

The Study of the Innovative Design Method TRIZ on 3G Products

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Abstract A scientific design method is critical to the implementation of innovative product design. This article describes the definition of TRIZ, its basic principles and method, states basic definition, necessity, principles and procedure of 3G product development, performs analysis and study on the application of customer experience method from the TRIZ substance-field analysis theory in the process of 3G products design. It is expected that the TRIZ theory will be a very effective tool in the development of 3G products.

Keywords 3G product development, TRIZ theory, substance-field analysis, customer experience

1 Introduction

With the evolution of telecommunications technology from 2G to 3G, as for mobile communications carriers, the core competitiveness of an enterprise is innovative design capability of products. A long term study has been made on product innovation design, from the 1930s to 1980s, more than 300 types of innovation methods and more than 10 kinds of creation principles were emerged in the world. Through repeated practice and summarization, there are several common innovation methods as follows: the brain storm method, the SWZH method, the bionic association method, the listing category technique, the combination innovation method, the function design innovation method, the reverse design innovation method and so on.

Although these innovative design methods have made a breakthrough in constraints on relevant factors that restrict innovation to a certain degree from their respective angles, they have not formed a set of comparatively complete theory system, which cannot implement the overall process of product innovation systematically. For instance, it is easy for the brain storm method to obtain various kinds of innovation concepts, but it will also generate a lot of useless concept solutions, which will lead to a waste of resources, moreover the resolution of technical conflicts is lack of support from knowledge base. Therefore, various industries have a pressing need for systematic innovative design methods^[1]. As for innovation, it requires to make use of knowledge in a certain filed for identifying and solving problems. Having said such, are there any rules for innovation to follow? Are there any theories that can be used for guidance? The answer is affirmative. One scientific and advanced theory that is used by Russia, USA, Japan, Europe and other developed countries for guiding technical innovation, namely the theory of inventive problem solving (TRIZ), has been widely applied^[2]. To take hold of the TRIZ method, we have to understand the TRIZ theory first.

2 TRIZ Theory

The theory of inventive problem solving is established by Mr. G. S. Altshuller, an expert with Patents Bureau, Navy Department of the former Soviet Union (TRIZ is an abbreviation in Russian, whose English translation is Theory of Inventive Problem Solving TIPS), which is a kind of problem solving system built on the basis of technical system evolution rules. 8 modes of technical system evolution, 40 invention principles, 39 technical parameters, conflict matrix, standard solution to 76 inventive problems, inventive problem solving algorithm (ARIZ) and engineering knowledge effect base altogether make up the TRIZ theory and method system^[3].

2.1 The Theory of Technical System Evolution

The core of TRIZ is the theory of technical system evolution. Such theory points out that technical system is always in the process of evolution, solving conflict acts as the driving force for its evolution, evolution speed decreases with the resolution of general conflicts in technical system, the only method that leads to its mutation is to solve underlying conflicts that impede its evolution^[4].

Through the analysis of the world patent base, TRIZ study personnel have found and confirmed the evolution trend of technology from structure, namely technical evolution mode and evolution path. In

addition, they have found that technical evolution mode and evolution path summarized in one engineering field can be implemented in another engineering field, that is to say, evolution mode and evolution path have transferability. These modes and paths can guide designers to find new core technology fast. Technical evolution mode and technical evolution law are one concept, which reflects technical system, components, important, stable and repeating interaction between system and environment in the evolution process, therefore technical evolution mode and evolution law are universal. Likewise, the evolution from 2G technology to 3G technology also conforms to the technical system evolution theory.

2.2 The Essence of 3G Technology

3G is only one technical innovation of the telecommunications industry. After the adoption of 3G technology, when carriers provide existing products and service, their marginal costs are reduced undoubtedly. On one hand, technology and concept of 3G are all made by device manufacturers themselves, namely product innovation often originates from production departments of end products; on the other, from the view of innovation degree, 3G is a “quantitative” improvement to 2G and 2.5G other than “qualitative” breakthrough, since technical principles behind them are the same. It can be seen from the above analysis that 3G product innovation is the same with that of other products. As a result, being the same with the development of any other products, 3G product development also requires them to have a profound understanding of definitions and so on.

3 3G Product Development

3.1 Product Definition

Modern marketing believes that a product can be anything which can be delivered to the market and used for satisfying a certain kind of requirement or desire, including material object, service, location, organization, thought, creativity and so on. Similarly, a telecommunications product also has the above contents. All products have their lifecycle, also known as product lifecycle, which means all the periods experienced by a product from study and development, then entry into the market to growth and development until final exit from the market. Product lifecycle of every product is different from that of others, a typical product lifecycle is divided into four phases as follows: investment phase, growth phase, maturity phase and declination phase.

A new product is in a relative sense to an old product, which means a brand new product that is developed and produced by adopting new technical principle, new technical conception, or a product in which apparent change has occurred compared to an old product in one of structure, material, technology and other aspects or a combination of several aspects, consequently enhancing performance remarkably or expanding use function. A new product generally features advance, time effectiveness, uniqueness, cost effectiveness and multi-dimension.

A telecommunications new product is a brand new telecommunications product developed by mobile carriers to enhance enterprise competitiveness, raise service competence, satisfy ever-changing telecommunications demand of customers and increase market shares, which takes service product on the basis of the existing telecommunications network and device as its main expression mode.

3.2 Definition of Product Development

By development, it means to perform rational organization and scheduling of relevant factors so as to make full use of resources and expand application field. By new product development, it means the complete process of rationally combining product elements so as to obtain much larger benefits, including new product planning, activities of a new product from creativity to trial production, production and sales, product brand planning and other aspects. New product development must pay equal attention to technical factors and market factors.

New product development belongs to long term strategic decision-making of an enterprise, being an important constituent of its operation strategy decision-making. As for mobile carriers, it even relates to their existence and development, therefore it is very necessary. To grasp opportunity and not be lost in direction will require mobile carriers to strictly abide by product development principles.

4 Product Development Principles for Mobile Carriers

The process of new product development is a very complicated system engineering, relating to a very broad range of aspects, requiring to spend a certain amount of manpower, financial and material resources, and being time constrained, and there is no exception for new products of mobile carriers, therefore the following principles must be abided by in the new product development process of mobile

carriers .

4.1 Basic Principle

Namely, when mobile carriers develop new products, they must obey the national laws and regulations, economic policies, expense habitude, social psychology as well as social development trend, conforming to the national industrial policy.

4.2 Stability Principle

When mobile carriers develop new products, first they need to set up stable development institutions, organizations and implementation system, performing well technical and economic analysis of certainty and uncertainty, applying assessment methods and the success and failure analysis theory to study in all-around manner, trying to reduce and avoid any uncertain factors, and enabling various tasks to move forward along a predetermined direction.

4.3 Hierarchy and Integrity Principle

When mobile carriers develop new products, they must follow the principle of hierarchical design, hierarchical analysis and hierarchical optimization from simplicity to complexity and from low to high. Namely, as for internal development and design of products, they have to set up an integral concept, any local development has to follow the overall requirements of such products. In addition, the development of an individual product has to conform to the general strategic development requirements of mobile carriers.

4.4 Sustainability and Interaction Principle

It is rather rare for new product development to stay still, since the market, environment and other external conditions always change, therefore in the process of product development, they have to adjust development steps in a continued manner according to change over actual conditions, continuously study and establish a kind of interactive relations with main concerned parties of interest, making new product development to accommodate to changes over the mobile carriers market and customer demand, only by doing so can new products finally launched not be disintegrated with the market and can they succeed in the market.

4.5 Advance Principle

When mobile carriers develop new products, they have to make full use of their own technical advantages, talent advantages and market advantages, finally transforming such advantages into advantages of new products. As for new products developed, they should be situated in the upstream of the mobile carriers market in terms of technical contents, business concept and delivering service, having a certain level of forward-looking feature. New products not only have to accommodate to the tide of the mobile carriers market but also guide the direction of market development.

With the help of product development principles, but how to succeed in 3G product development, it requires mobile carriers to follow 3G product innovation rules, which are the 3G product innovation procedure.

5 3G Product Innovation Procedure

3G product innovation procedure consists of 8 phases as follows: looking for creativity (conception), screening of creativity, formation of product concept, working out marketing planning, commercial analysis, product development, trial sales in the market and making available in the market in batch, as shown in Fig. 1 below.

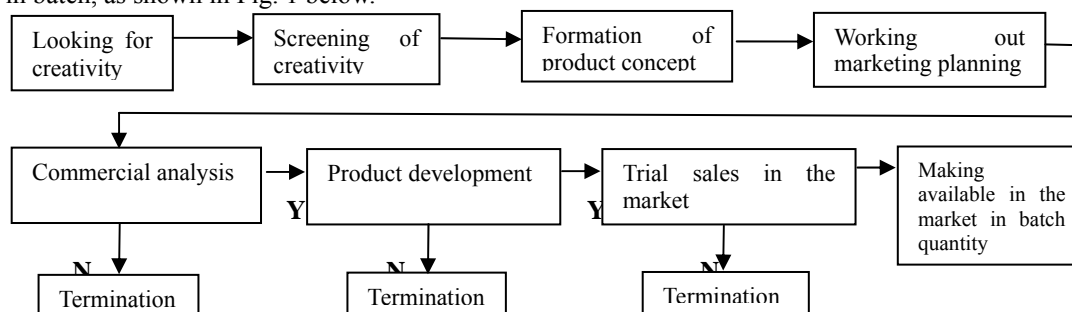


Figure 1 3G product innovation procedure

With the 3G product innovation procedure, this only indicates that we have a basic path diagram

for product innovation, it also requires specific tools and methods to be successful, the substance-field analysis theory of TRIZ has a very good application here.

6 The Application of the TRIZ Substance-Field Analysis Theory in 3G Product Innovation

6.1 The Substance-Field Analysis Theory

Solving technical contradictions requires finding accordant invention principle through contradiction matrix, then making invention and creation according to such principle. However, only by determining the type of technical contradiction can we find corresponding invention principle in the matrix, which requires experience and power of judgment of working personnel in such process, but it is unable to determine the type of technical contradiction in many unknown fields, therefore we need another tool to guide us in finding the type of technical contradiction, then the TRIZ theory has also introduced substance-field model. The substance-field model is an important problem description and analysis tool in the TRIZ theory, which is used as a function model for building up relations with the already existing system or new technical system problems. In the process of problem solving, we can look for standard solution and general solution corresponding to a problem in accordance with the substance-field model analysis.

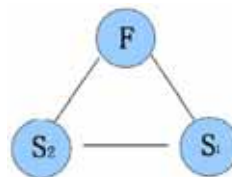


Figure 2 Scheme of the substance-field analysis theory

The substance-field analysis is a tool in TRIZ for establishing model for relevant problems in the existing technical system. A minimum unit in a technical system consists of two elements and energy transferred between such two elements so as to execute a function. Altshuller defines the function as interaction between substance (element) and field (energy) acting on them, as shown in Fig. 2 above, namely, the generated output (function) as a result of Substance S2 acting on Substance S1 through Energy F.

The so-called function is normal relations that are expected to exist between system output and system input.

We can define one function: $y = F(x_1, x_2, x_3, \dots, x_n)$, whereas y expresses output, $x_1, x_2, x_3, \dots, x_n$ indicates input, and Function F is function. We can also describe function in a rather popular language, namely function is the process of solving problem using method.

In the TRIZ theory, there are three pieces of law for function:

- (1) All functions can be finally broken into three 3 basic elements (S1, S2 and F);
- (2) One existing function definitely consists of 3 basic elements;
- (3) An integral combination of 3 interacted basic elements will shape up a function.

In the 3 basic elements of a function, S1 and S2 are specific, namely "substance" (we generally use S1 for raw materials and S2 for tools); F is abstract, namely "field". This makes up the substance-field model.

S1 and S2 can be material, tool, component, man, environment and so on; F can be mechanical field (Me), thermal field (Th), chemical field (Ch), electronic field (E), magnetic field (M) and gravity field (G)^[5].

Likewise, user-centered design (UCD) is a good application of the substance-field analysis theory in the development of 3G products.

6.2 User-Centered Design (UCD)

Communications products are a kind of product in which sense of hearing and visual sense take a very great part, therefore users pay much more attention to experience process of a product. Based on customer experience, there exist three aspects allowing users to perform interacted UCD with development and design personnel in various links of product development: first, listen carefully to the voice of customers, enabling customers to take part in the early stage process of product development, paying sufficient attention to user demand and experience in the demand mining phase. Second, introduce the availability testing (consumer testing) link, making tests of a product prior to its launch into the market in such aspects as its function, technology and customer experience, observing whether

or not there are any problems. Third, apply professional psychology and methods from availability engineering, making analysis and observation over users, analyzing their inherent demand and experience from their facial and eye expressions, movements and conversation [5].

In our case, S1 is a well-inclusive network system of mobile carriers including mobile terminals, S2 is terminal handset users, mobile carriers allow their products to satisfy demand of end users through the use of the UCD method, F is product field that is delivered from mobile carriers to end users through such well-inclusive network system and can bring about profits.

UCD product development flow is a process of establishing this kind of substance-field, which covers all phases from product creativity to product launch in the market and to the use of products by users, of which it includes user demand mining phase, prototype design phase, availability testing phase, negative customer experience phase (refer to Table 1) [6].

Table 1 UCD product development flow

Phases	Main Contents	Tools and Methods
Demand mining phase	Analyze target user groups, mining potential demand of customers through quantitative and qualitative investigations .	Scenario diary method, in-depth interview method, on-site survey method, user role model and focus symposium
Prototype design phase	Perform structural analysis of customer demand and product function design. Transform abstract product concept, technical performance and specifications into specific product prototypes and use scenarios.	Card classification method, interactive design, UI design, flow design and information architecture
Availability testing phase	Conduct availability tests on product prototype, allowing products to match with use habitude of customers in such aspects as appearance and color, function design and menu operations.	Body movement analysis instrumentation, eye movement analysis instrumentation and mission analysis
Negative customer experience phase	Study feedback information from customers, improve the available products, find new demand, obtain optimization and innovation thoughts of service and products, and enhance customer satisfaction.	Quantitative visits and text mining

Performing product availability testing with the help of related principles of UCD can enhance application efficiency of users, reduce error rate and use failure rate, decrease learning costs of users meanwhile creating healthy and comfortable use experience, this is the internal essence of finding out S2 (end user) demand so as to lay a solid foundation for smooth launch of new products and bringing about abundant profits for mobile carriers.

6.3 Analysis of a 3G Product Development Process Case

China has performed construction of TD-SCDMA trial network since 2007, offering 3G service through the TD-SCDMA network with independent IPR. In the process of 3G service innovation, the carrier has applied the substance-field theory and UCD method. First, it made investigation and analysis of customer (S2, material) demand and user group characteristics, knowing that the demand of customers for 3G mainly focuses on real time demand for mobile video, multimedia and large file sharing. It decided from various service schemes that in the preliminary phase of network construction, it will launch 4 types of 3G new services (F, field) for users using large capacity 3G wireless broadband and terminal (S1, material): video message (adding the picture of the person who leaves a message to the voice of such person), multimedia ring (similar to MTV, a user can hear multimedia ring during connection establishment meanwhile being offered with relevant pictures), video sharing (a user can record DV and other multimedia files at any time, sharing with the receiving party through transmission over the 3G network), videophone (both parties can hear each other while viewing the image of the opposite party in voice communications). After the business was launched, China Mobile made a publicity of 3G multimedia service through TV ads and other forms, and conducted trial commercial operations of service broadly in 8 cities including Beijing by adopting complimentary call expenses and other offers. During the trial commercial operations, it solicited experience feedback

comments from customers about 3G service on a regular basis, and made improvements in such aspects as video-audio synchronization, service time delay and picture quality according to such feedback, and obtained better customer satisfaction. As for the innovation of these 4 types of service, it made full use of 3G high speed data network to satisfy the actual demand of users for multimedia communications, having met their requirements for work, life and entertainment; in various links of service innovation, it was always ready to hear about and analyzed customer experience, making 3G service to find their way into users fast. 3G service innovation has injected new vigor into its development.

7 Conclusions

Currently, extreme attention is being given to the TRIZ theory in the industrialized countries in the western world, the study and practice of TRIZ has been popularized and developed fast. Up to now, it has given substantial benefits to various renowned enterprises.

Practice has proved that the application of the TRIZ theory can not only speed up greatly the process of creation and invention of the people but also obtain high quality innovation products. It can help us systematically analyze problem scenarios, fast find the essence of problem or contradiction; it can precisely locate problem exploration direction, will not miss various kinds of possibilities, moreover, it can help us make a breakthrough in thought impedance, break away from regular thought tendency, analyze problem with a new visual sense, make logic and illogic system thought. In addition, it can also predict the future development trend according to technical evolution rules and assist us in developing competitive new products.

We are confident that with the in-depth exploration and practice of TRIZ product development mode in 3G product innovation, it will provide much better products and service for mobile communications users.

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