

# Exploring Additive Manufacturing through the Lens of Value Innovation

Presentation Notes

for

ICAT 2014

## International Conference on Additive Technologies

Vienna, Austria, 16 October 2014

---

*Presented by*

Willie van Straaten of Inventec

[Inventec@icon.co.za](mailto:Inventec@icon.co.za)

+27 11 883 7992

+27 82 785 685

[www.inventec.co.za](http://www.inventec.co.za)

---

### **Copyright © Inventec 2014** All rights reserved

The information contained in these materials is for the private use for individuals who attended the presentation by W van Straaten of Inventec during the International Conference on Additive Technologies (ICAT) in Vienna, Austria, on 16 October 2014. No part of these materials may be reproduced or transmitted in any form or by any means (electronic, mechanical, photo copying, recording or otherwise), without the prior written permission of W van Straaten of Inventec.

### **Disclaimer**

This information is provided as a guide only and is provided without responsibility on the part of W van Straaten or Inventec, which cannot accept any accountability or consequences of anyone acting on the information contained herein.

# Exploring Additive Manufacturing through the Lens of Value Innovation

---

- Contents
- A. Introduction ..... 3
- B. Value Innovation ..... 4
  - 1. Overview ..... 4
  - 2. Star Innovation Model™ ..... 4
- C. Ideation ..... 8
  - 1. Idea Generation ..... 8
  - 2. Idea Evaluation ..... 9
    - 2.1 Information Gathering ..... 10
    - 2.2 Commercialization Requirements ..... 11
- D. Customer Value Proposition (CVP) ..... 14
  - 1. What is Value? ..... 14
  - 2. What is a Customer Value Proposition (CVP)? ..... 15
  - 3. Defining the CVP ..... 16
  - 4. Evaluating the CVP ..... 17
  - 5. GO/NO-GO Decision ..... 17
- E. Value Tools ..... 18
  - 1. Value Configuration Tool Tools ..... 18
  - 2. Ideal Value Tool ..... 20
    - 2.1 The Concept of Ideal Value ..... 20
    - 2.2 Ends versus Means ..... 20
    - 2.3 Questions to ask for implimenting the Ideal Value Tool ..... 21
    - 2.4 Implimenting the Ideal Value Tool ..... 21
- F. Business Model Design ..... 23
- G. Manufacturing ..... 25
- H. Concluding Notes ..... 27

## A. Introduction

The purpose of this document is to summarize the information provided to participants during the live ICAT presentation. In addition, supplementary information is provided to further enhance understanding of the topics discussed during the presentation. The focus is on the potential positive impact that value innovation can have on additive manufacturing as it relates to the creation of value, delivery of value and the capturing of value in the form of profits.

There are major forces reverberating through the world today such as an explosion in information and knowledge, instant connectivity on a world-wide basis, exponential growth in social networks, rapid technological advances and fierce competition. These influences add complexity and risk to doing business, directly or indirectly impacting upon individuals, companies and industries alike, including those involved in additive manufacturing.

The key questions to be addressed are: Firstly, how to effectively navigate the trends and forces of change that are sweeping through the business environment; secondly, and perhaps more importantly, how to exploit these changes as opportunities within the realm of additive manufacturing; and thirdly, what can be done to advance the case of additive manufacturing as a disruptive, evolving and enabling technology?

One perspective is to investigate challenges and opportunities facing additive manufacturing through the lens of additive manufacturing. Such a view, however, may be too limiting to be practical and productive. The risk of a limited few is well expressed by Maslow who said that *if you only have a hammer, you see every problem as a nail*. In a similar vein, Winston Churchill said: *We shape our buildings; thereafter they shape us*.

An alternative point of view would be to apply a wider lens and see additive manufacturing as a link in a value chain, i.e. part of a sequence of activities aimed at progressively transforming a product idea into a market offering that is responsive to the needs and wants of the target customer. Such a perspective leads to the concept of value innovation – rooted in the capacity to think and act creatively, strategically and innovatively – a capability considered by leading companies around the globe as key to gaining competitive advantage and profitability.

By placing additive manufacturing within the context of value innovation, the perspective of the practitioner can be broadened and attention can be directed and focused on the stages, phases and sequence of activities necessary to create product offerings that are competitive, unique and valuable.

Value innovation and its underlying components are discussed by addressing the following questions: What is meant by the term value innovation? How is value created, delivered and captured? How to generate and evaluate new product ideas that has the potential to be transformed into an item of value? What is a customer value proposition (CVP) and how must it be defined in order to resonate with the target market in order to be seen as distinct from competitive offerings? What is the interrelationship between creativity, invention, innovation and a business model?

## B. Value Innovation

### 1. Overview

Innovation is arguably one of the most lucrative endeavors known to man. Analogically speaking, it is like “spinning straw into gold” – generating an idea at zero cost and transforming it into an innovation that may return millions – an infinitely high return on investment!

An idea or invention alone, however, has limited value. To add value, a suitable business model, including a systematic product development process, must be implemented to progressively transform the idea along a value chain into a product offering that is responsive to the needs and wants of the target market. Once developed, the market-ready product must be presented, promoted and delivered to the target market in such a way so as to capture value in the form of profits.

Given the high rate new product failure, a decision to generate new ideas to serve as an input for the innovation process is risky and carries great uncertainty - a decision that runs the risk of substantial cost with little or no return. Deciding not to invent however, could see the individual or company forced out of business by more innovative companies. In short, a decision not to invent – notwithstanding the high risk of failure, can be riskier than being passive.

Generating new ideas can be in pursuit of any one or a combination of innovations such as: Business model innovation, process innovation, market innovation or product and services innovation. To generate new ideas for a product, there are a number of key strategic questions that must be asked:

- What type of invention to pursue: Major, moderate or minor?
- What type of product to invent?
- What customer value proposition (CVP) to offer?
- How to differentiate the product from competitors?
- What technological concept to incorporate into the product?
- Based upon the technological concept, what embodiment option to select?
- What business model to design that is capable of commercializing the new product?
- How will the product idea be transformed and developed into a market ready product?

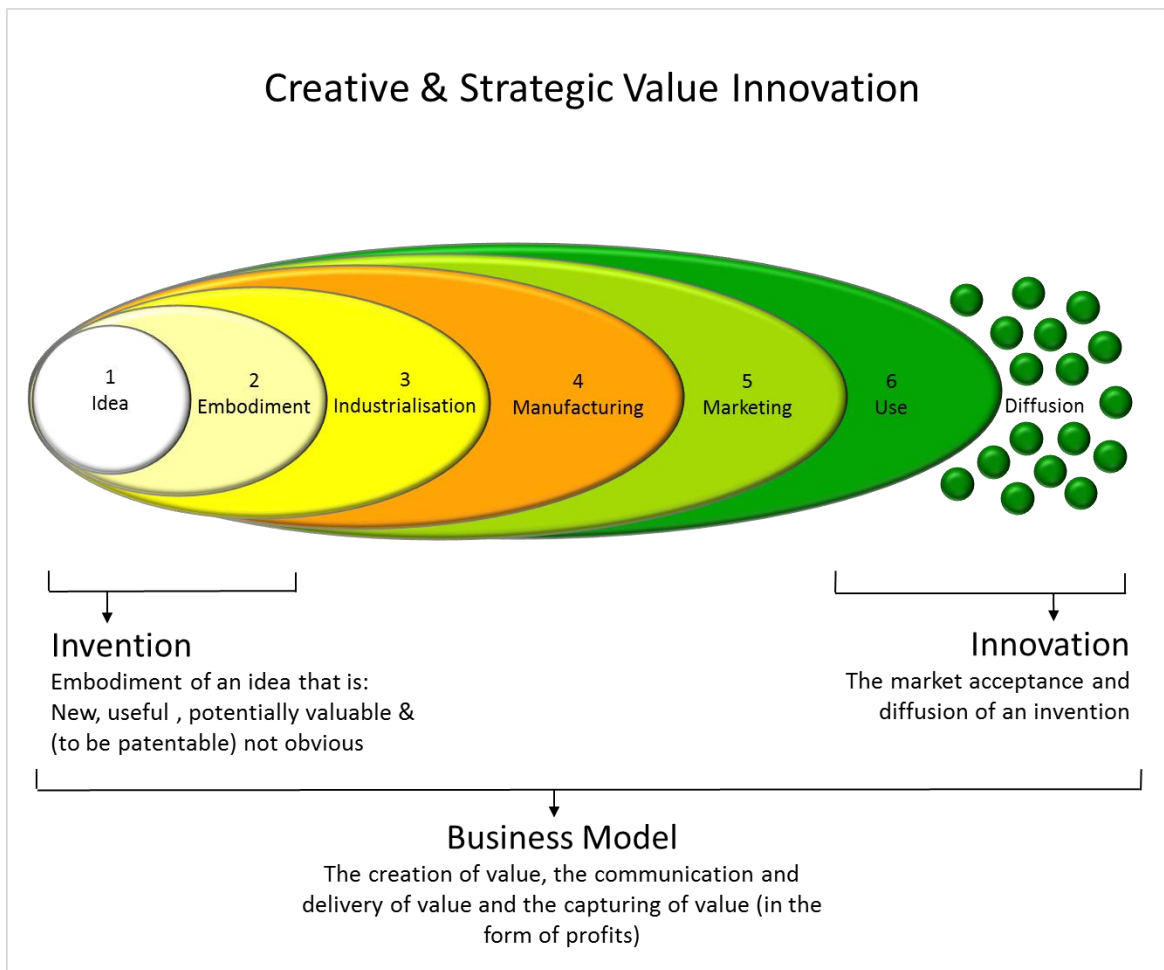
Answers to these questions will be explored in more detail throughout this document.

### 2. Star Innovation Model™

The Value Innovation Framework discussed in this document is called the Star Innovation Model™. This model offers a structure for describing the logical, goal-directed activities that underlie value innovation – rooted in the capacity to think creatively and strategically. The purpose of the framework is to facilitate and structure the process of new idea generation so as to come up with one or more ideas that can serve as a basis for a compelling customer value proposition (CVP) - one that can form the basis of a new product or service offering.

Before discussing the Star Innovation Model™ in further detail it is necessary to address the concept of a value chain. Figure 1 below is an adaptation of the Star Innovation Model™ and illustrates a generic

value chain – aimed at progressively adding value at each stage of the process whilst transforming a new product idea into a market ready product.



**Fig. 1.** Generic Value Chain

Within the context of value innovation, and with reference to the above diagram, the relationship between creativity, invention, innovation and commercialization can be described as follows:

Creativity involves the generation of a new product idea that is potentially useful and valuable. Invention is the embodiment (or the reduction to practice) of the product idea. For the invention to be patentable, the idea must be new, useful and also not be obvious.

The generation of a new product idea and invention takes place at the starting point of the value chain and relates to the physical product. Innovation, on the other hand, takes place at the opposite end of the value chain and relates to the response of the target market to the new product offering, i.e. the market acceptance and diffusion of the invention.

Linking invention and innovation and bridging the gap, requires the design of a business model capable of creating and transforming a new product idea into a market ready product, offering and delivering the product to the target market and in so doing, offering value to the customer whilst capturing value for the company in the form of profits. This includes the implementation of a

product development process to systematically and progressively transform the new idea along a value chain into a market ready product. To improve the chances of success, this offering must ideally, be unique, distinctive and perceived by the target customer as representing a desirable and compelling value proposition.

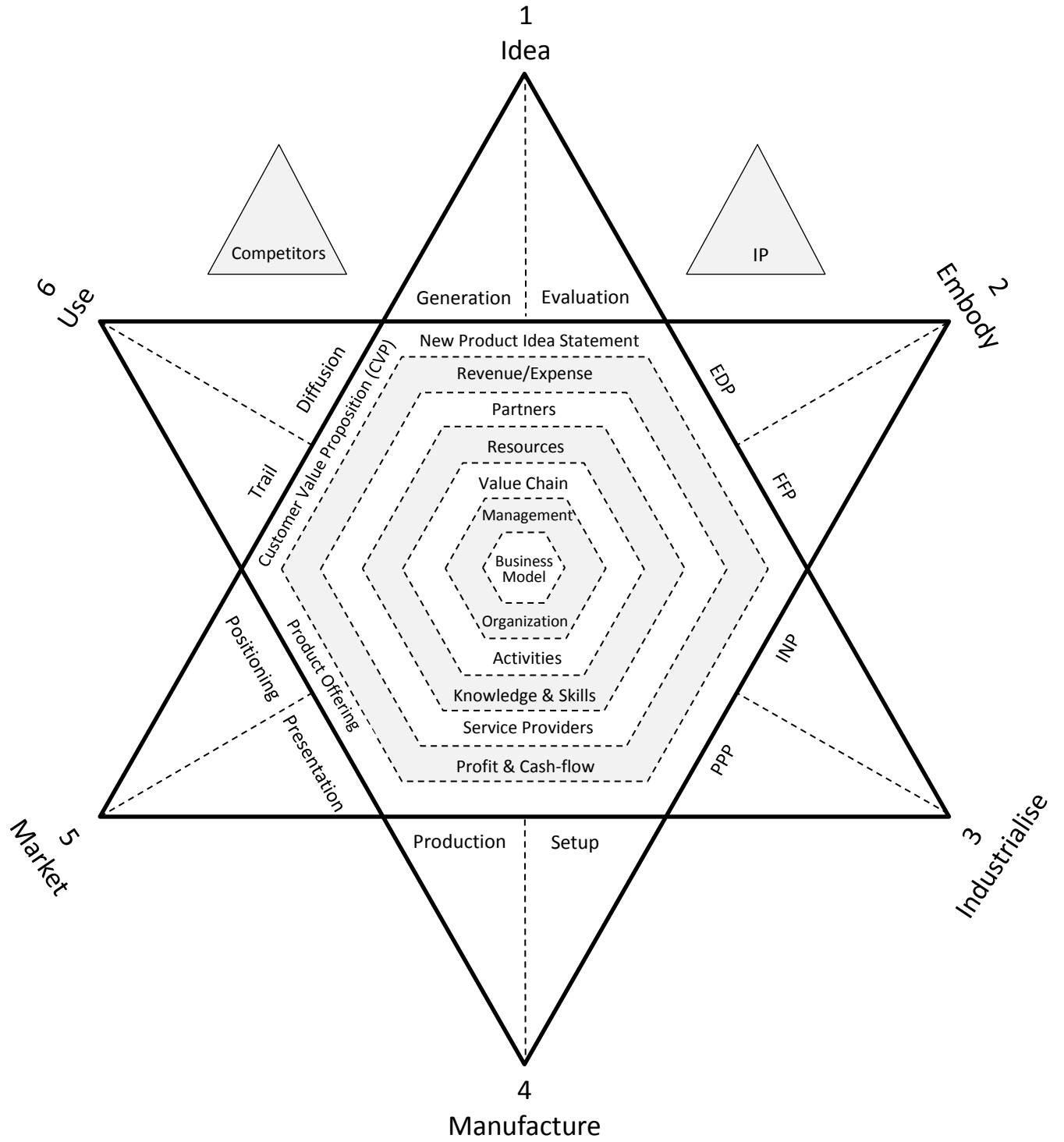
The Star Innovation Model™ has been developed to guide the product development process and comprises a sequence of 6 stages – each with two steps of value-creating activities to be performed as follows:

1. *Ideation*
  - a. Idea Generation
  - b. Idea Evaluation
2. *Embodiment*
  - a. Development of an Experimental Development Prototype (EDP)
  - b. Evolving the EDP into a Fully Functional Prototype (FFP)
3. *Industrialisation*
  - a. Evolving the FFP into an Industrialised Prototype (INP)
  - b. Refining it into a Pre-Production Prototype (PPP)
4. *Manufacturing*
  - a. Tooling
  - b. Production
5. *Marketing*
  - a. Positioning
  - b. Presentation
6. *Use*
  - a. Trial
  - b. Diffusion

It is important to appreciate that innovation is a dynamic, interactive and an iterative process (with numerous feedback loops in between). Activities performed and decisions taken in one phase or step directly or indirectly impacts upon other stages or steps in the process. When implementing the value innovation process, it is therefore necessary to adopt a holistic, systemic approach.

Figure 2 below illustrates the integration and interdependencies of the various stages and steps within the Star Innovation Model™. Also, as can be seen from the diagram below, embedded within the value chain is a business model that provides strategic direction to the activities taking place within each of the stages of the value chain.

Fig 2. The Star Innovation Model™



## C. Ideation

### 1. Idea Generation

Implementation of the Star Innovation Model™ and the process of value innovation typically commences with idea generation. For idea generation to be effective, the individual or group involved with idea generation must have or acquire the intent, motivation, knowledge and skill to do so – all factors that are within the control of the idea generator.

Generating new ideas can be in pursuit of any one or a combination of innovations such as: Business model innovation, process innovation, market innovation, or product and service innovation. If the purpose is the generation of new ideas for products, the focus can be on coming up with new ideas relating to:

- Changes in the embodiment of an existing product. This may result in a minor invention.
- Change of the technological concept underlying an existing product, which usually involves the generation of new ideas for the embodiment of the new technological concept. This may result in a moderate invention.
- The invention of a new technology, furthermore involving the generation of new ideas relating to the embodiment of the technology. This may result in a major invention.

The trigger for generating a new idea can be initiated from anywhere along the value chain. For example, the stimulus may spring from:

- Information about the unserved or underserved needs and wants of a potential target
- Knowledge about the market success of competitor or other related products
- Prior art (i.e. what went before) in terms of intellectual property (IP)
- The availability of marketing channels and/or promotional methods
- New technologies or manufacturing methods
- Industrialization requirements
- The result of experimentation and product development activities

In practice, two main sources of ideas for new products are:

- Coming up with a new or improved technology that can be embodied into a new product (referred to as a technology push). Here the challenge lies in finding a target customer that may be responsive to the features, functions and benefits afforded by the new technology.
- Having information about the needs and wants of a potential target customer(s) that may be served by a new product or service (referred to as a demand pull approach to new products). In this case, the challenge lies in coming up with a new product that is can resonate with the needs and wants of a target customer

In order to generate new ideas that can be turned into an invention, and for the inventor to evaluate the merits and significance of the invention, the inventor must be familiar with the “symbolic knowledge” (the prevailing paradigm) of the field. Without this knowledge, there are no criteria available for



evaluating the merits of the new product idea. This presents a paradox as stored information and knowledge, resulting from the pattering nature of the mind, causes “mind block” – an obstruction to creativity. Therefore, to invent, it is not only necessary to be knowledgeable and familiar with the territory but also to be able to escape from constricting mind patterns. Fortunately, with the aid of creativity tools and techniques, such a feat is possible.

A new idea can appear seemingly serendipitously out of nowhere! Mostly these ideas are the coming together (integrative reconciliation) of existing information and knowledge. Often, the starting point for new ideas can be top-of-mind thinking. At other times, new ideas can be the outcome of deliberate efforts in applying creativity tools, techniques and practices such as:

- Analogy
- Provocation
- Closed World Solution (CWS)
- SCAMPER
- Resolving Contradictions
- Serendipity
- Experimentation

Once a new idea for a product has been generated, the idea generator will most likely have at least a provisional (if not a complete) understanding of the commercialization potential and applicability of the idea. Regardless of the confidence level for the potential of the new idea, it should be subjected to an in-depth evaluation to, firstly, evaluate the it has potential and secondly, to perhaps further refine , improve or even reject the idea if it turns out to have no or limited commercialization potential. This process of idea evaluation will be discussed next.

## 2. Idea Evaluation

A product idea that evolves into a successful invention can be a lucrative windfall for a company or a lone inventor. The dream of a pot of gold at the end of the rainbow must, however, be tempered with the reality of the high rate and cost of new product failure (estimates of failure in turning new product ideas into marketable products varies between 5 in 100 to 1 in 3 000!). Given this high failure rate, it is vitally important to carefully evaluate new product ideas at the outset and as early as possible in order to cull “dead ducks” and to identify potential “home runs” – i.e. separating the winners from the losers.

Apart from generating and evaluating a new product idea upfront in terms of its potential, testing and evaluation of the product along its development path is critical and serves as a guide for evolving and refining the product idea into a market ready product. Very few inventors have the expertise and resources available to implement a systematic testing and evaluation program to guide their product development efforts. As a consequence, many product ideas enter the development phase and continue to be developed without being subjected to testing and evaluation. Often, this results in the embodiment and development of product ideas which have little or no commercial value – a waste of time, money and effort and adding to the graveyard of “failed ideas”.

It is worthwhile to remember that developing a new product idea with low commercial potential will cost as much as developing one with high potential. The difference being that, in the case of the former, the inventor can be financially crippled whereas in the case of the latter, the new product idea can serve as the starting point in building a successful and profitable business.

Idea evaluation can be split into two phases:

- **Information Gathering:** Information is gathered to enable evaluation of the idea and/or for the further improvement or refinement of the idea.
- **Commercialization Requirements:** From the previously gathered information a list of commercialization requirements is extracted, i.e. factors that must be taken into account to enable evaluation of the new idea, to formulate a customer value proposition, to design a business model and to facilitate the design and development of a possible new product.

## 2.1 Information Gathering

In general terms, a new idea for a product or service either emerges from information and knowledge about a particular domain, or the new idea generated must still be subjected to validation against criteria such as desirability (can it motivate customer behavior), feasibility (can the idea, technically speaking, be reduced to practice) and viability (does the idea make sense from a business and financial perspective). Depending on how knowledgeable the inventor or product developer is, once an idea has been generated, additional in-depth information must usually be obtained to validate the merit of the new idea, to refine, modify or improve it or even to reject it.

Uncertainty and ambiguity are a natural part of developing and commercializing a new product idea. To reduce uncertainty and risk, the merit and potential of a new product idea must therefore be thoroughly investigated. Studies have shown that ideas generated based upon in-depth knowledge of a field or a domain have a higher chance of being successful.

During the information stage of the idea generation process, it is necessary to become focused upon the area or domain relevant to the new idea. By asking questions such as: “who,” “what,” “where,” “when,” “why,” and “how”, multiple perspectives, factors and information can be gathered to shed light on the potential and merit of the new idea. This involves doing the necessary “homework” through consulting available sources of information, talking to prospective customers and people in the industry, and doing the necessary background research.

Furthermore, it is important to consider that the current thinking is likely to include assumptions, dominant ideas, boundaries, essential factors, avoidance factors and polarizations. These must be questioned and challenged in order to test the validity thereof.

In order to gather in-depth information, a feasibility study can be conducted to fill the gap between what needs to be known and what is currently known. Performing a feasibility study

results in a better understanding of the factors that will determine, firstly, whether or not there is justification for putting time, money and effort into the implementation of the product idea and, secondly, whether or not there is a level of confidence that the new product idea can be turned into a successful innovation.

The feasibility study is undertaken (through a combination of primary and secondary research) to gain information relating to all of the stages of the value chain – i.e. potential target customers, marketing, manufacturing, industrialization and embodiment of the idea. Also, information concerning the status of competitors and intellectual property (IP) matters must be investigated. And finally, the feasibility study must also consider the nature of the industry and PESTEL (Political, Economic, Social, Technological, Environmental and Legal) factors.

## 2.2 Commercialization Requirements

Commercialization requirements are a list of criteria (desirable characteristics) and constraints (limitations and boundaries) that are applicable and relevant for evaluating the potential of the new product idea. Requirements and constraints are derived from available information and from information gathered during the feasibility study.

Commercialization requirements are drawn up as they relate to the following factors:

- Competitors:  
*Key considerations: Can we compete? What are the strengths and weakness of competitor offerings? How are competitor product positioned in terms of buying criteria used by the target customer to evaluate alternative products?*
- Intellectual Property (IP) IP Status  
*Key considerations: Do we infringe? Can we obtain potential protection? What can we learn from the prior art?*
- Use of the product by the target customer  
*Key considerations: Is there an actual or potential demand for the new product? What are the target customer needs and wants in terms of job-to-be-done and the underlying buying criteria used for evaluating alternative product offerings? How is competitor performance rated in terms of these criteria? What are the ideal requirements in terms of buying criteria?*
- Marketability  
*Key considerations: Is the new product marketable in terms of price, availability of distribution channels and promotional methods?*
- Manufacturability  
*Key considerations: Are suitable manufacturing facilities available? Can the new product be manufactured, at the target cost, at acceptable quality levels, in sufficient volumes and within the specified time frame?*
- Industrialization

*Key considerations: Can regulatory approval and certification be obtained? Can both compulsory and self-imposed standards be met?*

- Embodiment

*Key considerations: Is there access to know how and show how in terms of industrial designers and prototyping facilities?*

Two of the above commercialization requirements - competitors and target customer, will be discussed below in further detail.

### **2.2.1 Competitor Positioning**

From the commercialization requirements, extract those factors relevant to competitor products. Specifically, identify and list the main factors (such as features, functionalities and benefits on offer) used by competitors to compete in the market. Evaluate each competitive product against these criteria to identify their strengths, weaknesses and relative positions. Included in these factors must be positioning of competitive offerings in terms of the buying criteria (criteria used by the customer for evaluating alternative products within the product category or class).

The above information is important, firstly, as criteria for comparing the merit of the new product idea against competitive offerings, to evaluating the potential of the new product to compete in the market and to serve as an input when formulating a customer value proposition (CVP) that can be meaningfully differentiated from competitive offerings.

### **2.2.2 The Target Customer**

The target customer has needs and wants. Needs are basic human requirements which, according to Maslow, can be arranged in a hierarchy: Physiological (e.g. food, water and sleep), safety (e.g. personal and family), love and belonging (e.g. family and friends), esteem (e.g. self-esteem, respect) and self-actualization (e.g. creativity, morality, integrity). From a marketing perspective, another classification of needs is: Adventure, Autonomy, Discipline, Security, Enjoyment and Excitement.

#### **Customer Job-to-be-done**

Needs become wants when they are directed to specific objects such as a product or service aimed at getting a specific “job” done for the customer (i.e. for the customer there is specific job-to-be-done). The needs and wants of the target customer can thus be expressed in terms of the job-to-be-done.

For example, a person has a need for a clean home, but wants a vacuum cleaner to perform the job of removing dust from a the carpet; or a person needs food but wants to perform the job of eating a hamburger to satisfy hunger. Wants become further focused as a result of branding, i.e. the person does not only want a hamburger but a Big Mac.

When generating new ideas for products, and in order to evaluate the merit of these ideas, it is necessary at the outset to understand what is the job-to-be-done by the new idea. The following format can be used to understand and describe the job-to-be-done:

*Job performer + “wants to” + active verb + object of the action or event involving the action + job context or circumstances*

Examples of job statements:

- *The housewife (job performer) wants to clean (active verb) clothes (object of action) at home (job context)*
- *The pedestrian (job performer) wants to remain dry (active verb) on route (event involving action) to work (job context)*
- *The jogger (job performer) wants to listen (active verb) to music (object of action) while jogging (job context)*

### Customer Buying Criteria

To be useful for the purposes of generating and/or evaluating new ideas, the overall job-to-be-done, must be de-composed into its underlying elements. For each job to be done, there is usually a main (or primary) job involved as well as related (or secondary jobs) involved. Typically these relate to performance, user interface, harms and cost factors. In the case of *cleaning clothes at home* these may, for example include: stain removal ability, cleaning speed, after clean smell, damage to the fabric, harm to the environment and cost to buy.

The individual elements that make up an overall job can be referred to as buying criteria. For each product class or product category, there are a set of buying criteria relevant and used by the customer for evaluating alternative products within the product class or category. These criteria vary in importance to the customer, with the most important criteria being the ones that will enable performance of the main or primary job to get done.

More specifically, a customer is believed to weigh each of the criteria in terms of importance and then evaluate alternative product offerings against the weighted criteria in order to make a decision which of the available products offers the best value (in terms of performance, interface, harms and cost) for purchasing.

From an idea evaluation point of view, it is necessary to:

- Establish what buying criteria the customer is using for evaluating alternative products in the product class under consideration
- Determine how competitive products in the product class or category under consideration are perceived and rated by the customer - including positive and/or negative perceptions in terms of customer buying criteria
- identify what the customer considers to be the “ideal” performance of a “hypothetical” product in terms of each of the buying criteria

## D. Customer Value Proposition (CVP)

The outcome of the idea evaluation process serves as the input for determining whether or not the new idea has potential to serve as the basis for a compelling value proposition (CVP). Assuming the outcome is positive, the next step is to construct a CVP. Before discussing the CVP in further detail, the following questions will be addressed: What is meant by the term value? What is value innovation? What is a CVP? What are the elements that bring about and make up a CVP? These topics will be discussed below before addressing the task of defining the CVP.

### 1. What is Value?

Customer value, in the context of new product commercialization, can be defined as the ratio between what the customer gets (benefits) and what the customer gives (price). In short, the term value can be reduced to the following value equation:

$$\text{Value} = \text{Benefits minus Price}$$

Alternatively, value can be expressed as the ratio of benefits to price.

Appreciating the significance of the above value equation is fundamental to understanding the concept of value innovation, i.e. the creation of value, delivery of value and the capturing of value (in the form of profits). The concept of value and its underlying components – benefits and price, as discussed below, serves as the overarching guide for translating the new product idea into a compelling CVP. Once formulated, the CVP serves as a compass for steering the design of the business model and for implementing new product development activities.

**Benefits:** The customer enjoys benefits (or believes that benefits will be enjoyed) once needs and wants become satisfied by getting a job done well. This will be the result of using a product or service offering the required functionality, performance, user interface, causing a minimum of harm and offered or bought at the right price. Thus, to the extent that the product is able to function (or perceived to be able to function) in a way that gets the job done, the customer's needs and wants will be satisfied and the customer will enjoy the benefits from getting the job done.

The benefits can be functional and/or emotional. Functional benefits are derived as a result of the way the product works. Emotional benefits can be personal or social and relate to the way the product makes the customer feel. Also, the job a customer would like to get done involves the main job and less important jobs related to the main job. The main job is the primary reason for a customer buying a product and this must be identified.

**Price:** The price of a product includes monetary cost and non-monetary cost (such as time cost, energy cost and psychic cost and "harms") to the customer. Harmful effects involve factors such as safety, durability, reliability, reparability, environmental impact, noise, size and weight and other undesirable factors.

Monetary cost, contrary to popular belief, is not fixed but immanently variable depending on, for example, the pricing model to be implemented, involving factors such as payment terms, offer structure, discounts, and refund guarantees.

Price represents a key factor in the value equation – both from the perspective of the customer and the company. Seen from the customer’s perspective, price means what the customer will pay for the product. A change in the price, therefore directly impacts on the customer’s evaluation and perception of the value of a product or service.

## 2. What is a Customer Value Proposition (CVP)?

Customer needs and wants and the product’s affordance (in terms of functional and/or emotional capabilities) are linked by putting forth a Customer Value Proposition (CVP): A set of benefits offered to prospective customers to satisfy their wants at a given price. The CVP is made physical by a product or service offering which is usually a combination of product, customer service, information, experience and access to the product or service and price.

As can be seen from Fig. 3 below, on the one side, the customer has needs and wants, expressed as a job-to-be-done which, in turn, is manifested in a set of buying criteria use for evaluating alternative product offerings.

On the other side, the customer needs and wants are addressed by companies or individuals by generating new product ideas, based upon a technological concept (i.e. the fundamental method of how the product’s primary function is to be achieved), and the design of a suitable embodiment option capable of affording the required functional and emotional benefits desired by the customer.

When considering the concept of value, it is important to take into account not only value to be received by the customer but also value to be generated by the company supplying the product. Unless both the customer and the company can benefit value wise, commercial success of a product over the medium and long term cannot be achieved.

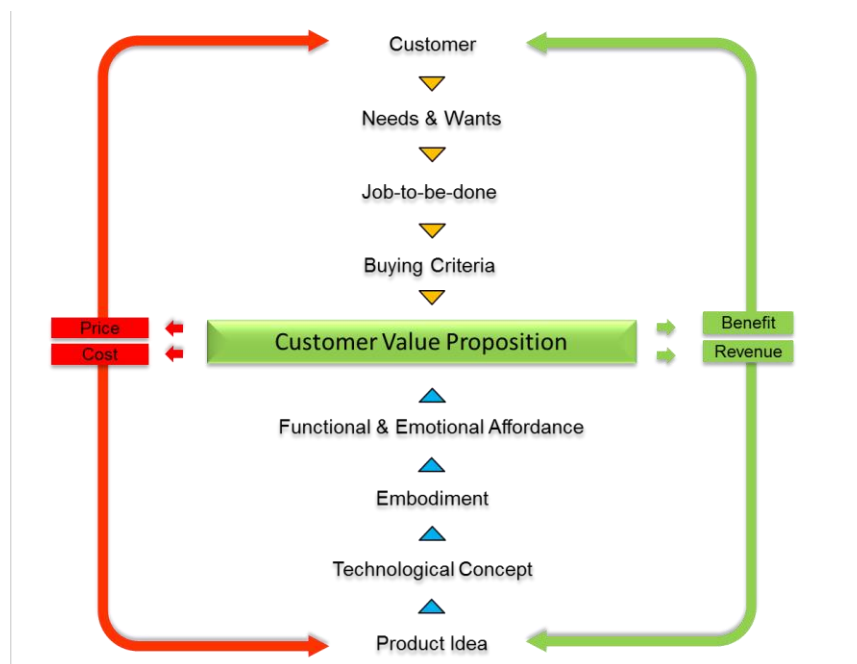


Fig 3. Customer Value Proposition

The product offering will be successful to the extent that the target customer perceives the new product (and its underlying CVP) as desirable and offering value and satisfaction superior to that of competitive offerings.

Note: In addition to desirability of the offering to the target customer, for the new product idea to serve as the basis for a CVP, it must also be feasible (i.e. technically speaking, can it be made?) and viable (i.e. financially speaking, does it make sense?)

Based upon the foregoing, customer value is therefore a function of the ratio between price (paid or to be paid) and benefits (actual or perceived) resulting from the use of the product. Key factors to determine value to the company is the revenue generated from the sale of the product (corresponding roughly to the price paid by the customer) and the cost of the goods (COG). This interrelationship between customer value and company value is graphically illustrated in Fig. 3 above. For the CVP to have merit and potential, the idea once transformed into a CVP must offer value to both the customer and the company.

### 3. Defining the CVP

The CVP can be defined by answering the following questions:

#### *Product Description*

- a. What is the name of the product?
- b. What product class or category does the product fall into (e.g. household; beauty; fitness; consumer electronics; mining etc.)?
- c. What is the *job-to-be-done* by the product (expressed as: Active verb + the object of the action + a contextual clarifier)? For example: Clean (active verb), clothes (object), at home (contextual clarifier).

#### *Target Customer*

- a. What are the customer's needs and wants, described in terms of the *job that needs to get done*?
- b. What is the demographic description of the target customer? (Only relevant characteristics)
- c. What is the psychographic description of the target customer? (Only relevant characteristics)

#### *Competitive Products*

- a. What is the nearest competitive product(s), substitute(s) or the next best alternative(s)?
- b. Compared to the nearest competitive product, substitute or the next best alternative, how can the product be differentiated in a way that is meaningful to the target customer?

#### *Price*

Compared to competitive products, substitutes or the next best alternative, at what price point is the product to be offered:

- a. Below competitive products?
- b. On par with competitive products?
- c. Above competitive products?



### *Substantiation*

What convincing proof is available to show (preferably to demonstrate) that the product is able to get the job done and can deliver the promised benefits?

## **4. Evaluating the CVP**

The CVP is fundamental to value innovation. Ultimately, all new idea generation efforts are aimed at establishing a compelling CVP or improving upon an existing CVP. The CVP lies at the intersection and ties together the needs and wants of the customer with the features, functions and benefits that can be offered by the new product.

Once an idea has been generated and a CVP has been formulated, the CVP must be assessed and evaluated against the previously generated commercialization requirements to assess its merit to determine the extent to which the new product idea can be utilized as a basis for a new product or service offering capable of delivering value and satisfaction to the target customer.

## **5. GO/NO-GO Decision**

Based upon a consideration of the new product idea, the commercial requirements, competitive product positioning, the emergent CVP, and by taking into account the risk versus reward ratio, a GO/NO-GO decision must be made whether or not a business opportunity exists to warrant proceeding with the further commercialization of the CVP.

## E. Value Tools

The Value Configuration Tool and Ideal Value Tool discussed below go hand in hand and supplement one another. Whereas the Value Configuration Tool involves manipulating the variables—benefits and cost in order to arrive at a compelling CVP, the Ideal Value Tool attempts to improve the CVP by intensifying the variables underlying the CVP – benefits and cost, in the extreme.

### 1. Value Configuration Tool

It can be argued that ultimately, all strategic and creative initiatives are aimed at improving value, i.e. by putting forth of a customer value proposition (CVP) that is desirable, feasible and viable. In this regard, Value Tools are pivotal as they facilitate the formulation of a customer value proposition (CVP) by linking the new product idea (with its underlying functionality) to the needs and wants of the target customer (expressed as the job-to-be-done) in a way that is likely to be perceived by the target customer as offering value superior to that of competitive products.

From a new product idea and invention perspective, coming up with such a value proposition requires an understanding of the interrelationship between the following factors:

- The target customer has needs and wants. Needs become wants when they are directed to specific objects such as a product or service
- Customer needs are addressed putting forth a CVP made physical by a product or service offering
- The process of value innovation can start by considering the customer needs and wants and addressing these with a new product offering aimed at satisfying these. Alternatively, the process can start from generating a new product idea and then endeavor to find a target market with needs and wants that are responsive to and that can be satisfied by the new product or service
- A customer will want a specific product if it is believed that the product is able to get a specific job done
- The purpose of a product or service is to afford delivery of one or more functions to enable getting the customer's job done
- The customer enjoys benefits once needs and wants become satisfied by getting a job done, and as a result of using a product or service affording the required functionality

Based on the formulation, **Value = Benefits minus Price**, there are a number of different ways to raise value as follows:

- Raising existing benefits by enabling the customer to get a job done in a better way by, for example:
  - Improving the product's functionality and performance
  - Improving the product's user's interface

The above may be achieved by:

- Changing the product concept (i.e. the fundamental method or principle by which the product achieves its primary function)
- Implementing an alternative embodiment option

- Reducing price by, for example:

*Monetary cost reduction:*

- A reduction in the cost of the product to the customer
- Offering alternative ways of payment
- Improving the terms of payment

*Harm reduction:*

- *Improving on the safety, durability, reliability, reparability, environmental impact*
- *Reduce waste, noise size, weight*

*Example: Blue Ocean Strategy*

Blue ocean strategy (see Blue Ocean Strategy) is one approach to the implementation of the Value Tools in pursuit of value innovation. Four strategic approaches to creating value innovation called “blue oceans” of uncontested market space have been suggested, achieved by addressing the various components of the CVP in the following ways (discussed by means of an example involving Cirque du Soleil as reported in The Wall Street Journal):

*In broad terms, application of the blue ocean strategy involves: Elimination of animals and reduced the importance of individual stars. It created a new form of entertainment that combined dance, music and athletic skill to appeal to an upscale adult audience that had abandoned the traditional circus.*

Four of the ways of manipulating the value equation:  $Value = Benefits \text{ minus } Cost$ , which can result in creating a blue ocean strategy, are by answering and responding to these questions:

- Which of the factors that the industry takes for granted should be **eliminated**?  
*In the case of Cirque du Soleil that included animals, star performers, and the three separate rings*
- Which factors should be **reduced** well below the industry’s standard?  
*Cirque du Soleil reduced much of the thrill and danger associated with conventional circuses*
- Which factors should be **raised** well above the industry’s standard?  
*Cirque du Soleil increased the uniqueness of the venue by developing its own tents, rather than performing within the confines of existing venues*
- Which factors should be **created** that the industry has never offered?  
*Cirque du Soleil introduced dramatic themes, artistic music and dance, and a more upscale, refined environment*

(For more information see: Kim, W. Chan, and Renee Mauborgne. 2005. *Blue Ocean*)

## 2. Ideal Value Tool

### 2.1 The Concept of Ideal Value

The Ideal Value is said to be achieved when the ratio between benefits and costs has been maximized. It is not important whether or not the search for the *Ideal Value* is realistic or practical. What is important, however, is that by pursuing the *Ideal Value* one is able to escape the confines of the current thinking and to consider possibilities beyond what is currently being taken as a given.

Leonardo da Vinci has suggested that it is good practice to think of the end before the beginning – Rather than starting from what is believed to be feasible and viable (in terms of the current thinking and assumptions) and working towards a solution, one starts with a theoretical, perfect solution (the end point) in mind and then works backwards by finding ways and means to achieve this ideal outcome. In practice, one must often take a step back from the Ideal Value towards reality and work with the next best option.

In short, the *Ideal Value* helps one to step out of the confines and limitations of the current state of thinking and imagine an ideal future state – thereby propelling one forward from what we've got to what we want.

### 2.2 Ends versus Means

In contemplating the *Ideal Value*, it is important to be aware of the simple but profound difference between the desired outcome or end result and the means of achieving the end result. The distinction is important because the end benefit (in terms needs and wants and jobs-to-be-done to satisfy these) remain relatively stable but the means (in terms of the functionalities to enable getting a job done) change.

#### *Examples*

- *A company focused on delivering the best washing powder (a means to deliver the end benefit of clean clothes) will be in trouble if another company finds a superior means such as inventing a self-cleaning fabric that removes the need to use washing powder*
- *People want a hole (the end benefit), not a drill bit (the means to achieve the hole – there are other ways to make holes); People want the end benefits of communication, and a mobile phone is only one way or means of satisfying this want.*
- *The famous example (perhaps urban myth) of the American Space Pen illustrates this. The stated end benefit included the means of achieving the result or benefit, i.e. “we want a pen to write in space”. In order to improve the chances of finding alternative – perhaps better, solutions to the problem, the objective could have been stated as: “we want to write in space” Because of an incorrect definition of the purpose or challenge, the Space Pen was developed at great expense. The Russians, on the other hand, asked the right question as they started with only the desired outcome without limiting their options by specifying a particular means of achieving it. Their problem statement was: “we want something to write in space”. Resulting from this question, they allegedly chose the pencil.*

### 2.3 Questions to ask for implimenting the Ideal Value Tool

To facilitate implimentation of the Ideal Value Tool (illustrated with reference to washing powder), the following questions can be ask:

- What benefit are you trying to achieve? If we have a magic wand what benefits would our ideal solution deliver?  
*Clean clothes*
- What is the Ideal Value or outcome? Think about achieving the benefits without any cost or harm and wherby the product, service or system solves the problem by itself?  
*Clothes that clean themselves*
- What is stopping you from achieving the Ideal Value?  
*Clothes fibres are not able to perform this job or function*
- Why is it stopping you?  
*If the fibres can't get the job done (perform the function), the clothes can't be cleaned*
- How could you make the things(s) go away or dissapear that are inhibiting you from obtaining the Ideal Value?  
*If there was a fiber or something that was able to clean itself*
- What resources are available to help create the above circumstances?  
*Fibre, atmosphere, wearer, wardrobe, sunlight, water, heat, etc.*
- Has this problem been solved anywhere else – perhaps in a different context? Are there any analogiacal solutions available elsewhere?
- *The self-cleaning function is performed in nature (by the Lotus Plant)*
- How might you work back from the Ideal Value, using the proposed solution to find a practical solution?
- *Study how the Lous pant achieve its function of self cleaning, extract the working principal and apply to the challenge at hand in persuit of the Ideal Value*

(For more information see: Mann, Darrell. 2002. *Hands on Systematic Innovation*. Belgium: CREAM)

### 2.4 Implimenting the Ideal Value Tool

To implement the Ideal Value Tool, proceed as follows:

Step 1            Define the job-to-be-done in terms of:  
(Job performer) wants to (active verb) + (object of the action or event involving the action) + (job context or circumstances)

*Example*

*In the case of washing clothes at home, the job can be expressed as:*

*The housewife (job performer) wants to clean (active verb) clothes (object of action) at home (job context)*

Step 2            Break down (decompose) the overall job into individual elements or buying criteria, rating the criteria in terms of importance (i.e. primary or main job and secondary or related) jobs to be done.

Note: A product class or category is defined by the set of buying criteria used by target customers to evaluate the alternative product options

- Step 3 Rate and plot the positions of dominant competitive product in the product class or category in terms of each of the buying criteria. Typically these would be criteria relating to benefits (performance and user interface) and cost (monetary and non-monetary)
- Step 4 For each of the most important choice criteria, contemplate and plot what would be regarded as the “ideal”
- Step 5 The gaps that exists between the current ratings and the ideal in terms of that particular criteria, represents an opportunity in terms of new idea generation for a product offering the required functionality to overcome the gap.
- Step 6 Depending on the condition, several opportunities may present themselves, for example:
- A particular buying criterion is rated high in importance, but current products perform poorly. This is an opportunity to offer a product with significantly improved functionality
  - A particular buying criterion is rated low in importance and available product performs well in terms of this criterion. This represents an opportunity to perhaps drop the functionality relating to the choice criteria completely or perhaps achieve performance of the functionality through another, already available component in the product. In doing so, a significant cost reduction may be achieved
  - A particular buying criterion is important (perhaps the primary criteria used by the customer to evaluate alternative product offering). Available products may perform satisfactorily in terms of this criterion. The opportunity presented here, is to invent a new product based upon a different technological concept that is capable of drastically improving performance with respect to this particular choice criteria. This new product is likely to be seen as a “wow” item – that is a product seen to be surprising and unexpected with regard to some feature or functionality – ideally one that can be demonstrated

Examples:

- *Chinese engineers have developed a process for making self-cleaning clothes using titanium dioxide. Dirty clothes are dropped into a mixture of chemicals, which become a self-cleaning mechanism when exposed to sun*
- *In the past windows were kept clean by using a sponge and squeegee. Recently a technology for self-cleaning glass has been developed*
- *Mostly teeth are cleaned by manual brushing. Lately cleaning of teeth is automated with sound waves*

## F. Business Model Design

To bring to life the customer value proposition (CVP) requires the design, implementation and operation of a business model. Important, however, is that the design of the business model must take place prior to the commencement of embodiment of the new product idea.

Unless a business model and a product development process can be set up that is suitable to implement the CVP, attempts at commercializing the new product idea will be in vain. It is therefore essential that during the process of idea generation and evaluation to keep in mind the question of whether or not a suitable business model can be established capable of generating value, delivering value and capturing value in the form of profits from commercializing the new product idea.

In summary, if a decision is made to proceed with further commercialization of the new product idea as express through the CVP, a suitable business model must be designed to guide subsequent product development and other commercialization activities along the value chain (see Fig. 4 below).

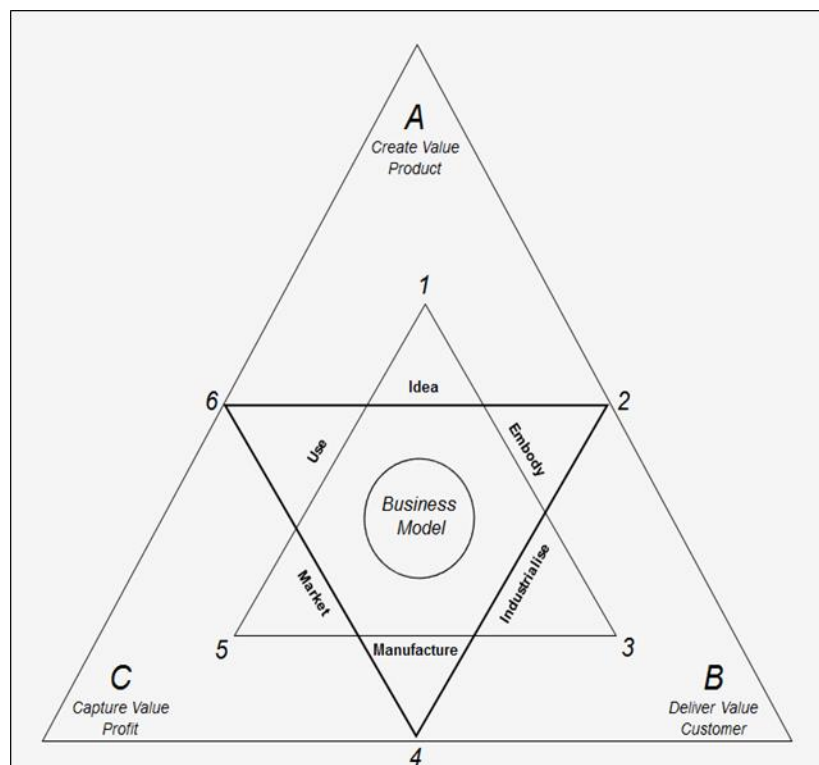


Fig 4. Value Innovation System

When designing and implementing a business model, there is much that is unknown to the designer, requiring intense contemplation, experimentation, deliberation and discussions in an attempt to reduce uncertainty. For the most, the design and implementation of a successful business model is not a one-time event, but the outcome of a process of testing and experimentation of the various components that make up the business model to find out what works.

Key factors to be considered and questions to be asked when designing the business model are:

- Product (or Service) Offering  
*What product is to be offered to the target customer?*
- Target Customer  
*Who is the target customer and what is the job-to-be-done?*
- Customer Value Proposition (CVP)  
*What value (in terms of benefit(s) in relation to cost(s)) does the product offer?*
- Management and Organizational Structure  
*What must be the makeup of the management team and how must the organizational (or business) structure be designed?*
- Value Chain & Activities  
*What is the value chain and related activities to be performed to create, deliver and capture value?*
- Resources & Skills  
*What resources, knowledge & skills are required to create, deliver and capture value?*
- Partners & Service Providers  
*Who are the key partners and service providers to perform key and support activities?*
- Profitability & Cash-flow  
*What revenue will be generated? What are the expenses? Can the business be profitable? How is the business to be funded?*

Following the design of the business model, which may result in a re-definition or refinement of the customer value proposition (CVP), the CVP will be embodied and evolved further along the value chain into a market ready product via the following stages:

- Embodiment
- Industrialization
- Manufacturing
- Marketing
- Use

Of the above stages, manufacturing within the context of additive manufacturing will be discussed in further detail.



## G. Manufacturing

At this stage of the value chain, the focus shifts away from the building of prototypes to manufacturing and production of the product - with the emphasis on the features, functions, appearance, quality and the cost of the manufactured product. Much has been written about additive manufacturing, however, for the purpose of this document, a few comments will be made concerning additive manufacturing within the context of value innovation.

It has been said that whereas the industrial revolution offers mass production of goods and economies of scale, additive manufacturing provides mass customization at reduced costs. This statement can be appreciated by considering the breakeven analysis as shown in Fig. 5 below. From a value innovation point of view it is important to understand the strengths and weakness of additive manufacturing compared to other technologies and to perhaps follow the advice of Sun Tzu who advise that one must “focus on your strengths, not your weaknesses”. Rather than competing head-on and on price, a better strategy may be to explore hidden opportunities that can be used to leverage the strengths of additive manufacturing to create unique and innovative products considered to have value by the target customer.

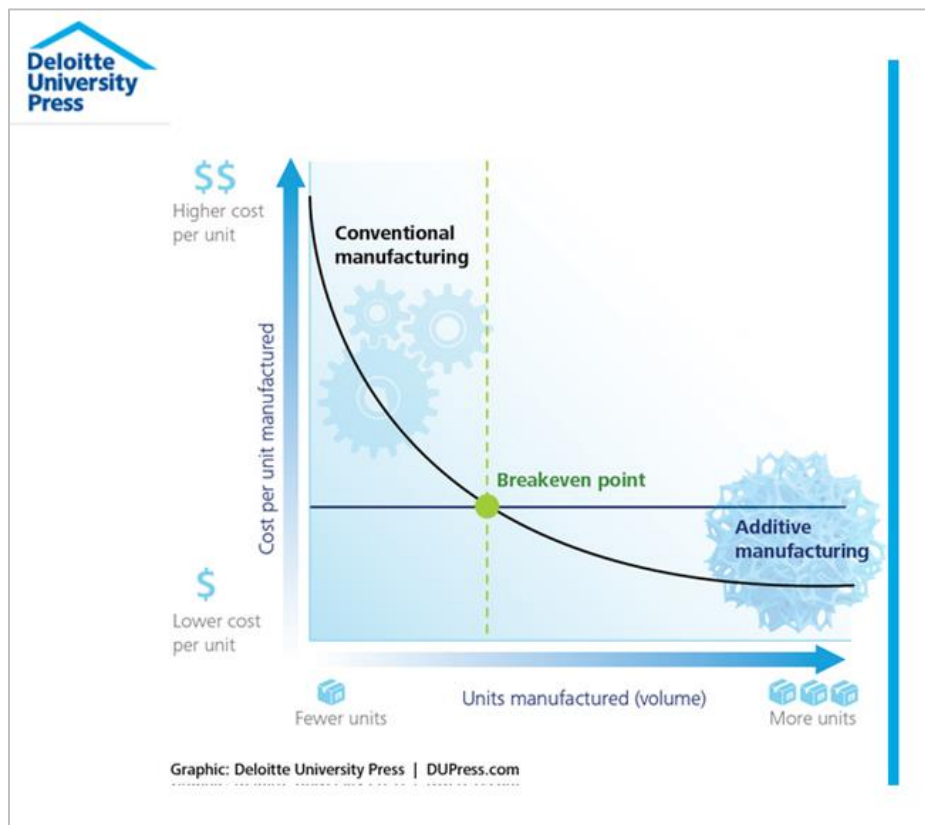


Fig 5. Breakeven analysis comparing conventional & additive manufacturing processes

According to TRIZ (Theory of Inventive Problem Solving), technological systems evolve towards ideality – improved performance at lower cost. Furthermore, Dough Engelbart (the inventor of the computer mouse) noted that the technology is always way ahead of the ability of the system to absorb it. One can thus expect that additive manufacturing as a technology will continue to evolve towards ideally, thereby

further improving its potential as an enabling technology to be harnessed as opportunity for creating unique and innovative products.

In addition to the above, the convergence of additive manufacturing with related technologies - intelligent software, novel materials, dexterous robots, and a range of web-based services, is likely to offer those involved in additive manufacturing a wide array of options to compete, innovate, and grow profitably.

One further advancement in additive manufacturing to be expected, and to be encouraged, is the integration of hardware (technical skills) with mind ware (creative and innovative skills). Such integration will allow additive manufacturing to become aligned with and to capitalize on the benefits offered by seeing additive manufacturing as a component in the broader process of value innovation.

Based on the current trajectory of additive manufacturing - as an emerging, and enabling technology, the future seems to shine bright. This, however, must not blind the practitioner to take into account the high failure rates of new products. According to the Pareto Principle, 20% of products will generate 80% of revenue. Ideally, one aims to invent and commercialize a new product with the hope that it will turn out to be one of the few products that are responsible for the bulk of the turnover. Sometimes it is argued that even if the new product does not make the cut as one of the lucky few (the 20% of products generating 80% of revenue), it will still generate income as one of the “long tail” products (the 80% of products generating 20% of revenue). As is the case with any new product, there is no guarantee that the new product will turn out to be a “winner” nor that it will become a “long tail” item. Worst, as is illustrated in Fig. 6 below, the new product may end up on the pile of failed products.

Those involved with additive manufacturing must be aware of the “ease of manufacturing trap” – i.e. because a new product can be manufactured - and so easily, this in itself is no guarantee that it will sell. Unless the potential of a new product idea has been carefully evaluated and translated into a compelling customer value proposition (CVP), or the new product idea has emerged from an in-depth knowledge and understanding of commercialization factors relating to the new product, the new product can end up on the pile of failed – usually ill conceived, products.

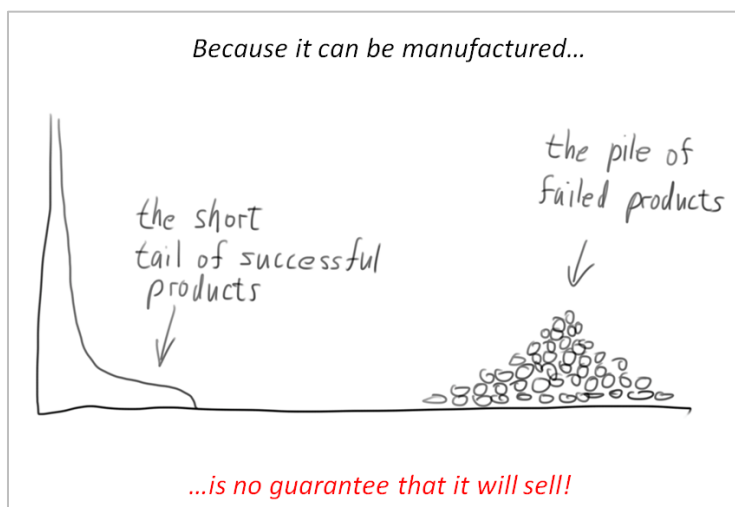


Fig 6. Successful & Failed Product Graph

On a positive note, by seeing additive manufacturing a part of a broader value creation, delivery and capturing system – i.e. value innovation, practitioners of additive manufacturing are well positioned to capitalize of the unique features, functionalities and benefits afforded by this technology of manufacturing to produce products that is unique and desirable.

## H. Concluding Notes

Practitioners of additive manufacturing are currently engaged in a wide array of activities along the value chain where they act, for example, as makers, hobbyists, marketers, product developers, suppliers and manufacturers. The convergence of additive manufacturing with related technologies - intelligent software, novel materials, dexterous robots, and a range of web-based services, offer those involved in additive manufacturing a wide array of options to compete, innovate, and grow profitably.

It is proposed that by embracing a value innovation perspective, practitioners of additive manufacturing will be better equipped to leverage the strengths of additive manufacturing, capitalize upon the new and emerging technologies and ultimately, create competitive and profitable products capable of delivering value and satisfaction to the customer.