Paper #1569309243

Stage-gate Process for Innovation:

A Pedagogical case study

Chakravarthy B. K., Kusale Sarang, Sharma Susmita
Shenoy Innovation Studio
Industrial Design Centre, Indian Institute of Technology Bombay, Mumbai, India
chakku@iitb.ac.in, sarang.k@iitb.ac.in, susmitasharma@iitb.ac.in

Abstract:

The process of creating an innovative product is not well established and falls in the domain of tacit knowledge hence this process is demystified by undertaking a student project and creating a design pedagogy for innovative product idea generation. The various stages in creative processes were established by the types of triggers for creativity and the shift from one stage to another was brought about by the type of creative exploration. Hence we created the stage gate process for innovation wherein the creative product ideation as well as experiencing the product creativity happens in parallel.

The methodology outlined here strongly derives from how creative inputs at each stage can be varied and different but collectively help in developing innovative solutions. The core of the process is to develop the chosen idea in each stage using the other ideas in the same stage. The process of developing an innovative product is also aided by experiencing and interacting with the exploratory models developed from the ideas and understanding the interaction by enacting as well as role-playing in the later stages.

This paper aims to contribute to the design process and methodology in discussing an emergent process for innovative idea generation. Our process for Innovation emphasizes the use of creative exploration by way of choosing different materials for the same product idea and imagining it shape as a key method to generate alternative models. The result of the stage gate iterative strategy of enactment/role-play and material-exploration is showcased with a pedagogical case study, executed during a course for product design at the Industrial Design Center. The case study highlights the process involved in design of an innovative spoon for a particular use .

Keywords:

Innovation, Design process, Design Pedagogy, Exploratory Models, Idea Sketching, Enacting, New Product Development

Introduction

Design process and thinking involves generating creative and innovative product solutions. No matter how much user-study a designer does, it may not necessarily create a

base for developing creative and innovative ideas.

The process of innovation starts by defining the need for the product. The design insights are generated from the experience as well as all the new knowledge prevailing . Jose Alcides Gobbo & Annika Olsson (2010) states that 'the creation of innovations requires highly specialized knowledge in fields and networks are a breeding ground for the creation of radical innovation through new knowledge.

The innovation design process is a combination of multiple methods, which involves a number of iterations. G. Seliger (2001) emphasizes the role of both inventive and exploitative thinking for product innovation. He also states in the etymological definition of innovation as "not something totally new but rather a new mode of something already existing." Reinstating at the definition of innovation in the pedagogical framework, we outline role of key stages in the new stage-gate mode to support innovation in design. Pace S. (2001) illustrates the use of function as one of the triggers for product innovation in various environments. Bordoloi S et al (2007) explores the perspective of the control at various stages in the design process in industrial environment, which is also the back-bone of the design process of innovation suggested in this paper. Though limitations loom large over designers, an adventurous pedagogical environment that emphasizes iterative or mixed-methods create an enormous range for the designer to customize yet innovate depending on demands of the situation.

Dahlander L and Gann M D (2010) emphasize the role of "openness" as a chief construct in innovation. The method of using the variation of the shape of the product as a key strategy for creative idea development and the doctrine of , 'form follows function' has supported the creative idea generation .

Treating product shape as a key to innovation (Berkowitz M, 1987) is the main trigger used for design innovation in this paper. A pedagogical environment indeed gives a stretchable and open platform for identifying the trigger which emerge as key construct for the Innovation Process. It is strategic and important that opportunities are created within the Innovation Process by way of triggers for product idea development.

The Design Process Methodology

The brief given was to design a 'Innovative spoon'. As a primary trigger for the Innovation Process a specified need is chosen. Thus for this representative case study the design brief was, 'designing an innovative spoon for children of age group two to five years to promote play while having food'.

The need statement helps to be more imaginative and leads to creative ideation

Stage IA-Idea Generation: The goal of the initial stage was to generate numerous idea sketches, using various creative methods. The techniques like brainstorming, and synectics, were used while sketching to create maximum variety and out of the box thinking .(Rawlinson, 2006)

The aim was to have a variety of ideas, that range from ideas for gripping the spoon, various spouts for holding the food and also the imaginative use of the spoon.

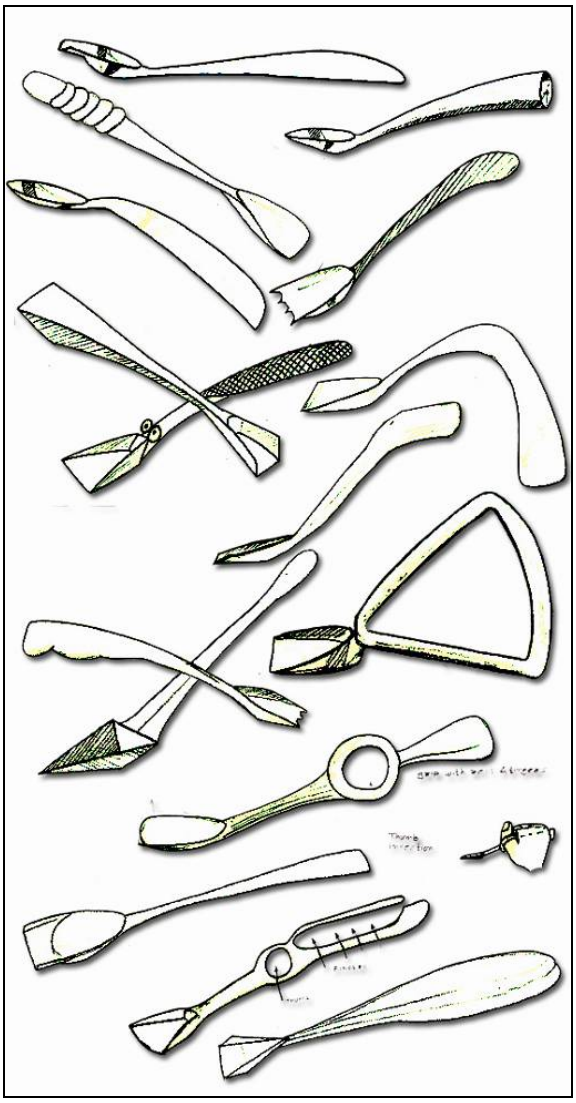

Fig 1: Stage I-Idea Generation

The key factors leading to the innovative methodology in this Stage were:

- Mix methods to create variety of ideas
- Emphasizing and generating clairvoyance on imaginative use and environment it is used in

Stage I B-Cluster Formation: As lot of ideas was produced, it was an strategic task to form clusters depending upon affinity in the ideas. To sort the idea in to clusters, cards were created. Each card represents an idea as illustrated in figure 2. The size of cards was kept as palm size for easy handling.

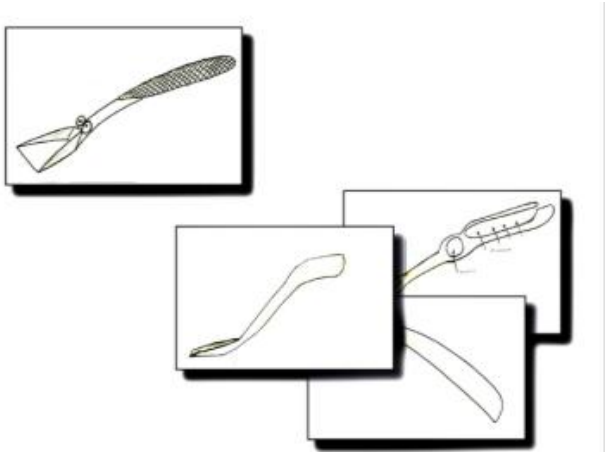

Fig 2: Making a card for each idea.

While sorting the cards, the number of cluster was kept to 3, and attributes and characteristics were given for each developed cluster. Cluster 1. slender handle and deep scoop; Cluster 2 novel grip handle; Cluster 3 long handles with flat scoop (as shown in Fig 3)

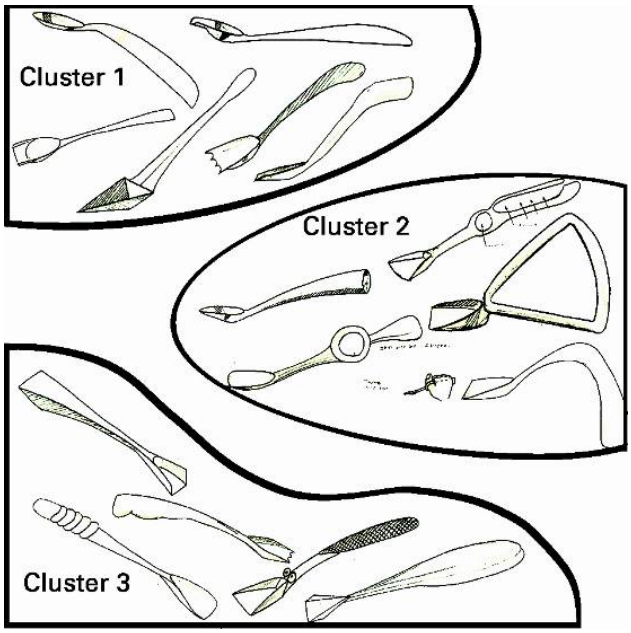

Fig 3: The clusters

For each cluster a representative idea was chosen with strong affinity to the emotion or nature of the cluster. The cluster was detailed and refined. Every idea was added gradually

to the concept thus furthering a serial and visible development process.

The key factors in this stage are the growth of the idea by using the multiple creative ideas of the clusters. This cannot happen intuitively. The growth of concept is completely due to the insights taken from the rest of the ideas of same cluster.

A few developmental clusters can be seen in fig 4 and 5. The fundamental process of concept development is illustrated in fig 6.

The key factors in this stage were:

- Cluster formation
- Concept development by Additive idea method

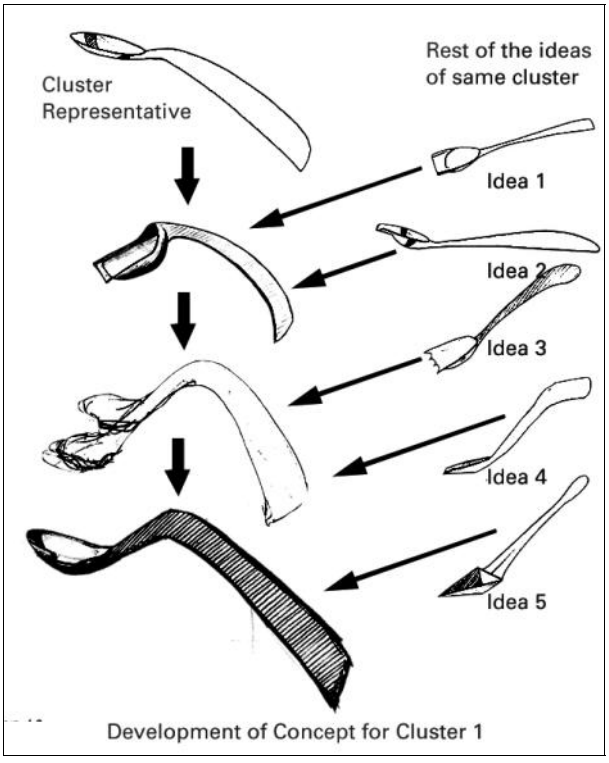

Fig 4: Cluster 1, Concept Development

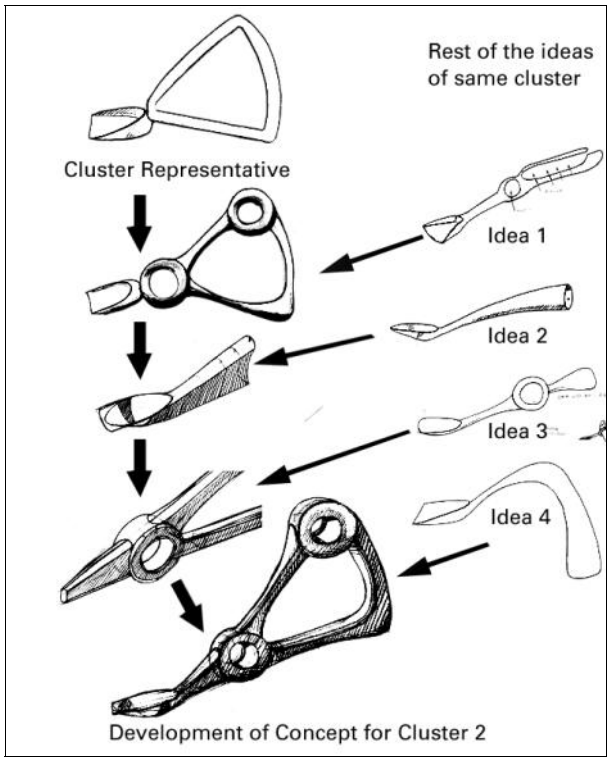

Fig 5: Cluster 2, Concept Development

Stage II: Exploratory Models: The factors like material, scale, proportion, degree of dimension and interaction were used effectively to generate new ideas which helped in developing the concept. The creative Technique of "making familiar strange & strange familiar" enabled breakaway from linear thinking modes. The concept further evolved with each idea building upon the other and thus creating an evolutionary idea generation .

A spoon in wire-framed model is inconceivable and strange but creating and interacting with it, creates an assessment of outer dimensions and brings out new creative expression in the frame structure. The properties of wire material were taken as constraint and hence the flow of lines and the boundries got well demarcated and thus helped in creative exploration .

Similarly wood and paper were explored. Paper was quick to make and manipulate, useful to get the ideas for creating creases or fold to get strength in the form. Wherein wood is hard material which defines stiffness.

Plastic sheets and other specified materials were introduced to add a new dimension to the concepts. The Expanded polystyrene foam (EPS) made of pre-expanded polystyrene beads proved a quick medium for quick exploratory models, and three-dimensional form could be created by sculpting.

The key factors in this stage were:

- Material as creative tool for exploration
- Exploration with form attributes: by maximizing or minimizing

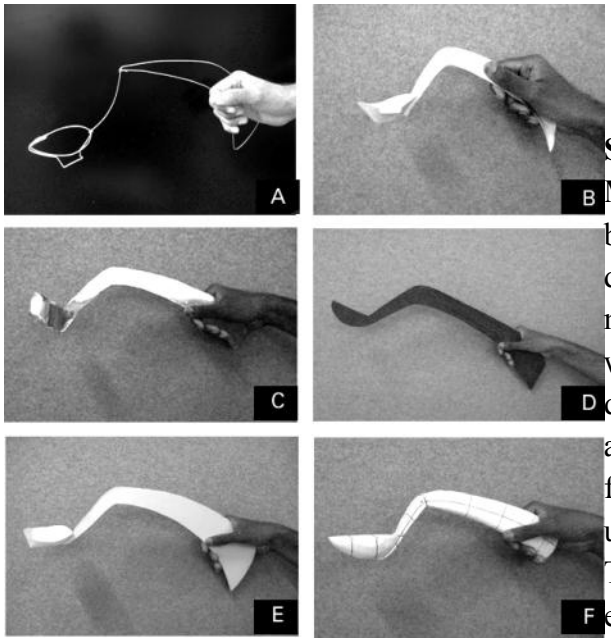

Fig 7: Exploratory models for concept#1 Medium used A: G.I.Wire, B: Cartridge Paper, C: Aluminium Sheet, D: Plywood, E: Polystyrene Sheets, F: High-Density Polystyrene Foam

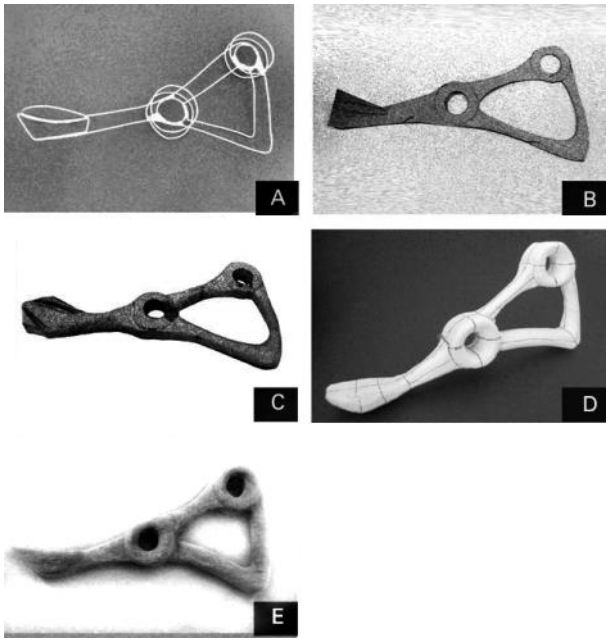

Fig 8: Exploratory models for concept#2 Mediums used A: G.I.Wire, B: Cartridge Paper, C&D: High-Density Polystyrene Foam E: Medium density Poly-Urethane Foam

Stage III: Interacting with Exploratory Models: To understand the interaction between product and the user, an exercise was devised where the designer experienced the mockup models and enacted the activity for which the product is designed. By performing drama and doing the role play idea refinement and insights were generated. It was important for the designers to encounter the imaginative use and perception of use and environment.

The technique of Creative analogy was effectively used to create variations. Explorative Models with different scales were used to challenge perceptions. Glimpses of this Stage can be seen in Fig: 9.

In the development of design, three main attributes were considered viz. form, interaction and material exploration .

Form: In development of 'form', the shape of product evolves with insights generated in the process. This Stage is more imaginative, and layered developmental as per process.

Interaction: defines not only relationship between product and user but also interrelation between the different parts of the spoon ..

Material: As the form follows the Material characteristics it was used as a creative anology to high light the various aspects of form .

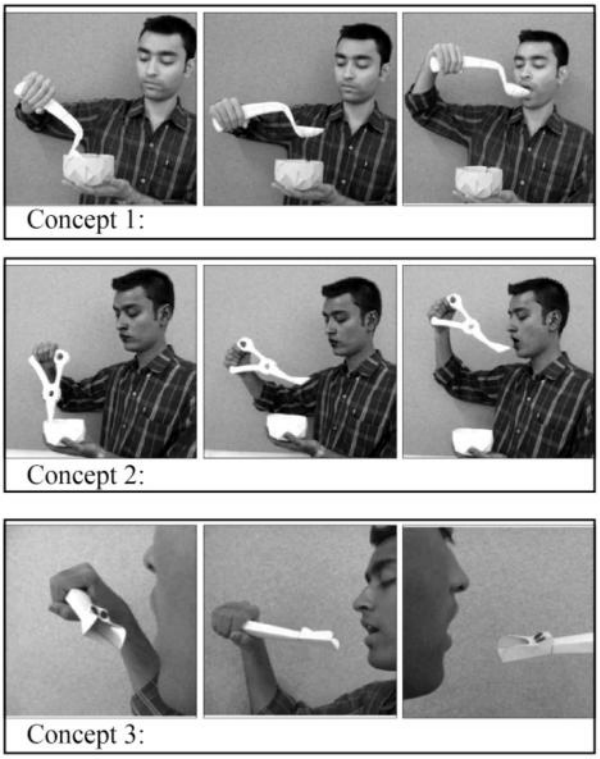

Fig 9: Enacting with exploratory models

The key factors in this Stage were:

- Enacting and role-playing with mock up models as a tool for generating insight to develop deeper interaction.
- Assessment, Imagination and perception of variety in use
- Understanding multi-level relationship between user, product and environment.

Concept Selection

Considering the level of innovation in each concept based on following parameters one concept is chosen out of three by comparative analysis. The parameters for concept selection were:

- Playfulness in form
- Better Interaction
- Challenge the Material to br used
- New Technology for Manufacturing

The concept 2 is selected and 1:1 scaled prototype is made to experience the interaction and to refine the details.

Fig 10: Illustrating various holding position

The final model is created as well defined form by using prototyping techniques. refer fig 12.

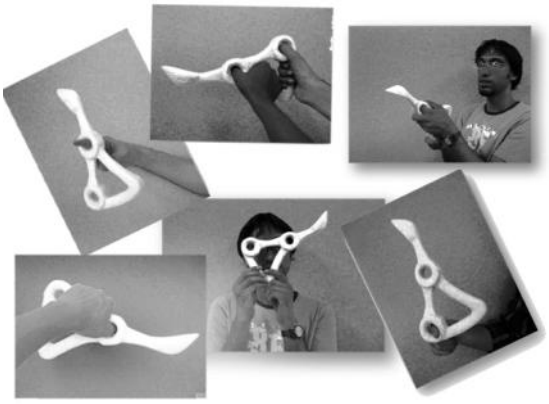

Fig 11: Various levels of interaction between product and user

Fig 12 : Final prototype of Spoon for kids.

More innovative spoons

Along with the above case study, some more innovative spoons were developed for different activities. These projects are also the outcome of the Stage-Gate process for innovation. A bried description of the projects is as follows.

A traveler's spoon is shown in fig 13. The light weight spoon also helps in gripping well while having food during travelling. Also the scoop helps in fast scooping with good edges .

Fig 13: Spoon for having food during travel

The feeder spoon as shown in Fig 1 for dogs encourages the interaction between pet and owner. The shaft handle and wide sprout helps in easy feeding of the pets.

Fig 14: Feeder spoon for dogs

The fig 15 shows the spoon for having soup. This spoon helps in easy sipping as well anchors on the bowl .

Fig 15: Spoon for soup

The spoon shown in fig 16, is developed for adding spices while cooking. This helps in measuring spices and by tapping the spoon a precise amount of spices can be added

Fig 16: Spoon for adding spices

Fig 17 shows a special spoon, which is developed for wedding rituals followed in Indian Gujarathi culture. The elaborate form helps to match the importance of event where in one elder from the Bride groom side tastes the food as a ritual. The form also supports the importance by providing a special holding

position.

Fig 17: Bridal Spoon for food tasting ritual (Gujarathi weddings)

A spoon for long jars is shown in fig 18. It has a movable spout, which helps in picking up contents from deep jars. The lever mechanism helps in picking up by making the spout stand up.

Fig 18: Spoon for long jars

Overview of Process

The process of developing innovative products starts with identifying need of the product. The flow of process followed stages as well as triggers, thus together it can also be term as Stage-gate process of innovation. Experiencing the product in an open and controlled environment plays a key role in generating innovative ideas and concepts to solve user needs. The methodology outlined here strongly need assessment as basis of Product innovation.

In the C-K Theory presented by Hatchuel and Weil (2004) the dynamics of the flow of activities between concept space [C] and knowledge space [K] in the design process for innovation . The C-K theory illustrates the flow of the design Innovation Process in a tree structure, where the depth of concept is discussed. The theory is unable to explain the iterative nature of the Innovation Process, where the design insight generated in one stage helps to grow the concept, which follows a closed loop process of iteration. Hence as discussed in this case study, the process of design innovation combines the both lateral as well as linear processes.

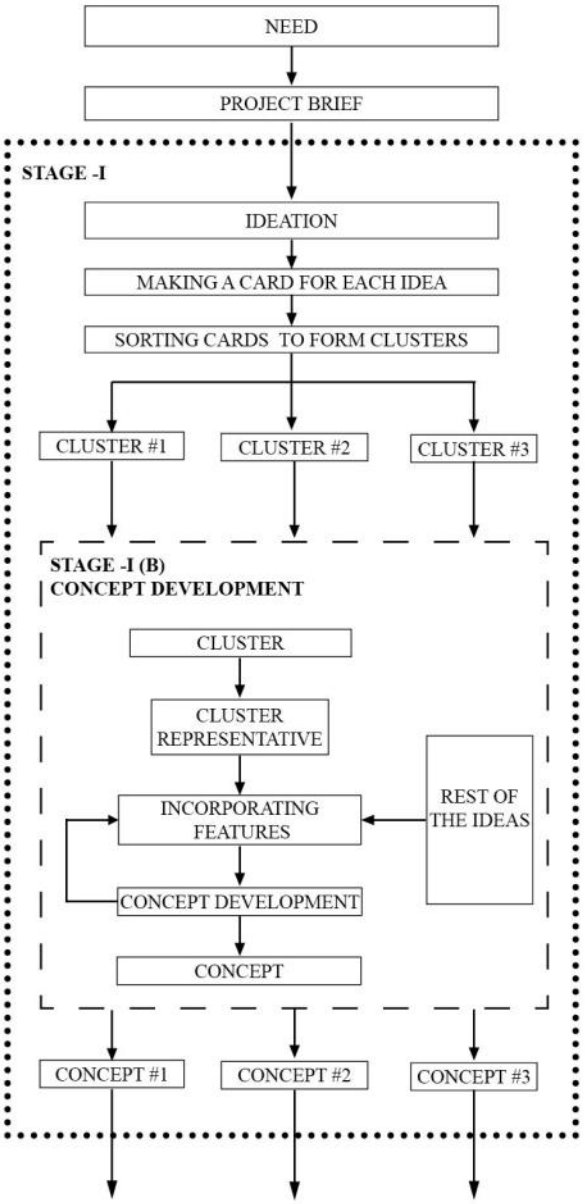

Fig 19: Overview of the Stage-gate Process of Innovation (till Stage 1)

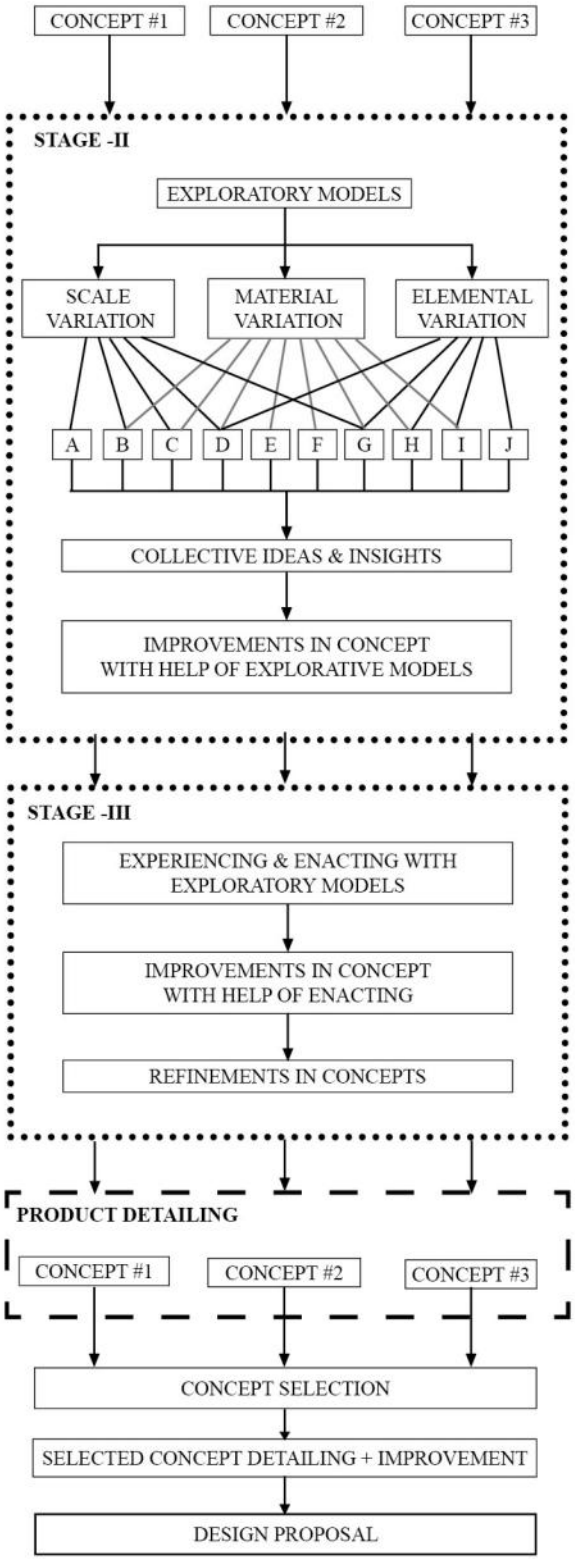

Fig 20: Overview of the Stage-gate Process of Innovation (Stage I onwards)

Observations and Insights

The project started with design brief, and designers were encouraged to recollect the needs of activities rather than going for research to understand the user need. This way the designer's views were not biased with the research survey. Also rhetorically they had to find the user within themselves to study deeply.

We outlined in this paper learning, implemental and validating journey of the Innovation process for creative ideation and concept development .

The case study while in design discourse validated the stage gate innovative methodology that effectively resulted in innovative design concepts

The evolutionary development of the concepts is based on the building of the concept by using the strength of all the ideas generated thus creating a innovative product which is not possible intuitively. The creative methodology using stages and triggers can help in generating innovative concepts for all product.

Acknowledgement

The authors gratefully acknowledge the contributions of the students as well as faculty at the Industrial Design Centre (IIT Bombay) namely Prof Chakravarthy B.K. and Prof. Bapat Vijay and IDC IIT Bombay.

Bibliography

Berkowitz, M., “Product Shape as a Design Innovation Strategy”. J. PROD INOV MANAG 1987:4:274-283.

Dahlander, L. and Gann, D. M., “How open is innovation?”. RESPOL-2409; Research Policy (2010)

Jose Alcides Gobbo, Jr.Annika Olssons, "The Transformation between exploration and exploitation applied to inventors of packaging innovations", Technovation, Elsevier Ltd., (2010) Vol. 30, pp.322-331.

Pace, S., “Aids to innovation in the design and manufacture of hand-held consumer products”. Journal of Materials Processing Technology 118 (2001) 261-268.

Pr. Armand HatchuelDrPascal Le Masson, Pr Benoit Well, “C-K Theory in Practice: Lessons from Industrial Applications". 2004. International Design Conference-Design 2004. pp.1-13.

RawlinsonJ.Geoffrey *Creative Thinking & Brainstorming*. Mumbai, Jaico Publishing House, 2006. (ISBN-81-7224-348-0.

Salter, A. and Gann, D., “Sources of ideas for innovation in engineering design”. Research Policy 32 (2003) 1309-1324.

Seliger, G., “Product Innovation – Industrial Approach”. Department of Assembly Technology and Factory Management, Institute of Machine Tools and Factory Management, Technical University Berlin, Germany.

Biography

Chakravarthy Battula Kalyana

Initiated 'Shenoy Innovation Studio' in IDC, IIT Bombay, to encourage design in Industry and academic area, with help of collaborative design activities.

Professor, Industrial design Centre, Indian Institute of Technology Bombay, Mumbai, India. (2001 to till date)

Associate Professor Industrial Design Program IDDC, Indian Institute of Technology Delhi, (1994 to 2001)

Ph.D. in the area of "Strategic design and innovation".

Master of Design (Industrial Design), Industrial Design Centre, Indian Institute of Technology, Bombay, May1988

Bachelor of Engineering (Mechanical), Osmania University, Hyderabad, May 1986.

Kusale Sarang Nagesh

Design Associate, Shenoy Innovation Studio, Industrial Design Centre, Indian Institute of Technology Bombay, Mumbai, India.

Master of Design (Industrial Design), Industrial Design Centre, Indian Institute of Technology, Bombay, May 2009

Bachelor of Engineering (Mechanical), Government College of Engineering Pune, University of Pune, Maharashtra, May 2005

Sharma Susmita Y

PhD Scholar: Domain: Perception of Form. Industrial design Centre, Indian Institute of Technology Bombay, Mumbai, India.

MFA. Sir JJ School of Art. Mumbai.

BFA. Chandigarh of Art. Chandigarh. India