Chapter 1

Introductory Chapter: Product Lifecycle Management - Terminology

Razvan Udroiu and Paul Bere

Additional information is available at the end of the chapter

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1. Introduction

The enterprise business information technology (IT) domains include four main management approaches [1, 2]: **product lifecycle management** (PLM), **enterprise resource planning** (ERP), **customer relationship management** (CRM), and **supply chain management** (SCM). The ERP goal is achieving the best enterprise resource utilization. This system enables companies to plan their manufacturing processes and control all aspects of manufacturing including inventory, purchasing, process planning, warehousing and delivery, human resources, finance, etc. SCM system is focused on the supply chain, having the main goals the design, planning, execution, control, and monitoring of all aspects related to storage and distribution. Customer relationship management (CRM) is an approach to manage a company's interaction with current and potential customers [3].

PLM is a business strategy for managing the entire life cycle of products. This strategy includes the management of conception, design, design validation and simulation, prototyping, manufacturing, quality control, use, maintenance, and disposal of products, having integrated people, methods, CAx (computer-aided technologies) tools, processes, documentation, and data management solutions. PLM is a digital paradigm, products being managed with digital computers, digital information, and digital communication [4]. The main benefits of a PLM system implementation in companies are faster time to market, improved productivity and collaboration, better product quality, decreased cost of new product introduction, reduced prototyping costs, improved design review and approval processes, identify potential sale opportunities and revenue contributions, maximize supply chain collaboration, and reduce environmental impacts at the end of product life.

2. Products diversity

Standard living increase of the population has led to the development of new materials and unique services. Those services were hard to be guessed in the past. The diversity of the products is different from one domain to another. All this requires a rigorous planning on waste and resource management in order to obtain some products or to recycle them after end life. The arising problems caused by technological development have begun to affect the life of our planet. This fact has led to the emergence of management measures and decision-making on emerging issues related to the use of this kind of materials, resources, environmental pollutions, and recycling of end-life products.

The world's increasing production has led to the use of special materials [5, 6] as composite materials and smart materials. These have been created and adopted to solve a number of industry production problems, to replace the traditional materials used for manufacturing process of the products. These were created to improve physical and mechanical properties and were developed to solve the production industry problems.

There are different kinds of products on the market. There are different approaches in the word regarding the classification of the products in the world. An approach can be made following their complexity. We can say that there are simple products, or complex ones, which are assembled by another product. From the point of view of materials which is embedded in products, we can say that some products are from a single material, from two, or from many constituents. From the recycling point of view, at the end of the products' life, the products which are made by a single material are easier to be managed. Unfortunately, these products represent a small percentage of the diversity of existing products. Today the materials' constituents are very vast, and the constituents of the products are composed of many chemical substances. These are combined in order to achieve, at the end, a material with custom properties for certain products.

Another type of the products is represented by a large used, a **product in great demand**. These types represented in generally the goods, which integrate more options to use. The beneficiaries of them have the possibility to have more devices integrate in a single one. From PLM point of view, each of the extra options is traded like single one, and all are integrated in a single one. An example of this can be the smartphones or smarts TVs. Each of them is designed for a specific function, to communicate or to watch and get some information. At the same time, we benefit from clock, internet access, calendar, games, and many programs that help us. Also, it is observed in an abundance of mechatronic products on the market. These products contain mechanical, electrical, electronic, and software components.

Another type of the products is represented by **customized goods**. These are customized for each individual customer. They must meet certain specific personalized requirements. In general for these types of products, the cost price is higher, manufacturing time is increasing, and life cycle is bigger.

Nowadays, the life of the products has been getting shorter. This is due to technological progress and the requirements of today's demanding market. The life of the products decreases because new products appeared and those have replaced the old ones quickly.

Passing on to the **complex products** that include a large variety of materials, from PLM point of view, the situation is more complicated. The recycling and the managing of the end life of products are a challenge. We can ask ourselves which will be the costs of a product in reality, if the recycling costs at the end life of the product are bigger than production costs.

The diversity of industrial products is a very vast domain and includes embedded materials, the products themselves, the equipment that led to their fabrication, the resources used, the auxiliary substances, and materials that contributed to the technological process.

3. Product life cycle

The product life cycle includes three main stages: **beginning of product life (BOL)**, **middle of product life (MOL),** and **end of product life (EOL)**. These stages consist of processes which create the PLM process flow.

BOL is the most complex phase of the product life cycle including conceive, design, prototyping, testing, development, production process elaboration, and manufacturing of the product.

In the second phase of the product life cycle, MOL comprises distribution/sales, product use of the final customer, maintenance, repair, and overhaul (MRO) of the product.

End of product life is the last stages of the product life cycle. This stage includes retire, disposal, and recycle of the product.

4. Product lifecycle management

According to the CIMdata Inc. [7], "Product Lifecycle Management is a strategic business approach that applies a consistent set of business solutions that support the collaborative creation, management, dissemination, and use of product definition information" [7]. Integrating people, processes, business systems, and information, PLM supports the extended enterprise [7]. The extended enterprise is a wider entity that includes the customers, the employees, the suppliers, the distributors, etc., who collaborate in the design, development, manufacturing, and delivery of a product to the end user. The PLM concept is focused on six important concepts, as follows: strategic business approach, phases of product life cycle, collaboration within the extended enterprise, unique and timed product data source and consistency, traceability, and long-term archiving [8].

Product lifecycle management for "X field" is a general term to define a type of management within a specific field of work, for a specific product. "X field" is a generic term that is related to a specific industry. Thus, different products require different process developments, resulting the following: PLM for aerospace and defense; PLM for the automotive industry; PLM for the construction industry; PLM for the consumer and retail industry; PLM for the energy, process, and utility industry; PLM for the fashion industry; PLM for the food and beverage industry; PLM for the industrial equipment industry; PLM for the life sciences industry; PLM for the marine and offshore industry; PLM for the oil and gas industry; and PLM for the telecom and electronics industry.

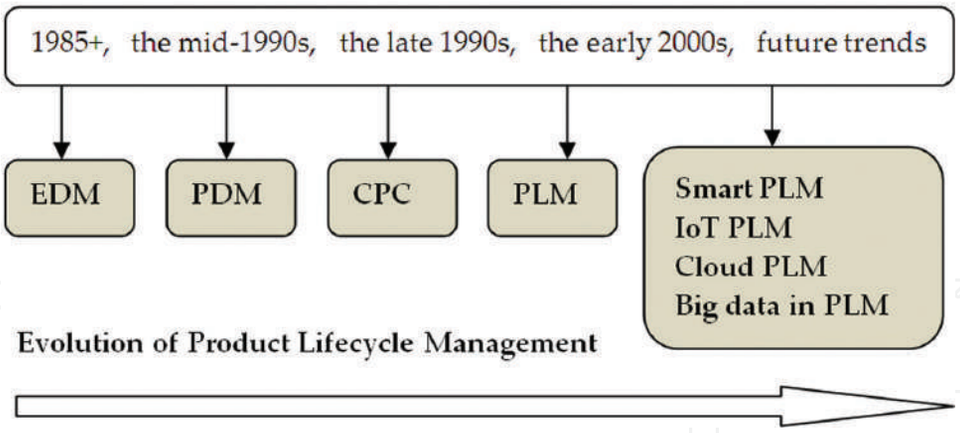

Figure 1. The evolution of the concepts related to PLM.

The evolution of the concepts related to PLM is shown in **Figure 1**. PLM concept was developed based on product data management (PDM). **Product data management** is the business function often within PLM that is focused mainly on design, manufacturing, and engineering data having the purpose of the management and publication of product data. PDM is the link between "islands of automation" such as computer-aided design (CAD), computer-aided engineering (CAE), and computer-aided manufacturing (CAM), being a PLM infrastructure. PDM system provides access and security controls, maintains relationships among product data items, enforces rules that describe and control data flows and processes, and provides notification and messaging facilities [7, 9].

The fundamental terms about PLM are shown in **Figure 2**. Processes, technologies, methods, software tools, and data managed by people are the main fundamentals of PLM that are involved in the lifecycle stages of the product.

Concurrent engineering [10, 11] or **simultaneous engineering** is an approach for product development that integrates all product lifecycle phases and carries out a number of tasks in parallel, minimizing the product development time. One of the most used methods of CE is **design for manufacture and assembly (DFMA)** that integrates two concepts such as design for manufacture (DFM) and design for assembly (DFA). DFM is a design methodology of the parts for their easy manufacturing, reducing the manufacturing costs. DFA is focused on the design of the product for easy assembly, reducing the assembly costs.

Generally, the methods can be classified as follows [12]:

- Methods supporting designers and engineers in the product development stage (e.g., theory for inventing problem-solving (TRIZ, design in context, bottom-up design, top-down design))
- Methods based on past experiences (e.g., design for X) used in BOL, MOL, and EOL
- Evaluation methods of the product responsiveness to needs coming from diverse phases (e.g., risk analysis and failure mode effects analysis (FMEA), fishbone/Ishikawa diagram)

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- Management approaches supporting continuous improvement of the enterprise (e.g., just in time, lean manufacturing, six sigma, total quality management, and total productive maintenance)

CAx [4] is a generic term that includes all computer-aided technologies used to process the information and knowledge regarding the product data along the PLM stages. A CAx system is focused on a "X" task, and it contains the following main components: hardware component consisting in computer and interactive devices, software packages, data, knowledge, and human's activities [4]. The "X" task can be product design (computer-aided design) [13–17]; product manufacturing (computer-aided manufacturing) [13–17]; product simulation,

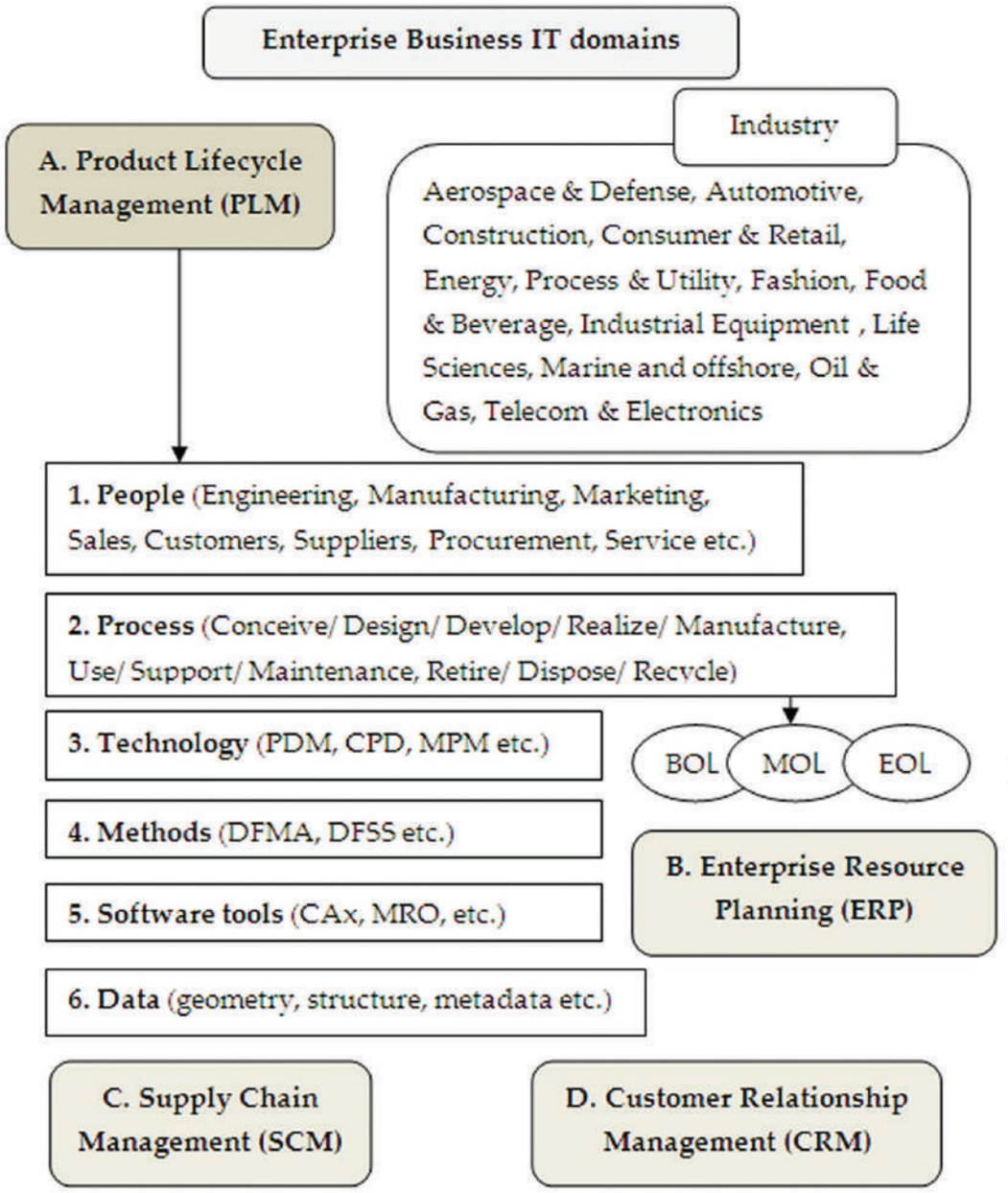

Figure 2. The fundamental terms related to PLM.

Concepts	Remarks
PLM	Product lifecycle management
ERP	Enterprise resource planning
CRM	Customer relationship management
SCM	Supply chain management
EDM	Electronic document management, enterprise data management, or engineering data management
PDM	Product data management
CPC	Collaborative product commerce
PPLM	Product and process lifecycle management
SRM	Supplier relationship management is analogous to customer relationship management
MPM	Manufacturing process management
CE	Concurrent engineering
CPD	Collaborative product development
DFMA	Design for manufacture and assembly
DFSS	Design for six sigma is a business process management method related to traditional six sigma, based on the use of statistical tools
NPD	New product development
Standards of PLM	STEP, DXF, IGES, XML, UML
Virtual enterprise (VE)	Virtual enterprise consists in "a group of people who work together on a project, communicating mainly by phone, email, and the internet, rather than regularly going to a central office to work providing operations as competitive as those in a traditional enterprise" [4, 21]
Digital mock-up (DMU)	Digital mock-up is a concept that allows the description of a product, usually in 3D, for its entire life cycle [4]
Digital manufacturing (DM)	DM links digital product development, digital production planning, and digital facility planning [22]. DM is a manufacturing process in a virtual environment working with digital features (tooling, machining, assembly lines, resources, ergonomics, and factory layout)
Digital factory (DF)	Digital factory consists in a digital mock-up of the factory

Table 1. Terms connected to PLM.

analysis, and optimization (computer-aided engineering); product process planning (computer-aided process planning, CAPP) [11, 14–17]; product quality assurance (computer-aided quality, CAQ); etc. CAE tools are available for a wide range of analyses: finite element analysis (FEA), computational fluid dynamics (CFD), kinematics and dynamic analysis of the mechanisms, etc. The numerical control (NC) of the machine tools and programming of industrial robots that perform tasks as assembly, welding, etc., are the most known applications of CAM.

Also, new technologies such as rapid prototyping (RP), additive manufacturing, and reverse engineering play an innovative role, especially in the BOL phase [18–20].

The main terminology connected to PLM is presented in the **Table 1**.

Digital factory is the foundation of the factory of the future, "a comprehensive approach of network of digital models, methods, and tools—including modeling, simulation, and 3D/virtual reality visualization—integrated by a continuous data management" [23]

New opportunities and future trends for PLM (**Table 2**) have appeared in areas such as **big data**, **smart products**, the **Internet of things**, **knowledge management**, and **SMAC** (social, mobile, analytics, cloud) [30]. **SMAC** is driving business innovation, being a concept that converges of four technologies, social media platforms, mobile technologies and platforms such as the iPhone/ iPad, data analytics, and cloud computing. Cloud computing is one of the key enablers for advanced manufacturing supporting not only storage of product data but also retrieval and reuse of product and process knowledge.

Future concepts	Remarks
Factory of the future/ smart factory	Factory of the future [4, 24] is the combination of "virtual" and "real" that "can self-optimize performance, self-adapt to and learn from new conditions in real or near-real time, and autonomously run entire production processes" [25]
Industry 4.0	Industry 4.0 [26, 27] supposes the introduction of the Internet of things and services into the manufacturing environment [4]
Cloud computing	Cloud computing store, manage, and process data, rather than a local computer by using a network of remote servers hosted on the Internet [4]
CMfg (cloud manufacturing)	Cloud manufacturing [28] uses cloud computing, the Internet of things, service-oriented technologies, and high-performance computing for solving manufacturing applications
Industrial Internet	The industrial Internet "is the integration and linking of big data, analytical tools and wireless networks with physical and industrial equipment, or otherwise applying meta-level networking functions, to distributed systems" [27]
IoT (Internet of things)	The Internet of things comprises of an intelligent interactivity, via the Internet, sensors and actuators, etc., between human and things to exchange information and knowledge
Big data in PLM	"Big data represents the information assets characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value."[29]. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy, and data source
IoT PLM	Big data and the IoT work in conjunction. Data extracted from IoT devices provides a mapping of device interconnectivity
PLM for digital factory (PLM 4.0)	PLM system within the Industry 4.0
Cloud PLM	The applications of cloud computing in PLM
Smart PLM	PLM system for a smart factory

Table 2. Terms connected to the future PLM.

5. PLM software

On the market today, there are several software solutions for PLM implementation. The most known solutions are offered by dominant players such as **Dassault Systèmes** (ENOVIA™ PLM Software)**, Siemens** (Teamcenter PLM)**, PTC** (PTC Windchill), **SAP Systems, Applications, and Products in Data Processing** (SAP PLM), **Oracle** (Agile PLM), **Arena** (Arena PLM), and **Autodesk** (Autodesk Fusion Lifecycle). **SAP Business Suite** is a collection of integrated applications such as SAP-CRM, SAP-ERP, SAP-PLM, SAP-SRM, and SAP-SCM modules. The most important tools of these software solutions are material management, configuration and change management, design and simulation processes, product planning, project management, document management, deliver projects on time and under budget, collaboration solutions, product quality, and product certification, stocks, and sales management. These tools are increasingly used in large companies, and the offered solutions are customized for different areas of activity. Company databases offer a better management of company resources, of the customers or of suppliers of materials in a timely manner. The PLM software solution increases the companies' productivity, reduces the manufacturing time of the products, and increases the quality. Managing company databases that have workstations in different locations is one of the integrated tools of these software instruments. The companies can manage the common databases, the drawing projects, materials, existing stocks, different stages of product development, as well as the marketing and distribution part or the product phases use throughout their life cycle.

6. Conclusion

PLM systems can manage information across the life cycle of a broad range of products such as manufactured products (airplanes, automobiles, computers, mobile phones, toys, etc.), software product, utility distribution networks (telecommunications), facilities (airports, harbors, and railway systems), and other products (bridges and highways). In the future, every industrial product will be smart like smartphones. These integrated a series of requirements and needs that, besides the basic solution of the product to meet certain needs, will also have a number of facilities which are not strictly necessary but contribute to the comfort of the beneficiary. All this products' facilities not only make it more attractive but also increase its complexity. Requirements and products are increasingly diversified, all contributing to consumer welfare, as time passes.

Author details

Razvan Udroiu[1]* and Paul Bere[2]

*Address all correspondence to: udroiu.r@unitbv.ro

1 Department of Manufacturing Engineering, Transilvania University of Brasov, Brasov, Romania

2 Department of Manufacturing Engineering, Technical University of Cluj-Napoca, Cluj-Napoca, Romania

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Chapter 2

Product Development and Management Strategies

Musa Gambo Kasuwar Kuka

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Abstract

The chapter seeks to discuss and describe the concept of product from the marketing perspective, how companies come about new product, product development options, and the various strategies available to a company to manage new and existing products. It is a conceptual paper which reviews relevant literatures from various sources. In essence, the proposed chapter will be divided into three main sections. Section 1 will introduce the concept of product, its meaning, and core components from the marketing point of view. It will also contain discussion on the various connotations of the term product, what constitute a new product, and new product adoption. Section 2 will dwell on the options available to a company on how to come up with new products including mergers, acquisition, and licensing, franchising, and proactive new product development. It will also explain the two product development strategies that companies adopt in the market place. The last section will discuss the product management strategies available to a firm either from the product life cycle way or the individual product management strategies or both. At the end, conclusions and the general context of the paper are drawn.

Keywords: product, product development, product life cycle, product strategy, product management

1. Introduction

Let us begin this chapter with a brief overview of the marketing process in order to have a clear understanding of marketing and its relationship with product development and management. By and large, marketing practice is built upon the following process:

1. Conducting research to find out the needs and wants of the customers.
2. Market segmentation, targeting, and positioning.

3. Developing the marketing mix program that consists of taking decision on product, price, place (distribution), and promotion.
4. Implementation of the marketing plan and program.
5. Control and evaluation of the marketing program.

The above process is what is usually referred to as the marketing management process which adopts the marketing concept philosophy. This is built on the notion of finding out the needs and wants of the customers before developing the products to satisfy the identified needs and wants. This goes to show that products are developed to solve any identified customers' problems and not the other way round.

1.1. Definition of Product

Product is one of the four elements of the marketing mix; the other three being price, place and promotion, which are all geared towards serving and satisfying the target market. Companies fix the product's price, promote and distribute it to the target market. Therefore, a product is the basic element of marketing mix. The word "Product" has several meanings, but it is generally a bundle of satisfaction that customers purchase or patronize in order to solve a problem. In our day-to-day life, we use many goods, such as soap, biro, book, ball, etc.; as well as services like banking transport, healthcare, or legal services. The term product has been defined differently by various authors and authorities in the field. For example, Harry [1] defines a product as the sum of the physical and psychological satisfactions the buyer receives when he makes a purchase. It is thus a tangible and/or intangible attribute that is offered to the market for sales. Other definitions of a product include:

i. "A product is anything that can be offered to a market for attention, acquisition, use, or consumption that might satisfy a want or need: it includes physical objects, services, personalities, organizations, and ideas [2]."
ii. "Product is a bundle of utilities that satisfy the customer's needs and wants, [3]."
iii. "A product consists of the intrinsic features, extrinsic characteristics, and its intangibles associations [1]".

Thus, from the above definitions, a product can be described as anything that is capable of providing solution to a customer's perceived problem whether it is physical or psychological. Therefore, any product that fails to provide the needed solution to a customer is a not a good product. To this end, when a student buys a biro to write test but it fails to write smoothly, it is not a good product; or when you pay for a healthcare service but get poor service in return. So, to a consumer, the product is anything, which satisfies his needs and wants while to a marketer, the product is a bundle of attributes that can bring returns through satisfaction of customers. It is also pertinent to note that in marketing, the concept of a product covers goods, services, ideas, people, places, and organizations except otherwise specified.

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1.2. Product features

To understand the concept of a product well, it is pertinent to consider the issue of product features. These features help to give a vivid description of a product and what a buyer is really buying in a given product. The important features of product are:

1.2.1. Tangible features

A tangible product has some physical features that can be seen and handled, such as shape, size, color, weight, etc. It can be touched and its physical presence can be felt. It is made up of materials like plastic, metals, iron, or wood. Products like perfumes, jewelries, and wrist watches are sold in very attractive packages with esthetic appeals.

1.2.2. Intangible attributes

The core aspect of the product such as its performance, quality, dependability, and reliability are often built in the product or service and therefore intangible. These key attributes cannot be seen, but rather can be felt and experienced after using the product or patronizing the service. Some after-sales services, augmented services, and such pure services like tourism, story-telling, consultancy services, and counseling services fall in this category. Here, the organization is selling experiences or feelings.

1.2.3. Association features

Product may have associated attributes to facilitate its identification and acceptance by buyers. Such attributes may be a brand name, package, warranty, credit terms, delivery terms, or payment options. For example, in Nigeria we have brands like Joy, Lux, Royal Foam, Engen, Tantalizers, etc., which depict positive brand associations.

1.2.4. Exchange value

For marketing purposes, every product, whether tangible or intangible, should have an exchange value and should be capable of being exchanged between buyer and seller, based on mutually agreed considerations. This exchange is a function of product value and the asking price. If the buyer feels that the value he is receiving from the product is equal or even higher than the money he is giving out, he feels satisfied and contented. Otherwise, he feels cheated and shortchanged and will most likely not buy it again and may even de-market the product if he gets the chance.

1.2.5. Customer satisfaction

The product should be able to satisfy consumer needs. Satisfaction can be both real and psychological. For example, when we eat food, wear clothes, or take medicines; we get a real satisfaction; whereas, when we buy insurance plan, services of travel agency, or beauty salon, we derive psychological satisfaction.

1.3. Components of a product

In product development discourse, marketers should understand the key components that make up any product, be it a good or service. The import of this is that it will enable companies to know what to incorporate in their product in order to produce a good and acceptable product. Products have three main components; the core, tangible, and augmented services.

1.3.1. Core product

The core product constitutes the unique selling propositions of the product or service. It connotes the key benefits that a customer is looking for in a given product. Core product provides satisfaction to the customer, thereby becoming the main reason for producing and buying the product. It is an intangible attribute that is built in the product. For example, the core of a robot is performance through artificial intelligence; that of aspirin is pain relief, while the core of a school is imparting knowledge.

1.3.2. Tangible product

This is a product component that can be seen, touched, and identified. In most cases, it is the tangible product that makes the core product tangible and ready for repeated purchases, especially packaging, brand names, marks, or symbol and distinctive coloring. For example, the colors of Chelsea and Manchester football clubs of England are blue and red, respectively.

1.3.3. Augmented product

This is the support package that completes a total product offering such as after-sales service, warranty, delivery, and installation. At this level, the marketer prepares an augmented product that seeks to exceed customer expectations. For example, the hotel can include remote-controlled TV, 24/7 free Wi-Fi internet service, fresh flower, room service, and prompt check-in and checkout.

2. New product development

Product managers only manage the brands produced and introduced into the market. This goes to show that a company has to first develop a product or follow any legal means to acquire a product in order to sell it to the target market. For this reason, it may not be out of place if we appraise the ways through which a company obtains a product. A company can use any of the following ways to get a product, among others.

i. Merger with other company, such as the one between Nigerian Breweries and Consolidated Breweries, which increases the product portfolio of both companies.

ii. Acquisition of an existing company or brand, such as 7Up and Pepsi; Coca-cola and Limca as well as acquisition of Mainstreet Bank limited from Asset Management Company of Nigeria (AMCON) by Skye Bank Plc.

iii. Licensing rights, such as Nigerian Bottling company makers of Coke under license from Coca-Cola Inc. of USA.

iv. Franchising arrangement, like that of McDonalds or Kentucky Fried Chicken (KFC) throughout the world.

v. Management contracting, as a system of marketing expert services such as coaching and technical advisory jobs. For example, the job of Zidane at Real Madrid or Mourinho of Manchester United.

vi. Leasing, a written or implied contract by which an owner (lessor) of an asset grants another party (lessee) the right to use and possess it exclusively for a specified period of time based on some conditions in return for a periodic rental payments.

vii. Hire purchase option for some specific assets.

viii. New product development option by which the company internally follows certain stages to come up with a new product.

Out of the aforementioned ways of obtaining a new product, the main focus of this section is to discuss the process involved in developing a new product by a company.

2.1. New product development process

New product development (NPD) is a complete process of creating and bringing a new product to market. New product development is the process of exploiting market opportunity by turning it into a product or service available for sale. A good understanding of customer needs and wants, the competitive environment and continuous practices, and strategies to better satisfy the customer requirements and increase their market share regulate development of new products. The notion of new product needs to be explained here. By and large, the newness of a product depends on what the customer or target market consider as new. For this reason, a new product can be an invention (entirely new which does not exist before), innovation (new to the company but existing in the industry), or product modification (changing the package, size, design and other features). There are eight steps involved in new product development namely:

i. Idea generation

ii. Idea screening

iii. Concept development and testing

iv. Business analysis

v. Marketing strategy development

vi. Product development

vii. Test marketing

viii. Commercialization

1. **Idea generation**: It is the act of getting as many ideas as possible. Ideas for new products can be obtained from customers, sales representatives, employees, distributors, company's research and development department, competitors, focus groups, or brainstorming. Lots of ideas are generated about the new product and out of these ideas some are implemented. Idea generation or brainstorming of new product, service, or store concepts usually begins when market opportunities are identified so as to support your idea screening phase.
2. **Idea screening**: It is the process of screening the ideas generated in order to do away with those ideas that are not consistent with the company's objectives and resources. This is with a view to eliminate ideas that are not feasible, viable, and acceptable. Many organizations use different criteria in screening the ideas, but in general, screeners often look at the viability, feasibility, and acceptability of the ideas at hand.
3. **Concept development and testing**: The ideas that pass through the screening stage are then developed into concept on paper stating clearly the marketing and engineering details of the product. In essence, the concept will indicate the target market for the product, its benefits, features, and attributes as well as the planned proposed selling price for the product. Similarly, concept should contain the estimated cost of producing the product and its perceived competing brands in the chosen market. When the concept is developed, it has to be tested by asking a number of prospective customers to evaluate the idea based on its feasibility and marketability.
4. **Business analysis**: This stage of the new product development process is geared toward evaluating the overall cost, sales revenue, and profit potentials of the contemplated product idea. This is achieved through such analysis as industry's market potential, market size and growth rate, sales forecast and demand estimation, as well as the estimated profitability, and break-even point for the target product. The main purpose of this analysis is identifying those ideas that are apparently feasible and financially viable. Ideas that are not viable can also be dropped at this stage.
5. **Marketing strategy development**: The most viable ideas that scaled through the previous stages can be used as good candidates for marketing strategy development. In its basic form, this stage calls for formulating the product, pricing, distributing, and promotion strategies to be used in marketing the proposed products when it is introduced. It is pertinent to note that these strategies should be flexible such that it can be modified to conform to the dynamism of the environment.
6. **Product development**: It is at this stage that the actual or physical prototype of the successful idea will be produced. For example, if a company is producing an auto car it will produce a car prototype-like toy car containing all the features and designs specified in the concept development stage. If it is a service, a complete service package will be developed ready for test marketing.
7. **Test marketing**: Here, the company will test the product (and its packaging) in typical usage situations by conducting focus group customer interviews, dealer research or test it at trade shows to determine customer acceptance or otherwise. The company can use the outcome of the test to make adjustments on the planned marketing strategy where necessary. However, a company has to be extra careful in test marketing its planned new

product in order not to expose it to competitors who can easily see and imitate it to come up with their own version sometimes even quicker and better than the initiator.

8. **Commercialization**: This is the final stage of the development process in which the new product will be launched or born. Once it is introduced, it is no longer under the company's control but that of the market. Here a company has to decide on when, where, and how to introduce the product. The timing of the launch is critical as it can make or mar the product's success. For example, launching a new ice-cream during cold season is a wrong timing. The place or venue of launching should also be strategic and closer to the target market. Similarly, a company has to decide on how it can launch the product. There are two main options here namely waterfall and sprinkler approaches. In waterfall approach, a company decides to commercialize it at once in the whole market, which is, introducing it to the whole Nigerian market at a go for instance. The other option is to launch it gradually from one section to another up to the time that the whole market is covered, thus using sprinkler technique. However, the choice of an option depends on the nature of the market, company's resources and level of competition in the market.

In addition, to make its commercialization successful, a company should produce and place an effective promotion to create awareness after ensuring that the products are adequately distributed throughout the market. This is because it will be counterproductive for a company to promote a product that cannot be found in the market by potential buyers.

Nevertheless, it is important to note that these steps may not be followed religiously as some stages may be eliminated or done concurrently in order to reduce the time that the new product development process takes. There are two types of new product development strategies namely proactive and reactive product development strategies. Most leading companies in the industry see new product development as a *proactive* process, where resources are allocated to identify market changes and seize upon new product opportunities before they occur. Conversely, a *reactive* strategy is adopted by follower and strong challengers in which nothing is done until problems occur or the pioneer company introduces an innovation. And because product development process typically requires both engineering and marketing expertise, cross-functional project teams are usually formed to execute the task. The team is responsible for all aspects of the project, from initial idea generation to final commercialization, and they usually report to senior management or project manager as the case may be. Thus, the path to develop successful new products points out three key processes that can play critical role in product development. They are talking to the customer, nurturing a project culture, and keeping it focused [4].

2.2. New product adoption process

The key to successful new product introduction is its acceptance by the customers and this is determined by the adoption process. Adoption process is a series of stages by which a consumer decides to adopt a new product or service. In today's competitive world, a consumer is faced with a lot of choices from a number of competing products. A consumer often passes through five stages in deciding to adopt or accept an innovation from awareness to adoption. These stages are briefly explained below.

1. **Awareness**: This is the step where major marketers spend a huge sum of money to create awareness about their innovation. This can be done through intensive advertising campaigns, aggressive selling, use of consumer and dealer sales promotion, and e-marketing communication.

2. **Information search**: Following the dissemination of adequate information about the product, buyers in the market will be aware of the product and will look for more information in order to know it better. People search for information from company adverts, dealers, sales agents, and other consumers.

3. **Evaluation**: Here, the prospective buyer uses the information obtained to compare different product features and benefits such as price, performance, quality, availability, or durability. All this is an attempt to make rational decision.

4. **Trial**: It is usually done on products with low unit value and higher degree of divisibility. For technical products and other bigger assets, marketers use demonstration to enhance its trialability. This is, however, difficult in services as services are generally intangible in nature. However, service marketing managers do find ways of offering trial packs to users, but it is easier in product marketing through sales promotional activities like giving out free samples, contests, premiums, discounts, etc.

5. **Adoption**: Based on the outcome of the trial process, this is where the consumer finally decides to adopt the product. It is expected that the customer will continue to buy the product repeatedly based on the satisfaction he/she derives from using the product or service. Otherwise, the process might end in rejection.

2.3. Product life cycle and its stages

Products are like human beings, they spend their life in the market. Some stay longer in the market, while others have a shorter life span. However, unlike human beings whose life is in the hands of God, the life of a product is controlled by the company and its market. It depends on whether it is adopted or rejected by the target market. Therefore, because companies know that the products they sell all have a limited lifespan, majority of them invest heavily on new product development in order to make sure that their businesses continue to grow. By and large, the product life cycle has four very clearly defined stages, each with its own characteristics [4]. These stages are introduction, growth, maturity, and decline stage (**Figure 1**) [5].

Introduction Stage: Once a product is launched in the market, it enters into the introduction stage. This is the first stage in an ideal product life cycle. It is characterized by high promotion and intensive distribution especially for fast moving consumer goods (FMCG). These marketing activities often lead to increase in costs at the initial stage particularly for a company with a pioneering status which has to spend a lot to create awareness. It is at this stage that the product is formally born and it enters the competitive field in the market. This goes to show that once in a market, the product's life is determined by the market forces and the ability of the company to manage the product successfully in the market. Thus, if the product is accepted in the market, it will attract other competitors to the market if the market has no

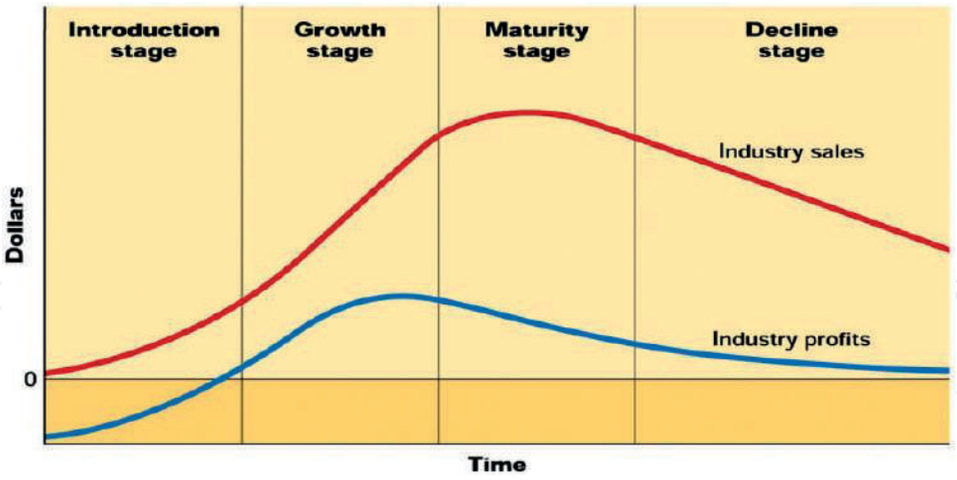

Figure 1. Product life cycle stages. Source: [5].

or low entry barriers. Otherwise, it may even die at this stage. This happened with Fanta blackcurrant soft drink brand of Nigerian Bottling company makers of Coca-cola which died immediately after introduction.

Growth stage: The growth stage is the next phase of the "S" shaped product life cycle. The growth here means increased sales of the product because it is widely accepted by the target market. As the sales rise, the market will also grow and revenues will now upset the initial cost of developing and launching the product resulting to profit generation. To maintain the growth momentum, a company has to emphasize brand preference in its promotion rather than brand awareness.

Maturity stage: When sales stabilize and market is saturated the maturity stage sets in. This is probably the most competitive time for most products and businesses. Companies here need to consider the strategy of product modifications, market expansion, or marketing mix modification, which might give them a competitive advantage. The aim here is to get more customers for the product. Organizations usually like to maintain their products in this stage in order to enjoy the cash inflows from the market, but it is very difficult to manage.

Decline stage: This stage is characterized by steady decrease in sales and profit in the market. This may be because the product has lost its appeal with the customers or presence of better products in the market or the product becomes obsolete, and therefore needs further improvements. Companies do not like this stage because of its adverse consequences and will do everything possible to avoid it. However, for some products this stage is inevitable, and as a result, measures should be put in place to either resuscitate the product or phase it out of the market. In general, the main objective of the product life cycle stages is to enable product managers to know how they can enhance the performance of the products within the context of the company's business strategies [6].

2.3.1. Product life cycle patterns

Some products follow the idealized S-shaped life cycle as explained above, while others follow some patterns depending on how they are managed in the market by the company. This

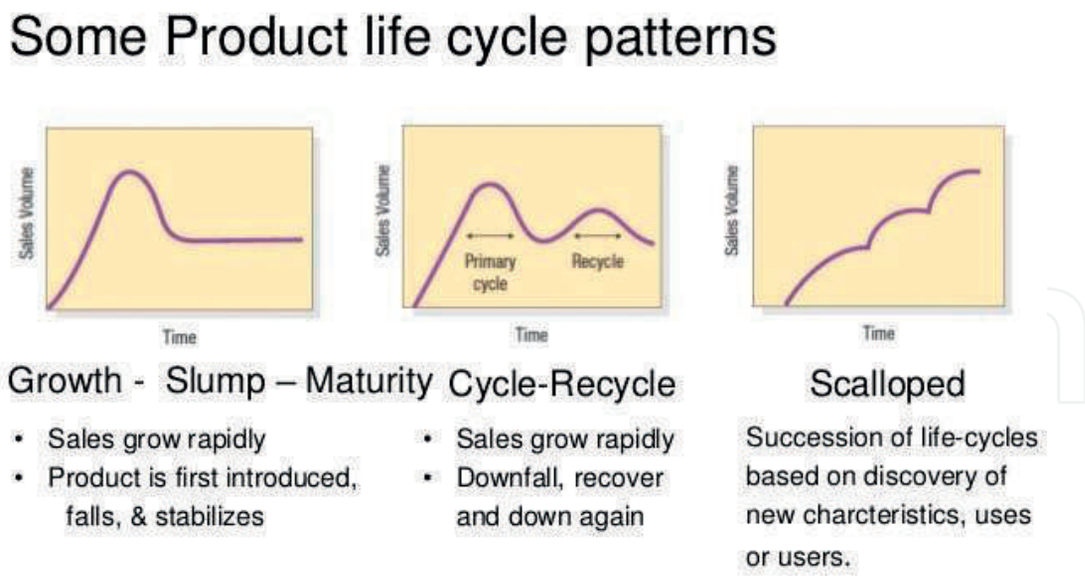

Figure 2. Other product life cycle pattern. Source: [7].

goes to show that product management plays a major role in determining the length of a products life cycle. A product can follow a pattern known as **growth-slump-maturity pattern**. This kind of pattern usually encounters a rapid growth initially but later in the life cycle sales decline with a stabilization at a certain level. One of the examples of such product in Nigeria is the Globacom mobile communication services which experienced a very high sales volume at introduction but slumped down and stabilizes presently.

The **cycle-recycle pattern** depicts a two-phased product life cycle. At the initial phase, a product goes through the ideal stages probably up to decline stage. But after using some strategies to reinvigorate and re-launch the product in the market, it starts another life cycle and depending on how it is managed, it may stay longer or shorter in the market. A good example here is Maclean toothpaste in Nigeria, which went out of the market before it was later re-introduced into the Nigerian market as a new product thus starting a new life cycle entirely.

Another common pattern is called **scalloped pattern**. This is where sales enjoy a succession of growth periods based on the discovery of new product characteristics, uses, or users [7]. Omo and Maggi cube brands in Nigeria show a scalloped life cycle because of the way each of these brands is managed for a long period of time. **Figure 2** illustrates the life cycle patterns.

3. Product management

Product management is a unique function [6]. It is an important area in marketing because it paves the way for sustainable product performance and profitability for companies. Bjernulf and Billgren define product management as "the task that consist of product planning (making sure that the right product is offered), product marketing (enabling the product to reach its potential market), product strategy (the guide for product value delivery over the life cycle), and creating insights (understanding legacy, ecosystems/markets and driving forces)" [8]. Haines and Ausura also define it as a strategic and tactical management of products which

are already in the market [6]. In addition, Windley sees product management as the process of designing, building, operating, and maintaining a good or service [9]. From these definitions, it can be clearly seen that product management is all about conceiving, developing, maintaining, and controlling the product sustainably over its life cycle. It deals with deciding on what the product will be and ensuring that it remains like that in the market profitably. Thus, an effective and high performing product management in a nutshell, enables companies to sell what is developed and develop what they can sell.

Similarly, product management can be seen as the act of effective customer life cycle Management. According to Windley, "customer life cycle consists of two phases; customer buying the product and customer using the product," [9]. Here, it is important to add the third stage, which is the decision to discard the product by the same customer. But in product management, companies are always trying to avoid the third stage because it leads to product decline or death in the market. In general, there are two methods of managing a product; the product life cycle and individual product management strategies.

Perhaps a more comprehensive definition of product lifecycle management is the one offered by Razvan Udroiu who views it as "a business strategy for managing the entire lifecycle of products. This strategy includes the management of conception, design, design validation and simulation, prototyping, manufacturing, quality control, use, maintenance and disposal of products, having integrated people, methods, CAx tools, processes, documentation, and data management solutions" [10]. The import of this definition is that product life cycle management can be seen from two different angles; traditional and modern perspectives. The traditional product life cycle management is very conservative and outdated. There is no innovation and creativity in it but rather a dormant, rigid, and stone-age orientation. Traditional farming system, local textiles, blacksmith, cobblers, and pottery especially in some African countries fall in this category. There is no modification or addition of new features but a religious utilization and protection of the past.

The modern perspectives on the other hand deals with the use of modern technology to produce and manage products overtime. There is creativity, innovation, and frequent modifications here which, in turn, lead to the development of many products variants and even new inventions. The application of computer-aided designs (CAD), robotics, drones, internet facilities, and other digital devices fall into this category. The design, manufacture, use and management of airlines services are examples of modern product life cycle management. To remain competitive and relevant in today's market, a company has to adopt the modern perspective of product life cycle management.

3.1. Product life cycle management strategies

The key focus here is to successfully and proactively manage products throughout their lifetime, by applying the appropriate resources and sales and marketing strategies, depending on which stage a product is in the cycle.

3.1.1. Strategies in the introductory stage

The nature and characteristics of the introductory stage have been discussed earlier in this chapter. Therefore, the main challenge in this stage is that when a new product is launched,

there is typically small market which translates into low sales. There is high cost associated with research and development, marketing, and promotion. These costs notwithstanding, most companies will see negative profits in this stage with limited competition especially if the product is entirely new in the market.

A company can adopt any of the four product introduction strategies; rapid skimming strategy using high promotion with higher initial price, rapid penetration strategy (involving high promotion with low price), slow penetration strategy (using low promotion with associated lower price), and slow skimming strategy (involving low promotion with higher initial price). Each of these strategies is built upon the objectives of the company of either market penetration or market skimming, i.e., higher profit. This, in turn, depends on how price sensitive the market is. In any case, it is always better to adopt penetration strategy in order to encourage more product adoption which produces higher sales volume.

3.1.2. Growth stage strategies

At this stage, brand managers have to effectively manage the challenge of increased competition as new manufacturers seek to benefit from a new, developing market, and its resultant effects. In response to the growing number of competitors that are likely to enter the market during the growth phase, manufacturers tend to lower their prices in order to achieve the desired increase in sales. Marketers should also change the focus of their promotion from product awareness to brand preference which will help to increase the size of the market and sharp increase in sales.

3.1.3. Strategies in the maturity stage

In product management, this stage can be quite challenging and difficult to manage for manufacturers. In the first two stages, companies try to establish a market and then grow sales to achieve increased market share. However, during the maturity stage, the primary focus for most companies will be maintaining their market share amidst many challenges such as market saturation, decreasing market share, and profits caused by stiff competition.

While the market may reach saturation during the maturity stage, manufacturers might be able to grow their market share and increase profits in other ways. Kotler and Keller opine that market, product and marketing modification are the three broad strategies that can be used to manage products in the maturity stage [2]. Market modification calls for expanding the existing market by getting more users for the product, developing new uses for the product and promoting more usage for the product. For example, for Unilever to encourage buyers of its Close-up toothpaste to use it three times after every meal. This will increase the usage rate and need for replacement. Product features modification involves quality, features and style improvements, and other innovative marketing campaigns to improve market share through differentiation. In the same vein, marketing program on pricing, distribution, advertising, sales promotion, and services can be modified to further stimulate sales and market share for the product. Thus, the main goal here is companies to develop innovative ways to make their product more appealing to the consumer that will maintain, and perhaps even increase, their market share.

3.1.4. Decline stage strategies

The key focus here is to be able to harvest the declining product by offering cheaper products, selling to the laggards' market segment that is the last to adopt an innovation. Firms can also offer discounts and other promotional activities to increase sales in the short run. In the long run, a company can think of entering a new market with the existing product, product modification or even selling the product in foreign market thereby starting a new life cycle entirely. However, poorly managed product cannot withstand the harsh conditions of this stage which gives organization no option other than to phase the affected product out of the market. To do this, a company should establish a product review committee consisting of members from marketing, finance, engineering, production, and research and development to study the performance of a declining product [11]. After the review, the team can then recommend a product or products that can be built through re-investment, those to harvest, hold, or divest from the portfolio. Therefore, decision on phasing out a product should not be taken haphazardly in a rush; rather, it should be based on an informed decision. Consequently, the product life cycle curve needs to be applied with a certain amount of care, even though it is still a useful model which provides businesses and their marketing departments with the opportunity to plan ahead and be better prepared to meet those future challenges.

3.2. Product mix and product-line analysis

It is equally important for companies to appreciate the significance of product mix and product line in the product management discourse. This is because of the relevance of the two concepts in determining the level and complexity of managing a product portfolio. A product mix is the set of all products and items a particular company offers for sale. It is the total product portfolio that a company manages. While a product line is a group of closely related

Retail banking	Corporate banking	e-Business	Private banking
Jaiz saving acct	Jaiz Corporate Acct.	Jaiz Online	Jaiz Premium
Jaiz current acct	Corporate saving	Jaiz Mobile	Investment Acct
Jaiz salary acct	Domiciliary Acct	Point of Sales (POS)	
Jaiz Kids acct	Working Capital acct	Jaiz pay	
Jaiz Tier one acct	Project Financing	SMS Banking	
Jaiz Tier two acct	Real Estate Financing	Jaiz just Top-up	
Personal Finance	Service Lease	Verve cards	
Rental Finance	Import Finance	Master cards	
Medical Finance	Export Finance		
Education Finance			
Jaiz Travel Finance			

Source: [12].

Table 1. Jaiz Bank's product mix.

products that are considered a unit because of marketing, technical, or end-use considerations. In other words, a product line consists of a set of brands that are closely related due to the similar functions they perform, they are sold to the same customer groups, use the same channel of distribution or fall within the same price range [4]. For instance, a personal computer is one product line. An example of a product mix and product line width, length, depth, and consistency for Jaiz Bank Nigeria is depicted in **Table 1**.

A company's product mix has a certain width, depth, and consistency. The width of a product mix refers to how many different product lines the company carries. In the table, Jaiz Bank has four lines of services. Product mix depth is the total number of product items under each line. In **Table 1**, the depth of retail banking line is 11 different services. While the consistency is the degree to which all the products in the mix are related in one or the other. This may be in terms of the market being served, distribution channel used, or common production processes. All the services of Jaiz Bank are consistent in their banking focus. Companies normally develop a basic platform and modules that can be added to meet different customer requirements. This modular approach enables the company to offer variety while lowering production costs.

3.3. Product differentiation

Successful product management cannot be achieved without product differentiation which is a process of designing and formulating unique and meaningful features that provides an identity around company's products. Differentiation can be built around goods or services such as automobiles, furniture, designer shoes, bags, and healthcare services. The aim is to make the target market identify and recognize the difference. If the market perceives no difference between two competing products, then the only possible means of competition is through pricing. In a situation such as this, products are viewed by customers as very easy substitutes for one another.

Products can be differentiated through many different ways. This differentiation may for example take the form of different packaging, marketing and product features, performance, conformance, durability, reliability, reparability, style, and design [2]. As long as a business can come up with a creative way to differentiate its product or service, gaining a competitive advantage is possible.

3.4. Other product management strategies

Apart from the life cycle product management strategies, companies also have an array of specific product strategies to use in managing their product assortments. These, products include, among others, the following:

i. Limited versus full-line product strategy

ii. Line filling strategy

iii. Line stretching strategy

iv. Line modernization

v. Line Featuring

vi. Line pruning

vii. Brand extension strategy

viii. Product repositioning strategy

ix. Planned product obsolescence

x. Product deletion strategy

Limited versus full-line strategy: As the name implies, this strategy simply deals with a company's decision to carry few or many product lines in its portfolio. Small scale enterprises (SMEs) and micro enterprises, for example, manage few products or even one product item based on their size. Companies like Procter and Gamble, Unilever, and Dangote Group carry many product lines and product assortments which make it very complex to manage than just few line or brands. However, it should be noted that companies should not put their eggs in one basket by offering one brand or few lines; rather, they should spread their risks by expanding their product lines.

Line filling: Line filling means adding products to fill a gap in the existing line. It is the process of lengthening the product mix by adding more items within the present range. Reasons for line filling may include getting incremental profits, maintaining dealers who complain about lost sales because of missing items in the line, utilizing excess capacity, becoming a leading full-line company and to keep competitors away. To achieve this, a company can introduce flanker products to protect the main brand from competitors. For example, Nestle Foods Nigeria Plc. has introduced different flavors of Maggi to give protection to Maggi star brand like Maggi chicken, Maggi crayfish, Maggi beef, Maggi pepper soup, etc. However, care should be taken not to introduce a product that will kill or cannibalize the existing product. Charles Schewe argues that the introduction of Classic Coke has cannibalized the sales of regular Coke [13].

Line stretching: This occurs when a company lengthens its product line beyond its current range. This is a frequent measure taken by companies to enter new price slots and to cater for new market segments. The product may be stretched by the addition of new models, sizes, variants, etc. For example, Toyota car comes in different models and brand names such as Carina, Corolla, Camry, Yaris, Prius, and Mirai in order to serve different customer segments. A company can choose to trade up or trade down. Trading up is a situation in which a company known for marketing low priced product will add a high quality brand sold at higher price. For example, Volkswagen traded up from Beetle to Arteon model to serve the upper class. Trading down, on the other hand, is a strategy by which a company that is positioned in the upper market may decide to introduce a lower price line. A company can adopt this strategy to exploit strong growth opportunities in the lower market segment, tie-up lower-end competitors so that they do not move up-market or move out of a stagnating market.

Line modernization: Product lines need to be modernized continuously. Companies plan improvements to encourage customer migration to higher-valued, higher-priced items. For instance, Microsoft has upgraded its Windows operating system from Windows 7 to Windows 8, XP, Vista, and Windows 10.

Line featuring: The product-line manager selects one or few items in the line to feature. Sometimes, a company finds one end of its line selling well and the other end selling poorly. Then, the company may try to boost demand for the low-selling ones that are threatened with extinction due to lack of demand.

Line pruning: This is otherwise called line reduction. At times a company finds that over the years it has introduced many variants of a product in the product line probably because of the changing market situations which makes the product lines become unduly complicated with too many variants. So, when the products are not satisfactorily performing, the product managers need to drop them from the product line. This may lead to increased profitability due to cost reduction from promotion and other marketing expenses. Thus, line pruning is a well thought-out decision by the product manager to drop some product variants from the line.

Product repositioning strategy: First, positioning is the process of placing the product's functionality, relevance, or attributes in the minds of customers. Positioning helps to create a unique perception about a product in the minds of consumers such that a mere mentioning of that brand will evoke an association of quality or otherwise on the product. For example, Mercedes brand evokes good manufacture, McDonald's means quality fast food and snacks, and Singapore Airlines means responsive and reliable airline services. Therefore, a company may decide to reposition its products in order to serve another market segment thereby extending the product's life cycle. For example, Cadbury Nigeria Plc. initially positioned its Bournvita brand as food drink for future sporting champions. But today, it is repositioned as a food drink for child nourishment in their advert slogan "every child deserves nourishment, every child deserves Bournvita." So, repositioning is used in order to add value to the brand to enhance its marketability.

Brand extension strategy: Brand extension or brand stretching is a marketing strategy in which a firm marketing a product with a well-developed image uses the same brand name in a different product category [4]. Companies use this strategy to increase and leverage brand equity (which is the net worth and long-term value of the original brand name) to market a new business or product to a new customer market. An example of a brand extension is PZ's Venus brand which is used to create Venus Soap, Cream, lotion, powder, and hair relaxer. It increases awareness of the brand name and increases profitability from offerings in more than one product category. Another example is Dangote brand which is extended to Dangote cement, Dangote sugar, Dangote salt, Dangote flour, and Dangote transport.

Product standardization versus customization in global market: Customized and standardized marketing strategies are two opposing product management options in international marketing operation. In recent years, there has been an increased urge among local organizations to diversify their operations in the international market to enhance their revenues, competitiveness and global market share. This makes it essential for organizations to adopt international marketing strategies to guard them against foreign competition. Customization strategy is based upon the polycentric orientation of international marketing operation. This ideology holds that due to cultural and other differences among countries, marketing strategies should be tailor made for each country. This strategy is influenced by the differences in buyer behavior characteristics, socio-economic condition, and competitive environment.

Standardization, on the other hand, is a complete contrast to the customized strategy by which a standard product is produced to serve a homogeneous market worldwide. When there is a convergence of needs due to consumer behavior or socio-economic similarities, a product can be produced to serve these markets anywhere in the world. For example, sporting equipment and products and services such as club jerseys, boots of EUFA Champions league matches are sold to customers all over the world without any modification. Similarly, Sony uses the same packaging across several countries for its Play station product; Coca-Cola has prevailed successfully in the global market while Emirate Airlines adopts the same marketing strategy and services to serve its global markets.

Planned obsolescence: Obsolescence occurs when an object, service, or practice is no longer wanted even though it may still be in good working order. Obsolete is something that is already disused or discarded, or antiquated. Therefore, planned obsolescence is a deliberate strategy which a company employs to purposefully make a product outdated or non-functional within a set period of time, so that customers have to buy a new one. A good example of this is the lifespan of a light bulb which does not lasts longer; one has to keep buying more and more. For planned obsolescence to work, the customer must feel that he has value for money from using the product as well as having enough confidence on the company.

Planned obsolescence is a business strategy in which the life of a product is designed and built into it from its conception. This is done so that in future the consumer feels a need to purchase new products and services that the manufacturer brings out as replacements for the old ones. For instance, fashion of any sort is deeply inclined to built-in obsolescence. Also, the strategy of planned obsolescence is common in the computer industry too. New software is often carefully developed to reduce the value of the previous version in the eyes of consumers. However, a strategy of planned obsolescence can backfire if a manufacturer produces new products to replace old ones too often, which leads to consumer resistance.

Planned obsolescence can be physical, functional, style, and technological obsolescence. Physical obsolescence is a situation in which a product becomes outdated due to the wear and tear of the product. Old products such as refrigerators, car tires, and clothes fall in this category. Functional obsolescence is a reduction in the usefulness or desirability of an object because of an outdated design feature, usually one that cannot be easily changed. Sometimes functional obsolescence is built in the product when designing it. For example, car or cell phone batteries, electric bulb, entry visa and spark plugs, among others. With regards to style obsolescence, whenever a product is no longer desirable to the customers because it has gone out of the popular fashion, its style is considered to be obsolete. It is principally a matter of esthetics and not one of performance or function. The periodic introduction of new models of cars by Honda and Toyota which renders the existing models out of fashion is an example of style obsolescence. While technological obsolescence occurs when a technical product or service is no longer needed or wanted even though it could still be in working order. Technological obsolescence generally occurs when a new product has been created to replace an older version as a result of technological development. For example, the introduction of computer and printer render manual typewriter obsolete, the same thing applies to digital camera and analog camera like Kodak, color and high definition television versus black and white television, and so forth.

Product deletion strategy: Whenever a product is not performing and is not patronized by customers, it is a good candidate for deletion, i.e., deciding to remove or phase out the product from the market. The strategy for deletion can be instant or gradual depending on the fate of the product in the market. If it is consuming money without bringing any return, instant deletion is recommended. But if the product is still bringing some revenue to the company, it can be allowed to die gradually in order to harvest the remaining cash inflows. Alternatively, that product can be withdrawn from its existing market and introduced in another market to start its new life cycle.

4. Case study

To illustrate and validate the foregoing theoretical discussion, a practical product development and management case study is presented here. This is from an earlier published research conducted by the author of this chapter.

Dala Foods Nigeria Limited: Effective Product Development and Management in Foods Processing (Agribusiness) Firm

Introduction

"Dala Foods Nigeria limited is a resilient indigenous food processing company which was incorporated in 1979 and started operation in 1980. Its proactive product development strategy enables it to introduce and manage five unique brands of instant food drinks namely Dala city tea, instant *Kunu*, Diet *Kunu*, dried *Fura*, and *Bisk i* (local couscous). It is this innovative drive that made DALA to be recognized both locally and internationally through many awards that the company won for itself and the country. The fact that the company was and is still able to survive and prosper in the hard business environment of Nigeria shows that agribusinesses have something to learn from this indefatigable company hence the case study.

Company background

Dala Foods Nigeria limited was incorporated as a food processing company with an initial share capital of N400,000 by a visionary and innovative entrepreneur late Alhaji Safiyanu Madugu who served as the Chairman. The Company is wholly owned by Nigerians and it is located in the North Western State of Kano, Nigeria. It started operation in a rented apartment in 1980 with staff strength of 35 members. Today, it employs 135 people in its permanent site at Sharada industrial estate in Kano State with a capital base of over N 100 million and reaching N 250 million turn over annually.

Dala Foods has a well-equipped laboratory manned by qualified and experienced Food Scientist, Technologist, and other laboratory attendants. Its flagship brand, Dala city teabag, is a house hold name in Kano, a state with a total population above nine million (9 m) people, and it has been competing with both local and foreign brands for the past 32 years.

The tea market in Northern Nigeria and Kano in particular is very attractive and viable due to stable demand and high population growth. People in the area always want to drink tea

or *shayi* in Hausa language anytime of the day. This opportunity is what attracted local and foreign brands such as Lipton (local and imported), Top tea, Tiger tea, Highland tea, Akbar, and Tea king to the Nigerian market. Another opportunity is the affordability of tea to the mass market. With your N5or N10 you can get one or two tea bags to quench your thirst for a beverage drink.

The market performance of city tea bag is very encouraging. The brand name of Dala city tea emanated from the famous Dala hill in the ancient city of Kano so, it is a well-known brand which made it easier for people to pronounce and remember. But the company did not relent; it launched Dala city tea with aggressive promotion through radio and Television Jingles. In addition, the company sponsored a popular TV Indian film show in the night. Little wonder then that the brand got massive acceptance and from 1980 to 1989 the sales and market share of Dala city grew steadily. Due to population growth and better disposable income, the demand for tea increased and from 1990 to 1999 down to 2010 the sales of Dala city tea made a significant move upward. Dala city tea brand can be considered to be in the growth maturity stage because the company is yet to meet the growing demand of tea in Kano in spite of the increased influx of foreign tea brands.

Following the success of Dala tea, the company introduced instant *Kunun Tsamiya* to the market in 2001. Immediately, the sales of *Kunun Tsamiya*, a Hausa term for Tamarind millet gruel, started to grow and it follows the same trend and even better than that of Dala tea. This is because of the unique nature of the product, and unlike city tea, *Kunun tsamiya* has no identified competitor in the market apart from local unhygienic products from informal businesses that are inherently insignificant. Another key characteristic of Dala's *Kunun tsamiya* is it brings succor to housewives from the chore of dehusking, winnowing, and grinding of millet in the process of making local *Kunun tsamiya*. This process takes more than 5 h to finish in the traditional method, but with instant *Kunu*, the difficulty has been reduced to just 5–10 min! That is why at present, Dala Foods could not adequately meet the demand of the product. This brand is apparently in the introductory stage but moving into its growth stage.

Similarly, the company introduced Diet *Kunu* to serve the market segment of those with diabetics. This is quite innovative and timely because of the sizeable number of diabetic patients in Kano who are largely old and incidentally, consumers of traditional *Kunu*. Diet Kunu is its infancy stage but its demand is increasing due to the rise in the number of diabetic patients in the region. In general, we can confidently say that instant *Kunu* is swimming in blue ocean waters as the only brand of its type in Nigeria presently. Other brands produced and marketed by the company are Instant *Fura* (cooked ground millet) and instant Biski (local couscous). All these brands are adapted household names of some traditional food and beverages that are difficult to prepare but made easy courtesy of Dala Foods.

Moreover, Dala Foods produces another food product called Action Meal – a food supplement for malnourish patients formulated by Institute of Human Virology, Nigeria (IHVN) and processed from Maize, Soya beans and Groundnut on contracts for other global organizations. The company has benefited from those contract productions in form of increased sales turnover and revenue, gaining more experience in other grains processing and availability of ready-made market niche (malnourished children) and easy access to foreign market through donor

organizations. Similarly, Dala foods will have the opportunity for free promotion of its corporate identity in all areas served by donor organizations in form of humanitarian aid to malnourished children. All the above products are registered and certified by the National Agency for Foods Drugs Administration and Control (NAFDAC) and Standard Organization of Nigeria (SON).

In all these brands, the company followed the new product development process discussed earlier in this chapter, but albeit not as comprehensive as it should be. This is because the staff that carried out the tasks lacked the required skills and experience as at then. However, Dala Foods is able to succeed in this regard because of its innovative drive and pioneer status. It is this innovative drive that made the Company to win many awards for itself and the country such as the Quality certificate from SON in 1988, Gold medal in 1989 as one of the best product exhibited in Leipzig International Trade Fair, a Global Food Industry award in 2008 from the International Union of Food, Science and Technology (IUFoST) and the Nigeria50 Awards as a fast growing company in 2013 by the Tony Elumelu Foundation. This is by no means a small achievement by any standard.

Some Pictures of Dala Foods Brands. All these brands have pioneer status. Dala Foods is an indigenous firm. Source: [14].

Key success factors

The success story of Dala food can be attributed to its ability to practice and maintain its mission and core value: "To produce clean, cheap, and quality products that meet our customers need." This is achieved through developing locally relevant, quality products that are not only affordable but also scalable. The company was also able to create a strong value proposition for its products at the right price points through a combination of product re-engineering, smaller pack sizes, and low-cost operating models.

Another driver of the company's success was its effective brand building strategy. Getting brands into consumers initial consideration set is very important in emerging markets such as Africa than elsewhere. With this knowledge, Dala Food vigorously built its city tea, instant *Kunun tsamiya*, *Biski* and *Fura* to acquire an indelible position in the consumers mind through

aggressive promotion and marketing strategies. Similarly, the company has painstakingly developed and maintains a set of activities to effectively get its product to market such as account management, order taking, delivery, payment and in-store merchandizing. Using his vast experience as an erudite merchant, the late chairman of the company Alhaji Safiyanu Madugu took some strategic steps to build a powerful and profitable route to the market, a feat that is being religiously implemented by his heirs today. This strategy apparently works due to a well-developed program based on succession plan, which is reviewed from time to time with cognizance of the original plan in mind. The route to market (RTM) model combines the benefits of direct customer relationships with the cost advantage of outsourcing to achieve distribution economies.

Other steps cover effective management of the distribution network within Kano and outside the state as well as developing a compelling retail value proposition to achieve a win-win solution that drive increased volume, improved efficiency, and outlet loyalty. The distribution network for convenience products like food and beverages in Northern Nigeria is intensive, that is from the company to the distributor, retailer, on to the final consumer. This is done with a view to make the products readily available and accessible to the target market. However, this channel may likely change in the near future, when the company starts exporting its products to the neighboring West African countries like Niger, Cameroon, Chad, Togo, and Ghana. To achieve this, Dala Foods intends to use indirect export, first, through domestic-based export merchants and reliable export management companies. As the operation grows further, we will do it directly by establishing a home-based export unit to market the products, or export sales representative to sell the products in foreign country or by appointing a reputable but reliable distributor based in the host country.

Furthermore, the company has absolute control of the production process. It is pertinent to note here that the production process of *Kunu*, *Fura*, and *Biski* was pioneered by the company as it was the only entity that started to produce these products using such technology, so there is absolute control which gives it advantage over others and makes it difficult for others to enter the market without the permission of the company, thus creating a strong entry barrier. Another critical success factor is the availability of raw material because all the materials are wholly sourced locally. The main raw materials include fresh tea leaves, millet, ginger, cloves, and pepper; all in natural form with no additives or artificial preservatives. This provides the company with competitive advantage of making product easily available, qualitative, and affordable.

In a nutshell, Dala Foods Nigeria owes its success to its key role in supporting the local agricultural produce through its proactive product development, limited line product management strategy, and strategic market niche operations" [15].

Source: Adopted from [15].

5. Conclusion

From the foregoing discussion, it is hoped that the chapter has provided a clear basis for proper understanding of product development and management toward improved and sustainable

company performance. It is important to note that the tasks and strategies discussed in this chapter cannot be carried out by the product/brand manager or any other body charged with the responsibility for product management alone, but in conjunction with other units in the organizations. This is because a product manager has to relate with such units like research and development, engineering, production, marketing, finance, advertising, procurement, etc., in order to be successful. Thus, a brand manager is expected to be a good diplomat and a team player in order to succeed.

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Author details

Musa Gambo Kasuwar Kuka

Address all correspondence to: gambokk@gmail.com

Department of Marketing, School of Management Studies, Kano State Polytechnic, Kano, Nigeria

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Chapter 3

Product Design Process and Methods

Jinxia Cheng

Additional information is available at the end of the chapter

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Abstract

Suitable design procedures and methods will lead to twice the result with half the work. Hence, good products need a good beginning in the design process. The design procedure is the basis for guiding the steps of design process, while the design method is the guarantee for effectively developing the design process and improving its quality. A clear and reasonable process can lead to a simple and smooth way in design, while the proper use of creating techniques can let the designer find a better way to solve the problems in a wider range, so as to develop and design a good product.

Keywords: product design, design method, creating technology, design process, survey, evaluation

1. Introduction

"What is a process?" A process may be defined as "a series of steps, actions, or operations used in making something or bringing about a desired result: a manufacturing process" [1]. Similarly, a design process can be defined as a sequence of creative problem finding, analyzing, and solving steps used by the designer to develop an appropriate design solution for the given client, which is an organizational framework used by designers during the process of product design.

Design activities are complicated and interlocking. There must be clear steps to plan and integrate, and the whole process should be rationally arranged according to scientific laws, so as to achieve the final design goals clearly, as shown in **Figure 1**.

In these steps, series of problems, puzzles, and brand-new ideas will be brought in, to analyze to lead our future products. We need to find the key point to explore our product, know about

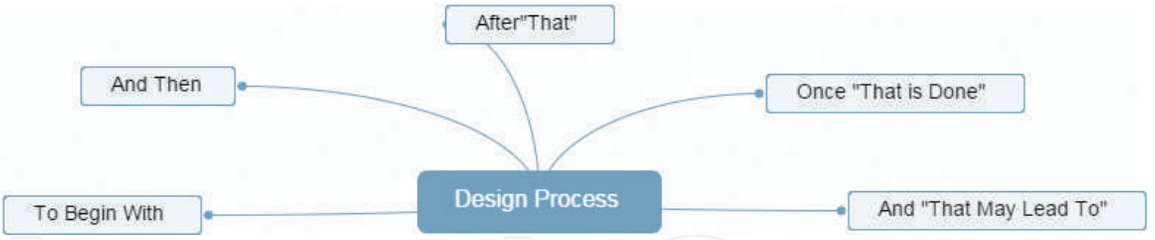

Figure 1. Design process.

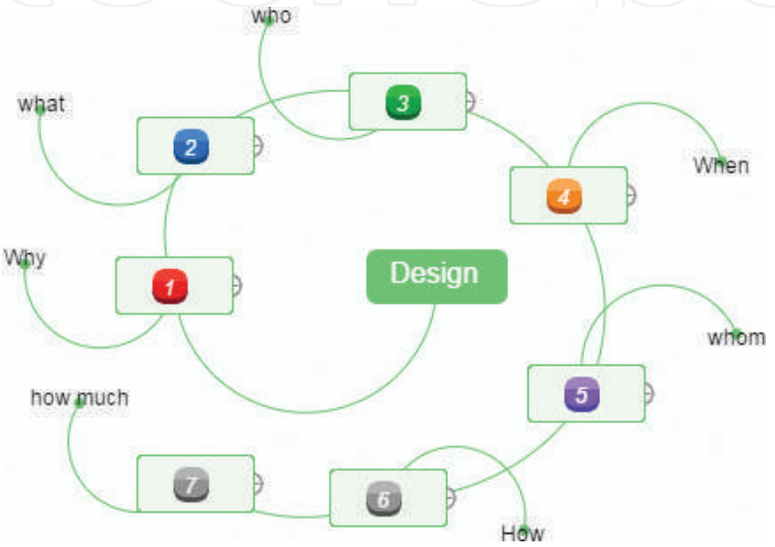

Figure 2. Design analyses.

the market and potential customers, and get important information about the variety of functions, what is more, we need to deal with the whole developing and design operations and have control on its correspond costs, as shown in **Figure 2**.

2. Definitions and relationship between product design process and methods

2.1. About product design process

The product described in this chapter refers to the concept in a broad sense, which refers to the sum of the products formed with a certain purpose and to meet the needs of targeted people as well as nonphysical services. Its general process is shown in **Figure 3**.

Modern product design is a planned, step-by-step, targeted, and directional creative activity. The design process refers to the development process of the design and the order in which the design tasks are completed. According to the arrangement of the process, it can be divided into linear programs, parallel programs, and complex programs. It is an organic combination of finding, analyzing, and solving problems.

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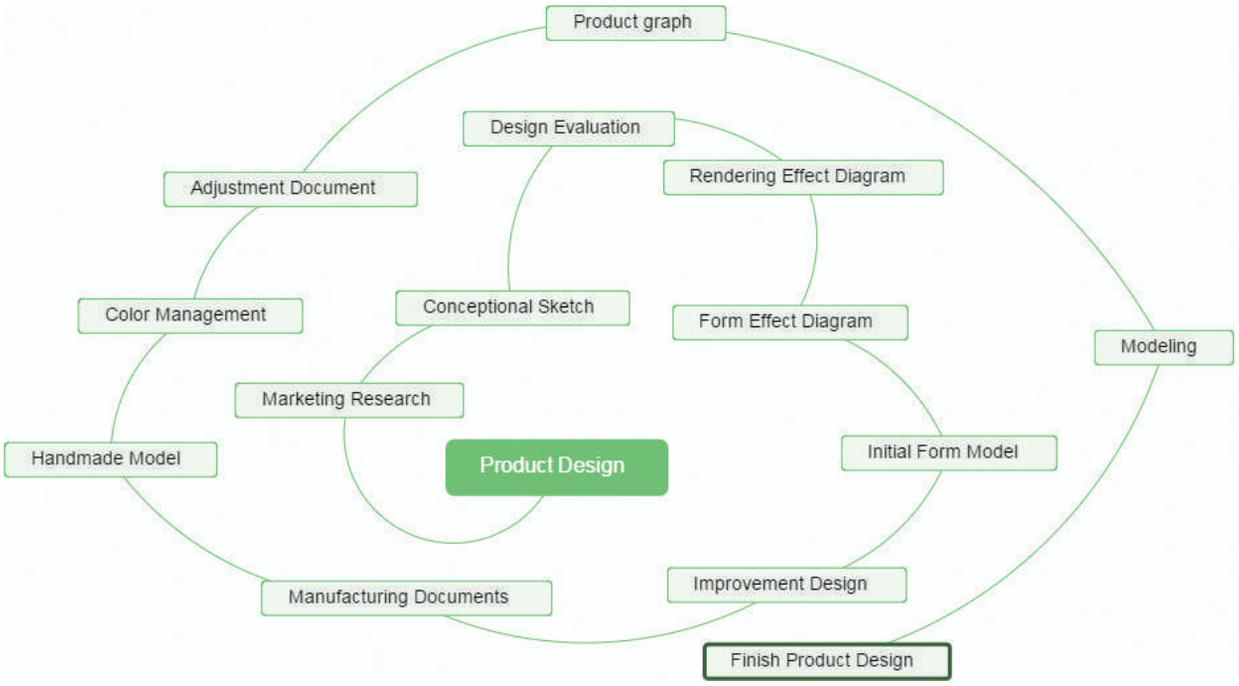

Figure 3. General product design process.

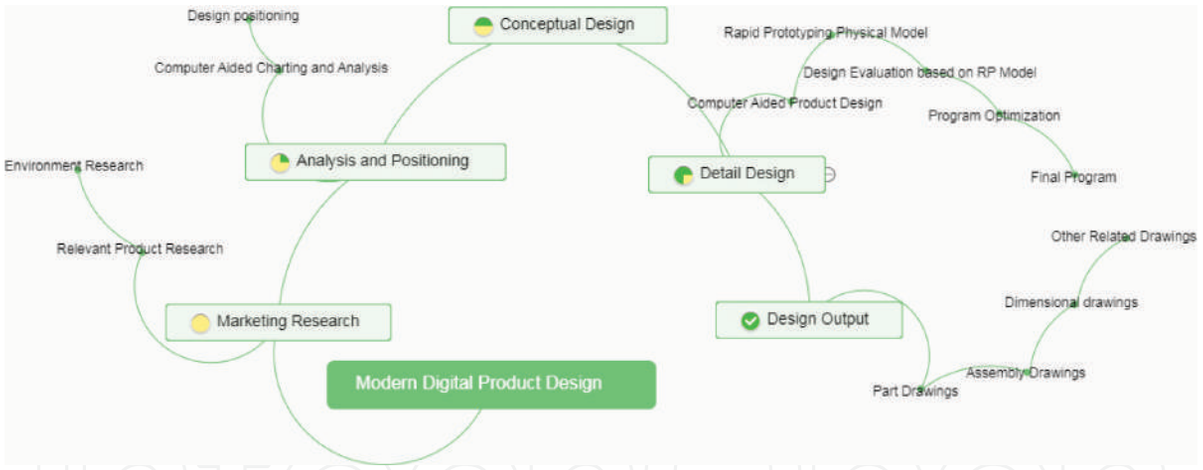

Figure 4. Modern digital product design process.

With the advancement of technology, computer-aided design and manufacturing have been widely used in the product design process. For example, in the market research stage, computer data analysis can be introduced; in the concept stage, product sketches, renderings, and even real physical models are created through rapid prototyping based on computer-aided design, as well as design evaluation, reversing, and optimization iterations. Thus, the design process of the above figure can be reduced to the following modern digital design process as shown in **Figure 4**.

2.2. About the design methods

Methods refer to the sum of the receipts that can be used to achieve certain purposes in any fields. When people want to know and transform the world, they must engage in a series of

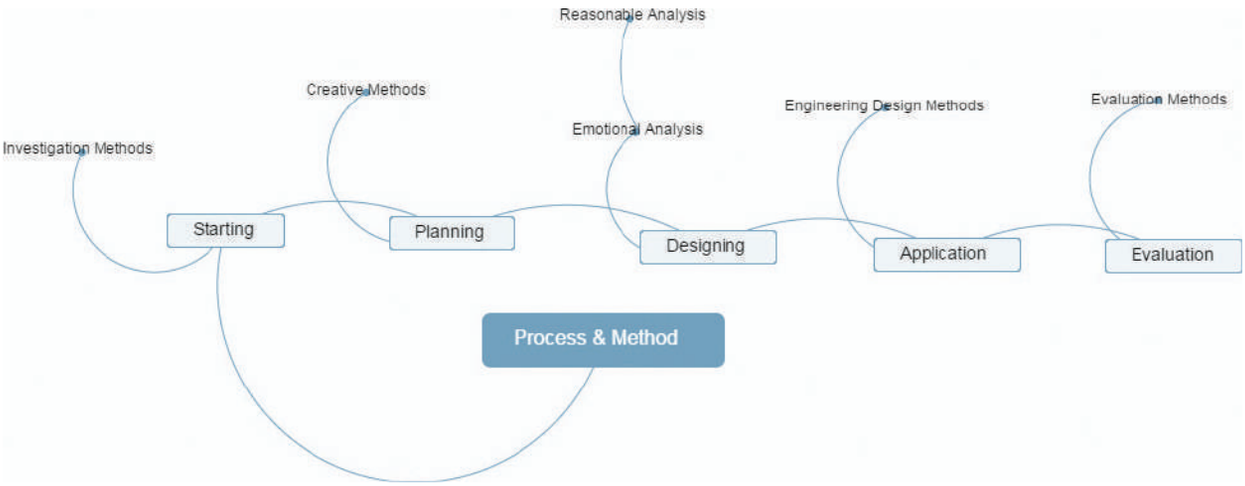

Figure 5. Relation between process and methods.

thinking and practical activities. Those various methods used in the activities are collectively referred to as methods. No matter what you do, you must have proper methods, and the correctness or inferiority of the methods directly affects the success or failure of the work.

The main features of modern design are optimization, dynamics, diversification, and computerization. Commonly used design methods mainly include catastrophe method, information theory method, system theory method, discrete theory method, intelligent theory method, cybernetic method, correspondence theory method, optimization method, fuzzy theory method, and art theory methods [2].

2.3. Relationship between process and methods

As for the relationship of product design process and methods, they complement and rely on each other, which is shown in **Figure 5**.

Firstly, the design process determines the steps of the design, while the method determines the design measures and effects.

Secondly, the design process itself requires specific methods and overall strategies to guide and support, and methods must be adapted and changed according to specific procedures. A clear and complete design process can guide in an orderly manner, simplify, and optimize the results in process. While designing, the appropriate method involved can solve the design problem efficiently and creatively.

Finally, a design program provides a platform for the application of the method, which ensures the smoothness and efficiency of the program.

3. Product design process

Generally speaking, product design involves four periods, namely, the research phase, the analysis and positioning phase, conceptual design phase, detailed design phase, and the

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design output phase. According to different design objects, the specific matters of each stage are slightly different and complicated.

3.1. The research phase

Design and research are in the initial stage of the design process. Knowing what we have, what we want, and where to get as well as how to get required information from seeing the micro-knowledge to know the significance, using existing information as the starting point, by means of analysis and synthesis methods, etc., to integrate the important influencing factors of the products involved, so as to guide the follow-up design in a targeted manner.

Generally speaking, the research phase mainly focuses on people, machines, and environment, as shown in **Figure 6**. Among them, people include target users, potential users, producers, sellers, recyclers, etc., which are related to the product life cycle; gender, age, education background, income level, social status, family conditions, as well as other factors which reflects in status, lifestyle, and values all have a profound impact on the future direction of product design. The machine mainly refers to the various attributes involved in the design object and related products including the current status of the market products and various property expectations of the products involved such as function, form, structure, color, human-machine relationship, usage, carrying method, etc. The existing attributes of the product market have a certain reference and guiding role for future design. From the existing market survey, we can understand the distribution and gathering of market products, so as to find the opportunity of post-development positioning. At the same time, the investigation of the attributes of future products can further clarify the product characteristics, zero to thin, and gradually deepen the refinement of product concept until the entire product design process is completed. The environment mainly refers to the natural and human context in which

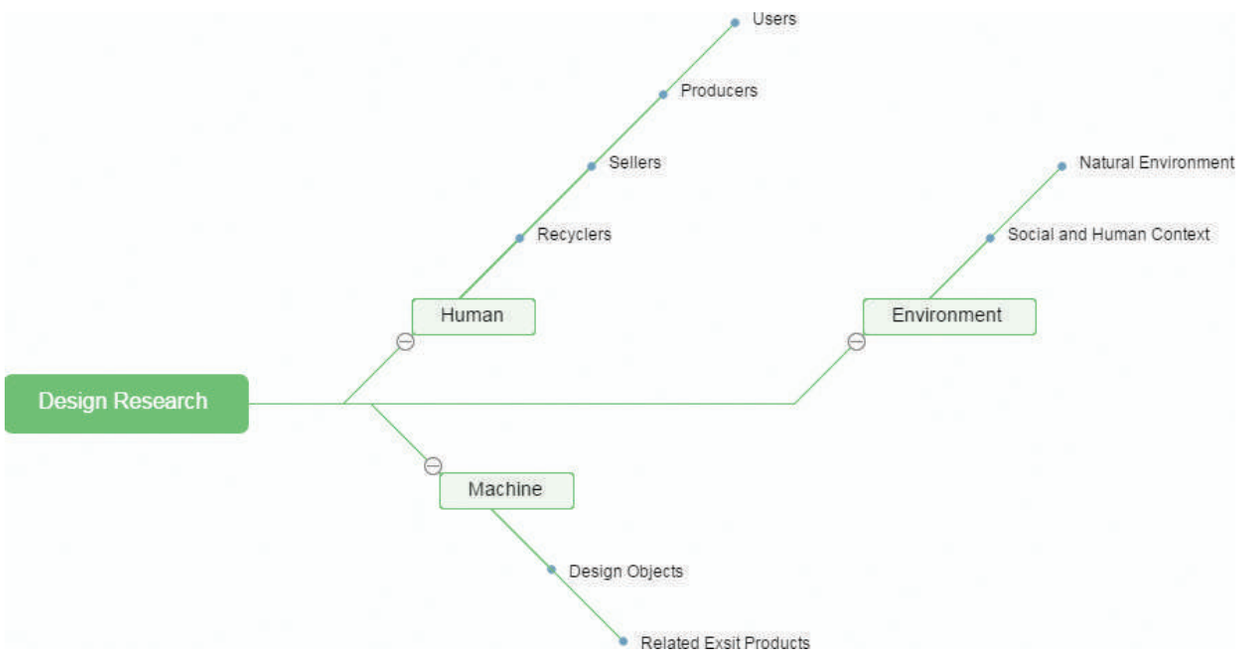

Figure 6. Design research.

the design object is located. Any product is used in a certain time and space and social environment, and the product status should match the current environment, which can highlight the design intent and the characteristics of the times.

3.2. The analysis and positioning stage

The analysis and positioning stage is mainly based on the abovementioned research information. Through the actual deep investigation of people, machines, and environment, we are firstly able to analyze the direct and potential needs of the users, so as to achieve design customization in a targeted manner. Secondly, the investigation of the machine can be intuitive and effective in discovering market development opportunities. In general, we can explore products from two aspects. On the one hand, in the state of market agglomeration, it means that the product status is very suitable for the current trend and can meet the needs of most users. It can be used as a follow-up product development, taking the advantages of popular goods and targeting the mainstream of the market. On the other hand, as to the market's unpopular performance, the challenge of the alternative way of solving problems with the mutant thinking and the use of unique strategies to creatively complete the development of brand-new products can be reversely considered, as shown in **Figure 7**. In terms of environment, in view of the indivisibility of product use and environment, the product environment is reversely inferred from the use environment, and the consideration and development of the support are beneficial to maintain the performance of the product for a long time, thereby ensuring the service life of the product and saving the human, material, and financial investment in the industrial chain.

On the basis of design analysis, the related aspects of the products involved are positioned to create a benchmark for subsequent series development and visual design, which lays the design direction and basis for the whole design process.

3.3. Conceptual design stage

Conceptual design is a series of organized and targeted concepts of concise design based on analysis of the previous market demand and user needs. It manifests itself as an evolving

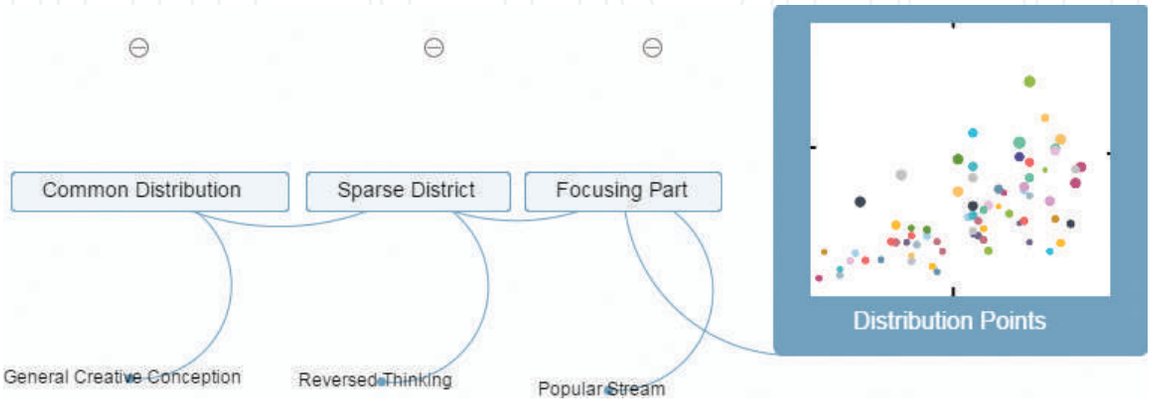

Figure 7. Distribution analysis.

process from coarse to fine, from fuzzy to clear, and from abstract to concrete, which is a preparation stage for the visualization of the design conceptions after the above design positioning is determined.

Conceptual design determines the main purpose and developing direction of the future product, through which we can save our resource input as much as possible, help the following production and sales, extend the profit margin, and effectively estimate and guide the late recycling issues. Thus, conceptual design in the initial stage of product is undoubtedly a crucial part of product life cycle.

3.4. Detailed design

Detailed design is a visualization process based on the previous design concepts. It is extending and diverging based on design concepts and gradually forms a visual clear plan, as

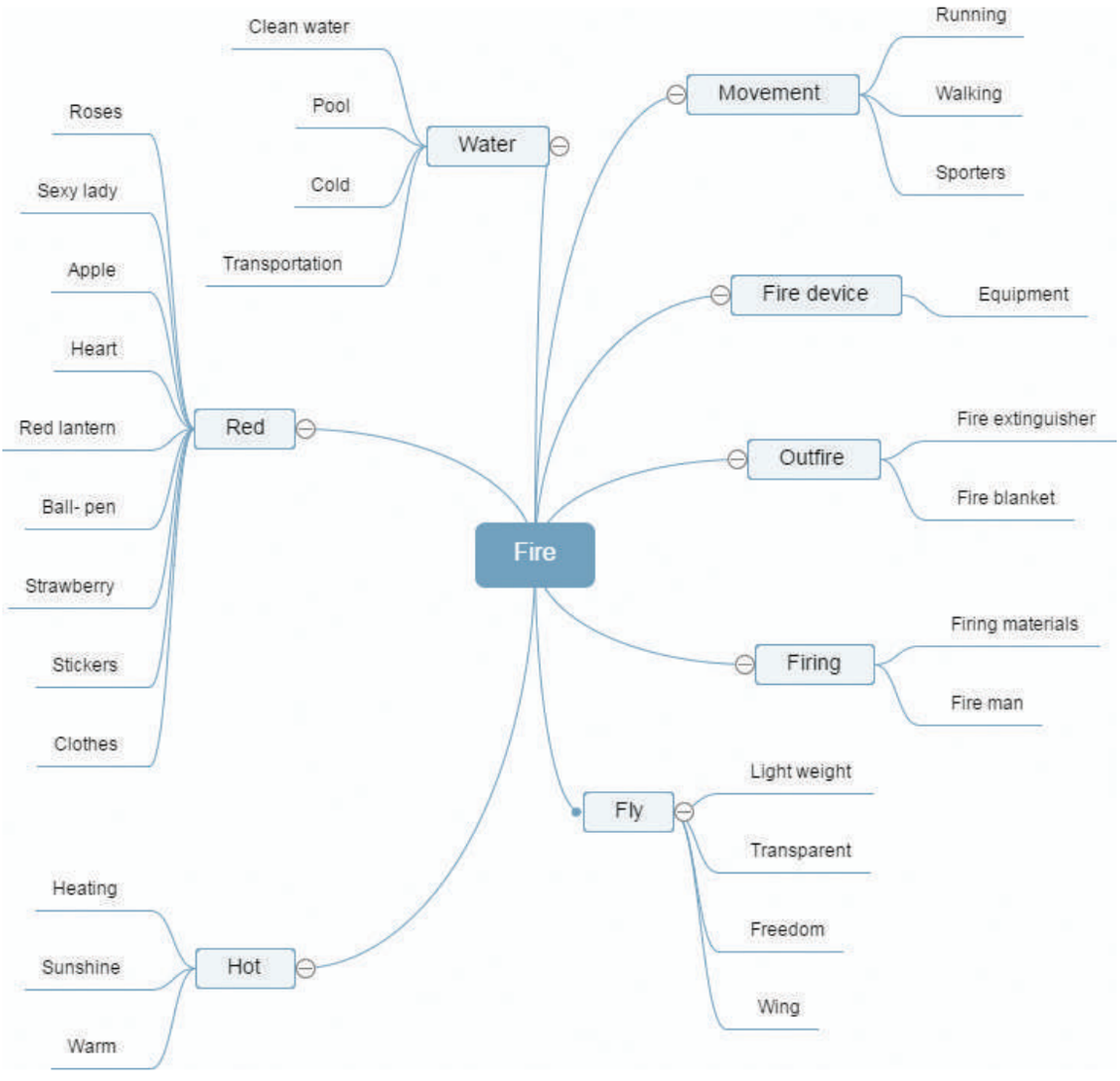

Figure 8. Divergent thinking.

shown in **Figure 8**. Based on this, the process of design evaluation, program selection, and optimization, as well as the product expressions, is carried out. With a same script, different interpretations produce different works. The same is true of the design concept. Focusing on the abstract design concept, divergent thinking, and extension, starting from different angles,

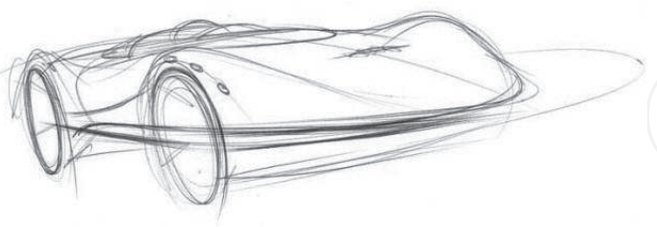

Figure 9. Original handmade sketch [3].

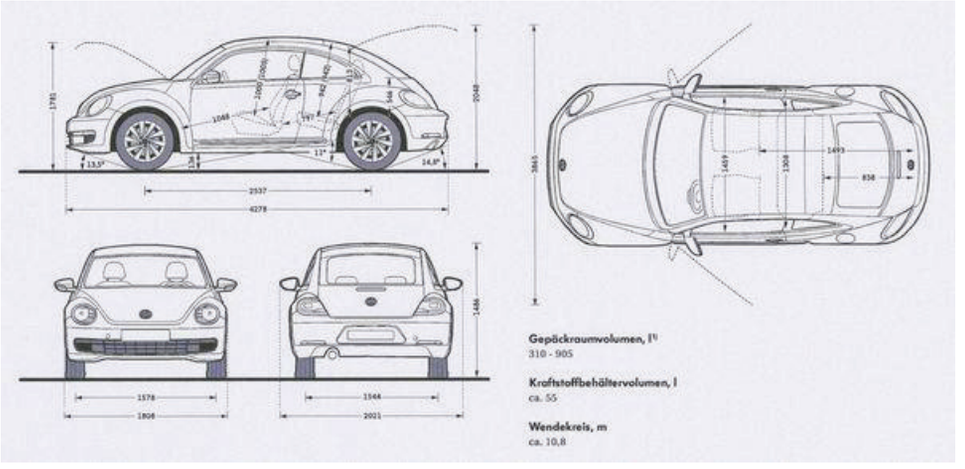

Figure 10. Computer-aided sketch [4].

Figure 11. Handmade model [5].

different characteristics, different ways, etc., the abstract concept is gradually associated with concrete objects, and the design process is gradually cleared and definitely expressed, as shown in **Figures 9** and **10**.

In terms of design evaluation, program selection, and optimization, based on the advancement and popularization of modern technology, computer-aided design and manufacturing technology can be fully utilized; digital models can be built with design sketches, and even 3D physical models can be obtained by using rapid prototyping technology, as shown in **Figures 11–13**. The model carries out product functional design, structural design, color design, human-machine interface design, etc. At the same time, according to the evaluation results, the digital model or physical model is optimized and improved through computer-aided design software and reverse engineering technology, as shown in **Figure 14**.

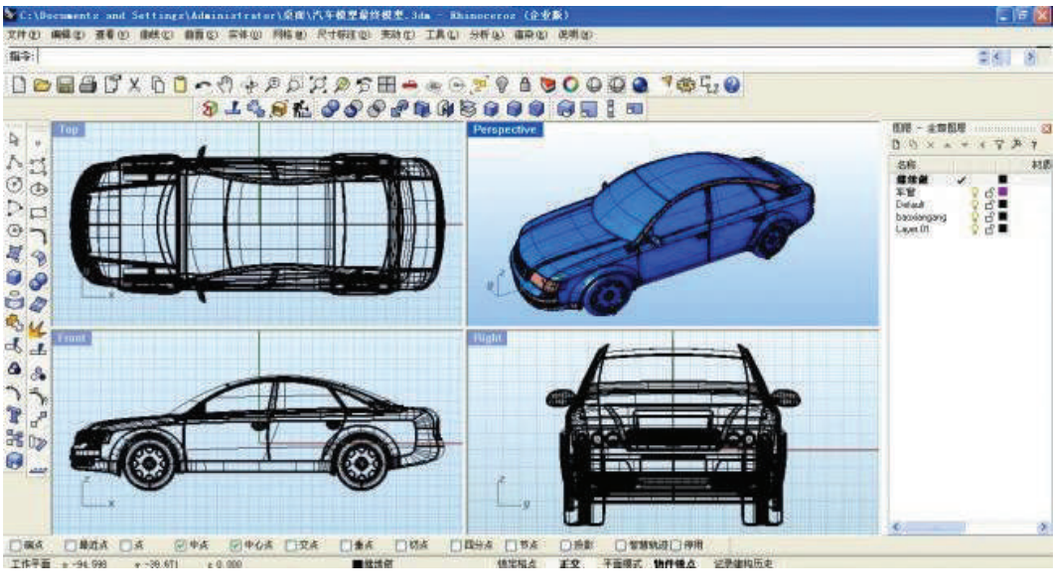

Figure 12. Computer-aided model [6].

Figure 13. Prototyping model [7].

Figure 14. Reverse scan [8].

3.5. The design output stage

The design output stage mainly refers to the expression of design results and the preliminary preparation for the following production. At this stage, through the design renderings, dimensional drawings, parts drawings, construction drawings, detail display drawings, structural drawings, etc., the design results are presented in a detailed and complete manner. Through this way, the above design work is closed and integrated on one the hand. On the other hand, these outputs also provide the basis for production and construction after the design phase.

4. Product design methods

In different design stages and target objects, the complexity of the steps is slightly different and so as the design methods involved. Generally spoken, blows are the common methods involved in the main four steps of product design.

4.1. Design survey

With the advent of the information age, the world has become smaller and smaller, and the acquisition of various information has become feasible and convenient. The factors that people choose products are increasingly influenced by the individual and the mainstream. At the same time, in the whole product design process, each step has a series of internal or external constraints. The design is just like "dancing with shackles." Every involved part needs information intervention and guidance and gradually coordinates, optimizes, and iterates so as to initiate better ideas and works. This factor makes the investigation and research at the beginning of the design particularly important.

Common survey methods include comprehensive surveys, typical surveys, and sample surveys. The main difference is the coverage of survey samples. When carrying out the survey,

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firstly, it is necessary to prepare for the whole investigation, determine its objectives, and clarify whether its form is inquiry, observation, experiment, or case, and based on preliminary analysis, formulate the basic ideas and problems of the investigation, and highlight the key points concisely as much as possible.

The second one is to conduct an investigation. This stage is the way to obtain information. Incorporate the survey objectives to determine the respondents, select appropriate survey techniques to determine the query items and design questionnaires, and then conduct a field survey in an orderly manner.

Finally, collate the survey results by analyses and research, draw into various forms, and then present analysis results of the survey, as shown in **Figure 15**.

At different stages of design, surveys are conducted around different surveyees, with different design goals and processes to make sure the final results are armed with comprehensive information feedback, so as to develop and create new products in a targeted manner.

4.2. Creating techniques

The creating technique is an important part to improve the design quality. It is a means to use the multi-directionality, the differentiation, the suddenness, the broadness, and the flexibility of creative thinking to propose new ideas. According to different classification criteria, creating techniques can be divided into different types. Such as according to the personality characteristics of the creative team members, the creating techniques can be divided into open speech and anonymous expression. The typical representative techniques are brainstorming

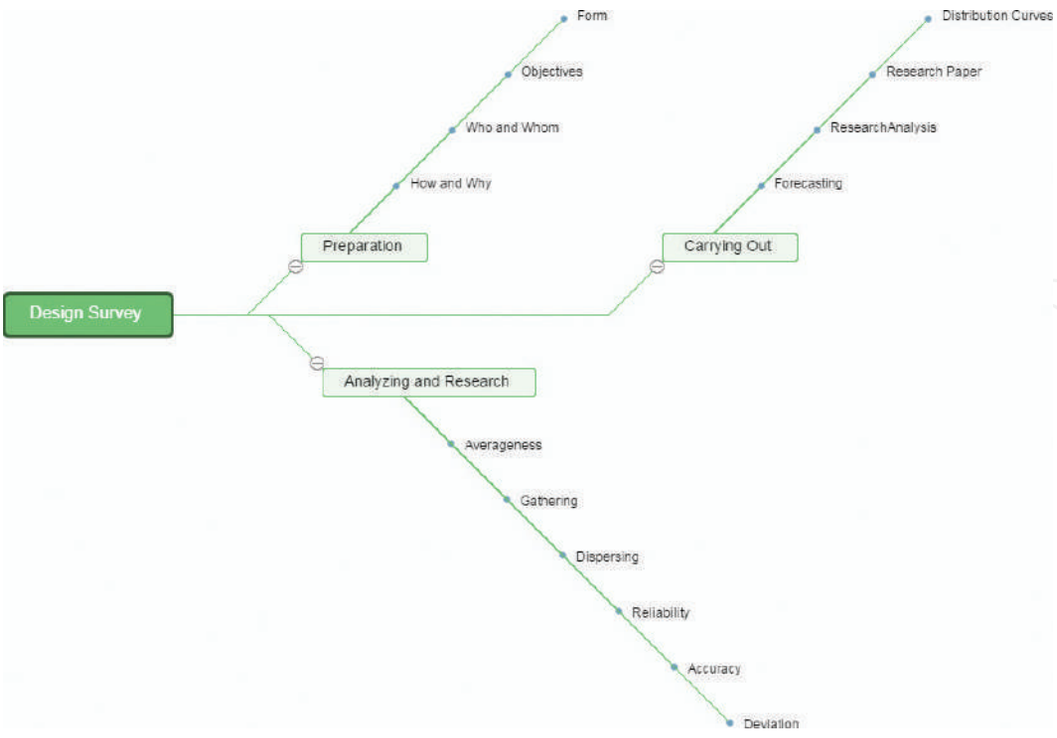

Figure 15. Design survey.

and 635 method. The former is free expression of team members, not bound to each other, and open to freedom. By this free style, the creativities of the group are stimulating, while the latter is to be silence in the whole previous period. Each one needs to avoid mutual interference and privately express their ideas in a recorded way. According to the nature of the creative proposal, it can be divided into active stimulating and passive stimulating. The typical representatives are the comprehensive method and enumeration method. The former uses abstract expressions to let the team members of different professional backgrounds associate with each other freely; the latter is based on existing objects, enumerate expressions and deep cognition one by one, and then use these expressions as sources of creativity. Flexible selection of different creative techniques at different stages of design is needed. As shown in **Figure 16**, it is a passive method by which we can make ourselves much more aware about the design purpose and processes after the relevant technique.

4.3. Product form design method

This stage of creating techniques is designed to complete the visualization process from design concept to product modeling. After completing the functional positioning of the product, the product structure and the later modeling design become the final platform for design creativity. Therefore, the product design method mainly includes the following three steps.

Firstly, decompose the product into individual parts according to the previous function and form positioning. Secondly, confirm the changeable parts of each shape. Thirdly, the changeable part is changed. Finally, recompose the relevant individual parts into a complete one, and select the best shape you evaluated. For example, a simple face will be a brand-new one

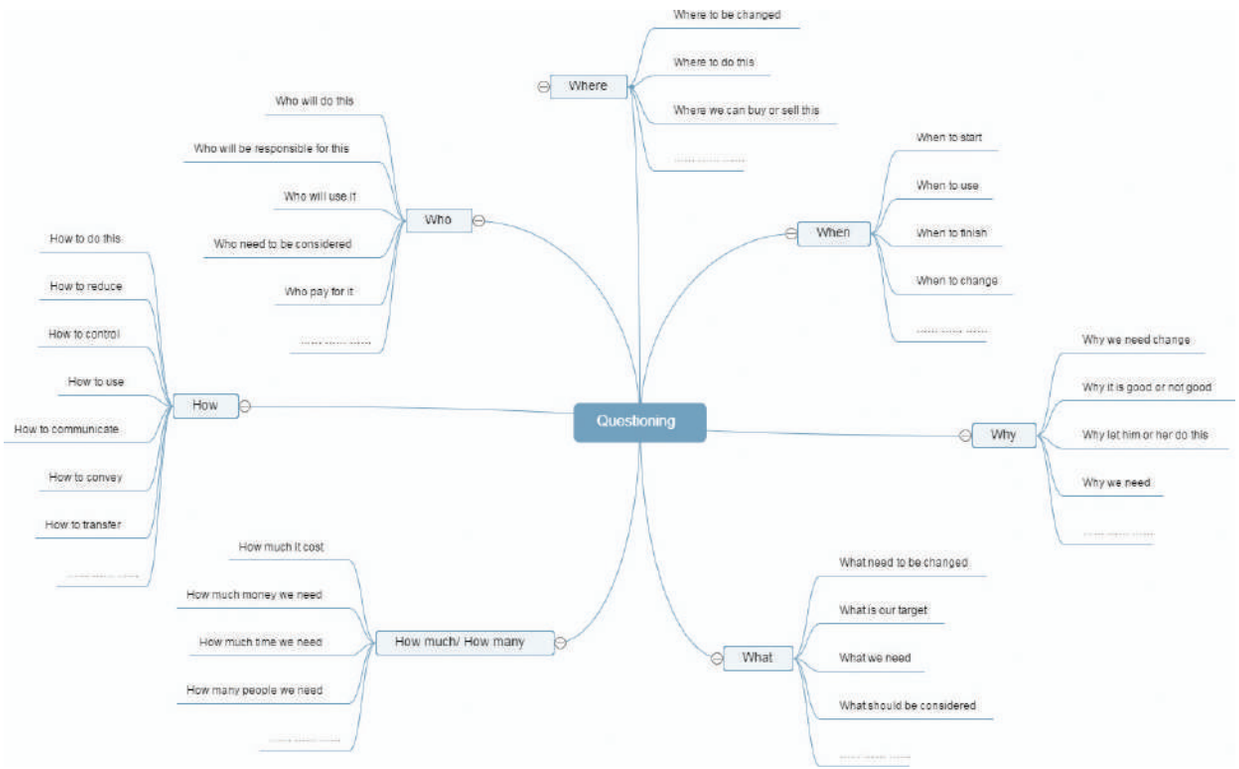

Figure 16. Questioning.

if we change parts of it, including face skin color and facial features and any other aspects. In principle, the number of new schemes is the same exponential power of the changeable part. As shown in **Figure 17**, the principle sum of the complete scheme is n^n.

4.4. Design evaluation method

Design evaluation is to compare and evaluate the solution to the problem in the design process, thereby determining the value of each program and judging its merits and demerits in order to screen out the best design. The meaning of "program" here is extensive and can be in various forms, such as principle program, structural program, modeling program, etc. From the perspective of its carrier, it can be a component or an overall drawing, or it can be a model, a prototype, a product, etc. In general, the "program" referred to in the evaluation is essentially the answer to the problems encountered in the design. The significance of design evaluation is to consciously control the design process, to target the direction of the design, and to assess the design plan with scientific analysis rather than subjective feeling, which provides designers with the basis for judging design ideas. Through design evaluation, the quality of design can be effectively guaranteed, and the best solution in which all aspects of performance meet the target requirements can be selected among many design programs. Secondly, proper design evaluation can reduce the blindness in the design and improve the efficiency of it. In addition, the applicative performance of evaluation can effectively verify the design plan, find out deficiencies during the process, and provide the basis for deeper design improvement.

In the actual evaluation process, due to the complexity of the design factors, the main influencing factors are generally selected. According to different design objects and different stages of the design, different evaluation objectives are determined, and the most appropriate content is selected to establish the evaluation target system. After selecting the evaluation items, the

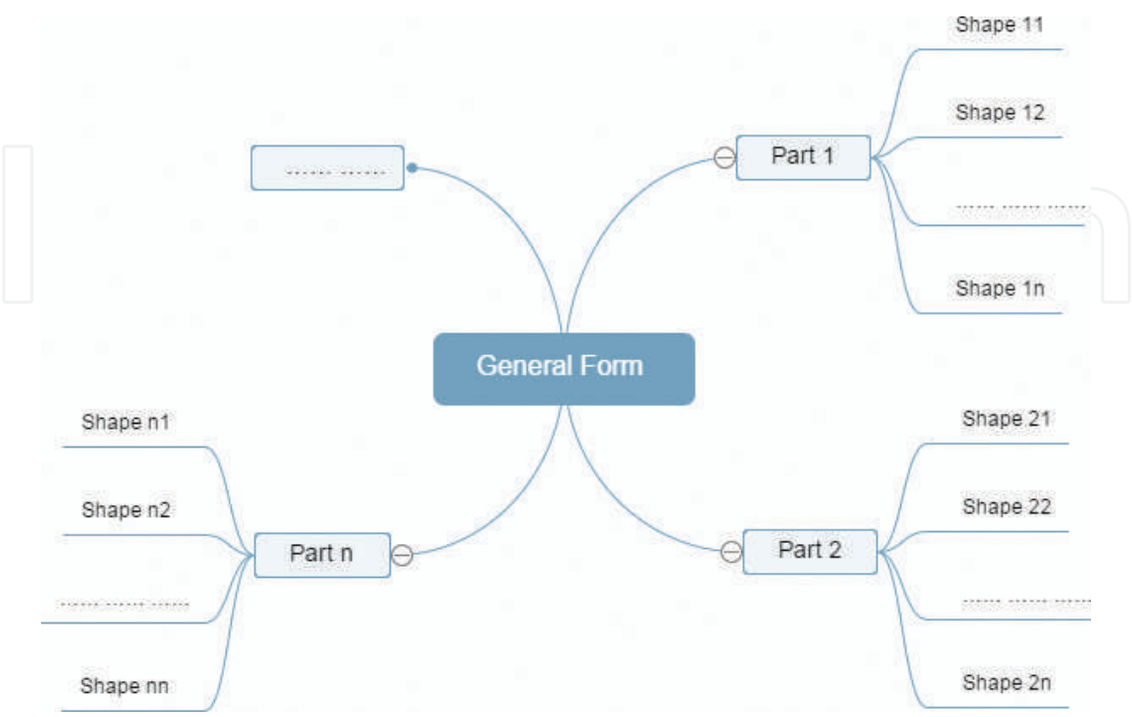

Figure 17. Questioning method in general form design.

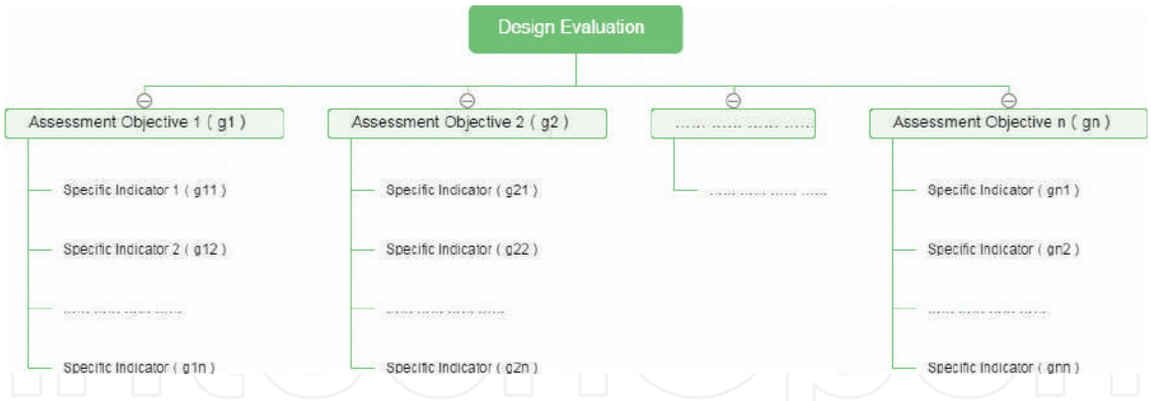

Figure 18. Design evaluation.

weighing coefficients are, respectively, set according to the importance of each evaluation item, and the entire project evaluation process is finally completed as shown in **Figure 18**.

5. Conclusion

The design procedure is the basis for guiding the steps of design process, and the design method is the guarantee for effectively developing the design process and improving its quality. A clear and reasonable process can lead to a simple and smooth way in the design, while the proper use of creating techniques can let the designer find a better way to solve the problems in a wider range, so as to develop and design a good product.

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Author details

Jinxia Cheng

Address all correspondence to: 414708353@qq.com

School of Software Engineering, Jiangxi University of Science and Technology, Nanchang, China

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