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Teaching Case

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The Technological Innovation Journey of Hisense Group

Abstract This case illustrates key innovations that took place in Hisense Group, one of the leading companies in the electronic appliances industry in China, from 1990s to 2010. Several factors contributed to its leading position, including strategic positioning, consistent technological innovation over decades, and an efficient administrative system. Since 1992, Hisense has paid close attention to technological innovation. It makes it clear that R&D plays a dominant role in competition. Hisense has continuously invested heavily in R&D and restructured its R&D administrative system, including the organizational framework, incentive mechanisms, project management and teamwork. Hisense's strategy has resulted in major technological innovations. Hiview chip is a technological breakthrough, which helps the company gain competitive advantages.

Keywords Hisense, technological innovation, process orientation, Hiview, China

On December, 31st, 2005, Mr. Houjian Zhou, the chairman of Hisense Group, was nominated as a Distinguished Figure in China's Economic Development by

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China Central Television (CCTV). In his speech at the awarding ceremony, Zhou said, "This chip in my hand is the first high-definition digital chip made in China, and it can be produced in a large scale. More importantly, the technology is created on our own. It means that the intellectual property right of this chip belongs to us. The technology is developed by a group of young people over the past five years. Previously, China manufactured over 70 million TVs annually, yet none of these 70 million TVs had a domestic chip. Now, this team of young people from Hisense has made history."

Chips play a vital role in the information industry. The chip manufacturing industry is referred to as the "vital industry" or "food for industries." Over the years, the United States and Japan have been the world leaders in chip design and manufacturing. Naturally, the industries of electronic information product in these two countries are well developed.

China has been the largest TV sets producer in the world since 2004. There are 68 TV manufacturers in China, with a total annual production capacity of 88.6 million units and actual output of 73.3 million units. However, almost all the video processors, the heart of a TV set, were imported. Statistics from the Ministry of Commerce of China show that imported chips amounted to $41.67 billion in 2003. But only 3% of the chips were made in China, and none was designed in China.[1] As a result, China is the biggest TV manufacturer in the world, but not an important TV designer or technology leader.

In June 2005, Hisense changed the history. The birth of Hiview chip signifies the country can produce digital video processors of its own. Since then, China-designed and China-made "hearts" have begun to beat in more and more Chinese TVs. How did Hisense make such an inspiring breakthrough?

1 Development of Hisense

Hisense was set up in 1969 in Shandong province. Starting with only 10 people, the main product at that time was semiconductor radio. In 1970, Hisense sent technicians to other TV manufacturers to learn technologies on TV production. Before long, the factory successfully assembled the first 14-inch black-and-white electron tube TV in Shandong. In February 1979, led by the Qingdao Economic Commission, Hisense completed mergers with three other businesses and

[1] See Chi (2006).

changed its name to Qingdao TV General Factory (QTVGF).

Since the reform and opening-up in China in 1978, more Chinese families could afford TVs. Under such a circumstance, Hisense's change from radio to TV manufacturing turned out to be a great success. The annual production value reached 2.5 million yuan. Besides, the number of employees grew rapidly to 835 in 1981.

On June 11th, 1984, QTVGF started to cooperate with Panasonic Company. The purpose was to learn advanced technologies from Japan. Three technicians were sent to Panasonic to learn color TV designing and manufacturing. They later became the cornerstones for Hisense's R&D. On December 26th, 1984, the factory produced its first 14-inch color TV, and the annual sales volume reached 37.48 million yuan that year. The factory soon became the leader in China's electric appliances industry.

In 1992, Zhou was appointed as the managing director of QTVGF. Under his leadership, the company made explicit strategies as follows: to solidify the leading position in TV manufacturing industry, and to pursue diversification in the electric appliance industry, including electronic appliances, information technology, and air conditioning.

In July, 1994, QTVGF restructured itself as a group company, and changed its name into Qingdao Hisense Electric Appliances Company, consisting of seven wholly-owned subsidiaries, seven holding companies and several joint ventures.

After decades of development, Hisense has become a giant company. It ranks the top in terms of innovation in China's electronic appliance sector, including many patents concerning digital multimedia technology, communication technologies and intelligent information system technologies, etc. Hisense has also entered into a number of different industries, including multimedia, electric appliances, communication equipments, real estate and service, etc. Two of its subsidiaries, namely Hisense Electrical Co., Ltd, and Hisense-Kelon Electrical Co., Ltd, are public companies. Recently, Hisense has begun its globalization. Fifteen overseas branches have been established across the world, such as Creative Production Centers in South Africa, Egypt, Algeria, etc. Hisense products are sold in over 130 countries and regions. In 2010, the sales volume of Hisense reached 63.7 billion yuan, ranking No.1 in Top 100 electronic & information technology enterprises in China.[2]

[2] Data obtained from the website of Hisense group, http://hisense.com.cn

2 China's Color TV Industry

In the early 1980s, Chinese companies started to produce color TV sets of their own. Changhong Company imported the first color TV production line from Japan in 1980. After that, many domestic TV factories followed suit. At the beginning of 1990s, there were about 120 color TV production lines in the country. In 1995, the installed production capacity of color TV reached 44.76 million sets, while only 20.58 million sets were produced, and less than 20 million sets were sold.[3] Thus, the capacity utilization was only 46.1% in 1995, indicating a huge waste of production capacity. In spite of all that, domestic TV enterprises were still busy in importing TV production lines from abroad. At that time, preserving a large amount of production capacity was regarded as a great business success. It was often used as a criterion of market competitiveness. By 1998, the nationwide production capacity redundancy of color TVs reached as high as 15 million sets per year.[4]

The redundancy gave rise to cut-throat price war among color TV manufacturers. In 2000, the average price of TV sets decreased by 15.6%. The profitability of color TV industry dropped sharply, which, in turn, forced some companies to exit from the market. By 2000, only about 30 color TV manufacturers survived (from about 97 manufacturers in 1997). In 2001, the price of color TV dropped another 18%, most of color TV manufacturers suffered heavy losses.

However, the other side of the story is that competitive and innovative TV manufacturers gained more market shares by accelerating their technological innovation. For example, Changhong made a fortune with its high-definition RPTV, so did TCL with its Hid Series and Hisense with its ITVs. These new gadgets won popularity among consumers. As a result, the top five TV manufacturers, also the most innovative ones, including TCL, Konka, Changhong, Skyworth and Hisense, expanded their market shares quickly from about 47.16% in 1997 to 59.03% in 2000.

By 2002, TCL, Konka, Skyworth, Changhong, Hisense, and Haier ranked top 6 in the industry, occupying about 65.7% of the market share. These leading companies all invested heavily in R&D, own rich production lines and developed marketing & distribution channels. A consensus among these leading TV

[3] A number of which were imported color TV.
[4] Data obtained from CEI's Statistical Data Bank.

manufacturers was that high-tech, high-definition, digital color TV would be the future of the industry.

By 2005, both production and marketing in color TV industry kept thriving, as a result of the introduction of high-end flat TVs, like PDP TV, LCD TV and new generation of PJ TV. These new products created new demands. With favorable price, excellent quality, and large screen, LCD TV soon became the new norm in China's color TV market. In the same year, the sales of flat TV surpassed traditional CRT TV and became the most popular products in electric appliance retail market. Meanwhile, the market concentration ratio of flat TV manufacturers kept rising. In 2005, top 5 domestic brands captured more than 70% of market share.[5] Meanwhile, Chinese TV manufacturers started to enter the global market, China-made color TV amounts for about 50% of the global market.

In 2009, a market survey conducted by Display search, a famous market research organization, showed Chinese enterprises seized 54% market share in the flat TV market in the world, while the market share of the foreign brands such as Samsung, LG, Sony, Panasonic and Sharp dropped rapidly.[6] In fact, these giant foreign TV makers have lost their dominating power over the LCD market in China since 2008.

Flat TV and related technologies have played important roles in the reshuffling of the TV market in China. Nowadays, digitized, high-definition, networking become the new norms of TV industry. New functions and technologies spring up like mushrooms, such as Internet TV, LED Backlight LCD TV, 3D TV. In March, 2009, Internet TV, a new internet-based multimedia terminal, occupied about 10% share of national color TV market. In addition, LED Backlight LCD TV was also welcomed by the market due to their brightness, environmental friendliness and ultra-thin width. According to the retail monitoring data published by CMM on December 2009, LED Backlight LCD TV has been developed rapidly since it came into market in May 2009. Its market share reached up to 10% within a short time. Besides, 3D film and upstream panel manufacturers brought a fashion trend of 3D color TV. In such contexts, all color TV manufacturers launched their 3D TV products and 3D TV became the new norm of high-end competition in China.

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[5] The five top domestic TV brands were TCL, Konka, Changhong, Skyworth and Hisense.

[6] According to the report by Displaysearch, the total market share of domestic firms in the first quarter of 2009 exceeded 70%.

In 2010, the focus of competition in color TV industry shifted from terminal products and technologies to the whole industrial chain, particularly the control power over upstream suppliers. The year 2010 also witnessed a sharp decline in LCD panel price due to a lack of market demand. In addition, since the 3rd quarter of 2010, owning to a serious inflation, number of domestic TV consumers has decreased continuously. Therefore China's TV manufacturers faced new challenges.

3 Hisense's Technology-oriented Strategy

As mentioned above, Hisense has defined its development strategies in 1992, including a technology-oriented strategy, and emphasized its implementation. The company invests more than 5% of sales volume in R&D activities annually. In 2010, Hisense established a national-level technological center focusing on digital multimedia research. Besides, the company has set up national post-doctoral programs and built R&D centers in North America and Europe. By 2010, Hisense Electrical Company won 862 authorized patents, including 600 patents related to TV manufacturing.

Hisense's continuous effort in R&D has brought fruitful results. In 2005, the birth of Hiview chips changed the history that chip production had been monopolized by overseas suppliers. In 2008, Hisense produced the first super slim LED TV in China. It was also the thinnest LED TV in the world, a milestone of Hisense's breakthrough in flat TV technology. In 2009, Hisense launched Blue Medium series LED TVs, ranging from 19-inch TV to 55-inch TV. This makes Hisense the first company mastering the richest specifications and most comprehensive product line in the world. In December 2009, IEC entrusted Hisense to take the lead to draft sub-specification of international standard for LED back-light LCD. This fact signifies that Hisense has become a world leader in TV manufacturing and display area.[7]

There are several reasons behind Hisense's success in R&D. First, Hisense has been investing in R&D on a regular and continuous basis. Second, Hisense has built, over the years, a very effective administrative system on the operation of R&D activities. Since 1997, Hisense has been restructuring its organizational framework to better support a technology-oriented strategy. Policies and

[7] Adopted from the official website of Hisense Electric Co. Ltd, http://hxdq.hisense.com/gsjs/gsjj/

incentive mechanisms concerning R&D have also been redesigned.

3.1 Organizational Framework of R&D in Hisense

Hisense's R&D organizational framework has undergone a series of changes in different stages of its development. For example, it started from a radio research office at the beginning. Later, it evolved into QTVGF and established a technology research institute. After Zhou took office in 1992, he gave top priority to technical innovation. In 1993, Hisense founded an independent technology center to administrate all research staff. It was also stipulated that all son companies in Hisense should purchase technologies needed from the center. However, the structural problems were exposed soon after. Because funding for the technology center came from product companies, all companies were unwilling to invest in medium-term and long-term projects. Instead, they were inclined to cultivate their own R&D personnel. In Hisense's words, two kinds of R&D forces began to compete for scarce resources.

In 2000, Hisense reformed its R&D structure and fund administration systems. For example, for the short-term research tasks, research funds are allocated to corresponding subsidiaries. For the medium-term and long-term R&D tasks, the funding responsibility remain at the headquarter. Unfortunately, the above arrangement did not encourage the sharing of R&D resources. Soon, it became obvious that a new reform would be needed.

In 2002, Hisense reshaped its R&D administrative mechanism again, trying to integrate R&D resources in all product companies. Besides, a new three-layer R&D organizational framework was established.

Specifically, the first layer concentrates on fundamental technology and core technology development. The goal for this layer is to predict the direction of technology development and serve as a technology foundation for Hisense's new products development. In other words, this layer provides technology support to the development of core products, which would be used in many terminal products.

The second layer, however, is more market-oriented, which consists of many specialized research institutions focusing on different areas, including digital display, intelligent multimedia, digital TV, optical projection, intelligent appliance, mobile communication, intelligent communication, and network security. The major task of this layer is to design new products to meet the

requirements of consumers. The principles of the product development here are high efficiency, high level and quick rhythm. Therefore, the research centers in this layer are both the research institutions for all companies and important part of the overall R&D system in Hisense Group.

The third layer mainly includes a technology inspection center, industrial design center, data center, and training center. This layer provides a public platform for all product companies.

The three-layer R&D organizational framework has not only helped integrate Hisense's R&D resources, but also provided reliable administrative support for R&D efficiency.

3.2 Procedures and Managerial Mechanisms of R&D

To enhance R&D, Hisense introduced a new process management regulation, ranging from new product project establishment to mass product development. In addition, a specialized division of product introduction center (PIC) was established to take charge of new product R&D.

To illustrate the process management system, we took the operation mechanism in Hisense Multimedia R&D Center as an example. The center is affiliated to Hisense Electrical Company, consisting of the following divisions: product development division, technical research division, and network multimedia division. The product development division can be further divided into management center, products center, and public platform. Among them, project management center is responsible for developing new products, and the product center takes charge of circuit layout in new product development. The public platform offers the public software and public platform. The technology center focuses on new technologies development. Hiview TV series are developed by this division.

3.2.1 Establishment of New Product Projects

For establishment of new product projects, Hisense implements a product manager responsibility system. The product manager of marketing company plays a leading role in developing new products. New product proposals come from two sources. The first is market-oriented, as proposals put forward by the

product managers are based on a careful study of customer needs and market requirements. The second one is technology-oriented, with proposals put forward by product development managers. These proposals should be sensitive to the industrial technical trends and market competition. In Hisense, market-oriented proposals account for about 70% in new product development. The integration of the above two sources can bring a better match between market demands and products, as well as help promote technology development in Hisense.

3.2.2 Building Project Teams

Whereas Hisense R&D activities serve its technology development goals well, previously they were specialized, conducted solely by technology divisions. However, since the establishment of Hisense R&D center, R&D activities have been conducted by project teams. The backgrounds of these project teams' members are diverse, including production, techniques, PIC, cost control, product planning and quality departments. Project managers usually came from project management division.

3.2.3 R&D Process and Critical Control Points

Typical R&D process usually includes conceptual design, specimen machine molding, finalized design of specimen machine, manufacturing of 30 units for design trial, 200 units for verification of techniques, and 2,000 units for batch verification. Critical control points (CCP) are inserted along with all important stages of product invention and technology development.

In order to ensure R&D quality, regular quality-control meetings are held at each stage. These meetings are organized by project managers, with a goal to solve problems emerged. When disagreement occurs, the president of Hisense has the final say. In addition, decision-making rights are distributed to corresponding divisions in accordance with different R&D stages. In general, product manager of marketing company has the decision-making right before new product project is established; R&D divisions are responsible for conceptual design to the stage of "200 units for verification of techniques"; and product divisions take charge in from the stage of "2000 units for batch verification" and afterwards.

3.3 The Incentives for R&D

Hisense gives a priority to the training and retaining talents, particularly outstanding research talents. Since 1992, the salaries Hisense offered to its research staff was usually 3 times higher than that of non-research staff. The salary for excellent R&D talents was 10 times higher than that of for average researchers. Well-performed employees are assigned to R&D posts by the group every year. Besides, Hisense creates a promotion channel for R&D experts. In order to ensure morale in the company, Hisense designs and implements a compensation system highlighting competition and fairness. Specifically, Hisense selects and awards excellent technical innovation projects and R&D personnel each year. Furthermore, they implement a new performance-earning system, in which the earnings of R&D staff are linked to the degree of difficulty and progress of each project. Hisense also takes a tolerant attitude towards R&D failures. All these measures together give rise to more innovation in Hisense.[8]

Through long-term efforts and technology accumulation, Hisense has now successfully established a high-level, multi-echelon, stable R&D team. By 2010, there were more than 2000 full-time R&D personnel working at the Hisense R&D center, over half of them had intermediate or high professional title, more than 50 personnel are senior experts or held a doctor degree, over 300 held master degree and over 90% were below 40.[9]

4 Birth of the "Hiview" Chip

Since the adoption of technology-oriented strategy in 1992, Hisense has invested continuously in technological innovation. The company has achieved many important breakthroughs, such as RPTV, flat TV, digital TV and video process chip.[10] "Hiview" chip is one of the most important achievements in Hisense, thanks to the company's long-term technical accumulation and innovation-oriented R&D strategy.

The director of "Hiview" R&D team, Mr. Jiajin Zhan, the father of Hiview chip, put it as follows:

> *"It was impossible to establish a chip design division in Hisense, were it not the firm belief of Hisense's senior managers in advanced technology.*

[8] See Hisense Group. 2006.
[9] See the website of Hisense, http://www.hisense.com/hxkj/cxtx/
[10] Sun Yumin. 2008.

Similarly, it was also impossible to insist on an "unprofitable" project (chip design and development) for 4 years, without continuously striving for excellence and longing for core technological breakthrough."

4.1 Establishment of the Chip Project

In 2000, China's electric appliance industry suffered a huge loss and indulged in price wars. At that time, Panasonic, Sony, Toshiba, Sanyo and Phillips controlled the world TV market. The electric appliances market in China was quite chaotic. In 2000, the sales income of Hisense was only 13.47 billion yuan, and the profit was just 282 million yuan. Zhou and his team members decided it was time to make changes.

Facing Hisense's poor market performance, Zhou and Mr. Xiaodong Xia, the former vice-president of Hisense and director of the Technology Center, made the following comments on the prospects of the electric appliance industry in Chinese market:

"Although the demand of color TV in China is huge, we are unable to produce our own chips. Chips are the key for TV manufacturing. Only when we can make our own chips, can we become the final winner in TV market.

After Hiview chips have been developed successfully, Zhan Jiajin said in one interview:

"When domestic companies manufacture color TV, they usually face the same suppliers and the same chip solution. Such a high degree of homogeneity drives the manufacturers to cut-throat price war. In fact, many Chinese companies are unwilling to compete on a low price, and have tried to find a way out. Unfortunately, without the core technology on TV, Chinese TV makers are at a disadvantageous position, when competing with foreign manufacturers."

Before the birth of Hiview, all chips used in Hisense color TVs were imported from European or American companies, such as Siemens, Phillips, Trident or Genesis. These foreign firms controlled the TV chip market as well as the fate of Chinese color TV industry. R&D personnel in China were quite clear about the situation: The chip suppliers sold only out-of-date chips to Chinese TV manufacturers. State-of-the-art chips were retained for huge transnational companies like Panasonic, Sony, or Toshiba. Thus, Chinese TV manufacturers are destined to miss the most profitable part of TV market.[11]

[11] Sun & Qin. 2007.

Zhou talked about this history in an interview:

"In 1999, I attended the Creative Electronic Systems Exhibition. At the exhibition, I realized that without the chip technology, the electronic information industry in China could hardly make a breakthrough on technology. But Hisense had no experiences at all in managing chip projects. There were a lot of controversies over whether we should invest in chip R&D. At last, Zhan and his 8-member team from the R&D center convinced the rest of us and our chip development project was formally launched. "

4.2 Team of 11 Members

When the chip project was launched, the Technology Center of Hisense Group set up a new division named "Research Institute for Integrated Circuit Design." Mr. Jiajin Zhan, the former deputy director of the Technology Center, Digital Institute of Hisense, was appointed the director of the new division. For a long time, he was the only employee of that division.

In the same year, the national government issued the "The 18th Document" to encourage software development and integrated circuit designing. The Shanghai municipal government seized the opportunity and built a hi-tech industrial park in Huangpu district in Shanghai. The park aimed to become an incubator for integrated circuit researchers and manufacturers. When the Shanghai government heard of Hisense's keen interest in the R&D of integrated circuit, it sent officials to Qingdao to invite Hisense to move its R&D department to the park. Given the friendly business environment, advanced R&D facilities, and strong processing capacity in Shanghai and its neighboring areas, Hisense decided to move its R&D to Shanghai. In June, 2001, Zhan, together with three other colleagues, set up a new ASIC R&D Center in Shanghai.

Settled down in Shanghai, the Center gradually managed to recruit researchers as needed. At the end of 2001, Mr. Yunpeng He joined the center. He was the 7th researchers in the Shanghai Center. By 2003, the number reached 11, with an average age of 28. In spite of the lack of experiences in chip design and manufacturing, the young 11-member team was full of determination and enthusiasm. By comparison, Zhan was the most "experienced" one. He had worked in an American chip company for three months. Besides, He had limited experiences in research on chip materials. As a result, the young team had to start their chip R&D almost from scratch.

Zhan later recalled:

"Although the team was established, we knew nothing about the direction. Where should we start? We were at a lost. In 2000, the global semiconductor industry as a whole was in a recession. Although some predicted that it was the dark time before the dawn. But we saw no hope. We could not find the first ray of light in the darkness. Even the leaders in the industry felt perplexed and had no idea about where to go. Everyone was busy firing people, selling the businesses. Under such a depressed situation, Hisense made a decision to enter into the integrated circuit industry. However, our team was young and lacking experiences. The whole world was suspicious about our team's future and our capability."

4.3 Heading for Breakthroughs

Since the team had to start from scratch, the first step was to determine the R&D direction. They began to do intensive research and investigated more than 10 product projects, such as remote control chips of TV, air condition chips, general 8-bit micro processor, digital TV decoder chips, GPS chips and so on. Based on these investigations and repeated discussion, the R&D team reached an agreement focusing on developing digital video processor chips. It was made at the end of 2001. Zhan later recalled:

"We hoped to start from a new place. Our main business has always been TV in the last 30 years. But our TV products have to be updated. We believe flat TV and digital TV will be the future trend."

4.4 Challenges in 4 Years

As soon as the R&D direction was decided, the implementation of R&D strategy has been carried out systematically. By the end of 2002, Hisense's Shanghai R&D team finished designing LCD IC, a circuit board. Though the board was smaller than a piece of A4 paper, it consisted of more than 3 million transistors. As Zhan put it:

"The achievement of this project is a breakthrough of IC design. It connects what we have done before with what we are going to do in the future. For one thing, it proves that our process is feasible; for another thing, it proves we have found the correct way for IC designing."

After that, the Shanghai team took another two months completing the design of digital video processor chips. In the following six months, they completed all research and design of algorithms needed. By January 2004, they finished the design of RTL circuit. In May 2004, circuit design passed testing. Two months later, the team succeeded in integrating IP into a chip. On August 9th, 2004, the back-end design of the chip was completed.

The challenges faced by the R&D team were extremely huge. For example, in August and September 2003, when putting the CADed sample into an actual test, everything was in disorder. The researchers repeated the test many times and it turned out that the problem was caused by minor negligence at the coding stage. This incident provoked reflection by the leaders: Why did such a small negligence in verification cause big troubles and waste the R&D team almost four months to identify the problem? Possible explanation might be that there was a lack of holistic consideration among researchers. Each researcher worked on his or her own, thus there was no consistent and team-wide code system. Lastly, both Zhan and He found out that it was not a technical breakthrough that prohibits the efficiency. Rather, it was the project management mechanism and well-designed R&D procedure that work. Only when Hisense reengineered its project management system and improved its R&D procedures, could it improve its R&D efficiency and competitiveness in the international market.

4.5 The Birth of Hiview Chip

On September 28th, 2004, after 1,600 long days of hard work, Hisense at last made a breakthrough in TV chip R&D. On this very day, Hisense's Shanghai R&D team, using the advanced 0.18μm technology, succeeded in putting hundreds of thousands lines of mini-chips into an A4-size circuit board and integrating about 2 million logical gates and over 7 million transistors. On November 27th, 2004, the chip was produced in batches and applied in Hisense's TV products, such as CRT, LCD and PDP, etc.

Since February 2005, the chips have been installed and tested repeatedly. The test results showed that the Hiview chips even had superior performance over imported chips. On April 23rd, 2005, the Science & Technology Department of Shandong Province completed its independent test on "Hiview" chips and announced that the chips have the best performance in the world in terms of video processing algorithm, chip structural system, and design of deep

sub-micron IC. On the same day, Hisense formally named the chips as "Hiview," indicating that its self-relied innovation and success will greatly promote the TV manufacturing industry in China.

On June 26th, 2006, the Ministry of Information Industry (MII) of China completed its tests on Hiview chips and praised the chips as "high-definition, high-quality digital video processor chips." Mr. Qinjian Lou, the vice minister of MII congratulated Hisense on its success in Hiview chips. On the same day, Zhou sent a letter to Premier Wen Jiabao. In the letter, Zhou wrote as follows:

> "*Dear Mr. Premier, you inspected our company last year and gave us inspiring instructions on chip development. This is very encouraging. Our designers have succeeded in achieving the innovations. I would like to bring you the good news personally. Now Chinese companies are able to 'create in China,' rather than "made in China."*

On June 27th, the stock price of Hisense Electric rose rapidly and reached its peak value within 10 minutes, indicating the positive market response to Hisense's invention of Hiview chips.

4.6 Problems in Industrialization in Hiview Chips

In fact, Hiview was not the first domestic chip in China. As early as 2003, a company in Chengdu, Sichuan province, successfully invented the first TV chips in China. Later, Xi'an Jiaotong University also developed similar chips. However, these domestic-made chips were not, due to their instability and inefficiency, welcomed by China's TV manufacturers. By comparison, Hiview chips were superior to other domestic-made chips, or even imported chips in both performance and cost, hence could be applied widely to TV manufacturing. As Zhou pointed out:

> *"The success of chip development lies in whether a chip can meet the demands of TV manufacturing. The key to our success is the fact that we did a good job in integrating our chip with the whole TV manufacturing industry in China.*

On July 2nd, 2005, Hiview-chipped TVs were manufactured at five different locations simultaneously, namely Qingdao, Liaoning, Guiyang, Zibo and Linyi manufacturing bases. Mr. Geng Xia, the mayor of Qingdao city, Ms. Shumin Yu, the president of Hisense, and Zhou packed the first new TV set produced together, signifying the industrialization of Hiview chips in China's TV

manufacturing industry.

On the same day, Yu took the chance and announced a new strategic transition of Hisense:

"The company aims to change from a mere TV manufacturer into a creator and patent supplier. Our aim is to become the largest chip supplier in China."

Mr. Qingcun Guo, the Vice President of Hisense Group, said:

"*The first step of Hisense in chip development has proved to be a great success, which brings us more confidence. We are going to take further steps. The next step is to develop system-integrating chips. The goal of our R&D staff is to design and produce all-in-one chip. Furthermore, multiple-functional chips are going to be explored. All in all, we will work closely with the demands of our customers. The realignment of various chips will surely help to cope with these different demands."*

"*Our plan consists of three parts: Firstly, we are going to develop systematic –integrated chips; secondly, multi-media chips with high-level functions will be developed. Thirdly, derivates based on the above two will be produced in a large scale. Out chip products will be favorable in costs but qualified in functions."*

However, the industrialization of Hiview chip turned out to be somewhat difficult. In the international market, Hisense had to face powerful competitors, such as Pixworks, Genesis, Huaya, Phillips, Sony and Toshiba; while in the domestic market, Hisense faced fierce competition from other domestic TV manufacturers like Changhong, TCL, Konka, and Skyworth. These domestic companies have refused to apply Hiview chip in their products in the near future. Under such circumstances, the economies of scale of Hiview chips were hard to be achieved.

Till August 2008, Hisense remained the only domestic TV manufacturer adopting the first-generation of Hiview chip, though Hisense has tried hard promoting Hiview to other domestic TV manufacturers. In January, 2008, the second-generation of Hiview chip—the SOC (with large scale integrated circuit) was born. The new chip had the following features: improved image quality, enhanced edges, image zoom-in and zoom-out, motion detection, 3D noise reduction, and gamma correction. When Hisense displayed the new chip at the famous CES in USA, it soon became the focus.

In June 2008, Zhou talked in an interview with the South Daily:

"In fact, Hiview broke the technical monopoly of foreign chips. Within half a year, the price of TV chips in the international market dropped quickly. For high quality chips, the price decreased from $15 to $ 8 dollars. For lower level chips, the price dropped from $13 to $6.5 dollars. The average price has been reduced by 40%. However, no domestic companies buy from us, no matter how hard we try. I feel sad about it."

It seems that the prospects of industrialization of Hiview chips remain uncertain in the foreseeable future.

References

Chi, Y. 迟宇宙. 2006. *海信突围 (Hisense Breakout)*. 北京: 北京大学出版社 (Beijing: Peking University Press).

China Statistical Yearbook. 2000–2010. Retrieved August 6, 2011, from http://annual.apabi.com/ruc/ybsearch/ybsearch_text.aspx

CMM retail monitoring data. 2009. Retrieved August 24, 2009, from http://tech.qq.com/a/20090824/000232.htm

Hisense Group. 2006. 创新是企业的生命力——海信集团自主创新报告 (Innovation is vital to enterprises—Independent innovation report of Hisense group). 中国科技产业 (Science & Technology Industry of China), (5): 18–21.

Hu, C. 胡春民, & Ruo, H. 若怀. 2005. 海信信芯之路不平坦 (The difficulty of Hisense's Hiview development). *中国电子报 (China Electronics News),* July 8: 11–13.

Ji, J. 纪建悦, Guo, C. 郭春静, & Zhang, Z. 张志亮. 2007. 海信自主创新能力的分析与启示 (Research on Hisense's independent innovation capability). *工业技术经济 (Industrial Technology & Economy),* (2): 66–69.

Sun, Y. 孙玉敏. 2008. 海信科技前行史 (History of hisense technical growth). *招商周刊 (Merchants Weekly),* (12): 60–63.

Sun, J. 孙健, & Qin, F. 秦奋. 2007. 海信的技术创新四部曲 (Hisense Technical Innovation Tetralogy). *企业经济 (Business Economic),* (1): 81–83.

Appendix 1 Subsidiaries of Hisense Group[12]

Hisense Electronics Industry Holding Co., Ltd.

Hisense Kelon Electrics Co., Ltd.

Hisense Electric Co., Ltd.

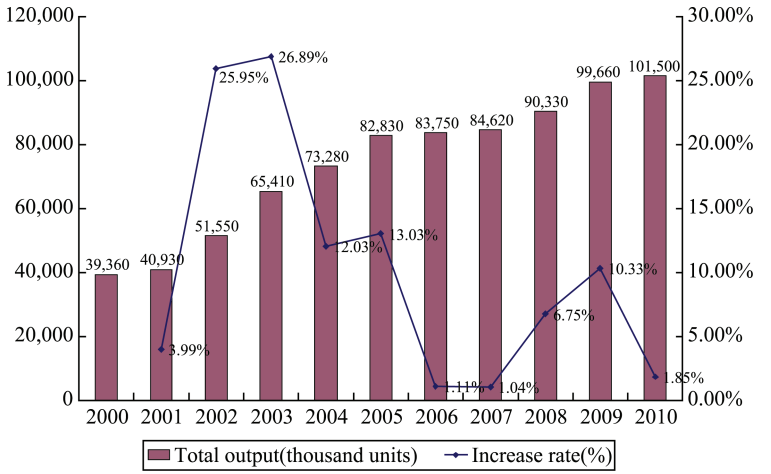
Qingdao Hisense International Marketing Co., Ltd.

Qingdao Hisense Intelligent Commercial Equipment Co., Ltd.

[12] Data obtained from the official website of Hisense Group, many small subsidiaries were not listed.

Hisense/Hitachi Air-Conditioning System Co., Ltd.
Hisense (Zhejiang) Air-Conditioning Co., Ltd.
Hisense (Beijing) Electrics Co., Ltd.
Hisense (Nanjing) Electric sCo., Ltd.
Hisense Marketing Co., Ltd.
Hisense (USA) Optical Communication Co., Ltd.
Qingdao Hisense Broadband Multimedia Technological Co., Ltd.
Qingdao Hisense Network Technology Co., Ltd.
Qingdao Hisense Real Estate Co., Ltd.
Qingdao Savor Electronic Information Services Co., Ltd
Qingdao Hisense Communication Co., Ltd.
Qingdao Hisense Mobile Communication Technology Co., Ltd
Qingdao Mold Co., Ltd
Hisense Group Finance Co., Ltd
Qingdao Media Network Co., Ltd
Qingdao Hisense Property Management Co., Ltd

Appendix 2 Total Output & Increase Rate of Chinese Color TV Industry: 2000–2010[13]



[13] Data obtained from the China Statistical Yearbook.

Appendix 3 Market Share of the Top 10 Digital TV Brands in Domestic Market[14]

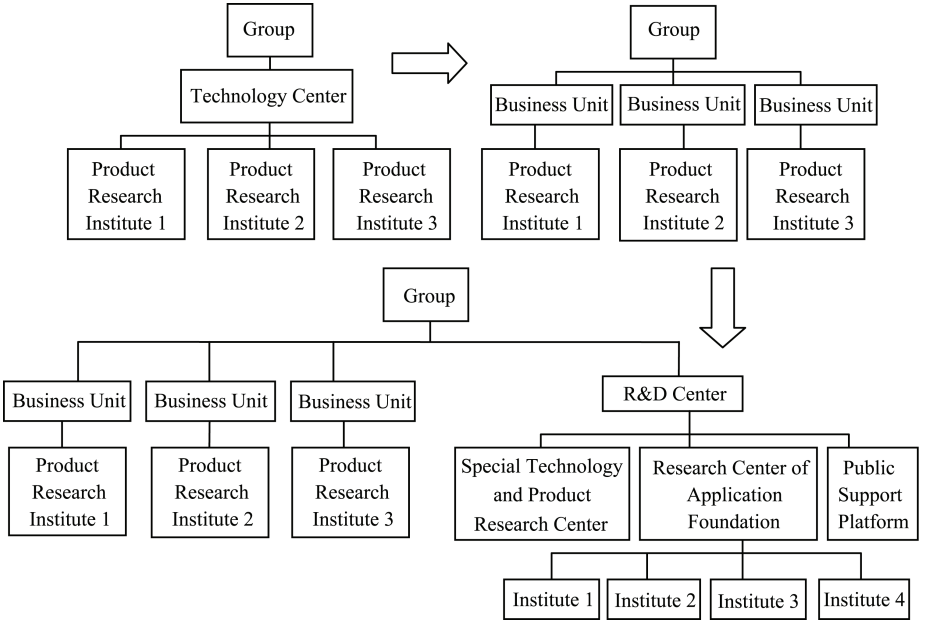
NO.	Brand	Market Share
1	Hisense	15.3%
2	Konka	12.1%
3	TCL	10.4%
4	Changhong	9.7%
5	Skyworth	7.2%
6	Samsung	6.6%
7	Xiahua	4.9%
8	SVA	4.5%
9	LG	3.8%
10	Song	3.6%
11	Others	4.2%
Total		100%

Appendix 4 Market Shares of TV Brands in Domestic Retail Market in 2008–2009 (by quarter)[15]

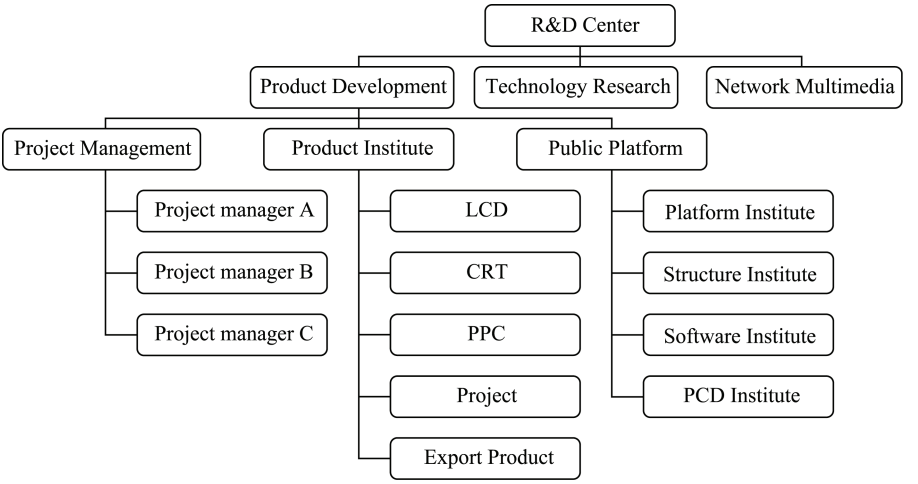
Rank	Brand	08Q2	08Q3	08Q4	09Q1	09Q2
1	Hisense	10.0	11.1	12.5	13.2	13
2	Skyworth	7.9	9.2	9.9	11.1	11.4
3	TCL	7.4	7.5	9.7	10.8	9.7
4	Sharp	8.8	10.3	9.4	9.9	9.7
5	Kanka	7.6	8.7	10.3	9.1	8.9
6	Changhong	6.6	6.6	7.5	7.4	8.4
7	Song	10.3	8.1	8.2	7.4	7.5
8	Samsung	11.6	9.0	7.3	6.6	8.2
9	LG	5.8	4.8	4.3	5.4	6.2
10	Panasonic	3.0	4.6	3.0	3.5	4.3

[14] Data obtained from CEI.net Statistical Data Bank.
[15] Data obtained from CMM at http://tech.qq.com/a/20090824/000232.htm

Appendix 5 Changes of R&D Organization in Hisense[16]



Appendix 6 Organizational Structure of Hisense Multimedia R&D Center[17]

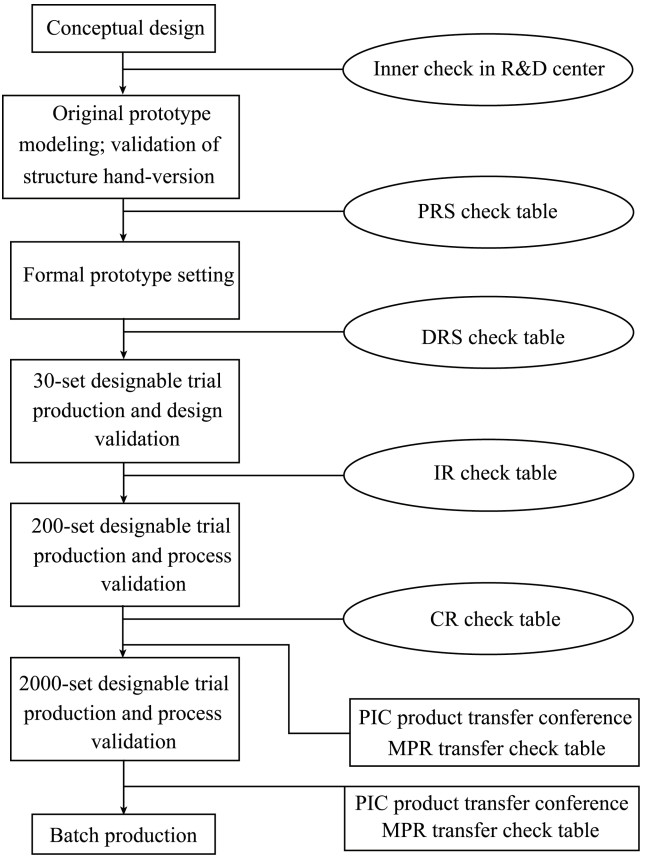


[16] Data obtained from interview records.
[17] Data obtained from the internal database of Hisense.

Appendix 7 Comparison of Product Manager and Project Manager[18]

Product managers	Project managers
1. Belonging to the marketing center	1. Belonging to the multimedia R&D center
2. Responsible for the product planning, market investigation and project establishment	2. Responsible for organizing and implementing R&D activities
3. In charge of the affairs before the conceptual design	3. In charge of the affairs after the conceptual design
4. Responsible for the marketing of new products	4. Responsible for the development cycle, quality and cost of new products

Appendix 8 General Process for R&D in Hisense[19]



[18] Data obtained from interview records.
[19] Data obtained from the internal database of Hisense.

Appendix 9 Important Events in Hiview R&D[20]

1. In 2000, Hisense technology center established the "Application Specific Integrated Circuit (ASIC) Institution." In 2001, the institution moved to Shanghai and was upgraded into a National IC Industrial Base.

2. From 2000 to 2001, Hisense embarked on a preliminary investigation of chip design direction.

3. In 2001, Hisense decided to focus on the R&D of TV video processor chip.

4. In January, 2003, the project of "digital video processor" was formally established.

5. In March, 2004, Hisense completed its own circuit development and prototype verification of FPGA.

6. In November, 2004, Hiview chip was produced successfully for the first time in SMIC, the yield rate reached up to over 90 percent.

7. On February 12th, 2005, TV installed Hiview chips passed reliability testing.

8. On March 7th, 2005, Hiview project-level chips were installed and tested in finished TV products in Hisense.

9. In April, 2005, Hisense completed its continuous testing on Hiview chips in two batches of TVs (30 sets for the first testing and 200 sets for the second testing). The performance of Hiview chips was proved to "have attained international advanced level" in a number of indexes.

[20] Data obtained from both the official website of Hisense Group and media reports.