

CAD In China: Applications and Industrialization

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Abstract

The current status of CAD applications and industrialization in China is concisely described in the paper. Then, the potentiality of an extensive market of CAD applications is analyzed. Finally, models of developing CAD applications and industrialization in China are related.

1 THE CURRENT STATUS OF CAD APPLICATIONS AND INDUSTRIALIZATION IN CHINA

1.1 Chinese government supports the development of CAD applications and industrialization

Computer aided design is a critical high technology to accomplish design automation, expedite the transformation from scientific and technological achievements to production forces, and to accelerate national economy development and four modernizations. The application of CAD technology is not only the main aspect of reformation of traditional industrial technologies but also an important leverage to raise product and engineering design to a higher level, reduce cost, shorten design cycle, and to improve the labor productivity, as well a significant requirement for enterprises to enhance their competitive power and adaptive faculty in market. The level of applying CAD technology is also one of the major marks indicating the level of national industrial technologies.

Part One Keynote Papers

In order to impel the development of CAD applications and industrialization, Chinese government has been including the development of CAD in the National Science and Technology Key Projects and Torch Program for a long time, encouraging enterprises to adopt CAD technology and carrying out preferential policies for them. The national developing plan of CAD applications has been formulated, in addition, a coordinating and directing group of CAD application engineering, which was sponsored by the National Science Committee and participated by eight state ministries and committees, has been established.

1.2 The current status of CAD applications and industrialization in China

Starting in 1960s and passing through its developing period mainly in 1970s and 1980s, CAD in China is now beginning its preliminary applications in engineering designs and product designs in diverse fields such as machinery, electron, aviation, aerospace, architecture, shipbuilding, light industry, textile industry, and so on, and has obtained remarkable technical and economic benefits. For example, in National Designing Institutes, more than 90 percent of calculation, 50 percent of project design and 30 percent of drawings were finished by using CAD technology. It raised working efficiency as 3 to 10 times as before, and saved as much as 2 percent of capital construction investment. As a result, 2 billion yuan of engineering investment has been cut down on only during the 7th. five-year plan period.

According to the results of our sample survey, the installation situation of computers and CAD systems in 1992 is listed as follows.

	<i>Aviation Industry</i>	<i>Shipping Industry</i>	<i>Weapon Industry</i>	<i>Oil Industry & Capital Construction Bureau</i>	<i>Railway Ministry</i>	<i>Machinery</i>	<i>Electron</i>	<i>Construction</i>
Installed Computers Number	5280	2000	6464	577	2352	21500	25453	16069
CAD System Number	1160	515	1006	499	949	5427	10555	9000
Percentage (%)	21.96	25.75	15.6	86.13	40.37	25.24	41.34	55.9

Among CAD systems in our country, microcomputer based CAD systems account for more than 90 percent, whereas workstation based CAD systems are increasing year by year. Hundreds of CAD software have been developed so far. However, a few of CAD systems have been transformed into merchandise.

1.2.1 General situation of CAD hardware

The general situation of microcomputers made in our country is as follows. They have already reached the engineering scale production with a yearly yield of 250,000 sets including 286, 386 and 486 microcomputers produced by computer groups such as Great Wall, Changjiang,

Langchao, Legend, and so on, and supply users with microcomputer based CAD hardware platforms.

The general situation of workstations made in our country is as follows. Huasheng series workstations, as scientific and technological achievements during the 7th and 8th five-year plan periods, have begun its batch production, among which Huasheng 4065, 4075 SPARC workstations have already been produced in a small scale production. Huapu HP workstations are at the initial stage of small scale assembling, while Huaqi SGI workstations have gone into assembling.

Taiji series computers, small-sized computers made in our country, are produced in a small scale production.

The general situation of peripheral devices is as follows. CRT, printer, plotter, floppy, hard disk, and compact disk drive, etc., are produced in batch production by more than 10 factories in our country, respectively.

1.2.2 General situation of CAD software

During more than 10 years CAD software in our country have obtained fairly great development, got a large number of achievements up to now, and started carrying out industrialization. The majority of these software have been developed by universities, colleges, and scientific research institutions.

Nowadays, we have gotten some fairly successful CAD software, listed as follows.

Machinery	ZDMCD, MGPS	Zejiang University
	MSD, BSURF-GI	Nanjing University of Aeronautics and Astronautics
	GEMS, GWCAD	Tsinghua University, Northern CAD Company
	JBZ-CADM, PC-MECADS	Automation Institute of Mechanical Ministry
	APT-X System, CAMS	No. 625 Institute of Aviation and Aerospace Ministry
	NPU-CAD/CAM	Northwest Industrial University
	CAED, PDA	Huazhong University of Science and Technology
	PICAD	Beijing Software Engineering Developing Center of Academia Sinica
Electron	PANDA System	Beijing Integrated Circuit Design Center
	ECADS	CAD Laboratory of Institute of Computing Technology of Academia Sinica
	Printed Circuit CAD	Shanghai Institute of Computing Technology
Architecture	AEDS	Beijing Engineering Design Software Company
	Architecture CAD	Chinese Architectural Scientific Research Academy
	JT-HBCADS	Tongji University

In the mechanical CAD aspect, ZD-MACD system of Zejiang University with SUN workstation as its hardware can accomplish many tasks such as geometry modeling, structural finite element analysis, numerical controlled manufacturing, and so on, meanwhile its software

performance/price ratio meets the requirements of domestic users fairly well. GEMS, a geometry modeling system of Department of Computer Science and Technology of Tsinghua University, has already been implemented in varied hardware platforms including PC, HP/APOLLO and SUN workstations, and used by dozens of domestic units. PICAD, a two-dimensional drawing system developed by Beijing Software Engineering Developing Center of Academia Sinica, has already been sold in batches.

In the electronic CAD aspect, PANDA Version 1.0, an IC CAD software of Beijing Integrated Circuit Design Center, which possesses all of the functions of an overseas software, DIASY, was formally promoted on August 17, 1992. PANDA system is presently being used by more than 20 domestic users, and has been used to accomplish several IC design tasks. ECADS software of CAD Laboratory of Institute of Computing Technology of Academia Sinica runs on UNIX workstation and has got fairly good applications in our country.

In the architectural CAD aspect, the CAD software of Chinese Architectural Scientific Research Academy, including architectural CAD, structural CAD, and high-rises CAD, have been developed and used by as many as thousands of domestic users, and have extensive application areas and strong influences. Running mainly on PC microcomputers, these software are all fairly practical and can be directly served in architectural constructions.

2 Prediction of Chinese computer CAD system market in 1990s

2.1 Prediction of national computer market

In 1990s, the computer market in our country will be expanded steadily. According to our prediction of national computer market, the aggregate sales of commodities of computer market will increase with a rising rate of 20 to 25 percent, meanwhile it will account for a bigger portion in the social fixed investment.

	1995	1996	1997	1998	1999	2000
Aggregate Sales in Market (100 million yuan)	500-520	620-640	740-800	900-1000	1100-1200	1300-1500
Yearly Rising Rate	25-30%	23-25%	20-25%	20-25%	20-22%	20-25%

2.2 Prediction of national CAD demands

To summarize what are mentioned above, during the 8th five-year plan period, there will be a demand of 60,000 or 70,000 to 100,000 sets of CAD systems, including 50,000 or 60,000 to 85,000 sets of microcomputer based CAD systems and 15,000 to 20,000 sets of workstation based CAD systems. During the 9th five-year plan period, there will be a requirement of 310,000 to 360,000 sets of CAD systems, including 250,000 to 280,000 sets of microcomputer based CAD systems and 60,000 to 80,000 sets of workstation based CAD systems.

2.3 Characteristics of the national CAD market

The first characteristic is that the CAD market in our country is still in its primary stage of developing and growing, and needs supporting, fostering and further developing.

Only 10 percent of enterprises are currently using CAD technology. The workstation based CAD systems constitute a low proportion among CAD systems, for example, 7.6 percent in mechanical and electronic enterprises presently, but in developed foreign countries, it occupies 65 percent in mechanical enterprises and 86 percent in electronic enterprises, respectively.

The second characteristic is that the CAD market in our country is a component part of international market, in which mostly CAD software and hardware products from foreign companies have a dominant position currently, whereas CAD software independently developed by our country are of fairly low level, few of which have been industrialized. Forty to 50 percent of microcomputer based CAD systems are developed in China, but 80 percent of CAD products on workstations, small-sized computers and superior computers are products of foreign companies. During 1990s, the national market will still be an international market dominated by foreign products. However, CAD software in China will gain a fairly rapid development.

The third characteristic is that there is a potential extensive market in China.

China has about a million industrial enterprises and a potential extensive market which provides lots of excellent opportunities for China to develop CAD industry and software industry. CAD products developed by our country will undoubtedly share the market, but we will strive for the dominant position in the next century.

The fourth characteristic is that the policies of our government such as the social economy developing strategy, the industry policy, the equipment policy, the investment policy, and the import policy, have great influence powers on the market. The general and specific policies of our country have determinant impact on the market in our country.

The computer and software market are presently forming. The national policies are directive for the development and growth of the CAD market.

The fifth characteristic is that laws and regulations of administering on the market are not perfect enough while the CAD market are currently in its growth period. There exist some chaotic phenomena in the market. The software protection rules still need propagating and carrying out continuously. There also exist CAD products of low quality, and counterfeit and inferior CAD systems. It is necessary to enhance administration on the CAD market so that a good circumstance of developing CAD technology could be formed.

3. Models and ways of developing CAD industry in China

3.1 Developing models

In order to develop CAD industry in our country, we should take domestic and overseas markets as guidance to adjust the product structure and the industry structure continuously.

We should select finite objects and give prominence to what is significant. We should vigorously develop CAD software and applications so as to give an impetus to hardware manufacturing industry. We should develop specialized CAD with diversified sectors in the national economy, encourage cooperation among domestic enterprises and introductions of foreign advanced technologies. We should enhance the combination of human resource, financial resource and information resource and the integration of factories, colleges and institutes. We should establish hardware manufacturing industry, software industry and application industry, and ensure them develop harmoniously. We should establish a strip-block-integrated, rationally distributed CAD industry system with specialized CAD companies as its core.

3.1.1 Carrying out the policy of impelling industrialization by applications, meeting needs of overseas and domestic markets, and of being directed by the market

It is urgent to spread and apply CAD achievements and continuously promote industrialization in this process.

Mechanical and electronic industry should close integrate with users and departments in various national economic fields which are engaged in developing, producing, applying CAD technology, and offering CAD technical service, so that we can develop, then produce, and finally spread a large number of CAD products, continuously adjust the product structure, and advance in a rolling style.

We should select finite objects and give prominence to what is significant, for example, machinery, electron, shipping, automobile, and architecture CAD in the near future. The integrated product of CAD application supporting software with CAD system will be selected as a breach to develop CAD systems and products with Chinese characteristics.

3.1.2 Diversified developing models incorporated with national situation

The first model is that the state supports and organizes developing and spreading, impels developing and spreading industrialized achievements of science and technology, meanwhile these achievements can be continuously adjusted and perfected and become more practical and maintainable.

Beijing Integrated Circuit Design Center and CAD Software Center of Institute of Computing Technology of Academia Sinica have made beneficial attempt on CAD industrialization.

The second model is that industries sponsor and organize developing CAD application systems and products which meet their own urgent needs.

With general CAD supporting software as emphases, industrial departments organize a combined group consisting of research units, colleges and universities, and application

demonstration factories, to jointly develop CAD basic database and engineering database in their own industries, and to develop CAD software with their own industrial characteristics. Upon this basis, they jointly establish an integrated entity to spread products, which includes industrialized CAD software development, production, sell, management, and technical service. Chinese Architectural Scientific Research Academy of Construction Ministry has made remarkable achievements in industrializing architectural CAD software and spreading them, and gains beneficial experience.

The third model is to organize diversified specialized CAD companies.

Diversified specialized CAD system companies and software companies will be established with scientific research units, colleges and universities, and enterprises as their main body, which aim at developing CAD application software and application systems which will be extensively used by lots of people in many practical areas and meet large amount of market demands. Specialized CAD companies may also be established by powerful users and key enterprises as main force together with computing centers, institutes and product design sectors of enterprises as auxiliary force.

As a successful instance, Hangzhou Xidebao Electronic Engineering Company, jointly established by Zejiang University and Hangzhou Printing and Dyeing Mill, developed printing and dyeing CAD software.

The fourth model is to establish joint ventures so as to absorb foreign investment and technologies and drive national CAD software infiltrate international market through overseas sales and service channels.

Northeast Arpai Software Company, a joint venture established by Software Center of Northeast University and Japan, has exported software to Japan.

<i>Models</i>	<i>Market Object</i>	<i>Investment Source</i>	<i>Achievements Source</i>	<i>Organization Form</i>
The state organizes developing and spreading	CAD supporting software suitable for national industries	State allotments, State loans	National scientific and technological achievements	Enterprise group stock company ECR, State laboratory
Industries organize developing and spreading	CAD supporting software suitable for specific industries	Loans (mainly)	Scientific and technological achievements in Ministries and Committees	Enterprise group CAD company
Enterprises and public institutions organize developing	middle or small sized CAD system, CAD application system	Loans, Enterprises-raised funds	Achievements accomplished by enterprises independently	Specialized CAD company of collective ownership, Scientific and Technological enterprise run by the local people
Joint venture companies	Export (mainly)	Domestic and overseas joint investment	Further development of overseas achievements	Joint venture

3.2 Developing ways

3.2.1 CAD hardware manufacturing industry

To develop CAD hardware manufacturing industry, we should depend on existing state-enterprises, which are engaged in manufacturing microcomputers, workstations, small-sized computers and peripheral devices, as main force, and unite joint ventures and new high technology enterprises run by the local people in new technology developing zones. Nowadays, we should vigorously enhance development of workstations and peripheral devices, cooperate with interested enterprises in USA and Japan, etc., and heighten performance/price ratio of hardware product and market occupying rate.

3.2.2 CAD software industry

Existing scientific research academies and institutes are encouraged to derive specialized CAD software companies, specialized service companies and enterprises run by the local people, which are specially engaged in developing, producing, managing, and technically serving CAD software product.

Joint ventures will be established in new technology developing zones to go in for developing and maintaining CAD application software.

Powerful users take charge of developing, selling and spreading special purpose CAD application software of their own industries.

3.2.3 CAD application service industry

Application service key enterprises will be established by existing factories, institutes and computer enterprises in various industries that are engaged in CAD application system integration. They are encouraged to close cooperate with users, develop typical CAD application system, and to provide complete set of service.

Through technical cooperation with overseas CAD firms, we will absorb technologies and investment, contract domestic and overseas application system engineering, and provide domestic and overseas markets with application systems and specialized service.

In all large areas, technical service nets will be established, including specialized service net and maintenance net concerning selling, maintaining, training, and so on. They will promptly provide various specialized service to vast numbers of users.

3.3 Accelerating the transformation from CAD scientific and technological achievements to products and industrialization

3.3.1 Enhancing developing and spreading CAD achievements

All industries should formulate their programs of spreading and applying CAD technology, and form a large number of typical demonstration enterprises of applying CAD technology.

The combination of enterprises leaders, specialized technicians and operators, and the cooperation of CAD researching and developing units, producing enterprises and users, can ensure spreading and applying CAD technology efficiently.

3.3.2 Drawing up plans in an integrated and overall way, and enhancing CAD application system integration

Through drawing up plans in an integrated and overall way, industrial departments should carry out technical standards and policies, enhance CAD software evaluation and test, and strengthen macroscopic direction for spreading, applying, and industrializing CAD technology.

By introducing more flexible policies and deepening reform, Chinese government will establish a flexible circumstance for developing CAD software, application and service industries, and support and promote the growth of a large number of CAD software companies, application system companies and technical service companies.

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