as a key to creativity.

problem in these three waves in that, “each of the three waves has largely proceeded in *parochial isolation*”, and calls for a more interdisciplinary approach to understanding creativity. While there is the need for interdisciplinary research, it is important also to ascertain how each of the disciplines or areas has understood and defined creativity²⁶ at the time of writing this thesis.

Approaches to defining creativity. With researchers working on creativity (and innovation) from different fields, literature survey generally points to several theoretical frameworks as well as experiments and investigations. From these theoretical discourses and the various creativity measurements, results of creativity seems to lead to numerous definitions and conclusions. Taylor (1988) in a chapter titled, “Various approaches to and definitions of creativity”, quotes an unpublished report made by L.C. Repucci of Dow Chemical Company:

If we examine the many definitions which have been offered, we can classify them into six major groups or classes. These groupings are not mutually exclusive since each definition may contain elements which fall into different classes. To overcome this difficulty, the class into which a definition was placed was determined by the main theme of the definition. (Taylor, 1988, p. 118)

The six major groups or classes as described by L.C. Repucci is tabulated in Table 4.1.

²⁶ Chapter 2 has several interpretative definitions of creativity from three dictionaries, as well as from authors and researchers, which served as an observation for the motivation to do this doctoral study. This chapter studies creativity in more detail.

Table 4.1: Grouping the definitions of creativity from Taylor (1988, pp. 118 – 119)

Group/Class	Description	Example	Remarks
Gestalt	The major emphasis is upon the recombination of ideas or the restructuring of a 'Gestalt'.	Translation of knowledge and ideas into a new form by Durrssen in 1957.	Also 'perception'
End Product	The emphasis is on the end product or result.	Any process by which something new is produced – an idea or an object, including a new form or arrangement of old elements by Harmon in 1955.	Also 'innovation'*
Expressive	The major emphasis is on self-expression. One needs to express himself in a manner which is unique to him.	Ability to think in uncharted waters without influence from conventions set up by past practices by Lee in 1957	Also 'aesthetic'
Psychoanalytic	Creativity defined in terms of certain interactional strength, ratios of the id, ego and superego.	All forms of creativity are permanent operant variables of personality by Harmon in 1955	Also 'dynamic' This view is more or less superseded over the last 60 years
Solution Thinking	The emphasis is upon the thinking process itself rather than upon the actual solutions of the problem.	In order to solve a problem one often must move tangentially from common types of solution by Dunker in 1945.	This relates to Edward de Bono's lateral thinking principles
Varia	There is no easy way of categorising them.	Creativity is the addition to the existing stored knowledge of mankind by Rand in 1952. The integration of facts, impressions, or feelings into new form by Porsche in 1955	

* the term 'innovation' has been used by L.C. Repucci, the author of the report reproduced by Taylor (1988).

Though the examples shown in Table 4.1 is from the 1950s in the paper by Taylor (1988), the groups/classes are generally valid for contemporary definitions of creativity as well, the exception being 'psychoanalytic' group derived from the emphasis on id, ego, etc., which were of interest in the 1950s.

Transactualisation basis of creativity. Taylor (Taylor and Getzels, 1975) in a chapter titled *An Emerging View of Creative Action* (pp. 297 – 325) introduces the concept of transactualisation. Intertwined with early concepts of self-actualisation, the definition for transactualisation seems odd, looking at it from contemporary perspective. According to Taylor, transactualisation, "involves a person-environment system in which the person alters the environment (rather than being altered by it) in accordance with self-actualising forces". What is interesting is the introduction of five essential interacting and interfacing components, which includes the person, the problem, the process, the product and the climate.

As per Taylor's description:

1. The creative person is **transactive**
2. The problem is **generic** (or basic)
3. The creative process is one of **transformation**
4. The creative outcome or product is **generative**
5. The environment that facilitates creativity is **stimulating**

To put into a sentence, "...creativity as a system is viewed as involving a *transacting person* (italics by the author) who performs basic or *generic* problems into creative outcomes or products in a stimulating environment" (Taylor and Getzels, 1975, p. 303). Taylor's transactualisation basis of creativity is shown in Figure 4.1.

Figure 4.1: Transactualisation basis for a creativity system

Source: Taylor & Getzels (1975, p. 302)

This definition based on transactualisation has a lot in common to the definition of creativity by Khandwalla (1984) and Sathikh (2010) and probably shows the way forward in thinking about the how creative ideas become innovative propositions.

Hierarchy of creativity; Developing from Taylor's concept on transactualisation, Liu and Schönwetter (2004) present a hierarchical diagram of creativity much like the well-known Moslov's hierarchic diagram as shown in Figure 4.2.

Figure 4.2: Taylor's hierarchy of creativity

Source: Liu & Schönwetter (2004)

By this diagram in Figure 4.2, according to Taylor's hierarchy "...creativity is perceived as a hierarchy from a low to a progressively higher level" (Liu & Schönwetter, 2004).

- The lowest level is **expressive creativity** which creates ideas without any concerns to other contributing factors (such as cost, size, etc.)
- The second level is **technical creativity**, '...which is the proficiency to create products with consummate skills, but with little expressive spontaneity.
- The third level is **inventive creativity**, which is 'the ability to develop a new use of old parts and new ways of seeing old things in an ingenious manner'.
- The fourth level **innovative creativity**, '... is the ability to penetrate foundational principles or establish a school of thought and formulate innovative departures.
- The fifth (highest) level is **emergent creativity** which is, ... "the ability to incorporate the most abstract ideational principles or assumptions underlying a body of knowledge, as in the example of Einstein's work on general relativity".

(Liu & Schönwetter, 2004)

There may not be a need to set such a tight demarcation of different type of creativity. Rather than use the term 'hierarchy', which sets one over the other as discrete creativities with ascending values, the author proposes '**accents**' in creativity, which would be a better terminology.

These accents form a foundation for establishing a diagrammatic representation of the flow of ideas which has repercussions to the creativity-to-innovation path that the author intends to depict in this thesis. It is important also to acknowledge that different areas and fields could define creativity, and for that matter, innovation, based on their domain requirements as researchers such as Csikszentmihalyi (1996) point out.

Definitions of creativity in different fields. In looking at the various range of areas/fields in liberal arts²⁷, a spectrum may be selected which ranges from pure (visual) art till pure science as shown in Figure 4.3 with a view to chart out the following in each of the areas:

- interpretative definition of creativity
- creative process
- (expected) outcome

Figure 4.3: Liberal arts spectrum for the study of creativity (and innovation)

Source: Derived by the author for this thesis

This spectrum is based on a centrum located at design / applied art, an area that is the domain of practice (product design/industrial design) of the author. This also has a reference to Chapter 6, where the author discusses on the need to understand art creativity and science creativity before establishing a relationship between creativity and innovation.

a) Creativity in visual art. With particular reference to visual art, Margaret Boden (Boden, 2011) in a book titled *Creativity and Art: Three Roads to Surprise* refers to three forms of creativity²⁸, namely **combinational**, **exploratory** and **transformational**. This leads one to infer that if there are

²⁷ Liberal arts has taken many interpretations over the years from the original medieval *trivium* and *quadrivium* originating from Aristotle. Liberal arts in this study takes the opposite context to 'vocational' or 'mechanical'. Hence a spectrum of areas/subjects, from pure arts to science is considered for this thesis.

²⁸ While the three forms of creativity defined by Boden (2011) may also fit creativity in all fields, these 'roads' seem to suit better in explaining visual art better as Boden herself explains in her book.

more than one road, there must be more than one type of visual art. Western art historians trace back visual art to tens of thousands of years, starting from pre-historic art till contemporary art and classify them in Art Movements²⁹. Since research for this thesis study starts from the 20th century, especially mid-twentieth century, the study of creativity in several significant modern and post-modern art movements are considered in this section:

- Cubism
- Surrealism
- Pop Art
- Conceptual Art
- Contemporary Art

Zimmermann (2005) quotes James (1999- 2000) as defining artistic creativity as a series of, “decisions and actions that are both purposeful and not predictable ... it is an individual and a social process during which materials, forms, and cultural conventions are fused with the artist’s personal history and emotions. Something is created that has never before existed in exactly that form. Something created that never before existed indicates the surprise that Boden (2011) mentions. What is interesting is the inclusion of personal history and emotions, which the author is able to identify with.

The uniqueness of creativity in visual art is that, unlike many other fields, the creative process is successful when it is centred on ‘problem-finding’ as against ‘problem solving’ which is a common interpretation of creativity in many other areas. Sawyer (2006) cites experiments done in the early 1960s where a group of students from the Art Institute of

²⁹ Art Movements are periodised and given specific names to indicate specific periods, styles and thoughts that shape the particular artwork at that period of time. Schapiro et al. (1970) mentioning about periodisation say, “As historical classification, it is an instrument in ordering the historical objects as a continuous system in time and space, with groupings and divisions which bring out more clearly the significant similarities and differences, and which permit us to see a line of development; it also permits correlation with other historical objects and events similarly ordered in time and space, and thereby contributes to explanation.”

Known art movements commonly classified are: Prehistoric Art, Ancient Art, Medieval, Renaissance, Mannerism, Baroque, Rococo, Neoclassicism, Romanticism, Realism, Art Nouveau, Impressionism, Post-Impressionism, constructivism, Fauvism, Expressionism, Cubism, DeStijl, Surrealism, Dada, Abstract Expressionism, Op Art, Pop Art, Arte Povera, Minimalism, Conceptual Art, Contemporary Art (<https://www.invaluable.com/blog/art-history-timeline/>). While this is based on Western Art History, there are other movements that have emanated from other parts of the world that has not been mentioned here.

Chicago were asked to select objects placed on the table and proceed to generate pastel drawings of them. At the end, the students who were ‘problem-finding’ artist tended to generate drawings that were, “judged to be more original” than the drawings from “problem-solving” artists that were judged to be, “more craftsmanlike³⁰”. The researchers also followed up on the students they had tested in 1970 and 1981 and found that the art students who were problem-finders were most successful in their career. This extends to creative writing as well according to Sawyer, who reports of a study on student writers where the result, “resembled art students in their problem-finding behavior; the writer whose stories rated the most original by experts were the ones who used a problem-finding style” (Sawyer, 2006). Creativity in visual art seems to be most written about and hence the decision to elucidate only the most important points that the author felt are required for this thesis, namely problem finding rather than problem solving approach to creativity in visual art. Examples of problem finding in the key art movements selected for study is discussed as follows:

Cubism. Cubism represents the rejection of the idea that art needs to imitate nature, which included perspectives, foreshortening, modeling, etc., instead representing a new reality through abstraction in the two dimensional plane.³¹ An example of creativity in Cubism is the famous Guernica by Pablo Picasso dated 1937 shown in figure 4.4.

Figure 4.4: Pablo Picasso's Guernica
Source: www.pablopicasso.org

³⁰ Boden (2011) has a chapter dedicated to

³¹ <https://www.britannica.com/art/Cubism> retrieved on 08 July 2018

In Guernica, Picasso depicts the vagaries of Spanish War on a small town named Guernica where the German Luftwaffe conducted multiple raids/bombing. While a photojournalist's view depicting the gory scenes that lay in the town would have been more realistic, Picasso has used his creativity in depicting the scenes in his own style, evoking emotions at a higher level, perhaps a more contemplative level than what a photograph would have evoked. Since the Cubist works of Picasso's and others move away from accepted artistic space into a new conceptual space, it may be termed as **exploratory creativity** as per Boden's (2011) classification.

Surrealism. Surrealism³² abhors the idea of rationalism that had wreaked havoc of the World Wars of the Twentieth Century. According to the originator of the Surrealist Manifesto in 1924, Andre Breton, "Surrealism was a means of reuniting conscious and **unconscious** realms of experience so completely that the world of **dream** and **fantasy** would be joined to the everyday rational world in 'an absolute reality, a surreality' ". (<https://www.britannica.com/art/Surrealism>)

How does creativity in surrealism manifest as visual art then? In an article titled *Creative Imagination: Hypnagogia and surrealism*, McKellar (1995) cites **hypnagogia**³³ as an important element in connecting that world of dream and fantasy to conjure up visual art. McKellar states that, "The imagery is autonomous, being experienced rather than thought up, and often described as surrealistic". He mentions about, "Entopic processes in the retina explain 3 qualities of hypnagogia: originality of form, shape, and color; autonomous unbidden characteristic; and the unrecognizability of the images to the observer".

Salvador Dali's famous work titled *The Persistence of Memory* from 1931 (Figure 4.5) is an example of surrealistic work.

³² Before discussing on creativity in surrealism, which stands for 'surrogate realism' (Leplin, 1987), it is worthwhile to understand realism which the movement seems to stand opposed to. Realism, according to Leplin (1987), "...operates with a metaphysical conception of truth as representation of a theory-independent world. In supposing that true theories are more likely than false ones to be successfully extendable into new domains, realism adopts a principle of the ultimate unity of nature and concordance of natural law, which, however supported by the success of scientific method, is certainly metaphysical". Those who are anti-realist feel that, in making that connection between metaphysics and truth of the natural law, realism retreats, "...from truth to approximate or partial truth to increase the plausibility of its epistemic commitments" (Leplin, 1987).

³³ Hypnagogia is a subjective experience on the threshold of sleep when internal aurora from dissociated personality subsystems emerge. Some hypnagogic experiences may serve as subjects for visual art. (McKellar, 1995)

Michael Michalko³⁴ in an article titled *Salvador Dali's Creative Thinking Technique* explains how Dali was able to depict images, "...which occur at boundaries between sleeping and waking". In this instance of *The Persistence of Memory*, Dali had painted the scenery and the trees and was wondering what he needs to do further before deciding to switch of the light to go to sleep, when he could see the whole image, the solution, with two melting clocks and the rest of the details.³⁵ The end result is Dali conveying to the world on the loss of all certainties as his subconscious sees it. Dali's creativity may best be described as **combinational creativity** based on Boden (2011)

Figure 4.5: Salvador Dali's *The Persistence of Memory*
Source: <https://www.creativitypost.com>

Pop art. Pop Art emerged as a post-modern movement in the early 1960s as a parody to the world of mass communication. Kuspit (1976) in an article titled *Pop Art: A Reactionary Realism* state that, "Pop art is based on the discovery that fine art and popular culture are free to emulate and even because they often have the same information content and methods, but because underneath their apparent differences they are in the service of the same ideal of psycho-social control. They both exist as cultural "exhibitions"-mediums for making

³⁴ https://www.creativitypost.com/article/salvador_dalis_creative_thinking_technique, retrieved on 09 July 2020.

³⁵ Source: <https://auralcraive.com/en/2018/09/17/salvador-dali-the-persistence-of-memory-and-the-lost-meaning-of-a-melting-world/>, retrieved on 09 July 2020.

public-of the same ideology of control, based on assurances of the exclusive excellence of things American”. In other words, “Pop art in effect encourages the assumption that the world as known through the mass media fatalistically confirms the actual world. The media seem to say: this is the world, make the best of it, for it cannot be changed, since it has already happened. It can only be made newsworthy and glamorous- only celebrated, for better or worse”. (Kuspit, 1976). Pop Art³⁶ went ahead and did exactly thereby, “...the spectator is thrown into society's arms by Pop art, where he was before, but now the embrace crushes and strangles; it cannot even be evaded mentally”. (Kuspit, 1976). Some of the more famous exponents of Pop Art are Roy Lichtenstein and Andy Warhol whose work embodied American culture and messages it was conveying through the media. Figure 4.6 and shows an example of a work by Lichtenstein from 1961.

Figure 4.6: Lichtenstein's *I Can See the Whole Room! ...And There's Nobody In It!*

Source: <http://www.artnet.com>

Lobel (2001) in an article titled *Technology Envisioned: Lichtenstein's Monocularity*, describes 'I can see the Whole

³⁶ A book titled *Pop Art and the Origins of Post Modernism* discusses in detail about Pop Art through an approach to, "Establish a range of post-modernist assumption..." in order to identify post-modernist thoughts in response to American Pop Art.

Room...' as, "Removed from its narrative context and presented as an easel painting it can be read as a visual pun on abstraction..."³⁷", which means that there needs to be a narrative component to fully understand Lichtenstein's creativity. In this respect Lichtenstein's pop art may be classified as **transformational creativity** as per Boden's (2011) classification of the forms of creativity.

Conceptual art. The seeds of Conceptual Art has been sown as early as 1917 by Marcel Duchamp through his work *Fountain* (Figure 4.7) which evoked shock at two levels, according to Boden (2011), firstly because it was not sculpture since it was, " ...mass-manufactured object bought from a warehouse..." and secondly, "...its unsavoury associations" with disgust.

Figure 4.7: Duchamp's *Fountain*
Source: <https://www.britannica.com>

In the introduction to a book titled *Philosophy and conceptual Art*, the editors Goldie and Schellekens (2007) state that, "Conceptual art does not employ one specific technique or art medium, nor can it be categorized according to one distinctive genre" and that, "...the concepts or ideas

³⁷ Right from the beginning Pop Art strategies has been looked at from two distinct angles. According to Lobel (2001), "Those involves in that critical dialogue have most often been concerned with determining if these strategies, taken together, constitute a critique of consumer culture; or whether such gestures, relegated to the realm of fine art, are too circumscribed to fully confront the powerful effects of mass media". The author feels while the social pun, visual or otherwise, that Pop Art tried to bring forward has become fully into art forms, with J-Pop and K-Pop representing a form of Pop Art.

constitute the artworks' 'material'". Where is creativity in Conceptual Art then? Boden (2011) in the chapter titled *Creativity and Conceptual Art* brings argues that, "...the only sense in which conceptual art can be called transformative (creativity) is in the challenge it poses to the accepted concept of "art" itself" and concludes that it, "...doesn't qualify as transformational creativity on my analysis". Boden argues that conceptual artist juxtapose, "...the familiar notions of art, sculpture, music...etc. with other familiar notions that are normally regarded as irreverent, or even antithetical to it." This brings her to the conclusion that Conceptual Art, "...are cases of **combinational creativity**".

Contemporary art. In discussing on creativity in Contemporary Art, this thesis looks at the period after post-modernism that saw Pop Art and Conceptual Art, amongst others, till the present time of writing. Terry Smith (Smith, 2009) writing in the Introduction to his book titled *What is Contemporary Art* states that, "In the aftermath of modernity, art has indeed only one option: to be contemporary. But "being contemporary" these days means much more than a mindless embrace of the present". He also mentions that 'contemporaneity', "... requires responses that are in significant ways quite different from those that inspired the many and various modernisms of the nineteenth and twentieth centuries". He mentions recent universalisms such as, "...as globalization or the fundamentalisms, are falling conspicuously short or are overreaching, disastrously". As a consequence of this, Contemporary Art seems to cast a wider net into a variety of models, not only in terms of the problems and issues, but also in terms of, "...its forms and its contents, its meanings and its usages..." (Smith, 2009). Dumbadze and Hudson (2013) also concur and state that, "... the contemporary suggests an aesthetic phenomenon that is necessarily global in scope, and quotes Smith (2009) further stating that this also represents a historical shift toward a cultural condition that continually reveals new worlds, new senses of being, and ultimately new ways to exist in our collective, yet particularized, time". Taking on a wider themes and schemes, Contemporary Art then results in outcomes that cannot be tagged to a particular form of creativity that Boden (2011) has defined. Added to this, the advent of technology as a tool, both physical and intellectual, allows contemporary artists to combine several media, cutting across many established methods of visual arts

and discovering new methods, to produce works in two dimension and three dimension that are static and/or dynamic represented as installations and sculptures. Figure 4.8 shows examples of Contemporary Art from Anish Kapoor (Cloud Gate) and Damien Hirst (The Physical Impossibility of Death in the Mind of Someone Living).

Figure 4.8: Kapoor's *Cloud Gate* (Left) and Hirst's *The Physical Impossibility of Death in the Mind of Someone Living* (Right)

Source <https://theconversation.com> and
<https://www.lifeonthespot.com>

Kapoor's *Cloud Gate* is a large scale sculpture that is located in Chicago's Millennium Park. As per the website *The Conversation*, "... immense mirrored sculpture is made up of 168 stainless steel plates welded together and placed on the ground. It's about 10 meters tall, with a base of about 20 by 13 meters."³⁸ According the website *Statue Stories in Chicago*³⁹, "...Kapoor, explains, 'the work itself has a complete circle of meaning and counterpoint. Without your involvement as a viewer, there is no story'. The website also mentions that, 'Kapoor named this colossal sculpture 'Cloud Gate' for a simple reason — 80 percent of its surface reflects the sky'. As the website *The Conversation* puts it, 'Depending on the position you take, *Cloud Gate* is the mirror you choose for yourself. You can mix the elements as you wish: the sky, the city, the space above the lake and, and of course, the skyscrapers. It is gorgeous night or day, when weather is good and when it is not. You can be in the image you construct or not. If you want, you can even walk underneath to hide everything'".

³⁸ <https://theconversation.com/anish-kapoors-cloud-gate-playing-with-light-and-returnng-to-earth-our-finite-worlds-102272>, retrieved on 16 July 2020

³⁹ <http://www.statuestorieschicago.com/statue-cloudgate.php>, retrieved on 16 July 2020

As for Hirst's work shown in Figure 4.8, according to the artist, the title was, "just a statement that I had used to describe the idea of death to myself". The title is also in a clumsy manner expressed, "something that wasn't there, or was there". Hirst explains, "I didn't just want a lightbox, or a painting of a shark" instead he wanted to, "... force the viewer out of their element by introducing into a gallery setting, a shark that was "real enough to frighten you". Hirst further expands that, "By isolating the shark from its natural habitat, with the formaldehyde providing an illusion of life, the work explores our greatest fears, and the difficulty involved in adequately trying to express them".⁴⁰

Both the examples demonstrate that there were no problem finding or issues involved in their art work and that it was the artists' own thought process that brought about forms and meanings to the outcome.

Creativity in visual art in summary. Figure 4.9 is an interpretation of creativity in visual art. Central to creativity are problem finding, issues and thoughts of the artist, which are then worked through the three forms of creativity, namely, combinational, exploratory and transformational that leads to an artwork that is original. What is important is that many of the outcomes cannot be squarely branded as belonging to one form of creativity which may not be the case. Instead, the outcomes may be through what the author terms as 'the sphere of outcomes' which may have dominance of one form of creativity together with the act of the either or both of the other two forms.

⁴⁰ <http://damienhirst.com/the-physical-impossibility-of>, retrieved on 16 July 2020

Figure 4.9: Creativity in Visual Art

Source: Derived by the author for this thesis

b) Creativity in music. According to Deliége and Wiggins (2006):

... musical creativity is unlikely to be a unitary phenomenon. Music as performing art provides opportunities to exercise creativity in *composition, interpretation, expressive performance* and *improvisation*, as well as in allied fields such as tuning of complex instruments. (Deliége & Wiggins 2006)

This is depicted graphically in Figure 4.10 by Deliége and Wiggins (2006) where, “two polar dimensions; 1) novelty-fidelity and 2) performance and preparation represent the axis”, and the curved arrows suggest natural direction of transition from between arenas, such as the necessity to interpret a composition in order to perform it”(Deliége & Wiggins, 2006). This ability to be creative at the four arenas has influence on the outcome of the music depending on the position within the quadrangles.

Figure 4.10: Schematic space for four major areas of musical creativity.

Source: Deliége and Wiggins (2006)

Carole Talbot-Honeck, Austria Orlick and Terry Orlick (Talbot-Honeck et al., 1998) in a journal article titled, “The Essence of Excellence: Mental Skills of Top Classical Musicians”, state that, “It is very difficult to separate spontaneity and creativity”. This seems to fit into the ‘composition – interpretation – expression – improvisation’ direction of transition shown in Figure 4.5, where expression and improvisation require a high level of spontaneity. Talbot-Honeck et al. (1998) go on to state, “Creativity appeared to be a process that musicians described when they talked about visualization, imagination and/or musical interpretation”.

This uniqueness of creativity in music, therefore, is the inspiration for the spontaneous music to emerge in the form of jazz, rap, hip-hop and in other genres of music such as the ‘jugabandi’, which is a form of spontaneous response by musicians to each other in Indian classical music.

c) Creativity in performing arts. Performing arts, in many ways like music, has two important elements; the artists themselves and the audience. In the audience also, there are two types; one is the general public and the other is the expert/critic/connoisseur. Ericsson (1999) in journal article titled, “Creative Expertise as Superior Reproducible Performance: Innovative and Flexible Aspects of Expert Performance”, makes an interesting observation and states,

...a particular audience may perceive musicians' and dancers' performances as strikingly creative, whereas experts would judge the same performances as technically skilled but not necessarily sufficiently original to qualify as creative. (Ericsson, 1999)

Again, performing arts could be individual or in groups / collective, which has a bearing on creativity and creative output. It is further complicated by the medium through which the artist(s) perform. In performing arts, improvisation seems to play a major role in creativity and the creative process. In a chapter titled, "The influence of the medium on creativity in dance and fine art", Haworth et al. (1991) state, "In some instances, through the creative process, whole new avenues can be opened leading to a final product which is far removed from the initial ideas concerned, one which is true to the subject and not pre-conceived". Not forgetting the fact that performing arts require a cast of actors, dancers and performers, etc., as well as a director or choreographer, the outcome of such creative process could be different for every performance. As per Haworth et al. (1991), "Through the use of improvisation, the final product is not only that of the director or choreographer, but each dancer plays an important role in contributing his/her creative skills". The director or the choreographer play an important role in the creative process in performing arts by embedding his/her visualisation/vision of the performance with the creative interpretation of the artistes/performers to produce an outcome that may not have happened without 'the collective creativity'. Haworth et al. (1991) elaborate on the importance of collective creativity in performance by describing the activities of the ensemble, "Working as an ensemble allows for the creative process to become richer as one idea feeds off another and each individual interprets a certain concept in his own individual way' where the director/choreographer, '... gently directs the pathway during the creative process'" (Haworth et al., 1991), paving the way for an ensemble quality during the actual performance.

d) Creativity in design. Design is associated with many domains and contexts. Besides the traditional domains of design, it is not uncommon to read about software design, process design, job design, food design and so on with 'design' as a suffix. Design as used and realised in this thesis refers to design as applied art, which includes, industrial / product design, visual/graphic design, interface / interaction

design and environment design. Taura and Nagai (2009) define design as, “...the composition of a desired figure toward the future” based on three categories of design specified by them; “...drawing, problem solving, and ideal pursuing”⁴¹. Taura and Nagai further state that:

...we can perhaps evaluate the creativity of a designing activity by judging how close it is to the desired ideal figure. In that case, we can say that novelty is a result, as opposed to a factor, of creativity. In other words, if we started off by aiming at novelty, we would not be able to achieve our desired figure; instead, we would end up with a strange, unsuitable result. (Taura & Nagai, 2009)

The author agrees with Taura and Nagai about novelty being a result of creativity rather than an essential factor. Nigel Cross, an important design researcher in the last twenty years has proposed some of his (and his collaborators’) insights into creativity in design. Cross considers a unique state in the design process termed as “creative leap”(Cross 1997, Dorst & Cross 2001) which occurs as a sudden insight, becoming a pivotal point for the realisation of the design. According to Cross (1997) design problems is, “...decomposed into sub-problems, and then sub-solutions found and combined into an overall solution’. Cross(1997) goes on to assert that, ‘In practice, creative designing seems to proceed by oscillating between sub-solutions and sub-problems” which he terms as ‘symmetrical relationship’ and proposes an explanatory model as shown in Figure 4.11.

Figure 4.11: Model of the symmetrical relationship between Design Problem and Design Solution

Source: Cross (1997)

From Figure 4.11, it is apparent that creativity in design toggles between sub-solutions and overall solution, till an equilibrium is arrived at resulting in a design outcome.

⁴¹ Further details/expansion of the three categories can be found in the paper titled ‘A Definition of Design and Its Creative Features’ by Taura and Nagai (2009)

According to Cross (1997) the creative leap in such a process, “... is not so much a leap across the chasm between analysis and synthesis as it is the building of a bridge across the chasm between problem and solutions’. It is a common knowledge that designers use various methods and tools to aid in this creative leap, such as sketching, creative thinking, design thinking, quick models and prototyping, etc. Hence it is important not to mistake the tools of design with creativity in design.

e) Creativity in architecture. Architecture involves design at a larger scale for living, working and other habitat where humans interact. Casakin and Kreitler (2005) in an article titled, “The Nature of Creativity”, state that, “... (design problems and architecture problems) these kinds of problems are ill-defined, non-routine, extremely complex and unique”. Since they cannot be solved in line with any clear problem solving procedure, they do not allow the application of known operators or algorithms to arrive at a successful solution. These are strong reasons to infer that a successful design problem solving requires not only developed skills but a high level of creativity. In discussing about creativity in architecture, Casakin and Kreitler (2005) quote other sources with an observation that, “... while most creative designers tried to reach an artistic standard of excellence, the least creative group only tried to comply with general standards of the architecture profession”.

The following can be summarised about creativity in architecture from the section on creativity by Casakin and Kreitler (2005):

1. Creativity can be defined as, “the ability to produce novel solutions to apparently insoluble problems”
2. Creativity requires (from the architect):
 - a) Fluency in the number of solutions that are relevant
 - b) Flexibility in producing different categories of relevant solutions
 - c) Elaboration in the amount of details in the relevant solutions
 - d) Originality in producing statistically rare responses

f) Creativity in engineering. Engineering differs from science in a basic manner in that engineering is the application of methods and processes to bring scientific findings and associated technologies into tangible forms for the benefit of mankind. The Merriam-Webster dictionary⁴² defines engineering as, “the application of science and mathematics by which the properties of matter and the sources of energy in nature are made useful to people”. Dhillon (2006) in a book titled, “Creativity for Engineers”, classifies engineering into at least a total of 22 engineering disciplines. Hence, engineering is not a singular entity, and this could lead to many facets of creativity. Most of the literature on creativity in engineering including Cropley (2015), Liu and Schoenwetter (2004) and Dhillon (2006) associate creativity with engineering design problem solving method. This seems to conveniently bring about ‘formulaic’ creativity methods. Dhillon (2006) dedicates a complete chapter titled *Creativity Methods* lists and describes the following common methods:

1. Crawford Slip Method CSM)
 2. CNB Method
 3. Force-Field Analysis Method
 4. Attribute Listing Method
 5. The Seven-by-Seven Method
 6. Forced Relationship Method
 7. Mind Mapping Method
 8. Nominal Group Technique
 9. Rice Storm Method
 10. Delphi Method
 11. Six Thinking Hats Method
 12. Assumption Reversal Method
 13. Story Boarding Method
 14. Two Worlds Method
 15. Brainsketching Method
 16. Excursion Method
 17. Brainwriting Method
 18. Random simulation Method
 19. Scenarios Method
 20. Lotus Blossom Method
- (Dhillon, 2006, Chapter 6)

Dhillon (2006) goes on further, to list creativity methods specially for applications in engineering as follows:

⁴² <https://www.merriam-webster.com/dictionary/engineering>, retrieved on 12 September 2018

1. Group Brainstorming Method
2. Morphological Analysis Method
3. Synectics Method
4. Checklist Method
5. And-Also Method
6. Tear-Down Method
7. Distribution Method

(Dhillon, 2006, Chapter 6)

The (total) twenty-seven methods for creativity, Dhillon (2006) states are, “...applicable to a variety of problem-solving situations”. While more details on the actual methods can be obtained from Dhillon (2006), it is not the author’s intention in elaborating on each and compare them for effectiveness in creativity in this study. In including these methods, the intention is to point out the fact that engineers tend to simplify creativity and creative processes as problem solving methods and not otherwise. This is reflected in the two definitions of creativity in engineering that follow:

... to explore and scrutinize the available data or information and generate novel solutions to specific engineering problems or to the production of a unique product. (Liu and Schoenwetter, 2004)

Creativity is “the interaction among aptitude, process and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context. (Cropley, 2015)

Due to the heavy accent on problem solving, most of the literature on creativity in engineering define a creative process which goes through a series of, at least, four stages, according to Stouffer et al. (2004), beginning with:

- 1) a notion or need (sensing, problem definition, and orientation);
 - 2) an investigation of that notion or need (testing, preparation, incubation, analysis, and ideation);
 - 3) an articulation of a new idea or solution (modifying, illumination, and synthesis); and
 - 4) a validation process of that idea or solution resulting in an idea, theory, process, or physical product (communicating, verification, and evaluation).
- (Stouffer et al., 2004)

It is during the stages 2) and 3), it seems that any one or several of the creative methods mentioned by Dhillon (2006) could be applied to 'solve' the problem.

g) Creativity in pure science. An early insight into creativity in science comes from 1959 in an article titled, "Creativity in Science" by Bonner (1959), who states, "The popular picture of the scientist in our culture might then suggest that scientific work does not grip the emotions, that it is coldly logical, that it is not creative as is the work of the artist". Bonner also points out to the misconception between applied science and 'true' science in which, "...creativity lies much deeper than the repetitive search for a better plastic or the trial and error attempt to find a better *desmogger* for exhaust pipes". Creative science, according to Bonner (1959) lies, "...in the formulation of relations between facts – the genesis of theories which bring together under one roof the observations separately housed". Creativity in science, then, is to find one unifying fact from a multitude of facts and in this regards Bonner (1959) cites the works of Darwin, whose unifying act was, "...relatedness in all creatures, related by evolution", and Niels Bohr who, "...imagined ad hoc to relate the thousands and thousands of spectral lines described as miscellaneous facts by physicists over a hundred years' into the atom". This thought is also corroborated by Koestler (1985) in his statement, "The creative act (of science) does not create something out of nothing, like the God of Old Testament; it combines reshuffles, and relates already existing but hitherto separate ideas, facts, frames of perception, associative contexts". Koestler (1985) terms this two different sets of rules, to live on several planes at once. In researching on creativity in science, many scholars have questioned on what is the 'creative' in science; the process or the output (product)? Tang and Leonard (1985) take on this question, citing the difference in their thinking with Colin Symes (citation in Tang and Leonard, 1985) and state that, 'Symes is misled by his ordinary language approach ("In ordinary speech scientists 'discover' scientific laws, they do not create or invent them") into considering in detail only the *product* of both art and science, and into failing to consider in enough depth the process that give rise to these products". They go on to assert that:

While we do say that scientists ‘discover laws’, the formulation of these laws initially as *hypothesis* is, we maintain, a creative act in the context of discovery”, and further state that, “...the act of thinking up a hypothesis possesses; speculation, imagination, and guessing, leading to a unique product, viz., a scientific law or theory.” (Tang and Leonard 1985)

In looking back at examples of scientific discovery, such as discovery of atom (by Rutherford and later) by Niels Bohr, formulation of the Theory of Relativity by Einstein and the theory of evolution by Darwin (and Wallace), cited by Bonner (1959), Koestler (1985) and others, it seems to be clear that:

- creativity in science takes several strands of truths/rules/phenomena, to combine them together/ unify into a scientific law or theory (discovery)
- this is brought about by the creative process where a hypothesis is created through faculties of creativity such as speculation, imagination and guessing leading to distinct discovery

Such a discovery is then verified as ‘truthful’ through experiments and observation by the discover(ers) and others. The real aspect of creativity in this, in the author’s opinion, is the ‘aha’ factor that the discovery brings about to the expert and the layperson alike. Based on the discussions above, creativity in science is depicted through a schematic in Figure 4.12.

Figure 4.12: Schematic depiction of creativity in science

Source: Derived by the author for this thesis

Figure 4.12 points to two areas of creativity in science, a **primary area**, which seems to have been researched and proposed by experts, and a **secondary area** where creativity is required in developing validation methods or experiments, since there is a high chance that the law/theory being proposed is new, requiring design for validation before scientific discoveries can be accepted and announced to the wider community.

It may be noted here that numerous papers, articles, book chapters and books have been written on creativity in science in the past, each expanding and expounding on minute details, while the basic structure of the creative process in (pure) science remains, more or less, the same since Bonner's article in 1959. One such paper titled, "Scientific Creativity as Constrained Stochastic Behavior: The Integration of Product, Person, and Process Perspectives", by Simonton (2003) infers that, "...scientific creativity constitutes a form of constrained stochastic behavior", based on the product, person and process. However, the author feels that the essence of creativity in (pure) science has been better distilled in Figure 4.12 from the many works.

Summary of creativity in different fields. Table 4.2 shows the summary of the creativity as understood by interpretations from the various literature in each field.

Table 4.2: Summary of Creativity in Different Fields

Field	Interpretation	Process	Outcome
Visual Art	Problem finding, Issues and Thoughts	Application of tools and methods of artistic practice Combinational Exploratory Transformational	Original work of art in the medium
Music	Spontaneity in interpretation	Composition, interpretation, expression and improvisation	Fidelity to Novelty
Performing Arts	Interpretative vision and direction	Collective creativity (except where the performance is solo)	True to the subject; not preconceived
Design	Parameters formulated to achieve the desired 'figure'	Problem decomposed to sub-problems; sub-solutions found and combined into overall solution	Equilibrium in design; optimised solution
Architecture	Produce solutions to non-routine, complex and unique problems	Fluency in producing number of solutions; Flexibility in producing different categories of solutions; Elaboration on details	Original solutions that are statically rare in response to the problem(s)
Engineering	Scrutinise and explore data and information and interact to produce perceptible solutions	Multiple methods (as described in this Chapter)	Novel and useful products/systems within a technical and social context
Pure Science	To find/define one unifying fact from a multitude of facts	Hypothesis through speculation, imagination and insight	Distinct discovery; scientific knowledge

Some key literature reviewed. Before moving on to the study of innovation, it is important to discuss on some key literature on creativity that are pertinent in the effort to derive a synoptic map of the relationship between creativity and innovation. It is to be noted here that, this is not meant to be a comprehensive survey of literature on creativity but a discussion on publications that are considered to be key markers that form a volume of work that is valuable in this study. In general, books and articles on creativity may be classified into three categories;

- guidebooks on creativity for personal or business gains,
- books and articles that deal with the subject of creativity directly as a topic
- books and articles that approach creativity from a wider perspective or different angles.

More of interest in this study are books and articles from category b) and c) rather than on a), which are guide books on 'how to be creative'. However, points and discussions from such guidebooks that have relevance will also be discussed where necessary.

Similarly, research findings in the form of journal publications and proceedings of conferences maybe classified into two categories:

- 1) articles that, inform, educate and enrich the field of creativity
- 2) articles that are specific to a claim or research question from the authors

While articles from category 1) maybe of higher relevance in this study, pertinent articles from 2) are also important.

What follows are reviews on key literature which have helped the author in⁴³:

- distinguishing what has been done from what needs to be done
- synthesizing and gaining new perspective
- identifying relationship between ideas and practice
- establishing the context and rationalizing the significance of the topic
- identifying methodologies and techniques that will help in mapping the relationship between creativity and innovation

Book 1: Perspectives in Creativity. Edited by Taylor and Getzels (1975). This book is a good starting point for researching on creativity since it has collated articles from some of the early researchers and authors on creativity. Looking at the time period that it was written, this book is quite comprehensive in the topics it has covered and forms the kernel to catalyse the ideas of the contributors, as well as the researchers and practitioners who followed, to expand on the ideas presented. Chapter 1 authored by Taylor, titled *A Retrospective View of Creativity Investigation* offers a helicopter view of the field and the key players when creativity was emerging as an important field of study. This chapter describes how, from a view that mental capacities in people are inherited and follow certain laws of transmission the discussions move to the concept that creativity is about

⁴³ The points given below are taken/modified from Hart (2013)

generating correlates, “from one idea to another idea and thereby generating a further correlative idea which might be entirely novel”, as described by Spearman in his 1931 book titled, “Creative Mind”. This concept of generating correlatives has been important while formulating the relationship between creativity and innovation. Taylor also mentions the pioneering work done by Roe (p. 9) in the 1940s and 1950s where he examined the characteristics that distinguished eminent scientist and artist. Chapter 1 also gives a concise survey of research on important areas such as the creative personality, problem formulation, creative process, creative product and creative climate as well as the creativity’s relationship with mental health, and intelligence before going on to discuss on topics such as the assessment of creativity and, whether creativity can be developed to grow interest in creativity. Early work by well-known authors such as Freud, Maslow and Jung as well as seminal work by Osborne have also been highlighted in this chapter allowing one to understand the growth of creativity as a field of research. Chapter 2 by Guilford titled *Creativity: A quarter Century of Progress* highlights the development of the subject as research and is a broad survey of the psychological research which gives an insight into theoretical aspects that helps in the evolution of a relationship between creativity and innovation. It is of interest to find chapter 4 titled *From Problem Solving to Problem Finding* by Getzels and Csikzentmihalyi addresses the need to look at creativity as a means for problem finding and changing the conception of human beings. Of the other chapters in the book, a first level interest to this doctoral study is the Chapter 10 titled *Aha!* by Sydney J. Parnes (pg 224 to 247) where he starts by discussing about increasing the chance of the “aha” for the learner through creative studies.

The other interesting chapters that contribute to a better understanding of the creative process and path to innovation are Chapter 13, *An Emerging View of Creative Action* by Taylor (pp. 297 to 325) and Chapter 14, *Creativity: Prospectus and issues* by Getzels (pp. 326 to 344) which have, in ways, given a basis of this thesis allowing the explanation of the different phases of the creativity-to-innovation path as described in this thesis. Chapter 13 of this book also discusses the understanding creativity with relation to psychological functions of art such as perceptual organization, emotional expression, symbolic communication, art appreciation and

aesthetic creation (pg 299). By discussing creativity as an art function in Chapter 13, Taylor is able to state that art creativity as an outcome of activity of inner nature, setting the tone to pick up the thread in the discussions on art and science creativity in Chapter 6 of this thesis. Chapter 14 of this book starts with the statement, “creativity is a subject deserving the most vigorous systematic inquiry” and Getzels the author points to the three overlapping periods on the investigation on creativity (upto the period of 1975) which were marked by salient emphasis on: “genius”, “giftedness”, and “creativity”. According to Getzels, genius is defined by recognised achievements and giftedness by mental tests, both of which do not ascribe a unique quality of ‘creativity’ such as achievements as well as the ability to produce results that are unique or novel. Getzels, recognizes that there are many facets to creativity and different people are creative in different situations, producing an ‘omnibus definition’ of creativity, which has already been presented in Chapter 2 of this thesis. According to Getzels, “An omnibus definition has the advantage of inclusiveness”, while the drawback is, “of being an inventory without a unifying rationale”, which the author ascribes to and hence, the author’s definition for creativity in Chapter 7 offers a wider scope to be inclusive without being a ‘wish list’. Getzels’ introduction of **“cogito”** and **“intelligo”** is an important concept that this doctoral study has re-visited, in order to take a second look at the proposed synoptic relationship map of this thesis. Getzels also brings out the tendency to place creativity into cogito component or intelligo component which according to Getzels, ‘have not solved the issue; one group charges that failure to control the feely rising ideas leads to bizarre thought fatal to creative achievement, and the other group charges that control (censorship) of the freely rising ideas leads to sterile thought fatal to creative achievement’. He then rightly points to a possibility that, ‘An obvious alternate solution is to postulate that both impulse and control are necessary in equal proportion’. While Getzels is not clear as to the fruitful outcome by this compromise, both cogito and intelligo have a role to play in the journey from creativity to innovation in the relationship map proposed in this thesis. Getzels in this chapter also floats the concept of art creativity and science creativity, pointing to the fact both artist and scientist have nature in common, the former interested expressing his/her views on life and nature, while the latter is interested in the phenomenon in nature.

Fractals

Fractals are mathematical structures in which similar patterns recur at progressively smaller scales, and describe partly random or chaotic phenomena
Image:matthewjamestaylor.com

In summary, *Perspectives in Creativity* is still relevant as a reference though the field of creativity has expanded with new thoughts and findings adding to the large information available to researchers and practitioners today. This expansion in the knowledge and research on creativity, in the author's opinion, is like fractals expanding. Hence a re-visit to the 'root' of this fractal, to understand the foundation of the thoughts on creativity by authors who can be considered pioneers in the field of creativity, is essential. Surprisingly, several concepts on creativity and creative process were re-discovered, and in doing so, has helped in defining the relationship between creativity and innovation in this doctoral study.

Book 2: The Act of Creativity. by Arthur Koestler (1964) consists of two books, the first is about the theory of the act of creation, which underlies scientific discovery and artistic originality. Koestler includes 'cosmic inspiration' as the third outcome of this act. In book two, Koestler sets out to show the basic principles that operate throughout what he describes as *organic hierarchy* and that, "phenomena analogous to creative originality can be found on all levels". Right at the start of Part 1 (The Logic of Laughter, p. 27) of Book 1, Koestler mentions a 'triptych' – a three panel carving – reproduced at the front of the book as shown in Figure 4.13, as indicating, "the three domains of creativity which shade into each other without sharp boundaries: Humour, Discovery and Art". He calls this as a, "seemingly perverse order of arrangement – the Sage flanked by the Jester and the Artist on opposite sides", alluding to discovery (science?) supported by humour on one side and the artist on the other. What is interesting is that if the triptych is a cylinder, then the Jester will be flanked by the Sage and the Artist and the Artist will be flanked by the Jester and the Sage. The immediate question raised even before starting to read the book is there a relationship between humour, discovery and art?

Figure 4.13: Triptych: Humour, Discovery and Art

Source: Koestler (1964, p.6)

Part 1 of Book 1 is titled *The Jester* with four chapters that cover, the logic of laughter, laughter and emotion, varieties of humour and from humour to discovery. Koestler takes the reader through an elaborate route of arguments, illustrations and discussions before arriving at the three main criteria of comic technique, “originality, emphasis and economy” (p. 82) which seem to resonate with the concepts of creativity. By economics, within the context of humour, Koestler says he, “does not mean mechanical brevity but implicitness”, which is to say that the listener participates in filling in on some part of the joke to enjoy the humour in its completeness. Koestler leads one to the path ‘from humour to discovery’ in the last chapter of Part 1 of Book 1, wherein Koestler discusses how within the context of humour, humour manifests itself emotionally when the reader or audience is able to ‘get the joke/humour’. Koestler ends the summary of the Part 1 of Book 1 by stating that, “The creative act, by connecting previously unrelated dimensions of experience, enables him

to attain to a higher level of mental evolution. It is an act of liberation – the defeat of habit by originality”.

Part 2 of Book1 is titled *The Sage*, with seven chapters titled Moment of Truth, Three Illustrations, Thinking Aside, Underground Games, The Spark and the Flame, The Evolution of Ideas and Science and Motion. One significant statement from the chapter titled Moments of Truth is that, “Discovery often means simply the uncovering of something which has always been there but was hidden from the eye by the blinkers of habit”. Koestler, again, argues that habit is a human trait that could be detrimental to original thinking and to discovery, which in turn could impede creativity. While discovery, especially with reference to science, is to uncover a truth or natural phenomenon, not all are discovered serendipitously since science requires a methodical approach to discover the truth behind a perceived phenomenon. Koestler summarizes this chapter by stating:

Concerning the psychology of the creative act itself, I have mentioned the following, interrelated aspects of it: the displacement of attention to something not previously noted, which was irrelevant in the old and is relevant in the new context; the discovery of hidden analogies as a result of the former; the bringing into consciousness of tacit axioms and habits of thought which were implied in the code and taken for granted; the un-covering of what has always been there. (Koestler 1964, pp. 119 – 120).

Koestler in the chapter, Three Illustrations, reinforces his claim that there is a, “bisociative pattern of the creative synthesis; the sudden interlocking of two previously unrelated skills, or matrices of thought, through historically well know examples of, ‘Gutenberg’s invention of the printing press with movable types; Kepler’s synthesis of astronomy and physics and Darwin’s theory of evolution by natural selection”. The third chapter titled Thinking Aside seems to try to decipher the subconscious phenomenon that comes to the aid of creativity in some form of ‘mystical, serendipitous’ manner. Koestler feels that this is no mystery since, “Conscious and unconscious experiences do not belong to different compartments of the mind; they form a continuous scale of gradations, of degrees of awareness”. He lays the blame on, *the mechanization of habits*, which makes a mind that has gained the mastery and skill required of a job function to operate below the threshold of awareness,

perhaps under a monotonous condition of everyday activities such as driving. The mystery element is in the subconscious intervention leading to an, “upward surge from some unknown, fertile, underground layers of mind”. This resonates with other researchers/researchers such as Csikszentmihalyi (1996) who advocate that one must be trained extensively in a field when they suddenly get into the ‘flow’ of creativity. While in agreement on the ‘flow’ of creativity, the author feels that not all creativity in one field emanates from persons who are experts in that field, i.e., domain specific. Taking up the argument from Koestler, it may be possible for someone who is experienced, but not from a particular field, to come forward with creative ideas in another, unrelated field⁴⁴. In the chapters that follow, Koestler lays the ground for understanding of our thinking process and discusses on being different in dreaming and impersonation since the creative act depends on unconscious resources and states that:

...there is a two-way traffic between conscious and unconscious. One traffic stream continually moves in a downward direction: we concentrate on new experiences, arrange them into patterns, develop new observational skills, muscular dexterities, verbal attitudes; and when these have been mastered by continued practice, the controls are handed over to a kind of automation, and the whole assembly is dispatched, along the gradients of awareness, out of sight. (Koestler, 1964, p. 181)

This seems to be leading to a regular behaviour pattern which may not be what creativity requires. Koestler continues in the same paragraph:

The upward traffic stream moves in the small fluctuating pulses from the unconscious which sustain the dynamic balance of the mind – and in rare, sudden surge of creativity, which may lead to a re-structuring the whole mental landscape”. (Koestler, 1964, p. 181)

In other words, upward traffic happens when rational controls and behaviour patterns are suspended, however a small period it is for, in order for a pulse of creativity to occur.

⁴⁴ In an article titled, “General and Domain-Specific Contributions to Creative Ideation and Creative Performance”, An and Marco (An et al., 2016) have not been able to conclusively infer in favour of one over the other

The rest of Part two of Book 1 of Koestler (1964) goes on to elaborate on inspirations, linkages, evolution of ideas at which point Koestler tries to expound on science and emotion and aesthetic satisfaction and scientific boredom which may have relevance in other aspects of research on creativity than this study.

Part three of Book 1, titled Artist starts with ‘participatory emotions’ such as laughter and weeping, mourning and relief and so on. Koestler discusses about topics such as illusion, rhythm and rhyme and image, etc., which gives the reader sense of the artist and creativity. What is interesting to the author’s study is a chapter titled ‘Infolding’ (Koestler, 1964, p. 333) where Koestler writes about the tendency of art and artist to deliberately to make, “...implicit hint, from the obvious to the allusive and oblique’, with the intention, ‘... not to obscure the message but to make it more luminous’ by compelling the recipient to work it out by himself – to re-create it”. The trick to sustain curiosity and interest is to make the message, “... more implicit, more tightly folded”. This indulgence of art, Koestler calls it “law of infolding”. The takeaway from the concept of infolding is perhaps the idea that sustainable creativity that could trigger an innovative outcome of value may need to be infolded.

Book 2 of Koestler’s *The Act of Creation* gets too detailed with chapters such as Prenatal Skills, the Ubiquitous Hierarchy, Dynamic Equilibrium, etc., which are very descriptive about concepts bordering on psychology and science, which at the point of time of publishing of the book may not have had sufficient evidence through research findings to prove Koestler’s statements and concepts. Koestler himself describes Book 2 as “methodological approach” and is meant to build support for the, “controversial theories of creative activity outlined in Book One”.

The two appendices at the end of the book are chapters by themselves with the first one about discoveries in science and the scientists. The second appendix is titled ‘Some Features of Genius’ with short biographies of famous scientists and mathematicians.

In summary Koestler introduces through this book, as early as in the 1960s, “a theory of the act of creation – of the conscious and unconscious process underlying scientific discovery, artistic originality, and comic inspiration”, which has had deep impact on later researchers of creativity.

Book 3: Creativity: Theories and Themes: Research, Development and Practice. By Mark A. Runco (2007), gives in a textbook-like manner, a comprehensive theoretical perspective on creativity, and would require an entire chapter to review within this thesis. Hence, only the important elements that pertain to the topic of the doctoral studies is presented here. Organised into ten chapters plus a concluding chapter, this book starts with a chapter titled ‘Cognition and Creativity’ where an overview of the theories of cognition is presented, starting from creativity and intelligence through threshold theory that states that, “...there is a minimum level of intelligence below which a person cannot be creative”, through associative theory of idea generation and other important aspects of associated with being a creative person. Runco in the subsequent chapters dwells on:

Development trends and influences on creativity, biological perspectives on creativity, health and clinical perspectives, social, attributional and organisational perspectives, educational perspectives, history and historiometry, culture and creativity, personality and motivation, enhancement and the fulfilment of potential before concluding on what creativity and what it is not.

Of a larger interest to this doctoral study were the chapters on culture and creativity, personality and motivation, enhancement and the fulfilment of potential (chapters 8, 9 and 10). While any studies on culture and creativity, by Runco’s admission, pose a unique risk and that generalisations are usually inappropriate, Chapter 8 does bring out interesting aspects of culture and its influence on norms and values of individuals, groups and societies. Personality and Motivation, the topic of Chapter 9 of Runco’s book, has some insights for this doctoral studies. People who are nominally creative have been found to have certain personality traits that motivates them to be creative. Some of the interesting findings that Runco quotes from other sources are:

- Creative individuals have a tendency to have several things going on at once and are able to move back and forth among them
- Creative individuals preferred, ‘...the challenge of disorder to the barrenness of simplicity’ (Runco, 2007, Chapter 9)

Other topics in this chapter such as, “controlled weirdness, deviance, psychoticism, impulsivity and adventurousness, contrarianism”, while being interesting, may not have a big impact to this thesis. Some other topics such as, “childlike tendencies, playfulness, daydreaming and paracosms”, are of greater interests as is, “perseverance and persistence and openness to experience” Also topics on, “anxiety, tolerance of ambiguity, sensitivity and confidence, self-promotion, introversion and paradoxical personalities and antimonies” are traits and behaviour patterns which are within and unique to each individuals. The concept of self-actualisation has more of a deep personal involvement special to each individual, while factors such as motivation and values have more in common with everyone. Runco also discusses on personal identity and personal efficacy of creative people, where identity is visible to all and efficacy is something that is innate within oneself. Runco also describes aspects of values and risk tolerance in creative people as well as psychological androgyny, which he describes as, “... a kind of eclectic combination of both masculine and feminine behaviors”. Androgyny, Runco describes, helps in having, “... wider range of options available to them when faced with a problem and a wider range of perspectives with which to view experience”, which he quotes from other researchers as psychologically healthy.

Chapter 10 of Runco’s book covers a wide range of topics related to how a personal and organisational enhancement can be planned and achieved, through tactics, strategies and heuristics. In Chapter 10, Runco introduces pseudo-creativity which is, ‘... parallel behaviors that are original or innovative but not creative’. He attributes pseudo-creativity to possible criminal efforts due to the lack of inhibition in the efforts. He also mentions quasi-creativity, which, “... has a high level of fantasy – but only a tenuous connection to reality’. With a long list of topics, Chapter 10 of Runco’s book is best used as reference for an individual or an organisation when encountering creativity.

Book 4: The Nature of Creativity: Contemporary

Psychological Perspectives. edited by Robert J Sternberg (1989) is another important book from the point of view of this doctoral study. It is divided into four parts, each part building up in content, starting with the, “role of the **environment** in creativity”, followed by the “role of the **individual** in creativity”, and the, “role of the **interaction** between the individual and the environment in creativity”, before, “the **integration** and conclusions”. The contributors to the book are predominantly from the psychology and computer science departments, as well as from education and child study departments of several universities. In Chapter 1, the contributing authors, Hennessey and Amabile, write about the environment that will help in the motivational state of a person to creativity terming it as *intrinsic motivation principle of creativity* which they quote early researchers to prove that, “...intrinsic motivation will lead to higher levels of creativity than ‘ego involved’, extrinsic motivation...”. This has importance to this doctoral study since in a relationship between creativity and innovation, ideas have to move from a people-creative- centred domain to a team-centred-innovation domain.

Part II of Sternberg’s book concerns the role that individuals play in creativity and is separated into two distinct approaches, **psychometry and cognitive**. As the nomenclature indicates, psychometry has to do with measurement and the approach is very scientific, which involves ‘creativity testing’ including research definition, setting up experiments, data collection and analysis. What Chapter 2 in Part II brings about, that has relevance to this thesis, is the revival of IR Taylor’s work in 1959 (refer page 46 of this thesis) on five levels of creativity:

1. **Expressive** Creativity – spontaneous drawings in children
2. **Productive** Creativity – artistic and scientific products where there are restrictions/controlled to free play
3. **Inventive** Creativity – ingenuity is displayed
4. **Innovative** Creativity – improvement through modification involving conceptualising skills
5. **Emergenative** Creativity – entirely new principle or assumptions (paradigm shift)

While appreciative of this classification of five levels, the author feels that a creative person is capable of all the five levels and is only motivated by the challenges that is offered

at each level, though some like cartoonists may want to consistently exhibit expressive and inventive creativities. Chapter 3 in Part II seems like a laboured effort to finding ways and means to put creativity to work and be able to measure it while, Chapter 4 in Part II deals with the various approaches to creativity and also to define creativity. What is interesting is in the Appendix to Chapter 4 where the author has taken a communique by a senior office at Dow Chemical Company who has defined six classes to the hundreds of definition of creativity that a literature survey would reveal, which has been depicted in Table 4.1

In the cognitive approaches to the role of the individual, Steinberg in Chapter 5 of Part II presents three facets of creativity, namely:

1. **Intelligence** – can be accounted for in terms of theory of intelligence
2. **Intellectual style** – the manner, or style of directing intelligence
3. **Personality** – certain attributes are more conducive to creativity

These three facets have been studied in detail by many others since the publication of this book. However, the headings still hold good when studying the relationship between creativity and innovation, especially with reference to creative culture, which will be discussed in Chapter 10 discussions). Chapter 6 in Part II, on problem solving and creativity, is well organised to inform the readers on creativity from a problem solving perspective. An important question asked at the end is, ‘Can one’s creativity be increased’, for which many researchers and authors such as Csikszentmihalyi and De Bono have worked and published since. Chapter 7 in Part II, about computational model of scientific insight, is technical and represents the early ideas on creativity and computation that researchers such as Amabile have worked on. Chapter 8 in Part II, titled ‘Freedom and Constraints in Creativity’ is about insights into how freedom and constraints can be extrapolated for computational algorithms and programmes. Chapter 9 in Part II looks at creativity as mechanical process which may lead to programming for artificial intelligence (AI), probably as an early attempt at the cognitive requirements for AI.

Part III of Steinberg’s book deals with the role of interaction between the individual and environment with a section in the study of creative lives and another on the study of creative

systems. Under the study of creative lives, Chapter 10 in Part III is about the evolving systems approach to creative thinking in which one subsection titled 'the role of metaphor in creative work' is of interest. The authors of this chapter, Gruber and Davis define several roles for metaphors in creativity:

1. Serve directly as a modality of thought
 2. Play a synthesising role, expressing link between disparate domains
 3. Play an analytic role – where a complex idea can be broken into components, each expressed by a metaphor
 4. Concretise abstract ideas
 5. Illuminate the abstract idea that connects different groups of concrete experiences
 6. Highlight the mismatch between the literal and metaphoric forms of an idea
 7. Serve as theory-constitutive role during direct arguments
 8. Play an expressive role, allowing for restatement of ideas developed for emphasis or communication
 9. Play an affective role through its evocative powers to charge an idea with new excitement
- (Steinberg, 1988)

Though this sounds prescriptive, the explanation of the role of metaphors in creativity is different from the step-by-step methods approach from authors such as De Bono, allowing for a choice of using metaphors in different manner. The authors cite an example of Charles Darwin's use of metaphors creatively. Chapter 11 in Part III is on the unique ability of certain creative people, on how dreams, insights and sudden visualisation bring about creativity. Concepts such as friendly catalyst, co-incidence, child prodigies are discussed as well as insight creativity and how they help in the transformation of ideas. Chapter 12 in Part III presents a synthetic approach to creativity, where the author attempts, "...to develop a framework of model of creativity in the holistic sense...", by investigating on individuals and, "...with bodies of work that are uncontroversially creative", through a structured approach which takes them through Sigmund Freud amongst others. This chapter concludes with an interesting statement, "Creative individuals often are marked by an anomalous pattern of intelligence, by a tension between personality and

domain, intelligence and field, and biological constitution and the choice of career”.⁴⁵

In the study of creative systems in Part III, chapters include society, culture and person (Chapter 13), creativity and talent as learning (Chapter 14), the possibility of invention (Chapter 15) and creativity, leadership and chance (Chapter 16). The author of Chapter 13, Csikzentmihalyi presents, “a dynamic model of the creative process”, as shown in Figure 4.14, which shows the interrelation of the three systems that Csikzentmihalyi proposes jointly determine the occurrence of a creative idea, namely person, field and domain.

Figure 4.14: Interrelations of the Three Systems
Source: Sternberg (1989, p. 329)

Csikzentmihalyi defines the **person** as combination of genetic pool and personal experience, **domain** as the symbol system of a culture and **field** as the social organisation of the domain. While Csikzentmihalyi provides elaborate explanation on his dynamic model, he brings up the two interesting models on creativity, namely **Ptolemaic** and the **Copernican** models. In the Ptolemaic model, “...the person is at the center of everything”, whereas in the Copernican model, “...the person is a part of a system of mutual influences and information”. This concept is important to this thesis at the stage of establishing the relationship model between creativity and innovation where an idea moves from Ptolemaic (creative)

⁴⁵ This correlates with the experience the author has had, except for tensions between ‘biological constitution and the choice of career’, as can be seen in Chapter 2 and Appendix A of this thesis.

culture to Copernican (innovation) culture. Chapter 14 concerns creativity and talent as learning, where the author of the chapter, H.J. Walberg, brings forth topics such as human capital theory, exceptional performance (of creative people), educational productivity, childhoods of highly eminent adults and specialised performance and creativity which appear to be starting point for research in the field of creativity. Chapter 15 titled “the possibility of invention”, deals entirely with invention, as something unique to humans, from generation, selection and preservation as a mechanism to the boundaries on which people operate, and to human creativity till explaining the inevitability of invention from a Darwinian point of view. Chapter 16 is about creativity, leadership and chance which starts with the first proposition that:

Proposition 1: *Creativity is a form of leadership in that it entails personal influence over the others.*

The author of this chapter, D.K. Simonton proposes four distinct categories to define creativity – the ‘four Ps’ of which are, “**process, product, person and persuasion**”. While the first three are mentioned by many of the authors / researchers, persuasion seems to be a new. The argument is that, “...individuals become ‘creative’ only insofar as they impress others with their creativity”. Simonton’s second proposition is:

Proposition 2: *Creativity involves the participation of chance processes both in the origination of new ideas and in the social acceptance of the ideas by others.*

Simonton believes that, “Chance intervenes in the process, product, person and persuasion sides of creativity” and describes this proposition as an important part of the creative process through arguments and mathematical relations. What is relevant to this thesis is Simonton’s statement that, “Research has in fact demonstrated the central importance of diversified, enriching environments in the emergence of individuals who attain eminence”, pointing to five domains that are important:

1. Family background
2. Role models
3. Formal Education
4. Marginality
5. Zeitgeist

This seems to correlate to Appendix A of this thesis where the author's autoethnographic experience is explained in detail. Besides the first three, what corresponds more to the author's experience is marginality and zeitgeist. Marginality corresponds to persons who are exposed to more than one cultures and zeitgeist corresponds to the political influence that one is exposed to.

Part IV and the final chapter is the summary of the previous fourteen chapters in terms of creative process, person, products and creative places (domains, fields and context). As a part of the summary of creative person, Sternberg presents a consolidated chart of the characteristics of creative person, as shown in Table 4.3.

Table 4.3: Consolidated Chart of the Characteristics of Creative Person.

Source: Sternberg (1989, p. 434)

Characteristics	Barron	Csikszentmihalyi	Feldman	Gardner	Gruber & Davis	Hennessey & Amabile	Johnson-Laird	Langley & Jones	Perkins	Schank	Simonton	Sternberg	Taylor	Torrance	Walberg	Weisberg
Originality	•										•			•	•	
Articulate and verbally fluent	•										•			•	•	
High intelligence											•				•	
Good imagination	•											•		•		
Creative in a particular domain		•		•			•	•	•		•	•		•	•	•
Thinks metaphorically	•		•		•						•	•		•		
Uses wide categories and images					•						•			•		
Flexible and skilled decision maker		•							•		•	•	•	•		
Makes independent judgments	•										•			•	•	
Copes well with novelty												•	•			
Thinks logically	•								•							
Escapes perceptual set and entrenchment	•											•	•			
Builds new structures	•											•		•		
Finds order in chaos	•				•							•				
Asks "Why?"									•			•				
Questions norms and assumptions	•								•			•				
Alert to novelty and gaps in knowledge	•								•	•	•	•		•	•	•
Uses existing knowledge as base for new ideas		•	•		•		•	•	•	•		•		•	•	•
Prefers nonverbal communication												•		•		
Creates internal visualizations					•									•		

In putting together the characteristics that the different authors put forth for the creativity in the book, Sternberg finds major controversies and contradictions when they are inspected more closely. From this contradictions, "... there

emerges an underlying theme: the creative individual as one in conflict” (Sternberg, 1989). More studies on creative people have been done since then, as reported by researchers such as Runco (2007), which have shed lights on people who are inclined to be creative.

An interesting observation in the conclusion is about, “The one characteristic that seem to prevail among creative people, ... is what seems almost to be an aesthetic ability that allows such individuals to recognise ‘good’ problem in their field and apply themselves to these problems while ignoring others” (Sternberg, 1989). This seems to correspond to the concept of ‘flow’ outlined by Csikszentmihalyi (1997).

Other influencing literature on creativity. Boden (1996) in her book titled, “The Creative Mind: Myths and Mechanisms” introduces the concept of P-creativity and H-creativity, which has been described in Chapter 2 of this thesis. Boden’s interest in this book moves towards computation and computer science, at which point the relevance to the topic of this thesis becomes distant, though not irrelevant.

Csikszentmihalyi has written several books and research papers on creativity, of which the book titled, “Creativity: Flow and the psychology of discovery and invention” (Csikszentmihalyi, 1996) is often quoted since his work is based on the study of a cross section of creative people and his discovery of a mental state of ‘flow’ that exists during the act of creation. This state of ‘flow’ can be induced, according to him by being in the zone of knowledge and getting to know the details of the field a person is working within. To this statement, the author of this thesis, who has been involved in creativity since childhood, the concept of ‘specialising’ in a field before one’s output becomes creative, seems at odds with his personal experience, where knowledge brought in from two unrelated areas has always brought about creative outputs/outcomes. However the rigour which Csikszentmihalyi has put into research on creativity needs to be acknowledged.

Amabile, through her many articles and chapters in books (Amabile, 1982, 1988, 1996, 1998) has introduced three main components of creativity, namely, **expertise, thinking and motivation** and her definition of creativity has been a starting point to explore other definitions for creativity in this thesis. Edward De Bono, through his concept of lateral thinking (De Bono, 1990) has proliferated his books on creativity although the author feels that they are about methods and steps to

achieve creativity, rather than scholarly discussions on the subject. The author wishes to acknowledge here that he has personally benefitted from de Bono's books in the early years of his professional career.

The cognitive aspects of creativity is also an important area to study to understand how human beings become creative. Works by Finke et al. (1992) and a study of how cognitive development has led to creativity in human evolution and prehistory through two significant books by Mithen (1996, 1998) and Dunbar (2014) have been background studies to this doctoral studies.

*It requires a certain amount
of sophistication to
recognise genuine creativity*
M. Csikszentmihalyi
(2014, p. 49)

Dwelling deeper at work done by Brower (2000) a concept called '**orthogenetic**' surfaces, Brower believes that, "creativity relies on establishing a knowledge base for a domain, and then recombining, realigning and reconstructing the elements and themes of that knowledge base". Brower states that:

The creative process can be characterized as "orthogenetic". What do I mean by orthogenetic psychological development? It can be defined as a qualitative change in mental functioning; either in relationship to the world or in relationship to one's self that has certain properties along the way. To qualify as meaningful development, this change must be synthetic—that is, it must involve moving to a progressively higher level of functioning; moving to a new level that does not just negate previous levels but incorporates them. To be creative, **first**, one must be living in the domain; a knowledge base for an area of expertise is an essential prerequisite. **Second**, curiosity, critical analysis, and a salubrious scepticism are essential. The person must become, in the words of a Zen master, a "great doubting mass". **Third**, one must have the ability to synergise and synthesize ideas into a meaningful entity. (Bower, 2000)

This closely corroborates with the author's own journey map of Figure 3.1, though he does not fully agreeing with the concept of living in the domain which seems to corroborate with Csikszentmihalyi's (1996) concept of being in the 'zone'.

Brower's concept can be checked by studying about well-documented creative persons / artists such as Vincent van Gogh. It is now known that van Gogh weaved and networked through multiple enterprises. It is acknowledged that van

Gogh had been a minister, a teacher, a book dealer, an art dealer, and that he spoke four languages, Dutch, French, English and Latin. According to Bower, combinations of life experiences seem to serve three important functions for creativity which are:

First, it allows the person to continue working overtime even though blind alleys are encountered and projects are shelved. **Second**, it allows for the reorganization of purpose, effect and knowledge. **Third**, it allows for the increased opportunities for novelty and the potential for the amplification and elaboration of innovative discoveries. (Bower, 2000)

Models of creativity. several attempts at presenting models have been made by well-known researchers and authors on creativity and innovation. Two such models proposed are shown in Figures 4.15 and 4.16.

Figure 4.15: Map of Creativity modified from Csikszentmihalyi

Source: pinimg.com

The modified Csikszentmihalyi's map of creativity shown in Fig. 4.15 is interesting in that it connects culture-domain, family background-person and society-field through a series of three-way connectivity and where creativity seems to be the actual outcome of the application of this connection between person, field and domain. This interpretation leads to a central theme in Csikszentmihalyi's definitions of creativity where he lays importance to field, person and domain. This interpretation, in author's opinion, is restrictive since it seems to imply that one has to be well versed in the field (which comes from the society) and domain (which comes from culture) for a person (whose traits come from

family background) to be creative. This is different from many of the definitions, especially from Sathikh (2010), Khandwalla (1984) and Puccio (2006) who stress on the **person**, **process** and the **environment**.

The model shown in Figure 4.16 on the other hand, connects creativity with cognition. While cognition is not the primary discussion of this thesis, it is interesting to note how creative traits and cognition traits parallel each other with a common area where creative ‘artefacts’ maybe assessed. By artefacts, one needs to know if Varshney et al. (2013) mean creative outcome since the central percept of this thesis is that, creative outcomes are not necessarily valuable enough to be recognised as innovation. According to Varshney et al. while idea generation maybe, “... non- Von Nuemann architecture”, in terms of cognition, defining creativity as a problem solving cognitive activity may not be exact, since this brings into question the creativity in non-problem solving activities such as art, music, performance, etc. However, a similar Venn diagram approach could be applied to the different forms of creativity, which is beyond the scope of this thesis.

Figure 4.16: Venn Diagram of creativity and cognition
Source: Varshney et al. (2013)

There are many more visual representations and depictions of creativity which would require a dedicated documentation by itself and are not presented herein in order not to digress from the intent of this thesis.

Table 4.4: Summary of Literature on Creativity

Title & Author	Key Points	Remarks
Perspectives in Creativity I.A. Taylor & J.W. Getzels (Ed)	A comprehensive literature on creativity for its time. The editors seem to set the tone for future research.	Some fundamental concepts could be revisited in today's context
The Art of Creativity A. Koestler	Presents key concepts in creativity in performing arts topics (Jester, stage, artist, etc.). Brings out an understanding all aspects of creativity in an involved manner.	A detailed book outlining many concepts in a non-academic manner for everyone's ability to understand.
Creativity: Theories and Themes M.A.Runco	A summary of key research / research topics on creativity.	Each chapter is a research topic by itself; allows readers to understand that topic without having to read the book in sequence.
The Nature of Creativity: Contemporary Psychological Perspectives R.J.Sternberg (Ed)	Well laid out book, takes the concept of creativity through the roles played by the environment, individuals as well as the role of interaction between the two.	Concepts leading to future possibilities of creativity through computational science.

Table 4.4 summarises in brief, the key literature on creativity that have been discussed in detail in this chapter.

Understanding creativity which straddles several domains as a human quality, both as general and academic/research topic, allows for the understanding in detail of the key concepts in creativity in order to move the discussion towards innovation as a next step in this thesis.

5. Innovation

Innovation is not the product of logical thought, even though the final product is tied to a logical structure.
Albert Einstein
Source: forbes.com

Innovation is a subject of interest since the recent past, especially with the business and industry community around the world. Peter Drucker, a renowned writer on management, perhaps pushed innovation (along with entrepreneurship) to the forefront through his book, *Innovation and Entrepreneurship: Practice and Principles* (Drucker, 2007), which was first published in 1985. The earliest work on the subject that is traceable is a book titled, “Innovation: The Basis of Cultural Change”, by H.G. Barnett in 1953 (Barnett, 1953). The author finds Barnett’s definition of innovation and the treatment of the subject to be more concise and suitable for today than the definitions from many other experts.

In this doctoral study that intends to discover the relationship between creativity and innovation, it is important to understand the innovation process across the spectrum of several fields and establish the differences between creativity and innovation. In order to achieve this, Chapter 5 is dedicated solely to the study of Innovation.

This chapter starts with a study of some models of innovation that will help in the understanding of innovation, before moving on to interpretative definitions of innovation in the wider spectrum of liberal arts, where examples that illustrate the different meaning of innovation in each of the field will be presented and discussed briefly.

This chapter will then review some of key work done by academic, consultants, writers and commentators, such as Drucker (2007), Kelley (2001, 2005), DeBes and Kotler (2012), King (1990), Isaksen and Akkermans, (2011), Jacobs (2007) and Morris (2011) amongst others. Recent work by Vijay Kumar (2013) will also be studied together with the author’s own work in the recent past (Sathikh, 2010,2014,2015). This chapter intends, not only, to understand and unravel the many concepts on innovation, but also to lay the basis for understanding the relationship between creativity and innovation.

Models of innovation. Chapter 2 of this thesis introduced two models of innovation, one from Amabile (1988) and the other from de Bes and Kotler (2012) (Figures 2.5 and 2.6), arguing that both are very complex, and hence, complicated, and that there may be other models of innovation that are simpler. A

more interesting model of innovation has been derived by Cropley (2015) called ‘the Innovation Phase Model (IPM)’ as shown in Table 5.1. According to Cropley the IPM model is derived through an instrument called “Innovation Phase Assessment Instrument” (IPAI) which is complicated and is meant to be used in measuring organisational creativity. IPAI is derived from an innovation process based on seven phases and six dimensions as described by Cropley et al. (2013) as follows:

Seven phases of innovation: preparation, activation, generation, illumination, verification, communication, and validation

Six dimensions of innovation: process, motivation, personal properties, feelings, product, (environment) press

(Cropley et al., 2013)

More details on the derivation of IPAI can be had from Cropley et al. (2013). To summarise, there are 42 nodes derived from multiplying the seven phases with the six dimensions. According to Cropley et al. (2013), “The instrument contains four items for each of the 42 nodes represented by the intersection of a phase and a dimension. This results in a total of 168 items, and which during testing with human subjects, “...are scattered randomly throughout the 168-item scale, to reduce the likelihood of raters recognizing that certain items belong together”.

Table 5.1: The Innovation Phase Model (IPM)
Source: Cropley (2015)

		Invention					Exploitation	
	Phase	Preparation Knowledge, problem recognition	Activation Problem definition, refinement	Generation Many candidate solutions	Illumination A few promising solutions	Verification A single optimal solution	Communication A working prototype	Validation A successful 'product'
Dimension	Poles							
Process	Convergent vs Divergent	Convergent	Divergent	Divergent	Convergent	Convergent	Mixed	Convergent
Person (Motivation)	Reactive vs Proactive	Mixed	Proactive	Proactive	Proactive	Mixed	Reactive	Reactive
Person (Properties)	Adaptive vs Innovative	Adaptive	Innovative	Innovative	Innovative	Adaptive	Adaptive	Adaptive
Person (Feelings)	Conserving vs Generative	Conserving	Generative	Generative	Generative	Conserving	Conserving	Conserving
Product	Routine vs Creative	Routine	Creative	Creative	Creative	Routine	Routine	Routine
Press	High Demand vs Low Demand	High	Low	Low	Low	High	High	High

While IPM model is a comprehensive approach to depicting innovation, it is complicated for a non-trained person to understand. In trying to build a heuristic models of innovation, Cropley (2015), as well as Amabile (1998) and de Bes and Kotler (2012) describe the creativity-to-innovation process as going back and forth. While convergent-divergent thinking and action is a part of creative process, this process may not happen in a formulaic manner as described by Cropley et al. (2013) and others. Far more interesting is a table comparing the different innovation models presented by Cropley et al. (2013) as shown in Table 5.2. This model is a consolidation from the description of generation of models of creativity by Marinova and Phillimore (2003).

Table 5.2: Comparison of Classes of Innovation Models
Source: Cropley et al. (2013)

<i>Model Class</i>	<i>Focus</i>	<i>Strength</i>	<i>Weakness</i>
Black Box	R&D \$ in = new products out.	R&D investment and forward looking management leads to innovation.	No focus on the innovation process itself.
Linear	Technology-push or market-pull drives innovation.	Success/failure of innovation traced to rational, economic “push” or “pull” factors.	Unrealistic model of innovation processes. “Technological incrementalism” and neglect of R&D (Rothwell, 1994).
Interactive	“Complex net of communication paths, both intra-organizational and extra-organizational, linking together the various in-house functions and linking the firm to the broader scientific and technological community and to the marketplace” (Rothwell & Zegveld, 1985, p. 50).	“Focus on the variety of interactions necessary for the success of innovation” (Marinova & Phillimore, 2003, p. 51). Successful innovation based on multiple factors.	“Still did not explain what drives the engine of innovation and why some companies are better at doing it than others” (Marinova & Phillimore, 2003, p. 47).
Systems	Small firms and networks as a means to effective innovation. “Integration and parallel development” (Rothwell, 1994, p. 11).	Shows how small companies can play a role in the process of innovation.	The same qualities which make networks of small companies a strength can also be their weakness.
Evolutionary	Biological analogy – Darwinian evolution as a model for innovation in companies.	Innovation is driven not merely by rational economic factors. Stresses the role of the business environment in determining successful innovation.	The model is based on continuous, unpredictable change and adaptation. Lack of predictive power. Model does not explain “revolutionary” change.
Milieux	“Innovation stems from a creative combination of generic knowledge and specific competencies” and “territorial organization” is a critical component (Bramanti & Ratti, 1997, p. 5).	The interaction of small, flexible organizations and geographical location as a driver of innovation. “Innovation Clusters” (Marinova & Phillimore, 2003, p. 47).	Looks at cognitive aspects (knowledge), but does not take account of non-cognitive factors (e.g., motivation).

Note: The citations given within this table is from the reference section of Cropley et al. (2013)

The six models of classes shown in Table 5.2 follow a chronological derivation of six generations of innovation models. More detailed explanations of the six model classes shown in Table 5.2 can be had from Marinova and Phillimore (2003). Again, this comparison shows a plethora of approach and seems to aim at presenting a value proposition of profit from a business management perspective, except for ‘Evolutionary’ model, which is derived from Darwinian evolution as analogy. If taken in its more purer form, the evolutionary model of innovation may present socio-

evolutionary value propositions. This is better understood from Mithen (1996 and 1998) where he explains creativity of ‘making for survival’ as leading to the application of creativity for a more ‘pleasurable pursuit of depicting reality in a near realistic as well as abstract manner’, thus presenting an evolutionary innovation over time.

More concepts and models of innovation, including, “e-innovation” in relation to artificial intelligence is discussed in detail in the book titled, “The International Handbook on Innovation”, edited by Larisa V. Shavinina (Shavinina, 2003).

Approaches to defining innovation. Innovation may be seen from two different perspectives. The first, from an economic/business proposition as many of the experts on innovation including Drucker (2007) imply and the second, as change, including new methods or process that a creative individual or group may engage in, bringing about a new value proposition in the outcome of that innovation. Again, unless one dwells deeper into the concept of innovation, even the second proposition, innovation bringing a certain value proposition may be deducted as economic/business entity. Does innovation appear beyond the business / economy realm then? Is innovation equally important within the liberal art spectrum that is depicted in Figure 4.3. In naming the first chapter as **Pigment to Pixel** (page 3) in his book titled *Art Practice as Research*, Sullivan (2010) seem to point to innovation in visual art clearly as that of finding a new medium to express the work of visual arts. This seems to suggest that definitions for innovation within the liberal art spectrum is possible. Hence before seeking out interpretative definitions for innovation within the realm of business and economy, it is important to attempt at establishing the definitions for innovation within the various components of the liberal art spectrum depicted in Figure 4.3.

Innovation in visual art; In a working paper titled, “Analyzing Artistic Innovation: The Greatest Breakthroughs of the Twentieth Century”, David W. Galenson (Galenson, 2006) quotes Alan Bowness on the importance of innovation in visual art:

[The artist] has to make an enormous effort to lift himself above his contemporaries. This results in what we often call the “breakthrough,” that every artist on the path to success has to make. (Galenson, 2006)

In visual art, innovation seems to occur in the following manner:

- a) Innovation in technique
- b) Innovation in tools (& their techniques)
- c) Conceptual

a) Innovation in technique. This is evidenced in the works of Vincent van Gogh, especially in his use of complimentary colours. Berezhnoy et al. (2007) in their paper titled, “Computer analysis of Van Gogh’s complementary colours”, state that, “Attempting to mimic and amplify the perceptual impact of natural scenes, Vincent Van Gogh used complementary colours as a means to emphasize contours and to enhance the vividness of natural colours”. To prove this Berezhnoy et al. (2007) went on and, “performed a digital analysis of 145 of Van Gogh’s oil-on- canvas paintings in an attempt to quantify and detect the transition in his usage of complementary colours”. Van Gogh’s artistic innovation was not only in techniques of using colours but also in the technique of applying them. Close-up studies of the usage of colours, brush strokes and application techniques have been widely undertaken to show Van Gogh’s innovation in painting technique. Figure 5.1 shows a detailed image of Van Gogh’s application technique from Google Arts & Culture⁴⁶.

Figure 5.1: Close-up detail of Vincent van Gogh’s Quay with Men Unloading Sand Barges, 1888.

Source: artsandculture.google.com

⁴⁶ <https://www.google.com/culturalinstitute/beta/exhibit/UQKy1roGr95tKw>, retrieved on 18 July 2020.

b) Innovative in the use of tools and their techniques. Roy Lichtenstein, another artist from the Pop Art era was innovative in the use of tools and techniques. His innovation in visual art was in appropriating, “the Benday dots, the minute mechanical patterning used in commercial engraving, to convey texture and gradations of color—a stylistic language synonymous with his subject matter”. According to The Lichtenstein Foundation⁴⁷, “The dots became a trademark device forever identified with Lichtenstein and Pop Art”. This foundation also has another website dedicated to Lichtenstein’s art over the years from which Figure 5.2 shows a typical art piece titled ‘WHAAM!’ which depicts his innovation in visual art technique.

Figure 5.2: WHAAM! by Roy Lichtenstein, 1963

Source: www.imageduplicator.com

c) Conceptual innovation. This can be seen in the works of Pablo Picasso and Andy Warhol. According to Galenson (2006), “Cubism was a quintessentially conceptual innovation, which Picasso created to represent his knowledge of objects rather than to describe their appearance”. Galenson’s (2006) article titled, “Analysing Artistic Innovation: The Greatest Breakthrough of the Twentieth Century”, discusses about Picasso’s early discovery of cubism in which Picasso, as early as 1907, “unambiguously declares the radical new approaches to the representation of space and to the construction of form that would stand as Cubism’s most important legacy to modern art”. Picasso progressed from, “early, or analytical, Cubism to late, synthetic Cubism”, which is a radical innovation by Picasso according to Galenson (2006), where Picasso pasted a small piece of oilcloth to the canvas in a work titled *Still Life with Chair Caning* (1912). According to Galenson (2006), “This marked a radical departure from artistic tradition, for by attaching a real object

⁴⁷ <http://lichtensteinfoundation.org/biography/>, retrieved on 18 July 2020.

to his canvas Picasso violated the two-dimensional surface of the picture plane that Western painters had respected for five centuries” and, “This apparently innocuous act was the seminal event for the unprecedented proliferation of artistic genres that would occur over the course of the twentieth century”. Figure 5.3 shows the outcome of synthetic Cubism of Picasso.

Figure 5.3: Still Life with Chair Caning by Pablo Picasso, 1912
Source: www.pablopicasso.org

Andy Warhol’s conceptual innovation, on the other hand, was to pick up commonly found, mass-produced objects and painting them in a manner that reflected his background in graphic design and advertising. According to The Andy Warhol Foundation for the Visual Arts⁴⁸:

Decades before widespread reliance on portable media devices, he documented his daily activities and interactions on his traveling audio tape recorder and beloved Minox 35EL camera. Predating the hyper-personal outlets now provided online by social media sites such as Instagram, Warhol captured life’s every minute detail in all its messy, ordinary glamour and broadcast it through his work, to a wide and receptive audience.
(Warholfoundation.org)

This is another of his conceptual innovation, well before the Internet era. Figure 5.4 shows one of Warhol’s famous prints of Campbell’s Soups, which went on to become one of the recognisable icons of the Pop Art movement.

⁴⁸ warholfoundation.org, retrieved on 18 July 2019

Figure 5.4: Campbell's Soup Cans (partial) by Andy Warhol, 1962

Source: guyhepner.com

Many more examples could be presented for innovation in technique and conceptual innovation, in view of the technological development over the last twenty-five years leading to 'digital art' and 'digital artists'. For example, even as early as 1979, the Ars Electronica Festival has been organised by Ars Electronica Linz GmbH & Co⁴⁹ According to their website, the Ars Electronica Festival, "...was designed to take the Digital Revolution's emergence as an occasion to face important questions about the future and to focus these inquiries on the nexus of ART, TECHNOLOGY and SOCIETY". The works exhibited throughout show examples of how digital technology has proved to offer both innovation in technique as well as conceptual innovation. Figure 5.5 shows such a digital art work titled *Light Echoes* by Aaron Koblin and Ben Tricklebank, both from the United States of America at the Ars Electronica Festival 2017.

Figure 5.5: *Light Echoes* by Aaron Koblin & Ben Tricklebank
Source: aaronkpblin.com

⁴⁹ <https://www.aec.at/about/en/>, retrieved on 18 July 2019

Innovation in music. While creativity in music provides opportunities to exercise creativity in, “*composition, interpretation, expressive performance and improvisation*”, most of the scholarly writings and examples on innovation in music tend to focus on the technological and commercial value propositions in the music industry rather than on the innovation on the music per se. Dedicated books on this subject, such as a book titled, “Creativity and Innovation in the Music Industry”, written by Peter Tschmuck (Tschmuck, 2012), analyse and write about how the music industry has benefitted from technology and how business innovations has opened up new means, markets and distribution channels/methods, especially over the last century. On closer look at music and musicians, innovations, especially in the genre of music, start to emerge. Jazz, a musical art form to emerge particularly from American born black people at during early twentieth century, according to Bastien, et al. (1998) is, “a celebration of the process of creating music, a form for musical innovation that engages performers as active composers in the collective invention, adoption, and implementation of new musical ideas”. Similarly, the emergence of music genres such Blues, Rock n Roll, Pop, Rock, Country, etc., maybe cited as examples of innovation in music which have either many roots including innovations in music instruments through technology. Traditional music innovations that resemble jazz music in terms of its collective invention, adoption, implementation, etc., have emerged in many parts of the world, a better example being ‘jugalbandi’ performance where two musicians of, many times, different musical traditions such northern Indian classical (Hindustani) and south Indian classical (Carnatic), play together. Jugalbandi could be also be between, say Hindustani music and Jazz music, or Hindustani music and Arab music, etc. A more interesting aspect of music innovations that developed and evolved in South Africa as a cultural influence on the resistance to apartheid has been well documented in a journal article written by Ingrid Bianca Byerly titled, “Mirror, Mediator, and Prophet: The Music Indaba of Late-Apartheid South Africa”, (Byerly, 1998). Elaborate and detailed, this article by Byerly has captured the multi-faceted aspects of colonisation, people, language, tradition and culture that came together, which is depicted in Figure 5.6. As a foot note to the figure shown in Figure 5.6, Byerly (1998) cautions, “This figure serves as a visual representation of seminal genres as they moved from their approximate appearance towards

trends of collaboration. Some styles are, of course, more influential than others, but suggesting these details would not only be subjective, but also add excessive complexity to the visual image". The music 'indaba' described by Byerly (1998) may perhaps be one of the clear example of musical innovations that contributed to a societal level value proposition that ultimately lead to South Africa becoming a republic, free of apartheid. The example by Byerly (1998) depicts the example of the fourth level '**innovative creativity**', described in Figure 4.2, which was able to, "a) penetrate foundational principles as well as b) establish a school of thought, and c) formulate innovative departures which influenced the ongoing struggle to the end of apartheid in South Africa at that point in time".

Figure 5.6: Development of Musical Styles from Autonomy to Collaboration

Source: Byerly (1998)

Innovation in performing arts. Innovation in performing arts, in many ways, like innovation in music has two facets to it. On the one hand, commercial value creation through advances in technology count as innovation, while performing arts by itself has potentials for innovation, on the other. Andrée Grau (Grau, 2010) in an article titled *Intercultural Research in Performing Arts* discusses the opportunity for innovation in performing arts in stating:

Artists all over the world and throughout history have been inspired by and have borrowed from the art of 'others'. Their societies' views on creativity, originality, or innovation dictated what was acceptable for them to incorporate in their art if they wanted it to be recognized as such by at least some members of their social group. (Grau, 2010)

This points to, much like in the case of innovation in music, the ability to learn other performing art forms, work together with those who practice other forms of performance. While discussing on 'The Desire for Truly Intercultural Work' (Grau, 2010, pp.14 - 15) he observes that performing art exponents derive intercultural performing arts by:

- a. immersing themselves into another form of practice say Western artiste immersing in non-Western performance form and become an accomplished artiste in that new form
- b. immersing themselves, not to become an accomplished artiste but to derive a 'hybridization', which he sees as, 'analogous to the process of formation of a creole language'
- c. some artists going beyond a) and b) to try to find, '...the opportunity to gather together masters of both Eastern and Western theatre, to compare the most disparate work methods, and to reach down into a common technical substratum.... This common substratum is the domain of pre-expressivity' and use this as a basis to develop new form of performance".
- d. when the time is right in their own creative process, they want to study and understand principles of one or more forms in order to enrich their own vocabulary.
- e. seeing, '...themselves as artists working in the West, wanting to develop their creativity further and they are interested in underlying principles which may be

'universals', but in addition they are not interested in a one-way process of borrowing, but are looking for interactions between artists from different cultural systems, so that different kinds of artistic knowledge can be shared in order to create something new'.
(Grau, 2010)

The description by Grau (2010) is a clear indication of innovation in performing arts which can be seen even today as we move towards the digital era of performing arts. One of the early proponents of innovation in performing arts is Jean Michel Jarre, a French composer, performer and music producer, and a pioneer of electronic music, who may be considered as the “Godfather of electronic music”⁵⁰. He has been acclaimed as the creator of a new format of out-door concert performance which involves performing in front of 2.5 to 3.5million in public spaces that are not the typical venues for concerts. Jarre’s innovation in performing arts can be described as:

The combination of composed electronic music, together with carefully (computer)programmed lighting performance synchronized with large scale computer created image projection, that uses the environment and the architecture of the location as the canvass, all of which are coordinated to the music.

Figure 5.7 shows two such innovative performance by Jean Michel Jarre showing the spectacle and the scale of his concert.

⁵⁰ <https://jeanmicheljarre.com>, retrieved on 18 July 2019

Figure 5.7: Jean Michel Jarre's concerts in Helsinki (left) and at Monaco (Right)

Source: rashmee.medium.com (Left)
montecarlodailyphoto.com (right)

In searching for literature on innovation in performing arts, several articles surfaced, written at a scholarly level, on the innovation in this field. In an article titled, "Cultural Matrices and the Shaping of Innovation in Central Javanese Performing Arts", Benjamin Brinner (1995) identifies "concept of *cultural matrix* as a formalized expression of common patterns of characterization and categorization of repertoire, practice, and other cultural knowledge associated with Javanese performing arts". According to Brinner (1995), "A cultural matrix is a set of categories created by the intersection of two or more sets of distinctions. I shall use the word dimension to denote each such set of distinctions". Brinner (1995) brings out the inner ideas of the dimensions by mentioning that, "A dimension can be musical, dramatic, choreographic, social, geo-graphical, or political in nature". In the example of Jean Michelle Jarre, he could bring about a cultural matrix consisting of different dimensions from music, electronics and programming, lights and projection, pyrotechnics, both real and as light and laser spectacle, on stage music concert and stage performance, pointing clearly to innovation in performance arts. Brinner's article (Brinner, 1995) goes on to develop a visual representation of matrices related to Central Javanese culture and performing arts, which, though very involved and interesting, goes beyond the scope of this thesis. What is interesting is that Brinner argues that, "Much of the change that has occurred in Javanese performing arts results from altering existing pieces or practices, mixing and matching

traditional elements, or creating new compositions modelled on existing ones” and states that, “in many cases the choice of subjects to alter, items to combine, and models to copy has been influenced by cultural matrices”, and that:

... matrices have served to channel innovation in a substantial number of cases by restricting or privileging particular options, and that the qualities of completeness and balance associated with matrices have provided motivation, directing attention to untried possibilities and offering a means of judging and justifying the appropriateness of artistic decisions.
(Brinner, 1995)

While the concept of matrices may be applied to the different types of innovation explained in this chapter, *cultural matrices*, through its social and political dimensions, probably are the underlying structure on which innovation in performing arts could derive from.

Innovation in design. Since design is associated with many domains and contexts, innovation in design can be construed in at least two ways:

- a) Innovation in design methods
- b) innovation through design

a) Innovation in design methods represents innovation in design itself as a subject/topic/profession in terms of the tools, approach or process, etc. From the early days of design, perhaps dating from the start of Vereinigten Werkstätten (United Workshops) in 1897 by Peter Behrens⁵¹ till today, design as a subject/topic and profession has undergone profound changes brought about by innovations in several supporting fields and in terms of tools. Victor Margolin, professor emeritus of design history at the University of Illinois in Chicago, USA, in an interview with Steven Hiller of “The Atlantic Magazine”⁵² states that, “What we call design today, is continuous with the basic human need to organize the material environment for survival purposes”, signifying that there needed to be continuous innovation in planning, knowledge, skills, tools, methods and strategy for design to be effective. Hence, when design emerged as a separate entity or profession at the end of 19th century, it initially

⁵¹ <https://designhistoryresearch.wordpress.com/category/peter-behrens/>, retrieved on 18 July 2019.

⁵² <https://www.theatlantic.com/entertainment/archive/2015/04/a-more-inclusive-history-of-design/390069/>, retrieved on 18 July 2019.

borrowed techniques such as sketching and model making from architecture to be used as visualising method and presentation tools. Raymond Loewy⁵³, a celebrated industrial designer who launched his career in 1929, has been credited to bringing clay as a model making material from sculpting when he was commissioned to redesign the Gestetner mimeograph machine in 1929. He also was an early proponent of perspective rendering using watercolour, crayons, pencil and gouache, known toolkits from the artist. Henry Dreyfuss⁵⁴, another pioneering industrial designer who also started his career in 1929, brought in ergonomics as an important element in design. Development in machinery such as milling machines which became CNC machines contributed to better model and prototype making abilities. Gradual introduction of computing, leading to real time sketching and computer aided design software accelerated the design process from the mid 1960s onwards, aligning design with engineering and manufacture. The emergence of 3D printing as additive manufacturing technology has further influenced the whole design process in the last twenty years. These are only key indicators of innovation in design methods, in one area, namely industrial design. Similar innovation in design has occurred almost parallel in graphics design/visual communication over the years. With the advent of electronics and information technology, design has seen the emergence of an entire new field of interaction design and user interface/experience design with more and more being added such as service design, etc.

b) Innovation through design is the outcome of process in which design is the primary or dominant operator to arrive at an end point, which maybe a product, system, graphics, media or any other outcome that is valuable and qualify as innovation. A notable book on the subject of innovation through design is written by Roberto Verganti (Verganti, 2009). Titled “Design-Driven Innovation”, Verganti has been able to clearly argue that innovations in design methods such as ‘user-centred’ and ‘human-centred’ design are useful for incremental innovation while only ‘design-driven’ innovation can bring about a true radical innovation which brings about a change in the meaning of the end destination of a design process. Verganti (2009) drives this point further by quoting

⁵³ <http://www.raymondloewy.org>, retrieved on 19 July 2019.

⁵⁴ <http://www.idsa.org/content/henry-dreyfuss-fidsa>, retrieved on 19 July 2019.

Klaus Krippendorff's definition of design as, "The etymology of design goes back to the Latin *de + signare* and means making something distinguishing it by a sign, giving it significance, designating its relation to other things, owners, users or gods", and interprets Krippendorff's definition as, "*design is making sense [of things]*" (p. 27). While, incremental innovation through the process of design, resulting in styling/aesthetics, better comfort, brand visibility, etc., is still innovation, if there is perceivable/measurable value at the end of the design process, the author tends to agree with Verganti on the need to look at radical innovation that is possible through a design-driven process which goes beyond the object to the making meaning, be it in use and function, through new technology, etc., as the value proposition. Verganti (2009) presents a model that shows the area of design-driven innovation against innovation led by technology-push and market-pull as seen in Figure 5.8.

Figure 5.8: Positioning Design-Driven Innovation

Source: Verganti (2009, p. 5)

What Figure 5.8 signifies is that, irrespective of the level of technology - high or low, design-driven process brings about a radical change in the meaning or in other words, the value, thus bringing about radical innovation. This thesis will take as case studies of such design-driven innovation from the industry in Chapter 8, to illustrate not only the occurrence of radical, and to a level transformational change in the values, but also to elucidate the main core of this thesis, namely the flow of creativity into innovation.

Innovation in architecture. Innovation in architecture is similar in characteristics to innovation in design. The first level of innovation in architecture is in the approach, methods, tools and practice in architecture, while the second level is innovation brought about by architecture. These two may be termed as:

- a) Innovation in architecture design methods
- b) Innovation through architecture

a) Innovation in architecture design methods. Architecture in general involves design in a larger scale and involves living, working, leisure, entertainment aspects of, predominantly, human habitat. A study of innovation will likely take us to the historical evolution of human kind and their living environment across the migration out of Africa. Hence, innovation that have occurred over the industrial revolution period, spanning two centuries, which could better represent innovation within the context of this thesis, may be considered. The use of steel together with concrete as building material allowed for not just for the tall skyscrapers but also allow for pre-built structures to be assembled together paved the way for innovation in architecture design methods. In a book titled, “The New Architecture and the Bauhaus”, Walter Gropius (Gropius,1965) writes about the definite change in architecture design methods by declaring:

The liberation of architecture from a welter of ornament, the emphasis on its structural functions, and the concentration on concise and economical solutions, represent the purely material side of that formalizing process on which the practical value of the New Architecture depends. (Gropius, 1965, pp. 23 – 24)

Gropius further says:

One of the outstanding achievements of the new constructional technique has been the abolition of the separating function of the wall. Instead of making the walls the element of support, as in a brick-built house, our new space-saving construction transfers the whole load of the structure to a steel or concrete framework.
(Gropius, 1965, pp. 25 – 26)

The words of Walter Gropius puts in place the innovation brought about by architectural design methods, due to developments in materials and civil engineering practice, that

followed, from the likes of La Corbusier, Louis Kahn, Frank Gehry and other famous architects.

Another example of innovation in architecture design methods is given by Boland et al. (2007) in an article titled, “Wakes of Innovation in Project Networks: The Case of Digital 3-D Representations in Architecture, Engineering, and Construction”, where they cite how the visually exciting architecture of the famous Frank Gehry for a building called, ‘Peter B. Lewis Building’, in Cleveland, Ohio, USA as shown in Figure 5.9.

In that article, the authors state, “his (Gehry’s) ability to spawn wakes of technology and process innovations in the tradition-bound architecture, engineering, and construction (AEC) industries is another important part of his legacy”, and go on to mention the following innovations during the building of Peter N. Lewis Building alone:

- (a) the structural engineering firm invented a new method for designing a steel roof with dramatically curved surfaces, which won an industry award for engineering innovation;
- (b) the drywall contractor invented multiple patent-able ways to frame undulating wall surfaces, and began a new line of business, consulting on high-profile construction projects;
- (c) the Cleveland fire marshal developed new techniques for modeling smoke evacuation, which were then presented at their national training academy;
- (d) the specialty metal contractor invented a water-proof shingling system that dramatically reduced the thickness and cost of the roofing;
- (e) the construction manager expanded its scope of work and began providing location measurements to contractors, increasing its own risk, but reducing construction time and construction errors; and
- (f) the drywall contractor became the first American company to license a soundproof plaster system from Swiss developers, which created a new line of specialty business for them. (Boland et al., 2007)

Figure 5.9: Peter B. Lewis Building by Frank Gehry

Source: <https://bluffton.edu>

In each of these innovations, unique value propositions seem to have been achieved which are unique instead of falling back on time trusted existing methods and processes. Boland et al. (2007) also indicate the same by stating, “...these innovations were carried forward into subsequent, non-Gehry projects by the innovating firms, thereby strengthening each individual organization, as well as the AEC industries” and further mention that, “...they also served to influence each other as interacting wakes of innovation.”

Innovations in architectural design methods also seem to be the hallmark of architects such as Zaha Hadid Associates and Thomas Heatherwick as seen in the examples of their architectural work in Singapore as shown in Figure 5.10.

Figure 5.10: Nassim Villas by Zaha Hadid (L) & The Hive by Thomas Heatherwick (R)

Source: <https://buro247.sg> & medium.com

b) Innovation through architecture. While innovation in architecture design methods provide means to design, architecture by itself could be innovative. Buckminster Fuller's geodesic dome is one example of innovation through architecture. Geodesic domes are unique in the sense that it can carry large loads with minimum amount of materials. Added to that is the energy efficiency offered by geodesic domes. Ingber (1998) in an article titled, "The Architecture of Life", mentions that the geodesic dome is based on a concept of 'tensegrity' which make the structure mechanically stable by, "...the way the entire structure distributes and balances mechanical stress" and, "... are basically frameworks made up of rigid struts, each of which can bear tension or compression" which are, "oriented so as to constrain each joint to a fixed position, thereby assuring the stability of the whole structure". Figure 5.11 shows one of the most famous geodesic structure designed by Buckminster Fuller for the American pavilion at the Montreal Expo 67.

*Figure 5.11: The American Pavilion at Montreal Expo 67 by
Buckminster Fuller*

Source: untappedcities.com

Another example of innovation through architecture is the architectural work of the Zimbabwean born architect Mick Pearce. Pearce has designed and seen to completion, at least two buildings that answer to his 'energy imperative' for the earth. In a chapter titled "From Eastgate to CH2: Building on the Energy Watershed" in the book *City Edge: Case Studies in Contemporary Urbanism*", edited by Charlesworth (2005), Pearce describes two projects, the first done in Harare, Zimbabwe and the other in Melbourne, Australia, where he brings in the three international laws or principles that govern the tax based economic system which are equally important to energy management in architecture; the laws of scale, allocation and distribution (Charlesworth 2005, p. 182). Pearce's first success in his pursuit of energy imperative in architecture was in the design of Eastgate, a commercial building in the business district of Harare, Zimbabwe. Eastgate is a low-energy building designed based on the ecology of the termitary built by termites in nature. In Pearce's own words, "Like a termitary it was 'air-conditioned' naturally. Cool night air was harvested and stored within the concrete structure of the building for dispersal the following day to cool the building passively" (Charlesworth 2005, p. 185). The sectional view of the building drawn by Pearce's practise is shown in Figure 5.12.

Figure 5.12: Cross sectional view of the Eastgate designed by Mick Pearce

Source: www.mickpearce.com

Figure 5.13 shows the images of the Eastgate where the two energy-saving 'chimneys' are clearly shown. Pearce has used this termitary ecology to build another commercial building 'CH2' in Melbourne, Australia, which harvests wind energy as well as mine the sewer below, besides using the energy

saving principles of tectonics and other energy saving materials and methods (Charlesworth 2005, p. 186).

Figure 5.13: Eastgate designed by Mick Pearce

Source: earthbound.report

Based on the Taylor's Hierarchy of Creativity shown in Figure 4.2, innovation through architecture is a result of what may be termed as the fourth level or accent of creativity, namely innovative creativity since it paves way for a new or innovative departure. This is depicted clearly in the examples of Geodesic dome and the termite based Eastgate and CH2.

Innovation in engineering. Engineering, in applying technology derived from science, at the outset seems to apply hypothesis which are synthesised from technology that could be measured, verified and validated within a system as well from outside. The late astronaut Neil Armstrong, in his foreword to the book titled, "Century of Innovation: Twenty Engineering Achievements that Transformed Our Lives", clearly captures this when he says, "Engineering turns those explanations (of science) into new or improved machines, technologies and processes – to bring reality to ideas and to provide solutions to societal needs" (Constable and Somerville, 2003, p. vi). What perhaps started out as civil engineering, added mechanical engineering, followed by electrical, electronics and chemical engineering, now spans a wide variety of areas such as bio-engineering, materials engineering and micro-electronics. This makes it difficult to grasp the exact nature of innovation in engineering. Many a book, articles and papers seem to lead to innovation in or through engineering design rather than engineering itself. This seems to stem from the nature of engineering itself, that of aggregator and applicator of technology from many

different fields. Shepard et al. (2006) classify engineering into three distinct functionalities:

1. Engineering as problem solving, considering the systematic processes that engineers use to define and resolve problems;
2. Engineering as knowledge, considering the specialized knowledge that enables, or if you will, fuels the process; and
3. Engineering as the integration of process and knowledge. (Shepard et al., 2006)

From the classification by Shepard et al. it is very evident that the nature of engineering is that of aggregator (knowledge) and applicator of technology (process) from many different fields. In which case, innovation in engineering could manifest itself in the way problems are resolved. Unlike many other areas, engineers see the need to measure, in some way or the other, the outcome of engineering innovation. This measurement need not be in numerical form and could be in several forms that show the tangible effect of the innovation during evaluation. This approach of engineering is outlined by Millet et al. (2017) in an article titled, “Open the ‘black box’ creativity and innovation: a study of activities in R&D departments. Some prospects for engineering education”, where they have introduced, “a schematic representation of the place creativity and innovation, or innovative potential, hold in the process of a company’s economic success and longevity” as shown in Figure 5.14. In this schematic, Millet et al. (2017) introduce ‘inventiveness’ where creativity moves towards innovation as a lesser known aspect of the process, which according to them ultimately leads to lasting quality. This brings about an important topic, namely invention, which will be elaborated further in this chapter to better understand invention within the context of the creativity to innovation journey that this thesis is interested in.

Figure 5.14: Introducing ‘inventiveness’ between creativity and innovation

Source: Millet et al. (2017)

Based on a premise that innovation manifests in the process in the engineering quest for solving problems, and that inventiveness plays a role in bringing about innovation, several developments in the field of engineering could be cited as innovation in engineering. The three that are cited in this thesis based on their significant contributions to lasting quality are:

- a) engineering computational tools and methods
- b) manufacturing tools and methods
- c) rapid visualisation and evaluation tools and methods

a) Engineering computational tools and methods.

engineering as a profession has relied on measurements and precisions in mathematical calculations from its early days of Greek philosophers. Perhaps the first innovation in engineering computational methods is the **slide rule**. William Oughtred, an Anglican minister has been recognised the inventor of the slide rule in 1622⁵⁵, though many other such as John Napier, Isaac Newton and Henry Coggeshall have had a hand in the final version by 1633. Slide rule remained the main engineering computational tool till the coming of computers in mid 20th century. Critical engineering tasks were still counterchecked by slide rules well into the early 1970s, as can be seen by the, now famous, 5-inch slide ruled used by the crew of Apollo 13, after an explosion caused the mission to be aborted (Figure 5.15).

⁵⁵ <http://www.oughtred.org/history.shtml>, retrieved on 12 December 2018.

Figure 5.15: The 5-inch Slide Rule used by Apollo 13 crew
Source: airandspace.si.edu

The next engineering computational tool to appear was the computer, starting from 1940s or so, though the first calculator/computer is attributed to Bell Laboratories which built 'Model K' in 1937⁵⁶. The innovative aspect of computers became evident when they ran on special 'programmes' where 'inputs' could be given to obtain 'outputs' which would have been laborious if conventional calculation methods and slide rules were used. Engineering computation has seen many 'sub-innovations' over the years, with the notable being in computers moving from main frame computers to desk workstations to laptops, tablets and handhelds of today (Figures 5.16, 5.17 and 5.18). In any of its form through the times, computational methods/tools have allowed the level of accuracy and precision in the calculations in engineering's quest for lasting quality.

ENIAC, 1948

Wang 2200, 1974

Raspberry Pi, 2012
(Anything it can be)

Figure 5.16 to 5.18: Computers over the ages
Source: seas.upenn.edu (Left), lunil.com (Centre) and wired.com (Right)

Computational methods and tools has also spawned a generation of innovation in software engineering, from the strict algorithmic centred programmes of the main frame computers to the much more visual language centric ones at present.

⁵⁶ <http://www.computerhistory.org>, retrieved on 12 December 2018.

b) Manufacturing tools and methods. Advent of computers and computer programming at the right point in time of the industrial revolution gave rise to the next engineering innovation, numerical control (NC) and computer numeric control (CNC) machines that can be programmed and operated through other innovations in manufacturing such as stepper motors and robotics. Taking the human out of the actual machining of (predominantly) metals brought a level of precision in parts, components and products that was not possible before. Five axis and 3¹/₂ axis CNC machines at present are sophisticated enough to build parts for automobiles, trains, airplanes and space ships, besides manufacturing toothbrushes. The rise of manufacturing tools and methods as engineering innovation was (and is) complemented by developments in robotics and artificial intelligence.

Early NC Machine, 1948
Source: <https://125jahre->

CNC Machines
Source: www.craftechind.com

Figure 5.19 and 5.20: NC and CNC Machines

c) Rapid visualisation and evaluation tools and methods. Innovations in engineering from computation methods and tools and manufacturing methods and tools furthered an innovation in rapid visualisation and evaluation tools and methods. **Computer aided design (CAD)** which started as a research venture of two academics, Professor David Evans and Dr. Ivan Sutherland at the University of Utah in 1968⁵⁷ has revolutionised all aspect of engineering design (and industrial design) leading to sophisticated levels of visualisation in design (CAD), engineering (CAE), computer aided simulations and manufacture (CAM). Corporations such as Autodesk, Solidworks and CATIA provide complete solutions in CAD, CAM, simulation and CAE, which plays a major role in the globalisation trends such as contract manufacturing.

⁵⁷ <https://osu.pb.unizin.org>, retrieved on 12 December 2018.

Early CAD from Evans & Sutherland
Source: designworldonline.com

Modern CAD system
Source: kehratec.de

Euclidean Holographic CAD system
Source: solidsmack.com

Figure 5.21 to 5.23: Computer Aided Design Methods and Tools

Innovation in pure science. Innovation in science is often discussed as end results that bring value through products or processes. Many a time, this value is perceived and measured through commercial or economic success. Typical of such notion comes from Cardinal et al. (2001) who state that, “Science-based firms such as DuPont, Monsanto and Hoechst, among others, have built strong sources of competitive advantage through their exploitation of internal innovations, giving rise to a multitude of new products across vertical and horizontal markets”. At another level, organisations such as the United Nations and the UK Department for International Development (DFID) consider innovation in science as an important vehicle for human development across all areas from health and well-being to economics. From Figure 4.7 of this thesis, it is evident that the outcome of creative process in science is scientific discovery, which by itself only has intrinsic value since discovery itself only adds to the expansion of knowledge. This knowledge must be furthered through technology for it to be ‘harvested’ to realise the value proposition. According to Cardinal et al. (2001) scientific knowledge may be highly tacit, i.e., embedded in an organisation or explicit (transparent) i.e., open to public and therefore easily codifiable. This brings scientific knowledge into “... developed science and developing science” (Cardinal et al., 2001). Conway et al. (2010), define scientific innovation as, “... a process starting with curiosity-driven, basic research which generates new understanding. This then leads to translational research, which relates this fundamental understanding to systems we want to improve, and then to applied research, which produces the products which we can use”.

This definition gives a clear idea of three levels of research required to achieve scientific innovation, **basic or fundamental research, translational research and applied research**. Conway et al. (2010) recognise that scientific innovation is not always a linear process, “...it often involves an interplay back-and-forth between basic, translational and applied research stages”. This iterative process is more prevalent in developing sciences where, according to Cardinal et al., “Scientists combine partially codified knowledge with complimentary resources, such as cross-functional teams or learning-by-doing capabilities, which leads to new products and process innovation”. Examples of such scientific innovation maybe seen in biotechnology and nanotechnology today. Innovation from developed science tends to be from ‘learning-before-doing’, since prior codified knowledge is available to translate.

Translating scientific knowledge can be studied in a complex manner bringing in commercial propositions such as sales and marketing, volumes and profit, etc., as shown by Caraça et al. (2008). In doing so, the starting point of scientific innovation, which is the fundamental knowledge, is given an insignificant role and others like the market knowledge and organisational knowledge tend to pull towards commercial outcome based on potential market, etc. The end result is that the innovation process seems more like a product design and development diagram, according to Caraça et al.

In searching for scientific innovation, it is from developing science that, the author feels, innovation in the true sense is exhibited and realised, bringing often that paradigm jump/change that is associated with high value proposition. Examples of such scientific innovation may be classified as:

- a) Innovation through conceptual thoughts
- b) Innovation through action / experimentation

a) Scientific innovation through conceptual thoughts. The most famous series of examples of innovation through conceptual thoughts are the ‘thought experiments’ or ‘gedankenexperiments’ that the renowned physicist Einstein had used, to derive scientific phenomenon that were otherwise difficult to grasp. Evidence of this approach to innovation is seen through Einstein’s notes on autobiography described by authors such as John Norton (2004) and Topper (2013, pp. 9 – 14). A sample of Einstein’s one such thought experiments (paraphrased for easy reading) is:

Chasing a beam of light: What it would be like to watch someone chase a beam of light? To you as a bystander, it might look like the person was nearly caught up to the light, but to the person who is actually chasing the light, it could appear that they were never even close.

(from Norton, 2004 and Topper, 2013)

Through this thought, Einstein concluded that the person's brain and clock were running much slower than the beam of light. The light could never freeze, but it could appear differently depending on the speed of its chase. This paved a way for Einstein to refute earlier concepts of light as an emission which travels through 'ether', and work on what was to become his research on relativity.

Another example of innovation through conceptual thoughts comes from the prominent quantum physicist named Werner Heisenberg. Carlo Rovelli (2017) in a book titled, "Reality is not what it seems", describes an incident when Heisenberg was walking at night through a park strewn with only the occasional lamp, where pools of lights are separated by large expanses of darkness. Heisenberg sees a person passing by, as Rovelli (2017, p. 99) describes, "Actually he does not see him pass: he sees him appear beneath a lamp, then disappear into the dark before reappearing beneath another lamp, and then vanishing into the dark again." Seeing that the person, a substantial object, does not simply appear and vanish but is seen only where there is light from the lamp sets Heisenberg through a thought process of envisaging electrons vanishing and appearing before realising that this defines the mysterious quantum leaps which seem to underlie the structure of atomic spectra at that time (1925). Subsequent work allows him to discover, "...a fundamental description of the movement of particles, in which they are described not by their position at every moment but only by their position at particular instants: the instants in which they interact with something else" (Rovelli, 2017, p. 100), which became a corner stone of quantum mechanics.

Why are these two examples, innovation and not creativity? By definition, creativity is necessary, though not sufficient, for innovation (Amabile et al., 1996). Both Einstein and Heisenberg had a spurt of creativity that lead them to an insight that had to be translated into valuable knowledgebase, which they did through application of theories in physics and mathematics. Since innovation is a

process through which tangible value may be created, the conceptual thoughts of both the scientists may be considered as an example of scientific innovation.

b) Scientific innovation through action / experimentation.

Many of the scientific findings from 14th century onwards needed concrete proof as to their reality within the sphere of science. This was especially so in Europe, when the society believed in religious axioms based on the ‘creation of man’ up until the 18th century or so. Galileo Galilei (1564 – 1642) needed to prove for himself what his mathematical calculations and intuition revealed as scientific facts. MacDougal (2012), in the book titled, “Newton’s Gravity: An Introductory Guide to the Mechanics of the Universe states” states, “He (Galileo) was an experimentalist who for the first time had the insight and talent to link theory with experiment... He discovered in this way that objects of any weight fell toward the Earth at the same rate – that they had a uniform acceleration”. To prove this, Galileo, around 1589 or so, went up the Leaning Tower of Pisa and dropped two balls of different masses to see that ultimately both the balls travelled at the same speed. Galileo postulated that a ball and a feather will land at the same time if this experiment is done in vacuum, where there will be no air resistance. This experiment have been done several times in vacuum conditions, once famously on the moon when in 1971, an American astronaut David Scott dropped a hammer and a feather to see it land at the same time on the moon surface (as reported widely by all media upto this time). This and the series of experiments that Galileo conducted as a professor in the University of Pisa could be considered as scientific innovation through experimentation.

This scientific convention is still in practice today, with the recent example of the 27-kilometer Large Hadron Collider (LHC) built by the European Council for Nuclear Research (CERN) in 2008⁵⁸ to study important phenomenon in particle physics, some of which had been predicted by Einstein in the early 20th century. The LHC consists of a 27-kilometre ring of superconducting magnets with several accelerating structures to boost the energy of the particles along the way. The LHC’s recent success includes the 4 July 2012, experiments at LHC, where the scientists had observed a new particle in

⁵⁸ <https://home.cern/topics/large-hadron-collider>, retrieved on 14 December 2018.

the mass region around 126 GeV which is consistent with the Higgs boson predicted earlier.

Many more experiments are underway that are meant to prove the findings from theoretical physics, proving that LHC is a scientific innovation through experimentation.

Summary of innovation in different fields. Table 5.3 shows the summary of innovation as understood by definitions from the various literature in each field.

Table 5.3: Summary of Innovation in Different Fields

Field	Interpretation	Methods & Types	Outcome
Visual Art	Breakthrough in conveying the artist's thoughts / ideas	1. Innovation in technique 2. Innovation in use of tools (& techniques) 3. Conceptual innovation	Art / artifact / installation of value commercially or otherwise (to society)
Music	Redefinition and collective invention	1. Collective participation invention 2. Innovative creativity	Transformatal; departure from norm
Performing Arts	Multifaceted, hybridised, interactive	1. Intercultural 2. Immersive 3. New form	Original, transformatal
Design	Technology driven, radical change / deviation	1. Innovation in design methods 2. Innovation through design	Transformatal, methods change, efficacy in design
Architecture	Approach & Technique Construction methods	1. Innovation in architecture design methods 2. Innovation through architecture	Harmonised environment / habitat
Engineering	Aggregating knowledge and processes	Innovation through: 1. Computational tools & methods 2. Manufacturing tools & methods 3. Visualisation and evaluation tools & methods	Value through optimised product / system
Pure Science	Fundamental research, Translational research Applied research	1. Innovation through conceptual thoughts 2. Innovation through experiment	Verified scientific knowledge that are valuable for translation for societal use/benefit

Some key literature on innovation reviewed. Before forming a relationship between creativity and innovation, it is important to discuss on some key literature on innovation. Once again, it is to be noted here that, this is not meant to be a comprehensive survey of literature on innovation but a discussion on publications that the author considers to form a volume of work that is valuable in this study.

As in the case of creativity, books and articles on innovation, in general, may be classified into three categories;

- a) general essays and books that are mostly business centric and are opinion based
- b) books of descriptive nature giving examples of innovation
- c) books offering strategies and step-by-step guide for successful innovation
- d) books and articles that deal with the subject of innovation directly as a topic
- e) books that approach innovation from a wider perspective to explore innovation as bringing value to people and society

Books under a) include “Successful Innovation” (Syrett et al., 2008), “Harvard Business Review on the Innovative Enterprise” (Harvard Business School, 2003), “Innovation and Entrepreneurship” (Drucker, 2007), and, “The Future of Innovation” (von Stamm & Trifilova, 2009). A lot more books under the business section in a book shop or library belong under this category.

Books of descriptive nature under b) include “The Myths of Innovation” (Berkun, 2010), “Design-Inspired Innovation” (Utterback et al. ,2006), “The Innovator’s Dilemma” (Christensen, 2006), “Make Create Innovate” (Kinnaird, 2006), and, “The Seeds of Innovation” (Dundon, 2002). Many more titles under this category can also be found in book shops and libraries.

Books that offer strategies and guides under c) include, “The Ten Faces of Innovation” (Kelley, 2005), “101 Design Methods: A structured approach for driving innovation in your organization” (Kumar, 2013), “8 Steps to Innovation” (Dabholkar & Krishnan, 2013), and, “Innovate: 90 Days to transform your business” (Shetty, 2010) as well as many more that are easy to find in book shops and libraries.

Books that come under d) seem a little rarer to find since the topics directly with the subject of innovation through theoretical framework, examples and models. Books under this include, “Winning at Innovation: The A-to-F Model” (de Bes, 2012), and, “Adding Values: The Cultural Side of Innovation” (Jacobs, 2007).

Much rarer are books under e), that take a deeper and wider look at innovation as value creator for people and society. Surprisingly such a book titled, “Innovation: The Basis of Cultural Change” (Barnett, 1953) explores a wide variety of topics that are dealt with by publications under a), b), c) and d) and which are relevant today.

All five categories have relevance based on who is the target reader/audience. In this study, which aims to build a relationship between creativity and innovation, it is more important to understand the process of innovation, be it from the angle of business/profit or value proposition to people and the society, rather than the end point(s) alone.

A survey of the literature on innovation in journal publications and proceedings of conferences, one can observe two categories of articles:

- 1) Larger number of articles that are specific to a claim or research question from the authors and mostly interested in deriving a business/commercial angle for market value and profitability
- 2) Lesser number of articles that, inform, educate and enrich the field of innovation as a topic

It was important not to place emphasis on one over the other, but to distil the findings and facts about innovation as a process and the different value proposition that innovation could generate through that process. Again, value proposition does not mean quantifiable measure such as profit but also the difference that innovation brings to raise a system or society from one state to another.

While a comprehensive review of all articles, publications and books about innovation would be lengthy and tedious, two books that have helped in understanding innovation with reference to the aim of this thesis will be summarised for key concepts and ideas with an explanation as to how these are important to this study. Further three authors whose books have considerable bearing on the thought process on innovation today are also briefly reviewed.

An innovation is here defined as any thought, behavior, or thing that is new because it is qualitatively different from existing form.

H.G. Barnett
(1953, p.7)

Book 1: Innovation: The Basis of Cultural Change.

Published in 1953, this book by Professor H.G. Barnett (Barnett, 1953), an anthropologist who spent considerable time studying innovation as a basis for cultural change with five different groups; three native American tribes, Palauans of Micronesia and the Shakers from the USA, besides considering Europeans as a whole, is about analysing, “...the conditions for, and immediate social consequences of, the appearance of novel ideas.” (p. 1) What is of importance to this thesis is the fact that Barnett states that the aim of the book has been, “...to describe the process rather than substance, universal rather than singularities”. This approach is very different from the large number of books on innovation of today. Barnett believes that, “The real challenge for a general theory of innovation lies in the realm of behavior, belief and concept”, which puts to rest the idea that innovation requires external support in the form of technology or material representation. Barnett’s definition of innovation, has been an important cornerstone in this thesis and the effort to realise a visual representation of the relationship between creativity and innovation in more general terms. According to Barnett:

...every innovation is an idea, or a constellation of ideas; but some innovations by their nature must remain mental organizations only, whereas others may be given overt and tangible expression. ‘Innovation’ is therefore a comprehensive term covering all kinds of mental constructs⁵⁹, whether they can be given sensible representation or not. (Barnett, 1953, p. 7)

Barnett’s use of the term, “qualitatively different from existing forms”, in his definition of innovation, paves the way for identifying many ‘mental constructs’ as innovation. By his definition, the ‘labour theory of value’ of Karl Marx, which led to communism and socialism and ‘satyagraha’ or non-violent struggle of Mahatma Gandhi, which was the centre of India’s independence movement, could be classified as innovation in the same way that mobile connectivity can be identified as innovation today.

⁵⁹ The use of the term ‘mental constructs’ is exactly the term used by Vygotsky in 1925 when he defined creativity (Vygotsky, 2004)

In his book, Barnett set's about elaborating on his thoughts on innovation in four parts; Part 1 – The Setting, Part 2 – The Incentives to Innovation and Part 3 – The Innovative Processes and Part 4 – Acceptance and Rejection.

Part 1, “**the setting**”, is perhaps the difficult one, in terms of the chapters presented. Barnett discusses on ‘The Protagonist’ (Chapter I) where he states, “Every individual is basically innovative for two reasons. (First) No two stimuli to which he reacts are ever identical...the variables which affect their presence and their organization inevitably make them distinct in some way”. The second reason is that, “...no one ever entirely or minutely duplicates his responses to what he regards as the same stimulus”. This allows for a dynamic situation that is, “...pregnant with novelty; and it is continually bearing strange fruit...”. I believe that this statement alludes to creativity though the author does not directly bring in creativity as a prelude to innovation throughout the book. Barnett is also empathetic, through his long study of the six different conditions (which started in 1938), in his conclusion that, “...no ethnic group has yet to be shown to have a monopoly upon originality because of its biological endowments”. This puts a brake to any thoughts that ‘advanced’ societies of the West have any superior status in terms of their ability to be innovative. Barnett cites historical references to Aztecs, as well as African kingdoms of the past, to highlight the position that every culture and every ethnic group has been innovative bringing about results that are qualitatively different from the existing forms and that innovation is not the hallmark of developed societies.

In Part 1, Barnett also discusses elaborately on the cultural background and its effect on innovation. He states that, “With a shift of conditions in the experience of an individual, or with an alteration in the conditions in that affect one society at different times in its history, or with a diversification of the conditions that affect different societies, there must go a variation in innovative possibilities”. If society is replaced by the (modern) organisation, it becomes apparent that the external conditions that are prevalent within the organisation, or the cultural background of the organisation will influence innovation possibilities within. This has been the topic of a paper by the author (Sathikh, 2017) which explores how an innovative culture is brought about within an organisation. In this chapter on cultural background, Barnett dwells deeper on topics such as, “the

accumulation of ideas, concentration of ideas, collaboration of efforts, conjunction of efforts and expectations of change”, which are essential to innovation before attributing one full chapter on socio-political topics such as, “the dependence of authority, the competition of rivals, the deprivation of essentials and the modification of a dominant correlate”. As for authoritarianism, Barnett states that, “Authoritarianism in government, like authoritarianism in anything else, sets the goals and the limits of ingenuity rather than suppressing it completely”. He also observes that, “The collapse of controls during period of social and political upheaval opens the way for innovation”, allowing for the, “...emergence of ideas, many of them predatory”. This idea seems to manifest today as emergence of disruptive innovation, when a system or trend seems to choke progress and point to status quo in following established norms. Barnett statement, “...new ideas are frequently scouted by scientists, not because of their intrinsic merits but because they do not conform to existing doctrine”, seem to show the way to innovations of the late 20th century such as smartphones (iPhone by Apple Inc) and web search engines based on fast and accurate algorithms (google).

On competition and innovation, Barnett states that, “Competition is a potent incentive when mutually desirable rewards are allocated on the basis of performance”. His view is that stimulus such as incentives will spur greater efforts resulting in innovation. Barnett believes that competition is conditioned by tradition across the world and, “There are ethnic differences in the extent to which it is encouraged, tolerated, or merely expected”, and cites examples. This is interesting from two perspectives. On the one hand the globalised world has seen organisations, corporations and societies that are built of people of different origins, ethnicity and culture as seen in the Silicon Valley in California, USA, where Barnett’s statement that competitions (and incentives) are different for different cultures and ethnicity may not hold true. On the other hand, there still exists homogenised societies, such as in Japan and Korea, where this could be true. Barnett also has a word for monopolistic practices. He states that while such practices, “...encourage new ideas within controlled limits”, they also are, “...directed toward minimizing the total number of innovations by reducing the number of individuals who may hope to profit from their new ideas”. This is a similar yet different take to the present-day

complaint and law suits by competition and country states on technology giants such as Apple, Google and Amazon. Vince Cable, a leader of the British Liberal Democratic party and a former secretary in the government, has the following to say about monopoly in his article in the 20 April 2018 electronic issue of *The Guardian*⁶⁰:

Firstly, because they hold back innovation. By acquiring potential challengers before they become a threat, spending millions lobbying governments to ensure their economic interests are protected, and tying in users through the sheer scale of features and social interaction they offer, the tech giants' dominant position often leaves entrepreneurs feeling they have no choice but to sell up, or close up. This is bad for innovation and bad for consumer choice – two things the tech giants once stood for.

Barnett mentions deprivation of essentials as a part of the cultural background for innovation and points to crises, manmade or otherwise. He says that there two kinds innovative reactions to extreme crisis, “One contributes to survival while the other only gives the illusion of doing so; one employs materialistic instruments to accomplish its rational ends, the other resorts to fantasy thinking and employs supernaturalistic devices”. This brings one back to the period of ‘cold war’ where (mostly western) countries with democratic values were pitted against the communist and socialistic countries accusing each other of ‘fantasy’ about each other’s doctrines and dogma coming closer to brinkmanship and war many a times from the 1950s till 1980s.

Barnett introduces a concept called, “the modification of a dominant correlate”, wherein a resultant change is forced upon a culture (or system) due to a change in some other part of the same culture. This resultant change can trigger innovation or a series of innovation. A contemporary example can come from the internet, which was conceived as a private means to share data within government organisations. Once the concept of the world wide web (WWW) and the web browser came about, use of internet has permeated into all strata of the society in most part of the world. This has shown an endless series of innovation that allows from free telephone calls around the world, to on line shopping to

⁶⁰ <https://www.theguardian.com/commentisfree/2018/apr/20/tech-monopoly-apple-facebook-data-extreme-content>, retrieved on 14 December 2019.

matchmaking for couples to many other recent innovation based on the Internet of things (IOT). The dominant correlate in this incidence is the cable network technology that has morphed into high speed internet communication through the world.

Part 2 of Barnett's book concentrates on, **"the incentives to innovation"**, whose chapters consisting of, "Self Wants, Dependent Wants and the Desire for Change". Reading this part, one realises lots of concepts presented have been studied in detailed since the book's publication in 1953. Barnett, however, looks to his research with the different communities to discuss on the incentives for innovation from a society point of view and relates it to the society of 1953, mostly in the USA. While this part does not directly address the 'why innovate?' question, the discussion of this part gives an idea of the clear motives for taking creative ideas to valuable innovations. It is of interest to know how Barnett further splits self wants into, "credit wants, peripheral subliminal wants and central subliminal wants", which directs innovation for desires. He further divides dependent wants into, "convergent wants, compensatory wants and entrained wants", which points to innovations that are inspired where, "...one want is entangled with another, and pressure of the resulting impasse is resolved by an escape in novelty". He cites an example of car owners' desire to protect the (new) car from deterioration and minor damages which leads to them to install spot covers to protect the seat covers that are meant to protect the original upholstery. This sets up a chain of innovations to satisfy the entrained wants as Barnett explains, "Catering to wants of the car owner has set up wants in the designer, the manufacturer, and the insurer", which in turn requires, "...innovation, mechanical skills, additional personnel and materials – which have set up their own chain of demands for tools and men". Barnett ends Part 2 with the words, "The continued stimulation of one flux within another, the construction of an arbitrary universe within a natural one, has unending consequences". This statement is prophetic, coming from 1953, when the many 'arbitrary universe' humankind has produced over the last hundred years in the name of progress of the society, such as the extensive use of oil and mineral resources, the proliferation of plastics and other environmentally damaging materials, exhaustive build-up of factories and such has come

back to create another set of universes that is interested in environmental protection, sustainability and so on.

Part 3 of is titled, “**innovative process**” and is divided into three chapters, “The Basic Processes, Ramifications and Compounded Processes”. In the chapter on the basic processes, Barnett opens with, “When innovation takes place there is an intimate linkage or fusion of two or more elements that have not been previously joined in this fashion, so that the result is a qualitatively distinct whole”. There are two distinct points covered here; the first describes the act of creativity, the starting point of good ideas that migrate into valuable innovations. The second describes the outcome as a successful innovation. What happens in between has been touched upon in the Part 3, though not entirely or directly linking creativity, which this thesis intends to link through a synoptic relationship map. Barnett seems to allude to this relationship by stating, “The linkage is between the ideas of things. This means that the process and its result are something different from a union of the things themselves”, and goes on to say, “The innovative union of ideas is a complex commingling of perception, cognition, recall and affect”. What is interesting to note is that, according to Barnett, “In innovation the fusion takes place on a mental plane”, which means that, while the valuable outcome of innovation is measurable in terms of either quantity or quality, the complex process of arriving at the innovation is human dependent (centred) even when advanced (manmade) tools are used to assist in the process. This very much in line with the development ideas of this thesis. In other words, innovation is (as Barnett says), “...never in the sense that it is something emerging from nothing”. Barnett urges the use of (mental) configuration instead of a concept of things since, “Ideas are mental activities no matter to what they relate”, which means, “...the idea of a thing with substance can react to the idea of another thing of substance, or to the idea of intangible; or even to the idea of an idea”. Why configuration? The chapter unfolds after a long portion of justifications to explain, “The individual who analyses the conventional configurations to which he and others have been accustomed so as to provide possibilities for new organizations takes the first and indispensable step in innovation”. Barnett then emphasises on detailed analysis of the configurations where there seems some gap in the thinking, since the relationship of the ideas and derived

configurations to creativity has not been established by Barnett. Readers are left wondering how to generate these ideas before they could be configured and analysed. What operatives are to be used for analysing and moving forward towards valuable innovation is not visible from there on, though Barnett goes on to explain the basic process in words. This thesis looks at this gap, to derive the operatives, operations and operators and their mental construct, in each of these phases of progress (of ideas to innovation) in its attempt to show a clearer picture of the innovation process. Besides configuration, Barnett also discusses on “substitution and discrimination”, as well as “gain and loss” in the chapter on basic processes, all of which he elaborates as to why they are necessary for innovation, which again seems to be necessary when the creative process that precedes the innovation processes are combined in describing the innovation process.

The next chapter of part 3 is on ramifications, in which Barnett sets out to demonstrate how all innovations conform to a few basic patterns and follow the same processes. This is possible, according to Barnett because, “...every innovation has a prototype, substitution for or by which accounts for every kind of new idea”. This maybe a large calling, unless a generalised model for the process of arriving at innovation is created which allow for variations described by Barnett. This thought is carried forward in this study’s quest to build the relationship between creativity and innovation. In his efforts to show ramification as a part of the innovation process, Barnett outlines language as a change maker in many of the substitutions that are necessary for innovation. His examples include the creation of coded form of speech such as ‘secret’ languages created by children. Technology as a ramification is discussed next where Barnett highlights that, “... it is instructive to take notice of the fact that our technology, for all its varied manifestations, play many an old tune... replete with what in other contexts we could call clichés and old reliables”. This statement has some truth when one looks at the proliferation of mobile phone apps offering different functions on the same or similar kernel/ codes. At the other end, technology today is evolving so rapidly that there is hardly sufficient time to design, develop, test and release products with the new technology in place, which means that Barnett’s statement may not be true today. Behaviour is another aspect of ramification discussed in this chapter, when

Barnett correctly states about when new behaviours are invented saying, “In such instance the innovator identifies himself with the person or some nonhuman organism that is accustomed to doing something he is not”. By doing this, the innovator can create ideas that become valuable. Barnett also discusses ideas – how an idea from one society gets adopted - as 1) unrecognised prototypes – where, “... a prototype is obscure, vague, or not consciously appreciated” can become an innovation at another instance/location/time, 2) lost prototypes – to revisit, 3) ambiguous prototypes – which may have not been seen as useful earlier, and 4) posteriori prototypes – a regularisation of unpremeditated or accidental combinations of things and ideas into innovation.

As the last chapter of part 3, Barnett moves on to discuss on compound processes where higher idea lead to innovation, especially the use of analogies in details, with examples from the different culture / societies that he has studied. Alternatives, including the juxtaposition of two configurations with one common element juxtaposed, are discussed, again with society level examples of compounded process of innovation. This chapter reads more like a step-by-step guide to innovation of other books, albeit through verbatim and examples from Barnett’s study of the six different cultures.

The final, Part 4 of the book is about, “**acceptance and rejection**” which is divided into five chapters, “the advocates of change, advocate assets, novelty characteristics, novelty values and acceptors and rejectors”. For a book that started off as more of an anthropologist’s view of innovation as a basis of cultural change, this chapter discusses topics and outlines ideas that are suitable for contemporary settings.

The first chapter of Part 4 is on the advocates of change. Barnett starts by stating that, “... the fate of the innovation is as important as its conception”. According to his study of innovation as a change agent for cultural change in the society, acceptance of an idea is first within the cultural sphere of the innovator. On this Barnett states, “The growth in popularity of a new idea within the society of its origin then comes under the heading of ‘adoption’, ‘acceptance’ or some similar term, whereas the passage of an idea across ethnic boundaries is usually referred to as its ‘spreading’, ‘borrowing’ or ‘diffusion’ ”. Barnett goes on to say that, “...these varied phenomena are merely manifestations of the same process”. This distinction between adoption and

acceptance and spreading and diffusion is of importance to this thesis. Moving an idea from creativity to innovation within an organisation is akin to “within the society of its origin” situation mentioned by Barnett. Once the innovation is shown to be of value and is released to a wider audience/customer, that is across “ethnic boundaries”, the success of the innovation is through spreading or diffusion. Major marketing efforts and advertisement campaigns of today is all in the effort to spread (or gain market share) the innovation. This concept of acceptance within an organisation or a team and spreading and diffusion of innovation in the market place is important to this thesis which will become apparent in the synoptic map of the relationship between creativity and innovation.

The question that may arise is; How does one evaluate or identify valuable innovations that warrant efforts in diffusion? Can a path of success be built in the process itself? To this Barnett puts forth answers, though they are spread-out within the first few pages of the first chapter of Part 4. He starts off by saying, “...the conditions that are conducive to innovation also simulate acceptance. The cultural areas of anticipated change are also favorable to the acceptance of new ideas”. Taking this statement to contemporary context, it amounts to moving forward ideas which meet the criteria based on, some form of, insight, survey findings, etc., that point to a need for change/improvement. This seem to indicate a conducive environment and a process that also is ready to accept change. In other words, a motivated team with the clear idea of the need to achieve innovation. What about the leader? Barnett picks up this point in the statement, “...the psychological characteristics of innovators and acceptors are different, although they maybe complementary”. Of leaders, he says, “Some men want to lead and can; others, while preferring the new, need a leader. On the other hand, many innovators are reluctant pace setters and need follower-advocates”. If this is true, can one innovator take a significant innovation that can make the (anticipated) change to success and acceptance? Barnett says it is important to be concerned with, “... the characteristics of situations, persons, and things relative to the acceptance of new ideas and with the process by which it takes place.” Clearly, this point to environment, persons/team, the process and an evaluation method to ascertain the success and ensure (a level of) acceptance of the innovation. According to

Barnett, these are necessary, but not sufficient to ensure wider acceptance or diffusion of the innovation. What else is needed?

In this chapter, Barnett points to the need for, “advocates” who champion change and can recognise when an idea has the potential to become innovation. Barnett, in many ways anticipates what is common in the age of ‘Silicon Valley’ – investors, venture capitalists, angel investors and other ‘promotional organizations’. He is also cognisant of inventors and innovators falling to the trap of selling their ideas outright, leaving the impression to the public that the sponsor is the innovator, leaving the original innovator by the wayside, though not offering any solution for this. Instead Barnett describes potential sponsors for the invention/innovation much like a present-day guide to starting-up business, mentioning neighbour contacts, family, members of kinship group and others as possible advocates.

In the following chapter titled, “Advocate Assets”, Barnett touches on quality of the advocates, which very much can be related to venture capital companies, seed funders / individual investors and companies. He cites key attributes of advocates such as, “reputation, acceptance control, prestige (of the advocate), popularity, personality, personal relations and majority affiliation”. A visit to the website of some of the well-known venture capital companies such as the Northwest Venture Partners (NVP)⁶¹ relates very similar attributes that Barnett describes, albeit the description is to suit today’s climate, such as, talent-retention, business development, people advisory, public relations & marketing, operations strategy and community. Well known private investors such as Steve Wozniak (who invests in high tech ventures) and Bill Gates (who particularly invests in medical breakthroughs) exude the same qualities that makes them investors in new ventures with potential for innovation.

Third chapter in Part 4, titled, “Novelty Characteristics” seems to carry much more meaning to the word ‘novelty’⁶² than what it is associates with at present. To start off, Barnett

⁶¹ <http://www.nvp.com> retrieved on 16 September 2018

⁶² In a book titled *Architecture & Design versus Consumerism*, Ann Thorpe (2012) associates novelty in the age of commoditisation with ‘stimulation’ and satisfaction’ and presents the work of another researcher, Avner Offer who describes the relationship between both as ‘diminishing returns of novelty and satisfaction, where at lower level of newness (read introduction of novelty) pleasantness increases till after habituation, there is a decrease in satisfaction setting about unpleasantness. Thorpe also mentions how designers and architects tend to focus on short-term appeal for the sake of continued novelty at the expense of long-term benefits.

discusses about, “intrinsic and extrinsic values”, the former having novelty which are, “inherent in the novelty itself”, and the latter which are, “considerations having to do with the feasibility of adopting the novelty provided that it is in itself acceptable”. Having introduced intrinsic and extrinsic values, Barnett brings back the concept of “compatibility” in reference to novelty acceptability. By compatibility, Barnett refers to a definition that, “affords an analytical tool and (is) not another name for acceptability (of idea)”. According to Barnett, “An idea or a behavior, new or old, is adaptable or harmonious with something known, believed, or done by a potential acceptor, not with abstractions such as statistical averages, consensus, trends, common denominators, or cultural patterns”. Abstractions, he says, only, “... summarize or describe compatibilities” and not determine them. Following some lengthy discussions on acceptance of new ideas, Barnett states that, “The significance of novelty must be understood to be the meaning that it has for the acceptor” and not, “... the meaning it has for the introducer”. After citing examples from native American tribe Yurok, Barnett makes a significant declaration; “... only confusion and artificiality can result from a structuring of acceptance issues in terms of the thought processes of an observer or a novelty of introducer rather in terms of the mental prototypes and identifications of the actual acceptors and rejectors”. This statement has a significant meaning to the thesis’s outlook on innovation, which is, the outcome of an innovation process cannot be predetermined based on acceptance as a criterion. This means that the process and the possibility of success are entirely different things as far as acceptance goes. This will be apparent in one of the case studies presented in Chapter 8 of this thesis. Barnett introduces concepts such as “incongruence and structuralization” within novelty characteristics, but in more of a social change and progress, that is of prime interest of his book. He concludes the chapter by stating of novelty characteristics, “In any event acceptance, like innovation, is by units regardless of how complex they seem to others than the acceptors”, placing the users and consumers as an important element in the success of any innovation.

The next chapter of Part 4 is titled, “Novelty Values”, which takes novelty from its characteristics towards values. He talks of “novelty concordance” between the novelty and the custom, which within the scope of the book represents social

compatibility. Barnett introduces, “efficiency, cost, advantage and pleasure” as factors of novelty value, although one gets the feeling that he is looking at effectiveness instead of efficiency. If Barnett was to consider an example for novelty values in present times, based on the three factors he mentions, iPhone from Apple Incorporated may come out as the ideal choice with its effective touch screen functions, higher sales price than competition, introduction of novel features as advantage every time, deriving a new user experience that borders on pleasure. This seem to have the competition following Apple’s iPhone lead in innovation, introducing extra features to beat Apple’s iPhone. Mastery is also introduced as a factor of novelty value, in many ways anticipating computer based gaming consoles and controllers where a certain level of mastery is required to handle the hand-to-eye coordination required to play games. Barnett mentions penalty as a deterrent factor that could be a novelty value as well. Barnett’s observation that, “Social complications contingent upon the acceptance of a novelty stand apart from the linkages considered so far in that derive from the integration of social units”. This again is a factor that will be highlighted in one of the case studies in this thesis, where all efforts to bring novelty value did not make the innovation accepted to the level of expectation of the company and the world media.

The final chapter of Part 4, titled, “Acceptors and Rejectors” is to, “...explore the problem of individual variability in response to the presentation of novelties and to attempt to bring some order out of the bewildering complexity of data that are available on the subject”. In a given situation, where several products fulfil the same purpose, Barnett wants to know, “What attitudinal biases characterize the acceptor as contrasted with the rejector when all the other variables of the acceptance situation are held constant?” While this question seems to move the discussion towards contemporary studies in marketing, Barnett extricates himself from a purely commercial discussion by offering three hypotheses as to why innovations get accepted or rejected. The first hypothesis is that, “...an individual will not accept a novelty unless in his opinion it satisfies a want better than some existing means at his appeal”. As a corollary, he states that, “...a novelty has less appeal for those who are enjoying the benefits of its functional alternative than those who are not”. This explains the initial reluctance of mobile phone

users to move from a Nokia – Motorola – Sony Ericsson dominated handsets of the 1990s to smart phones, which had many innovations built in. In this example, the reluctance seems to have come not only from the subscribers but also the service providers who had invested heavily on infrastructure for the older technology. Once both the subscriber and the service providers realised that smartphones satisfy a want and needs better than the existing alternatives, innovation of the smartphone took effect.

The second hypothesis is that, “...there are biographical determinants for the lack of satisfaction that is characteristics of individuals who are predisposed to accept a substitute for some accustomed idea, and that these determinants result from the interplay and adjustment of an individual’s conception of himself and the events of his life history”. The idea here, according to Barnett is that, “...people develop tastes and preferences under the influence of particular experiences, and these orientations are significant to the acceptance or rejection of new ideas”. In the contemporary situation, this hypothesis may not be totally acceptable, with globalisation and media, especially social media, reaching almost all parts of the world. Products and innovation that are shown in any of the world channels such as CNN, BBC World, National Geographic, Discovery Channel, etc., could be easily accepted across the world. Innovations in products or practices that try to bring changes to societies with strong cultural identity or those in rural or remote places may show strong objection and hence may take longer to accept or may face outright rejection of the ideas.

The third hypothesis to acceptance or rejection of innovation, “...is to the effect that dissatisfaction or unsatisfaction may be a pervasive attitude of some individuals”, which then colours the view of a large sector of people. This could be more so when the innovation is towards habit changing or bringing social changes. Such ‘marginal individuals’ come around to accepting innovation according to Barnett since dissatisfaction may turn to be partial satisfaction when specific wants as perceived by such individuals are satisfied partially or fully.

Barnett goes on to identify four orders or categories of acceptors, “the dissident, the indifferent, the disaffected and the resentful”. Barnett discusses the characteristics and the

attitude of each category reference to social histories of different cultures and tribes from around the world. From this study point of view, the different categories of acceptors represent potential points of hurdles that may need to be addressed in the innovation process.

Barnett concludes his book with an appendix titled, “On Things” where he discusses several topics in detail that could fall within the space of cognitive psychology and perception today. A lengthy read, the appendix seems to be somehow represent the fact that Barnett had not considered creativity as a topic in itself and was not able to connect creativity to innovation, though he brings in concepts such as ideas, novelty and values. The appendix reads more like a stand-alone article with not much connection to the main book.

In summary Barnett’s *Innovation: The Basis of Cultural Change* has outlined topics and detailed them in a way that helps set up a framework for the innovation process within a contemporary setting. Written by an anthropologist in 1953, well before innovation became a business buzz word, this book does not bring in commercial and management aspects of innovation that is so prevalent in majority of work on innovation today. This befits the study for this thesis, which looks at the arrival of a value proposition through the creativity to innovation journey, rather than commercial success. Barnett’s book has allowed the author of this thesis to look beyond the value to factors that define acceptance and/or rejection of innovation. The lack of any indication on creativity as a precursor to innovation seems to take the discussion in the book through propositions that could have been better addressed if creativity was considered as well.

By the sheer fact that Barnett discusses Innovation as subject, that too, as a basis of cultural change makes it an important read for this thesis.

Visual model of Innovation based on Barnett (1953).

Barnett probably has the most detailed, if not complex, description of innovation as a basis for cultural change which is synthesised into a visual representation as shown in Figure 5.24.

Figure 5.24: Innovation based on Barnett

Source: Derived by the author

Book 2: Winning at Innovation: The A-to-F Model. Written by Fernando de Bes and Philip Kotler (de Bes and Kotler, 2012) and published nearly 60 years after Barnett's book (Barnett, 1953), "Winning at Innovation", written by two academics, though from a business/management outlook, explores innovation slightly differently from any of the step-by-step guide book on innovation. The authors in the introduction say, "The main objective of this book is to set down the principle elements that form effective and creative innovation management" and state that it is, "...a handbook that covers the most important theories, techniques and recent finding in this area". The aim of the book seems to be to transform an organisation into an innovative organisation through the four areas;

1. Strategic plan for innovation
2. innovation process
3. metrics / rewards
4. creative culture

These four areas together form the "A-to-F model" proposed by deBes and Kotler. What is interesting is that the first three areas, "planning, process and metrics and rewards" take place, "... against a background or atmosphere that is called creative culture". What Barnett (1953) was not able to explain in terms of creativity, de Bes and Kotler places it as an essential backdrop for innovation to occur. Figure 5.25 shows the "Total Innovation System" of de Bes and Kotler with creative culture as the binding element in the total innovation system.

Figure 5.25: Total Innovation System

Source: de Bes and Kotler (2012, p. 19)

One of the key thoughts that resonate with this thesis is that de Bes and Kotler think that, “...in the innovation area, at least, regarding processes and models, there is a strong need for an integrative model, a methodology which could allow organizing existing and future theories and techniques”. This approach is well within the intent of this doctoral thesis which aims to establish a relationship between creativity and innovation.

“Winning at Innovation” has the first chapter dedicated to “Entrepreneurial Barriers to Innovation”, which identifies seven problems that form the barriers:

1. What innovation means
2. fuzzy responsible assignments
3. confusing innovation with creativity
4. lack of framework
5. lack of control
6. lack of coordination
7. lack of customer focus

(de Bes and Kotler, 2012, pp. 3 – 10)

de Bes and Kotler clearly understand that, “...without creativity there is no innovation” and that innovation is, “...messy process – hard to measure and hard to manage”. They are also eager to disassociate themselves from books that advocate a particular approach.

The **first barrier** to innovation, highlights the fact that many people as well as companies and corporations think that the ‘real innovation’ is when there is a break through or radical innovation. de Bes and Kotler say that, “Gradual, step-by-step innovation is innovation too – and it is just as or more necessary than the radical version”. They also state that, “Innovation should also be understood as developing an innovative culture within the company, which is what will

enable it to produce and bring onto the market a steady stream of smaller, incremental innovation”. The ability to achieve a string of smaller innovation will lead to the ability for radical innovation, according to the authors of this book.

Most importantly, the Introduction of *innovation culture*, as well as *creative culture* in this book is of interest to this doctoral study. How are they different? Are they related? Where does innovation culture sit within creative culture depicted in Figure 5.25? Do the authors believe creativity and innovation are the same or do they think creative culture embraces innovative culture? This thesis is set on the notion that creativity and innovation are not the same and hence creative culture and innovation culture maybe related but not the same. Sathikh (2017), in a paper titled, “Creative Culture to Innovative Culture: Transformal Operation”, establishes some basis to show the difference as well as outline the characteristics of creative culture and innovation culture.

The **second barrier** (to innovation), fuzzy responsibility assignment is about who should oversee innovation in an organisation. de Bes and Kotler discuss this within a large company or corporation, where the responsibility is shared between the research and development (R&D) department, and product development and marketing. The end results is R&D feeling that the marketing did not know how to capture value and the marketing felling that the engineers were not creative enough. In this one paragraph is a glimpse of the link required between creativity, innovation and value creation, which this thesis attempts to make. For that link to be made, deBes and Kotler suggest that, within a small company, innovation should be managed from the top down. What if the company is large and/or the scope of innovation is high? For this de Bes and Kotler suggest that the solution is, “...to name someone as head of innovation and give them a 360-degree view of the innovation going on throughout the company, according to previously approved plan”. The caveat seems to be ‘previously approved plan’ which signifies that innovation is not a free for all ‘swing of the bat’, but an organised effort to garner creativity to create value by people who take responsibility of the innovation process.

The **third barrier** to innovation is confusion between innovation and creativity. de Bes and Kotler quote Theodore Levitt, who explained that, “...creativity that is not coupled with proper innovation management can spell death for a

business or enterprise”. The authors discuss about how managers in companies complain about the lack of creative talent, while what they really require ability in ‘functional idea management’. They bring out that, “...companies invest heavily in creativity at the expense of innovation; lots more resource go to training in creative techniques than to developing innovative functions”.⁶³ The authors postulate that, “It is true that creativity – that most human of gifts – when applied to business, leads to innovation. But an organization filled with creative people is not an innovative organization”. Innovation according to the authors, “...requires creative people, but it also means setting clear goals for innovation, defining strategies, establishing what your resources and risks are, allocating responsibilities and, most importantly, clearly delimiting and defining your innovation process, with someone in charge of each respective area”. This statement is significant to the premises of this doctoral study, giving a validation of the thought that creativity to innovation is a path that needs strategy and different people to manage the journey from creativity to innovation.

The **fourth barrier** is the lack of framework for innovation management. de Bes and Kotler state that, “When it comes to innovation, companies cannot look to any generally accepted management or operating framework”. With the result, the authors quote *Marketing Week* as saying that, “... 44 percent of business leaders admit they don’t know what essential tools they need to make creativity and innovation happen in their organization”. The authors cite the fact that, despite books and literature which give helpful ideas and facts, “... we do not have a comprehensive, unified and universally accepted theory on the subject”.

The **fifth barrier** to innovation is lack of control, which probably is the result of the four barriers mentioned earlier. According to de Bas and Kotler, “People think of innovation as a creative and non-linear concept. But that does not mean it not manageable”. They quote the Chief Executive Officer of Procter & Gamble from 2000 – 2008, A.G. Laffley as saying that P&G can manage innovation because they have a clear definition of innovation.

⁶³ Besides the fact that companies misspend on acquiring creativity, there has been a tendency to send the management as well as employees to ‘design thinking’ courses which again deals with methods to bring about viable ideas, which though clearly consider user satisfaction.

The **sixth barrier** is the lack coordination, which could be lack of “horizontal coordination and/or vertical coordination”. Lack of horizontal coordination is between departments; a clear sign that idea moves on the journey from creativity to innovation. The authors think that the problem is not in the lack of coordination, “...but rather a failure to involve from the outset in the ideation processes the departments that will be involved in them later”, indicating that some departments tend to be isolated from innovation projects. Lack of vertical coordination is between the various level of management and the rest of the organisation. The authors call it a ‘malfunction’ resulting in differences in the general management policies and innovation policies which could then become lack of support for innovation initiatives resulting in disastrous execution of the initiatives.

The **seventh barrier** to innovation is described as lack of customer focus. From the point of view of de Bas and Kotler, “...it is impossible to innovate if you don’t keep one eye on the end customer”. This relates to Barnett’s (1953) concept of acceptor and rejector which defines the success or failure of an innovation. The authors make it clear that the traditional market research methods do not fulfil the need of contemporary user requirements and suggest that observations of and interactions with the customer (end user) as a part of modern ethnographic techniques are required to ascertain what is needed. As with Barnett (1953), de Bes and Kotler also reinforce that innovation requires a switch from the old to a new which, “...entails an effort that the customer will only make if he gets a clear and superior benefit from it”.

As a conclusion to the first chapter, it can be said that de Bes and Kotler seem to clearly understand the shortfall in understanding as well as the undertaking that is required for an enterprise to be innovative. In breaking the barriers to innovation into seven parts, the authors have also been able to give credence to the premises of this doctoral study which will move towards unveiling a synoptic representation of the relationship between creativity and innovation where most of the barriers (except customer focus) mentioned will be considered.

After the first chapter, the book *Winning at Innovation* is divided into two parts. Part one introduces the A-to-F Model and the different players within that model. de Bes and Kotler make a strong argument for the need for every organisation

to evolve their own innovation process, which is a step in the right direction from other authors and experts of innovation. Even where there is a strong process, the authors feel that, “...each innovation, depending on the goals and nature of the project, will require its own ad hoc process and sequence”, which points to the need for the process to be flexible enough to be adopted for different situation. According to the authors, this is because, “Creativity requires analogical, not sequential thinking, and so does innovation which is nothing but creativity applied to a particular discipline”. This is a simplification coming from the authors who were able to clearly state that creativity and innovation are not the same earlier. What is agreeable though is their statement that, “...Innovation is not a linear process, rather it is process that advances, but with much backtracking and detouring”. According to de Bes and Kotler, for their A-to-F model of innovation to be effective there are six roles which needed to be anchored by individuals, “...allowing them to interact freely to create their own process’. The roles identified by the authors are:

- A. ACTIVATORS who initiate the innovation process
 - B. BROWSERS who are experts in searching for information, ‘...relevant to the start of the process and to the application of new ideas
 - C. CREATORS who produce the ideas – new concepts and possibilities – searching for solutions at any point in the process
 - D. DEVELOPERS who specialise in turning ideas into products and services and ‘tangible’ ideas and also develop rough marketing plans
 - E. EXECUTORS who take care of everything to do with implementation and execution
 - F. FACILITATORS who approve the spending items and investments needed as the innovation process moves forward
- (de Bes and Kotler, 2012, pp. 16 – 17)

Each one of them represent an alphabet from A to F, hence the name of the model.

de Bes and Kotler devote a chapter for each of the roles (Chapters 2 to 8), elaborately discussing the importance of each role. However, the details of roles played by each and the process seem to overlap and get repeated. Moreover, the whole innovation system depicted in Figure 5.25 becomes

progressively complicated with too many checklists and spreadsheets need to be filled. From this thesis' point of view, the 'total innovation system' of de Bes and Kotler seem to be a lexicon of words, interested in filling 'grammatically' right structures, that is bound to inhibit the creative energy which is so important for creating value proposition for innovation. However, in defining the roles of the various players in the innovation process, de Bes and Kotler have brought out the mind set required of the people involved, as ideas moves from creativity to innovation of value, which is of importance in the relationship model derived during the course of this doctoral studies. While chapters 2 to 8 are too elaborate to be mentioned in this thesis, important points on each of the roles will be briefly mentioned here.

Creativity is the result of a playfully exploratory process by a person who is open, curious and imaginative in a conducive environment whose result is novel.
Sathikh (2010)

Activators are to be preceded by the organisation preparing the "innovation framework, the innovation guidelines and innovation checklist", in order to "... ensure that activators start innovation processes that are relevant to the organisation". This seems to suggest some sort of controlled atmosphere or environment for creativity, which contradicts Sathikh's (2010) definition of creativity itself. de Bas and Kotler's point of view is that, "Limiting the scope of creativity does not necessarily limit the ability to innovate – on the contrary. Creativity needs a framework of activity". They also point out that even art, "...which is a paradigm of 'free' creativity", needs a framework, which could be also, '...a theme or a model". deBes and Kotler identify four types of activators and the resultant activation:

- *management or top management activators*, which results in *up-bottom activation* which is an explicit decision from the top management.
- *workers as activators* which results in *bottom – up activation* which originates from staff members who are not from the management.
- *stakeholder activators* resulting in *in-out activation* which occurs when an outside party is brought in to collaborate in the innovation.
- *Scientific community and researchers* as activators resulting in *out-in activation* when the organisation allows third party closely aligned to its business to innovate through its platform.

(de Bes and Kotler, 2012, pp. 28 – 29)

Browsers go beyond being just information gatherers and should not only focus on the early stages of the innovation, “...but remain active and provide information to innovation teams throughout the whole process”. They are also expected to inspire the team through coordinated information dissemination, be it trends, technology, budget or finance, etc., as well as by steering the “...thinking towards fertile territories and viable actions”. de Bes and Kotler go on to describe different browsing and information gathering techniques such, “as network monitoring, ethnographic studies, and geolocation”, adding to the checklist of things to do during the innovation process.

Creators are to provide not just any, but plausible ideas, “...which can be implemented and which add value to the customer”, and good ideas, according to de Bes and Kotler. For organisations that are short of creators, the authors recommend three options, “train internal staff in creative techniques or recruit new people with new profile or outsource creativity to other organisations”. While the second and third options is likely to have personnel, who are trained in one or more creative professions, the first options is quite different although de Bes and Kotler categorically state that, “Creativity can be taught and developed”. Since creativity is being dealt more in detail in this thesis, the content in this section seems catered to an audience who may be introduced to the details of creativity and creators, for the first time and hence, will not be discussed elaborately. It is pertinent to mention that, the authors are well aware of the fact that assessing and selecting ideas generated is difficult due to the subject nature of the creative process outcomes, and introduce methods that will be useful to the non-creators in the ‘total innovation’ team.

Developers are entrusted with taking a viable idea forward, that is, “... to take the idea into something tangible that can be marketed”. At this point de Bas and Kotler are clear that their book is, “...not a book about engineering and design”, but, “...a book about innovation – basically marketing innovation...”, where they present, “...a model for designing and organizing innovation processes”. Therefore, the role of developer according to the authors, is both technical and marketing development within that process. At this point their commentary on what is R&D and marketing seems to overtake the discussions on what is the role of the developer in innovation. Again, this could be attributed to both the

authors being marketing centred. While they seem to agree that both have to co-operate and work together, de Bes and Kotler appoint certain type of innovation to each of them. To the authors, R&D is about disruptive innovation, while marketing is about, "...marginal innovations, on portfolio extensions, on ensuring that innovations reflect customer needs". The question that arises here is: Doesn't disruptive innovation reflect customer needs or doesn't it? This is a dichotomy that has not been answered poignantly by the authors since ideas do not come instantly (nor progressively) just by following the methods of creation. Likewise, ideas do not get developed instantly to cater to customer needs just because of portfolio extensions. deBes and Kotler proceed on to make further difference between developers and marketers saying, "Developers should be master of the art of possible. Marketers should be masters of the art of the valuable – articulating for what people will pay". Here, the authors' total innovation system seems to hit a turbulence. In their A to F system, if an innovation frameworks is built with innovation guidelines and innovation checklist, the value proposition of the expected outcome of the process should have been defined. It is not for the marketers to state that they are the masters of the art of valuable.

The role of the developers as described by the authors seem to be further confused by introducing limitations to their contributions which are classified as:

- Technological Limitations
- Production Limitations
- Marketing Limitations
- Financial Limitations

(de Bes and Kotler, 2012, p. 99)

In each of the limitations, the authors advocate a critical review of the innovation process to ascertain if the project is viable and profitable before embarking further. The authors go on to elaborate on how a developer should, "...conserve the concept, advance further on development, decide on key features, do quality checks and test the solution/design". They also advice on exercising patience during the development part of innovation.

Executors take responsibility for the implementation of innovation. de Bes and Kotler quote several well-known exponents of innovation as describing the execution of innovation as the phase in which there is a depletion of energy and resources. The authors lay emphasis on deciding on who should execute the innovation in an organisation, whether from inside or outside the company and discuss options available in both, citing examples such as General Electric, Nestlé, Bharti Tele-Ventures and Walmart. The profile of the innovation executor is also important in the success of the project/innovation, since according to de Bes and Kotler, “The execution of an innovation, especially when it is disruptive or involves a new or independent business, creates new situation in an unfamiliar environment, which requires sharp reflexes: you have to be quick and creative in finding solutions...” Experience in having led innovation, they say, is, “...a better bet than proven success in turning a profit”. This discussion on the importance of having an able executor will be evident in one of the case studies in Chapter 8 of this thesis when discussing the development of a low-priced car by the Indian industrial giant, Tata Motors. Further discussions on executors becomes a detailed decision related to marketing success, taking away the attention on innovation.

Facilitators, the last in the A to F Total Innovation System, have the following functions, according to de Bes and Kotler:

- Approve the related investments
- Select the best options for innovation
- Advance the innovation process
- Jumpstart the group when it gets bogged down
- Give the definitive “go” for a launch or innovation execution

(de Bes and Kotler, 2012, p. 132)

The authors also state that, “The facilitators are also responsible for terminating a process before costs get out of hand or for putting it back on course when it goes awry, such as when it diverges from the objectives or budget”.

Facilitator’s, engagement in the project, unlike the others earlier in the innovation process should be less constant, as per the authors, who advice that, “...it is healthy to have them keep a certain distance from the process so that they can act more objectively than if they were involved on a day-to-day basis”. This is again evident in the involvement of Mr. Ratan

Tata of Tata Motors, who was the ‘Activator’ as well as the ‘Facilitator’ in the development of the low-priced car in the case study to follow in Chapter 8 of this thesis.

While the authors state that the Facilitators should keep a distance during the innovation process, they proceed to outline in detail, three areas of facilitation related to, assessment and selection of concepts, jumpstarting innovation in the event of a break down and approval and allocation of financial resources and investments. The first, assessment and selection of concepts, could best be handled by the earlier roles in the innovation process, leaving the Facilitators to assess the recommendation of those responsible for creation, development and execution of the innovation process. Methods to jumpstart the broken-down innovation process systems and tools for approving and allocating funds and investments seem to resonate with the roles of the Facilitator, though the methods and means discussed have lot more meaning for large corporation with the ability to manage large innovation projects.

At the end of Chapter 8 of their book, de Bes and Kotler expand the innovation process shown in Figure 5.25 into a very complex representation as shown in Figure 5.26.

Figure 5.26: Innovation Model of deBes and Kotler

Source: de Bes and Kotler (2012, p. 212)

Chapter 9 of Winning at Innovation is on the “Advantages of Designing Innovation Process” with the A-to-F Model. The first difference in the authors’ approach is in “the paradigm shift in terms of roles” rather than stages according to the authors. They argue that the natural sequence as proposed by them, which is, “A-B-C-D-E(F) could be changed to A-B-C-A-F-D-B-D-F-E-C-E or to something as simple and brief as A-D-E”.

Second difference is in “the engendering of new collaborative formulas”, which allows for, “... backtracking to previous stages without being seen as a setback”. This facilitates multiple interaction and emergence of new collaborative stages during the innovation process, which the authors call “cross-cutting inputs”.

The third difference is in the emphasis on “ the roles, not departments”, which provides for interactions among people with different fields of expertise, each taking a role.

These three differences enables the A-to-F model to design, “...totally different innovation processes that respond to objectives and specific innovation strategies”. de Bes and Kotler proceed to build innovation process by addressing four dimensions:

1. Main Person/s in charge of each role
 2. Techniques employed in each role
 3. Total time and time allocated to each role
 4. Resources allocated to each role
- (de Bes and Kotler, 2012, p. 161)

While the authors build on these dimensions using the A-to-F model to develop the innovation process, it is apparent that the process moves from complex to, what could become, complicated without the attention, resources and investments, all of which only a large organisation or corporation could allocate, in order to ensure the effective running of the whole innovation process.

While the authors conclude Chapter 9 by saying, “...this design is perfectly adaptable to any situation and industry”, it is more apparent that this method needs training of personnel in order to execute the level of complexity that the authors have derived. While the Total Innovation System seems logically correct, it may be burdensome to take an innovation from idea to fruition using the model suggested by the authors.

The authors have included three annexes to elucidate the method, which seem to be fitting the model into to process that has already been executed before concluding Part I of their book.

Part two of Winning at Innovation consists of four chapters that deal with:

Chapter 10. Planning Innovation

Chapter 11. Metrics

Chapter 12. How to Foster a Creative Culture

Chapter 13. Incentive and Rewards

Chapter 10, “Planning Innovation”, has a lot of repeated propositions, but is supported with additional topics such as, “corporate business diagnostics, fitting with company mission, goals and overall strategy, innovation goals, defining innovation strategy, implementing innovation strategy”, and ends with an example of innovation road map. The topics, though important, are of relevance to large corporations and seems to be based on a ‘marketing pull’ point of view.

Chapter 11, “Metrics”, is a topic not many advocates of innovation talk about and hence, it is fairly new. Innovation metrics, according to de Bes and Kotler is, “... a set of tools and systems for measuring the innovative capacity of an organization” and is not the measure of the success or effectiveness of innovation. The authors group metrics into four categories:

- Economic metrics – which measures the positive or negative results of innovation from the company
- Intensity – which measures the quantity of innovation without considering the results
- Effectiveness – which measures the profit in reference to the resources expended
- Culture - relates to the creative culture of the organisation

(de Bes and Kotler, 2012, pp. 215 – 221)

It is important to note that creative culture is a metrics for innovation according to deBes and Kotler. While creative culture is important, the author in his paper titled “Creative Culture to Innovative Culture: Transformal Operation” (Sathikh, 2017) points to the need for transformation of creative culture to innovation culture for innovation to be valuable. While deBes and Kotler mention four distinct innovation metrics, they also point out that organisations

need to use a combination of metrics and decide on the right mix as a function:

Metrics = f (complementarity, innovation strategy, industry)

which should:

- be understandable
- not be complicated
- exploit the indicators of the company
- be customer-related

(deBes and Kotler, 2012)

The need to be customer-related, in the author of this thesis' opinion, may not hold true for all circumstances. For example, an innovative method to measure overheating of engine in a passenger car need not necessarily be customer-related; it may have things to do with the general function of the engine and safety. de Bes and Kotler encourage organisations with experience in innovation metrics to move to the sophisticated combination of metrics where the "...construction of frameworks as a diagnostic of a company's innovative capacity and its evolution over time".

Chapter 12, "How to Foster a Creative Culture", dwells on the importance of cultivating a culture that, 'exudes interest and proactivity in innovation'. de Bes and Kotler, are quick to point out that, "... you don't want to ghettoize creativity". They see that the permeation of creative culture in an organisation leads to an interest in contributing ideas and describe creative culture as "contagious". Creative culture cannot be left alone once it has been introduced and hope that, "...sooner or later innovation will happen". deBes and Kotler state that an organisation has to have "culture builder" at all levels to establish creative culture and identify the chief executive officer (CEO) as the first and the most important culture builder in any organisation, citing examples of Infosys Technologies Limited and Proctor & Gamble as companies whose CEO and the top management stay involved in the innovation process from the beginning. They also cite a study showing 79.3% of the enterprises where the top or senior management championed innovation efforts to be the 'best innovation performers' (p. 229). deBes and Kotler also emphasise that the senior management also need to be creative in their roles and the appointment of a chief innovation officer (CIO). Besides this, this chapter also deals with, "inhibitors of ideas, creativity and innovation", identifying, "fear in general, deadlines, pressure, internal

competition, crisis and restructuring, and the lack of methods”, as the main ones, and discussing on identifying and eliminating them.

deBes and Kotler also touch on the need to encourage motivators and the need to activate both intrinsic and extrinsic motivation within them to promote creativity and creative culture within an organisation. The authors dwell on related topics such as the extent to which creativity should be popularised, role of communication, multiculturalism and cross functions, all of which play important roles in fostering creative culture. deBes and Kotler also highlight the importance of common spaces, atmosphere and time as important factors for creative culture. This chapter ends with eight point summary of how to create an innovation culture. The sudden introduction of innovation culture in a chapter on fostering creative culture again raises the question if authors and experts themselves have a clear idea of creative culture and innovation culture, a clear distinction which Sathikh (2017) has outlined in his paper titled, *Creative Culture to Innovative Culture: Transformal Operation*.

At the end of Chapter 12, DeBes and Kotler present their model of total innovation system as shown in Figure 5.27.

Figure 5.27: Total Innovation System Model of DeBes and Kotler
Source: de Bes and Kotler (2012, p. 243)

Studying the proposed total innovation system of deBes and Kotler (2012), the following could be identified:

- As a model, the proposal from DeBes and Kotler is complex, with a lot of details that could build to the complexity
- The model is more procedural with all permutations of possibilities laid out in one model. While the descriptive nature of the model is helpful, the nature of the relationship between creativity and innovation is not brought out
- There is a need for a model that could be derived that visually depicts the complex nature of the creativity to innovation relationship in a simpler manner

The final chapter of Winning at Innovation titled “Incentive and Rewards” brings out a subject not dealt in articles and books on innovation, the need for encouragement to creativity and innovation beyond building a culture of creativity and innovation. deBes and Kotler, at the outset of the chapter itself, indicate there are supporters as well as opponents to the concept of incentives as a way to, “...enable them (employees) to share the value derived from innovation”. They go on to discuss whether there is a need to incentivise through money and argue that, while researchers may find this not to their liking, marketing and sales team already offer money as a sole incentive for innovation. deBes and Kotler suggest that financial incentives in the form of raise in salary, special monthly bonus and success bonus is a better approach. The practice of issuing company stock or shares as an incentive is also discussed along with a portion of the shares as well as payment in kind (in rare cases).

deBes and Kotler also suggest intangible forms of incentives such as public recognition, access to restricted circles (associations, etc.) and research resources to buy needed equipment and hire more researchers.

At the end, deBes and Kotler also bring in metrics and criteria for incentives and awards, cautioning that incentive practices could turn out to be counterproductive, producing poor results. They also suggest that incentives linked to innovation must be defined before the occurrence and awards handed out only after the results are known. They end the chapter (and the book) by stating that, “Incentives reinforce the link between strategy and results, as our Total Innovation System shows”, and state that, “...the secret is to choose the right

combination of incentives that best work for your company: the most suitable for your industry, those that best reflect the objectives you are pursuing, those best reinforce your creative culture and those that best complement each other”.

While Figure 5.27 depicting the total innovation system of de Bes and Kotler is quite complex, a simpler depiction of the innovation process based on the individual/team/group involvement as depicted by de Bes and Kotler can be derived as shown in Figure 5.28.

Figure 5.28: Simplified Innovation Model of deBes and Kotler

Source: Derived by the author

Other influencing literature on innovation. four books on innovation needs to be mentioned as providing reference to the contemporary thoughts and works on innovation. Of this “Innovation and Entrepreneurship”, written by Peter F. Drucker (Drucker, 2007) is important, since Drucker, through his first edition in 1985, is said to have brought (or revived) innovation to the forefront of business and organisations. Predominantly targeted at what he describes as “the entrepreneurial economy” he describes innovation as, “...the specific tool for entrepreneurs, the means by which they exploit change and opportunity for a different business or a different service”. Drucker in Part 1 of the book titled “The Practice of Innovation”, prescribes methods and means to apply the principles of innovation for entrepreneurship. Drucker’s main contribution to the entrepreneur and business community was to categorically state that, “Innovation... does not have to be technical, does not have to be a ‘thing’ altogether”. His examples of innovation of the modern government by Machiavelli and the nation state by Jean Bodin and of social innovation by Japan with a, “...deliberate decision a hundred years ago to concentrate their resources

on social innovations, and to imitate, import, and adapt technical innovation – with startling success”. Drucker proposes a similar approach for entrepreneurs, which he terms “systematic innovation” and defines it as:

Systematic Innovation therefore consists in the purposeful and organised search for changes, and in the systematic analysis of the opportunities such changes might offer for economic and social innovation.
(Drucker, 2007, p. 31)

Drucker mentions exploiting change and terms the discipline of innovation⁶⁴ which he describes as a “...diagnostic discipline: a systematic examination of the areas of change that typically offer entrepreneurial opportunities”. Drucker specifies seven sources of innovation to be monitored, the first four of which occurs within the enterprise and the second three that happens changes outside the enterprise:

- The unexpected
- The incongruity
- Innovation based on process need
- Changes in industry structure or market structure
- Demographic
- Changes in perception, mood, and meanings
- New knowledge

(Drucker, 2007, p. 32)

The unexpected considers success and failures, incongruity considers the what is and what ought to be. The next four sources are more or less self-explanatory. What is more pertinent for this doctoral study could be the last source, new knowledge.

In discussing about new knowledge as a source for innovation Drucker in Chapter 9, portrays knowledge-based innovation as the “superstar of entrepreneurship” which differs from other sources in terms of, “...time span, casualty rate, predictability, and in the challenges it poses to the entrepreneur” and like all superstars it is, “...temperamental, capricious, and hard to manage”, both of which account for the long lead time of innovations, describing long lead time as the first characteristics of knowledge-based innovation. The second characteristics is in, “... the convergence of several

⁶⁴ The author does not consider innovation as a discipline by itself and believes that innovation is a process that can take many routes based on the ‘arena’ where value through innovation is sought.

kind of knowledge, not all of which is scientific or technical”. According to Drucker, these two characteristics gives knowledge-based innovation specific requirements which are:

1. **Careful analysis** of all the necessary factors – the knowledge itself or social, economic, or perceptual factors.
2. Clear **focus on the strategic position** – whether to develop from scratch, focus on the market and what position would enable the knowledge innovator to be largely immune to the extreme convolutions of a knowledge-based industry in its early stages.

Drucker also considers the risks and the unpredictability involved in knowledge-based economy, which, besides being turbulent, has a peculiar rhythm which Drucker attributes to long lead times and convergences where, “For a long time, there is awareness of an innovation about to happen which ends with a sudden near-explosion, followed by a few short years of tremendous excitement, tremendous start-up activity, tremendous publicity”, which then has a “shakeout”, which only a few survive according to Drucker. Drucker cites examples of the proliferation of automobile companies in the early 1900s which had shrunk to only four by 1969 and the nearly hundred railway companies that sprouted after 1830 in England as railroads were considered high-tech only to find the window shut by 1845 leaving only 4 or 5 companies to operate after fifty years. The implications of embarking on knowledge-based innovation, especially science-based or technology-based innovation according to Drucker are:

1. Time is working against them, not giving a second chance if there was a failure of some sorts.
2. With the ‘window’ much more crowded, any one knowledge-based innovator has far less chance of survival.

This probably is what accounts for the rise and fall of the ‘internet boom’ of the 1990s with the mushrooming of high-tech start-ups failing as fast as they started their companies. Those who survived such as Hotmail, WhatsApp, etc., have also been bought out by larger players such as Google, Microsoft, Facebook, Apple and others in the shakeout which Drucker predicts sets in as soon as the ‘window’ closes. What are the chances and the means, then, by which a knowledge-based innovation survives? Drucker prescribes that they have to be ‘ripe’ and have receptivity to it.

In discussing the principles of innovation, Drucker prescribes some 'dos' and 'don'ts' which become important in this doctoral study.

Dos

1. All sources of innovation need to be carefully analysed and systematically studied.
2. Successful innovation needs both the 'left side' and the 'right side' of the brain⁶⁵, taking what systematic analysis had provided and to see the expectations and needs of the customer.
3. Effective innovation needs to be simple and focused on specific needs.
4. Effective innovations start small not grandiose.
5. Successful innovation aims at leadership from the start.

Don'ts

1. Not to be clever since innovations have to be handled by humans.
2. Don't diversify, don't splinter, don't do too many things
3. Innovate for the present

Drucker also introduces **three conditions** in his principles of innovation as:

1. Innovation is work which requires tremendous capacity.
2. Innovation must build on their strength
3. Innovation is an effect on the economy and society

While Drucker builds his book on innovation as an important element in entrepreneurship, his take on innovation, though relatively small, addresses some fundamentals of idea generation and follow through. The takeaway for this doctoral study are:

- Innovation needs to be systematically approached with a specific focus
- Innovation needs a level of insight and leadership (all of the above cited from Drucker (2007, pp. 122 – 127))

The next two books on innovation are written by Tom Kelley; the first titled "The Art of Innovation" (Kelley, 2001) and the other is titled "The Ten Faces of Innovation" (Kelley, 2005). Kelley who works for the famous design and development

⁶⁵ The concept of the difference in the way the right and left sides of the brain work has been contested to prove that this is not entirely true.

consultants, IDEO Product Development, has written both the books at the height of the 'design thinking' phenomenon that IDEO lays claim to have propagated to a wider audience than designers. Not a designer himself, nor an academic, Kelley has written both the books to be descriptive and prescriptive offering a first level peek into innovation and how one could benefit from innovation. These two books are referred in this doctoral study due to the fact that many practitioners of new product design and development, web design, user experience (UX), user interface, etc., have been referring to these books when they talk about the success of their venture or business. The Art of Innovation (Kelley 2001) is about how to set one's self and/or an organisation to discover means to generate ideas and take them through prototype, emphasising the need to be open, creative, non-judgemental at the beginning, to be prepared for the unexpected and surprises, to be bold about prototyping and testing till a solution is arrived at. Kelly (2001) also discusses on roles one has to play in this process and the difficulties and barriers that needs to be prepared for. This book is filled more with anecdotes from IDEO's success / failures to elucidate the points that Kelley wishes to make.

The Ten Faces of Innovation (Kelley, 2005) , on the other hand claims to be, "...a book about innovation with a human face", and deals more with the people who are involved in innovation, as individuals, teams or groups. Kelley presents ten core chapters that were developed in IDEO that, "...you may call talents or roles or personas for innovation". These personas, Kelley (2005) has classified into three major groups:

1. The Learning Personas
 - The Anthropologist
 - The Experimenter
 - The Cross-Pollinator
2. The Organizing Personas
 - The Hurdler
 - The Collaborator
 - The Director

3. The Building Personas
 - The Experience Architect
 - The Set Designer
 - The Caregiver
 - The Storyteller(Kelley, 2005, pp. 8 – 12)

The learning personas, “...constantly gather new sources of information in order to expand their knowledge and grow”. The organizing personas are, “...savvy about the often counterintuitive process of how organizations move ideas forward”. Kelley (2005) states that, “Those who adopt these organizing roles don’t dismiss the process of budget and resource allocation as ‘politics’ or ‘red tape’. They recognize it as a complex game of chess, and they play to win”. The building personas, “...apply insights from the learning roles and channel the empowerment from the organizing roles to make innovation happen”.

While Kelley (2005) elaborates each of the personas as a chapter each, the take away from The Ten Faces of Innovation are the following:

1. Kelley (2005) portrays innovation in the manner of an ant colony or a beehive with roles taken by groups of ants or bees.
2. In order to move an idea from creativity through to successful innovation, the three groups of personas act in an almost linear fashion as may be depicted in Figure 5.29 by the author of this thesis.

Figure 5.29: Simplified Depiction of the innovation process proposed by Kelley (2005)

Source: Derived by the author

Through his book described as the ‘life time work’ of Professor Vijay Kumar of Institute of Design, Illinois Institute of Technology titled “101 Design Methods: A structured Approach for Driving Innovation in Your Organization” (Kumar, 2013) has gained reputation amongst the

organisations world over as a methodologist in innovation.⁶⁶ Kumar represents approaches to innovation within the context of design and design innovation process. In 101 Design Methods, Kumar presents seven modes of design innovation process and details them over seven separate chapters. In the introduction chapter, Kumar defines innovation as, “Innovation (n): a viable offering that is new to a specific context and time, creating user and provider value”.

Kumar’s definition is precise and specific to a system consisting of user/consumer and provider/organisation. He goes on to propose four core principles of successful innovation:

Principle 1: Build innovations around experiences. Kumar’s point of view is that, “Every company and organization in some measure creates or effects peoples’ experiences”. Focusing on the nature of those experiences provides the perfect starting point of innovation.

Principle 2: Think of innovation as a system Kumar defines a system as, “...any set of interacting or interdependent entities that form an integrated whole which is greater than the sum of the parts”.

Principle 3: Cultivate an innovation culture According to Kumar, “This principle is about cultivating a mindset among people in an organization that everyone is actively engaged in innovation on a daily basis and that everyone’s actions can add up to the overall cultural behavior of the organization”⁶⁷.

Principle 4: Adopt a disciplined innovation process. Kumar asserts that, “It is possible to create innovations using well-developed processes and repeatable methods, all in service of supporting and extending the other three principles of successful innovation – understanding experiences, thinking in terms of a system and fostering an innovation culture”.

(Kumar, 2013, pp. 3 – 7)

Kumar presents a model of the design innovation process as shown in Figure 5.30.

⁶⁶ <https://www.id.iit.edu/people/vijay-kumar/> retrieved on 14 January 2018.

⁶⁷ While the author of this doctoral study agrees with the need to cultivate an innovation culture, he questions the assumption that innovation culture can come about without considering creativity in the process as he has explained in a paper in 2017 (Sathikh, 2017).

6. **Frame solutions** – combine the large number of concepts to form a system of concepts
 7. **Realize offerings** – to ensure that solutions fit the people's experiences
- (Kumar, 2013, pp. 10 – 13)

Based on these seven modes, Kumar spends a chapter each to elucidate the concepts with examples, recommendations and advice. As a step-by-step method for design innovation in a large organisation Kumar's 101 Design Methods perhaps works very well, although as a practitioner of innovation, the author finds this so detailed that it may take a long time to realise paradigm jumps in innovation, or at the worst miss it altogether if caught in the detailed process in any one of the modes.

While DeBes and Kotler (2012) and Kumar (2013) have put forth different propositions to making innovation a business reality, describing the various elements, players, moves and process that would make it a success, Barnett (1953) was able to describe, more or less the same process and describe game play and players that bring societal level innovation. While Barnett (1953) touches innovation at the societal level, a book titled "Adding Values: The cultural side of innovation", written by an academic Dany Jacobs (2007) that brings culture as a significant influencer in innovation.

Jacobs' main assertion is that, "...innovation is more about culture than about technology". His contention is that, "In all discussions about knowledge-based economy, innovation is always associated with technology, but only sparingly with culture". Jacobs believes that successful innovation is about changing people's cultural value systems. In an easy to read and understand style, yet with academic rigour, Jacobs argues his case for considering culture as a strong basis for innovation, by first introducing the need to differentiate the technical and non-technical aspects of innovation, followed by presenting the need for, "... a Darwinian evolutionary approach towards innovation – with its traditional three steps: variation, selection (of the fittest) and retention/speciation". This is close to generation of concepts and selection of the most appropriate one to developing further towards a valuable innovation that DeBes and Kotler (2013) and Kumar (2013) describe in different ways. The inclusion of Darwin probably lays emphasis on the selection of

the fittest to survive or sustain without extra or regular efforts.

Jacobs also clearly segregates innovation into three:

1. Product Innovations
 2. Process Innovations
 3. Transaction Innovations
- (Jacobs, 2007, Chapter 2)

He sets out to propose a simple structural relationship between the three as shown in Figure 5.31.

Figure 5.31: Basic Forms of Innovation
Source: Jacobs (2007, p. 49)

While the innovation concepts of deBes and Kotler (2012) and Kumar (2013) can more or less identify with the depiction shown in Figure 5.31, the inclusion of social innovation by Barnett (1953) leaves a gap to be filled in the basic forms of innovation.

Figure 5.32: Social Innovation in Jacobs' Basic Forms of Innovation

Source: Derived by the author

Taking the cue from Jacobs that the different forms of innovation have relationship and influence on one another, social innovation, that Barnett (1953) has described as early as in the 1950s introduced, can be included within Jacobs diagram as seen in Figure 5.32 showing a direct relationship that social innovation has with process innovation and transaction innovation. Product innovation could have relationship or linkage with social innovation through either process innovation or transaction innovation or both.

Another key concept that Jacobs emphasises on is, “radical innovation”. In his opinion, any innovation that labours in the fringe of bringing marginal value is only incremental. While not dismissing incremental innovation as being trivial, Jacobs believes that radical innovation can create ‘dramatic change’ in products, process and transactions. One can include society as well based on the diagram shown in Figure 5.32. Jacobs also identifies “strategic innovation”, though he does not see any point in distinguishing this as a separate category. In the rest of the chapters before the final chapter, Jacobs revisits Darwinian framework (for innovation), before expounding and expanding his thoughts on the role of fitness (of innovation) in environments, and industrial design, before moving on to the selection systems, in order to selecting the right team internally or externally. Jacobs also dedicates the next two chapters to “understanding our clustered world”

and “co-evolution” before reaching the final chapter (Chapter 10) titled, “the dance of innovation”, where he summarises the whole of his book in ten paragraphs as his promise, “... to provide an analytical basis of the idea of ‘productive creativity’ ”⁶⁸. The gist/essence of these ten paragraphs is shown in Table 5.4.

Jacobs does not end with this; he has written an essay at the very end of the book titled “Creativity and the Economy”, where he critically reviews the concept of “creativity as a competitive factor” from economic standpoint. While defining creativity as, “...about breaking through existing patterns and establishing new combination”, Jacobs also critiques the conception of the “creative art of seeing” stating that, “...invention and innovation requires at least as much intelligence, accepted knowledge and purposive research as this creative art of seeing something in a totally new light”. As a counter critique, the author(of this thesis) wishes to comment that three other experts, Barnett (1953), deBes and Kotler (2012) and Kumar (2013) are very clear that innovation is more about an organised effort to take creative ideas forward to valuable innovation, and hence creativity, whether it be seen as ‘art’ or otherwise, places itself at the first step in the creativity to innovation journey.

⁶⁸ It is important to note that Jacobs (2007) does not mention creativity per se in his book, only making a statement that alludes to innovation being ‘productive creativity’. He has included an essay titled ‘Creativity and the Economy’, more like an epilogue to his book, right after the references, etc.

Table 5.4: *The Dance of Innovation of Jacobs (2007) – Summary*

No	Description	Remarks
1	It is useful to make a clear distinction between technical and non-technical aspects of innovation	
2	Innovation literature has placed too much emphasis on the technical aspects of innovation and too little on the cultural aspects	Missing out on experience, transformation (and society)
3	Technical aspects of innovations are more important in the early stages of the life cycle of a product category.	This is more related to product innovations
4	Successful selection of innovation is a necessary element in the survival of organisations.	A Darwinian approach is necessary
5	Fitness of innovation in economic environments can best be defined as value to various kinds of selectors in a certain selection systems.	Value entails both quantitative and qualitative evaluations, related to a culturally determined set of preferences.
6	Creating economic value through innovation entails marginal reconfiguration of cultural norms and values.	The more radical the innovation the further the cognitive distance from prevailing cultural value systems
7	Before innovation can be externally tested they are the object of internal selection within organisations.	
8	Innovation does not take place in isolation. It is a part of an co-evolutionary system	
9	It is quite helpful to map the complexity of interactions between the different selection systems to be able to concentrate on the most important links strategically and tactically.	Kumar (2013) provides methods for this. This aspect is important to forming the relationship between creativity and innovation
10	Reconfiguration of cultural norms and values remains a social deconstruction and reconstruction process.	Jacobs places importance on the ability to ‘translate’ others’ interests and perspectives into the innovation.

Jacobs subscribes to the notion that creativity alone does not provide for the growth in economy as famously stated by authors such as Richard Florida in his 2002 book titled, “The Rise of the Creative Class”.⁶⁹ Jacobs’ has, however, proposed a visualisation of the issue of creativity and the economy as seen as a, “...range of expanding concentric sets” as shown in Figure 5.33.

Figure 5.33: Creativity in the Economy

Source: Jacobs (2007, p. 171)

Based on Figure 5.33, Jacobs states:

- At the core are industries for which, ‘... the creation of innovation is work itself: the arts, scientific and technological research, the media, computer games, photography, architects and technological design, town and country planning...’
- At the next circle are industries that require creative design such as, ‘...fashion, furniture, cars, entertainment parks... mobile phones, kitchen tools...’
- The third circle is about, ‘... people having to think about new ideas, new ways of organising, new concepts’.
- At the final level, ‘... in relatively basic and/or traditional jobs (teachers, health workers, policemen,

⁶⁹ Florida, R. (2002). The Rise of the Creative Class. New York. Basic Books

social workers), employees increasingly have to think about the creative adaption of rules to a certain situation.

(Jacobs, 2007, pp. 172–173)

In introducing the a visual depiction of creativity in the economy, shown in Figure 5.33, Jacobs makes it sound like creativity on its own will figure within the four circles. This seems to contradict with the previous ten chapters, where he outlines methods and means to valuable innovation. By not being able to connect creativity and innovation, the relationship between both, is either not evident in the book or Jacobs somehow is not able to connect both through a meaningful engagement or relationship. This is in oddity to the whole purpose of the book by Jacobs since it has a potential to see far wider and deeper if developed further based on Barnett's (1953) idea that, "... challenge for a general theory of innovation lies in the realm of behavior, belief and concept".

Looking at creativity in the economy from the social innovation angle reveals some contemporary thoughts that may not have been a priority in 2007 when Jacobs wrote his book on the cultural side of innovation. In a recent article titled, "The creative economy is dead – long live the creative-social economies", Comunian et al., (2020) pick up on social innovation through the argument that creative economy as it was known do not have value at the present junction of global development. Instead Comunian et al., (2020) bring forth the thought of *creative-social economies* in the plural. In their article, Comunian et al., mention about recessions and how they lead to social centric strategies in communities leading to creative-social economies.

Summary of the works by five authors on innovation.

Table 5.5 gives a brief summary of the works on innovation done by five authors studied.

Table 5.5: Summary of literature on innovation

Title & Author	Key Points	Model Derived	Remarks
Innovation: The Basis of Cultural Change H.G. Barnett	An anthropology professor's work on innovation that could be derived to suit contemporary situations. Very elaborate in explaining how innovation could bring about cultural change.	Simplified model of innovation derived	A very early work (1953) which does not have business or profit accent
Winning at Innovation. F.T. deBes & P. Kotler	Written by two academics from a business/management outlook. Explores innovation slightly differently from any of the step-by-step guide book on innovation	Model depicted is very complicated Simplified model derived	The aim of the book seems to be to transform an organisation into an innovative organisation through the four distinct areas in innovation
Innovation and Entrepreneurship P.F. Drucker	A wider tome on entrepreneurship which lays innovation as an important path to success	Does not have any specific model	Drucker was an early influencer on innovation and entrepreneurship
The Art of Innovation & The Ten Faces of Innovation. T. Kelley	Not a designer or academic, Kelley has written both the books to be descriptive and prescriptive offering a first level peek into innovation and how one could benefit from innovation	Simplified model of innovation derived	This book has been a commercial success, fueled by the success of IDEO
101 Design Methods V. Kumar	Aimed at large (r)corporations, Kumar presents seven modes of design innovation process and details them over seven separate chapters. Lays emphasis on the non-linear and iterative qualities of innovation	Kumar had derived relatively simple model of innovation	Very elaborate and complex sub-processes outlined. Could be a distraction to small (and medium companies) in their quest for innovation
Adding Values: The Cultural Side of Innovation. D. Jacobs	Written by an academic with economics background and understanding of design, brings culture as a significant influencer in innovation.	Jacobs presents many models, though a simplified model is not derived	Jacobs has a rather disjointed view/opinion on the relationship between creativity and innovation

Invention and innovation. Where does *invention* feature in the creativity to innovation process? Perkins (1988) in the chapter titled, 'The possibility of invention' states that, "Our inventiveness often puzzles us a particular example of an *ex nihilo* problem; Something comes out of nothing." The question is, 'Does invention come out of nothing? Is invention a part of the innovation process?' Several authors and researchers make it clear that, while invention may be one of the factors leading to innovation, invention can also be realised external to innovation as well. This is evident in social innovation as described by Barnett (1953) where innovation is a way of thinking and behaviour that bring about a qualitative change. Marchetti (1980) states that, "Innovation – or basic innovation, is something that starts a new industry" and that "Inventions refer to the discoveries that are at the base of the

innovation”. This is corroborated in Figure 5.14 by bringing in ‘inventiveness’ between creativity and innovation. Further to this, Dr. Chesbrough (2003) states, “By innovation I mean something quite different from invention. To me innovation means invention implemented and taken to market” (as cited in Lane & Flagg, 2010). One of the case studies (Case Study 3) presented in Chapter 8 is about an automatic flat bread (chappati) maker which is an inherent invention that has been taken to the market as valuable innovation. However, the process of taking an invention successfully to the market, by itself is a part of the innovation process as shown in Chapters 7 and 8.

Taking the concepts and discussions from Millet et al (2007), Marchetti (1980), Lane & Flagg (2010) and Perkins (1988) together, one can infer that while creativity is a basis for invention, invention as an outcome of this creativity needs to pass through a process before it becomes valuable innovation. This is further corroborated by Arthur (2007) who states that invention is a process, “...whereby novel technologies came into being as fresh combinations of existing ones” which may be verified by Case Study 3 in Chapter 8 of this thesis. In summary, in the creativity to innovation journey, inventions could be one of the outcomes of creativity that needs to pass through a process before they become valuable innovations. It may be noted that, invention by itself has been researched and studied as an important topic by itself⁷⁰, and hence, lies beyond the research scope of this thesis.

Arts and innovation. Discussions on innovation emanating from key literature studies summarised in Table 5.5 have centred predominantly around the role of innovation in bringing value from corporate, management and industrial/commercial point of view (except for Barnett). Works of known authors like Drucker (2007) and Kelley (2008) have also laid emphasis on corporate level success through innovation as business strategies and the management of it as paths to profitability. Innovation and creativity are portrayed as means to a preferred end in this respect, a phenomenon that has dominated the business world since the 1980s with Drucker’s defining book, *Innovation and Entrepreneurship: Practice and Principles*

⁷⁰ A book titled *Creativity in Invention and Design* by Subrata Dasgupta (1994) dwells on this topic in great details from the point of view of computational and cognitive explorations of technological originality.

(Drucker, 2007) and reinforced by Freidman's *The World is Flat* (Freidman, 2005) and the works of scholar authors such C.K. Prahalad's *The New Age of Innovation* (Prahalad & Krishnan, 2008). Careful reading of Drucker, Freidman and Prahalad indicates a shift in business management thinking from the 1980s to the first decade of the twenty-first century. While Drucker points to innovation and entrepreneurship and the building of cohesive teams to successfully lead and manage it, Freidman predicted opportunity for all participating countries to benefit from global economy due to the advent of technology and the business that comes along to support it. Details on structures of organisations to part take in globalisation is not mentioned in details. Prahalad and Krishnan go further to discuss about the participation of the users/consumers in the value creation of an organisation, bringing in networked cocreation and present ideas on focussing, "... building organizational capabilities that allow a firm to create the capacity for continuous innovation" (Prahalad & Krishnan, 2008) that can work through global networks. How did this shift happen? How did this shift from structured organisation emphasised in the 1980s to a more networked organisation of the 2000s happen? One could argue that this was a logical development of globalisation. Research into areas of socio-political development as well as design for business bring out substantial evidence of other influencers in this shift.

The first sense of the shift comes from the seminal work done by Boltanski and Chiapello⁷¹ (2005) on the shift of the concepts of capitalism in France over the years. In analysing comparative study of their *new spirit of capitalism* of the 1990s with spirits of capitalisms before that, they found, "This analysis has lead us to conclude that a new representation of the firm has emerged, featuring an organisation that is very flexible; organised by projects; works in a network; features few hierarchical levels; where a logic of transversal flows has replaced a more hierarchical one, etc" (Boltanski & Chiapello, 2005), which they represent through their findings as shown in Table 5.6:

⁷¹ Luc Boltanski and Eve Chiapello have authored the authoritative book *The New Spirit of Capitalism* first published in 1999. While this book deals with several issues in detail, this thesis has referred to an explanatory article published in 2005 by the same authors due to its focus on the subjects from the book in a more concise way.

Table 5.6: Comparing the spirits of capitalism

Source: Boltanski & Chiapello (2005)

	First spirit End of nineteenth Century	Second spirit 1940–1970	Third spirit Since 1980s
Forms of the capital accumulation process	Small family firms Bourgeois capitalism	Managerial firms Big industrial companies Mass production States economic policy Career opportunities Power positions	Network firms Internet and biotech Global finance Varying and differentiated productions No more authoritarian chiefs
Excitement	Freedom from local communities Progress	Effectiveness possible in “freedom countries”	Fuzzy organisations Innovation and creativity Permanent change New form of meritocracy valuing mobility, ability to nourish a network...
Fairness	A mix of domestic and market fairness	Meritocracy valuing effectiveness Management by objectives	Each project is an opportunity to develop one’s employability
Security	Personal property, personal relationships Charity, paternalism	Long term planning Careers Welfare state	For the mobile and the adaptable Companies will provide self-help resources To manage oneself

It is very clear from Table 5.6 of the changes that have taken place since the 1990s. In pursuit of a theoretical framework for analysing the way in which norms change, they arrive at the role of criticism in effecting change of norm wherein they identify, “...artistic criticism and social criticism, were equally important in the process”. While social criticism may easily be understood, it is the role of *artistic criticism* that may need further study into. According to Boltanski and Chiapello:

This form first emerged in small artistic and intellectual circles, and stresses other characteristics of capitalism. In a capitalist world, it criticises oppression (market domination, factory discipline), the massification of society, standardisation, and pervasive commodification. It vindicates an ideal of liberation and/or of individual autonomy, singularity, and authenticity.
(Boltanski & Chiapello, 2005)

At this point, they leave artistic criticism and move on to summarising their article without elaborating on its influence and the end results in this change of norm to the *new spirit of capitalism*. This is picked up by other researchers such as Kevin McCarthy and his associates (McCarthy et al., 2004) in their book *Gifts of the Muse: Reframing the Debate About the Benefits of the Arts* which is the outcome of a research report commissioned by the Wallace Foundation in the United States of America. The research was to find about the benefits of funding arts as a policy, both public and private. The authors say that, in their effort to, “... consider the full range of potential benefits of the arts, we would have to step back from the terms of the current debate, which are colored by the need to justify public spending on the arts in the face of other pressing societal demands” (McCarthy et al., 2004). To do this they identified two types of benefits, namely, *instrumental* and *intrinsic* and developed a framework to distinguish between the two. According to McCarthy, et al., (2004):

- 1) instrumental benefits are indirect outcomes of arts experiences. They are called instrumental because the arts experience is only a means to achieving benefits in non-arts areas
 - 2) Intrinsic benefits, in contrast, are inherent in the arts experience itself and are valued for themselves rather than as a means to something else.
- (McCarthy et al., 2004, p. 3)

The frame work developed by McCarthy, et al., (2004) is shown in Figure 5.34.

Figure 5.34: Understanding the Benefit of the Arts
Source: McCarthy et al. (2004, p. 4)

Figure 5.34 establishes the benefits of the arts in both public and private spheres of the society, which includes the companies and corporations that form in between the two spheres. While McCarthy et al., point to the possibilities of an innovative approach to the inclusion and participation of arts, how this is done is revealed by others through study and research.

Giovanni Schiuma, in an article titled *Mapping Art-Based Initiatives: Assessing the organisational value of the arts* (Schiuma, 2010) states in the introduction as follows:

Arts in business can be a powerful means to develop an organisation and to increase its capacity to create value. The role of arts within an organisation can be interpreted as a catalyst, a lever, and a trigger to support and drive organisational changes, to increase the competencies of an organisation and to develop its potential and latent energy. As a consequence, artists and businesses are discovering the benefits of developing partnerships. (Schiuma, 2010)

This statement reflects the findings of Boltanski & Chiapello (2005) on the shift of the companies since the 1990s. Involvement of artists in business and corporation is beneficial to both the parties as explained by Schiuma (2010):

Artists are increasingly recognising and utilising the transformational power of the arts and artistic processes. Consequently, they are learning to reflect on their own artistic processes, outputs and outcomes, to sell them to businesses in order to address organisational change management issues, to support the development of new creative and innovative capabilities, and more generally to enable personal and organisational development. Businesses are in tandem discovering the benefit of bringing in artists, artistic processes and works of arts, in order to support organisational development mechanisms and impact upon organisational energy. But the arts are not only a mechanism to spur and develop emotional and energetic states within an organisation; they can play a range of instrumental functions generally related to the development and transformation of an organisation. (Schiuma, 2010)

Involvement of artists with corporate organisations is represented by the concept of Arts-Based-Initiatives (ABIs) and artistic interventions. In a chapter titled *A Fuzzy Cognitive Map Based Approach for Understanding Value Creation Mechanism of Artistic Interventions*, Carlucci et al., (2017) quote Schiuma (2011) to define Arts-Based-Initiatives as:

An ABI can be defined as any organisational and management intervention using one or more art forms to enable people to undergo an art experience within an organisational context, as well as to embed the arts as a business asset. It is primarily and fundamentally an experience-based process involving and engaging people both rationally and emotionally through either active or passive participation.
(Carlucci et al., 2017)

According to Carlucci et al., (2017) the emphasis of ABI is not on the introduction or intervention of the works itself and state:

An ABI is intended to use works of art and arts as media to trigger, catalyse, drive, harness and govern the emotional and energetic dimensions of an organisation which can have an impact on people and/or on the organisational infrastructure of tangible and intangible assets.
(Carlucci et al., 2017)

ABI may be explained further as:

... an alternative means or ground to address issues related to business, but which require intuitive thinking, emotional arousal, aesthetic understanding, social intelligence and more generally creative capabilities, such as imagination, improvisation, perception, empathy and flexibility.
(Schiuma, 2010)

Art based initiatives (ABI) and their benefits have been summarised as shown in Table 5.7.

Table 5.7: Summary of ABI

Description	Source
<p>Forms of ABI</p> <p>1. Intervention An intervention is the kind of ABI performed within a limited time frame, usually between 2-3 days, and it works towards a specific operative goal. This kind of initiative tends to take the form and function of arts-based workshops or courses. However, it can be recognised in other forms, for example through attendance at art performances or through the purchase of a work of art.</p> <p>2. Project An ABI takes the form of a project when the duration of an initiative is longer than 2-3 days and is characterised by a set of integrated and coordinated interventions, planned and programmed over a period of time usually ranging from one to six months to achieve a business performance objective. The focus of a project tends to be the production of an output; that is, the realisation of a work of art either tangible or intangible in nature, with related organisational and managerial outcomes.</p> <p>3. Programme Finally, when the initiative has a plurality of objectives and considers a set of different projects, although ascribable to the same strategic goal, the ABI presents the nature of a programme. This is usually related either to the definition or the renewal of the business model or to developing organisational performance in line with strategic direction.</p>	Schiuma (2010)
<p>Benefits ABI are thought-provoking and capable of engaging people into reflection, self-assessment and development of a new and different knowledge of the organisational issues.</p> <p>ABI can be a social experience, which involves a group of people to build and share emotions and energy states which are the result of the interactions between individuals.</p> <p>ABI can also have impact on the organisational infrastructure by changing the tangible and intangible organisational environment by means, for instance, of the use of colours, music broadcasting, forms and design of the workplaces as well as of the furniture and facilities</p> <p>ABI can have an impact on two fundamental dimensions of a business:</p> <ol style="list-style-type: none"> 1. The organisation's human resources (namely its people), and potentially any other organisational stakeholder; and 2. The infrastructure, or overall tangible and intangible structural assets grounding the working mechanisms of the business model. 	<p>Schiuma (2010)</p> <p>Carlucci et al., (2017)</p>

Realising the forms of ABI and its benefit in organised sectors leads to two important questions:

- 1) How does ABI relate itself to innovation in an organisation?
- 2) How is ABI different from design thinking in its involvement in the innovation process?

The answer to the first question is given by Carlucci et al., (2017) through what they describe as *the arts value map*, as shown in figure 5.35.

Figure 5.35: The Arts Value Map

Source: Carlucci et al. (2017)

(Quality of image as from source)

Figure 5.35 shows art based initiatives (ABI) cascading upwards through **organisational knowledge assets** enhancing the **organisational capabilities** in order to effect the **management processes** of which one of them is the **innovation management processes** creating **values** that may be delivered to the stakeholders.

The second question pertaining to how ABI is different from design thinking is provided in an article titled *Relating the artistic practice of design to the design thinking discourse* written by Ulla Johansson-Sköldberg and Jill Woodilla (Johansson-Sköldberg & Woodilla, 2013). They point, through arguments quoting several important sources that design thinking as understood and practiced in the realm of business and management is a problem solving tool in their kit. Johansson-Sköldberg & Woodilla then bring about the difference between ‘design thinking’ and ‘designerly thinking’⁷² which the profession of designers practice, “... in which designers operate within their learned, individual styles that are inherently subjective” (Johansson-Sköldberg & Woodilla, 2013). Business adherents of design thinking also do not consider the fact that, “...all designers are socialized

⁷² Designerly thinking, “...refers to the academic construction of the professional designer’s practice (practical skills and competence) and theoretical reflections around how to interpret and characterize this nonverbal competence of the designers”. (Johansson-Sköldberg & Woodilla, 2013).

into design practice through the studio system, and in so doing they absorb artistic methodologies and processes that are overlooked when the focus is on technique” (Johansson-Sköldberg & Woodilla, 2013). This brings them to attempt to correct this misnomer that design and art are not connected through their discussions that bring to light the, “...the consideration of artistic interventions in organizations and how they contribute to expanding notions of design thinking. Johansson-Sköldberg & Woodilla (2013) first state that:

In a broader perspective, design has an interesting relationship with both art and technology/production: if the relationship with art is removed, it is no longer design, only technology. Design deals with aesthetic relations and the senses of human beings, which are at the core of art. (Johansson-Sköldberg & Woodilla, 2013)

While design thinking as an innovation tool has specific process as highlighted by Kelley (2001 and 2005), artistic interventions are lot more unstructured. Johansson-Sköldberg & Woodilla (2013) quote Berthoin-Antal (2009) as defining artistic intervention as:

...a wide range of short- and long term forms of bringing people, processes, and products from the world of the arts into organizations. ... to intervene means to come between, to involve someone or something in a situation so as to alter or hinder an action or development. Intermediary organizations, artists, and host organizations define the nature of the interaction, e.g., collaborative, provocative, entertaining, or playful. (Johansson-Sköldberg & Woodilla, 2013)

What do artists do in artistic intervention, then?

During the interventions, the clash of the two contrasting logics (of the artist and the organization) releases energy in the form of new ideas, new visions and deeper understanding of the organization that later can shape a new vision of the organization, its stakeholders and the environment. In this way artists within organizations contribute to strategic development of methods, processes, creativity, change management and motivation. (Johansson-Sköldberg & Woodilla, 2013)

They go on to advocate that, together with the fact that artistic interventions can take place on their own through different initiatives (such as ABI) and, “...that the artistic side of design thinking should not be removed but carefully incorporated”, without which, “...And then design thinking has no *raison d’être* ” (Johansson-Sköldberg & Woodilla, 2013).

In summary, it has been established that artistic intervention, through several vectors and methods such as ABI, has brought about changes in the way organisations are managed and how innovations of value may be generated, especially in the era of *the new spirit of capitalism*. It is also clear that artistic intervention has brought about changes in the structure and in human resource management in successful organisations⁷³.

⁷³ Johansson-Sköldberg & Woodilla (2013) List examples of how successful artistic intervention has benefited both small and large organisation. Since the scope of this thesis goes beyond a single topic of innovation, this has not been included.

6. A case for art and science creativities

The line between engineer and artist is exactly as thin as between process and innovation. True innovation never follows a process, but without process, innovation cannot evolve.

Music seamlessly blends process and innovation and can extend that blending into other areas of thought... especially engineering
Mechanical Engineering
January 2012, p. 4

In the realm of creativity and innovation, creativity has been looked on as the magic ingredient, the elixir, the spark that ignites a fire, starting point of something that could just stay intriguing or become a storm that will bring benefits, monetary or otherwise. According to Briskman (1980), “To adjudge something to be 'creative', in other words, is to bestow upon it an honorific title, to claim that it deserves to be highly valued for one reason or another”. But to convert this creativity into innovation of value is altogether another process, though creativity as an ingredient is needed throughout, as was discussed in Chapters 4 and 5 which established that different types of people and process are required to take a viable creativity to valuable innovation.

It may be stated that creativity is not confined to any group of people or profession and could be a part of anyone and everyone, as it seems to be recognised as a value both the two ends of the liberal arts spectrum, namely art and science⁷⁴. Getzels (Taylor et al., 1975, p. 334) in the chapter titled “Creativity: Prospectus and Issues”, quotes Schachtel who has stated in 1959 that, “The main motivation at the root of creative experience is man’s need to relate to the world around him” and further goes on to say, “It is equally apparent in the artist’s lifelong effort to grasp and render something which he has envisaged in his encounter with the world, in the scientist’s wonder about the nature of the objects around him...”. This points to a fact that creativity is essential for art and science in order to bring out man’s experience with nature on the one hand and nature’s effect on the world on the other.

Koestler (1964, 1985) was one of the first to expound the concept of art creativity and science creativity by proposing three forms of creativity, “artistic, scientific and comic”⁷⁵. The author believes that comic inspiration is a pure form of creativity, which stands by itself in the emotional realm of

⁷⁴ Creativity, in the wider arts in terms of humanities and social sciences, needs to be acknowledged here. Language, literature, poetry and oratory are areas where higher level of creativity is acknowledged and appreciated. In order not to extend the complexity, it was decided to study creativity and innovation in the areas that have visual and physical manifestation such as painting, graphics, products, building and higher order ‘cause and effect’ that manifests themselves from fundamental science.

⁷⁵ While Koestler proposes three forms of creativity; artistic, scientific and comic, others such as Amabile (1988, 1996) and Russ (2014) include ‘everyday creativity’, representing creativity that occurs on everyday basis and does not necessitate specialised training. Kaufmann (2004) also proposes ‘reactive’ and ‘proactive’ creativity that, in my opinion, can occur in any of the four forms described by Koestler and others.

human beings and is universal, while both artistic and scientific creativities have an influence on the development of the society bringing about fundamental differences in the socio-political arena. For the first level of understanding, it can be stated that art creativity is associated with “self-transcendence and multiple level of awareness” (Koestler, 1964), whereas science creativity is associated with discovery, of universal truths and nature and moves towards resolving paradoxes. Are these two creativities the same?

Csikszentmihalyi (1989) questions us on our ability to discern between the both when he says:

... the reason we believe that Leonardo or Einstein was creative is we have read that is the case, we have been told it is true; our opinion about who is creative and why ultimately are based on faith. We have faith in the domains of art and science, and we trust the judgment of the field, that is, of the artistic and scientific establishments. (Csikszentmihalyi, 1989)

This, coming from a person who has, as he states, been, “studying creativity on and off for almost a quarter of a century and more”, and who has written several books and authored many key articles on creativity, points to the fact that Csikszentmihalyi and many other researchers and authors may not have grasped the concept of creativity in art and science. As a person associated with industrial design and who is acknowledged as nominally creative, the author feels that an understanding of what is art and what is science, followed by a study of how creativity occurs within art and science will enable one to appreciate the similarities and difference in art and science creativities. This is important as the author presents his synoptic map in Chapter 7, whose validity may be questioned as to whether the map can represent innovation in art and innovation in science.

This view of the author is again supported by Koestler and Briskman (1980), Dutton and Krausz (1981), Gardner (1982), Tang and Leonard (1985), Feist (1998), Zeki (2001), Singer (2011) and others, who lead the argument for the case for dwelling deeper into art and science creativities. Since this doctoral study is not only about creativity per se, it is best to see how creativity gets connected to innovation in both cases.

Taking Taylor's five accents of creativity introduced in Figure 4.2 and analysing it against the findings of Chapter 4 (on creativity) in the liberal arts spectrum, a visual map is generated as shown in Figure 6.1.

Figure 6.1: Accents of Creativity in the liberal arts spectrum

Source: Derived by the author

It is apparent from Figure 6.1 that:

- visual art, music and performing art have higher emotional value while pure science has a higher innovation value
- design/applied art seems to have a widespread with a higher emotional value
- architecture seems to jump the inventive creativity stage, which may be explained by the fact that in many cases inventive creativity from engineering and technology helps architecture towards innovation creativity
- engineering/technology also have widespread accents with a higher innovation value
- pure science seems to start from inventive creativity till emergent creativity which signifies higher innovation value. When technical creativity is applied to pure science, the idea seems to move to the technology side of the spectrum

Understanding the value proposition of Figure 6.1, helps in understanding the role of creativity in art and science where great artists such as Michelangelo, Monet and Picasso are celebrated as creative geniuses in the same manner as Sir Isaac Newton, Michael Faraday, Thomas Edison and Albert Einstein. The value proposition of the results of creativity from Newton, Faraday, Edison and Einstein is seen in a final form or incarnation that is visible or discernible to human faculties immediately and hence a higher innovation value seems to be accorded and derived to science creativity. What about the value proposition of the works of da Vinci or Warhol?⁷⁶ From Figure 6.1, it is clear that works of art derives a very high emotional value and points to the fact that art creativity concerns man's relationship with life and nature and science creativity concerns nature's effect on the world, representing two different starting points of creativity. Will this lead to two different types of innovation, each distinguishable from the other is a question that needs to be studied.⁷⁷

Characteristics of art and scientific creativities. Legranzi (2005) in his seminal book on creativity and innovation takes a stroll through artistic and scientific creativities in a manner that makes their characteristics clear. At the outset he places the axiom that “there is no creativity without freedom” be it in art or science. This at first seems to point to the commonly known notion that art has no ‘tethers’ while science needs to have constraints. Then Legranzi introduces the concept of “determinism” in order to bring about the differences while still holding onto his “there is no creativity without freedom” while talking about a physicist named Gianfranco Vidali who, “was creative when he constructed a machine for simulating the furthestmost conditions of interstellar space” where interstellar dusts with amino acids (which form the proteins of DNA) could be found and could replicate this condition and creation of the specific dust within a laboratory condition. According to Legranzi, “The actual process that took place in space was the result of a deterministic sequence” and that cannot be replicated but by simulation where, “it forces us to

⁷⁶ While the ‘eureka’ moments of Archimedes (specific gravity), Alexander Fleming (penicillin) and August Kekule (benzene ring) are well-documented records of creativity in science, it is not certain if there were such eureka moments for Leonardo da Vinci or Andy Warhol.

⁷⁷ This thesis, though not directly trying to study whether art and science creativities lead to different and distinguishable innovations, brings about a synoptic map of the relationship between creativity and innovation which may help in answering this question through case studies and further research.

proceed backwards in time”. In describing art, Legranzi proceeds to declare:

- Only one has remained invariant: in order for something (an object, an action, or an event) to be defined as creative, it must be the product of a free act and *not of a deterministic process* (italics by the author) and goes on to say,
- In synthesis: the non-determinism of the process allows for freedom of choice.

(Legranzi, 2005, p. 8)

In other words, the characteristic of art creativity is:

- a) freedom of choice and
- b) non-determinism

and the characteristics of science creativity is:

- a) Determinism of nature and
- b) the freedom to (re)create the condition in another way

Legranzi (2005) says that artists do not respond the way scientists do and states that, “Artists do not interrogate nature by way of experiments, but rather simply produce answers in the absence of explicit questions”, and that, “Artists not only do not ask ‘creative’ questions, they do not even conduct ‘creative research’, in the scientific sense of the term”.

Before a case for art and scientific creativities as unique entities on their own can be made, there is a need to understand the characteristics of art creativity and science creativity.

Runco et al. (1986) suggest that it is important to ascertain the implicit categorization of artistic and scientific characteristics since, “judgments given by significant individuals have more real-world contextual relevance than purely objective examinations”, and would help in validating the “social validity” of the explicit categorization of the same. In a survey Runco et al. (1986) asked 36 participants who were artists in different ways and 52 non-artists to help categorise the characteristics of people who are, “artistically creative, scientifically creative, creative on everyday basis and those who are not”. The results, listing the characteristics in the order of their frequency is shown in Figure 6.2.

Category of Creativity				
Artists (n = 36)	Artistic Expressive Imaginative Humorous Open-Minded Unique Emotional Exciting	Scientific Perfectionistic Intelligent Curious Patient Thorough	Everyday Active Helpful Humorous Resourceful Open-Minded Exciting	Noncreativity Boring Narrow Interests
Controls (n = 52)	Imaginative Expressive Intelligent Original Perceptive Draws Well	Intelligent (smart) Logical Experimenting Curious/Inquisitive Intuitive Problem-Solver	Imaginative Common Sense Organized Active Cooks Well	Unimaginative Boring Quiet Lazy Dull Conforming

Figure 6.2: Characteristics of Each Category of Creativity

Source: Runco et al. (1986, p. 96)

Though this study only involved artists and non-artists and did not involve scientists, technologists or engineers, the results however, give an indication of the nouns that characterise art and scientific creativity. This also lays out a vocabulary for each which clearly shows the higher emotive value for artists and very much no emotive value for scientific creativity in line with Figure 6.1. At this juncture, the question then is, ‘Do artists and scientists believe there is a parallel in their creative effort?’ In a 2001 survey, Heck (2001) asked scientists and artists if they saw a parallel between artistic and scientific creativity. In the answers given by the respondents virtually all believed that there was a parallel. Here are some answers selectively reproduced from Heck (2001):

- All is a creative endeavour... The work is different, but the joy is the same.
- I’m sure that creation of scientific ideas must undergo similar processes to artistic creation.
- Yes, but science does not move the souls as the arts do.
- Being creative is a gift, a fundamental attribute of a person, but it can take several forms: science, art, ...
- Definitely real parallel with scientists having however more boundary conditions (physical laws, etc.) to respect.
- I think research scientists who truly ask/theorize abstractly are great artists.
- Yes of course! An example is the long-term link between music and astronomy since Pythagoras.
- The science provides facts and principles that help our intellect grasp the physical nature and complexity of

things, while visual art that deals with these subjects provides interpretation and inspiration leading toward a deeper aesthetic, spiritual, and metaphysical understanding.

What is also interesting is Heck's comment on response to a question on comparing the creative process of artist and scientist:

But the painful character of creating, both mentally and physically, is often stressed, as well as the total isolation from the rest of the world during the most intense periods. (Heck, 2001)

While this points to some parallels, a European Commission (2008) publication titled "Art & Science - Creative Fusion" cautions against making close comparison between art and science, but ventures to state:

Both assume a curiosity about what happens in the world and the creativity and inventiveness that are necessary to make fascinating statements about it. Both presuppose a certain amount of curiosity about what's going on in the world and enough creativity and ingenuity to report this in an interesting way. (European Commission, 2008, p. 7)

This document from the European Commission also goes on to state that "scientist seek solutions", while "artists find their own solutions" alluding to the fact that artists are about self-discovery of a 'truth' that they hold personal. It is interesting to note in another statement that, "science is better if it reaches the same findings; art gets better as it keeps finding something different".

In the chapter titled "Creativity in Science" in the book *Concept of Creativity in Science and Art* by Dutton and Krauz (Dutton et al., 1981), Harré states that:

In science the most obvious product of creativity is a sort of discourse, the flow of theory... It is in our conceiving of ideas about them, by imagining possible potent things in which and among which causal activity occurs, that creativity is exercised. (Dutton et al., 1981, p. 19)

In other words, the outcome of a scientific creativity is not creative by itself, but are novel and/or unique, which fits the many definition of creativity. Harré further says, "...the resolution of the consequent paradoxical intuitions is achieved only by proofs of consistency created in the formal

domain of mathematics”. That is to say that the novelty and/or uniqueness in scientific creativity may not be immediately obvious and may require other means to verify which would take time and effort. In a glimpse of how creativity in science moves on the journey to innovation, Harré suggests that, “There is then a two-stage process, the invention or acquisition of the required concept, and then the novel use of this concept bringing out something new in the data”.

In a contrast to Harré, Symes⁷⁸ (1983) makes an interesting statement about scientists and creativity, saying, “Although scientists have been called ‘creative’ and studies carried out to determine the levels of creativity that might be involved, in ordinary speech scientists ‘discover’ scientific laws, they do not create or invent them”, and goes on to further state, “This is because, technically, a discovery brings nothing into existence that does not already exist. Scientific discoveries can only bring to light pre-existent realities that have lain veiled from view”. Symes in a way, misses the argument of Harré (Dutton et al., 1981) that scientific creativity provides that leap for the “icon” and the anecdotal connection which accounts for the discovery. According to Harré, from an epistemological point of view, the built-up knowledge through “prior icons”, to a known scientific fact requires a creative leap should the observed scientific phenomenon not match the icon (built up knowledge).

Putting the several arguments together, scientific creativity may then be defined the mental leap, inner visualisation, paradigm jump, that reveals that, till then unknown, inner nature that produces an icon that fits the phenomenon.

Why would artists and scientists be interested in creativity? For that matter, every field in between? André Heck’s (2001) survey revealed, “The most frequently reasons listed, about equally, were an inner necessity (mainly, but not exclusively, by artists) and the advancement of knowledge (by scientists)”. How do these connect then? Can a visual model be evolved to connect the creativity of pure art and pure science?

⁷⁸ Symes’ 1983 article is quite candid in laying out the basis for creativity in general and art creativity and science creativity in particular.

Models that connect art and science. Koestler (1964) had presented what could be the first attempt at visualising the relationship between art and science. According to Koestler (p. 28), “Science is said to aim at Truth, Art at Beauty; but the criteria of Truth (such as verifiability and refutability) are not as clean and hard as we tend to believe, and the criteria of Beauty are, of course, even less so”. With this, Koestler introduces a chart, shown in Figure 6.3, that, “... will indicate that we can arrange neighbouring provinces of science and art in series which shows continuous gradient from ‘objective’ to ‘subjective’, from ‘verifiable truth’ to ‘aesthetic experience’”. In this chart, one gradient starts from, what Koestler calls, as “exact sciences” – chemistry, biochemistry, biology, medicine and so on – through “much less exact sciences” – psychology, anthropology, history – and through biography, novel – till into the “abyss of pure fiction”. It is interesting that Koestler does not mention art as in sculpture or painting in this curve. He however, mentions similar graded series that, lead from construction engineering through architecture, interior design to the hybrid “arts and crafts” and finally to the representative arts.

Figure 6.3: Connecting the objective to the subjective
Source: Koestler(1964, p. 332)

Though Figure 6.3 dates back to 1964, the concept of fluidity from one realm to the other is still valid, the only difference being that there are many more subsets of science, engineering and art(s) that have entered into this curve⁷⁹.

Another attempt to visually depict the ‘creativity’ as hierarchy was made by Symes (1983) in which ‘invention, discovery, “can be scaled according to a number of salient features” as shown in Figure 6.4.

Figure 6.4: Hierarchy of Creativeness

Source: Symes (1983)

Symes places creativity along two sets of end points; reproducibility–irreproducibility and constraint–freedom and places ‘to make’ and ‘to create’ as the antipodes in respect of the values they bring, namely the values of instrumentality and intrinsic-ness respectively. Where ‘to make’ represents the ability to be of commercial value due to its reproducibility and ‘to create’ representing ‘intrinsic’ values associated with ‘one-offs’ or in other words, due its irreproducibility. Created works represent the art, while made works represent mass produced design and objects, with invention and discovery representing, in the author’s view, engineering/technology and science. In arguing his case for this hierarchy, Symes has deliberately left out pure science. Perhaps this stems from the fact that pure science, which is highly constrained, is not producible by human kind, since it represents ‘universal truth’. This puts the Symes’ model as a partial model, applicable only to a ‘man-made’ world. It is interesting to point out here that Legranzi (2005) has a viewpoint that seems an opposite take on the ‘reproducibility-irreproducibility’ end points of Symes. Legranzi (2005, p. 6) further says, “Here lies the first difference between artistic and scientific creativity. Scientific discovery does not

⁷⁹ Koestler seems to have missed out the opportunity to consider the fluid relationship between science, engineering, technology, design, applied art and pure art with reference to creativity, a relationship that this thesis establishes in Chapter 4.

acknowledge replications, only confirmations. Whereas, artistic creativity inspires replication”. A careful read of the examples given by Legranzi reveals that, in his opinion, artistic creativity is an outcome of a cognitive experience upon seeing something beautiful, encouraging the artist to replicate the emotional effect that something has caused, while in scientific creativity “replication is sheer confirmation” of a scientific or technological fact. In Legranzi’s words:

In human creation there exist hierarchies and gradation. There are two types of conditions that pertain to humans:

- every scientific or technological solution, any discovery or innovative product, is creative in respect to another which is less creative;
- a work of art that produces pleasure, joy, amusement (or any other emotion), recreates that emotion each time one comes in contact with it.

(Legranzi, 2005, p. 6)

Taking this idea forward, the author had presented a first level associative model of art creativity and idea creativity at an international conference on creativity and innovations at grassroots in January 2015 (Sathikh, 2015) as seen in Figure 6.5.

Figure 6.5: Associative Model of Art and Idea Creativity

Source: Sathikh (2015)

The associative model shown in Figure 6.5 predates the spectrum of liberal arts shown in Figure 4.3, where visual art is classified instead of pure art and includes music, performing arts and architecture. industrial design and applied art have also been combined into design/applied art. Based on this reclassification, the new associative model of art creativity and idea creativity is as seen in Figure 6.6.

Figure 6.6: Updated Associative Model of Art and Idea Creativity

In Figure 6.6, the y-axis represents the intensity of creativity. Visual art and pure science represent the two extremities of the spectrum along the x-axis, where art creativity and idea creativity⁸⁰ are at its highest intensity respectively. Music and engineering / technology represent areas where predominant intensity of creativity comes from art creativity and idea creativity respectively, while performing art and architecture requires both type of creativity in equal intensity. It is at design / applied art that one sees a balanced intensity of art creativity and idea creativity. Perhaps this accounts for the general confusion about where design, especially industrial design, stands; is it about aesthetics or is it about ideas? One can argue whether pure science requires art creativity and visual art requires idea creativity. They may and perhaps should be the case, as with Albert Einstein, who was an accomplished violinist and musician George Antheil who is said to have several electronic patents (Root-Bernstein & Root-Bernstein, 2004). According to a paper titled “Artistic Scientists and Scientific Artists: The Link Between Polymathy and Creativity”, Root-Bernstein and Root-Bernstein (2004) argue that artists and scientists, “...are part of one, common creative culture largely composed of polymathic individuals”. They base this on five basic types of evidence:

⁸⁰ While creativity associated with science has been termed as ‘scientific creativity’, the author defines it more as ‘idea creativity’ which enables it to be translated across the spectrum of liberal art as depicted in Figure 6.1.

1. Successful artists and scientists tend to be polymaths with unusually broad interests and training that transcends disciplinary boundaries.
2. Artists and scientists have similar psychological profiles as determined by widely used psychological tests.
3. Arts proclivities predict scientific success just as intellectually challenging avocations predict success in all fields.
4. Scientists and artists often describe their creative work habits in the same ways, using the same language, and draw upon a similar, if not identical, trans-disciplinary mental tool kit that includes observing, imaging, abstracting, patterning, body thinking, empathizing and so forth.
5. Scientists often state that their art avocation fruitfully informs their vocation; artists often draw explicit sustenance from their scientific interests. The arts have often stimulated scientific discoveries and science has often influenced the nature of artistic creativity.

(Root-Bernstein & Root-Bernstein, 2004)

It is interesting to note that a book titled “Artists as Inventors /Inventors as Artists”, edited by Dieter Daniels and Barbara U Schmidt (Daniels & Schmidt, 2008) dwells on this topic in more detail in its route to developing the nexus between, art, science, technology and culture.

Summary of the key points from this chapter.

Table 6.1: Summary of key points on art and science creativities

Reference	Description
Koestler (1981, 1989)	art creativity is associated with 'self-transcendence' and 'multiple level of awareness' science creativity is associated with discovery, of universal truths and nature and moves towards resolving paradoxes
Legranzi (2005)	the characteristic of art creativity is: a) freedom of choice and b) non-determinism the characteristics of science creativity is: a) Determinism of nature and b) the freedom to (re)create the condition in another way Scientific discovery does not acknowledge replications, only confirmations. Whereas, artistic creativity inspires replication'
European Commission (2008)	Both (art and science) assume a curiosity about what happens in the world and the creativity and inventiveness that are necessary to make fascinating statements about it. Both presuppose a certain amount of curiosity about what's going on in the world and enough creativity and ingenuity to report this in an interesting way.
Root-Bernstein and Root-Bernstein (2004)	Artists and scientists are part of one, common creative culture largely composed of polymathic individuals

The main point this chapter wishes to establish is that, though there could be two main categories of creativity, namely art and science⁸¹, they bring similar attitude and approach in the process of the creativity to innovation journey. However, within these two categories of creativity there are five accents of creativity that maybe / are applied which bring different sets of values from emotional value to innovation value. The question then would be, will there be different routes taken on the journey towards innovation by visual arts and pure science, and every area in between? Could a unified depiction of the journey be derived that could be applied to these different routes?

⁸¹ One of the external examiners of this thesis has brought about an important observation that, "...creativity in science is a question of reducing the dimensionality of very complex phenomena to a simpler one that gives the impression of clarity, but that once it is confronted with the 'real' world, over time (as equipment and thinking improve in precision) reveals that the phenomena concerned have only been captured partially. Creativity in art, is on the contrary for me, the exercise of increasing the dimensionality of phenomena so that new perspectives can be developed". The author wished to acknowledge this valuable comment from the external examiner.

7. Making the connection

Chapters two to six have established the following:

1. Creativity and innovation are not one and the same
2. However, they are related in a way that creativity is an essential, if not necessary, element for innovation
3. Both creativity and innovation are human centred activities. While creativity is a human quality that produces ideas, innovation is a process that is driven by many factors including creativity
4. It is possible to define creativity and that creativity in different fields across the liberal spectrum can be studied and summarised
5. It is possible to define innovation and that innovation in different fields across the liberal spectrum can be studied and summarised
6. Several models depicting creativity and innovation have been presented by authors and scholars each with different points of views in many cases, but none make the connection between the two in a seamless manner
7. There is a case for art creativity and science creativity in its purest form at the extremities and in combination along the liberal arts spectrum
8. However, there needs to be studies to ascertain if the creativity to innovation journey will be different for art creativity and science creativity

The question then is, “Is a unified depiction of the creativity to innovation journey possible that could fit the different routes?”

Peter V Rajsingh, writing in a chapter titled, “Thinking About Creativity” in the book *The Possibilities of Creativity* (O’Connor, 2015, P. 74) says that:

Creativity tout court can be firmly distinguished from innovation which arguably is more readily described and analysed. Whereas forms of creativity can exist for their own sake, untethered to a particular goal or teleology, innovation tends to be oriented towards finding solutions to tangible real-world problems. Innovation entails implementing change by a novel efficiency, is often related to technology and generally linked to commercial ends. Typically measurable, repeatable and scalable,

innovation is commonly brought through iterative steps of an ideation design process. Innovation also requires creativity and all innovation is in some manner creative. But not all creativity is necessary innovative. (O'Connor, 2015)

How then can one proceed to develop a relationship model or map that connects the both?

A framework for the new map. In a paper on cultivating innovation, Sathikh, (2010) has proposed the first level correlation between creativity and innovative result or implementation as shown in Figure 7.1, which identifies the three important conditions for innovation to occur / be implemented:

1. Person
2. Process
3. Conducive Environment

Figure 7.1: Framework for creativity leading to innovation
Source: Sathikh (2010)

According to Sathikh (2010), depending on the type of conducive environment, the type of person and the type of process, the results may stay on as pure creativity or become useful innovation. In this framework for creativity leading to innovation, two things are evident:

- Firstly, innovation does not occur in isolation. It does not appear suddenly, without a concerted effort to build the three support structures, namely the person, the process and the environment.
- Secondly, creativity is the road that leads to innovation, of the 'qualitatively different' kind that Barnett (1953) defines.
(from Sathikh, 2010)

Many of the established companies known for innovation such as Apple and Dyson, as well as international design consultancies such as IDEO and Ziba Design in USA, pay

attention to how their product design and development departments organize their manpower and physical environment, besides establishing a robust yet flexible innovation process. Figures 7.2 and 7.3 show the environment with a sense of informal culture that many researchers and authors who point out as conducive for creativity and innovation.

Figure 7.2-7.3: People and environment in IDEO

Source: forbesjapan.com(left) good.is (right)

To bring an example closer to the author's own experience, Figures 7.4 and 7.5 shows the workspace in INOVASIA Design, taken in 2006.

Figure 7.4-7.5: Workspace in INOVASIA Design (2006)

Source: Author

From a framework to visual cartography. Discourses, theories, books, articles, etc., on both creativity and innovation are full of tacit knowledge which are made clear through case studies, images, figures, and diagrams. Many of these have formed a considerable part of this doctoral study. Though they form a knowledge base, some important questions need to be considered:

- What about the dynamics of how creativity becomes valuable innovation?
- What are those steps and processes that a journey from creativity to valuable innovation takes?
- Is this journey a one-person journey?
- Does it take a team? What roles do each player in a team play?
- What amount of time and resources is required for a creative idea(s) to become valuable innovation(s)?
- How do we know when creative ideas become valuable innovation?

In the norms of research, it could be best to embark on quantitative methods, as many have done and cited in this thesis, to arrive at numerical data which then can be turned to results through statistical analysis, in the attempt to answer the questions raised above. However, the questions raised, may not be answered by quantitative methods alone since the answers need interpretation rather than definition.

The approach to this is provided by the special issue of *Visible Language* (Volume 49.3) titled “Critical Making – Design and the Digital Humanities”. In an article titled “Beyond Map: Unpacking Critical Cartography in the Digital Humanities”, Tania Allen and Sara Queen (Allen et al., 2015) introduce the importance of visualisation through mapping as a formative and evaluative tool and, “...its impact on the propositional nature of exploratory research”. According to Allen et al. (2015), “...the activity of visualisation through mapping is fundamental to generative research due to the overlapping nature of theory and practice” and also that, “...mapping as a critical and reflective activity is essential to the interpretive nature of both fields (digital humanities and design research)”.

According to Allen et al. mapping relationships, such as between creativity and innovation, allows for:

The translation of the non-visual to the visual through **encoding** (in the creation of the map, converting and abstracting information into a graphic language) and **decoding** (through dissection of the graphic image, evaluating alignment with or building meaning around its concept) perform important functions by encouraging a consistent evaluation of form, content, and communication that is essential to research, the

construction of knowledge, and the identification of opportunities for alternate futures'. (Allen et al., 2015).

The researchers also state that, besides encoding and decoding, mapping brings the following:

- 1) **Scale** describes relative or absolute in terms of spatial dimensions, temporal units, or thematic attributes
- 2) **Organize and prioritize** vast amounts of information through visualizing an overarching system of relationships
- 3) **Orient** the viewer and maker within an abstract construction by conveying the location of one's self, or a component, in relationship to other elements
- 4) **Framing**, where the mapmaker (and later viewer) intentionally defines the territory and agenda of the map

(Allen et al., 2015)

Inferring from the above, mapping the relationship between creativity and innovation will provide, "...a bird's eye view of a system with its complexity of nodes and connections' and also encourage, '.. iterative speculation through the use of overlay to test a variety of constraints..." (Allen et al. 2015).

Creative surge

I found myself experiencing a sudden creative leap in 2009, while researching for the paper (Sathikh 2010) to be presented at the annual conference of the National Collegiate Inventors and Innovators Alliance (NCIIA) held in March 2010 in San Francisco, USA. Unable to go beyond the framework that I had created, I went to bed not satisfied with the progress of the paper, only to wake up suddenly with a clear vision of a map that connected creativity and innovation in ways that I had not imagined. I woke my wife up as well and asked her to stick together a stretch of A4 paper on the dining table. After a few trials at depicting the map that I had seen in my mind's eye, the map shown in Figure 7.6 emerged in its complete form.

From framework to a synoptic representational map. How can the first framework for the creativity to innovation relationship shown in Figure 7.1 be transformed into synoptic map of the relationship between creativity and innovation? What form could this take? A manual or a guidebook? A spreadsheet? Can it be more visual? What are the steps and the process? These questions were lingering in the mind of the author before an opportunity to present a paper on cultivating creativity arose.

A sudden surge of creativity in one sitting saw the author create such a map as shown in Figure 7.6, which was the main focus of a paper titled, "Cultivating Innovation: by understanding creativity-innovation relationship", that was presented at the National Collegiate Inventors & Innovators Alliance 14th Annual Conference, San Francisco in March 2010 (Sathikh, 2010).

The map shown in Figure 7.6 is the culmination of over thirty-four years of experiencing creativity, many of which have transcended to valuable innovation. The first step to realising this map was to reflect on the personal journey from creativity to innovation. Figure 3.1 in this thesis points to two

important approaches, **personal approach** (creative) and **mental approach** which may be stated to be more of a cognitive function. These two sets of approaches that articulate the dynamics of the creative process was clearly defined as:

1. Creative Action Approach
 2. Mental Approach
- (Sathikh, 2010)

Besides the approach, five parameters were identified and introduced to further define the state of innovation as it moves from creativity to innovation as follows:

1. Area of Focus
 2. Mental State
 3. Human Reaction
 4. Outcome
 5. Concept
- (Sathikh, 2010)

In the first map of the realm of creativity and innovation (Figure 7.6), creativity starts at the left and proceeds towards valuable innovation or, innovation implementation, on the right. Based on this map, there is a **starting/initial spark**, followed by:

- three stages of **concepts**; *abstract*, *empirical* and *physical* which represents the manifestation of the idea at each stage
- the qualitative **outcome** through this process can range from purely novel at the start to potential to useful to valuable as it moves from abstract concept to empirical concept to physical concept
- the **mental approach** used during abstract concept is *imagination*, during empirical concept is *theory* and during physical concept it is *analysis*.
- The **human reaction** when the idea is sparked starts at 'Ha Ha!' moving to 'Aha !' (after abstract concept), then to 'Hmmm!' (after empirical concept) and, once the idea becomes (innovation) valuable, the human reaction is 'I see'(after physical concept)
- the **creative approach**⁸² used during abstract concept is *playful*, during empirical concept is *experimental* and during physical concept it is *focused*. (Sathikh, 2010)

⁸² There have been questions raised about the terms mental approach and creative approach whenever this was presented, as to how they are different, since both require the use of thoughts that originate in the

Figure 7.6: First Mapping of the Realm of Creativity and Innovation

Source: Sathikh (2010)

The map shown in Figure 7.6, clearly states that for creative ideas to flow from abstract concept to physical realisation, **creative approach** and **mental state** play important roles to influence the **outcome** and **human reaction**.

a mid-course correction; The map shown in Figure 7.6, is seen exactly as was presented in March 2010 by the author. Since then, after further study on the subject of the creativity to innovation journey as a part of the continuing research , it was felt that **Area of Focus** and **Examples** shown in the map (Figure 7.6) are just suggestion and was included to elicit first level interest of the map during presentations, and therefore, are redundant and may cause misrepresentations. Hence, these two parameters, area of focus and examples, have been dropped in subsequent maps in this thesis in order to make the map more focused on the creativity-to-innovation path. A second map was derived as shown in Figure 7.7.

Mental approach is more to do with the thought process within the brain itself, while creative approach uses both the brain and the hands (and aids such as computers and machines, etc.) to fashion out the result of a thought process. The actual thought process per se is the mental approach which works together with the creative approach to create an action plan. Hints of this is embedded in two chapters; one titled *Visual Thinking* and the other, *Verbal Thinking* in the book, *Notebooks of the Mind* by John – Steiner (1997)

Figure 7.7: Revised Map of the Realm of Creativity and Innovation

Source: Author

In order to explain the map of Figure 7.7, Table 7.1 depicts, in another way, the different results of the two approaches and the two states on an idea as it progresses towards valuable innovation.

Table 7.1: Results of the two approaches and states

		Spark*	Abstract	Empirical	Physical
1	Creative Approach		Playful	Experimental	Focused
	Mental State	Childlike	Exploratory	Discovery	Serious
2	Mental Approach		Imagination	Theory	Analysis
	Outcome	Novel	Potential	Useful	Valuable
3	Human Reaction	Ha Ha!	Aha!	Hmmm!	I see!

* Spark is introduced in Table 7.1 to depict the state of ‘eureka’ revelation usually experienced by the person at the outset. This was not introduced by Sathikh (2010) and is included by the author after further studies on the subject.

The modified map shown in Figure 7.7, is the start of a more poetic representation of the creativity to innovation relationship, in that it represents the flow of the process from creativity to innovation (from the left to right) without burdening itself on how this should be started, influenced,

shaped, directed, etc., and with whom and what wherewithal should the coercion of the flow be executed at each level, etc., and that is so representative of most of the models presented by various commentators. The map's simplicity lies in the following:

1. It represents the flow from creativity to innovation clearly
2. Once an idea is sparked, it introduces the notion that creativity starts at 'abstract' level, whereas innovation reaches tangible level
3. It introduces an intermediate, 'empirical' level which points to an experimental approach to verifying if creativity can become an innovation
4. It shows a 'physical' level where a focused approach together with analytical rigour results in valuable innovation that is tangible in many ways
5. It introduces four parameters (concept, mental state, human reactions and outcome) that define the progress as it flows from creative to innovation process
6. It proposed two sets of approaches (mental and creative) to define the dynamics of the creative process
7. It defines through its visual representation, the successful implementation journey of an idea to valuable innovation

Is this the final version? Has anyone else approached the creativity to valuable innovation journey in a similar manner?

Another way of looking at this map. As early as 1954, a means to describe the relevant distinction between the process in creativity was established according to Getzels (Taylor et al., 1975, p. 333) in a book titled "The Psychology of invention in the mathematical fields", where J. Hadamard introduces a dual process, "**cogito**" and "**intelligo**". Cogito refers to the initial stage of the creative process which has to do with "letting ideas, memories, impulses, fantasies rise freely", while intelligo is the second stage which refers to, "the process of choosing among the combination those patterns which have significance in reality". In other words, according to Getzels, cogito seems, "predominantly an impulsive, sub conscious, playful, divergent process", while intelligo seems, predominantly, "a reflective, conscious, directed, convergent process". This means that, creativity, which starts as 'novel' during cogito is then sieved for, to be selected and improve

on during intelligo to become ‘potential’. In the author’s opinion potential idea or concept coming out of intelligo is not sufficient to bring about an innovation of ‘value’, which needs a further process. This third process, which the author of this thesis has termed as “*efficio*”⁸³, is introduced which means to realise or complete. Efficio seems to be the missing ingredient in most of the discussion on realising innovation as can be seen in the discussions in Chapters 4 (Creativity) and Chapter 5 (Innovation). This was the main thrust of the 2010 paper by the author (Sathikh, 2010), though the concepts of cogito and intelligo had not been introduced to the author at that time. With the understanding of Getzels’ concepts on cogito and intelligo, it was easy for the author to identify efficio as the missing portion in the journey from creativity to innovation. The importance of categorising these three states in the journey will be discussed in the later part of this chapter. Adding cogito, intelligo and efficio to the map of Figure 7.7 results in the derived map as shown in Figure 7.8.

Figure 7.8: Introducing cogito-intelligo-efficio to the map

Referring to Figure 7.8, a simple way of interpreting the transformation of creativity to innovation would be to take a spark of an idea and process this in ‘cogito’ through a playful creative approach and imaginative mental approach whose outcomes is then be subjected to an ‘intelligo’ process through an experimental creative approach and a theoretical mental approach whose outcomes is further passed through

⁸³ Cogito, intelligo and efficio are from Latin. Efficio: I make or work out; effect; execute, complete, accomplish

an ‘*efficio*’ process with a focused creative approach and an analytical mental approach to bring about an innovation of value. It is important to understand here that, this process from *cogito* to *intelligo* to *efficio* is not a linear path starting from left to right since expectation of innovation which may be predicted through gap analysis or perceived requirement (for innovation) or any other analytical method could trigger a ‘pull effect’ that starts the *cogito* process within *intelligo* itself moving to *efficio* for valuable realisation⁸⁴. The result of this ‘pull’ or even ‘push’ effect will be a map that is slightly different. All parameters will still be present in such variations of the map. One such example will be presented in Chapter 8 as a case study, where the design and development of a household process jumped from an idea to *intelligo* and *efficio* without being processed through *cogito*.

Second way of looking at the map. Taylor (Taylor et al., 1975, p. 308), interestingly has described three creativity accents that manifest themselves in various stages or segments of the creative process⁸⁵. According to Taylor there is a need for people with different accents of creativity styles in order for creative ideas to be realised. The three creativity styles of Taylor are as follows:

1. **Endogenous** creativity, that originate from within a person or in other words ‘origination’ of ideas from a group of individuals.
 2. **Epigenous** creativity, which is the creativity that expands on which is already created. This is a development creativity articulated by those who are good at developing ideas once articulated.
 3. **Exogenous** creativity or creating upon external sources. This type of creativity is exhibited by those who are adept at applying, manifesting originality in the realisation of idea into valuable innovation.
- (Taylor et al., 1975, p. 308)

It is not difficult to see the connection between Getzels derived triple process added in Figure 7.8 and the three creative styles proposed by Taylor, and hence may be translated on to the map as shown in Figure 7.9. This is a clear indication that creativity does not stop at the ‘*cogito*’ or

⁸⁴ This is clear in a case study on Dyson vacuum cleaner and Tata Nano car that follows in Chapter 8.

⁸⁵ While Taylor refers to the path as ‘creative process’, the author identifies this as the creativity to innovation path which fits with the proposed map.

‘endogenous’ (stage) of the proposed relationship map, but different type of creative thinking (cogito, intelligo, efficio) from people with different creative ability (endogenous, epigenous, exogenous) is required for creative ideas to be realised as valuable innovation.

Figure 7.9: Combined map of the realm of creativity and innovation

A map that is further updated for clarity, as the ‘Synoptic Map of Creativity and Innovation’, is presented in Figure 7.10 for easier visualisation. It is evident from Figure 7.10, that a potential idea passes through several stages of creativity during the process to evolve as valuable innovation⁸⁶. At this point, the author questioned the inclusion of ‘physical’ as the concept aspiration at the ‘efficio’ process. After reviewing the evolving synoptic map, it was decided to replace ‘physical’ with ‘tangible’, since tangible represents an outcome whose value can be ascertained in different ways.

⁸⁶ One of the early reviewers of this thesis points out to a, “generally accepted progression in innovation development as *Proof of Principle, Proof of Concept and Proof of Value*. Figure 7.9 clearly shows alignment to this progression through cogito, intelligo and efficio.

Proposed Synoptic Map of Creativity and Innovation

Figure 7.10: Synoptic map of creativity and innovation

Where to go from here. Whenever the original map (Figure 7.6) is presented in conferences or workshops, two questions are asked by discerning members in the audience:

1. This map seems comprehensive, where do you want to take this from here? Is there more to it?
2. How robust is this map? Have you checked it against different realms in real life?

This map is, at best, a visual representation of the flow of ideas through creativity to valuable innovation. Knowing that innovation occurs across different spectrums in the real world, it is felt that this map will evolve into several variations based on which realm it is placed. How will this map evolve for innovation in art, music, design, image making, engineering, habitat (village, town, cities, etc.), society, government, and perhaps, the much wider world? Again, will this map differ significantly if the starting point is art creativity or science creativity?

Through this doctoral study the author intends to validate this map for its flow, its attributes and its claims to a successful representation through several case studies. Alongside, the effect of individuals, groups, leadership, environment, etc., as well as the influence of strategy and planning on the flow depicted in this map will also be studied. Validating a proposed map that is poetic rather than heuristic requires the application of research processes practiced in art and design that are mainly qualitative in nature as pointed out by Allen et al. (2015). Examples taken for validation will predominantly be in product design/industrial design, the area in which the author has the most experience, though examples from other fields that could benefit from this map will also be mentioned.

It is envisaged, as this study progresses, the synoptic map, proposed in Figure 7.10 will have the flexibility to accept variations that may arise due to the origin of the creativities that may arise from the different area within the spectrum of liberal arts.

Other models. Upto this point, many models on creativity and innovation proposed by several authors and researchers have been presented in this thesis. Specific positive aspects and the drawbacks have also been discussed at the appropriate portions within those chapters. Before moving on to validate this synoptic map of figure 7.10, several other models are presented as proposed by other authors and researchers, in order to make a comparison and to highlight the simplicity of the synoptic map that has been proposed in this thesis, as well as to explore how they can augment the derived synoptic map.

Figure 7.11: Model depicting coupling and decoupling ideation process and innovation process

Source: Cohendet et al. (2015)

In a paper titled, “Introduction to the Special Issue on Creativity in Innovation”, Cohendet et al. (2015) introduce a model seen in Figure 7.11, wherein the volume of idea generated seem to be more and more as the project passes through the different gates. This according to Cohendet et al. (2015) is because:

A major lesson learned from creative industries (Pixar, Google, Ubisoft, Whirlpool, Philips, Siemens, 3M, etc.) is that, contrary to traditional industries (where the process of idea generation and the process of project management tend to be sequential), the process of idea generation and the process of management of innovative

projects in creative industries are run in parallel. They mutually feed each other. (Cohendet et al., 2015)

In this way, it looks like a lot of ideas need to be generated at the 'launch' stage of the project, which seems to contradict the many models that look at selecting the few plausible ideas generated at the starting stage and then develop it rather than spend time and energy on initial idea generation. Cohendet et al. (2015) introduce a concept called "knowledge management"⁸⁷ which is used to couple the project process and the idea generation. At an empirical level, the researchers define the coupling mechanisms, though the exact role is not clearly defined. This model makes a good visual representation and has features that could be applied to improve on the proposed synoptic map presented in Figure 7.10.

Another example of an innovation model is shown in Figure 7.12, depicting closed innovation by Herzog (2008). According to Herzog, closed innovation occurs within the confines of a company or organisation within defined boundaries, which he terms as an "inward-looking innovation model", which will not exploit the capabilities of the organisation due to, "two major reasons: first, firms fear losing their intellectual property to other firms or organizations. Second, there is likely no firm that knows what to do with every new research finding or has all the necessary resources to execute all those opportunities". The model shown in Figure 7.12 may have the theoretical research to back it up, but it does not seem to portray the individual actions of each stages in the innovation process

⁸⁷ A precursor on the knowledge management can be found in a paper titled *Knowledge, Creativity and Innovation* by David Gurteen (Gurteen, 1998). While the paper starts off well, it finally points to software to aid in knowledge (and project) management.

Figure 7.12: Closed innovation model
Source: Herzog (2008, p. 20)

Herzog then proceeds to an open innovation model as shown in Figure 7.13. The open innovation model shows the emergence of a certain level of complexity, which in the author's opinion, will prove to be more complicated than complex. A highly complex systems procedure such as the design and development of a commercial airliner, perhaps use open innovation model to leverage on innovation from their suppliers/vendors much like the recent development of Boeing 787 Dreamliner and Airbus 350 show, where suppliers were asked to part take in the innovation process to design, develop, manufacture and deliver sub-systems and products which were then used in the assembly of the aircrafts, as widely reported by press and various media in the recent past.

Figure 7.13: Open innovation model
Source: Herzog (2008, p. 23)

Figure 7.14: Expanded Phase Model of Innovation
Source: Cropley et al. (2013)

Cropley et al. (2013) present an, “expanded phase model of the innovation process”, as shown in Figure 7.14. Intended as a model for business of making products, this model attaches a set of ‘action’ to the phases of innovation. With the outline of actions attached to each phase of the expanded phase model of Figure 100, Cropley et al. go further to map a social – psychological (or human) elements (4Ps) and a business model to derive what may be termed as Cropley’s combined model of innovation as shown in Figure 7.15.

Figure 7.15: Cropley’s Combined Model of Innovation

Source: Cropley et al. (2013)

This model by Cropley et al. seems more like an academic description rather than a working model. Lacking the quality of a unified model of innovation that considers the three aspects of innovation process, namely, the person, process and the influencers (people, environment, market/social

needs, etc.) and which is easily discernible by starters, journeymen and experts alike.

Baregheh et al. (2009) has proposed a ‘diagrammatic definition’ of innovation as shown in Figure 7.16.

Figure 7.16: Diagrammatic Definition of Innovation

Source: Baregheh et al. (2009)

The diagram shown in Figure 7.16 is not a process flow of innovation but is a description of:

- Stages of innovation
- Social aspects of innovation
- Means by which innovation is achieved
- Nature of the outcome of innovation
- Types of the outcome
- The aim of the innovation

According to Baregheh et al., “The model seeks to present the ‘essence’ of innovation, no matter the organizational or disciplinary context. The six components of the model not only describe the possible flow of the innovation process, they also indicate various starting points within the innovation process. This might be influenced by disciplinary background”. They also state that, “Individuals within organisations may choose different starting points on the journey to innovation. The chosen starting point might also have a strong relationship to the way innovation is achieved, or not”. The author agrees with Baregheh et al. on the relationship between the starting point and the achievement of innovation. However, this again is a

descriptive diagram rather than a model that can respond to innovation stemming from any part of the process.

Summary of essential points from the other models. Though the four models presented may not be complete in many ways, they point to several important aspects that may be included in the synoptic map of creativity and innovation that has been presented in Figure 7.10 of this thesis. The essential aspects for consideration are shown in Table 7.2.

Table 7.2: Summary of essential points from other models

Model	Salient Features	Remarks
Cohendet et al, 2015 Model depicting coupling and decoupling ideation process and innovation process (Figure 97)	Process <ul style="list-style-type: none"> - Idea generation - Knowledge Management - Innovation Coupling mechanism	Knowledge management has the potential to be incorporated into the synoptic map of creativity and innovation
Herzog, 2008 Open innovation model (Figure 99)	<ul style="list-style-type: none"> • Firm Boundary • Technology licensing • Spin off 	Innovation out of the boundary is an idea to consider
Cropley et al, 2013 Combined Model of innovation (Figure 101)	Mapping Social and Psychological Elements Business model	Social and Psychological Elements has some potential
Baregheh et al, 2009 Diagrammatic definition of Innovation	Process <ul style="list-style-type: none"> • Stages • Social • Means • Nature • Type • Aim Allows various starting points Relationship between the starting point and the achievement of innovation	Relationship between starting point and the achievement of innovation has a potential be included,

Taking three important aspects from Table 7.2, the synoptic map of Figure 7.10 is augmented by aspects of knowledge management and relationship building as shown in Figure 7.17. A people centred activity along the journey, knowledge management brings leadership, knowledge and experience together with the ability to build the *intelligo* and *efficio* teams to bring the idea from *cogito* to innovation of value. While Figure 7.17 shows only four persons (or groups of people) in knowledge management rows, the actual number could be more depending on the scope and scale of the project.

Figure 7.17: Including knowledge management to the synoptic map of creativity and innovation

Figure 7.17 proposes a comprehensive synoptic map of creativity and innovation that describes the three stages, the approaches, the states of minds, outcomes along, with faculty for knowledge management, responsibility and relationships is wholesome in describing the relationship between creativity and innovation. Could this map be validated through real life examples in order to be make it real and complete?

8. Validating the synoptic map

The synoptic map of creativity and innovation discussed and evolved to its final forms, (Figures 7.10 and 7.17) in Chapter 7 represents an important framework in the study of creativity and innovation. At the outset, it points to the fact that both creativity and innovation are human centric activities. This may lead to a question, “Can artificial intelligence (AI) be capable of initiating and managing creativity and innovation in the future?” While researchers and authors such as Margaret Boden (Boden, 1998B) have argued for a place for AI in creativity, application of this thought, in reality, seems to be for a distant future⁸⁸. Todd (2005) in exploring how computer could involve in creative work, proposes a classification based on four categories of human–computer interaction to promote creativity stating, “computers may facilitate (a) the management of creative work, (b) communication between individuals collaborating on creative projects, (c) the use of creativity enhancement techniques, (d) the creative act through integrated human–computer cooperation during idea production”. All four functions seem to be about automating the management of the creative process rather than play an independent role such as taking a proactive role in the creation of ideas, selection of possible ideas for innovation, development of the idea, etc. While the author agrees with Boden (1998B) that, “Creativity is not a special ‘faculty’, nor a psychological property confined to a tiny elite”, and that, “...it is a feature of human intelligence in general”, the question is, “Is AI ready for the normal feature of human intelligence of everyday capacities such as the association of ideas, reminding, perception, analogical thinking, searching a structured problem-space, and reflective self-criticism”, as stated by Boden?” A relatively mild attempt at finding a use for AI to evaluate creative design has been presented by Maher et al. (2012) where AI is proposed to be used within a known ‘conceptual space’. Till such time that AI has developed to a stage where it can independently conceptualise, select, develop and implement ideas through the three stages to innovation, *cogito*, *intelligo* and *efficio*, making discerning decisions, creativity and innovation is likely to be within the sphere of humans.

⁸⁸ Science fiction movies such as *Ex-Machina* by Alex Garland released in 2015 seem to point to a direction where AI evolve into beings with human aspiration and exhibit human qualities including appreciation of art and creativity. Again, human (like) aspirations seem to bring about in AI a rather ‘artificial’ creativity.

Based on the idea of creativity and intelligence as human activity, the synoptic map (Figures 7.10 and 7.17) created in Chapter 7 clearly represents:

- progression of idea(s) from creativity to valuable innovation(s)
- three types of activities that occur when ideas(s) move to innovation(s), namely, *cogito*, *intelligo* and *efficio*, which require different types of people and resources
- creativity is required during all the three types of activities, except that the types of creativity varies, namely *endogenous*, *epigenous* and *exogenous*

How true is this synoptic map in depicting the journey? How true are the claims of the different activities and the different types of creativity required in the journey to innovation? How do one validate this?

Validating this map. Any proposed framework needs to be validated under different context/conditions to ascertain if that framework is:

- a) robust
- b) flexible

In this regard, an important step is required to validate the revised synoptic map of creativity and innovation. A visual map derived from personal experience and through rhetoric discussion is unlike scientific theory or mathematical equations, which can be validated through experiments or calculations. Validating a map that depicts a journey that may have different paths or conjunction is different from validating a theory that could be verified by applying conditions of 'cause and effect' that give direct proofs or statistical numbers that may be analysed for validating that theory. Furthermore, since both creativity and innovation are not easily quantifiable, although innovations that have business and/or commercial value can be measured for effectiveness or profits numerically, qualitative research methods need to be pursued to validate this map and check for its universal applicability. In her book titled, "Using Narrative in Social Research", Elliot (2005) states that, "qualitative methods allow for a focus on process", and the synoptic map depicts a journey which may be described as a process. According to Gillham (2000), "Qualitative methods are essentially descriptive and inferential in character" which,

“focus primarily on the kind of evidence (what people tell you, what they do) that will enable you to understand the meaning of what is going on”. Gillham lists out what qualitative methods enables one to do as:

1. To carry out an investigation where other methods - such as experiments - are either not practicable or not ethically justifiable.
2. To investigate situations where little is known about what is there or what is going on.
3. To explore complexities that are beyond the scope of more ‘controlled’ approaches.
4. To 'get under the skin' of a group or organization to find out what really happens - the informal reality which can only be perceived from the inside.
5. To view the case from the inside out: to see it from the perspective of those involved.
6. To carry out research into the *processes* leading to results rather than into the 'significance' of the results themselves.

(Gillham, 2000, p. 11)

All the six points above fit the validation requirements of the visual map leading to a strong reason for qualitative research methods to evaluate the map.

How to validate; While the research path to arriving at the visual map was through the method of *narratives*, which is another qualitative method used in social sciences, narratives may not have significance in studying a visual map depicting a journey. In instances such as this, experts and authors on qualitative research advocate the use of **case studies** as the preferred research method. In the book titled, “Case Study Research Methods”, Bill Gillham (2000) defines case study as:

A case study is one which investigates [the above] to answer specific research questions (that may be fairly loose with) and which seeks a range of different kinds of evidence, evidence which is there in the case setting, and which has to be abstracted and collated to get the best possible answers to the research questions.

(Gillham, 2000, p. 1)

Case study methods allows for uncovering evidences that point out the *theory* behind it, not by collecting hard data (quantitative) but through one or combination of several of the following instruments, as per Gillham:

- **Documents** - letters, policy statements, regulations, guidelines
- **Records** – official/unofficial records kept in archives
- **Interviews** – formal, informal or through questionnaires
- **‘Detached’ observation** - 'fly on the wall' approach
- **Participant observation** - 'in' the setting - perhaps even working there - approach
- **Physical artefacts** - actual samples or photographic records of, for example, sketches, mock-ups, materials used, prototypes, and so on
(Gillham, 2000, p. 21)

Baxter et al. (2008) define the different types of case studies as, “explanatory, exploratory, descriptive, multiple-case studies, intrinsic, instrumental and collective”.

Gillham and others point out to the importance of not depending on one instrument to gather evidence, but to utilise several of them and weave the findings into a narrative account as ‘chain of evidence’. Use of different methods also allows for *triangulation* that is important in ascertaining a common chain of evidences that help validate the theory. This corroborates with the multiple-case studies defined by Baxter et al. (2008). In the evaluation process of the synoptic map proposed in this thesis, it is felt that, besides the use of several instruments of case study research, it is important to study examples of different sizes and complexities, from personal to corporate level innovation and from art to industry in order to validate the flexibility and robustness of the synoptic map of creativity and innovation. This will allow for another important requirement of case study method, namely *representativeness*.

What to study. In selecting examples for case study, the main criterion was that each of them should be acknowledged or recognised without any ambiguity as innovative. To ensure a good spread that is representative and triangulated, the following projects have been selected as case studies for validating the map of the realm of creativity and innovation as shown in Table 8.1:

Table 8.1: Case study possibilities to validate the synoptic map

S.No	Project	Corporation/ company/details	Type	Instruments of case study method
1	Editorial cartoon	Ann Telnaes, Washington Post	Small Dynamic art	Documents, media records
2	Plastic 'gold' jewellery	Florie Salnot (Ms)	Medium , Craft Product	Documents, media records
3	Rotimatic Automatic chappati maker	Zimplistic Pte Ltd	Medium Product	Documents, internet, media
4	Dyson vacuum cleaner	Dyson Ltd	Large product	Documents, books, internet, media
5	TATA Nano 'people's' car	TATA Motors, India	Large product	Documents, books, internet, media

The first selection is the dynamic editorial cartoons drawn for the on-line edition of Washington Post by Anne Telnaes. Plastic gold jewellery is a prize-winning jewellery making process that utilises empty (recycled) PET bottles to make exquisite jewellery based on the traditions of the Sahrawi tribes in the refugee camps in Algeria. *Rotimatic* is an automatic chappati maker from an entrepreneurial start-up in Singapore with small to medium volume production through contract manufacturing. Dyson vacuum cleaner and TATA Nano car are large products which are also high volume in terms of production.

Why to validate. With an idea of how to validate (method) and what to study (cases) it is important to define why to validate (objective) before evaluating each of the innovation case studies to see how they closely followed the journey depicted in the synoptic map of creativity and innovation. What is required, at the end of this study, is a validation of the map itself in terms of the path it took from creativity to innovation and a verification of the important parameters that help define the state of innovation in the path shown in the synoptic map derived in this thesis. To achieve this, it is necessary to set the objectives for the study.

Objectives:

1. To validate the map for first level correctness of the path and the parameters
2. To determine how the map modifies within the validity of the map for different type of cases studied

Primary evidence to look for:

1. Progression of overall path from creative idea to innovation, from *cogito*, *intelligo* and *efficio*
2. Application of *mental approach* and *creative approach*
3. Presence of *endogenous*, *epigenous* and *exogenous* creativity along the progressive path

Secondary evidence to look for:

1. Presence of conducive environment
2. Possible evidence of difference in creative culture and innovation culture

Caution. Gillham (2000) warns against looking for, “confirmatory evidence; evidence that confirms what you believe and understand”. Gillman also cautions against *prejudices*, which are, “pre-judgements of things we don't know or don't know much about...”, as well as against *preferences*, which is, “Not just what you expect to find, but what you want to find”. Another word of caution comes from Becker (1996) in an essay titled “The Epistemology of Qualitative Research” in which he states:

Epistemologically, then, qualitative methods insist that we should not invent the viewpoint of the actor and should only attribute to actor's ideas about the world they actually hold, if we want to understand their actions, reasons, and motives. (Becker, 1996, p. 60)

With these cautions in mind, what the author is seeking in each of the case studies is to identify patterns that show evidence at the primary and secondary level that validate the synoptic map. This is also in anticipation that the map presented will have some level of variation for each case study and hence variants of the original synoptic map may evolve as the study is completed.

Ann Telnaes

Source: unitedsketches.org

Case study 1: Editorial cartoons by Ann Telnaes; According to Fantagraphics ⁸⁹, “Ann Telnaes creates editorial cartoons in various mediums – animation, visual essays, live sketches, and traditional print – for *The Washington Post*”. Telnaes is, at the point of writing this thesis, is the president of the Association of American Editorial Cartoonists (AAEC) and is a member of the National Cartoonists Society (NCS). Ann Telnaes has won the Pulitzer Prize in 2001 for her print cartoons and the National Cartoonists Society’s Reuben for Outstanding Cartoonist of the Year for 2016. Before becoming an editorial cartoonist at the Washington Post, Telnaes has worked at Walt Disney Imagineering.

What is innovative about Telnaes’ editorial cartoons, when such work has been popular throughout the world? Editorial cartoonists have made their name right from the 1800s when newspaper became an essential media. Figure 8.1 shows a political cartoon (caricature) from the 1860s in the United States of America.

Figure 8.1: Political Cartoon in the 1860s from the USA

Source: indiana.edu

Ann Telnaes, who has a Bachelor of Fine Arts (BFA) degree in Character Animation from the California Institute of the Arts, has developed a unique style of representing her editorial cartoons in the on-line version of *The Washington Post*. Having been trained as an animator, Telnaes decided to have animated editorial cartoons with sound and voices – many a time the voices of real personality as they spoke that day or

⁸⁹ www.fantagraphics.com retrieved on 16 December 2017.

previous days. Telnaes explains her creative process in several YouTube videos⁹⁰. Firstly, she believes, irrespective of it is static printed version or an animated version, an editorial cartoon has to have a point of view. Once she has an interesting point or an event that is ripe for editorial cartoon, Telnaes starts sketching several sketches depicting the movement that she is looking for by hand, much like the animators from the past (Figure 8.2a). She then transfers it to tracing paper and inks the sequence using India ink (Figure 8.2b). When she is satisfied with the results, Telnaes scans them into a graphic software environment and edits and colours the cartoons (Figure 8.2c). The next step is to add the sounds and animate the sequence in the computer (Figure 8.2d) before verifying and saving it in a GIF format. The GIF file is then sent to the Washington Post's on-line department. The unique animated editorial cartoon is finally posted for the public to view. Each sequence is about 15 to 20 seconds which perhaps says more than what a static editorial cartoon can say.

Figure 8.2a

Figure 8.2b

Figure 8.2c

Figure 8.2d

Figure 8.2: Creative process sequence of Ann Telnaes
Source: youtube.com

⁹⁰ <https://www.youtube.com/watch?v=UPisG5Y92OU> and <https://www.youtube.com/watch?v=fMkS4rVCDcw>, retrieved on 16 December 2017.

A screen shot from an animated editorial cartoon of Telnaes is shown in Figure 8.3. Titled, 'A bad taste in W. Virginian's mouths' it was published in 2015 depicting the how clean coal will affect the citizens of West Virginia.

Figure 8.3: Screen shot of Telnaes' animated editorial cartoons
Source: The Washington Post

Analysing Telnaes journey. Taking reference to the final synaptic map that includes knowledge management (Figure 7.17), the first thing that is observable is that Telnaes moves from cogito (endogenous creativity) to efficio (exogenous creativity) bypassing intelligo (epigenous creativity). The whole journey in Telnaes' process happens in hours rather than weeks, months or years, since Telnaes has no time to apply theoretical mental approach nor experimental creative approach (although Telnaes spends a lot of time making corrections and improvement to the sketches). Initial human reactions of 'ha ha' and 'aha' are also experienced by Telnaes herself rather than by external parties. During the cogito stage of the journey, Telnaes does take an imaginative mental approach and playful creative approach. However, during the efficio stage, Telnaes skims past without much of an application of analytical mental approach, only applying a focussed creative approach before delivering a valuable animated editorial cartoon. In the case of Ann Telnaes, *abstract* to the *tangible* happens within one day. Points to note in this particular case study is that Ann Telnaes prefers to use pencil and paper for sketching. It could be envisaged that the same (or similar) result of sketching can be achieved from the use of tablets and sketch pads, cutting down the time required for scanning and editing, etc., shortening the duration.

Salient features of Telnaes' journey. Table 8.2 summarises the key features of Telnaes journey in taking hand sketched cartoons into animated editorial cartoons on-line.

Table 8.2: Salient features of animated editorial cartoons

Description	Observation
Creative Phase	Prominent cogito phase Due to short duration of the process, Telnaes bypasses the intelligo phase to finish her concepts at a relatively short efficio
Type of Creativity	Longer endogenous creativity followed by a shorter exogenous creativity. Epigenous creativity is most likely folded into endogenous and exogenous creativity
Mental Approach	Very imaginative throughout
Creative Approach	Moves from playful to focused in a short time
Knowledge Management	Telnaes' catalyst are the events that unfold that day or the previous day Telnaes is the sole innovation designer

Based on Telnaes' process the synoptic map of creativity to innovation is as shown in Figure 8.4

Knowledge Management

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Florie Salnot
Source:
rca.academia.edu

Case study 2: Plastic gold jewellery; Florie Salnot is a designer who works in the areas of social design, craft and product design. Born in France, she obtained a Master of Art (MA) in Design Products from the Royal College of Art (RCA) in 2010. Florie describes her master's thesis work in the RCA website⁹¹ as:

Building on a new craft technique I have developed, using south-west Algeria, the project seeks to enable Saharawi refugees to set up their own jewellery-making business. The aim is to offer a sustainable way for generating badly needed income and thereby reducing dependency on humanitarian aid. It also aims to promote self-reliance and innovation, and invigorate local craft traditions in an original way.

(<https://www.rca.ac.uk/students/florie-salnot/>, retrieved on 17 December 2017)

Florie's solution in her own words in the same website:

Plastic from bottles is the raw material. It is transformed with a low technology that is widely available in the camps, using simple hand tools and hot sand.

(<https://www.rca.ac.uk/students/florie-salnot/>, retrieved on 17 December 2017)

Background to the Saharawis. According to the international human rights organisation *Minority Rights Group International* (MRG), "Saharawis are of mixed Berber, Arab and black African descent who inhabit the harsh desert region stretching from southern Morocco to the valleys of the Niger and Senegal and traditionally lived a nomadic life as traders"⁹². Due to events in history, they have been at constant loggerheads with Morocco as well as Mauritania for a long period of time. The end result is that MRG estimates that, "...of a Saharawi population of around 250,000, some 160,000 remain displaced in southern Algerian refugee camps". Florie Salnot's research showed that the Saharawi refugees lived off mostly humanitarian aids and the women especially had difficulty in securing any vocation or income.

Florie Salnot's innovation. What Florie Salnot has achieved is an innovation in bringing back lost culture and tradition of jewellery making with its unique aesthetics, while designing and developing a technique to upcycle plastic bottles that are

⁹¹ <https://www.rca.ac.uk/students/florie-salnot/> retrieved on 17 December 2017

⁹² <https://minorityrights.org/minorities/saharawis/> retrieved on 17 December 2017

easily available at the refugee camp, into faux-gold ornaments that show the intricacies that the Saharawi women could bring to jewellery that is fashionable and contemporary. Salnot worked with an organisation called Sandblast who were already working with the Saharawis in Algeria to realise her project through to fruition.

The journey as explained by Salnot. In her website⁹³ Florie Salnot sets out the project outline as follows:

Economical: To offer Saharawis a sustainable way for generating income and reduce dependency on humanitarian aid.

Cultural: To provide them with an open-source technique and tools with which they can design their own pieces and invigorate their local craft traditions in an original way.

Social: To provide the Saharawis with an activity that could strengthen their self-esteem in the context of a refugee camp where job activities are virtually inexistent. (<http://www.floriesalnot.com/PlasticGoldPart1.php>)

THE PROCESS

The **first** step is collect plastic (PET) bottles (Figure 8.5a), peel off the label and clean them before cutting them into smaller pieces (half).

Figure 8.5a

Second step is to painted in any colour on the outside (there are jewellery where Salnot has coloured the insides in red) as seen in Figure 8.5b.

Figure 8.5b

⁹³ <http://www.floriesalnot.com/PlasticGoldPart1.php> retrieved on 17 December 2017.

Third step is to draw plastics strips. Once the bottle is cut into smaller shape, a specially designed block with a small knife like protrusion allows the women to draw the plastics in the bottle to long strands of wire as shown in Figure 8.5c & d.

Figure 8.5c

Figure 8.5d

The coiled strip of plastics that are produced from the coloured plastic bottles through the stripping is ready to be made into parts of jewellery.

Fourth step is to use the nail boards that Salnot has custom built, pushing the nails through to form shapes that each women have desire to make as shown in Figure 8.5e&f.

Figure 8.5e

Figure 8.5f

re/strip is then passed nails to make the shape. Once a shape is made, it is taken out and carefully adjusted to get the shape that the woman planned to do as shown in Figure 8.5g.

Figure 8.5g

Figure 8.5h

Fifth step is take the shapes and immerse them in heated sand as seen in Figure 8.5h. This will heat the plastics and allow it to keep its shape.

Final step is to weave the pieces into a full jewellery set as shown in the sample of Figure 8.5k.

Figure 8.5k

Figure 8.5 a to k: Plastic gold jewellery from Saharawi women
Source: *floriesalnot.com* and *youtube.com*

Once the women have mastered the technique, Salnot was able to train them further and show the range of faux-gold jewellery that can be replicated by everyone with some level of practice. Some examples are shown in Figure 8.6. For her efforts, Florie Salnot has won several awards including the Jameel Prize 3 organised by the Victoria and Albert (V&A) Museum in London⁹⁴. Salnot's work has been getting much attention and review since winning the V& A Jameel Prize 3 in 2011.

⁹⁴ <https://vimeo.com/70948977>, retrieved on 17 December 2017

Figure 8.6: Plastic gold jewellery
Source: inhabitat.com

Analysing Salnot's journey. Taking Figure 7.17 as reference again, Salnot's journey from creativity and innovation seems to have prominent *intelligo* period wherein she has spent at least a year or so in experimenting through *epigenous creativity*. Her ideation period in *cogito* has been formulated by a background study to the culture of the Saharawi people and their lack of independence and self-reliance during her major project period at the Royal College of Art, London. Coupled together with an interest in how to upcycle plastics, Salnot seems to have had her *Aha* moment at the end of the *cogito* phase. Once Salnot started working with Sandblast, who is the *Innovation Catalyst*, Salnot started on her *intelligo* phase garnering the experiments and details that are required to take the outcome to the *efficio* phase, where Salnot trained and worked together with Saharawi women to develop it through *exogenous creativity* for an outcome of valuable innovation.

Salient features of Salnot's journey. Table 8.3 summarises the key features of Salnot's journey in taking an idea of upcycling plastic bottles and to uplift the social horizon of the Saharawi women.

Table 8.3: Salient features of plastic gold

Description	Observation
Creative Phase	Short cogito; longer intelligo; equally longer efficio Iteration back to intelligo before final efficio
Type of Creativity	Short endogenous creativity; much more epigenous and exogeneous creativity through several iterations at intelligo and efficio
Mental Approach	Spark of imagination ignited by research; lot more of (theoretical) study of experimentations such as plastics and heated sand, etc. Analysis of experimental results rather than scientific analysis
Creative Approach	Short playful period leading to more experimental and focused approach
Knowledge Management	Innovation catalyst – Sandblast Main innovation designer and driver Benefiters join in during intelligo phase; provided valuable participation

Florie Salnot's journey from concept to valuable innovation is depicted in the synoptic map shown in Figure 8.7. Winning the Jameel Prize 3, and the exposure that ensued after, has allowed Florie Salnot to go back to *intelligo* phase again to develop the outcome further that could mean economic success for the Saharawi people, making this a valuable innovation. During the creativity to innovation journey, there were three important entities in terms of *knowledge management*; Sandblast was the *innovation catalyst*, while Salnot herself was the *innovation designer*, managing the whole process. As the project entered *intelligo* phase, Salnot was able to go the Saharawi region and work with the *benefiters*, who followed her through to till valuable innovation was achieved learning and giving feedback for further *intelligo* process till completion.

Figure 8.7: Synoptic Map of Plastic Gold

Pranoti Nagarkar Israni
Pranoti worked as a Design Engineer at Inovasia Design Centre @Amtek with me from 2006 to 2007 before co-founding Zimplistic in 2008
Image: conference.techiasia.com

Case study 3: Rotimatic – automated flatbread maker.

Rotimatic, developed by a Singapore start-up, Zimplistic Pte Ltd, is an automated roti (flatbread) maker invented by Pranoti Nagarkar Israni, who co-founded Zimplistic together with her husband Rishi Israni in 2008. Pranoti, a mechanical engineer and Rishi, a computer scientist, who started their company on their own savings have been invested from the likes of Robert Bosch Venture Capital GmbH (RBVC), Germany, NSI Ventures, Singapore and the investment arm of the Economic Development Board of Singapore (EDBI) to the tune of US\$43 million by August 2018⁹⁵ In the words of Rotimatic website⁹⁶, “Eight years, eleven iterations, and thirty-seven patents later, Pranoti invented the first ever fully automated kitchen robot –Rotimatic”. In their office, the eight years of product development is displayed in a showcase as seen in Figure 8.8.

Figure 8.8: Eight years of development of Rotimatic
Source: rotimatic.com

Background to roti making; Roti is a common name for flatbreads made from, mainly, wheat flour dough. Roti has been a staple diet of people from the central and northern part of India, Pakistan, Bangladesh, Nepal and other parts of the Indian subcontinent. Also called *chappati*, roti is made from the dough made from wheat flour (or *atta*, as it's known

⁹⁵ <https://www.asianmoneyguide.com/pranoti-nagarkar-israni>, retrieved on 20 December 2017

⁹⁶ <https://rotimatic.com/>, retrieved on 20 December 2017

in Hindi), warm water, a little oil , and salt. Smaller portions of the dough is then rolled into perfect flat rounds, and cooked over hot fire until brown with some portions blistered. While the cooking roti over a tava (flat or concave frying pan) is easy, making the dough to the right consistency needs quite a bit of strength and lots of practice. The whole process of making roti is shown in Figure 8.9, where dry atta is mixed to consistency, made into balls before being flattened on a board using a rolling pin before cooking. While a tava is used by many, some household cook the flattened dough over open fire using a mesh or grill.

Figure 8.9: Traditional method of making roti

Source: veenaazmanov.com

According to Pranoti, who started cooking as a newlywed, she tried making rotis from scratch for six months and soon realised that the whole process took more than 40 minutes. Cleaning up the utensils, the rolling board and pin, the tava, etc., also seems to be problem not forgetting the consistency of cooking, texture and taste. This lead Pranoti and Israni to research on if any solution was available. Finding none, they set out to work on how to make chappatis that will pass the muster with the minimum intervention of human hands.

Pranoti, who was working as a Design Engineer, in what was then known as Inovasia Design Centre of Amtek Engineering⁹⁷, decided to leave the company to co-found Zimplistic Pte Ltd in 2008. Initially located in the incubation park of National University of Singapore, Pranoti produced her first prototype in several months which is shown in Figure 8.10.

Figure 8.10: The first prototype of Rotimatic

Source: channelnewsasia.com

As figure 8.10 shows, the prototype was the outcome of straight forward application of the principles of engineering. Zimplistic won the top prize of S\$40,000 at the Startup@Singapore Business Plan competition organised by the National University of Singapore in 2009. This allowed Pranoti to develop on the prototype while located within the incubation park of National University of Singapore. Several

⁹⁷ Inovasia Design Centre at Amtek Engineering was originally Inovasia Design Pte., Ltd., co-founded by the author in 1996. It merged with, the then listed, Amtek Engineering Ltd., in 2005.

refined working prototypes and first production runs were made over 15 iterations and 8 years before a commercially viable product was ready to enter the market in 2016. This process is described in a video posted by Channel News Asia in October 2016 in YouTube⁹⁸. With initial funding coming into Zimplistic, Rotimatic was already a 'known' product over the internet by 2014 when pre-orders for 8,000 units were accepted by the company. However, a commercial product was not available to enter the market with teething problems being discovered to be solved. By 2014, Pranoti and Rishi had hired a bigger team and moved into an industrial premises in Singapore. The problems were not just about mechanical development and software, there were issues with different types of wheat flour, consistency of the roti and taste, etc. There was a need to make the product as small as possible as well.

With development still in progress, Pranoti took on the task of selecting vendors to tool and manufacture parts as well as to find a suitable contract manufacturer. Rishi had taken charge of the software development as well as the investment aspects of Zimplistic. During several conversations that the author had with Pranoti during 2013 and 2014, Zimplistic was set on a contract manufacturer in the southern state of Johor Bahru in Malaysia, which would be a drive away from Singapore. By mid 2016, Zimplistic was able to manufacture a reliable model of Rotimatic to be sold through on-line portal. According to sources in Zimplistic, as of 2018 they have sold more than 35, 000 units and have back orders to fill. In 2017, Zimplistic made the decision to sell Rotimatic through selected departmental stores, starting with Mustafa Centre in Singapore.

Figure 8.11 shows how rotis are made by Rotimatic in comparison with how it is traditionally made as in Figure 8.9.

⁹⁸ https://www.youtube.com/watch?time_continue=222&v=l6ux-hDsCps retrieved on 20 December 2017

Figure 8.11: Making roti with Rotimatic

Source: channelnewsasia.com

Rotimatic that is available in the market as of 2019 is shown in Figure 8.12. According to the Rotimatic's website:

Rotimatic can make freshly puffed flatbread from dry flour in a minute, which is possible, '... possible with a 32-bit microprocessor that harmoniously orchestrates 10 motors, 15 sensors and 300 parts in parallel. The 10 motors work together based on the data from 15 different

sensors, which measure things like temperature, position and the most complex and important metric, that is, consistency. It manages all processes seamlessly to save every second possible. (www.rotimatic.com)

In a YouTube video, Rishi Israni, the co-founder can be seen stating that, “Rotimatic is not a machine but a robot with artificial intelligence built in and connected to the internet through WIFI”.

Figure 8.12: Rotimatic from Zimplistic in 2019

Source: entrepreneur.com

While the novelty is clearly visible, has the development of Rotimatic produced valuable innovation? This may be ascertained by mapping the chronology of events leading to release of fully commercial unit of Rotimatic in 2016 till 2018 as shown in Figure 8.13. From Figure 8.13, it can be seen that in 2008, Pranoti felt the need for an automated roti maker for the profile of customers such as herself. This may be considered the ‘Ha-ha!’ moment sparking a spurt of creativity. Winning a prize for S\$40, 0000 in 2009 was the ‘Aha!’ moment where the idea was shown to be possible through a ‘proof-of-concept’ prototype. From there on a high level of concentration seem to have been gone on to raise capital between 2010 and 2015 with several iterations of prototypes produced before a final moment of ‘Hmmm’ had been reached and investments to the tune of US\$11 5 million had been invested into Zimplistic in order to start the tooling and manufacturing.

Case Study 3
Rotimatic: chronology of development

Figure 8.13: The chronology of events in Rotimatic development

In the meanwhile, with only partially functioning prototypes in hand, Zimplistic started the marketing campaign in 2014 itself, taking upto 8,000 units for pre-orders. This kept the potential customers/consumers waiting which was heavily criticised by many in the social media in the Internet. Even after production commenced, Zimplistic team had to trouble shoot to solve potential problems. A study of the creativity to innovation journey could reveal the inherent cause of this. Juxtaposing the creative processes of ‘cogito’, ‘intelligo’ and ‘efficio’ onto Figure 8.13 as shown in Figure 8.14 allows for such analysis.

From Figure 8.14, firstly, it is clear that, in a journey that has stretched to ten years, with very little time was spent on the ‘cogito’ process and that also was much more into building the ‘proof-of-concept’ prototypes after several experimentations. Secondly, with a prolonged ‘intelligo’ process in place, the ‘efficio’ process is telescoped into the ‘intelligo’ process. This, the author suspects, may be due to pressure to get investments into Zimplistic as early as possible. This brings about a situation where the handover from ‘intelligo’ to ‘efficio’ gets protracted, resulting in a situation where the innovation leadership has to balance both the ‘intelligo’ and ‘efficio’ part of the journey at the same time. The end result is that, the product Rotimatic seems to be what Taylor terms as ‘inventive creativity’ (Figure 4.2) rather than ‘innovative creativity’. Hence the value proposition of the innovation of a robotic roti maker seems to be much more diminished than what was anticipated, especially with the buzz surrounding Rotimatic as early as 2014.

How does this happen in the creativity to innovation journey? Going back to the proposition by Taylor et al. (1975) on the type of creative people (Figure 7.9), it becomes more clear that throughout the process, from ‘cogito’, ‘intelligo’ and ‘efficio’, the journey is lead and operated by two talented ‘epigenous creative’ people, Pranoti and Rishi. What the project needed, though, was a mix of talents who are predominantly endogenous creative at the cogito process, epigenous creative during the intelligo process and exogenous creative at the efficio process. Though, Zimplistic did hire ten employees initially and eighty-five once the first investment disbursement of US\$3 million came in, the employees seem to part take on the directives from the two co-founders, with minimum to moderate creative input. Even

as late as 2016, the conversations that Pranoti had with the author pointed to most of the key initiatives where taken up by Pranoti and/or Rishi themselves, with Pranoti looking after multiple iterations at the ‘intelligo’ stage of the innovation journey.

Salient features of Rotimatic’s journey; Table 8.4 summarises the key features of Rotimatic’s journey in taking an idea of automating the making chapati’s .

Table 8.4: Salient features of Rotimatic

Description	Observation
Creative Phase	Very brief cogito; long period of intelligo and efficio being merged. Iteration back and forth between intelligo and efficio
Type of Creativity	Very brief endogenous creativity; dominant epigenous creativity through several iterations at intelligo and efficio with very short exogenous
Mental Approach	Spark of imagination ignited by a perceived need; heavy experimentations through engineering prototypes. Analysis of experiments more of troubleshooting with engineering corrections
Creative Approach	Very small evidence of playful. More of experimental and focused approach
Knowledge Management	Chief Inventor and Innovation catalyst – Pranoti Nagarkar Israni Business leader – Rishi Israni Field team joins at quite late in the intelligo phase

Rotimatic’s journey from concept to innovation is depicted in the synoptic map shown in Figure 8.15, which shows the fusing of intelligo and efficio process thus confusing the outcome; is it useful or valuable? Human reactions (consumer) is also confused, between ‘hmmm’ and ‘I see’. The mental state is also oscillating between ‘discovery’ and ‘serious’. During the creativity to innovation journey, there are three important entities in terms of *knowledge management*; Pranoti is the *innovation catalyst* well as the *lead inventor*, while Rishi took on the role of *business leader* and perhaps, *general manager* . A field team comes in more than half way into the intelligo phase which stands at hundred and fifty according to Pranoti.

Case Study 3
Rotimatic: creativity to innovation journey

Figure 8.14: Creativity to Innovation journey of Rotimatic

Figure 8.15: Synoptic Map of Rotimatic

Sir James Dyson
Artist, designer
and inventor
Image:
richardhartley.com

Case study 4: Dyson cyclone vacuum cleaners. This case study is about an individual, Sir James Dyson, forming a company, Dyson Limited, to develop and manufacture an innovative concept in vacuum cleaning from idea to manufacture. In many ways, James Dyson is the sole innovator who has changed the idea of domestic and industrial vacuum cleaning, making 'Dyson' a global brand in the likes of Samsung, LG, Sony and Apple. From a single product, Dyson DC01 vacuum cleaner, Dyson today is a manufacturer of a range of products such as vacuum cleaners, bladeless fans, commercial hand dryers and hair dryers (as seen in Figure 8.6). A survey in retail outlets reveal that each of them is selling at a premium price. In this case study, the background that made an artist into a world renowned innovator is discussed first before discussing on the innovation aspects of the product. This, presented in a chronology allows the understanding Dyson's innovation.

Figure 8.16: Dyson range of products
Source: Various

Dyson Limited, incorporated in the United Kingdom, was established in 1991 by Sir James Dyson, the inventor of cyclone vacuum cleaning. James Dyson, an artist and designer was an inventor right from his days as a student at the Royal College of Art (RCA) in London, according to several sources which include his autobiography *Against the Odds* (Dyson,

1997) and reliable web resources⁹⁹. His final project at the RCA was a design of a boat which he named 'Sea Truck' seen in Figure 8.17 which was inspired by one Jeremy Fry, the Managing Director of Rotork, who later employed him to manufacture the Sea Truck. At Rotork, James Dyson was also a marketing/sales person, a job he did quite well, able to sell many Sea Trucks to several countries including Egypt and Libya amongst others. James Dyson decided to leave Rotork in 1974 to start a company of his own named Kirk-Dyson, with his brother-in-law. At Kirk-Dyson, James Dyson designed and developed the 'Ballbarrow' (Figure 8.7).

Figure 8.17: Sea Truck (left) and Ballbarrow

Source: cbsnews.com

As per the article titled, "The Seventh Disruption: How James Dyson reinvented the personal heater" (see footnote below), "It raked in around £600,000 a year". Kirk-Douglas' plan to launch the Ballbarrow in the US was thwarted when a former employee stole the design and started selling it in Chicago. Since James Dyson had assigned the Ballbarrow patent to the company, Kirk-Douglas launched legal proceedings against the former employee in the US against his wishes.

In 1978, while attempting vacuum his house with an old reconditioned vacuum cleaner, Dyson noted that it kept losing suction as its bag kept clogging up and was wheezing instead of sucking in dust. He bought himself a new much more powerful vacuum cleaner with the same result. Intrigued by the result, James Dyson, "... did a fair amount of vacuuming with one of the new bags, and noted rapid decline in performance', while the bag, 'had only a thin coating of dust on the inside" (Dyson, 1997).

⁹⁹<http://www.famous-entrepreneurs.com/james-dyson>, <https://www.wired.com/author/james-dyson/> and <http://www.wired.co.uk/article/the-seventh-disruption-james-dyson>, retrieved on 23 December 2017

It so happened that James Dyson was facing the same suction problem elsewhere at the Ballbarrow factory, where there was a powder coating plant, which used charged epoxy particle to coat the frames of the Ballbarrow. Since not all the epoxy powder is required to coat the frame, the unused powder, 'had to be collected for disposal by means of what was, in essence, huge vacuum cleaner', which passed through an 8 x 8 ft cloth screen, which acted like the bag in the vacuum cleaner, clogging up every hour or so, stopping production to brush down the screen for the powder collected for reuse. James Dyson went back to the supplier of the powder coating plant who told him that the solution to the problem is a 'cyclone', which happens to be according to James Dyson, "a 30 foot high cone that 'spun the dust out of the air by centrifugal force' and which cost 75,000 British Pounds" (Dyson, 1997).

James Dyson decided to sneak into a nearby factory in the night to have a look at their cyclone. James Dyson recounts that the next day:

We welded up a 30-foot cyclone from sheets of steel, blew a hole in the roof, and stuck this Vulcan's ice cream cone defiantly out into the sky. I gleefully tore the cloth veil from the opening of the duct and started the conveyor belt. The spray came at the narrow frame and whatever passed on went straight into the gaping hole, up the ducting and around the walls at the top of the cyclone, spiralling down through the inverted cone to be collected by a bag at the bottom, while the air escaped into the sky. (Dyson, 1997, p. 105)

The success of the cyclone at the industry level set James Dyson on thinking about the vacuum cleaner at home. If the cyclone could be scaled down to a domestic appliance level, he thought that vacuum cleaners will not need bags after that.

Figure 8.18: James Dyson's early sketches of cyclone

Source: nymag.com

In James Dyson's words:

It was not, perhaps, the 'Eureka!' that it should have been, considering how important its ultimate application was to be, because I had the fundamental idea up and running. But it occurred to me at that moment that there was really no reason it shouldn't work in miniature – using a cyclone about the size of, say, a Perrier bottle.

(Dyson, 1997, p. 106)

James Dyson went back home that night and built a prototype of a cyclone vacuum cleaner using cardboard, gaffer tape, hose and motor from his regular vacuum cleaner. James Dyson reports:

I plugged the vacuum cleaner in and flicked the switch, expecting the worst. But there was no explosion, no blasts of dusty air into the kitchen, I just pushed it around the house and it seemed to be perfectly happy. After a few minutes, I disconnected my cardboard construction and peered into find a deposit of dust in the bottom of the cone. (Dyson, 1997, p. 107)

At the end of this experiment in the night, he realised that, "he was the only man in the world with a bagless vacuum cleaner".

James Dyson quickly realised that, "...a tiny particle that appears to be quite happy floating around in the air, and would continue to do so for ever without the slightest encouragement, suddenly assumes a huge weight and is forced by the imparted momentum of the cyclone into the bottom of the cone where it is collected" (Dyson 1997). The air, in the meanwhile, escapes from a hole or series of holes at the top at the opposite side or the larger side of the cone without expelling dust.

From concept to a working vacuum cleaner. Convinced that the cyclone vacuum cleaner is more than a possibility, James Dyson decided to bring it up at the Kirk-Dyson board meeting, only to be told, "But James, your idea can't be any good. If there were a better kind of vacuum cleaner, Hoover or Electrolux would have invented it"(Dyson, 1997) and was told "...not to develop this further, it's a stupid idea".

It was a lesson for James Dyson, as it will be for anyone who is presenting an idea that needs to pass through 'Ha Ha!' to 'Aha!', since an initial spark of an idea is a 'personal view' says James Dyson. In his own words, after the rejection of the cyclone vacuum cleaner idea, "Your 'personal view' is more than enough to give your dream credibility in your own mind, but all anyone will say, when asked to put money to pursue it, is, "...I am not backing your own personal view with my own personal cash"(Dyson, 1997). The problem James Dyson faced was that he could not quantify his idea in terms of a comparable value such as efficiency or profit, etc. This is different from what Ratan Tata faced in the Case Study 5 (presented next in this thesis), where Tata Motors' resources in terms of funds and people were allotted for the Tata Nano project. Not interested in James Dyson's attempt to take the project past *cogito* to *intelligo*, the board asked him to leave the company.

Not to be frustrated by this set back, James Dyson went back to his old friend and mentor, Jeremy Fry and convinced him to invest in a new company that they co-founded named Air Power Vacuum Cleaner Company in 1979. With the money they had raised between them, James Dyson started to build the first of the 5,127 prototypes that he built before going into production. Well engrossed by himself in the *intelligo* phase of the creativity-innovation process, James Dyson was looking at two issues. One was, "the ability of the cyclone to separate the visible bits of rubbish like mud, hair, finger nails, fag

(cigarette) butts, bottle tops, half-munched crisps, dry bogey... and old pilau rice... and its ability to separate the very fine dusts you can't see" (Dyson, 1997). The second was that James Dyson had to find a way of measuring how much dust was coming out of the machine, in relations to how much was going in which, in reality, is testing how the system filtered the dust so that it does not escape back to the room. In order to test the two issues in a measurable way, James Dyson built a bread board as shown in his own sketch in Figure 8.19. For the next four years, James Dyson spent most of his time making prototypes and testing them on the breadboard. After two years of testing, James Dyson discovered that each of the two issues required a cyclone each and the 'Dyson Dual Cyclone' was born, where the outer cyclone retained the larger bits and the inner cyclone collected the fine dust.

In 1982, after obtaining an efficiency level that more than proves the principle of cyclone vacuum cleaning, the partners decided to rename the company as Prototypes Ltd, and decided to sell license the production of the cyclone vacuum cleaners. In other words, they wanted to stop at *intelligo* and license the *efficio* part of the project to a company that had interest and the experience and resources to take the product through manufacture and marketing.

Figure 8.19: Breadboard to test the cyclone

Source: Dyson (1997, p. 124)

Selling pure innovation. Knowing the need for exogenous creativity which requires a higher level of resources than what Prototype Ltd could offer, James Dyson approached every

possible makers of appliances between 1981 to 1983, starting with Black & Decker, which only sent an agent to look at it and Hoover, which wanted to ensure through a clause in an agreement that whatever ensued between Prototype Ltd (essentially James Dyson) and Hoover belonged to Hoover which meant that whatever James Dyson disclosed through demonstration and explanation can officially be owned by Hoover; in essence the cyclone idea would be theirs. James Dyson recalls that he knocked on the doors of almost every company that they could think of. Everywhere he went, James Dyson got a good reception and the prototype was given a look, before the ridiculing started with statements such as, 'This project is dead from the neck up'. Electrolux told James Dyson that he would never sell a vacuum cleaner without a bag, indicating there is a lot of money to be made in selling the bags. Having spent all the money that was invested and heavily in debt, they turned to Jeremy's old company Rotork which took some interest and even tooled the design based on technical drawings done by James Dyson. Rotork sold about 500 units through direct sales and that gave valuable feedback to improve. This set out a second round of interest from American companies such as Black & Decker which did not come to any fruition. As James Dyson puts it, "Once again, my point of weakness was my smallness, isolation and dire need" (Dyson, 1997). Companies that were interested such as Amway, instead of producing and selling the cyclone vacuum cleaner, engaged them in a costly litigation accusing Dyson of '... fraudulent conduct, deception and misrepresentation on the grounds that it was not ready for the market'. It dawned on James Dyson (1997) that as long as there is a litigation hanging over the cyclone, "I could not license the thing to anyone else...". This is another lesson in the creativity to innovation path. Any idea which has a high perceived innovation value and which requires a high level of resources in the *efficio* phase needs the 'creator-innovator' to be continuously involved in the project till reaching the 'I see' stage of human reaction.

A Japanese breakthrough. All was not a debacle for James Dyson and the cyclone. Despite all the problems, the Cyclon, a brand name given by Rotork, had been featured in the annual edition of a design magazine in November 1984 generating the interest of a Japanese company named Apex Inc. James Dyson recounts that, "In fact, they thought the machine was wonderful... they understood exactly what I was trying to do

and knew exactly how to sell it” (Dyson, 1997). A deal was struck which allowed for some upfront money, design fees and an minimum royalty. Named ‘G-Force’ in the style of the Japanese trend of the mid-1980s, the vacuum cleaner gave visibility to James Dyson and value to his innovation. The G-Force (Figure 8.20) was sold at a high price of 1,200 British Pounds, catering to a niche market; of those choosing novelty.

Figure 8.20: The G-Force manufactured by Apex Inc of Japan
Source: nymag.com

Hot on the heels of the G-Force success, James Dyson, struck out an agreement for North America with a Canadian company called Iona, bypassing an existing non-competition agreement that Iona had with another American company. Sold as Iona Drytech or Kenmore Drytech, the product still

has a fond following in the internet some thirty years after introduction¹⁰⁰.

With both the Apex G-Force and Iona Drytech, it is apparent that James Dyson was directly working with designers, engineers and draftsmen to ensure that the products are manufacture ready. In other words, James Dyson was involved in the *efficio* stage of this creativity to innovation journey.

While everything seemed to be going fine with two agreements in place and Iona wanting to work out another agreement for a proper vacuum cleaner, James Dyson was given the news by Iona that Amway is selling a cyclonic vacuum cleaner exactly like Dyson's dual cyclone vacuum cleaner. This triggered another legal war in the US with Amway, which James Dyson decided to fund through the royalties from the sale of Iona Drytech. In 1990, with the Amway litigation on going, Johnson Wax approached James Dyson and proposed technology license agreement for a tank vacuum cleaner and a back-pack cleaner for a worldwide commercial cleaning market.

After a lengthy litigation, Amway backed out in 1991 leaving James Dyson to concentrate on creating an innovation company capable of creating sustainable value proposition from the core cyclone idea. James Dyson was now ready to carry the creativity to innovation journey through *efficio* under his own leadership.

Completing the innovation cycle. The cyclone vacuum cleaner idea had successfully passed through the *cogito* and *intelligo* phase, as well as given James Dyson the taste of *efficio* phase through the requirement for providing the development drawings and documents for Apex G-Force and Iona Drytech. If James Dyson is to have his own company, he needed his own *efficio* team with abundant *exogenous* creativity to complete the tasks. To start with, James Dyson hired four design engineers from RCA's industrial design engineering (IDE) programme¹⁰¹. He also hired a project manager to organise and keep the employees focused. James Dyson describes the team as, "We were a band on a mission to

¹⁰⁰ For example: <http://www.vacuumland.org>, retrieved on 23 December 2017

¹⁰¹ The four hires were from a batch a year senior to the author at the RCA. Graduates of the IDE programme mostly have engineering or science background and study in a joint master's programme between the RCA and the Imperial College, making them suitable for *intelligo* and *efficio* stages of the creativity to innovation journey. The IDE programme has since been renamed as Innovation Design Engineering by RCA / Imperial.

design a vacuum cleaner that could challenge the world...”
(Dyson, 1997). With this team, he was able to:

...put into unhindered practice all the things I believed, about interdependency of design and function, about the way in which aesthetic perfection could be generated out of the engineering principles of the work, rather than being used to hide them, and about enabling the consumer to understand the technological benefits of new products, by using them to make the products fun.
(Dyson, 1997, p. 193)

This statement underlines the fact that Dyson was building up a strong talent that is a mix of *epigenous* and *exogenous* creatives and they were comfortable working at the *intelligo* and *efficio* phase of the creativity to innovation journey. James Dyson describes a work setting as, “Upstairs, which was the office, we designed every detail on computer, and downstairs, in the ‘factory’, we made our models. It was a fantastic environment to work in, for it was just engineers and designers, and no one to mess us around. There were no salesmen, no advertising people, no marketing managers, to interfere and try to guide us in a direction” (Dyson, 1997).

Pages 196 to 200 in James Dyson’s autobiography (Dyson, 1997) describes in detail, how the team not only designed, engineered components and built prototypes, but how it also built their own test rigs to use and abuse the vacuum cleaners in ways they imagined consumers may use/abuse. James Dyson mentions that he took advantage of the experience gained in engineering for the Johnson Wax licensed products called ‘Vectron’. The dyson team seem to have exhibited their *exogenous* creativity whenever they had to be resourceful. James Dyson mentions the team devising their own sprinkler system for their workshop which shows evidence of this creativity. Everything including colours and the selection of materials were decided at the *efficio* phase of the journey.

Once Dyson team was satisfied with the industrial design, engineering design, material selection, etc., they released component/ part drawings/computer files for tooling to Italian mould makers, another *exogenous* creative centre, in the author’s opinion, who manufactured the parts for molding. Initially, molding and assembly of the vacuum cleaner, named DC-01, were done in Wales, England, with the first ones rolling out end of January 1993. By 1994, DC-01 was selling very well and if Dyson DC-01s were to be selling

worldwide, they needed to explore manufacturing in more cost-effective regions of the world, James Dyson realised this in the few more years to come. Figure 8.21 shows the first Dyson model to go on sale, Dyson DC01. The shape, form, colours and the details, with the see-through housing attracted a lot of attention when it hit the stores in 1993. The retail price of the DC01 did not match up with what was the trend in the industry, and was about 300% more than other brands, which did not make business sense to many at the point in time.

I do regret that Hoover, as a company, did not take the product technology off the shelf, take it off Dyson. It would have lain there on the shelf and not have been used.

Mike Rutter

VP Hoover, Europe

Source:

Grundy (2018, Chapter 9)

Figure 8.21: Dyson DC01 vacuum cleaners. The earliest version in the background

Source: <https://worldofinnovations.files.wordpress.com>

Back - aspirateur.free.fr

The decision to use product form, design details and colours that were not common for household products, brought two advantages to Dyson. One, it caught the attention of the reviewers and journalists. In James Dyson's own words, "It is one of the virtues of having a strange looking product, however, that the journalists are more likely to take an interest in it" (Dyson, 1997). Secondly, this interest, then manifest as, "business stories, initially, and then ultimately

product stories that explained why we'd got rid of the bag, and the value of doing that" (Dyson, 1997). It is this worldwide reviews and stories, James Dyson believes, gave people reason to buy Dyson vacuum cleaners. Once they bought them, retailers in Britain such as Curry's and Comet, "... realised that customers were not bringing them back... (they) went home feeling they had made a discovery, which they demonstrated to their friend, who in turn came into buy them" (Dyson, 1997).

A survey done by an independent company, GFK Lektrak on the total floorcare brand value from January 1994 till 1997 showed that Dyson's value of units sold rose from around GBP 400,000 in January 1994 to 14 million in January 1997, a rise of 35 times over a period of 24 months. The brand leader in January 1994, Hoover went down from around GBP 5.5 million to 5 million over the same period (Dyson, 1997).

Newsweek¹⁰², in an article wrote in 2002:

The dashing Dyson was trying to sell something to the U.S. consumer that nobody voiced a huge need for and at a price point that felt, well, outrageous. But within two years, he had nearly 15 percent of the \$4 billion vacuum-cleaner market, second in market share to Hoover, the inventor of the upright cleaner. At first glance, the vacuum is an unlikely place to find a game-changing concept. But the British entrepreneur not only improved the technology—a feat not attempted in nearly a century—but introduced a revolutionary design that made the vacuum nothing short of a cool and even "sexy" purchase. Dyson soon became a household name and a kind of cult figure. (<http://europe.newsweek.com>)

James Dyson and his team have not let down on product ideas and innovation ever since 1993. After the DC01, several variations have followed. After the bag-less vacuum cleaners, Dyson has developed 'blade-less' fans, hand dryer and hair dryer. Dyson had also developed and released to the market a washing machine, which has been withdrawn for some reason that James Dyson has not disclosed.

¹⁰² <http://europe.newsweek.com/how-james-dyson-revolutionized-vacuum-67039?rm=eu>, retrieved on 05 February 2018

Summary of Dyson's path to innovation. Dyson's journey is unlike the three earlier case studies, since it has several products of the same innovation that were developed and marketed. Hence Dyson's journey is better ascertained by checked for:

- a. cogito – intelligo – efficio path
- b. spread of endogenous – epigenous – exogenous creativity
- c. creative approach and mental state through the progression
- d. mental approach and outcome through the progression
- e. human reaction at each stage / path

The spark was ignited based on Dyson's observation and quick cardboard model experiment. When James Dyson presented his findings of his experiment with cyclone as an idea for dust collection to the board of Kirk-Dyson, the immediate **(human) reaction** was a 'Ha ha!' with a few of them ridiculing James Dyson by saying that if his cyclone idea was as good as he said it was, the big players such as Electrolux and Hoover would have done it. Again, when James Dyson presented his vacuum cleaner to major manufacturers he was ridiculed. At the same time, all the big players were intrigued by the idea that was **novel** and arranged for their key people to look at the prototype.

a. Evidence of cogito – intelligo – efficio path

In this case study, there were a few false starts that proved to be costly for James Dyson, making one wonder if the idea of the cyclone could cross the spark into a product(s) of value completing the innovation cycle. The interesting part of this case study is that James Dyson had taken the idea and spent several years on fabricating and testing prototypes in much more of an **experimental** creative approach with James Dyson himself taking a **theoretical** approach to calculate the geometry and wind speed (944 mph, etc.) and explored formulae related to movement of particles in cyclones (Dyson 1997, p. 112–113). This resulted in an *intelligo* path albeit in a very exploratory and rudimentary manner. In this respect James Dyson jumped straight into *intelligo* to produce a 'proof of concept' prototype which shows how the cyclone technology worked. (Which Pranoti also did for Case Study 3 on Rotimatic) Though an artist and a designer, James Dyson chose to jump the *cogito* phase initially. Perhaps this is the

way an inventive idea on the journey to innovation needed to traverse. Was there any evidence of *cogito* in James Dyson's early process then. He was well aware that the prototype in his hand was not what he wanted to have manufactured, for it lacked consideration to aesthetics, human factors, colours, etc., and he also was aware that he would have to return to a *cogito* phase for the idea to carry forward to a valuable innovation, and possibly a profitable venture.

His success with signing a licensing agreement with Apex to sell the cyclone vacuum cleaner under the brand name G-Force had him take an **imaginative** mental approach and a **playful** creative approach clearly indicating a *cogito* path in the journey. In many ways, the Japanese partners encouraged James Dyson to be **exploratory** and come up with an idea of a pastel pink coloured product with a market **potential** and had the Japanese react with an '**Aha!**' Since the cyclone was a technology that can wear any 'design', James Dyson could start with the *cogito* phase for Iona and Johnson Wax and come out with suitable industrial designs for each. In both cases, Dyson worked closely with the development team of each of the company influencing the form and function factors, smoothly transiting to a *intelligo* path. For a self-taught engineer, James Dyson seemed to have not only moved from *cogito* to *intelligo* but also to *efficio* as he would show when he worked on Dyson DCo1 in the early 1990s.

By the time he was working on Dyson DCo1, James Dyson had hired graduates of industrial design engineering (IDE) from the Royal College of Art and later, talents from other engineering schools as well. With a talented team who were equally comfortable in *epigenous* and *exogenous* creativity required for taking the cyclone vacuum cleaning idea through *intelligo* and *efficio* journey together with James Dyson, the development of Dyson DCo1 was able to go through.

Well documented evidence of the journey that the cyclone vacuum cleaner idea took from the spark till manufacture of a successful product confirms the *cogito – intelligo – efficio* path taken by James Dyson. It must be said, though, that he had an initial straight to *intelligo- (partial) efficio* path journey when he was developing and building working prototypes of cyclone vacuum cleaner and testing them for proof of concept. This prototype did not immediately become a valuable innovation since it needed to be sent back to the *cogito* path first.

b. Spread of endogenous – epigenous – exogenous creativity

Being an artist, designer, self-taught engineer and an inventor, James Dyson seems to have the talent exhibiting all three types of creativity when and where necessary. Reading the documents available on James Dyson as well as reading his biography (Dyson, 1997) it leads us to conclude at the outset that, in some ways, James Dyson was much more of an *epigenous* creative person himself, always curious to solve problems rather than dwell on aesthetics at the first instant. The artist side of James Dyson surfaces at any period along the creativity to innovation journey, making him versatile. This, together with his ability to be involved till the *efficio* path is completed makes him a total innovator.

What about the team that James Dyson built on the way to Dyson DC01 and beyond till today? His initial team building could be taken as a prototype for the Dyson teams that have successfully produced innovation of value. Though the development of DC10 took much longer and did not follow the more structured development process of Tata Nano discussed in Case Study 5, the creativity to innovation of journey of Dyson DC01 follows the synoptic map depicted in Figure 7.10 of this thesis.

Though at the *cogito* phase, James Dyson seems to have been the only person involved he showed his ability to think and imagine freely exhibiting *endogenous* creative ability. Subsequently he hired four graduates of the masters programme in Industrial Design Engineering (IDE) from the Royal College of Art, Simeon Jupp, Peter Gammack, Gareth Jones and Mark Bickerstaffe, who could flow from *intelligo* through *efficio* phase till the DC01 went into production. James Dyson also hired Judith Hughes who acted as the ‘coach’ of the team who in James Dyson’s words, “...marshalled us all, organised everything and generally kept us in shape – resilient, resourceful, funny, ungetdownable, and blessed with an imperious voice that strikes terror into the strongest hearts...” (Dyson, 1997, p. 193). James Dyson also mentions Andrew Thomson, an IDE RCA graduate and Connie Yuen, an aerodynamics graduate from Bath University who joined the team towards the end of DC01 development. Figure 8.22 shows the knowledge management during the development of Dyson DC01. It can be seen in Figure 8.22 that James Dyson, through his complete dedication to the development of DC01 and determination to enter the

international market for floor care, was not only the *change agent* but was also the *innovation catalyst* as well as a hands-on member of the *field team*.

Figure 8.22: Knowledge Management in Dyson DC01

Judith Hughes, who is considered to have been the *coach*, is reported to be still with Dyson Ltd (at the time of writing this thesis), taking on wider roles. Since DC01, Dyson Ltd is reported to have filled the development team with a balance of *endogenous*, *epigenous* and *exogenous* creative personnel leaving James Dyson to be the *change agent* and the *face* of Dyson Ltd.¹⁰³ James Dyson's autobiography as well as other sources corroborate with the knowledge management shown in Figure 8.22.

c. Creative approach and mental state through the progression

At cogito; In a more structures development process, the creative approach during *cogito* path is expected to be *playful* and the mental state is to be that of *imagination*. From the study of James Dyson's inventive approach to developing the cyclone principle as a vacuum cleaner, it becomes apparent that James Dyson is able to merge the *cogito* and *intelligo* *phases* of the journey smoothly for himself. His hiring of

¹⁰³ The author had the opportunity to spend some time with Dyson's development team as well as to meet and dine with Sir James Dyson in 2002/2003 in Singapore, when Dyson Ltd., was in negotiations with Meiban Ltd., Singapore to set up a development centre in Singapore and for contract manufacture of the vacuum cleaner, and later, their short-lived washing machine, by Meiban Malaysia. Several of his batch mates from the Royal College of Art's IDE programme joined Dyson Ltd., in the 1990s, including Andrew Thomson who is mentioned by Sir James in his autobiography.

industrial design engineering (IDE) graduates from the Royal College of Art also points to talents who can absorb the creative inspiration from James Dyson from the *cogito* context and work creatively within the *intelligo* phase of the journey. This smooth transition of the same people from *endogenous* to *epigenous* creativity allows for James Dyson and his development team to switch between *playful* and *experimental* creative approaches and *imaginative* and *theoretical* mental approaches operating on both *endogenous* and *epigenous* creativity modes.

In the author's opinion, switching between *endogenous* and *epigenous* modes of creativity is not an aberration of the proposed map, since James Dyson himself had taken the idea through one round of iteration through the creativity to innovation journey producing a working prototype of the cyclone vacuum cleaner, attaining the first level of innovation, to start with.

At *intelligo*; Is there evidence to show that at *intelligo* the creative approach was *experimental* and the mental state was that of *discovery* during the development process of Dyson DC10? Documentation of James Dyson's working style as well as Dyson team's during the development of DC01 show clearly that there was a level of curiosity as to how the cyclone principle can be used, even exploited, to design a vacuum cleaner that will be well ahead of its competition. They were always experimenting with engineering details, and physical theories and kept discovering means to put their ideas to effective use, thus matching the claim on the creative and mental approach by the synoptic map proposed in this thesis.

At *efficio*; With James Dyson and his team exhibiting capabilities in *exogenous* creativity, the creative approach was clearly on of *focus* and their mental approach, *serious*, especially since they had to work against all odds to take the final design through tooling, pilot production till final manufacture. James Dyson and his team seem to use ingenious ways to set testing procedures to ensure that DC01 was compliant with safety and manufacture standards. This shows that the development team matched closely with the claims made by the proposed map.

d. Mental approach and outcome through the progression

At *cogito*; Was mental approach at *cogito* phase of DCo1 that of *imagination* and the outcome *potential*? In the case of the development of Dyson DCo1, James Dyson had spent considerable periods of time taking his own journey from idea to innovation, putting a lot of imagination in making the cyclone work. This meant that during the actual development of DC10, the team in many ways built on this imagination to come with more than a potential outcome of the vacuum cleaner, matching the proposed map in more than one way. With *cogito* interchangeably merging with *intelligo* the process allowed for imaginative mental approach in several ways at several points along the way.

At *intelligo*; James Dyson and his team, with an experimental approach to product development, set up their own methods to verify through engineering principles which shows a mental approach centered around *theoretical* in order to arrive at a *useful* outcome. Making prototypes in a resourceful manner to test their solutions through experiments which can be reasonably calibrated showed this approach during *intelligo*, matching the depiction of the proposed map.

At *efficio*; Once the final design was approved and components were either made or developed and sourced worldwide, and working first models were machined/handmade, the *exogenous* creativity commenced showing high level of mental approach related to analysis (and testing) which led to a final and valuable result. People entrusted with planning and setting up of a new factory as well as dismantling, packing/shipping were quick enough to catch on the *exogenous* creativity requirements. All the evidence points out to clear cut adherence to the synoptic map of creativity and innovation shown in Figure 7.10.

Synoptic map of Dyson's journey. Figure 8.23 shows the synoptic map of Dyson's journey to develop the DC10 vacuum cleaner.

Figure 8.23: Synoptic Map of Dyson DC 10

Summary of Dyson's journey to DC 10. This case study is unique in the sense that, though the synoptic map of Sir James Dyson's development of the cyclone vacuum cleaner shows a period of fifteen years, Dyson was able to license the cyclone to three different companies with different use for the technology. This means that there were at the least three different synoptic maps that depict each of the journey. Each of them had had a dominant *intelligo* and *efficio* phases. The insights gained from the three projects had fed into the journey of Dyson DC 10 vacuum cleaner. This may be better depicted through a visualisation shown in Figure 8.24.

Figure 8.24: Insight inputs from multiple innovation outcomes

What is also interesting is that, of the three projects that Dyson had licensed, only Apex G-Force was a vacuum cleaner like the Dyson DC 01. The others, Iona Drytech and Johnson Wax Vectron were for different uses using the cyclone technology. James Dyson had been the main knowledge manager and field team for the three since his hiring of proper *intelligo/efficio* team started only in 1991. In essence, James Dyson, as the sole inventor, design and innovator carried forward the insights from the three projects with a focus to create his own, Dyson branded product.

Sir James Dyson the innovator. James Dyson, in many ways, is an example of a self-made innovator entrepreneur, much similar to Sir Richard Branson, the founder of Virgin Group, the difference being that James Dyson could be tracked on the creativity to innovation journey and mapped on the synoptic map of Figure 7.10¹⁰⁴ much more easily.

¹⁰⁴ Deriving a synoptic map of the innovation process of Sir Richard Branson is much more complex due to the nature of the different types of business Virgin has ventured into, starting from a record label till

Sir James Dyson's autobiography "Against the odds" gives a glimpse of the background to him becoming the innovator he is today. Sir James' perception of himself is that, "I have been a misfit throughout my professional life, and that seems to have worked to my advantage"(Dyson, 1997). In his opinion, "Misfits are not born or made; they make themselves. And a stubborn opinionated child, desperate to be different and to be right, encounters only small refractions of the problems he will experience. And he carries the weight of that dislocation for ever". Losing his father at the age of nine and growing up with an elder brother and sister has had an effect on what he turned out to be later. Sir James recounts that with his mother and his siblings being older than him, he was always up against people who were bigger and stronger than him when playing sports/games together with the family. Because of that, Dyson says, "It raised my standards – in that I was not prepared to lose everything all the time just because I was the youngest – and taught me that I could take on something much bigger than I was, and win". This attitude is what Sir James attributes his tenacity when he later faced intimidation and lawsuits from companies bigger than his because, "... in the wider picture there is really not so a great difference between a rampaging industrial giant trying to sue you out of business, and a hulking great fifteen-year-old trying to knock you of a rock or duck you in the sea" (Dyson, 1997).

Sir James also recalls his tendency to be, "... different on a whim" (Dyson, 1997) and recounts his decision to take up playing bassoon in his **school orchestra** and how he taught himself to play the bassoon, though not familiar with musical vocabulary and parlance. Together with his discovery that he could run long distances without much fatigue, his forays into bassoon shows his ability to take on multiple tasks besides studying. This according to Sir James, has been helpful as he became a designer, inventor and innovator along the way.

Discovery of **art**, especially **painting**, which started in 1956 set Sir James on a new trajectory. According to Sir James, "You are totally without inhibition, without pretension, and without shame"(Dyson, 1997). Sir James acknowledges the support given by his **mother** for his involvement in art.

spaceships. This complexity coupled with the decision to present design related creativity to innovation journey in this thesis meant that the innovation attributed to Sir Richard and the Virgin Group was not taken for one of the case studies in this thesis.

Sir James left for London in 1966 to study at the Byam Shaw Art School located in Kensington. There he mentions, two teachers, Peter **Sedgeley** and Bridget **Riley** from whom he learnt, "...to see and understand form and how to draw it". Sir James says that, "It was this appreciation of form, as much as anything else in those years, that would direct me towards design and ultimately engineering" (Dyson, 1997). He met his wife Deidre Hindmarsh while studying there, who he says, "... would not only share my life, but make possible all the professional things that I did, and provide me the strength to see me through the desperate years of struggle" (Dyson, 1997).

Having completed a course in art, Sir James discovered the Royal College of Art (RCA) , which even at that time was, "...running an experiment in educational anti-elitism at the very time when I was looking for my new direction" (Dyson, 1997). Along the way, excited by the very different programmes within RCA, Sir James 'jumped ship' twice before settling for industrial design. Sir James in his autobiography also talks about being influenced by Buckminster Fuller, the American inventor-architect-engineer and also by Isambard Kingdom Brunel, the British engineer and planner. Sir James describes the period when he graduated from RCA thus, "All this led to the happy coincidence of two things: a period which led one to believe that one could do anything, and a period which appeared to need my skills, particularly" (Dyson, 1997). His first job designing and marketing a boat and the subsequent design venture leading to the formation of Dyson by Sir James, described in this chapter earlier, points to the making of a successful inventor and innovator.

In an interview to the New York Times dated 05 December 2018 (and portions of which was published on 22 December 2018 by The Straits Times, Singapore), Sir James was asked how he got interested in design. His reply is very interesting:

I did art at boarding school, which I really enjoyed. So, I decided to go to art school in London. That's where I discovered design and thought, "That's what I want to be doing. I want to be designing and creating things." I started off with architecture, and then I discovered Buckminster Fuller, the great American inventor, entrepreneur. And suddenly, the thing that was interesting me the most was the thing I always thought was incredibly boring, which is engineering.

(The Straits Times, 22 December 2018)

What is interesting to the author is that, while the author took the route of studying in an engineering school, then a design school within a technological university before pursuing industrial design at the Royal College of Art, Sir James seems to have come from the other side, art school to the Royal College of Art, and through interest and involvement, into engineering.

As he established himself as a very successful design entrepreneur, Sir James has taken on public roles such as the **Chairman of the Design Museum** in London from 1999 to 2004. He was also appointed as the **Provost of the Royal College of Art** from 2011 to 2017. In 2015, Sir James Dyson donated 12 million British Pounds to establish the **Dyson School of Engineering Design** at the Imperial College in London.

Sir James' first innovation of value, Dyson DC10 bagless vacuum cleaner was just the starting point. As an innovation leader, Sir James and Dyson (the company) have influenced the whole of the vacuum cleaner industry, with copies and derivation of Dyson vacuum cleaners proliferating the market place today. A simple Google search yields many such products, as seen in Figure 8.25.

Figure 8.25: Bagless vacuum cleaners
Source: Author's collection

www.globalcarsbrands.com

**Jamsetji Nusserwani
Tata (1839-1904)**

Tata group was established by Jamsetji Tata when he set up a trading company in 1868 in Mumbai, India, after working for his father establishing business in Hong Kong. His vision was:

- a) set up an iron and steel company (Tata Steel)
- b) start a world-class learning institute (Indian Inst. of Science, Bengaluru)
- c) set up a one of a kind hotel (Hotel Taj)
- d) set up a hydro-electric plant (Tata Power).

Today Tatas are in every segment of the market in India, including airlines, mobile communication, hi-tech consultancy and many more.

Image: tata.com

Case study 5: TATA Nano car. Of the five case studies presented in this thesis, the development of Tata Nano by TATA Motors is by far the largest and the most resource intense, both in terms of knowledge as well as finance management.

TATA Motors, established in 1945 and headquartered in Mumbai, India, is amongst the largest manufacturers of cars, utility vehicles, buses, trucks as well as defence vehicles in Asia and the world. According to the statistical figures released in their website¹⁰⁵ by TATA Motors, which owns the prestigious British brands Jaguar and Land Rover as well as the Korean Daewoo heavy vehicles, has 60,000 employees, selling over 9.5 million vehicles with a turnover of US\$ 42 million in 2018. Besides being a market leader in India, Tata cars, buses and trucks are sold in several countries in Europe, Africa, the Middle East, South Asia, South East Asia, South America, Australia, CIS and Russia. Tata's automotive company, officially named Tata Engineering and Locomotive Company (TELCO) started manufacturing trucks in 1954 in collaboration with Daimler-Benz. When the collaboration ended in 1969, Tata manufactured and sold its own brand of trucks and developed its own commercial vehicles. In 1991, Tata entered the passenger vehicle market in India with the launch of *Tata Sierra*. In 1998, Tata launched *Tata Indica*¹⁰⁶ which is acknowledged as the first indigenous Indian passenger car to be sold in India. Indica catapulted Tata Motors overnight into the largest vehicle maker able to compete with Maruti Suzuki which is the dominant passenger vehicle manufacturer in India. Today, Tata Motors has a wide range of cars under its stable as can be seen in Figure 8.26.

¹⁰⁵ <http://www.tatamotors.com>, retrieved 20 December 2016

¹⁰⁶ While the Tata Indica was fully developed, and manufactured in India, the exterior design (styling) was done under contract by I.DE.A Institute located in Turin, Italy.

Hatchbacks

<p>Tiago</p> <p>The new zippy car, Tiago from Tata Motors. Innovative & fresh design language with cutting edge driving dynamics. It's #Fantastico.</p>	<p>GenX Nano</p> <p>Designed for the next generation, the GenX Nano Easy Shift (AMT) will take ease of driving to the next level with all of its technologically advanced features.</p>	<p>Bolt</p> <p>The Bolt is the perfect fusion of sporty design and thrilling performance. This ultimate hatch is designed to make heads turn and engineered to set your pulse racing.</p>	<p>Indica</p> <p>With a refined 1.4L CR4 diesel engine, an incredible mileage of 25 kmpl* and striking interiors, it's everything you would want in a car. It's a whole new world inside.</p>
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Sedans

<p>Zest</p> <p>Loaded with state-of-the-art features to help you power through the week and be at ease through the weekend, the Zest isn't just a car. It's an extension of you.</p>	<p>Indigo</p> <p>The all new Tata Indigo eCS - exteriors high on style, interiors full of elegance and immense power under the hood - a never before sedan experience is here.</p>
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Utility vehicles

<p>Safari Storme</p> <p>Generating tremors across the surface as its engine roars to life, it exudes class & finesse conquering every terrain. Pray to the new power.</p>	<p>Safari DiCOR</p> <p>Designed to be a cut above the rest, Tata Safari DiCOR is for those who take the road less travelled. Make your own path as the majestic car conquers all.</p>	<p>Sumo Gold</p> <p>An all new roaring 3.0L CR4 engine, along with top notch features guaranteed to bring you more style and comfort than ever before. It's the ultimate power statement.</p>	<p>Xenon XT</p> <p>Highly adaptable, the new Tata Xenon XT is game for whatever's on your mind. Take on any terrain with the raw power under the hood.</p>
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Aria

Created using a technology called hydroforming, the Tata Aria gives your car the rigidity, robustness and comfort you need for an amazing drive.

Figure 8.26: Tata Motors Passengers Cars
Source: Tatamotors.com

The TATA Nano story; Of all the cars that have been designed and developed by Tata Motors, *Tato Nano*, released first in 2008, captured the world's attention as an example of innovation in car design and development. The world watched in amazement, dis-belief and amusement for a full-fledged small car, named swiftly as the 'people's car', to be ready for sales at a promised retail price of US\$2,500 or Indian Rs 100,000, wondering amongst other things, if it will meet safety standards or will it be a 'mickey mouse car' fit for a comic strip.

The story unfolds, according to Freiberg et al. (2010), on a rainy morning in 2002 in the Indian city of Bengaluru (Bangalore), with Ratan Naval Tata, the Chairman of the Tata Group travelling in a chauffeur driven car, when a family of four, husband, wife, and two children packed into a scooter

(two wheel petrol vehicle) slide on a wet road at an intersection spilling the rider and passengers all over the road, facing the risk of being run over, then get up shaken and 'dust' themselves and continue on their journey. Ratan Tata recounts his thought at that instance as, "I think that's when the whole thing started in my mind. Looking at what is now a pretty familiar sight in India – an entire family travelling on a scooter with three or four family members"(Freiberg et al., 2010). Ratan Tata felt that something had to be done for the ever-growing middle class of India, who can afford two wheeled scooters and motorcycles but had no financial reach to buy cars which would protect them from rain and shine, protecting them from dangers on the congested roads.

Figure 8.27: A family of five on a scooter in urban India
Source: blog.bedandchai.com

Four things were of concern to Ratan Tata in 2002:

- 1) production of two-wheelers was outstripping the meagre production of cars by 8.5 times (4,271,321 two wheelers to 500,301 cars¹⁰⁷)
- 2) while two-wheelers were financially reachable by the middle class, cars were too costly for them
- 3) there was no car in the market in India that could match the price of a two-wheeler as an alternative for middle class to consider and buy
- 4) the statistics on accidents and death involving two-wheelers were alarmingly high. There were 7.7 accidents per million vehicle miles versus 4.2 for cars and 6.3 injuries on two-wheelers against 1.2 for cars (Freiberg, 2010, p. 9)

¹⁰⁷ Source: www.community.data.gov.in retrieved 20 December 2016

Ratan Tata returned to Mumbai and sat on the idea of creating a covered vehicle, perhaps a four-wheeler, doodling away ideas whenever he could. In early 2003, convinced that there was a market for an affordable car, Ratan Tata called some engineers in to ask them to explore the idea of a small car for the Indian market, before heading for the Geneva Motor Show. It was at the Geneva Motor Show in March 2003, that Ratan Tata first spoke of the idea of an affordable car for the masses. Giving an interview to the *Financial Times* he said, “It will look like a real car and have proper seating - stretched canvass seats would not, for example, be acceptable. Not that it would be a luxury car. It would be alright for the car to be a bit more noisy than an ordinary car but it has to be both simple and safe”. When asked about the time line, Ratan Tata replied, “It is my dream to make the car a reality within... five years”. What would it cost for the common man? Ratan Tata said, “Around one lakh rupees” (Rupees 100,000 or US Dollars 2100 at that time). On 10 March 2003, the *Financial Times* ran the headline, ‘Tatas plan Rs 1-lakh car’. (Freiberg, 2010)

It was official; that the Tatas are taking up the challenge of their Chairman, Ratan Tata and work towards releasing the affordable car by 2008. The whole automotive world around the world looked at Ratan Tata and Tata Motors with disbelief – this was a tall mountain to climb, even for a Tata company. People were starting to talk of ‘Chairman’s folly’. The affordable ‘people’s car’ christened Tata Nano was realised as promised in 2008, but after numerous challenges including shut down of the factory in West Bengal, India even before production could begin. This innovation also does not have a fairy tale ending, with decisions to stop ten years later.

Tata Nano’s path to innovation. The information gathered for this case study is from a first-hand account of the development of Tata Nano and the innovation culture in Tata Motors in the book titled *nanoVATION* by Kevin and Jackie Freiberg and Dain Dunston (Freiberg et al., 2010) which was checked and corroborated through various sources including an informative book titled *TATA NANO: THE PEOPLE’S CAR* compiled by Pradeep Thakur (Thakur, 2009) as well as numerous news website, including an interview with Ratan Tata in Tata Group’s website¹⁰⁸. The corroborative information was more for use as check point for information

¹⁰⁸ <http://www.tata.com/aboutus/articlesinside/Sd75BUBmzSM=/TLYVr3YPkMU>, retrieved 21 December 2016

from Freiberg et al. (2010) unless specifically cited, since they had exclusive access to all the personnel involved in the Tata Nano project. This section will check for evidence of:

- a. cogito – intelligo – efficio path
- b. spread of endogenous – epigenous – exogenous creativity
- c. creative approach and mental state through the progression
- d. mental approach and outcome through the progression
- e. human reaction at each stage / path

In a large scale projects such as Tata Nano, all of the five are inter-related, for instance *cogito* stage needs *endogenous* creative people who will use imagination as the *mental approach* and be playful in their creative *approach*. However, since the task at hand is to find evidence which need to be ‘mined’, it was decided to pick up information even from anecdotal conversation which can then be used to piece together the whole journey.

The spark. Ratan Tata, in a thoughtful, perhaps in a childlike manner, had let known to the world, his idea for a small, low priced car, to the reporter from the Financial Times, who extracted a retail price of ‘around’ 1-lakh Rupees. The immediate **(human) reaction** was a ‘Ha ha!’ and many from the automotive industry said that Ratan Tata must be joking. However, it was obvious that his idea was **novel** in many respects. This corroborates very much with the synoptic map of Figure 7.17.

a. Evidence of cogito – intelligo – efficio path

While a team of hand-picked young engineers and designers was put together under the watchful eye of Ratan Tata in 2003, there is evidence of confusion and chaos at the beginning which lasted for nearly two years till 2005. Ravi Rajhans, who had been successful in earlier projects and had been trained as industrial designer (a profession which is an endogenous to epigenous activity from the author’s own personal experience) recalls that, “... the first reaction was fear... it was a big project and we were not sure where to start, where to start the first line even” (Freiberg et al., 2010) This, one suspects, is because the germ of the idea, to develop a Rs 1 – lakh car, came from the chairman of Tata Motors himself and announced at the motor show in Geneva in a serious manner, signalling an immediate *intelligo* stage,

putting a damp on imagination, the mental approach, and the playful creative approach so badly need at the *cogito* stage. Ratan Tata himself observed, “There was a general undercurrent that this was the chairman’s folly, it could not be done, people had tried before and it hadn’t worked. And so, progress was rather slow and I remember I used to get upset during review meetings, bogged down with what we were going to do”(Freiberg et al., 2010). Ratan Tata recounts that there was dead silence in the room when he made suggestions. Despite the involvement of the industrial design section of the Engineering Research Centre (ERC), with two designers in the core team, the burden of the task at hand (fixed retail price, fixed five years for development, inflation, high price of raw material, looming economic difficulty worldwide) seems to have had a detrimental effect on the *cogito* path.

With a dampened *cogito* stage, Tata Motors’, especially ERC’s, experience¹⁰⁹ carried them forward to the presentation of ‘mule’ – a basic working prototype to test ideas about package and the dynamics – in April 2005 in Tata Motors facility in Pune, India, where everything seems to have gone wrong. Ratan Tata later admitted that he should not have test driven that mule. Ratan Tata, an architect by training, clearly understood that another team is required and a different style of creativity needs to be in place. “There are two things you have to have. You have to have ‘what-ifers’ who will explore innovative new paths, and people who will say truthfully, ‘That is not an elegant solution’...”(Freiberg et al., 2010). He needed people who could put some, “kind of forced discipline on what we did” in order for the project not to “melt into some sort of jelly bean”.

What the team needed at that point in April 2005 was, in the author’s opinion, an *innovation catalyst* who had tasted success under similar circumstances to jolt creativity into action. Ratan Tata and Ravi Kant, the then Managing Director of Tata Motors, just did that by bringing in Girish Wagh from an earlier and successful Tata Ace team to lead the Nano project on a day-to-day basis. This signalled the start of the *intelligo* phase of the project. Girish Wagh, merged a refreshed *cogito* team which included a vehicle design and development contractor I.DE.A Institute from Turin, Italy to

¹⁰⁹ Tata Motors had successfully designed and developed a cost effective mini-truck named ‘Ace’ which created a new segment for trucks in India when it was launched in 2005

support industrial design and product development, with a fresh attitude to the *intelligo* path.

From there on, decisions were rapid; all speculative ideas such as external structures, exploring 3-wheelers, using a golf cart platform, etc., were thrown out and Ratan Tata's insistence for a, 'complete car, not a vehicle that is made to be car', was heeded in full; decisions to develop a new engine solely for Tata Nano was taken under way; the industrial design team started working closely with the 'package design engineers' of the development team. Principles of automotive engineering and theoretical calculations together with advanced CAD software helped this path. Placement of the engine at the rear, increasing the wheel diameter at the back to make the ride stable, and development of a new steering conversion system that gave the smallest turning radius of only 4 metres for a car the size of Tata Nano and the development of a pressed steel wheel hub, called Stylein, that looked and felt like die cast alloy wheel, all point to a reflective, conscious, directed and convergent process by a group of engineers and designers lead by a focussed project leadership. This points to a high order of *intelligo* path.

Exterior and interior styling design team worked on Ratan Tata's axiom, 'smaller than others outside, larger than others on the inside'. According to Siva S Atilli, industrial design manager at ERC:

The inside volume was quite large and we are always faced with the challenge that with the so much of space if we reduce things, it will actually look more like there is less things. So we tried to integrate functionality in components. (Thakur, 2009, p. 58).

With every detail bench marked to be for best-in-segment, designers had to be focussed in their creativity; again, evidence of *intelligo*. Thakur (2009) also points to other interesting and unique concepts that include, "... a central exhaust and the scoop (airway) required to cook the engine, which became a part of the design, part of the door feature" (Thakur, 2009), that are indication of a convergent *intelligo* at work.

The *intelligo* path of Tata Nano development also included early involvement of key suppliers and vendors in the *intelligo* path. Freiberg et al. (2010) recount of two incidences that attests to this involvement; first being the willingness of the

Indian tyre manufacturer, MRF Tyres in developing the smaller tyres that the Nano needed and the other being a reluctant involvement of a supplier to develop an engine component who then proceeded to sit and sketch together with the engineer and the head of sourcing team to come out with more than one solution that can be implemented within the cost target of Tata Motors. International automotive suppliers such as Bosch, Delphi and Visteon also got involved in the *intelligo* path with Tata Motors according to multiple sources. Dr. Bernard Bohr, chairman of Bosch's Automotive Group recounts:

If our goal is to cut 10 percent out of the costs, we can do that with 'value engineering'. But if your goal is to take 60 to 70 percent of the cost out, you have to start from scratch". (Freiberg et al., 2010, p. 102)

This means that Bosch probably would have gone through their own *cogito-intelligo-efficio* path in parallel with Tata Motors.

From all this, the evidence for a robust *intelligo* path in the development of Tata Nano is clear and is confirmed by the approval to go ahead by Ratan Tata and his management team based on the prototypes and the CAD model presented in August 2007.

With the only sixteen months before the self-imposed deadline for the release of Tata Nano, the *efficio* path had to be rapid. Tata Nano being a completely new platform to the Tata Motor stable, Ratan Tata and the Board of Tata Motors decided to set up a new plant in the eastern state of West Bengal¹¹⁰ in India. According to Thakur (2009, p. 64), "... the 120-member strong manufacturing team was built with personnel from within Tata Motors, as well as from outside and graduate trainee engineers from the Indian Institute of Technology, Kharagpur (IIT Kharagpur) and Jadavpur University, making, 'a mix of experience and youthfulness". The diversity was blessing, with ability to generate unique and fresh ideas, a requirement for *efficio* path towards innovation of value; Tata Nano, in this case. Cost cutting exercises continued, with creative ideas required to reduce the number of tools at the same time increase its life. The product design

¹¹⁰ The new plant at Singur had to be shut down even before the first Nano can be assembled and a new factory had to be built in the state of Gujarat due to political drama in the state of West Bengal. This did cause a huge loss to Tata Motors, causing undue delay.

team was of great help to the production engineers, who were already controlling costs through industrial engineering techniques. Serviceability of the rear engine Tata Nano was very important and even at this stage design modifications were made to allow for accessibility and serviceability, according to Nagbushan R. Gubbi, the head of engineering for passenger cars overseeing production engineering.

Passenger safety, noise and emission control as well as other safety related issues were built into design. However, tests to verify compliance had to be done at the *efficio* stage. Tata Motors recruited experience hands to ensure that compliances were met, even it meant hiring experts. Dave Hudson, an acoustics and vibration specialist was hired from Jaguar to, ‘focus on NVH; noise, vibration and harshness’. Balancing the investment in eliminating NVH, while keeping cost down was a huge challenge for a team with very little previous experience, needed creative solutions at the *efficio* path. The team in charge of *efficio* had to work every millimetre of the way to see that Tata Nano, while being extraordinarily light, also passes European and US crash-test standards without any major changes. Following Ratan Tata’s ethos of ‘no apology’ product, Dave Hudson says that Tata Nano is, “the quietest 1 – lakh car ever built”, even though it was not the quietest car on the road (Freiberg et al., 2010).

A higher evidence of *efficio* came by an unfortunate chance, when the brand-new factory had to be abandoned and a new factory rebuilt thousands of kilometres away (see footnote 83). Creativity and ingenuity had to be at the fore front in order to dismantle production machinery, pack them and ship to the new premises where another group was waiting to assemble the plant again.

In summary, there is sufficient evidence to show that the development of Tata Nano during the period of 2003 to 2008 went through a *cogito – intelligo – efficio* path although *cogito* seems to have been suppressed initially before *intelligo* took over and integrated *cogito* back again. This project shows evidence of concerted efforts in the *intelligo* and *efficio* phases with insufficient *cogito* placed at the front end of the journey.

b. Spread of endogenous – epigenous – exogenous creativity

An important claim of the synoptic map of creativity and innovation (Figure 7.10) is the dominance of *endogenous* creativity during *cogito* path, *epigenous* creativity during *intelligo* path and *exogenous* creativity during *efficio* path when a potential idea is translated from creativity to innovation of value. The spread of talent and experience that Ratan Tata and his senior management brought into the Tata Nano team, identifying that each path needs creative and able people of different kind attests to evidence of this claim.

The composition of the very initial team that Ratan Tata handpicked, right after his announcement of the “1-lakh car” at the Geneva Motor Show in March 2003 itself shows a spread of different creativity in the team as seen in Table 8.5.

Table 8.5: Initial spread of creative talents (TATA Nano)

endogenous	epigenous	exogenous
Nikhil Jadhav Exterior Design		
	Raj Rajhans Body Systems	
	Narendra Kumar Jain Engineering Design	
		Jay Bolar Development

Table 8.5 shows Tata Motor management’s consideration to choose two specialists; Nikhil Jadhav and Narendra Kumar Jain and two ‘straddlers’ : Raj Rajhans and Jay Bolar. There are two points to note:

- there are no absolute creative types, only dominance of one type in certain phases of the project
- there are people with the ability to move from one type to the other, much like being ambidextrous, who can ‘straddle’ between two paths. Straddlers provide translation, interpretation and smooth transfer of ideas from one path to the other during transition.

As the project moved on the management identified more people to be introduced into the team, including specialists from other countries such as Dave Hudson from Jaguar.

After the debacle of April 2005, when the ‘mule’ disappointed Rata Tata, Ravi Kant, the then managing director decided to call in Girish Wagh to be the ‘super boss’ of the project. Girish Wagh cannot be assigned a specific place in the map since his job was to enthuse and lead the team through the path when it was already in the *intelligo* path. This job function, of Girish Wagh, can be as *innovation catalyst*. Similarly, Ravi Kant and Prakash Telong, who became the managing director after Kant, cannot be placed in any one of the paths in the journey, since they played the role of a *coach*. Ratan Tata, whose brainchild was the Tata Nano, and who saw it from initial doodles till production is the innovation *change agent*¹¹¹. Figure 8.28 shows the names of key personnel who have been mentioned in many sources spread over the creative spectrum based on their dominant activity curing the journey.

Figure 8.28: Knowledge Management in Tata Nano

Figure 8.28 depicting the knowledge management of the Tata Nano journey clearly provides sufficient evidence of the team consisting of different creative types, *endogenous* – *epigenous* – *exogenous* in their journey.

¹¹¹ Change Agent, Coach and innovation Catalyst are terminologies related to key managers/supervisors of the creative to innovation journey, especially in a large project such as Tata Nano.

c. Creative approach and mental state through the progression

At *cogito*. The synoptic map of creativity and innovation (Figure 7.10) states that the creative approach during *cogito* path is expected to be *playful* and the mental state is to be that of *imagination*. However, due to the dampened *cogito* path created by the charged atmosphere of expectation after the surprise announcement of an imminent '1-lakh' car release in five years from 2003, there is no evidence of a playful approach to creativity and there certainly was no imaginative mental state, though sense of imagination was restored well into the *intelligo* path. This is clearly due to absence or minimalisation of *cogito* path. The initial team had an exterior designer and a body specialist who are trained in the region of endogenous creativity, but the dominant focus went straight to *intelligo* path.

Absence of any evidence of playful creative approach and exploratory mental state in this particular case study of the development of Tata Nano does not point to fault in the map. It means that there was a deliberate jump to *intelligo* path in this project that required more of *epigenous* creativity.

With such a high stake at hand, a playful creative approach and an imaginative mental state may have brought out more interesting ideas to the table allowing for more interesting options. The importance of playful approach is corroborated by Koestler (1964) as early as 1964, and by Khandwalla (1984) and Sathikh (2010). An exploratory mental state and humour, in the author's opinion, would have allowed for the right mental approach required for novel solutions that are so needed in projects such as this. The lack of, is clearly seen in the disappointing presentation in April 2005, full two years after the start.

At *intelligo*. The map states that at *intelligo* the creative approach will be experimental and the mental state will be that of discovery. With the a suppressed *cogito*, the need for *epigenous* creativity stepped in with experimental work being carried out in terms of putting a boat motor from another Tata subsidiary onto vehicle body frames to test and building quick prototypes before arriving at a 'mule' (Freiberg et al., 2010). This shows an experimental creative approach and a mental state that was pointing to discovery. *Endogenous* creatives, who could have contributed better in *cogito* also stepped in to support this activity. The team were producing

empirical concepts to try out their idea. The evidence therefore is in favour of the map's claim of an experimental creative approach and discovery mental state of the team.

At *efficio*. The exogenous creativity activity of focused creative approach and a serious mental state, is highly evident during *efficio*. The need to see it through production while complying to the necessary safety and emission standards required focus and the ability to discover possible problems and solve it within the constraints of an almost complete design for the Tata Nano requires 'seat-of-the-pant decisions' which is where exogenous creative people are good at. Trouble shooting and fixing are evident as described by the various sources. The highest level of exogenous creativity was required especially when Tata Motors had to close their brand-new factory in Singur, pack all the commissioned machines and equipment to redeploy them in temporarily within other Tata Motor factories as well as to a new factory in Gujarat. From the study of Tata Nano, it becomes clear that the *efficio* path required lot more personnel in order for the intended innovation to be realised.

d. Mental approach and outcome through the progression

At *cogito*. The mental approach at *cogito* is expected to be imagination and the outcome potential during *cogito*. Since the team went straight to *intelligo*, the mental approach, imagination, required for the project, was not effectively utilised. Hence, what could have turned out to be potential ideas were not generated, which may have contributed to the confusion and chaos so described by sources such as Freiberg et al. (2010) and Thakur (2009). Again, it does not mean that the model is incorrect in placing a mental approach of imagination with a potential outcome. It only points out to the fact that *cogito* was not fully utilised by the Tata Nano team, though aspects of *cogito* seems to have been utilised as a part of *intelligo*.

At *intelligo*. With the creative process shifting straight to *intelligo*, the evidence for a mental approach centered around theoretical, that is, scientific and engineering knowledge, is very high, which lead to an outcome, which is the delivery of a useful solution for a small car fitting the dream of Ratan Tata. Experienced personnel of the Engineering Research Centre (ERC) seem to have been involved, with support from the industrial design team, as well as the production planning and procurement team during this path. From quick prototypes,

the team moved onto computer aided design (CAD) modeling and visualization techniques. The potential was clearly seen and understood by Ratan Tata and his senior management team. Therefore, activities in *intelligo* has followed the map as depicted.

At *efficio*. Once the final design was approved and components were either made or developed and sourced worldwide, and working first models of Tata Nano were handmade, the exogenous creativity commenced showing high level of mental approach related to analysis (and testing) which led to a final and valuable result. Correction of any structural or performance deficiency, homologation requirements for international conformity and adjustments for driver and passenger comfort were all done during this phase, which points out to a correct approach. People entrusted with planning and setting up of a new factory as well as dismantling, packing/shipping were quick enough to catch on the exogenous creativity requirements. All the evidence points out to clear cut adherence to the synoptic map of creativity to innovation.

e. Human reaction at each stage / path

The synoptic map proposed in this thesis, the expected human reaction at:

spark – Ha Ha! indicating cynicism

cogito – Aha! Indicating discovery

intelligo – Hmmm! Indicating things are getting together

efficio – I see! A level of acknowledgement that things have come together.

At *spark*. Ratan Tata and Tata Motors got a lot of ‘Ha Ha!’ as soon as he announced his dream of building a Rs 1-Lakh car in five years’ time. Thakur (2009, p. 81) quotes Ratan Tata as saying, “On this car, I think, there was a fair amount of ridicule when we started the project started that it is a pipe dream and in honesty that would have extended into the company also in certain quarters”. By his own admission, Ratan Tata was being ridiculed from Tata Motors itself, calling Tata Nano a “chairman’s folly”. The Indian auto industry was not any different. In an interview in Tata Motors website in January 2008, Ratan Tata mentioned:

I got in touch with an industry association and suggested that we join forces and produce what, at that point, I called an Asian car: large volumes, many nations involved,

maybe with different countries producing different sets of parts... Nobody took the idea seriously, nobody responded. (www.tata.com)

In fact, there seems to have been a collective 'Ha Ha!' from the world at large to the idea of Tata Nano.

At *cogito*. From this study, it is quite obvious that there was an absence of 'Aha' since *cogito* itself was dampened and joined together with *intelligo*. Internal pressure to come with ideas took a serious stand, hence the team did not have much time to elicit an 'Aha' from Tata Motors' management, who were the only personnel privy to the result thus far.

At *intelligo*. The team had got bigger and the reviews got more frequent, according to many sources including Freiberg et al. (2010) and Thakur (2010) as the project progressed and news spread around the industrial city of Pune, where Tata Motors' ERC is located. Potential vendors and consultants were brought in, as prototypes were being built, creating a buzz in the automotive component and ancillary industry in India and around the world (see Figure 8.31). Seeing the rapid progress, there is evident that many were starting to say, 'Hmmm' finally. From what has been documented, Ratan Tata himself joined in on the thoughtful 'Hmmm' while contributing to the *intelligo* process.

At *efficio*. By the time working prototypes were made and released for testing, lot more people were starting to say, 'I see'. People were anticipating the launch of Tata Nano on 10 January 2008 and when they saw the car being driven onto the stage by Ratan Tata himself, there seems to have been a collective 'I see!' The president of rival Renault-Nissan, who is also is a friend of Ratan Tata was one of the VIPs to inspect Tata Nano at the Geneva Motor Show in 2008 to join in on the 'I see' (Freiberg et al., 2010). The world caught on through the media, and there seems to have been a global 'I see'. The 'I see' factor was evident for a long time, though the novelty had worn off, and Tata Nano has not become the 'people's car of India', as prophesised.

Based on the above, it could be safely concluded that the human reaction to the events in each stage/path has been near to that in the proposed map wherever opportunity for such reaction presented itself. The 'Ha Ha!', 'Hmmm' and 'I see' is more documented and presented more than the 'Aha!'

reaction due to the dampened *cogito* in this particular project as I have discussed earlier.

Tata Nano the launch. Tata Nano was launched on 10 January 2008, to a large fanfare, at the Delhi Auto Expo in New Delhi, by none other than Ratan Tata, but as a hologram, addressed the assembled thus:

And since we commenced this exercise four years ago, we are all aware that there has been a very steep increase in input process of steel, tyres and various and sundry other inputs. Bearing all this in mind, I would like to announce today that the standard car will have a dealer price of one lakh only (100,000 Rupees), VAT and transport being extra. I just wanted to say that, because a promise is a promise and that's what we would like to leave you with. (Thakur, 2009)

Thakur also quotes that Ratan Tata also mentioned that:

This is being referred to as one man's dream and indeed it was. But it took a tremendous amount of team work to convert this or translate into reality. I think it would be but fair to recognize and acknowledge the achievement of a young group of engineers who undertook the challenge for four years and great sacrifice to themselves, and produce this car" (Thakur, 2009, p. 71)

With this Ratan Tata has recognised several things:

- The idea spark was a 'dream of one man'; Ratan Tata
- It was a challenge to work with a target price when everything else was on a rising trend. In other words, his team had to be very creative in coming out with innovative solutions at all stages/paths of the project
- The project was the work of a large team

In many ways, this validates the journey that the synoptic map of creativity and innovation depicts. Figure 8.29 shows Ratan Tata just after he had made a dramatic entrance driving a Tata Nano up the stage in darkness, right after his holographic image finished the speech.

*Figure 8.29: Ratan Tata after revealing Tata Nano
on 10 January 2008*

Source: britannica.com

Figures 8.30 shows the Tata Nano exterior and interior which goes on to prove the success of the Tata Nano as a valuable innovation. Tata Nano captured the imagination of the world putting Tata Motors as global player in the automotive business. The success of Tata Nano as an innovation is also due to the creativity and innovation path of a large number of suppliers, many of them being global players as can be seen in Figure 8.31.

Figure 8.30: Tata Nano at the time of release in 2008
Source: autoworld.wordpress.com

Figure 8.31: Global supply base for Tata Nano

Source: autonews.com

Tata Nano's map; Knowing the creativity-to-innovation journey of Tata Nano, how will the proposed synoptic map look like, reflecting the different activities, shortfalls and successes? Figure 8.32 shows the synoptic map of creativity and innovation for Tata Nano as derived from the original (generic) map proposed in this thesis based on the case study analysis. The unique points to note in the map for Tata Nano are:

1. The almost absence of *cogito* activities
2. The chance for deriving 'potential' solutions was diminished due to the foreshortening of *cogito*
3. Creative approach and mental approach of *cogito* has all but merged with those of *intelligo*
4. A hybrid creative approach of playful and experimental could have happened during *intelligo*, which may have had some influence on the creative process
5. The mental approach at *intelligo* also seems to have been hybrid resulting in a mix of imagination with theory
6. With a suppressed *cogito*, the role of *endogenous* creativity also seems to have been diminished

Figure 8.32: Synoptic Map for Tata Nano

Summary of Tata Nano's journey. The map shown in Figure 8.32 suggests that, perhaps the outcome of the innovation, the Tata Nano car, could have been even more valuable, although as an end result Tata Nano has performed to the requirements set by Ratan Tata and to the expectation of automotive world and thus is successful as innovation. Is there more to this? Could Tata Motors have done better?

Cogito at Tata. Evidence of the case study shows that tremendous effort has been put during both *intelligo* and *efficio* paths, although this is where Tata Motors has excelled all along due to extensive experience gained by at least prior two decades of vehicle design and development initially in the commercial vehicle sector, starting with Tata 407 in 1986, and later in the passenger car sector with the introduction of Tata Indica in 1998 (Figure 8.33). In the author's opinion, Tata Motors had a lot more success in *cogito* during the development of Tata Ace, a micro truck launched in 2005, which according to Freiberg et al. (2010) was designed, "...as a global alternative to the three-wheeled utility scooters used for city deliveries, rural transport and farm work". Tata Ace is seen in Figure 8.34.

Figure 8.33: Ratan Tata driving out the first Tata Indica from the production floor

Source: indianauto.com

Figure 8.34: Tata Ace as it was released in 2005
Source: topseed.com

Figure 8.35: Tata Ace Zip and Tata Magic Iris
Source: trucks.cardekho.com & Business-standard.com

Tata Ace's success had Tata Motors go back to the design stage that has resulted in Tata Ace Zip and Tata Magic Iris (Figure 8.35) which is filling the gap left between three-wheelers and micro trucks¹¹². Tata Ace Zip and Tata Magic Iris clearly show the influence of *Endogenous* creativity and a greater participation of *cogito* in their development. Playful creative approach and imaginative mental approach at the stating of the project seems to be clearly evident in both the vehicles.

¹¹² Seeing the success of Tata Ace, other automakers in India followed suit with their own version of the micro truck

Innovation continues. Concerted efforts in staffing the design department with a balance of *endogenous* and *epigenous* creatives seems to be resulting in continued push for innovation within Tata Motors. Release of Tata's concept cars, which represents a highly *cogito* path, have become an anticipated event in international motor shows, especially the Geneva Motor Show. Figure 8.36 shows some of the concept cars from Tata Motor stable in the recent past.

Source: caclubindia.com

Source: cartoq.com

Figure 8.36: Concept cars from Tata Motors

These concept cars probably dispel any doubt in the automotive world on the design ability of Tata Motors and assures them of their *endogenous* creative capability. The concepts are partly styling exercises, with the idea generation being in the speculative use of technology for user experience and car performance. Concept cars are an important aspect of automotive marketing and Tata Motors has been able to stand their ground on their ability, post Tata Nano.

Ratan Naval Tata

Chairman Emeritus

Tata Group

Image:

aknandy.wordpress.com

Car Magazine

Word of Advice: don't get into bragging contest with Ratan Tata about who achieved the most in 2008. Not unless you can beat purchasing Land Rover and Jaguar from Ford, launching the world's cheapest car, building a city car powered by thin air, exporting electric trucks to America and brazenly announcing your plan to buy a chunk of Ferrari

- after announcing Ratan Tata as one of the **10 Men of the Year 2008**
Freiberg et al
(2010, pp. 17 – 18)

The next innovation from Tata. As early as 2007, Tata Motors bought the license to develop a car that runs on compressed air from a Luxembourg-based company named Motor Development International (MDI) for marketing in India. Developing a passenger car with this innovative technology has not been as rigorous as Tata Nano, where Ratan Tata's promise was at stake. According to sources¹¹³, Tata is ready with the first "proof of the technical concept" at the first phase of the program the compressed air engine concept having been demonstrated in two Tata Motors vehicles, Phase two will involve completing detailed development of the compressed air engine into specific vehicle and stationary applications. A proof of concept 'air car' has been exhibited by Tata Motors in several motor shows in the last two years. Figure 8.37 shows the Tata Motor's Air Car.

Figure 8.37: Tata concept 'air car'

Source: designboom.com

¹¹³ Source: <http://newatlas.com/tata-motors-air-car-mdi/>, retrieved on 21 December 2016

Tata Nano: final summary. The objective of the Tata Nano case study was to understand the events leading to valuable innovation and the creative-to-innovation path of the design, development and launch of Tata Nano, a low-cost passenger car for a targeted Indian market of the burgeoning middle income group in India, especially the urban and suburban regions of major cities and towns. The innovation was in conceiving the idea, designing, engineering, vendor development, testing and analysis of the car to keep to within the target cost to develop and manufacture to match the target price of Indian Rupees one hundred thousand (1 Lakh Rupees). The creativity-to-innovation journey of Tata Nano was compared with the synoptic map of creativity and innovation proposed in this thesis and to check for evidence of Tata Nano's path being matching or close to the map proposed. There were some interesting revelations in this study:

1. The process flow seems to have followed the synoptic map proposed in this thesis
2. The front end of the development, at *cogito* was literally transferred to *intelligo*
3. Tata Nano team was well balanced in terms of endogenous-epigenous-exogenous creative talents
4. Tata Motors, where they could have had the opportunity to push for even more valuable innovation, decided to go straight for *intelligo*. The end results, in the author's opinion, could have been different otherwise
5. Tata Motors has followed a path to innovation that they have been familiar since the mid 1980s. Since the launch of Tata Nano, Tata Motors' design team has developed advanced level cars that attest to the fact whenever there is opportunity thrown at them they can rise to the occasion
6. Three levels of innovation support were revealed, *change agent*, *coach(es)* and *innovation catalyst* as an important innovation management element, especially in large projects such as the Tata Nano

Unhappy ending to Tata Nano. While the development of Tata Nano could be cited as an example of valuable innovation, the success of the product as a whole was rather short-lived due to the following:

- To start with Tata Nano, instead of being marketed as a low-priced car was marketed as a ‘poor man’s car’. The world media picked up on this. *Irishtimes*¹¹⁴ stated, “Listen to Ratan Tata talk about his baby and it sounds like a social project rather than a commercial enterprise”.
- Secondly, Tata spent a lot of resources in setting up an exclusive factory in the state of West Bengal. Even before the first car can be manufactured, this factory plan got embroiled in political crisis, with a prominent political leader raising the ‘red flag’ and starting a huge movement stating agricultural land has been forcibly taken from the farmers. Opposition to the opening of the factory snowballed into a major political movement, so much so, that a quick decision was made to build another plant in the state of Gujarat at the invitation of then then Chief Minister Narendra Modi (the Prime Minister of India at the point of writing this thesis).
- Thirdly, though Tata Nano was declared to be sold at a retail price of Rupees one lakh (100,000) the cost of manufacture was way more according to reliable sources. This was highlighted by Cyrus Mistry, who was appointed Chairman of the Tata conglomerate in 2012 when he was quoted as saying:

Beyond this, the Nano product development concept called for a car below Rs.1 lakh, but the costs were always above this. This product has consistently lost money, peaking at Rs.1,000 crore. As there is no line of sight to profitability for the Nano, any turnaround strategy for the company requires to shut it down. Emotional reasons alone have kept us away from this crucial decision.¹¹⁵ (micorporate.com)

¹¹⁴ <https://www.irishtimes.com/life-and-style/motors/car-of-the-recession-the-tata-nano-1.918607> retrieved 21 December 2016

¹¹⁵ <https://micorporate.com/Bureau/Corporate-News/1054/Cyrus-Mistry-praised-Tata-Nano-a-loss-making-project-admits-Tatas-Motown-India-Bureau>, retrieved 21 December 2016

- Cyrus Mistry, who took the reins from Ratan Tata had an early fallout with Ratan Tata and the Tata's board. Ratan Tata accused Cyrus Mistry of not following through on indication of interest from Ola and Uber, both ride-hailing companies. Ratan Tata is quoted as writing to Cyrus Mistry, "I mentioned to you that Bhavish Aggarwal (co-founder of Ola cabs) told me that they were keen to acquire 10,000 Nanos and Indicas /Indigos from Tata Motors on outright purchase, lease or joint venture". On annual basis, Ola cabs seemed to have had plans to acquire 150,000 such vehicles. Ratan Tata mentioned that, while Ola was keen to do the transaction with Tata Motors, there was no positive response from Tata Motors. By contrast, Maruti Suzuki was believed to have been chasing Bhavish Aggarwal every day. Ratan Tata proposed that Ola cab's offtake of 150,000 Indicas and Nanos should have been welcomed by the company, as it constituted about 15 months production. Ratan Tata further urged Cyril Mistry to consider the offer from Uber that would have helped keep Tata Nano alive"¹¹⁶.
- With the actual innovation process completed and the Innovation Change Agent Ratan Tata away from the action, Tata Nano started losing the market that Ratan Tata had anticipated. Cyrus Mistry did try some (more or less) cosmetic changes, even naming it Tata GenXnano, but the initial stigma attached as 'poor man's car' had not shaken off. The Tata board under Cyrus Mistry recommended in 2016 that the Tata Nano be shut down.
- The battle between Cyrus Mistry and Ratan Tata became acrimonious and in October 2016, Cyrus Mistry was ousted as the Chairman of the Tata conglomerate. Ratan Tata took over as the interim chairman before Natarajan Chandrasekaran was appointed as the Chairman of Tata conglomerate shortly afterwards.
- The Tata group decided to close down the Tata Nano plant on 03 August 2018, ending a valuable innovation that was left wanting due to many reasons, the most

¹¹⁶ <https://m.dailyhunt.in/news/india/english/cartog+old-epaper-cartog/tata+nano+could+have+survived+reveals+ratan+tata+s+letter+to+cyrus+mistry+details-news-92300330>, retrieved on 11 February 2020.

important being the lack of marketing innovation that was needed to shake off the 'cheap car/poor man's car' stigma. Ratan Tata's tried once more to be change agent when he suggested the deal with Ola and Uber, proving himself to be a business innovator as well.

Were there take aways? The excitement and enthusiasm brought on by the development of Tata Nano has had a rub on effect on Tata Motors, I believe. This is seen in the development of their line of light trucks, Tata Ace Zip and Tata Magic Iris (Figure 8.35) and their foray into concept cars including the technologically challenging air car shown in Figure 8.37. With the saturated vehicle market in India and the pressure of designing for a sustainable future knocking on the doors of every automaker, the excitement of Tata Nano is needed to make a leap through design innovation. However, it may take another iconic figure to emerge as the innovation change agent and catalyst to make that paradigm shift in innovation that Ratan Tata was able to bring with the Tata Nano.

Ratan Tata the innovator. Is Ratan Tata an innovator from a design point of view? He is well known around the world as an industrialist who led one of the largest and oldest industry house in Asia, i.e., Tata Sons. His business acumen and the gravity of the decisions that he has made as Chairman of Tata Sons makes him a business innovator. What is Ratan Tata's creative profile and personality, viz-a-viz his contribution in the Tata Nano project?

A lot has been written about Ratan Tata the person, which synthesised briefly. To start with, Ratan was born in the wider Tata family, and is the adopted son of Naval Tata, who was a third generation Tata after the founder Jamsetji Tata. He studied **architecture** at Cornell University and is said to be familiar with **industrial design**¹¹⁷ from his undergraduate days. This places him as a designer in many ways in the Tata Nano project. He later went on to study **management** at Harvard University. Ratan Tata joined Tata Steels in 1961 at the shop floor and moved up the ranks, eventually helming group companies, when in 1991, his uncle and Chairman of Tata Sons, JRD Tata, chose Ratan Tata to succeed him as Chairman. Under the chairmanship of Ratan Tata, the Tata

¹¹⁷ Biographers give different version of Ratan Tata's undergraduate education at Cornell University. Some say that he minored in industrial design, while other say that he minored in structural engineering.

group grew exponentially (40 times, some pundits say), acquiring Jaguar Land Rover, as well as Daewoo heavy vehicles division. He also acquired Corus Steel besides Tetley Tea for Tata. Under his watch, it is reported that 60% of the revenue came from sales outside of India. Ratan Tata also presided over the expansion of Tata consultancy, which became a world player in software engineering with the technology / internet boom that began in the 1980s.

Coming from a family renowned for business, Ratan Tata seems to have enjoyed a life of privilege that the other innovators such as Sir James Dyson did not have. Growing up in India, the author was able to read and witness the **mentorship** of the mercurial JRD Tata to Ratan Tata during the thirty years that he had worked in Tata group, before becoming the Chairman of Tata Sons. Sitting at the top of the large conglomerate did not seem to have isolated Ratan Tata. He was **hands on** in overseeing the management of key Tata companies such as Tata Engineering and Locomotive Company (TELCO) and Tata Consultancy Services (TCS) amongst others.

After retiring from day to day activities in Tata companies, Ratan Tata has emerged as a seed investor and venture capitalist, encouraging individuals and start-ups with game changing or disruptive business propositions such as Ola, the ride hailing company and the Chinese mobile industry start-up Xiaomi. Ratan Tata's leadership achievements as a business innovator have been acknowledged by important institutes and people around the world. Besides the multiple honorary doctorates from major universities around the world, Ratan Tata has been awarded two of the highest civilian awards, Padma Bhushan and Padma Vibhushan by the Government of India. He sits in the board of many companies and institutions around the world and is advisor to many more. Ratan Tata is also an advisor to the Government of the Republic of Singapore. Today, Ratan Tata enjoys the admirations of the Tata group as its Chairman Emeritus, lending his name where and when necessary.

Taking a look at Wallace's (1989, p. 37) contextual system that defines creative personality: a) Relevant work enterprise (s), b) Work as a whole (oeuvre) c) Professional milieu, d) Family and personal life and e) Sociohistorical period, it is evident Ratan Tata is more of a business innovator unlike the other four; Anne Telnaes, Florie Salnot, Pranoti Nagarkar-Israni and

Sir James Dyson. This is because of his association with the Tata family and the conglomerate, which was established long before Ratan Tata joined at a lower rung in one of its companies. As far his contribution, researchers on Tata Nano development mention instances where Ratan Tata himself has sat down to sketch, etc., which is not fully corroborated. His role as the Change Agent and Innovation Catalyst, however, cannot be denied, as well as his role as 'godfather' when it came to budget and fund allotments. The last role has been heavily criticised by his short lived successor, Cyrus Mistry, who is reported to have written that Tata Nano was an emotional trip of Ratan Tata and it was never destined to be profitable.

9. Dialogue with an innovator

A show case

This show case is different from the five case studies presented in Chapter 8 of this thesis which highlighted innovations that were tangible and values, more or less, ascertainable. Each of the case studies has individuals who were the chief architects of the innovation presented. While the self-analysis study of the author set out in Chapter 2, to analyse and derive the attributes of an 'innovator', the other five innovators have not been analysed in detail to make any comparison. In this chapter, a mercurial personality is presented, who has shot to world recognition, first as a creative designer and now as an innovator.

Jackson Tan, the designer- innovator of this show case has created a place for himself in the design industry in Singapore and Asia, and has been behind some of the well-known design works in this region. Over two sessions with the author, Jackson Tan, whom the author has known since 2003, narrated his life journey, providing insights to his approach to creativity and innovation. The approach to this dialogue was in the form of semi-formal conversation.

Why this approach? Donoghue and Punch (2003) state that: Researchers reflect upon the unexpected turns that qualitative research can take and the way such projects can move through different theoretical and methodological positions, often ending up significantly removed from the original premise, but all the more valuable for that... (Donoghue & Punch, 2003)

This gives a basis to move forward with exploring the premise of the creativity to innovation journey, through such dialogues with innovators. The basis for the dialogue with Jackson Tan follows what Elliot (2005) quotes as:

Narratives (stories) in the human sciences should be defined provisionally as discourses with a clear sequential order that connect events in a meaningful way for a definite audience and thus offer insight about the world and/or people's experiences of it. (Elliot, 2005, p. 3)

Jackson Tan: a pathfinder in a cultural desert

When we were designers starting out, Singapore was a cultural desert. It was tough to be an artist or designer. Now, we're in the teenage years of the industry, where designers are starting to challenge and rebel, but forming their own identities. It's an interesting age to watch.

*Jackson Tan
in dialogue with
the author*

Figure 9.1: Poster of Jackson Tan speaking on internship at the School of Art, Design and Media (ADM) in 2014

Source: Author

Jackson Tan Tzun Tat (Jackson Tan), 45, is Singapore's best-known designer, whose work through, what he terms, 'design collective' spawns from T-shirt design in his early years through typeface design, magazines design, video campaigns for MTV, advertisement campaigns for Levi's, Casio, AMD and others, designing logos for Singapore, to curating exhibitions and museums. Jackson's latest design venture is titled Art Zoo (figure 9.2) which consists of large inflatable animals (zoo) which entertains adults and children alike. Jackson Tan has many awards along the way, including Designer of the Year in 2007 by the President's Design Award (Singapore) together with his partners in PHUNK. Three years earlier,

British magazine Creative Review featured PHUNK as the "champion of Singapore's graphic scene". Jackson Tan is highly regarded in Japan, Taiwan and Hong Kong where, as he said in his interview for this thesis, "design takes different meanings that interest him".

Figure 9.2: Jackson Tan's Art Zoo in Singapore

Source: klook.com

In an exclusive dialogue for this study, Jackson Tan agreed to recount the 'autobiography' of his life as creative artist, designer and innovator to give a glimpse, of the influencing factors in his life that would allow the author to compare it against his own.

Influencers. Born in 1974 to very young parents (his mother was 16 and father was 22) Jackson Tan calls himself a 'latchkey' kid since his parents had to work hard to make their ends meet and he was left to fend for himself. Throughout his life, people have continuously influenced him; his grandmother, mother, father and friends who he acquired during his secondary school (junior high school) days. Where he lived during his childhood has been a big influence in the makeup of Jackson Tan as an artist / designer. His social status, growing up poor has 'grounded' him, making him sensitive, yet resourceful. The schools he had studied in and the activities he had taken up while studying have also had effect on his life. Jackson Tan says he was also influenced by the pop culture that he grew up surrounded by.

Grandmother. with a father who was a dispatch rider for a local bank and mother who had to work as a waitress, Jackson Tan's was left with his paternal grandmother. Living in a rented shophouse on Tan Quee Lan Street in Bugis area of Singapore, was a cultural boon to Jackson as a young boy. Tan Quee Lan Street had everything he could ask for within its vicinity: a street market with fried food right at his doorstep, temple, cinema theatres, dancing transvestites, illegal cassette tapes featuring latest English, Malay and Chinese music together with a Malay barbershop that had magazines and comics and schools conveniently located within a walking distance. According to Jackson, his grandmother 'consumes' story of any form and she would take him along without fail in this journey of hers. Being at Bugis area with Chinatown, Arab Street(s) and Little India within its vicinity helped. Jackson and grandma would go to all the street side Chinese Opera and movies they can muster. With famous cinema theatres such as Prince, Odeon and Capitol very near, he would see as many as two movies per week. Movies from his memories include Thai horror movies, Hollywood hits, Malay and Indonesian movies and 'Bollywood' movies¹¹⁸. Jackson remembers going to a Star Wars movie with his grandmother and both thoroughly enjoying the show, even though his grandmother did not understand English. A bubbly character, who had the duty of bringing up all the children from her husband's three wives, Jackson describes his grandmother as a strong pillar in his life, who allowed him to explore beyond what is considered a comfort zone by Chinese families of that era.

Parents. Jackson Tan described how his 22-year dad and 16-year-old mum had to marry in 1974 because he was on the way, and went on to tell about their influence on him. They had two more children, a son¹¹⁹ who is 2 years younger to Jackson and a daughter, who is 4 years younger than him. With only a partial school education, his parents had to struggle to keep the family running, which according to Jackson never bothered him. His mother left her job when Jackson was 7 years old to look after the children. Jackson's father joined a local bank as a dispatch rider using bicycle as

¹¹⁸ Though Jackson Tan mentions 'Bollywood' movies, a name that is of recent origin to Indian movies, especially Hindi movies, a check on the Indian movies that were shown in the theatres that he mentions include mainly Tamil and Hindi movies.

¹¹⁹ Jackson Tan's younger brother was given to his uncle (dad's elder brother) and aunt to bring up. Though Jackson knew of this, neither of his siblings knew. After his uncle's passing away, his brother was told of his real parents during the Chinese New Year re-union in 2016.

his mode of transport. Though poor, Jackson remembers them living the style of the 70s and 80s, with long hair and bellbottoms, going for discos. His parents would listen to, besides Beatles, legends such as Deep Purple and Eagles, in their record player and his father had a large collection of vinyl records, which Jackson has inherited and added on till today. From early on, Jackson would be interested in the sleeve designs of the record collection of his father, which he says has had an influence on him as a designer. Jackson fondly remembers his father taking him out around the Bugis area and his time at the Malay barbershop where the barber had to give him a comic book to sit him still why he got his 'Beatles' haircut. Of his mother, Jackson did not say much except that she was a good woman who took care of the two kids who were at home. The significant contribution that Jackson believes comes from his parents is music, and the design and style elements that came with it.

Jackson's father was an earnest follower of Taoism, involved in the temple functions and ceremonies when he was alive. Jackson remembers him as the person leading the Lion Dance during festivals and the Chinese New Year. His father would work with the local artisans to create different heads for different type of lions and taught Jackson that there are seven different lions, each with its distinct heads with different colours depicting different meanings to the lion as well as the dance itself. Here again, Jackson says, he understood how **form, colour, design and details** play a significant role as a **symbol** depicting power or other characteristics. Jackson Tan remembers that his father would bring black and white photo (Xerox) copies of comics, which he loved to colour in. It is important to note that photocopying was new and novel at that time and his father's access to photocopier at the bank allowed him to copy comic books for the young Jackson.

Preschool. Even at the kindergarten, Jackson's favourite past time was drawing and colouring. He remembers waiting for his grandmother to pick him up after the class when he would draw, mainly, the Chinese Monkey God and comic book superheroes with the crayons and pencils that he had. His grandmother enjoyed his drawings and encouraged him by buying exercise notebooks and jotter books on which he would draw. Teachers at his kindergarten also appreciated his drawings and his skill, often hanging the pictures up on the walls in the school. He felt **rewarded** by the appreciation from

his grandmother and the teachers. During this topic, Jackson talked about how he was drawn to the power that the Monkey God and the superheroes exuded and the visual symbols and their meanings each of these brought out. This, he said, has influenced him throughout his life to date. Jackson remembers going to the Haw Par Villa¹²⁰ and be amazed at how statues and figurines can be arranged to tell a strong story.

School. Being in the Bugis area of Singapore had its own advantages then, one of them being good schools within walking distances. Jackson Tan went to Saint Anthony's Boys School for his primary education and Saint Joseph Institution for secondary school¹²¹, both Catholic educational institutions. Jackson remembers his primary school education through his love for drawing the Monkey God and Superman, whose power and symbolism had attracted him since his preschool days. Jackson enjoyed the aura of the church in both the schools, and was drawn to the power that the church represented with its architecture, interior, stained glass windows and the symbolic objects, crests, etc. Besides study, which he was not inclined to, and drawing, Jackson joined the school band as a trumpeter. He also joined the Boys Brigade, which introduced him to another form of Christianity. When he was in primary five, Jackson started playing football, which became an integral part of him throughout the rest of his school education.

At this point, Jackson shared his memories of being quite poor and having only one pair of uniform to wear to school. Without enough money to pay for the utilities bill, his household had to go without electricity and water for many days. He remembers going to public swimming pool to shower/bath when there was no running water in the house. With this, he added that both St. Anthony's Boys School and St. Joseph Institution allowed students to experience the diversity of Singapore society at that time by admitting students from diverse backgrounds and status. He recounts being able to interact with students, with rich, poor, gangster and political backgrounds with the same attitude and

¹²⁰ Haw Par Villa, also known as Tiger Balm Gardens, is a theme park that was established around 1935 along Pasir Panjang Road in south west part of Singapore and has more than 1000 and 150 dioramas that depict scenes Chinese mythology, folklore, legends, history, and illustrations blending the teaching of Confucius.

¹²¹ St. Anthony's Boys School, founded in 1893, whose original building still stands at Victoria Street, is gazette for conservation by the Government of Singapore. St. Joseph's Institution founded in 1852 was located along Bras Basah Road and the original building now houses the Singapore Art Museum.

approach. This he credits to the sense of moral fortitude and earnestness that both the Catholic schools and its teachers had inculcated in him.

His experience as a boy going through the two schools has had the following outcomes in Jackson Tan:

- It is very important to get out of the present situation and that education is very essential in this
- Things are not as bad as you think. There are means always available for you
- You have to be mindful of how you handle finance

Experience and influences in youth. Jackson Tan recounts several factors that had lasting effect on his thinking during his secondary school days:

- Playing football and hockey allowed him to be friends with a group of schoolmates with similar interest in art, design and trends
- Television brought the whole world to him and in several languages – English, Chinese, Malay and Tamil. He could watch Ultraman, Mat Yoyo, English football, wrestling, Indian movies, all with a twist of the channel knob
- Television also brought more vivid images to study and draw. Hindu mythology, Hindu Gods/Goddesses, details, images and symbols
- Pop music and their imagery, trends, colours, etc.
- Graphic novels from Frank Miller and others which again formed a framework for how power and image could be portrayed with a storyline

During secondary school, Jackson and his friends were hooked onto the dynamic board game that was popular at that time, titled Dungeons & Dragons¹²². Jackson liked to be the Dungeon Master, which allowed him to define the characters of especially the non-playing characters and set the rules for the encounters of the playing characters and the non-playing character and the settings at which these encounters take place. Through this game, Jackson described how he enjoyed imagining the roles (role playing). His interest in Dungeons & Dragons as well as the Star Wars series inspired him to invent his own game, as early as 13 years of age, called *Star Dragons*.

¹²² Dungeons & Dragons (D&D) released in 1974 is a tabletop fantasy roll playing game that predates the digital roll playing games of today and is still popular in its digital version (<http://dnd.wizards.com>). Experts recognise D&D as the beginning of modern role-playing games and the role-playing game industry.

Jackson confesses that he was more interested in music, sports and games than academics while studying at St. Joseph's Institute. His better memories of secondary school curriculum is of the arts class where he preferred to design posters for many of the 'boring' brief given by his teachers. With the result, according to Jackson was that the end of secondary school public examination; the 'O' Level results were not good. With the score that he had obtained, he could apply for a skills certificate in secretarial practice or join one of the polytechnics in a management related diploma. While he joined the secretarial course, and attended classes for a few weeks, Jackson was keen on applying for the polytechnic diploma. When he went to submit his application at the Temasek Polytechnic, Jackson saw a display of design work done by one of the schools of the polytechnic and found out that he could have applied to study design, but was late. He realised that he could either join the Nanyang Academy of Fine Art (NAFA), for which he had to wait one full year of, or join a new private institute named LaSalle, which had a January intake as well.

LaSalle. Jackson Tan applied to study graphic design at LaSalle, where he was interviewed by the founder Brother Joseph McNally, who admitted him after seeing his drawings. LaSalle, which was founded only few years earlier, was operating from an old (former) school in Telok Kurau in Singapore. Three years in LaSalle gave Jackson the greatest impetus to be the iconic designer that he is today. At LaSalle, according to Jackson:

- Every day was good or better than the previous day
- Doing homework was fun
- He was in his own elements finally
- The school was very open, and the artistic energy was every where
- While he thought he was a very good artist before joining LaSalle, he realised there were many more like him or even better
- As he progressed from year 1 to year 2 and 3, it got better. He was in love with graphic design
- Apple Macintosh descended on him and his classmate like a wildfire, capturing everyone's imagination

While Jackson Tan was enjoying his experience at LaSalle, his financial woes were far from over. In order to pay his fees he took a loan scholarship from the Chinese Development Assistance Council (CDAC), a government supported non-

profit organisation to help in the welfare of the Chinese community in Singapore¹²³. To make ends meet and to take some financial load off his family, Jackson worked as a waiter at the Kings Hotel on their night shift. Jackson recounts that coming back to school after working long hours the previous night was tiring. However, the atmosphere at LaSalle energised him physically and mentally, according to him. Jackson fondly remembers the atmosphere of every one helping each other, irrespective of the year they were studying and did not care if one was rich or poor.

At LaSalle, Jackson Tan found himself ‘hanging out’ with Melvin Chee, whom he has known from St Anthony’s days, Alvin Tan and William Chan. Jackson Tan says that the four of them were not only very passionate about graphic design, but they were also curious about Apple Mac and the software that came with it such as Freehand, PageMaker and Macromedia Director. Suddenly they discovered that graphics could move! Soon they created a role-playing game using the Director. From an interest point of view he continued his interest in graphic design as it relates to symbolism, mythology but now was also interested in the future possibilities of these.

Teachers and others. Besides Brother McNally being an inspiring person at the college, Jackson Tan remembers Anton Mazer¹²⁴ being an influence during his days at LaSalle, even though he officially taught him professional practice in design. There were many visitors passing through Singapore who spent time in LaSalle, giving Jackson Tan and his classmates valuable lessons in design and informing of the international trends of that time. Jackson Tan says that the takeaways from LaSalle were:

- Jackson was well informed about things related to design and realised he could influence (people and events) through design.
- He started asking basic questions – Why do we do this? As human being? Whose answers influenced his design thinking

¹²³ Singapore government recognizing the need for community help for its citizens and residents of different races has created three distinct non-profit organisations; Chinese Development Assistance Council (CDAC) for the Chinese, Yayasan Mendaki for the development of the Malay/Muslim community and the Singapore Indian Development Association (SINDA) for the betterment of the Indians. The Eurasian Association founded in 1919, which supports the Eurasian community, has also been given a government support status since 1994.

¹²⁴ Anton Mazer designed the logo and corporate identity for Inovasia Design Pte Ltd in 1997.

Jackson Tan graduated from LaSalle with a diploma in graphic design and is one of the most famous and accomplished alumni of the institute, which has grown many folds since the Telok Kurau (Figure 9.3 a.) days to a modern campus in the heart of Singapore's creative district today (Fig 9.3 b.). LaSalle has grown in stature and today offers graduate and postgraduate programmes and has a partnership with London's Goldsmiths College.

a) At Telok Kurau

b) Present campus

Figure 9.3 a and b: La Salle School of the Arts campuses

Source: a) joochiattoday.files.wordpress.com & b) arch2o.com

Graphic design direction. Having been interested in images and symbols from his school days, Jackson Tan and his friends built on the theme into symbolism and its representations at LaSalle. They also started experimenting with typeface in Apple Mac and soon found that they could create fonts. Encouraged by their teachers and peers they sent some of the fonts to the American designer and art director David Carson who was running the 'GarageFonts Inc.' an internet based typeface portal. To Jackson's surprise, David Carson asked them to develop them for distribution. At this point, Jackson and his friends had to learn fontographer software in order to deliver professional quality fonts. Till today, their fonts such as *Acid Queen* and *Bloody Valentine* are still available on the web.

Acid Queen

abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890()!@#

37

Designer: Jackson Tan Tzun Tat

Year: 1996

Publisher: GarageFonts

Buy this font online from:

Fonts.com:

<http://www.fonts.com/>

Linotype Library:

<http://www.linotype.com/>

FontShop:

<http://www.fontshop.com/>

Phil's Fonts:

<http://www.philfonts.com/>

Figure 9.4 Acid Queen Typeface by Jackson Tan

Source: www.identifont.com

Music, national service and camaraderie. Fresh out of college and waiting for the compulsory National Service, the four friends founded 'PHUNK' in 1994. Interested in rock and pop music, they formed a band trying their hands at music, which they soon realised was not their cup of tea. 'Having a liking for and being talent in something are not the same', explained Jackson Tan. They would regroup over the weekend even when they were in National Service, enjoying things that they thought would make meaningful life for them afterwards. Soon they were spending their time with the Apple Mac, building their capabilities in the new tool of design. Jackson remembers helping out Brother McNally in designing the layout and contents in Aldus PageMaker during that time. Jackson explained that the camaraderie that they kept active during their National Service days built the solid foundation of their collective 'creativity', and their understanding of each other's strengths.

The collective experience. Out from National Service, the four regrouped to try their hand at freelancing. Ideas and opportunity was abound with the 90s and the internet. With four chairs, a table and two Apple Macs in a shophouse in Pagoda Street, Jackson and his three friends, founded 'PHUNK' as a collective became a full time reality. Initially shy

to market, Jackson remembers his mentor Anton Mazer making that all-important phone call to Levis Strauss from a public phone booth and forcing Jackson to talk to the client. This resulted in a magazine design and a print production for Levis Strauss. At this point in time PHUNK decided to publish a magazine on pop culture. The newly opened music and dance club Zouk was starting a fresh lifestyle phenomenon at that time. With the young, old, new and notables wanting to be seen in that club, Jackson Tan and his friends were attracted to Zouk as well. Zouk took a liking to PHUNK's approach and allowed them to hold regular theme based parties that were 'experiential'. The pop culture magazine titled 'Trigger' was released at Zouk and had a good take up. PHUNK even convinced Zouk and a Japanese supermarket chain, Daimaru to convert Zouk into a supermarket for one of the theme parties. Though many people were attracted to the theme parties, PHUNK only published two issues of Trigger (which is a collector's item now amongst pop culture enthusiasts in Singapore). Jackson remembers the initial PHUNK days as having only one meal a day assembling together to drink 'teh tarik¹²⁵' and taking the midnight bus from Chinatown to home.

Attending one of their experiential parties was an executive from yet another new phenomenon Music Television (MTV) which mostly broadcasted music videos and was a hit with the youngsters the world over. MTV asked PHUNK to design an animated graphic as a sort of video to attract the targeted audience to watch MTV. Never having done something like this before Jackson Tan and the PHUNK produced a short clip which was shown all over the Asia Pacific region getting other corporations interested in finding out who did the video. Soon calls started from international brand names such as Casio, Levis and others from the USA.

It was apparent by then that though PHUNK as a collective is an interesting concept in co-operative design, it was not a company and hence was not going to be commercial. It was decided to keep PHUNK alive virtually while each of the four pursued their own interest as well. Three of the four friends, which included Jackson, decided to start an advertising agency named Brazen at River Valley in 2001, which soon became a hub for talent. Even at Brazen, Jackson was

¹²⁵ Teh Tarik is a sweet tea introduced by Indian teashops, which comes with a milky froth on the top due to the way the tea, is tossed (pulled) between the glass and a container to cool it to a drinkable temperature.

interested in hosting regular parties that brought young designers who were in turn influenced by Jackson's thoughts on design. The famous American processor company AMD became their regular clients and had regular work flowing in before tragedy struck in the form of the SARS¹²⁶ outbreak in Singapore in 2003. SARS in a short period of time killed Brazen (and many other small businesses) by choking the business coming from outside Singapore. Decision was made by Jackson and his friends to close Brazen.

PHUNK, in the meanwhile thrived with its 10th anniversary celebrated at the National Museum in Singapore. International brand names such as Finland's NOKIA sought out PHUNK for their creative work. Why was Phunk thriving then? Jackson Tan explained:

- We started to move the business from a 'outside-in' model to a 'inside-out' one.
- PHUNK started to self-create art, stories and exhibits
- Kept the intellectual property (IP) of the works created and licensed them
- With the result, business with clients such as Casio and Levis became a creative collaboration rather than a commissioned business
- PHUNK was being built as a brand and would survive even when the four do their own things.

BLACK and after. Jackson teamed up with Patrick Gan to found BLACK a multi-disciplinary creative agency and turned his attention to curating, besides design and brand consulting. Culture, heritage, cities and civilisations started interesting Jackson. One of his first exhibition design, titled '20/20' celebrated Singapore design with its unique 'boxes in conveyor belt' concept. He has since worked on many exhibitions and has curated museums such as the Peranakan Museum in Singapore. In 2008, Jackson Tan was invited by the Center for Creative Communications (CCC) in Japan, where he curated and presented an exhibition titled 'New Wave – Singapore's Contemporary Design Culture'. By the time he was named as the Designer of the Year in 2007, Jackson Tan was already an international design personality. Everyone was looking to Jackson Tan, either through BLACK or PHUNK. The English rock band Rolling Stones' tour of 2011

¹²⁶ SARS, Severe acute respiratory syndrome is a viral respiratory illness caused by SARS-associated coronavirus (SARS-CoV). SARS was first reported in Asia in February 2003. The illness spread to more than two dozen countries in North America, South America, Europe, and Asia before the SARS global outbreak of 2003 was contained. Source: <https://www.cdc.gov/sars/> retrieved on 03 March 2018.

featured PHUNK designed merchandise for that year. Famous names such as Herman-Miller started seeking Jackson and his team.

Back to the collective mode. Jackson Tan says that collaboration has always been in the DNA, which translated bringing back the individual companies of PHUNK members as well as new ones into a single umbrella. Today, PHUNK looked after by Melvin Chee, Artillery run by Alvin Tan, TMMRW of William Chan, BLACK of Jackson Tan and Patrick Gan and Brian Ling of Design Sojourn share a common space, resources and costs and do joint projects. Jackson Tan and Brian Ling have found a design education company called Methodology, which is also situated in this, collective of studios.

Companion and life. Jackson married a former air stewardess, Talia Huang who hails from Kaohsiung in Taiwan. Jackson first met Talia in 2008 at the Kaohsiung Design Festival and kept in touch till he married her in 2014. Coming from a humble background herself, Talia has had influence on Jackson since, according to him, in being even more people centric and to be himself in terms of design thinking and business integrity.

Driving thoughts and philosophy.

- Images, symbols, symbology and the power of icons and symbols have interested me since young
- My design style has been influenced by pop culture, MTV, grunge, rock and electronic music
- I was fortunate have likeminded friends right from my secondary school, even primary school¹²⁷ who are all in the creative industry in Singapore or elsewhere
- Technology (and internet) has leveled the field
- To be successful one must understand the old craft and ride the new (technology) wave
- Kindness comes before business and friendship comes before partnership
- As I have gone through all the different phases of my designer life, I see myself sophisticated in terms of my relationship with people; different kind of people.
- I now see myself playing different roles in business and life

¹²⁷ Hanson Ho of H55; Justin Long of Underscore Magazine; Benjy Choo of Kilo Studio; Terrance at Wieden + Kennedy; Danny Tan of Dita Audio and Melvin Chee of Phunk

Comparing creative paths. In Appendix A of this thesis, the author had set the scene by narrating his path from creativity and innovation analysed this journey to discover his personal path to innovation in Chapter 3. The author's journey is sufficiently unique path that a comparison could be made with another person whose path has taken him/her to innovation. Interviewing Jackson Tan gave this opportunity to compare the paths and analyse both of journeys, taking Wallace's (1989, p. 37) contextual systems as a basis for comparison, as shown in Table 9.1.

It is apparent from Table 9.1 that both Jackson Tan and the author have built their creative enterprise towards a similar direction through the life history of influencers, capability building and creative outputs. In terms of the public recognition for creative output and innovation Jackson Tan has won several prestigious prizes and awards in a short period of time.

What is very special and different about Jackson, is the interest in images, symbols and symbolism right from his kindergarten days that has influenced his aesthetics and graphics. Music, pop, grunge, rock and electric, has also added to his outlook on art and design. This together with growing up with and working alongside a group of likeminded friends also allowed him to expand on his ideas into the ideas presented by his friends (and vice versa) bringing about a richer vocabulary to all of Jackson's work.

Table 9.1: Comparing the contextual frames

Context	Jackson Tan	Peer Sathikh	Remarks
Relevant Work Enterprise	Yes and continues to build on it	Yes; deliberately sought different direction and career path	Jackson has built his enterprise as a self-made person/group and has never been employed by a corporation unlike Peer
Work as a Whole (oeuvre)	Very good at building enterprise from graphic design to curating and beyond to organising specialist seminar as business	Has been successful; venturing into different domains of enterprise	Both have applied different coping mechanism and not afraid to drop or close one enterprise and carry on with others
Professional Milieu	Has built a reputation and has built a network of professional milieu	Has carefully cultivated a network in a wider spectrum from engineering to art	Both have been influenced by good teachers/mentors
Family and personal life	Heavy influence of family on the way to being creative	Good variety of people including family have influenced	Jackson has been in Singapore (although works extensively for collaborators abroad) all his life while Peer has been moving places in India and has lived in several countries
Sociohistorical period	Opportunities created in Singapore initially moulded Jackson and his grasp of the societal influences (historical and contemporary) from the East and the West continues to shape him	Opportunities were presented as Peer moved from one place to another, studied in different countries and sought opportunities beyond the profession into full academic world where research is important	Both have relevance. Creativity and their creative path have been influenced by the sociohistorical period in which they grew and were moulded

Jackson Tan's most visible design – the oft used logo for Singapore's 50th anniversary of formation.

Source: *The Straits Times*

Innovation. Jackson Tan has had several innovative approach as to how he has been as an individual, as a creative designer, as a partner, as a design visionary and as a business visionary. In all this what stands out is his 'collective' approach to design with a close group of likeminded and long-time friends, together with the freedom to do their own thing at the same time. Although Pentagram¹²⁸, a multidisciplinary design consultancy founded in 1972 by five partners may be the first instance of a collaborative, Jackson Tan and Phunk represent an approach uniquely different from Pentagram in that Phunk was not to be a commercial company to offer consulting work but meant to offer its own artwork and design in collaboration with the client. Also, freedom to do their own things meant doing anything that was valuable to each of them and not necessarily in the area of design. With the effect the value proposition of their innovation is multifaceted though mostly within a visual arts field, which includes curating and exhibition design, bringing a fresh approach and perspective to the collaborative work at hand¹²⁹.

Jackson Tan's Art Zoo is an example of doing things that are valuable to him. Jackson recounts that he was inspired by his childhood memories of going to the zoo and playing in animal-themed playgrounds to create an cartoon inflatable 'Art Zoo' with giant animals and playgrounds. Taking up 4000 square feet and weighing at 11 tonnes, this inflatable playground, first commissioned in 2017 in Singapore, is for children and adults. In an interview to Singapore's Today¹³⁰ newspaper, Jackson says, "We thought (about) our childhood fascinations. When we were children, what were the things we always wanted to do? We always wanted to meet a giant spider for example, or we want to go inside a whale (referring to his inflatable whale whose belly one can walk through). All these are childhood fascinations, and we want these fascinations to come to life. I thought it would be really fun to have art installations that you can literally touch, and you can even bounce on it and play with it." Art Zoo has been exhibited in 8 cities around the world since 2017. Jackson Tan's business model is that he works with a sponsor who will

¹²⁸ <http://www.pentagram.com>, retrieved on 12 January 2019

¹²⁹ <http://www.straitstimes.com/lifestyle/home-design/jackson-tan-the-man-behind-sg50>
<http://designperspectives.org/en/2015/05/15/jackson-tan/>, retrieved on 12 January 2019

¹³⁰ <https://www.todayonline.com/entertainment/arts/bounce-giant-inflatable-animals-art-zoo>, retrieved on 12 January 2019

make and set up the inflatable based on the intellectual property (IP) he holds. Jackson's income comes from the royalty he negotiates with the collaborator. Since 2017 Art Zoo has been winning awards including several Creative Circle Awards and Golden Pin Awards.

In the author's opinion, through Art Zoo alone, Jackson Tan exhibits several levels of innovation which amounts valuable innovation for the consumers (novelty), collaborators (for new attraction), location cities (for uniqueness) and for himself (sustained business and income).

Figure 9.5 Jackson Tan in front of the Art Zoo in 2018
Source: www.todayonline.com

10. Discussions

The preceding nine chapters take one through a transformatory research process which started with **self-analysis** that led to the thought that creativity and innovation are closely related and are both human centric activities, and that man-made algorithms do not have the judgemental quality required to identify creative outcomes that could possibly become valuable innovation.

The research that followed navigated through different topics and approaches, from **definitions** of creativity and innovation, to an understanding **the differences** between creativity and innovation across the liberal spectrum and innovation across that same spectrum before asking the question, ‘If the journey from creativity to innovation is a human centred process, could it be visually represented in some form?’ What was visualised as a first model of how creativity moves to innovation, during a ‘eureka’ moment by the author, offered the first step to this visualisation; a **synoptic map** of the creativity to innovation journey. Insights into the three stages, namely, **cogito, intelligo and efficio** and the discovery of three types of creativity, namely **endogenous, epigenous and exogeneous** offered a more comprehensive picture of the human centred process. In finality, valuable innovation is made possible by human intelligence through a series of human centric activities, which leads to **knowledge management** and **relationship building** as important aspects required to manage the creativity to innovation journey. The five **case studies** and the **show case** presented diversity, from one person’s journey, to collective, and finally to a team journey, creating variations of the generic synoptic map (Figure 7.10). Through the case studies, it was possible to validate how a ‘universal’ synoptic map varies with complexity of the journey, with Anne Telnaes dynamic editorial cartoon being the simplest and the development of Tata Nano car being the most complex. Though the journey is a human centred process, the study presented herein also points to the fact that there are two important phases during this journey; the first that is creativity dominant and the other, innovation dominant, whose characteristics may be

summarised as shown in Table 10.1¹³¹, where the common descriptors for the two phases are:

- 1) Process, 2) Person, 3) Environment, 4) Focus/Goal, and
- 5) Outcome/Value Proposition

Table 10.1 : Comparing the contextual frames

Descriptor	Creativity	Innovation
Process	Exploratory, work on interests and hunches	Deliberate; result oriented, work to a brief
Person	Individual, motivated, imaginative and open	Group of people, including creative, motivated by requirements and team dynamics
Environment	Conducive to allow exploration, experimentation	Management oriented, mixed dynamics allowing for individual exploration as well as group development.
	Less pressure on timelines and costs	Constrained by schedule, budget, etc.
Focus / Goal	Discovery, serendipitous, plausibility to be taken further	Viable, successful implementation
Outcome / Value proposition	New, novel, surprise	New to the market/industry, useful, return on investment (Note: the value proposition does not always have to be commercial as in the case of social innovation. Outcome's value, however, has to be measured by its acceptance and sustainability in which case)

Table 10.1 shows clearly the distinct difference of each of the descriptors at creativity phase and innovation phase. How,

¹³¹ These discussions include ideas that were presented by the author (Sathikh, 2017) in a paper titled *Creative Culture to Innovative Culture: Transformal Operation* at the 19th International Conference on Innovation and Creativity in Paris.

then does a viable idea from creativity phase move through innovation phase to become valuable? How does innovation start and flourish, once viable ideas have been identified? When does the creative process becomes innovative?

While the synoptic map proposed in this thesis (figure 7.10) identifies three stages (cogito, intelligo and efficio), it does not indicate at what point does creative phase become innovation phase. The main clue to answering this, lies on the fact that it has to do with the **conductive environment**¹³² mentioned in the author’s paper of 2010 (Sathikh, 2010) as shown in Figure 7.1.

A combination of people, process and conducive environment, points to what Tom Kelley, the general manager of IDEO calls a greenhouse for innovation when he says:

Innovation flourishes in greenhouses... A place where the elements are just right, to foster the growth of good ideas. Where there’s heat, light, moisture and plenty of nurturing. The greenhouse we’re talking about... is the workplace, the way spaces take shop in offices and teamwork together. (Sathikh, 2017)

Morris (2011), when describing the success of companies such as Apple Incorporated says, “They have created a true *innovation culture*”. While this mention of innovation culture signifies the importance of culture, the question that arises is, ‘Is there a ‘creative culture’ separate from an ‘innovation culture?’ If so, is this the ingredient that takes creative ideas into valuable innovation through the journey described by the synoptic map? Morris (2011) describes innovation culture as, “... an expression of people, their past, and their current beliefs, ideas, and behaviors. They make innovation happen, and they do so consistently over time”. With so much importance on innovation alone, one is led to ask, ‘Is creative culture a subset of innovation culture? Or is it a culture by itself?’

¹³² Figure 7.1, Framework for creativity is reproduced here for easy reference

Creative culture and innovation culture. In one of his papers, the author has established that creative culture and innovation culture are different in nature but can combine together to bring about innovation of value (Sathikh, 2017). As a start, Table 10.2 outlines the characteristics of creative culture.

Table 10.2 : Characteristics of Creative Culture (Sathikh, 2017)

No	Characteristics	Remark
1	Curiosity / playful	Person
2	Childlike approach	Person
3	Breadth /Disparate ideas	Ideation
4	Multitude of Ideas (Creative Darwinism)	Ideation
5	Experimentation and risk taking	Attitude, policy
6	Ambiguity and propensity of failure	Attitude, policy
7	Humour, eccentricity, horseplay	Attitude, policy
8	Individual freedom (autonomy)	Attitude, Policy
9	Complete freedom on space and work area	Policy
10	Limited respect for management	Attitude
11	Loose sense of time, deadlines and time management	Attitude, Policy

While creative culture is dominated by individual efforts and/or small group efforts, innovation culture seems different, especially in the way it is lead and managed shown in Figure 10.3.

Table 10.3: Characteristics of Innovation Culture (Sathikh, 2017)

No	Characteristics	Remark
1	Carry out mid-course corrections	Work dynamics
2	Preference for group anatomy and control	Group dynamics
3	Low level of associative barrier (both physical and psychological)	Work dynamics
4	Able to breakdown extrinsic motivation into chunks of intrinsic motivation	Work dynamics
5	Comprise of whole brained team with varied perspectives/expertise	Team Building, policy
6	Well defined roles for each person in the team	Group Dynamics, policy
7	Room for team play as well as solo play	Policy
8	Provision for 'encouraging' supervision	Policy
9	Organizational belief and support (in the innovative work)	Policy
10	Humour / jovial environment	Continued from creative culture
11	Means to manage creative abrasion	Leadership, Policy
12	Allow for ambiguity without losing sight of the goal.	Policy
13	Comprise of team that focuses on ideas rather than career	Team selection

From Table 10.2 and 10.3, it can be established that:

1. Creative culture is interested in creating ideas while innovation culture is interested in realizing those ideas that have value propositions
2. Creative culture is a loose composition while innovation culture thrives on a controlled system with certain level of autonomy and freedom
3. Creative culture needs to be nurtured while innovation needs to be cultivated
4. Leadership and management style have to be very different.

At this point it may be questioned if two silos have been created, namely creative culture and innovation culture and wondering how these fits in with the synoptic map of creativity and innovation.

Author's paper of 2017 (Sathikh, 2017) sets out to dispel any notion that ideas pass from one silo to the other as seen in Figure 10.1.

Figure 10.1 : Misconception of idea flow of creative ideas
Source: Sathikh (2017)

According to this paper (Sathikh, 2017) Figure 10.1 “... depicts a ‘shut door’ approach where an idea is pushed from creative culture to innovation culture, after which the creative have no involvement in seeing how the ideas get transformed into innovation”. A better model is proposed in the same paper for the transition as shown in Figure 10.2 , “... where there is physical and psychological open door between both the cultures. Potential ideas in this case, are transferred from one to another in a smooth manner” (Sathikh, 2017).

Figure 10.2: Improved representation of idea flow of creative Ideas
Source: Sathikh (2017)

This representation is translated into working space as well by successful innovation outfits such as IDEO and others, where open concepts have the team working in a manner that allows for smooth flow of ideas with no visible barriers. Example from IDEO studios as well as from the author’s former consultancy INOVASIA are shown in Figures 10.2a and 10.2b.

a) metropolismag.com

b) Author's collection

Figure 10.2 : Cultural Space for Innovation

Source: As specified above

What is interesting in Figure 10.2 is that, in both IDEO and INOVASIA, there is a marked difference in the way that the creative culture area and innovative culture areas operate, though the flow of ideas is also visibly noticeable. In INOVASIA, the area of creative culture was strewn with sketches, rough models, sofa sets and loud(er) music, while the innovation culture area had more tools, varied prototypes, sitting tables and mild music, if any. Does this mean that putting people together in a sort of 'primordial' soup allows creative ideas to become innovation? How does the transformation happen then? How do ideas go from *cogito* to *intelligo* to *efficio* if no demarcation of sort is identifiable?¹³³

Culture and types of creatives. Bringing back the idea that creativity and innovation are human centric activities, and that creative culture and innovation culture requires a certain type of people, it becomes obvious that the three types of creative personalities, endogenous, epigenous and exogenous play an important part in the constituents of creative culture and innovation culture respectively. Based on the research journey of this doctoral study and the five case studies presented in this thesis, visual model may be presented relating the two cultures and the three types of creative personalities as seen in Figure 10.3

¹³³ INOVASIA had a stage-gate system where relevant information is passed on from one stage to the next stage by means of documents, computer files, models/prototypes, etc. Leadership of the creative team and the innovative team were clearly identified with roles and responsibilities outlined.

Figure 10.3 : Cultures and creatives

In this model, the composition of creative culture is mostly endogenous creatives with an overlap of epigenous creatives, while the composition of innovation culture is a combination of epigenous and exogenous creatives. What is interesting is that epigenous creatives are required in all the three creative processes, cogito, intelligo and efficio. The epigenous creatives who overlap in to cogito and efficio may be considered the bridges that connect the two with intelligo.

Leadership in this journey. The consolidated synoptic map of Figure 7.17 includes knowledge management and relationship building, which signifies the involvement of humans in both. The different case studies presented in Chapter 8 show that there is not one type of leadership but more than one, depending on the different projects/journeys and the complexities. The author in his paper (Sathikh, 2017) identifies two types of leadership, one to manage the creative culture and the other, innovation culture:

Creative culture requires a '**shepherd**' leader with high level of tolerance for personal quirkiness, methods, housekeeping and time management, while innovation culture requires a '**captain**' who will steer the team towards a defined goal in terms of budget, time and results. The innovation captain will have a high level of tolerance for experimentation, iterations, inter-personnel relations, which include creative tension and multidisciplinary approach, amongst other things. (Sathikh, 2017)

These two leaderships are for managing the field team in the two culture and play a strong tactical role rather than strategic role. This statement points to the requirement of different type of leaderships and roles in the journey to valuable innovation.

The different synoptic maps derived from the five case studies from Chapter 8 introduce different personnel under knowledge management, representing the different roles that need to be played. Each have a role in building the relationships necessary for the 'shepherds' and the 'captains' to manage the journey to valuable innovation. These different personnel are:

- Change Agent
- Innovation Catalyst
- Coach
- Business Leader
- Innovation Designer
- Field Team

Change agent is an initiator of innovation journey and usually has personal interest in the success of the journey. He/she are at the top or access to the top of the organisation. **Innovation catalyst** is an experienced hand who can follow the process from cogito through intelligo and efficio. He/she has the knack of directing the journey through the hurdles. **Coach** is a person who can work with the change agent and the catalyst and work closely with the field team. **Business leaders** may not be seen in all projects, except in start-ups, business diversification, etc., where several business models have to be ascertained/developed and negotiations need to be done (example Rotimatic case study). They may not have the necessary skill level to part take in the innovation per se. **Innovation leaders** take on several roles including change agent and catalyst, when the project or set up is very small (example Telnaes and plastic gold case studies). **Field team** populates the creative and innovation culture and are directly responsible for taking creative ideas to valuable innovation.

In summary. The synoptic map depicting the relationship between creativity and innovation allows for several layers to be added on to it. However, the important element that this discussion points to, is the importance of nurturing both creative and innovation cultures without confusing between the two and to build the knowledge management with appropriate leadership while encouraging change agents, catalysts and coaches to play their roles with autonomy.

The synoptic map derived in this thesis could be used in several ways. The first is in the manner that this thesis has done; to study and validate realised innovations (successful or otherwise). The map can also be a starting point to ascertain the accent of a planned project as well as its depth and breadth in terms of setting the path and directions as well as to decide on the level of knowledge management that journey requires. To the author, the process of deriving a complex subject into a poetic form of a visual map itself is an accomplishment, and to see it validating itself through the case studies is satisfying. It would be left to everyone interested in the creativity to innovation journey, whether it be for business, industry, research or academics, to make use of this synoptic map in a manner that befits their purpose.

11. Conclusion

This thesis is a response to several questions raised by the author as he reviewed his journey from a creative designer to being called an innovator. Basic items such as: What is Creativity?; What is innovation?; Which is more critical?; and How can I harness these two?, led to more research questions on discovering the relationship between creativity and innovation and if this relationship could be derived as a visual map.

On the way to answering these questions, many other elements of the questions were discovered and dwelled upon, such as the definitions of creativity and innovation, how creativity is a human quality that generates ideas and innovation is process that is driven by many factors including creativity, and how creativity and innovation are realised in the different fields within the liberal arts spectrum. This gave a clearer understanding of the subject, as the author proceeded to put together a synoptic map of the relationship between creativity and innovation from an academic level diagram to a final, more poetic version, that encompasses earlier research by key researchers and thinkers. Though it would have been easier to take successful case studies with acknowledged innovation and validate the synoptic map, the author chose to select five case studies of progressive complexity with different level of success. This allows for validating the proposed synoptic map under different circumstances.

The case studies show how a general map changes with different types of innovation with different levels of complexity, from a team of one to a team of very many. They illustrate that careful mapping of the elements of the synoptic map provide a bird's eye view of the creativity to innovation journey and the level of involvements required at each part. These case studies demonstrate that the synoptic diagram is a useful diagnostic tool to ascertain which part of the process has done well and what needs to be improved. This ability allows the map to be a predictive tool, for individuals and organisations planning for success in their innovation journey.

Some key findings. Several discoveries and findings were made possible through this doctoral study. Three of which are presented below:

1. Process and Creativity

While the first map of the relationship between creativity and innovation developed by the author (Sathikh, 2010) seemed complete (Figure 7.6), this thesis reveals that the map can be made comprehensive. Investigations during this doctoral study uncovered two key elements, the first being the process of *cogito* and *intelligo* which was then joined by a new process, *efficio* (coined by the author). The second is the discovery that the three processes of *cogito-intelligo-efficio* have matching and distinct creativity styles, namely, *endogenous*, *epigenous* and *exogenous* creativities that play significant roles when potential ideas become valuable innovation.

2. Process and Culture

Investigations on how and when creativity becomes valuable innovation revealed that there is a distinction between creative culture and innovation culture. Putting together the concept of *cogito process & endogenous creativity – intelligo process & epigenous creativity – efficio & exogenous creativity*, it becomes much easier to assemble effective teams with appropriate creative culture and innovation culture to maximise effectiveness and the chance of deriving valuable innovation. This is especially valid for larger organisations which can build distinctive teams dedicated to innovation. That does not mean that individuals and smaller organisations cannot benefit from this concept of process and culture. It only means that single or several members will have to play different roles and exhibit the distinct process and creativities required to move ideas towards valuable innovation by being cognisant of the different expectations on creativity placed on them along the *cogito – intelligo – efficio* path.

3. Multiple Facets of the Synoptic Map

The five case studies presented in this thesis show different versions of the synoptic map of creativity and innovation, based on attention and effort given to the three critical processes of *cogito*, *intelligo* and *efficio*. Applied to a proven project, the synoptic map brings out a complete view of the innovation as it unfolds, clearly depicting possible shortcomings as well as successes on its way to completion. The structure of the synoptic map also allows for designing a desirable path to successful innovation at the outset itself. By this, appropriate teams and team members can be assembled for large projects, while allowing leaders and innovation

catalysts to understand the different roles and multiple tasks that have to play in smaller teams.

One could argue the possibility of setting up computerised algorithms, appointing numerical values to every variable and connecting it to the synoptic map, which allows one to see how changing each variable changes the map. While this could turn out to be an effective predicting tool, the author feels that this would make the map into heuristics and formulaic, deviating from the more poetic representation of the synoptic map presented in this thesis.

Limitations. A thesis of this nature, where an idea of a visual representation of the relationship between creativity and innovation has been researched and developed on, to arrive at a synoptic map clearly depicting the journey of an idea to valuable innovation, requires far more rigorous testing by experts. The five case studies presented herein, shows the first level proof of the real life possibilities of this synoptic map done under the constraints of a doctoral study. It is hoped that future researchers, both from the industry and academia can take this synoptic map to test thoroughly the validity, and perhaps develop on it.

Future directions. Time and again the possibility of introducing artificial intelligence (AI) has been brought before the author, suggesting that numerical values maybe attributed to the various variables across the cogito-intelligo-efficio path to make the synoptic map dynamic. This could be an area to study further so that pre-planning for innovation maybe better managed. With the power of AI to bring in big data in real time, it is possible that this synoptic map could become an important addition in the tool-kit for innovation.

In summary. At the end, this thesis has produced a detailed visualisation of the relationship between creativity and innovation as a synoptic map, outlining the process of progression, the operators and the anticipated outcomes of each stage of the progress. What the synoptic map depicts is the kind of activities and the type of people that could best serve in the development of ideas into valuable innovation. It also highlights the kind of personnel required for knowledge management and relations building that could pave a safe passage towards successful change of value. Through this, the author feels that this thesis has made a significant contribution to understanding the relationship between creativity and innovation.

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a) Main Thesis

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Appendix

Appendix A | setting the scene

'After climbing a hill, one only finds that there are many more hills to climb'

Nelson Mandela

Source: cnn.com

To be called a creative person for most of your known life needs a lot of reflection and contemplation before it sits well on the shoulders. Every creative person, I am sure has a narrative of their life history that took them through exposures, experiences and environments that made them into the person he or she has become. This is my narrative to set the scene for an autoethnographic study of myself for the doctoral study on the relationship between creativity and innovation.

Born in 1961 in south India, only fourteen years since the independence of the country from colonial rule, I can say that I grew up together with India as it went through its path to self-reliance. My own voyage to self-reliance has been unique, taking me in and out of India, before settling down in Singapore and becoming a citizen in 2010. Appendix A is meant to give a glimpse of the factors that have been influential in who I became. In setting this scene, my intention is to explore in an indirect manner, the correlation between my life experiences and takeaways and the various acknowledged models of creativity and innovation that have been researched for well over a half a century.

As in everyone's life, I was influenced by many factors: **people**; parents, grandparents, siblings, relations, friends of parents, neighbours, friends at school and college, wife and children, friends, colleagues and collaborators, distractors and detractors, and, especially, strangers in the new places that I find myself ever so often.

Physical environment. My first memory as a child starts in Chidambaram¹³⁴ and Tuthukkudi (Tuticorin¹³⁵), where I was born. I was then transported thousands of kilometres away into Ottawa, Canada, from the rustic, developing India, into a highly-developed world. This was followed by Chennai, Mumbai, Singapore, London and Tokyo (brief period) before settling down in Singapore. Living in different countries for time periods that could affect one's understanding of **culture** and **heritage**, has influenced how I think through any design

¹³⁴ Chidambaram is a city/town in Tamil Nadu, India, famous for its *Thillai Natarajan Temple*, built by the Chola Kings around 900AD and *Annamalai University*. Lord Shiva is reputed to have danced his *Ananda Thandavam* (dance of eternal bliss) where the temple stands today.

¹³⁵ Tuticorin, now called Thuthukkudi, was officially 'founded' around 1628 by the Portuguese, who later gave it up to the Dutch, before the British East India Company took charge of the town in the 18th Century. Reminiscence of the Portuguese can be found in the number of bakeries that are there today, as well as in the names of the families living in Tuticorin, such as DeVotta, Paiva, Fernandes, Charles (pronounced Char'lez) and the large Catholic community.

and/or **socio-cultural issues** that come in front of me. Sudden transportation to Canada, whilst I was getting to terms with myself culturally, was an experience not all children get to enjoy. The hustle-bustle of life in an Indian town, that I was getting used to, gave way to another one; the hustle-bustle of Western civilisation. Leisurely breakfast that my mom or grandmother made gave way to cornflakes with milk. Trip back for lunch from the school gave way to bread with peanut butter and jam, plus a fruit. Dinners which used to start at 8 30 pm gave way to 6 30 pm dinners. Free time also had different meanings. Sitting in the main hall chatting to my mom, sisters and grandmother and the time I had with my grandfather on Sundays, gave way to watching black & white TV and early bedtime. Weekends were organised outings with my mom and dad to spend with Indian and South Asian friends and families, or go on sightseeing trips to nearby places like the Niagara Falls. There were no temples, or mosques in sight. Churches looked grey, built of stone and cement; not the brightly whitewashed ones that I was used to.

Coming back to India after three years in Canada was another shock, both pleasant and otherwise. How I had missed my sisters, grandparents, and the countless numbers of granduncles, grandaunts, uncles, aunts and cousins. How I had missed the mosques, temples, churches, the religious processions, the music, the smell of camphor and sandalwood that went with the ceremonies and rituals of faith. I was so glad to be seeing the bazaars, the flower shops and the teashops. I was also shocked at the dirty streets, open sewerage, bad toilets and the smell. I was just getting used to the luxury of a developed nation, it seemed.

My later trips to Europe, North America and to Japan in Asia were more sombre, having experienced India turnaround, albeit slowly. I was more interested in understanding the way that culture in these countries has evolved from their respective roots, allowing myself to be immersed in the aesthetics of the culture in each of the countries. While Europe and USA evoked memories of life in Canada, it is Japan that made me sit up and notice, to take reference to the beauty of the culture I am from and how Japanese could internalize their concept of aesthetics and bring out order to their built environment, right from the kimonos to the tea ceremony, to the Zen gardens.

Faith and rituals. Born into a Tamil Muslim community in Tamil Nadu, I grew up surrounded by Hinduism, punctuated by Catholic and Protestant Christianity, with a dusting of Sikhism and Jainism. After my migration to Singapore, I was introduced to Buddhism and Taoism. I studied briefly in Saint Xavier's High School (Catholic) in Tuticorin, and Corley High School (Protestant) in Chennai followed by Loyola College (Catholic), Chennai for my pre-university before embarking on higher studies. I was introduced to Sufic Islam, by my maternal grandmother who followed the Shadaliah Tariqa (path) of Sufism when I was twelve years old. I was later married into a Singaporean family who hail from a town near Nagore, where the famous Sufi Saint Shahul Hameed's mausoleum (Dargah) dominates life in that region. Thoughts of Judaism came into my life as I grew older and was studying in London, through friends who are Jewish. For most part, I live as a private Sufic, adhering to the tenements of Islam, while respecting the Abrahamic faiths and the Hindu-Buddhist - Jain - Sikh influences of South, South East and East Asia. Having been in this journey through faiths has given me a greater perspective on *rites* and *rituals* and has allowed me to assimilate myself to different culture and heritage easily.

Our Lady of Snows Shrine Basilica, Tuticorin
Image: thoothukudilive.in

Thillai Natarajan Temple, Chidambaram
Image: TripAdvisor

Dagah Sharif, Nagore
Image: trawell.in

Figures 1-3: Three places and three faiths

Educational environment. since the age of five till fourteen, I studied in seven different schools, averaging one school every two years. This ranges from a village school, to municipal schools, to home school, to schools run by secular as well as Christian organisations. This has offered me several advantages. Making friends in any country, any society and any strata comes naturally to me, which in turn, has allowed travelling to the hundred and ten cities and towns much easier than I could imagine. Transporting from Chidambaram, India to Ottawa, Canada at the age of eight years old also has had a tremendous influence on me. I was thrown into an all English-speaking environment from an all Tamil-speaking

Two incidents during my study at Corley High School has had profound effect in the way I treat people.

One happened in my ninth standard, when I discovered that a studious student in my class had to rush back home after school to take a basketful of eggs strapped to his bicycle and sell door to door. I found him sitting in the front porch of my home one evening, selling eggs to my mom. He casually looked at me and said 'Hi' before explaining to my mother that I was his classmate. He had recently identified himself to my elder sister on the street, reminding her of his days of hardship. He has since become an engineer and migrated to USA.

The other occurred while studying eleventh standard when I was the class monitor.

I tugged at an unruly student only to have the shirt tearing away from the boy. His only shirt had been torn to shreds.

All of us put some money to buy him a white shirt from a readymade dress shop.

The fact that this classmate died tragically in a farm accident just before the high school results came out makes this memory painful.

The end result of these two experiences has been an acute awareness of what extreme materialism can do to societies and puts me on the guard when I design products. To this day, I have refrained from designing luxury products.

society, literally overnight. In three months' time, I found myself speaking fluently in Canadian English. Today I consider myself a native speaker of two languages, Tamil and English, since my thoughts need not get translated from my mother tongue (Tamil) to English before I speak, unlike Hindi, German and Japanese, which I try to speak with varying levels of difficulty, that require thinking in Tamil before I speak. Deliberately studying in non-elite schools - my father's decision - brought me face to face with classmates who come from different **economic strata** of the society. On the one hand, there were classmates who had the money for chauffeur driven cars, whose lunch was at a restaurant down the road every day, while on the other, classmates who have hardly one pair of school uniform to wear, which means that they wash and dry the same uniform every night to wear the next day.

Education. my path to becoming a designer was not only through seven different schools and their environments. It also had to do with what I chose to study. At the tenth standard in high school I opted to join the engineering stream, which meant I had to do carpentry and fitting as workshop modules, learn engineering drawing and study materials of engineering. For this, we had to trade history and geography subject and study a reduced Mother Tongue (Tamil) course. At the end of my high school (11th standard), discussions with my father as well as his friends and my peers led me to believe that the way to becoming a designer / applied artist is through a degree in engineering or architecture. Hence, I proceeded to study mathematics, physics and chemistry as the major subjects in the pre-university programme at Loyola College, a premier Jesuit institute in Chennai with a reputation of most of its pre-university graduates going on to study engineering, medicine or law at famous universities throughout India. Loyola College was a cauldron of ambitious youngsters, most of them city boys, wanting to make it rich in India or USA. This helped me to pull myself along, though not many of my classmates understood what I would do as a designer in India. Their point of view in the late seventies was, if Hindustan Motor could not design a better car than the Ambassador (Figures 4, 5, 6) that dates back to the Morris Oxford of mid 1950s, there is no job scope for designers, except in advertising, in India.

Morris Oxford 1955!
Image: theautomotiveindia.com

Hindustan Ambassador 1979
Image: carandbike.com

Hindustan Ambassador 1990s
Image: autorevolution.com

Figures 4-6: Hindustan Ambassador from the 50s to the 90s

One year of pre-university was followed by five years of undergraduate study in engineering at the College of Engineering, Guindy in Chennai, which was established by the British as survey school in 1794. After many attempts, I managed to squeeze myself into mechanical engineering major in the third year. While my heart was on becoming an industrial designer, my mind concentrated on engineering and its related mathematics. Somewhere at the end of the third year, I started clearly visualizing mathematical equations as 2D graphs and 3D objects. Suddenly, subjects such as thermodynamics/heat power engineering, fluid mechanics and control system became interesting and I even took numerical analysis as the honours subject in the final year. The final year project, a team project which involved first level foray into computer-aided design (CAD) won a state level prize. I realized early on in that project that I am a **visualiser**, rather than the programmer, when it came to CAD; a role that has continued into my profession as a designer. As in all colleges, there were teachers who inspire you to move forward. Professors G. Ramiyan, late P. Purshothaman and late A.M. Srinivasan provided me the motivation to reach out and become the industrial designer that I wanted to be. While waiting for the results of my Bachelor of Engineering (Hons) final examinations, in the Summer of 1984, I saw a small advertisement in the 'The Hindu', calling for applicants to study Master of Design (MDes) in Product Design or in Visual Communication at the Industrial Design Centre (IDC) at the Indian Institute of Technology, Bombay (IITBombay). The first hurdle of application process required me to sketch a product and explain its plus points and negative points and send to them, after which I was shortlisted for a common entrance examination and interview and was asked to come to IIT Bombay. Arriving at the IDC, I was shocked by the crowd that had turned up to take the entrance examinations, which I estimated to be around 450 or 500 for both product design

and visual communication. After the test, forty-five students were shortlisted for the interview next day, and my name was second on that list. More than a glimmer of hope occurred on seeing the list. The second day's interview went well and fifteen students were selected to study MDes in Product Design. Perseverance and hard work seemed to have paid off; I was on my way to becoming an industrial designer.

College of Engineering, Guindy
Image: thehindu.com

Industrial Design Centre, IIT Bombay
Image: From author

Royal College of Art, London
Image: artforum.com

Figures 7-9: Three institutions with history and heritage

Prof A.G. Rao (left)
Prof Uday Athavankar (right)
Image: dsidc.com and helloux.com

IDC was co-founded in 1968 by Prof Sudhakar Nadkarni, one of the last batch students of the famous Ulm School in (West) Germany. Formed as a part of the Indian Institute of Technology, Bombay, IDC's curriculum followed the Bauhaus/Ulm School tradition with strong emphasis on Indian art, design and culture. Relationships between form and function was accentuated by emotional connotation of form elements such as radius, proportion, colour, details, etc. Introduction to the application of semantics and semiotics in product design was tempered by courses in material and manufacture and ergonomics and human factors. During the two years, I found myself under the guidance of two professors, Professors A.G Rao and Uday Athavankar, who have shaped my thinking and helped me define what kind of industrial designer I wanted to be. Three intense projects and one internship later, I graduated with an MDes in Product Design in 1986. Between 1986 and 1990, I worked¹³⁶ for Larsen & Toubro Ltd, in Mumbai and later, for Thomson Consumer Electronics in Singapore before embarking on the next educational journey in 1990.

¹³⁶I will touch upon my work experience separately

Prof Daniel Weil (top left)
 Ross Lovegrove (top right)
 Prof Steven Kyffin
 Image: designcurial.com,
 bernhardt design.com and

Challenged by a non-Singaporean industrial designer, who was sceptical of design education in India, about my abilities as a designer, during a gala dinner function, I decided that I have to build my design education far beyond anyone's doubt. Royal College of Art (RCA), the pinnacle of postgraduate art and design education, founded in 1837 by Prince Albert, the consort to Queen Victoria, was where I was going to go next. Admission to the RCA was a long-drawn process with a portfolio review followed by an interview. I was delighted to fly into London to attend the interview for admission to the MDesRCA programme in industrial design. Walking into a room full of youngsters waiting to be experience. Half way through the thirty-minute interview, Roger Sale, the programme manager, asked for a lecturer to show me around the RCA as well as the Imperial College, to familiarise myself before going back to Singapore. I knew at that instant that I had become a student of the RCA. Returning to Singapore, I booked myself a flight back to London in September 1990. Till then, I had not thought about the exorbitant tuition fees that I must pay for the next two years. Having applied for the British Commonwealth Scholarship before leaving for the interview, I got back in time to attend an interview at the British Council for the Scholarship and soon was informed that I have won the scholarship and that the British Commonwealth Office will pay the whole tuition fee for the first year. British Airways sponsored my flight to London and back for the first year. While being a mature student at the RCA had its advantages and disadvantages, I learnt to veer towards the advantages. At the RCA, Professor Daniel Weil, Ross Lovegrove and Professor Steven Kyffin, influenced me and kept me challenged all the time. One of the highlights of my study at the RCA was orchestrating a three-month internship at the Sony Design Center, Tokyo, Japan during term time. To sum up, my higher education journey would be to say it was truly **multi-disciplinary** and **multi-cultural**. Having studied in three institutes with their own history and heritage has also had a bearing on my professional life.

Parental influence. I believe that when a child is encouraged, supported, and is allowed to exhibit and pursue thoughts in his/her own way, a creative mind is cultivated. The **multi-faceted exposure** and experience that I have been having since childhood maybe attributed to the influence that I have had from my parents, especially my father, Professor S.

Prof S. Sathikh, former Vice-Chancellor of the University of Madras. Hailing from a small village in Tamil Nadu, India, studied bachelors and masters in mechanical engineering before obtaining his PhD from Carleton University, Ottawa, Canada.

Inspiration to a generation of Muslims, as well as to people in the lower strata of the society, in Tamil Nadu, many children are named after him in the recent past.

Image: From author

Sathikh. Born in a village in the southern part of Tamil Nadu in India to a merchant father and landlord-farmer mother, Professor Sathikh, even though an engineer, had taken keen interest in Tamil and English literature early in his life. A self-taught artist, my father could grasp the fact that art and science have a special relationship, which can blossom into unique manifestations of beauty and function. From the day I can remember, I have been very keen to draw anything on everything that came my way; from books, to newspapers, to walls and floors. My father, and to a great extent, my mother, did not discourage me from drawing, and in fact they would buy chalk piece in bulk for me. While I have no specific memory, my parents would be able to see complex scenery in what I drew, which was mostly people interacting with buses, lorries, scooters or walking on footpath or engaged in farming. While I can explain the buses, lorries and scooters, I have no memory of where I could have caught glimpses of people walking on footpath or engaging in farming. The scale of the drawings got bigger and the stories larger when I started drawing on the brick tiled floors of the rented house we were staying in Chidambaram.

By the time I was seven I had an intuitive idea of perspective and that helped me further visualize sceneries. At this point in time, my father introduced me to caricature, and suddenly face and facial features became interesting. Comic books featuring the only superhero known in India at that time, the *Phantom*, became a regular feature of my drawings. While I grew up and travelled to all the places that my father either studied or worked in, I saw my father rise in the ranks to become senior administrator in several educational institutes. This meant that I had **access to books and magazines** that are not normally available to high school, or even college-going students unless they visit the university library or the British or American libraries. Being the head of the institute, my father got to read/glance the magazines before it went to the library. With the effect, I was reading *Popular Mechanics*, *Popular Science*, *New Scientist*, *Newsweek*, and even *International Design (ID)* magazine by the time I was fifteen years old. India of the 1970s, 80s and early 90s did not have mechanisms to allow the sales of international magazines freely. Hence it was a rare privilege that came with growing up with my parents.

Images: From the author's collection

Figures 10 -13: Magazines to read

My mother had studied only up to standard five (elementary school), after which she was home schooled in ‘civics and etiquette’ by the ‘fine ladies’ from the Catholic community in Tuticorin. This ‘finesse’ towards good taste, my mother passed onto me, in a rather Anglo-Indian style, as a child. My mother easily dissolved the complexity of thinking that my father posed into simpler thoughts for me to chew on, as a young boy. This understanding of **simplicity** and **complexity** in thoughts and deeds allowed me to deduce the path to **sophistication** in the time to come.

Relations, friends and neighbours. It did not take any one much time to see that my hands can draw the scenery that the mind had visualised, even at a very young age. The first family that encouraged me to draw was the house of ‘opposite house thatha (grandpa)’, situated opposite to the house we lived in, on VOC Street in Chidambaram between 1965/66 and 1968. ‘Thatha’ was the owner of the house that my parents had rented, and I could walk freely into ‘thatha’s’ house which had a central courtyard (Figure 14) shared by the innumerable sons, sons-in-law, daughters, daughters-in-law, nieces and nephews and grandchildren. On Sundays, after breakfast, grandpa himself will call out to me “thangappan” – literally ‘golden-boy’ - inviting me for the weekly sketching session. The courtyard will be kept dry for me and dozens of chalk pieces will lie be lying around. I will proceed to draw after a round of cheerful discussion on what I should be drawing. It could be the Taj Mahal, peacocks, scenery with mountains/hills, rivers and palmyra trees or women returning with pots of water from a nearby well or farmers tending to paddy fields. Many a time a ‘route’ bus will be seen at a distance – perhaps a reassurance that urban civilisation is not far behind. Everyone at the grandpa’s house would not only **encourage** me but also **praise** me for the talent that I had.

Opposite side grandpa's house had at least 20 people of all ages living there. There were rivalries and catfights, which was interesting for me to follow. Two cousins, Selvam and Mani, (both around 10 years old) would not talk to each other and each had a following within the house. My decision to support either one of them that week depended on what they could teach me. One of the interesting thing that I learnt from Mani was that you could actually screen movies by reflecting the silver of sunlight that came through the tiles of a corner (disused) room, through past a contraption made of card board disk and thread spools which rolled pieces of 35mm films and a piece of lens. We would watch the same few reels that Mani could muster from the nearby cinema theatre. Children from the family, except Selvam, were allowed to watch, after paying a few paise. Mani even had tickets to the screening, which I illustrated individually!

Image: stockicturesforeveryone.com

Figures 14: A courtyard similar to the one that I used to draw on

Was there any *inspiration* to how I drew back then? Watching women come out and draw the traditional 'kolams'¹³⁷ every morning (Figure 15) was, and is, breath taking. I would watch the kolams unfold as the ladies joined the dots. Not only patterns were drawn in kolam, birds and animals could also be drawn.

Image: dakshinachitra.net

Figure 15: Typical morning scene, like the ones I would wake Up to, in Chidambaram

At the age of seven, I was deeply aware of, not only the beauty of the kolams, but also the **beauty** and the **grace** of the women who were drawing it. This beauty, I would try to depict when sketching women drawing or carrying water or tending to the fields. This routine of drawing/sketching continued even when I went back to Tuticorin during vacations, where my maternal grandmother and grandfather would allow me to decorate the main living area floor with my sketches of elaborate scenery. Even the visitors, who were by

¹³⁷ Kolam is a geometrical line drawing composed of curved loops, drawn around a grid pattern of dots. In South India, it is widely practiced by female Hindu family members in front of their houses - Wikipedia

and large, relations, would sit together in the small corner that I allocate for them, allowing me to sketch to the extent that the room would allow me. Themes like robber and cops would have scenery of heist/crime followed by trails of objects. The cops would be visible on the floor and the thieves/bad guys will be drawn behind doors, since bad guys had to hide. This sketching went on till I left for Ottawa, Canada, where the education system by itself encouraged me to draw big sketches, watercolours and murals in the school itself.

Image:
Hopewell Avenue
Public School from
the west" by Dmitri
Lytov - from
Wikipedia

Figure 16: Hopewell Avenue Public School, Ottawa

Play and play-acting. Memories of playing with children starts around 1965/1966 at Chidambaram . Already a darling of the local municipal school for being an artist, I had some interesting friends who would come down to my house to play after school hours and weekends. Our regular play was an imaginary street scene where I would make a few shops out of large discarded cardboard boxes that my father had brought from the university. We would scrape coloured powders from chalk pieces, bricks and any other brittle objects, squeeze coloured liquids from end pieces of vegetables such as carrots, beetroots, spinach, etc., to get coloured liquids, keep some pieces of vegetable and make do with discarder toothpaste, soap and talcum powder packaging (representing the products themselves) before setting up the shop in the only living area in the two room house we were living in. The setting up of the shops,

arranging the items, tearing coloured sheets from the many magazines to decorate the shop took many hours. My mother and the neighbourhood aunties and kids would join in the make-believe world of me and my friends, and buy items from the shops. Paper currency notes that I would have painstakingly designed would be used for transaction. Even while pretending to be grown up shopkeepers we would take pride in the accolades, compliments and the occasional kisses from parents, aunts and uncles that come our way. Usually the play lasted for an hour or so (I think) before it starts to dither. My mother had the ominous job of cleaning up afterwards, which she would do without much complaining. As I grew up, pretend play gave way to real play such as marbles, kite flying, hopscotch and board games as well as sports such as football/soccer, while what I learnt from the pretend play¹³⁸ would feed the imaginary world of my sketches and drawings till today.

Socio-politics. Mid 1960s was less than twenty years since the independence of India, and events of the 30s and 40s were vivid to most of the adults alive. By 1966, with both the leading figures of Indian independence, Mahatma Gandhi and Jawaharlal Nehru deceased, India was looking to new leadership under Mrs. Indira Gandhi, the daughter of Mr. Nehru. As a boy of 6 or 7, I would sit and listen to friends and colleagues of our parents debate about which of the two leaders' ideals should India be following. Mahatma Gandhi's vision of India was 'swadeshi', a form of self-reliance in the 'desh' (country), which meant home production of basic goods, self-sufficiency in basic requirements in the village. Gandhi also expected everyone to spin cloth with a spinning wheel.

¹³⁸ Sandra W. Russ (Russ, 2014) has written a book titled *Pretend Play in Childhood: Foundation of Adult Creativity* where she places the importance of play; especially pretend play, in context to the development of creativity in adults. Even as far back as 1925, Vygotsky (2004) had written about children and imagination.

Image: pressenza.com

Image: congresschronicle.in

Figure 17 -18: Mahatma Gandhi and Jawaharlal Nehru

Nehru's vision, on the other hand, was towards the Soviet model, which meant steel mills, heavy industrialization, tractors in the farm, dams, and hydroelectric power plant. Nehru was for a socialistic form of government and eschewed capitalism that many countries in the western world yearned for. As a boy of seven-year-old, I would hear Nehruvians, who like my father, were mainly first generation educated, discuss the downside of the frugal economic model of Gandhi. While there were arguments for and against Nehru's vision, everyone agreed on the moral discipline of Gandhi's approach. Nehru's side, to me, represented the brain of the country while Gandhi's represented the heart. Which is better? This was a big question for a small boy. These arguments/discussions, and the country's need for rationing of basic necessities such as rice, sugar, oil, flour, etc., coupled together with a sudden exposure to the capitalist world at the age of eight, with its conspicuous consumption and endless departmental stores, with varieties of food items and abundance of produce gave me a clear idea of what I wanted to become when I grew up; someone who is interested in the social welfare of people. Later in life, walking along the slums of Chennai and Mumbai and strolling across the boulevards of North America, Europe and Japan helped me come to terms with design, particularly industrial design. I started to believe that the trappings of development do not mean it should lead to meaningless consumption. At the same time, as a designer, I need to part take in the potential real life use of technologies as they emerge and not shy away from it citing 'Gandhian' philosophies. The **dichotomy** is better balanced when one understands the socio-political visions of Nehru and Gandhi, as I still believe till today.

India: Ration Shop
Image: telanganatoday.com

India: Departmental store today
Image: ft.com

North America: K-Mart in the 1970s
Image: flickr.com

Figure 19 - 21: Provision shops in India and Canada

Logos of Larsen & Toubro, Thomson Consumer Electronics and Sony Corporation: L&T taught me decorum, Thomson on poetry and prose of design and Sony, discipline
Logo source: Various

Working for corporations. Right after graduating from the Industrial Design Centre, IIT Bombay, I started work as Assistant Industrial Designer at the Research and Development Department of the Switchgear Division of Larsen & Toubro Ltd. (L&T), one of the leading companies in India. Being the first industrial designer to be hired by L&T, I became de-facto 'head' of my own department, which allowed me to report to the second man in R&D, as well as to attend the heads of department meetings on Sundays (L&T's weekly off being Saturday). Sunday meetings allowed me to mingle with the senior 'covenanted' officers and get a first-hand experience of where the company was headed. Lunchtime on Sunday would see me sit with the senior management and giving me opportunity to talk about the potentials of design in L&T. Though a short period of time, L&T taught me about **ethics** of R&D and the **decorum** with which I should carry myself as an 'L&T designer'.

Marrying a daughter of a family friend from Singapore saw me emigrating from India. Moving to Singapore in May 1988, proved to be turmoil initially. After exhaustive efforts, I joined the French consumer electronics giant, Thomson Consumer Electronics, in the product development department of their European Malaysian Electronics. Thrown into their mechanical design department, instead of the industrial design department was a huge disappointment, especially after a stellar start at L&T. Sitting across the table with industrial designers and listening to diatribes on the 'aesthetic qualities' of their audio product designs was quite a humbling experience. At the same time, the opportunity to work on a given industrial designs and take them through mechanical layouts, detailed design of parts, dimensions, fits and tolerances, material selection, working prototype fabrication, trouble shooting and fine tuning part design, tooling for production, supervising pilot production runs, release of

product graphics for printing on parts, design of packaging, physical testing of first batch production and eventual handing over of the project to the production team, made me into a full designer. I suddenly understood the importance of **poetry** (aesthetics, shape, form, colour, and ease of use, etc.) and **prose** (functional relationships, parts and sub-parts, fitment, selection of materials, etc.) of design in bringing out successful products. I was ready for the next part my journey, to study, this time at the Royal College of Art, London in 1990.

Mr. Norio Ogha (L) and
Mr. Nobuyuki Idei of
Sony Corporation
Image: alchetron.com and
londonspeakerbureauasia.com

An internship opportunity to work at the Sony Design Centre, Tokyo during the time of my study at the RCA offered me a third insight into working as a designer within a corporate sector. Asked to bring a project with me to Sony, since the internship happened partially during term time, from December 1991 to February 1992, I was assigned to the ‘computer’ group that was headed by designer Mr. Masuda and had seven other industrial designers working on products ranging from mini computers to ‘my first Sony’ products. My study project, which was to design a ‘travel aid’ for air travel, was inducted into a department project and I had to present along with the others and discuss the progress of the project on a regular basis. With more than 200 designers under one roof and responsible for designing more than one hundred new products for Sony, at any one time, Sony Design Centre was sanctum sanctorum to learn about industrial design in the 90s. Working in close quarters with designers whose products are being sold around the world, was a great experience. Due to the short time period of internship, learning was accelerated. The lessons of L&T and Thomson and the prestige of studying at the RCA combined together, allowing me the **opportunity** to meet with the **top people** at Sony Corporation. I was taken to the corporate office to meet Mr. Nobuyuki Idei, then Vice-President for Marketing. Idei-san, a sophisticated person proved to be well versed in design. The fact that Idei-san came for the final presentation of my project work before I left back for the RCA, was a personal honour for me. A chance encounter, while working alone on a Saturday at Sony Design Centre, brought me face to face with the (then) Chairman Norio Ogha. After enquiring what an Indo-jin (Indian) is doing all alone in the office on Saturday, he warmly greeted me, enquiring about my experience at the Sony Design Center, wishing me well before continuing with his ‘stealth’ walkabout. A third person of importance that I met in Tokyo during my internship was Mr.

Hayashi of Axis Magazine in Japan. An influential figure in the world of design, Mr. Hayashi, founder of Axis Magazine, spent almost a full day with me when I visited him during January 1992. Mr. Hayashi was instrumental in my meeting famous designers such as Zohrab Vassoughi of Ziba Design, USA.

All in all, working for three corporate giants in three different countries taught me three concepts that have become important hallmarks in my work:

- Carry yourself with **decency** and **decorum** always (L&T)
- Understand the **nuances**, i.e., the **prose** and **poetry**, of design (Thomson)
- All creative endeavors need to be tempered by **discipline** for it to be successful (Sony)

Entrepreneurship. Returning back from the RCA in September 1992, I found myself working as the Industrial Design Manager for a company named Inventure Development Pte. Ltd., in Singapore, founded by a US based designer, Scott Voorhees, who had co-invented a rolling highlighter, which was aptly named *Rolliter*. Again, my experience of taking an idea till production saw me work on projects that were tooled and manufactured in Indonesia. Working for an enormously talented Scott Voorhees allowed me to learn about starting up and running a company on other's investment (Scott's father, in this case). Working mostly on the 'prose' side of design at Inventure Development seemed to be a dead-end street for a 33-year-old designer and an opportunity to work on the poetry side came in the form of Senior Industrial Designer with an Australian industrial design and product development company named NeoTechnics Asia-Pacific Pte Ltd., in 1994. Located at Tanjong Pagar in Singapore, NeoTechnics was managed by an Australian named Carol Liavas, with whom I forged a close professional friendship, becoming her right-hand man before she returned back to Melbourne, leaving me in-charge as the General Manager. The two years of working with Carol Liavas was one of the most creative time in my life. In rapid succession, I could design several products that were released quickly to the market, with clients such as Black & Decker-Bajaj, DeWalt, and start-ups such as P-Serv and Innomedia. NeoTechnics, through Carol, gave me an opportunity to learn the **marketing** side to the creative industries. To the three foundations of *decorum*, *nuance/finesse* (poetry and prose) and *discipline* that I had

INOVASIA Design
founded in 1996,
merged with Amtek
Engineering in 2005
Logo source: Author

learnt earlier, NeoTechnics added **tact and diplomacy** and finance/**economics** into my mental repertoire.

The short life of NeoTechnics in Singapore ended abruptly in August 1996, by which time, with encouragement from clients, I had decided to start a design and development consulting firm together with a younger, Australian educated industrial designer named, Derek Lim Yong Tang. Derek, who was working for another design consultancy, joined me in September 1996 to start INOVASIA¹³⁹ Design Pte Ltd. Started at the third level of a shophouse in Temple Street in the Chinatown area of Singapore, INOVASIA differentiated itself from the competitors through its design-to-production capabilities, offering services in industrial design, graphics and packaging design, mock-up and prototyping, mechanical design, tooling management till pilot production supervision. In other words INOVASIA offered both poetry and prose to discerning clients while agreeing to either prose or poetry from clients who wanted only one of INOVASIA's business. The period 1996 to 2000 was prolific, where the two of us serviced both local and multi-national clients and companies. Marketing of INOVASIA's services was mainly through word of mouth with a faint presence in the fledgling Internet through Core77.com. This period also coincided with what is described as 'design renaissance' of Singapore in a Chapter titled *The Transformal Role of Product Design in Singapore's Transition to a Service Economy* in the Handbook of Research on Trends in Product Design and Development (Sathikh, 2011). With only the two of us as full time employees, it became apparent by the year 2000 that, to grow further, we needed to expand with more talents (manpower) and up-to-date computer aided technologies. The revenue generated thus far was sufficient to keep our heads above the water, but there was no spare cash for expansion. The next personal ingredient for me was revealed at this point. Having decorum and discipline at work led naturally to good **business ethics**, which in turn allowed for **good relationships**¹⁴⁰ with both the clients and suppliers, vendors and business partners across Asia, Europe and North America. Word was sent out that we are looking for investment partners, especially to our vendor partners who were moving into the newfound business of

¹³⁹ The name, INOVASIA is derived from the Malay word 'inovasi' which means innovation and the word 'Asia'. In other words, INOVASIA means innovation in Asia.

¹⁴⁰ Good relationship is important when doing in business in Southeast and East Asia. *Guanxi* as it is termed in Chinese, is a system of social networks and influential relationships that facilitate business dealings.

‘contract manufacturing’. With the result, two of the emerging name in manufacturing in Singapore, both with stellar performance and ambitions to match, started courting INOVASIA about 2000.

Figure 22 - 23: With Derek Lim and first employee Lau Swee Heng (left) in 1998 and with Derek Lim, in 2015

meiban
we shape your ideas™

Meiban Group
and Amtek
Engineering;
both home
grown, Meiban
started as
plastics tooling
and moulders
and Amtek
started as
precision metal
stampers.

Logo source:
Meiban.com and
links. sgx.com

Investment experience. With an impressive portfolio of work in hand and expertise in taking products from sketches till pilot production, Derek and I were well versed with the verification and documentation procedures associated with new product development as well. This type of expertise is highly valued by parts manufacturing companies who were at the brink of entering the contract manufacturing market which had become the hall mark of globalization in the late 1990s. Two Singapore listed companies, Meiban Group Ltd., and Amtek Engineering Ltd.,¹⁴¹ entered into detailed discussion with us for investment. Leading the discussions as the Managing Director of INOVASIA, I had to quickly learn about company valuation, business plans, business and financial forecasts, return on investment, manpower and equipment planning based on sales forecast. Meiban being a plastic manufacturer, looked forward to INOVASIA become more plastic centered design and development team, while Amtek being precision metal stampers wanted INOVASIA to emerge after the investment as an expert in metal based product design. With the both not revealing how much they are willing to invest, we decided to go with Meiban, which made Amtek disappointed. Amtek called for a three-party meeting to sort this out to which all agreed and a date was set. Anticipating some trouble, we decided to take our

¹⁴¹ Meiban Group is no longer listed, with the founder Mr. Goh buying back all the shares. Amtek Engineering Ltd. was taken control over by a group supported by investors and since refocused its business and renamed as Interplex.

solicitor to the meeting. The deliberation looked like two elephants fighting for a coconut tree, each positioning themselves as the worthy suitor, before the Managing Directors of both the companies, both giants in their own right, decided that both should invest into INOVASIA. Our solicitor got alert at this point and said that Derek and myself should continue to have major shares after the investment and have the autonomy to run the company based on an agreed common strategy. A tripartite business agreement and shareholders' agreement was crafted by our solicitors before the boards of each company passed their own resolution to acquire shares in INOVASIA. This was the next learning stage for me, when I understood more about **business negotiations** and a **higher order of decorum** in one's behavior. I also learnt how to write agreements, working with our solicitors on the legal parlance to be used in securing fairness to all the three parties concerned. Between them both, the companies decided to invest 0.75 million with Derek and I holding 51% share together. It was also decided that INOVASIA would move to the 7th floor of Meiban Building at Ubi Road 1 in Singapore. Realising that Amtek and Meiban are competition for the contract-manufacturing share of the market, delicate non-written agreements were made between the both with INOVAISA left wondering how to balance the two suitors. Moving into the 7th floor at Meiban Building (Figures 24 to 27) in 2001 was a world of difference from the shophouse studio at Chinatown.

Figure 24 - 27: INOVASIA Design at the 7th Floor of Meiban Building

Staff strength increased from 1 (excluding ourselves) to 12 with 5 industrial designers, 6 mechanical designers and 1 electrical & electronics engineer. Equipped with multiple licenses of the state-of-the-art computer aided design (CAD) systems and light workshop for model making, INOVASIA Design moved a notch up with multiple and often complex projects from multi-national companies and established hi-tech companies in Singapore and the region. Being a part of two listed companies raised INOVASIA Design's profile. Revenue registered a sharp rise though the profit margin was down. INOVASIA Design seemed well on its way to fame and fortune. The euphoria was not to last too long. In 2003, Singapore was hit by SARS (Severe Acute Respiratory Syndrome), a deadly coronavirus that was brought in from Hong Kong by a few tourists returning back. Suddenly the country was gripped in paranoia, everybody was wary of moving freely in Singapore, wary of touching the objects of the environment such as doorknobs and escalator handhold. For INOVASIA, the shock was in multi-national companies cancelling projects since no personnel wished to travel to Singapore and the region. With booked orders being cancelled and sudden loss of anticipated income, and with heavy overheads from the expanded manpower and equipment lease, INOVASIA Design found itself struggling to run its operations. By the end of 2004, we called for a Board Meeting to explain the situation and to explore options for continuing the operations. There were less than warm exchanges, and at some point, during the meeting I declared that Derek and I preferred "one wife and not two", i.e., having two listed companies to watch over was hurting the business. There was complete silence before the board members from Meiban and Amtek requested Derek and myself to step outside for a while. We were called back in and the chair of the session said to us that one of the two will buy out INOVASIA Design lock stock and barrel, but for a token consideration only. This is to cover the liability exposure of INOVASIA Design in terms of loans and outstanding bills. Derek and I, however, had to prepare a new business plan to woo the top management of each partner (Meiban and Amtek) to buy us out. They, in turn had to present their plans for INOVASIA Design, if we were to agree to one of them. After a month of deliberations amongst ourselves and discussions with INOVASIA Design's employees, it was decided that we would merge with Amtek Engineering Ltd. Meiban Group was disappointment while Amtek felt

delighted at the prospectus of INOVASIA Design being a part of Amtek Group.

Figure 28 - 31: INOVASIA Design @ Amtek

The entrepreneur in me was not resting and continued to push me to look for the excitement of start-ups. In 2005, I brought a group of Indian plastics engineers together and co-founded Teknovate Group in Singapore, which has invested in establishing a plastics injection molding factory in Chennai, India. As a shareholder, I am a non-executive director and advisor to that company, **Teknovate Plastics Private Limited** which has grown in to a profitable company by 2018.

Leading the DAS delegation to ICSID2005 in Copenhagen

One of the highlights of my presidentship of DAS was leading the Singapore delegation to Copenhagen, Denmark in 2005 for a successful bid for the world conference of the International Council of Societies of Industrial Design (ICSID) 2009 to Singapore.

Image: author

Leadership experience/exposure. being one of the second generation of industrial designers in Singapore offered me opportunities to part take in the development of design profession as well as design education. An early member of the Designers Association Singapore (DAS), I was elected as Honorary Secretary in 1995 and became the Vice-President of DAS in 1997 before becoming its President from 2003 to 2007. With the whole country going through a review of the economy, I was invited to be a part of the **Economic Restructuring committee (ERC)** for the creative industries in 2001 by the Ministry of Information and the Arts (MITA, as it was then). For several months, there would be whole day meetings with government officials and members of the international advisory committee on design that included

Chris Bangle from (then) BMW, architect Toyo Ito, designers Seymour and Powell and others. I got to know key designers and design groups in Singapore and the region, thanks to the ERC. Recommendation of ERC on creative industries included setting up a high school level school for the arts (which is now SOTA) and a school of art and design in the Nanyang Technological University (which is now ADM). As the elected President of DAS, I was responsible for **representing** the **design community** of Singapore in public and private initiatives. The DesignSingapore Council was also set up under the MITA and I was inducted into their Industry Development Council as the President of DAS. This gave me insight into the policies that are in place and government's vision of art and design in Singapore. I was also invited to be a member of the **Art Education Council (AEC)** chaired by the State Minister for Education to discuss art and design education from K1 to undergraduate education, both private and public funded. Deliberations of the AEC gave me an opportunity to understand government's **vision** and **direction** on art and design education in Singapore. Having been involved in design education in Singapore in one way or the other since 1993, helped in my contribution during the discussions in AEC. As for participation in the development of design education in Singapore, it started in 1996, when Temasek Polytechnic Advisory Committee Member at the School of Design. Since then I have had the privilege of being in the Advisory Committee of the School of Design at Nanyang Polytechnic. In 2004, Ngee Ann Polytechnic invited me to be the Chair of the Advisory Committee for the Diploma in Product Design & Innovation, which I held till 2013.

At Ngee Ann Polytechnic, I was given a free hand to work with the faculty to set the syllabus and course modules. I was also given opportunity to develop parts of the syllabus for the BA programme in Industrial Design for the National University of Singapore as well as for Singapore Polytechnic's Diploma in Product Design and User Experience programme. In being the Chairman of an advisory committee for one programme and member of several others, I could take my experience as a consultant and member/president of a professional body into the deliberations and **guide the direction** of polytechnic education in Singapore.

Teaching experience. Since returning from studies at the RCA in 1992, I had been involved in teaching industrial design in one way or the other. Initially invited for guest lectures by NTU, Temasek Polytechnic, Nanyang Polytechnic and Ngee Ann Polytechnic, the first serious teaching offer came from the School of Design at Temasek Polytechnic in 1996, to be a part time lecturer for two semesters to cover for a lecturer who had gone on study leave. In 1998, I was invited to do an In-house practical training (IHPT) workshop for the Year 2 students of Bachelor of Engineering (BEng) the Design Stream at NTU. By now many key faculty in the (then) School of Mechanical and Production Engineering, had come to know me. When the Singapore-MIT Alliance (SMA) was formed, NTU offered me an annual contract to teach one module on Industrial Design to students of SMA's Masters in Manufacturing Technology. I had been teaching at SMA since 2002 till SMA's ten-year mandate with NTU was completed in 2012. The call to teach part time at ADM came in 2007 by the then Associate Chair (Academic), Associate Professor Suresh Sethi, who I had met during the 20th anniversary celebratory dinner of the Designers Association of Singapore. After seeking permission from Amtek's management, I agreed to teach one course, Product Design III, to year 3 students of the first batch of the cohort at ADM. When turmoil hit Amtek in mid 2008, I decided to apply for the Assistant Professor post that was vacant at ADM. In August 2008, I started my second leg of the journey as a fulltime faculty to teach design.

*'If I have seen further
than others, it is by
standing upon the
shoulders of giants.'*

Sir Isaac Newton

Source:

bbc.co.uk

Designer to innovator. By 1996 I was an established industrial designer, acknowledged as creative at both the poetry (aesthetics) and prose (function) ends of design. This perception of myself suddenly took a change when the Board of Amtek Engineering Ltd., decided to name me as *Lead Innovator* (Figure 32). How did this happen?

Figure 32: Amtek name card with the title of Lead Innovator

Source: Author

What do people see in me that has changed? When did I move from a *creative* designer to an *innovator*? Does my life journey reveal any pattern of development that shows my progression from creativity to innovation? Can this journey lead me to understanding the structural relationship between creativity and innovation? Could I start with an analytical study of my life thus far, that could lead to better understanding of the relationship between creativity and innovation? These are the starting questions of my doctoral study that intends to map the relationship between creativity and innovation as a synoptic diagram.

The observation of any concrete pattern in the life journey of the individual that could lead to a better understanding of the relationship between creativity and innovation and the analysis of this to brings out the essentials forms Chapter 3 of this thesis.

Annexe

Annexe 1 | IRB Approval

IRB-2018-06-015

3 July 2018

Associate Professor Peer Mohideen Sathikh
School of Art, Design and Media

NTU INSTITUTIONAL REVIEW BOARD APPROVAL

Project Title: Assessing the creativity and innovation abilities of leading designers/innovators through interviews

I refer to your application for ethics approval with respect to the above project.

The Board has considered your application and noted from your application that your research involves collecting behavioral data from participants through interview.

You have also confirmed that informed consent will be obtained from the participants and you have guaranteed the confidentiality of your participants' biodata obtained from them.

The documents reviewed are:

- a) NTU IRB application form dated **15 June 2018**
- b) Participant information sheet and consent form: version 1 dated **15 June 2018**
- c) Data collection form: version 1 dated **15 June 2018**

The Board is therefore satisfied with the bioethical consideration for the project and approves the ethics application under **Expedited** review. The approval period is from **3 July 2018** to **2 July 2019**. The NTU IRB reference number for this study is **IRB-2018-06-015**. Please use this reference number for all future correspondence.

The following protocol and compliances are to be observed upon NTU IRB approval

1. Any research involving subjects less than 21 years old would require IRB approved written Parental Consent and consent from the participant before any research protocols can be administered unless waiver of consent is given by IRB. Minimal risk refers to an anticipated level of harm and discomfort that is no greater than that ordinarily encountered in daily life, or during the performance of routine educational, physical, or psychological examination.
2. Only the approved Participants Information Sheet and Consent Form should be used. It must be signed by each subject prior to initiation of any protocol procedures. In addition, each subject should be given a copy of the signed consent form.
3. Consent forms are important documents therefore they should be stored in the strictest arrangement. Loss of consent form would result in disciplinary action.
4. No deviation from, or changes of, the protocol should be initiated without prior written NTU IRB approval of an appropriate amendment.

Research Integrity and Ethics Office, NTU Institutional Review Board

50 Nanyang Avenue, NS4-05-92A, Singapore 639798, T: (65) 6592-2495, www.ntu.edu.sg

5. The Principal Investigator should report promptly to NTU IRB regarding:
 - a. Deviation from, or changes to the protocol.
 - b. Changes increasing the risk to the subjects and/or affecting significantly the conduct of the trial
 - c. All serious adverse events (SAEs) which are both serious and unexpected.
 - d. New information that may affect adversely the safety of the subjects of the conduct of the trial.
 - e. Completion of the study.
6. Continuing Review Request/ Notice of Study completion form should be submitted to NTU IRB for the following:
 - a. Annual review: Status of the study should be reported to the NTU IRB at least annually using the Continuing Review Request/ Notice of Study completion form.
 - b. Study completion or termination: Continuing Review Request/ Notice of Study completion form is to be submitted within 4 to 6 weeks of study completion or termination.
7. All Principal Investigators should comply with existing legislation that would have an impact on the domain of their research.
8. Advertisements/ Notices for recruitment of subjects must meet the following requirements:
 - a. Advertisements must clearly state that volunteers are being recruited to participate in an NTU research project with proper research title and NTU logo.
 - b. Name and contact details of Principal Investigator (usually a faculty member), and NTU-IRB contact details (Tel: 6592 2495; Email: IRB@ntu.edu.sg) should be provided.
 - c. The NTU-IRB project reference number should be stated.
 - d. Advertisements should include eligibility criteria.
 - e. Advertisements recruiting Minors must explicitly state that parental consent is required for participation (unless NTU-IRB has granted approval for a waiver of parental consent).

Advertisements/ Notices should NOT contain the following:

 - a. State or imply a certainty of favourable outcome or other benefits beyond what is outlined in the informed consent form and the application/protocol.
 - b. Make claims, either explicitly or implicitly, that a procedure or intervention is safe or effective or superior to other standard procedures or interventions.
 - c. Use catchy words like "free" or "exciting."
 - d. Advertisements may state that participants will be paid, but should not emphasize the payment or the amount to be paid (e.g. by such means of larger or bold type)

Professor Lionel Lee
Chair, NTU Institutional Review Board
encl.

Indicative questions for Mr. Jackson Tan

Project

Assessing the creativity and innovation abilities of leading designers/innovators through interviews

Requirements

Indicative questions for the interviews with Mr. Jackson Tan, BLACK Design, Singapore to fulfil NTU's IRB requirements.

Preamble

The PI has been working on establishing a visual representation of the relationship between creativity and innovation since 2010 and has presented papers in several international conferences on this subject from then on. At present, he is in the process of validating the relationship representation by researching on successful innovation through case studies and by interviewing individuals who have been recognised for their creativity/innovation accomplishment. With reference to this research, the PI wishes to interview Mr. Jackson Tan based in Singapore who has attained international recognition for his work/company.

Interviews of this nature are meant to seek insights into the subject of study and needs to elicit the interviewees' involvement through engagement in dialogues which have an overall structure to ensure key points are discussed. Hence, standard questionnaires cannot be prepared and presented to the interviewees. Moreover, answers from each of them may vary in the style and delivery.

The following gives an overall structure with leading questions which may be elaborated as the situation warrants to elicit key insights that are so important to this research.

1. Question outline for Mr. Jackson Tan

The interview to start with small talks to get the interviewee comfortable. The PI had been a mentor in the 1990s to Jackson Tan in his capacity as the President of the Designers Association Singapore. This will help set the scene for the informal interview.

a) Establishing insights into Jackson Tan's childhood and how it has formed him into the creative designer today. The PI make secondary conversation about people and places that have influenced him in his childhood till completion of secondary school.

b) Establishing insights into his design education at La Salle – college of the arts. About the subjects he studied, his interests, his discovery of early Apple Macs, influence of teachers, especially Brother Joseph McNally

c) Establishing insights on his influences during National Service and the partnership he made to start a design group. Jackson and his team's early breakthrough into typography, surprises that made him such as MTV Asia asking him to do TV advertisement.

d) Establishing his progress in the design industry in Singapore as a young maverick. His team's creative efforts such as monthly design parties at Zouk's and how it helped him as an entrepreneur.

e) Establishing insights into his creative path and what (philosophy, roll models) shaped him. Jackson's climb to international recognition

f) Establishing what creative projects Jackson Tan and his team are doing at present and seek insights into how his thoughts on creativity and innovation has changed over a period of 25 years.

THE INTERVIEW WILL BE WOUND DOWN WITH SMALL TALKS AND WITH AN EXPLANATION THAT THE NOTES OF THE INTERVIEW WILL BE SENT TO JACKSON TAN FOR VERIFICATION AND APPROVAL BEFORE THE CONTENTS ARE USED FOR FURTHER RESEARCH.

Study Information Sheet

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email: peersathikh@ntu.edu.sg
IRB reference number: IRB-2018-06-015

Title of Study: Assessing the creativity and innovation abilities of leading designers/innovators through interviews

Objective: To gather expert opinion and information on the personal understanding of creativity and innovation as well as the experiences with creative process and innovative processes. This will help verify and validate a model of creativity to innovation process that the PI has proposed through a series of conference papers since 2010.

Procedures: The process follow an interview based on qualitative research, in an informal setting, which consists of leading questions to the subject about their background in their profession and the journey from their childhood through education till their professional experience that brought them to the point they are in at present in order to ascertain the influencing factors for their creative and innovative ability.

A specific project or group of projects that the subjects have successfully completes which is considers as creative or innovative will be discussed. The interviewer will use his earlier research papers as reference and will ask the subjects to take the interviewer through the process from the project brief to idea generation through the various stages in the project till completion and release to the market/public. The interviewer will also discuss on the type of workforce other than the subject(s) that was required for completion of the project to ascertain the driving forces during the process. The interviewer will also be interested to know the difficulties that the subjects and the team faced and the kind of actions that they took to overcome this obstacles. This will help in ascertaining potential hurdle points in the interviewer's model of the creativity to innovation process.

After taking notes, the interviewer will reveal the visual map of the creativity to innovation journey research to review through the subjects' journey(s) against the visual map. With this the interview will be concluded. Once the interview notes have been complied, the interviewer will send it to the subjects through email to confirm correctness and to seek their permission to use it for research publications

The actual interview will be in one sitting and is expected to last at the most three hours. Any other clarifications, especially to the accuracy of the notes will be through email communications.

Right to Refuse or Withdraw: The participation in this interview is voluntary and it is the interviewee's decision to participate in the interview session. If the interviewee decides not to participate or decides to withdraw from the study, there will not be any repercussion or penalties.

Risks and Discomforts: This interview will be informal and based on the professional level relationship with the interviewee and hence will not have any physical discomfort or risks. If the interviewee feels that the question is uncomfortable from psychological, social, legal, and economic point of view, this can be relayed to the interviewer immediately so that the interviewer can withdraw the question or discussions and proceed along a comfortable direction.

The notes of the interview will be compiled and sent to the interviewee for verification and if there are any statements or paragraphs that is perceived as uncomfortable from psychological, social, legal, and economic point of view, the interviewee can point this out and the corrected notes will be recirculated, as many times as may be required, till the interviewee agrees to the content and consents the notes for use in research study.

Benefits: This study on the relationship between creativity and innovation is a long standing research and will make original contributions to the subject. The benefit to the interviewee will be that his/her opinion and experience will be acknowledged in all the research publications.

Alternatives: Participation in this research study is best served by face to face interview. If the interviewee feels that he/she does not want to participate, interview will not be pursued.

Compensation: There will not be any financial compensation for taking part in the interview.

Anonymous and Confidential Data Collection: The data collected will be kept confidential with the PI. Only the approved notes of interview will be used and acknowledged in all research publications

Confidentiality of records: The approved notes taken will be converted into articles or chapters that is meant to be presented/published. The main data storage will be on PI's own laptop with back up on portable hard drive and will consists of the approved notes of the interview. This primary data stored in PI's own laptop and external hard drive will follow NTU Research Integrity Committee recommendation and kept for 10 years after publication before being disposed.

Personal Data: By signing the Consent Form attached, you are authorizing (i) collection, access to, use and storage of your “Personal Data”, and (ii) disclosure to, and use and storage by, authorised service providers and relevant third parties, whether located in Singapore or overseas, for the purposes of the study, and for publication in the form of research articles, thesis or books.

“**Personal Data**” means data about you which makes you identifiable: (i) from such data; or (ii) from that data and other information which an organisation has or likely to have access.

Note: In practice, any data collected in relation to an individual should be considered personal data. Examples of personal data would be include residential address, national identity documents, physical or mental health or condition, medications, investigations and treatment history, financial circumstances, educational or employment background, racial or ethnic origin, opinions, beliefs, if applicable. Among other obligations, the Personal Data Protection Act of Singapore requires you to notify the individual of the purposes of collecting, using or disclosing his personal data, obtain his consent, protect the data from unauthorised use, destroy (or anonymise) his data when there is no longer any business or legal reason to retain the data, and respond to any request from him as to how his personal data is being used. When transferring the data to a third party, whether located in Singapore or overseas, you must ensure that the standard of data protection and privacy is not compromised. For more information visit <http://teamsites.ntu.edu.sg/pdpa/pages/default.aspx>

Research arising in the future, based on this “Personal Data”, will be subject to review by the relevant institutional review board.

Data collected are the property of the School of Art, Design and Media of Nanyang Technological University. In the event of any publication regarding this study, your identity will remain confidential, and where there is a need to include details of your name, profession and organisation, you will be informed beforehand to seek permission and will be acknowledged as to the information disclosed is from you.

Who to contact with questions: If you may have pertinent questions regarding the research study you may contact:

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IRB Reference:

Should you have questions on participants' rights in the study, please contact:
NTU-Institutional Review Board
Research Integrity and Ethics Office
50 Nanyang Avenue, North Spine