Arts and Design Studies
ISSN 2224-6061 (Paper) ISSN 2225-059X (Online)
Vol.34, 2015

Conceptualizing Concepts: A New Approach to Industrial Design

Yohanna Egiri & Enoch Wuritka
Department of Industrial Design, Faculty of Environmental Technology,
Abubakar Tafawa Balewa University, P.M.B. 0248 Bauchi, Nigeria

Abstract
This paper discusses the role of conceptualization of concepts in proffering solution to design needs of consumers. It looks at the role mind plays in initiating creativity which spurs concept generation. We adapt the theoretical framework of Amabile which recognizes knowledge, creative thinking and motivation as the three integrated components that spur creativity. We also acknowledge that concept generation is burnt out of design needs of consumers which give us leverage to review some of the literatures on industrial design thereby establish definition that best fit into this paper. We also look at how computer aided design (CAD) has revolutionized design within the context of industrial design in the area of metal/jewelry design, graphic design and ceramic design.
Keywords: concepts, concept generation, creativity, industrial design.

Introduction

Since the beginning of the last decade when the competitive environment went through a major transformation due to globalization, business organizations have intensified their search for strategies that will give them a sustainable competitive advantage. The backdrop of this has given industrial designer a new dimension in the quest to meet the yearnings and aspiration of companies across the globe. Conceptualization of concept of artifact is an approximate description of technology, working principles, and form of artifact. Conceptualization is a process that involves coming up with clear, and concise definitions.

Creative mind is key to rational conceptualization of workable ideas. Mind is the factory where ideas are manufactured (conceived) and analyzed. Hence, absolute focus on the identified problem is required to keep in mind while searching for the needed solution. It takes a man with a creative mind to conceive ideas that can transmute from abstract state to concrete state (product that solves the problem).

Concepts that culminate in innovation are important for companies across all sectors of the economy, manufacturing and services, high and low technology, in slowly and in rapidly changing environments. Keeping up with the latest innovations, as opposed to being an innovation leader, is a conservative strategy in that it allows the company to choose to adopt only those innovations that appear to be most successful. But this conservative strategy has drawbacks. Research shows that for companies across all sectors to be leaders, it requires that they should be more innovative than the competitor. A team of design professionals are usually involved in the development of concepts, and it is usually communicated as a sketch or as a rough three dimensional model and is accompanied by supporting text, which may detail some of the ideas built into the concept. In any product conceptualization activity, designers generate concepts based on a set of target and specifications.

The traditional design model is gradually undergoing a transmutation into a mock-up of CAD model. We still create mock-ups and we still build prototypes, but these are largely a verification of the ideas, and the supporting calculations behind them. When the teams working on new concepts begin their work they do so from the position of an inherent knowledge of the subject, from a viewpoint informed by meticulous research and with the benefit of thorough benchmarking. They also bring together creative minds whose careers have been characterised by an almost constant obligation to solve problems with novel solutions. These concepts are tested at an intellectual level by the group and only pass muster if all the practical and manufacturing issues can be demonstrated to be sound, even if this assumes the availability of an emerging technology to complete the picture.

So the old experimental model is being replaced with the more recent one that starts along the developmental path. But it doesn't stop there. One of the biggest issues in today's design and manufacturing scene is the communication between participating teams, which are increasingly international in complexion. It is important that the same information that is available to each team is updated effectively as the project progresses. The latest design methodology embraces the use of 3D CAD (Computer Aided Design) and makes full use of the communication tools now available to ensure total integration and dispersion of information across disparate teams often located on different continents and in different time zones. Not only is the new methodology more efficient in linking teams, but it also results in a faster throughput of work and overall reduction in costs.

Most product designers prefer to work with traditional artistic forms of design, especially early in conceptual design. Computer-Aided Design systems have not reached the level of flexibility and ease of use

where they can be freely and creatively used by a designer. In spite of the richness of the choice of computer supported conceptualization tools, there is still a long way to go. Normally, in order to achieve better results in conceptual design, we have to bring the academic developments closer to the industry needs. We have to strive after developing methods, tools and representations without unnecessary abstraction. In order to achieve seamless integration, we have to be able to convert abstract representations to concrete ones, and vice versa. At the same time, it seems to be inevitable to implement knowledge-intensiveness in computer-supported conceptualization.

Concept

The word concept originated from Latin, concipere meaning "to take in, conceive, and receive." A concept is an idea conceived in the mind. Webster's college dictionary (1995) defines a concept as a "general notion". The same dictionary further defines it again as a "directly conceived or intuited object of thought". From the above definitions this can be inferred: a concept is a thought or idea, a general idea about a thing or group of things, derived from specific instances or occurrences. Creativity expert, Edward de Bono (1992) takes a more action-oriented approach to define concepts when he writes, "concepts are general methods or general ways of doing things". A concept is defined as "that which refers to the figure of an object, along with other representations such as attributes or functions of the object, which existed, is existing, or might exist in the human mind as well as in the real world" Taura, et al (2013). This definition is in line with previous considerations in the field of design study. Here, 'figure' implies the notion of an image as well as a physical shape, and 'object' involves not only a physical object but also a non- physical object: software, music, and so on. We assume that a new concept is not generated from nothing. This declaration involves two assumptions: that the basis of generating a new concept exists, and a new concept is generated by referring to some existing concepts which lie either in the real world or in a designer's mind. The word 'Idea' originated from Greek 'idein' meaning "to see." When someone says "Picture this!" they want to give you an idea. When you try to imagine something, idea can also mean a rough outline or a general sense.

Concept generation

Taura et al (2013) viewed Concept generation as "the process of composing a desirable concept towards the future". This definition aims at developing a framework in which the concept generation can be structured in an interdisciplinary manner, while focusing on the view of concept generation. With regard to this definition, we will first explain what we mean by the phrase 'towards the future'. The notion of the future is thought to be, of course, extremely abstract, as follows. We can never draw an exact picture of the future. We can imagine what things may be like in the future, but it is impossible to visualize a precise notion of the future itself. We think this kind of highly abstract notion can only be represented in language. That is, the notion of future is considered to be recognized only by human beings through the use of language. On the other hand, concept generation is also a highly intellectual activity. Hence, these two notions of future and concept generation are believed to be features in human beings. We would like to attempt to describe this part in order to identify the fact that concept generation characterizes human beings, whereas this characteristic is thought to be straightforward owing to the fact that every activity of living things is directed towards the future. In the context of concept generation, the future is considered to have two meanings: a future that we can grasp inductively, such as a marketing forecast, and a future that is recognized in the wish or desire for creation which is led by an inner sense. In our understanding of concept generation, we consider that the latter meaning is the more essential of the two. The word 'composing' is the part which determines the process of concept generation. For the composition, particularly in the composition of desirable concepts, finding a new concept which can be realized is thought to be insufficient. We assume it is also necessary to pursue the desirable concept towards the future which will never be realized, and there must be an intrinsic motivation in one's inner sense for this pursuit.

After identifying a set of customer needs and establishing target product specifications, the development team is faced with the following questions: What existing solution concepts, if any, could it be successfully adapted for this application? What new concepts might satisfy the established needs and specifications? What methods can be used to facilitate the concept generation process?

5-Step Method in Concept Generation

Step 1: Clarify the Problem

Develop a general understanding of the problem and then group the problem into sub-problems if necessary. For example, the design of a complex product like a photocopier can be thought of as a collection of more focused design problems: Document handler, Paper feeder, Printing device, and Image capture device.

Step 2: Search Externally

External search is aimed at finding existing solutions to both the overall problem and the sub- problems identified in step 1. External search for solutions is essentially an information-gathering process. Best to use an

expanded and focused strategy: first expand the scope of the search by broadly gathering information that might be related to the problem and then focus the scope of the search by exploring the promising directions in more detail.

Five (5) good ways to gather information from external sources:

- Lead user interviews: users in the know, users who have used many different similar products
- Expert consultation: ask experts in the sub-problem area e.g. technicians, suppliers, profs
- Patent searches: looking at old patents -internet
- Literature searches: trade maps, consumer reports, internet, brochures, Thomas Register of American Manufacturers, etc.
- Competitive benchmarking: compare with similar existing products.

"Benchmarking can reveal existing concepts that have been implemented to solve a particular problem, as well as information on the strengths and weaknesses of the competition. Skill in conducting external searches is a valuable personal and organizational asset. This 'detective work' is completed most effectively by those who are persistent and resourceful in pursuing leads and opportunities". ENGI 7936 -Design Project13. Langley et la (1996) aptly put it " benchmarking is the study of other organizations for the purpose of identifying practices or generating ideas that could be adapted to result in the improvement of the organization's areas of needs".

Step 3: Search Internally

Internal search is the use of personal and team knowledge and creativity to generate solution concepts. This activity may be the most open-minded and creative of any in new-product development. It is a process of retrieving a potentially useful piece of information from one's memory and then adapting that information to the problem at hand.

Step 4: Explore Systematically

Systematic exploration is aimed at navigating the space of possibilities by organizing and synthesizing the ideas generated.

Step 5: Reflect on the Results and the Process

At this point is it imperative to reflect on the results and the process so as to evaluate them in order to ascertain whether the aim has been achieved or not. This can be done by posing the following questions: Is the team developing confidence that the solution space has been fully explored? Are there alternative ways to decompose the problem? Have external sources been thoroughly used? Have ideas from everyone been accepted and integrated in the process?

Creativity

The creative mind is a fascinating and important part of human brain that under goes continuous research. Creative mind is key to rational conceptualization of workable ideas. Mind is the factory where ideas are manufactured (conceived) and analyzed. Hence, absolute focus on the identified problem is necessary while search for the needed solution. Human creativity is something of a mystery, not to say a paradox. One new idea may be creative, while another is merely new. What's the difference? And how is creativity possible? Creative ideas are unpredictable. Sometimes they even seem to be impossible, and yet they happen. "Creativity is the ability to come up with ideas or artefacts that are new, surprising and valuable" Boden (2004). According to her 'Ideas' here include concepts, poems, musical compositions, scientific theories, cookery recipes, choreography, jokes, and so on. 'Artefacts' include paintings, sculptures, steam engines, vacuum cleaners, pottery, origami, penny whistles – and many other things you can name. As these very diverse examples suggest, creativity enters into virtually every aspect of life. It's not a special 'faculty' but an aspect of human intelligence in general: in other words, it's grounded in everyday abilities such as conceptual thinking, perception, memory, and reflective self-criticism. So it isn't confined to a tiny elite: every one of us is creative, to a degree.

Amabile (1992) states that "creativity arises through the confluence of three components: knowledge, creative thinking and motivation". Many experts provide frameworks and hypotheses on the sources of creativity yet, it appears that the vast majority of their important contributions fall within Amabile's three intersecting components of creativity. Thus, this section of the paper will make use of Amabile's framework as a platform within which other theorists viewpoints are categorized.

Knowledge

Amabile (1992) describes knowledge as "all the relevant information that an individual brings to bear on a problem". Gardner (1994) goes deeper and explains that "there are two types of knowledge that may be required for creativity: in-depth experience and long-term focus; when this happens, it allows people to build the technical expertise that can serve as a foundation, or playground for creativity within a domain". He also states that "creativity rests on the ability to combine previously disparate element in new ways, which implies a need for a broader focus and varied interest". Creativity is a hard work, it requires the deployment of the mental capability to unleash creative potentials. In line with Johansson's position, "we must strike a balance between depth and

breadth of knowledge in order to maximize our creative potential" (Johansson 2004). He suggests that "one way to improve breadth is to team up with people with different knowledge bases.

Creative thinking

While both Amabile and Gardner assert that thinking is a key aspect of the creative process, they address this topic at high level. Amabile suggests that key aspects of creative thinking are:

- Comfort in disagreeing with others and trying solutions that depart from the status quo.
- Combining knowledge with previously disparate field
- Ability to persevere through difficult problems and dry spells
- Ability to step away from an effort and return later with a fresh perspective (incubation)

While there is no consensus on the subject, multiple theories provide insight on the subject of creative thinking. Sternberg (1998) promotes a 'triarchic theory' asserting that "there are three main aspects of intelligence that are key for creativity-synthetic, analytical and practical"

Synthetic: this is the ability to generate ideas that are novel, high quality and task appropriate. One aspect of this is the ability to re-define problems effectively and to think insightfully.

Analytical: this is the creative ability to judge the value of one's own idea, to evaluate their own strengths and weaknesses and suggest ways to improve them.

Practical: this is the ability to apply intellectual skills in everyday contexts and 'sell' creative ideas.

Motivation

Amabile (1992) explains that "we have found so much evidence in favour of intrinsic motivation that we articulated what we call the intrinsic motivation principle of creativity: people will be most creative when they feel motivated primarily by the interest, satisfaction, and challenge of the work itself and not by external pressure". Different types of motivation play a role in different parts of creative process. Intrinsic motivation is particularly important when the emphasis is on novelty. It can help an individual to sustain energy through the difficult times necessary to gain skills in a domain. Indeed, many theorists see motivation as the most important component of creativity.

Concept of design

We cannot talk about 'concept' in isolation without talking about 'design' because concept generation is tailored towards design that can either bring about improvement or solve a problem. Depending on the industry we are talking about, design can have many different definitions. Most generally, "design" is a process for creating a product to meet a set of needs. Mobile application development requires both engineering design and product design. Engineering design focuses on physics, such as speed, mass and other performance measures while product design considers users and consumers by asking what the user wants in a product. Ulrich and Pearson (1998) define product design as "the activity that transforms a set of product requirements into a specification of the geometry and material properties of an artifact." Crawford and Di Benedetto (2003), also define design firmly in terms of producing tangible artifacts as "the synthesis of technology and human needs into manufacturing products". Whyte, Davies, Salter and Gann (2003) define design, in its broadest sense as "where the intellectual content for value- added in production processes is created". Design can also act as a bridge between technical functionalities and value in a finished product or service (Walsh 1996). Just like the processes for creating a tangible product can be designed (Utterback 1994), so also can the processes for delivering a service which fulfills user expectations be designed (Shostack 1984). Industrial design concept, is associated with the creation of tangible objects that are users friendly. Example, Walsh et al (1992) found out that the function of industrial design may vary according to the factors such as the nature of the company's business and the design experience of the company. Industrial design studies function and form, and the connection between product, user, and environment.

Industrial designers don't usually design motors, electrical circuits, or gearing that make machines move, but they may affect technical aspects through usability design and form relationships. Usually, they work with other professionals such as marketers to identify and fulfill customer needs and expectations. The application of computer aided design (CAD) has revolutionized industrial design in the area of metal/jewelry design, graphic design and ceramics design.

Metal/Jewellry design

Someone who has been a vanguard of jewelry CAD/CAM is Anthony Nowlan. He explains that when he first began exhibiting new technology to the trade almost a decade ago, many jewelers were fascinated by it, yet struggled with the idea of implementing it into their day-to-day business.

A lot has changed for Nowlan's business, Evolution Jeweler, so much so that he says he's heartened that jewelers are increasingly considering the benefits of CAD/CAM in jewelry. While computer design and

manufacture transformed most industries decades ago to the extent that virtually none of the "old ways" exist today, it's a different story for the jewelry industry. CAD/CAM jewelry design has only gained a major foothold in the last few years; when Jeweler published its first CAD/CAM report in June 2012, many in the industry were still debating the benefits of the technology. A great deal has changed since the report two years ago; not only has there been huge advances in hardware and software, many jewelers have also changed their views, no longer seeing CAD/CAM as a threat to their trade. "Ten years ago CAD/CAM was a novelty, however, today it's an established technology that more and more jewelers are embracing," says Justin Elsey, managing director Rapid Prototyping Services.

Marc Gregory is another early adopter of CAD/CAM but considers himself as having only become proficient in using the technology in the last few years. As a trained bench jeweller with 40 years' experience, he sees many advantages including greater design accuracy and less material wastage. "A lot of our savings can be made in metal costs. There's not much wastage and you can probably save substantial amount of money to tune of 50 per cent. The time has been cut in half as well," Gregory says. "You've still got to know what you're doing, you've still got to put stuff together and you're still going to sit down with customers, so that aspect of it is still there."

Graphic design

Graphic design has gone beyond manual painting and mere illustration. It has evolved beyond the scope it was known for in the past owing to the conceptualization of modern concept. The application of computer on graphic design has revolutionized the field. This cut across online videos, web design, desktop publishing, digital photography, social media, game design, poster design, etc in order to make life more meaningful to humanity which is the sole aim of industrial design. With the aid of CAD technology, 3D design of machines, cars, phones, etc can easily be made and modified from concept through completion. This has actually aided concept generation in a multifaceted ways, because, you can actually visualize your concept and continue refining it until you are satisfied. The progress of 3D gaming has been awesome. In terms of raw performance and visual effects, today's games are on the cutting-edge, pushing innovation in hardware and software to new levels. And like professionals, hard-core gamers have shown an insatiable appetite for the fastest, most feature-rich graphics hardware. This has tremendous growth in 3D game technology which lead to hardware solution that satisfies both the gamer and the CAD.

Ceramics design

Ceramic industry is not left out in the revolution CAD technology has brought into industrial design. CAD systems have the ability to provide a digital prototype of the product at early stages of the ceramic design process which can be used for testing and evaluation. Many people from various departments can share it, they can express their opinion for the product at early stages, in order to complete the design in less time and with the least mistakes. Most researchers accept that having the digital prototype in early stages allows more effort to be spent on the definition stage (early stage) of the design process and not in redesigning an already completed design. Tableware and white ware companies already use 3D CAD and computer numerical control (CNC) models to produce tooling that feeds into traditional mould making methods. Some companies have advanced further and use 3D printing machines such as Z Corp and Objet to print out 3D visualisation design models. The positive model produced from this process can then be used to continue the process by traditional techniques. Denby Pottery are at the forefront of these developments in the UK using 3D printing in their design studio to aid in the development of new design concepts.

Conclusion

Design thinking attempts to inspire the essential element of creativity, the ability to take an abstract idea and create something with it. It's based upon the fundamental belief that an unexecuted idea, one that is never realized, is a worthless proposition and that doing it is equally as valuable as thinking. A big part of the Design thinking concept involves empathy for those you are designing for. It's often manifested through a series of activities, which attempt to create an experience of what or how your idea will ultimately be consumed. Indeed, the critical process to produce a novel product at the very early stage of design is assumed to be shared between the multiple design domains (engineering design, industrial design, etc.)

Reference

Amabile, T. (1992). Growing Up Creative: Nurturing a Lifetime of Creativity (2nd Ed.). Creative Education Foundation ISBN 978-0930222895

Boden, M. (2004) The Creative Mind: myths and mechanism. 2nd Edition. New York. USA

Bono, E. (1992) Serious Creativity. New York. USA

Crawford, M., & Di Benedetto, A. (2003). New Products Management. 7th Edition. New York: McGraw-Hill,

USA
Gardner, H. (1994) Creating Minds: An Anatomy of Creativity Seen Through the Lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham and Gandhi. Carson City NV USA
Gemser, G., & Leenders, A. M. (2001). How integrating design in the product development process impacts on company performance. The Journal of Product Innovation Management, 18 (1), 28-38.
Johansson, F. (2004) the medici Effect: Breakthrough insight at the intersection of ideas, concepts and cultures. Harvard Business School Press
Langley, G., Nolan, K., Nolan, T., Norman, C., & Provost, L. (1996) The improvement Guide: A practical approach to enhancing organizational performance. San Francisco, CA: Jessey-Bass
Shostack, G. L. (1984). Designing services that deliver. Harvard Business Review
Sternberg, R. & O'Hara, L. (1998) Creativity and Intelligence. Handbook of creativity. Cambridge University Press.
Taura, T. and Nagai, Y. (2013) Concept Generation for Design Creativity. Springer-Verlag London
Ulrich, K. T., & Pearson, S. (1998). Assessing the importance of design through product archaeology. Journal of Management Science, 44 (3), 352-369.
Utterback, J. M. (1994). Mastering the Dynamics of Innovation: Harvard Business School Press.
Walsh, V. (1996). Design, innovation and the boundaries of the firm. Journal of Research Policy, 25 (4), 509-529.
Walsh, V., Roy, R., Bruce, M., & Potter, S. (1992). Winning by Design. Oxford: Blackwell Publishers.
Whyte, J. K., Davies, A., Salter, A. J., & Gann, D. M. (2003). Designing to compete: lessons from Millennium Product winners. Design Studies, 24 (5), Pages 395-409.
Webster's College Dictionary (1995)
ENGI 7936 -Design Project13

The IISTE is a pioneer in the Open-Access hosting service and academic event management. The aim of the firm is Accelerating Global Knowledge Sharing.

More information about the firm can be found on the homepage:
http://www.iiste.org

CALL FOR JOURNAL PAPERS

There are more than 30 peer-reviewed academic journals hosted under the hosting platform.

Prospective authors of journals can find the submission instruction on the following page: http://www.iiste.org/journals/ All the journals articles are available online to the readers all over the world without financial, legal, or technical barriers other than those inseparable from gaining access to the internet itself. Paper version of the journals is also available upon request of readers and authors.

MORE RESOURCES

Book publication information: http://www.iiste.org/book/

Academic conference: http://www.iiste.org/conference/upcoming-conferences-call-for-paper/

IISTE Knowledge Sharing Partners

EBSCO, Index Copernicus, Ulrich's Periodicals Directory, JournalTOCS, PKP Open Archives Harvester, Bielefeld Academic Search Engine, Elektronische Zeitschriftenbibliothek EZB, Open J-Gate, OCLC WorldCat, Universe Digtial Library , NewJour, Google Scholar