Development Trend Analysis of Automobile Electronic System

ZhiRong Fan, Ying Xie, Cheng Yang, Yipeng Zhang and Jian Chen

Abstract *Research and/or Engineering Questions/Objective*: This chapter, based on the technology evolution theory, reviewed present situation of the automobile electronic system technology, based on this prediction that the electronic system in function, structure and new technology development trend. *Methodology*: Using on the S curve and technology evolution method based on TRIZ analyzing theory, also vehicle electronic system of china own brand passenger car, this chapter analyze developing tendency of vehicle electronic system with lamps, instrument, auxiliary parking, bus network. *Results*: Through a systematic analysis, the result of developing tendency of all the electrical and electronic systems is developed. *Limitations of this study*: As in short this chapter, development tendency of complete vehicle electronic system and specification of china own brand passenger car is not fully covered. What does the paper offer that is new in the field in comparison to other works of the author: This chapter analyzes the development of electrical and electronic system, by adopted S curve theory and technology evolution method based on TRIZ theory. *Conclusion*: Through the analyzing S curve of electrical and electronic system, a conclusion can be drawn that the electrical and electronic system will evolved towards platform, intelligent, and integration. The electronic specification of China own brand passenger car still has certain distance behind the frontier, yet still has a huge opportunity of development.

Keywords Electronic system · Technology evolution · Developing tendency · S curve · China own brand

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1 Introduction

As a combination of electronic industry and car industry, automotive electronic is developing rapidly. At present, the western developed countries have account 15–20 % of electronic products manufacturing, when many characteristic functions are realized by the dependent of automobile electronic technology [1]. Automobile electronic not only promoted the development of the car industry, it also greatly promoted the electronic product market. Modern automobile electronic technology has shown an irreplaceable role in improving automobile power, safety, reliability, driving stability and comfort.

At the same time, customers are more and more rational about function and performance requirements, regulations show increasingly harshness on reliability and quality, cost-down target is classified to design and development, manufacture, as well as the after-sales service, and in order to preemption market opportunities, the research and development time cycle is compressed. Based on the above factors, every famous carmaker is studying the development tendency of electronic system, to help research department developing electrical and electronic architecture platforms, at the purpose of reducing development cycle as well as development costs.

2 Analysis Methods

2.1 The S Curve of Technology Evolution

The evolution of technology system is not random, but to follow certain objective law, like the evolution of biological systems, technology system also is facing a "natural selection".

The S curve is developed by analyzing massive products. The product performance parameter evolution over time in law of S form curve, any product development process will experience the baby period, youth period, mature period and decline period, as shown in Fig. 1. Each product has its own core technology, in narrow sense the core technology is through the physical, chemical and geometry. If ever a new core technology substitute appears, two kinds of situations will appear as the following:

(1) The new product will top existing product performance limit in performance;
(2) The new products will exceed the original product at a higher rate and with lower prices, therefore the substitution process of product is also the substitution process of core technology, as shown in Fig. 2.

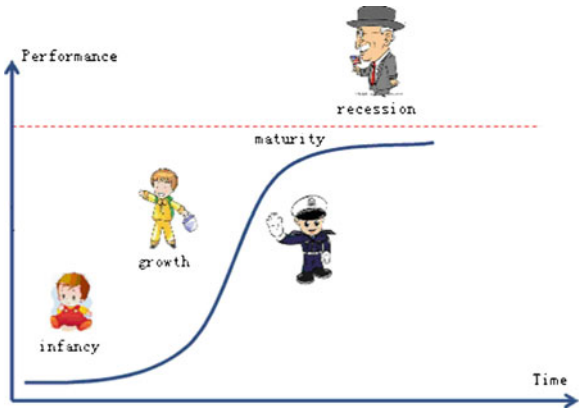

Fig. 1 S curve of technology evolution

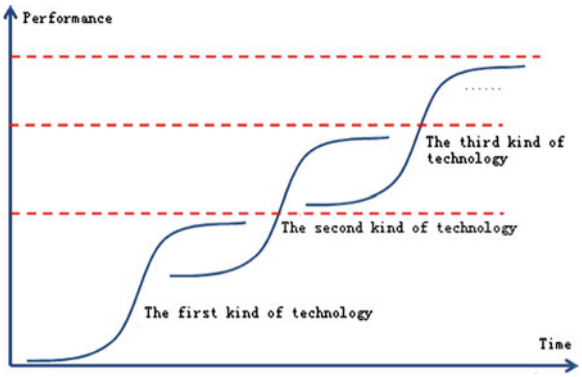

Fig. 2 S curve of product substitution

2.2 Technology Evolution Rule

Technology system evolution theory is based on analyze historical data of a lot of the world patent and other technical engineering system. It is concluded by G. S. Altshuler the founder of TRIZ and other TRIZ experts. It mainly embodies in the process of technical system corresponds functions, technology system improvement and development tendency. In the classic technology evolution theory of eight different kinds of technology system evolution rules [2]: completeness rule, energy transfer rule, improving ideal rule, dynamic evolution rule, subsystem unbalanced evolution rule, micro level evolution rule, super system evolution rule, using evolution rule.

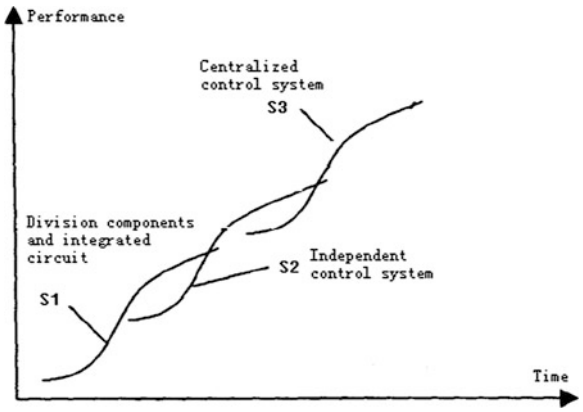

Fig. 3 S curve of automobile electronic system evolutions

3 Electronic System Evolution Analyses

3.1 Electronic System Overall Development Analyses

Automobile electrical system is an important part of the car, which has one of the performances of a direct impact on the car of the power, economy, emission, comfort and so on. Automobile electric development has three stages, first is automobile electronic products build by division components and integrated circuit, which has been eliminated now. Electronic devices from the scale integrated circuit to large scale integrated circuit, promote the rapid development of automobile electric product, which developed some special independent system, such as electronic control gas injection, antilock brake systems, and each system is linked through the hard wire, which is complex and inconvenience in maintenance. In order to perform a variety of functions of the comprehensive system and centralized control of vehicle integral system, there was such centralized control system as body control system and video entertainment system. Using one controller to focus on the control, each system will communicate buy network bus. As shown in Fig. 3.

3.2 Lighting System

The source of the light from the original system of tungsten lamp to improved halogen lamp, then to xenon headlamp, until the fourth generation of LED light source, new light source performance continues to improve, as shown in Fig. 4. The lamps periphery system development is mainly in headlight intelligent and

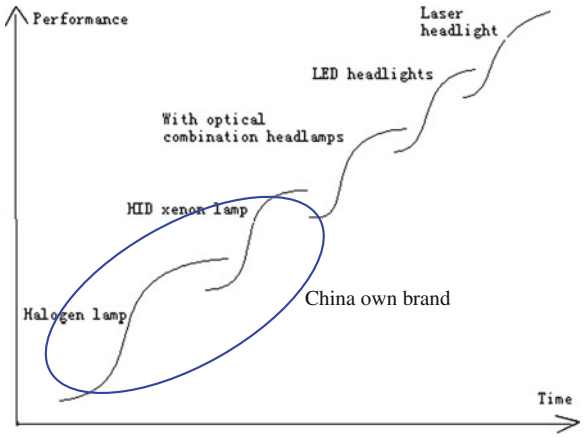

Fig. 4 S curve of light lamps system

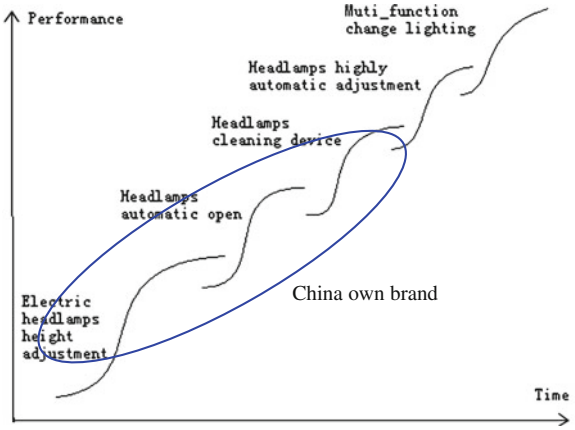

Fig. 5 S curve of the development of the peripheral lamps organization

energy conservation, especially the AFS system and other humanized design, the headlamps controller work in different environment and conditions to control the front combination lamp, so as to achieve the purpose of safe driving, as shown in Fig. 5. From the Figs. 4 and 5 can be seen that the china own brand passenger car brand is still in the HID xenon lamp and headlight cleaning device, the next step is the development of the headlights with optical waveguide and AFS system.

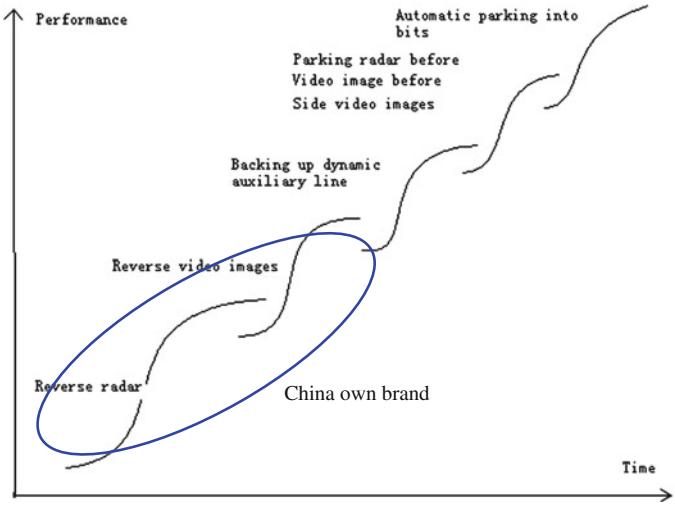

Fig. 6 S curve of the parking assistant system development

3.3 Parking Auxiliary System

The most basic of parking auxiliary system form is single reverse radar, after that, video system was also used as parking assist device. As the continuous improvement of the car safety requirements of customers, parking assistant system becomes more and more important, and move to the all-round, detection means development, such as the front anti-collision radar, backing up dynamic auxiliary line, video image, side video images and automatic parking, its development curve as shown in Fig. 6. We can see from Fig. 6, at present the china own brand passenger cars are still in reverse video image stage, the next step should be reverse dynamic auxiliary line function.

3.4 Instrument System

Today, most of the car instrument used digital processing technology. Typical applications are the stepping motor instrument, all kinds of digital instrument and LCD display information. From 3 in dot matrix screen to 7 in TFT color LCD screen, make meter visual tonal of drivers improved. Display information is more intuitive and easy to read. Recently, two to three years, full LCD screen appeared in the luxury car meter part and concept car, let instrument displays and interface entered a new area that, through the display screen, driver can see reverse images, map navigation, night vision displays, mobile TV etc. In the future, the meter will become information processing and display center. Through the instrument

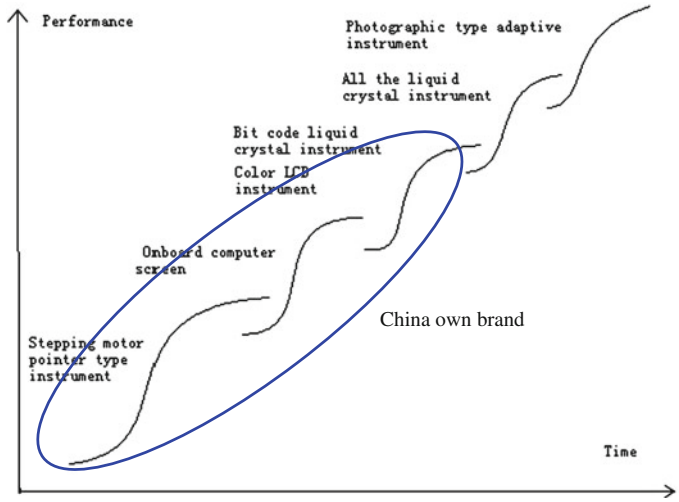

Fig. 7 S curve of combination instrument system development

information platform, drivers can not only understand the state of the vehicle and situation around the vehicle, but also through the intelligent Internet technology, understand the traffic and driving with relevant information. The development course is shown in Fig. 7. We can see from Fig. 7, the china own brand passenger car uses color LCD screen, the next step will be equipped with full LCD instrument.

3.5 Network Communication Technology

Currently popular car bus: CAN, LIN, MOST, FlexRay, Bluetooth etc. CAN/LIN network is mature technology, low in cost; within the next 5 years, CAN/LIN network is still the mainstream of network technology; Very few luxury cars will use FlexRay bus; MOST are mainly applied in navigation, multimedia systems. As shown in Fig. 8, we can see from Fig. 8, at present the china own brand passenger car uses the combination of the network CAN/LIN, the next step may use FlexRay bus technology.

The communication network topology is of two kinds: single segment and multi-segment structure, with the improvement of car, electrical function increasing and the interaction between controller signals increasing, from single segment to many segment is an inevitable trend.

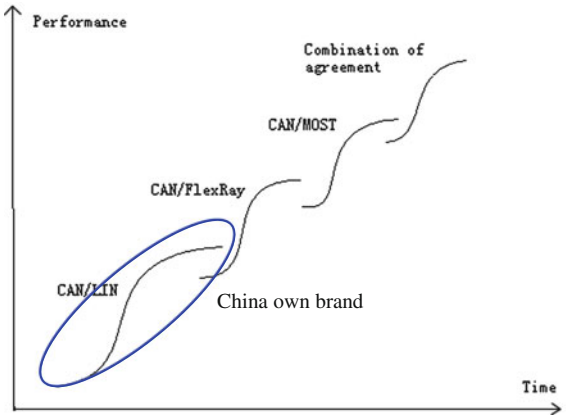

Fig. 8 S curve of the network communication technology

4 The Technology Evolution Analysis of Car Electronic System

Along with the computer technology, information technology and electronic technology, new materials and new technology advancing, automobile electric appliances product is also developing rapidly. More humane and intelligent automobile electric appliances will bring people more convenient and joy.

Using the technical system evolution theory to analyze the electronic technology using trend, in conclusion, automobile electronic system development trend will mainly embodied in the following aspects:

(1) EEA platform

Based on the existing models, combined with the next 3–5 years electronic technology development trend, construct the relatively complete electronic function architecture, which has good expansibility portability and terrace of electronic structure foundation, makes different models design engineers to work under one platform according to different demands, save the development cost, shorten the development cycle, ensure the development of electric vehicle quality.

(2) Network

At present CAN/LIN network is a mature technology, low in cost. Within the next 5 years, CAN/LIN network will still be the mainstream of network technology, very few luxury cars will use FlexRay bus, MOST are mainly applied in navigation, multimedia systems.

CAN network has been widely used in the development of domestic and foreign oem models, will still be the mainstream technology, and with the improvement of car configuration, electrical function increasing, and the interaction between

controller signal increases, single segment to multi segment of the development is an inevitable trend. At the same time the Internet technology, optical fiber, Bluetooth technology and network technology will also be applied largely to cars, and further improving the car networking.

(3) Intelligent

Smart sensors and actuators, car level micro-processing technology have developed rapidly, the new control theory and method of usage has made car electronic, digital and intelligent become mainstream car engineering.

Intelligent main is the adaptation to the change of environment and. In this state, oems need environment sampling information, such as AFS technology, biological recognition technology, automatic parking technology, etc. In order to meet the market growing demand, oems will improve the intelligent of future products, using AFS, Telematics and other new technology.

(4) Modular/integration

Through the integration to add control system function, which also divide function into several separate set function. Such as meter integrate gateway functions, which can realize the combination of the display and message routing, will combines the instrument panel and control module, make its have universal; Distributed car body control system, using one BCM and multiple units module, may provide more function, better meet body control function of humanity, comfort and safety requirements.

5 Summary

With the rapid development of industry, automotive technology is developing towards environmental protection, energy saving, sustainable development, humanity, intelligent, high technology, function integration and other development direction. Through S curve analysis of the electronic system, and technology system evolution analysis, it can be concluded that the electronic system will change towards the platform, network, intelligent, module/integration development direction, China own brand passenger car still has certain distance behind the frontier, yet still has a huge opportunity of development.

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