Collaborative Environment for Concept Generation in New Products

Authors
Battula Kalayana Chakravarthy
Associate Professor
Industrial Design Programme, IDDC
Indian Institute of Technology
New Delhi 110016 India

Prof. Albert Albers
Head Of Institute mkl
Department of Mechanical Engineering
Universitat Karlsruhe (TH),
D-76128 Germany

Dipl.-Ing. Dirk Schweinberger
MKL Department of Mechanical Engineering
Universitat Karlsruhe (TH),
D-76128 Germany.

Abstract

Concept Generation for new products is becoming more and more challenging as the products have to address global customers with contemporary technology and short product life spans. This demands customer centered concept development with all the key players like technology providers and manufactures playing a key role in concept generation and evaluation.

At the Industrial Design Programme of The Indian Institute of Technology in Delhi we have specially focused on the collaborative development of concepts and have conducted courses and workshops. The result is that we have enhanced creativity due to increased information; and concept evaluation acquired a new meaning by making it more user-and industry-centered.

Similarly at mkl at University of Karlsruhe Germany we focused on collaboration for innovative products in the course on Integrated Product Development.

This methodology helped students in getting a wider perspective in design. It also helped them to appreciate the value of the other players in the total life cycle of the product.

A number of studies were undertaken and the most interesting case was the development of a shaving system. The innovative concepts evolved were varied and interesting ranging from bio-technology solutions to laser-based systems and resulted in completely new products.

The collaborative environment used was the internet and standard programs were used to make it compatible to all. The important distinction is that customers and manufactures alike can be part of this process. The latter is particularly important as knowledge and

technology are becoming increasingly sophisticated and are no longer the domain of the privileged few, further emphasizing the need for effective collaboration. This process would teach the design students in school itself how to have faster innovations and faster time-to-market mobility at lesser risk.

Key Words

Collaboration, innovation, concept generation, visualization, webcentric environment, collaborative product commerce, extended enterprises, alliances & concurrent engineering.

Introduction

Collaborative new concept generation has become the focus as industries are becoming extended enterprises and new products are developed for global customers. This also brings new challenges to industrial designers to work collaboratively and to see that the basic ideology of the industrial design is not lost and they are able to perform better in collaborative environments.

It is no secret that we are living in a time of accelerated change. There is extreme pressure to deliver more effective products, more quickly, more reliably and more economically. Fortunately new technologies are continually providing us with options to help us rethink the way we work. In the new product development arena the increased importance of time to market together with the need to contend with global marketing issues have forced us to accelerate the design development process and to turn concept into reality in a short time span.

Collaborative New Product Concept Management is essentially a synergia created out of combining three areas: Internet Technologies, Industrial Design and Strategic Management and flexibility to come up with innovative new products.

The web is an all pervading factor (Eppinger, 2001) and a very valuable resource for collaborative work. There is an advantage that the technology is fast becoming the main channel of business communication and can be effectively harnessed for specific purposes by additional support.

In the complex matrix of liberalization and globalization there is a tremendous pressure on organizations to come up with New Products and services. New methodologies and tools have to be created to meet this new challenge Smith (1995).

The contemporary order of Management calls for strategic change mechanisms right from the conceptualizing phase of New product design. New Products are the lifeblood of many companies. Indeed, many companies like 3M &Gillette set goals for sales based on new products. The reason life cycles are often thought to be shortening is the increasing number of products with minimal technological changes and the decreasing fraction of really new ones.

Little evidence exists that really new products are being adopted faster. Our inherent tolerance for innovation is largely unchanged. Indeed, considering the risk taken by those who set out in small wooden boats across oceans, our reluctance to try new things seems almost laughable.

Really new products, are hard to forecast, raise numerous tough organizational issues, take a long time to develop and frequently produce profits for later entrants but not for the pioneers (or none at all, if a subsequent technology makes them obsolete). Because of the time it takes them to reach a mass market, really new products require a level of patience unusual for businesses driven by quarterly profits.

To address these issues of new products it is very important to look at the conceptualization phase and see how in a contemporary environment new concepts can be grown and nurtured.

1 New Product Strategies

Basically new product development could take place in two ways:

1. A company or industry discerns the need for a new product or product range, develops markets and sells to the widest possible market. To do this, it has to not only to come up with single products but be able to place them in product systems and even combine them in innovative ways, using existing unconnected product breakthroughs. Sony took a small tape player, married it to lightweight headphones and made the Walkman an entirely new product that, after a slight hesitation, became a world beater. The company originated and broke through with a new idea, using high quality elements from its flexible audio product system.

2. The end user develops an idea for a new product that is beyond the present vision of the industry and brings it to the attention of a manufacturer or industry. Many medium to high tech. industries have users as innovators. For example, at IBM in the Installed User Programs (IUP) Department, 30 per cent of IBM leased software for large and medium computers is developed by users. In other cases, such as medical electronics commercial applications very often lag behind the clinical front line until user specialists take a hand.

More and more companies are taking account of these two approaches to commercial innovation. Companies liked 3 M, Honda, United Technologies and Apple are providing the means by which new ideas can be recognized and commercialized whether they are insider or outsider generated. In the present situation the best bet is to involve all the key players both external and internal in the process in a collaborative environment.

Concept Generation for New Products is becoming more and more challenging as the products have to address global customers with contemporary technology and short product life spans. This demands customer centered concept development with all the key players like technology providers and manufactures playing a key role in concept generation and evaluation.

2 Background

There are a number of effective tools that can be used within the ‘collaborative concept development’ framework. These tools have been very successfully tried out and hence they could provide the trigger for the much needed change.

2.1 Integrated Design management

Successful companies use integrated design management as a means of ensuring that all products, communications and services of the organization are serving the overall

business . (Oakley, 1990) Organizations successful in integrated designing are often started and run by outstanding individuals who know the business, like Morita, Hewlett and Packard. They are people dedicated to seeing that corporate goals and cultures do not deviate from the chosen path. Accelerated rates of change demand improved organization and procedures to increase the ability to adapt to new conditions and to conserve money by well-designed, economical manufacturing; keeping this in focus often requires a single vision.

Business strategies (Oakley ,1990) which have to interface with designing are:

1. Develop market/user understanding thoroughly before design development.

2. Focus on commercially viable translation of ideas, i.e. innovation for successful commercial products.

3. Design a well-integrated organization to support product development in the milieu of ever changing conditions with product systems or cascading development from one product to the next.

4. Make room for alliances, mergers and cross functional collaborations to aid New product Design.

5. Make World markets as target customers to cover ever increasing costs and develop economies of scale.

Invention is the first stage in the process of technological innovation (Clipson, 1987). A tidy distinction between invention and innovation does not exist, even through there is a qualitative difference in the activities. They are frequently inextricably linked. Invention is best treated as the subset of patentable technical innovations. Inventions typically involve minor improvements in technology. Three general theories of invention exist: one attributes invention to the individual genius: another considers it to be an inevitable historical process, proceeding under stress of necessity, where need dictates and technology complies; and the third and most realistic approach sees invention arising from a cumulative synthesis of what has proceeded (Parker, 1974).

According to this view, the occurrence of invention is not certain: an act of insight is required. It is likely to occur to an individual directly concerned with the problem. This individual, however, is not suddenly struck by a brilliant idea. When and if the act of insight takes place, it is conditioned by the specific problems encountered, and occurs through a synthesis of previous knowledge. By this synthesis and the act of insight, the inventor may overcome a discontinuity. This theory conforms with the concept of technology building on technology, where progress is not a random process but a synthesis of what has gone before. It is true, however, that necessity hustles invention forward and that great inventors do exist, but these are not typical occurrences. Theories of invention must describe the usual. Economic factors are predominant in the motivation to invent. The primacy of economic forces, however, does not imply how research should be organized. Keeping the sources of invention as wide and diffuse as possible is considered to be the best approach.

Innovation may occur after a considerable time interval from invention. Successful innovation can greatly improve the economic performance of companies, enhancing growth and profit rates. The term innovation covers all the activities of bringing a new

product or process to the market. It tends to be a time-consuming transformation process which is both management and resource intensive, and is more expensive than invention. Development risks are divided into technical and market risks. The amount of technical risk involved depend upons the size and complexity of the desired advance. The market risk is, to a much larger extent, beyond the control of the company, being dependent on the achievement of an adequate market. When selecting projects, the criteria applied by management indicate a fear of the high risk of the market. Research allocations are typically modest and the payback periods required tend to be short.

R&D is expensive but is necessary. Commitment to research differs among industries, depending upon technological push and customer pull. The relationship between a company's size and its technological capabilities is unclear. Large companies do not appear to be unchallenged. In terms of relative expenditure, very big companies may carry out proportionately less research than smaller ones. In terms of major inventions, lone inventors and small companies may have a comparative advantage, while the large companies forte may lie in development and follow-up improvements. The same ambiguity seems to exist regarding the influence of specific market structures. The most crucial factor in the organization of R&D probably relates to the number of independent centres of initiative. By having numerous potentially creative units, an enterprise may greatly improve its chances for innovation (Plenert, 1998).

2.2 CPC Collaborative Produce Commerce

A new IT revolution (Kalakota,2000) is emerging in which the leading edge discrete manufacturers develop, build and manage products/processes differently. This new category of web-enabled software solutions called CPC has emerged that is allowing discrete manufactures to maintain and increase leadership on their products and innovations. CPC allows discrete manufactures to significantly improve their core processes around the management functions associated with the complete product cycle that are the basis of their existence. If one takes a look at the approach manufacturers have taken to develop products in the past, it has been very functionally oriented. They have marketing, sales, engineering, manufacturing and others who work autonomously, who generate their own data and manage the data in their own unique, distinct information systems that typically don't speak well to each other. As we go forward many companies are realizing that a more holistic approach is needed. They need to allow many different groups, many constituents with different processes, different data and different views of that data to actually collaborate. CPC essentially enables this.

CPC involves a class of software and services that uses web-centric technologies to permit all enterprise participants (executives, engineers, vendors, markets, etc.), with diverse roles, irrespective of their geographical location and technology platform to collaboratively develop, build, and manage products throughout their entire life cycle. What this means is that the parties connected have defined access to the product data at the design and development stage, so that they can chip in with their expertise in Real time to rapidly move to the manufacturing stage. The important distinction is that customers and vendors alike can be part of this process. The latter is particularly important as knowledge and technology is becoming increasingly sophisticated and is no longer the domain of the privileged few, further emphasizing the need for effective

collaboration, however large and powerful the organization. In turn CPC would mean a faster response time to customer choice. It would mean faster innovations and faster time-to-market movements.

2.3 Benefits of Collaborative work system

The most obvious benefit of a collaborative product development system is the quality and speed of work. It allows discrete manufactures to collapse the time it takes to translate intellectual property of new product ideas into deliverable, commercially viable products. This superior ability to be the fist mover usually translates into market share movement and profitability.

CPC addresses an important issue in that a products design locks in cost that cannot be removed throughout its entire lifecycle. Research indicates that nearly 80% of a product's cost are built in by the time the product file is released for manufacturing. This means no matter how efficient a discrete manufacturing enterprise due to initiatives such as ERP and SCM, such transaction based applications can only assist in lowering 20% of a product's cost. CPC's ability to bring about efficiency in engineering and design efforts could potentially bring about a more significant cost saving advantage as compared to any of the downstream processes.

In addition CPC could greatly assist companies in lowering the deployed product life cycle management costs such as those associated with product design defects. This is achieved not only through better design, but also by quicker response to customer feedback and warranty claims. Any manufacture that has had to recall a deployed product will easily testify to the above.

CPC technologies also facilitate product information exchange among various heterogeneous systems as shown in figure 1. It can be commonly expected that product developers use best-in-class tools to perform their specific tasks, which make data interchange among the various data models difficult. CPC will allow individual contributions to work with their chosen tools while exchanging ideals and information with others who do not know the intricacies of their system. An example would be that designers use a sophisticated CAD program, and use CPC tools to allow a consolidated 3-D view to a non-designer for feedback.

An intrinsic benefit of CPC would be to make product data available, throughout the lifecycle of a product from design to retirement, to all levels of the organization, to aid real time executive participation.

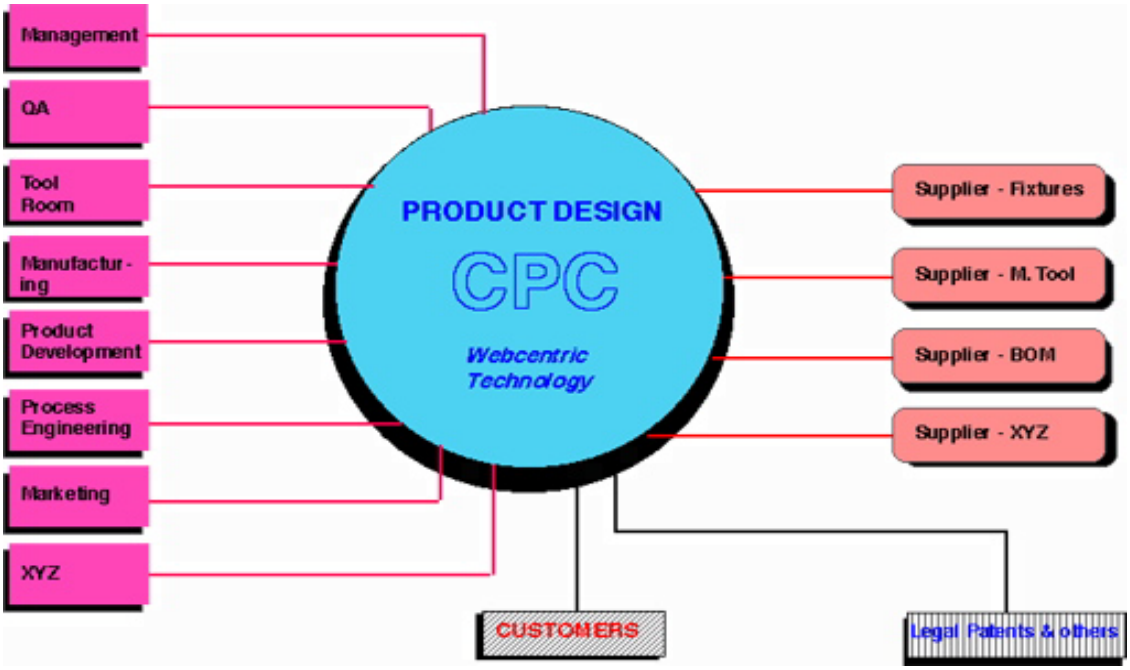

Figure 1 : Collaborative product commerce environment.

2.4 Implementation Challenges for Collaborative Work

The first part of the challenge, quite obviously is technological. It requires a discrete manufacturer to commit to a Networked world (Porter, 1998), and the internet in particular. Executives must gain confidence in the use of internet technology for data and information transfer by internal members, partners, suppliers and even competitors.

The second is cultural (Tetenbaum, 1999), where organizations must accept that in today's world partnering is the key and that to be continuously successful, suppliers and users have to build mutually beneficial relationships based on trust in their commercial environments. A collaborative environment, however will need a driver, which will establish processes and responsibilities that allow for surmounting organizational barriers while maintaining a continuous focus on the products.

The third part is that, for any significant technology transition to be successful, it is singularly important to have top level management commitment.

The impact of technology and Internet (Kalakota, 2000) is a force that no industry or commercial venture can stay away from. Discrete manufactures have to gear up to the fact that businesses indeed need to move at internet speed, and thus have product development strategies that address such needs. CPC is a powerful, enabling technology that can actually make such strategies work.

2.5 Quality Function Deployment

Quality Function Deployment (QFD) is a systematic planning process that was created to help a project team bring together and manage all the elements needed to define, design

and produce a product (or deliver a service) that would meet or exceed customer needs. The guiding principle of QFD might be stated as follows: Capture the "voice of the customer"(VOC) and make sure that you convert that customer voice into appropriate strategy, product, and process requirements.

The mind-set of QFD can be summarized as a belief in the importance of three imperatives (Prasad, 1998): Go to the customer, Work cross-functionally and Plan thoroughly up-front.

As a combination of mind-set and methodology, QFD provides both the customer focus and the methodological framework needed to assure that the VOC is recorded, translated into appropriate product and process requirements, and communicated to all the team members and relevant company executives.

In addition to the focus on customer needs, a customer relationship management has to be in place which requires cross-functional teams typically involving marketing, R&D/ design, and manufacturing personnel for hardware products in order to:

a) Adequately collect and interpret input on the needs of customers, customer's perception of the company's competitive standing, and the company's technical assessment of its products compared with competitors products;

b) Understand both technical and psychological relationships among customer needs and the means to satisfy them; and

c) Integrate all the significant factors into a winning product design and an effective production and delivery process.

In short, the use of Collaborative cross-functional teams guarantees a more complete and balanced view of customer needs, the competitive environment, and the company's possible responses when defining, designing, and producing new products and services. This approach will assure reduced cycle time ,innovation and higher "delight" potential to the user in the product solutions.

2.6 Innovation

Experimentation (Stefan, 2001) lies at the heart of every company's ability to innovate. In other words the systematic testing of ideas is what enables companies to create and refine the products .In fact no product can be a product without having first been an idea that was shaped, to one degree or another ,through the process of experimentation.

The innovation requires complex learning loops, like you repeat prior tasks after learning from subsequent ones. Hence we need tools which can provide us with information from other tasks before completing the given task. This can be achieved by using the design structure matrix for Integrated Product Development.

Coming to the core issue of creative concept generation (Unsworth, 2001), responsive creativity can play a vital role in coming up with innovative ideas as core team members respond to the requirements of the situation and to the presented problem rather than depend only on intuition. Yet to simply rely on individuals is an inefficient use of the organizational process; (O'Connor, 2001) Individual creativity is a critical factor, there are a number of management actions and attitudes that can be put in place to enhance the likelihood that the creative side of the individuals will be developed ,motivated and

directed in useful ways. The Head of Design BMW states that the process of conceptualizing has to be protected so that good ideas do not get lost due to early evaluation(Bangle, 2001).

The most important ingredient of successful innovation (Buderi, 2000) is the creative technological idea that serves a pressing human need. This kind of creativity in turn, requires a schizophrenic combination of rationality and insanity that is outside our ordinary experience.

The importance of knowledge for creating new ideas (Hargadon, 2000) is the backbone of a collaborative working culture .The four steps to the knowledge brokering cycle are:

1)Capturing good ideas,

2) keeping ideas alive,

3)imagining new uses for old ideas, and

4)putting promising concepts to the test.

3. Objective

The objective is to suggest a methodology for Collaborative New Product Concept Management using internet technologies to produce innovative product concepts as part of the integrated product development process. The methodology was developed by feedback generated by case study projects done by students at the Industrial Design Programme at the Indian Institute of Technology and the students of mkl at the University of Karlsruhe.

Some of the core issues in developing the methodology for collaborative concept generation are:

- How to bring in collaborative work methods in the concept generation phase of the integrated product development process.
- How collaborative work could generate innovative products which have high rate of success in the market place.
- How effective are the tools like Standard web browsers with plug-in's or special internet server software like CPC (collaborative product commerce) for the process of collaborative work.
- How to bring all the players to address a common problem on a common platform as in a global extended enterprise.

These issues were taken up by the student teams in both academic and industry sponsored projects and the experiences were recorded to further improve the methodology .

4. Methodology

The methodology for Collaborative concept management has to focus on the organization wide cultural change and the integration of the global extended family. This will be the key for the development of innovative new product concepts. It is presumed that the

industry uses Integrated product development and the paper focuses on the concept generation part where in nearly 70 % of the product future is locked in. Hence it becomes more and more imperative that all the people connected, get involved .

4.1 Concept Management

The first step in the methodology is to break down the process of concept management into logical steps so that a proper control and protocol can be developed.

1. Concept Creation and Generation: The development and creation of new ideas by using various methods of creativity to come up with a very large number of concepts. Even at this very early stage of concept generation interaction is maintained with the collaborating partners using various creativity techniques like synectics and brainstorming.
2. Concept focus and evaluation: Using the design strategy approach for word class management a framework is developed looking at the core values and core competency of the organization. Using this framework the concepts are clustered, grouped and evaluated.
3. Concept Engineering: This is the engineering of the ideas, converting the fuzzy concepts into usable consumer oriented ideas .Well noted methodologies of TQM and QFD are used to further narrow down the clusters of concepts to a workable two or three clusters.
4. Concept integration and finalization: This is the final evaluation and selection of the concept or concept cluster for integration into the integrated product development cycle This phase draws inputs from the collaborating partners with special evaluation norms and weightages .The needs of customers have a very strong bearing on the concept cluster selected.

Figure 2 illustrates the role of Concept management in the integrated product management process and highlights the interaction of the Internet based collaborative teams which constantly interact during all the phases.

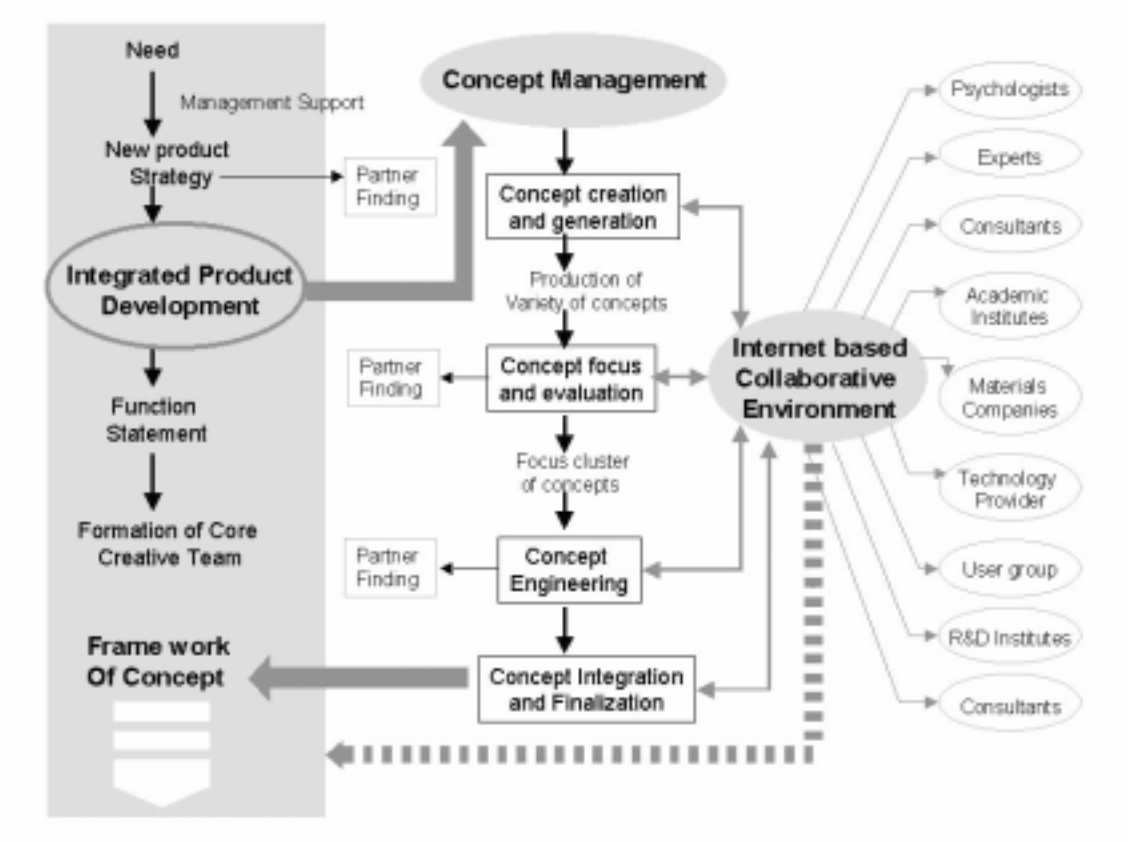

Figure 2 Model for collaborative concept management.

4.2 Projects

The method for collaborative concept development was developed and honed by doing a number of student projects to develop futuristic products. The projects were undertaken at the Masters of Design programme at the Indian Institute of Technology, Delhi as well as the product design students of the University of Karlsruhe Germany .

4.2.1 Easy Shave

The senior students of Mdes IITD did this project; they came from Engineering and Architectures background. Groups of five students formed a single team and had to use synectics to develop radically new concepts.

The group would use internet for various resources and information. A number of concepts were developed out of which three were shortlisted after evaluation:

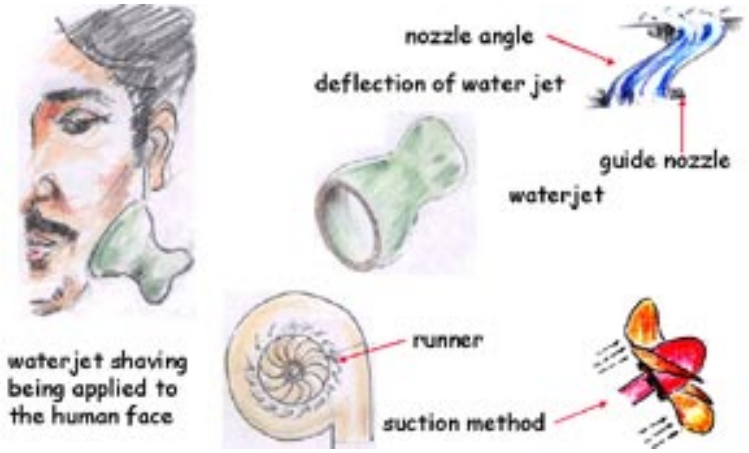

Figure 3: Concept Using high pressure water jets for shaving

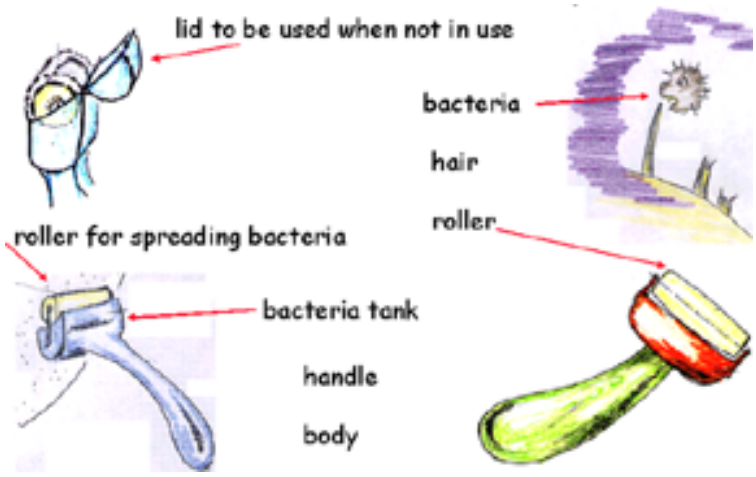

Figure 4: Concept of Bacteria shaving system

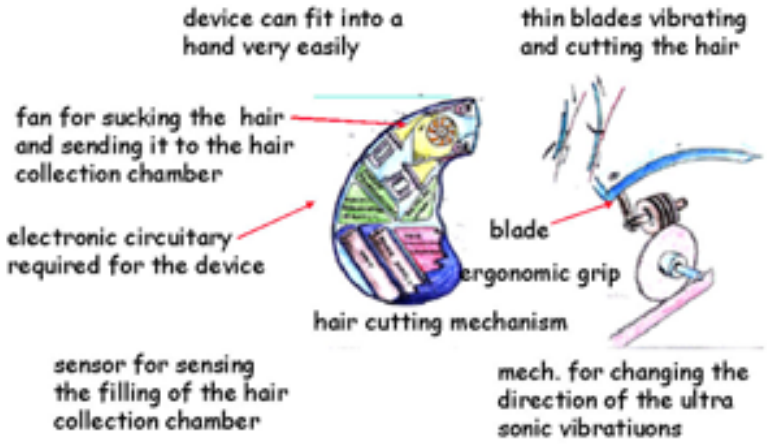

Figure 5: Concept of using Ultrasonic waves for Shaving

The concept in figure 3 uses water jet for shaving. The concept in figure 4 addresses a biotechnology solution where in bacteria is used to eat the hair. The concept in figure 5 addresses ultrasonic technology for removing hair. Here we see that depending on the strategy the new technology can be adopted by the company to create Innovative new products.

The vibrancy of concepts generated can be attributed to the collaborative knowledge sharing and the strategic decision to make a radically different product as well as an initial commitment of the management to opt for collaborations and joint ventures. At this early stage of concept generation, companies can consider collaboration with technology partners as a concept promoted activity. This further enriches the process of collaboration in the complete life cycle of the product. The above three concepts represent the concept focus phase after the concept generation phase which had 20 concepts. The laser based shaving system concept reached the concept integration stage after evaluation which involved rating by both the core creative team and the internet cluster. Fig6 shows the rendering of the hand held laser razor and the wall unit after the concept engineering stage wherein the complete organization of the product is given in detail. Here we see that a company which was predominately based towards mechanical technology synergy had to acquire laser technology to come up with new products in the market.

Another interesting project has been the development of the Bicycle. Figure 6 shows a sheet metal formed bicycle in contrast to the traditional welded pipe bicycle. This also demanded manufacturing skills outside the existing manufacturing domain of the sponsor which came into because of the collaborative concept management.

Figure6: Sheet Metal Formed Bicycle

The project innofridge (new concept of a refrigerator) done at University of Karlsruhe had some very good results due to collaboration. Teams generated innovative concepts

for insulation in refrigerators like transparent insulation and vacuum panel insulation as user driven concepts to revel the inside and provide more storage respestively in the refrigerators and figure 7 shows a user triggered idea of a fast bottle cooler. In this collaborative project the client was from Italy with head office in USA, designers in Germany and users from Europe .

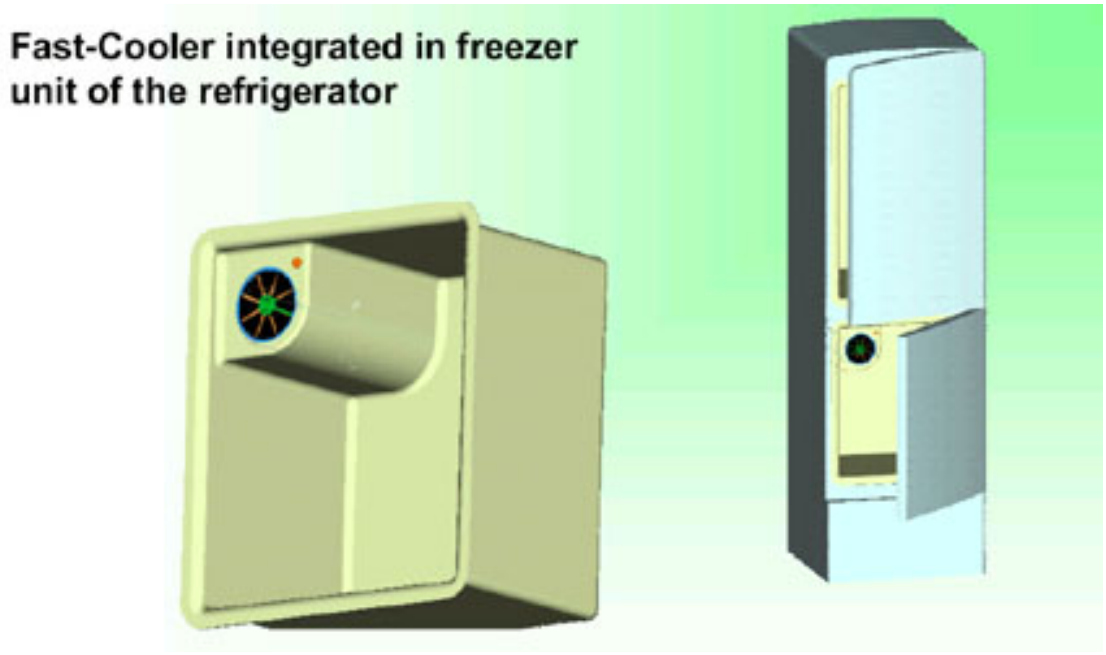

Figure 7: Fast bottle cooler concept

4.3 Issues and Concerns

There is no doubt that collaboration leads to innovative new concepts but the basic concerns in collaborative work have to be addressed appropriately to lead to any appreciable outcome. There is a very delicate balance between autonomy of partners and interdependencies. This demands high professional practice in this respect and has to be cultivated with some amount of training ,where the team members are encouraged to share their ideas very early or during the concept development so that they can assimilate more knowledge by interdependency and further improve the concept generation phase.

As illustrated in fig 2 the core creative team has to have periodic synchronization with the internet cluster and this synchronization need not only be result oriented but could be awareness oriented also .This helps in building the team sprit and a casual remark could lead to potentially viable creative concept evolution. Involving all the players connected in the complete life cycle of the product helps in developing environmentally friendly products.

Some of the main concerns which could hinder collaboration are;

- Difficult performance measurement
- Lack of approved standards

- Lack of integrated technology tools
- Lack of training
- Natural tendency not to change
- Little understanding for need to change
- Inability to quantify return

5.Conclusion

The collaborative methodology for concept generation and evolution could be a vital tool in developing new and innovative products as from the conception phase the process is transparent for review hence the design strategy formulated by the management can be effectively applied. The cross fertilization of ideas across various disciplines helps in coming up with innovative ideas for new products. It is also observed that to whatever extent the Industry can support collaboration in concept generation it should go ahead as there is tremendous improvement even for a small change.

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