

An Engineering Study for the Development and Marketing of Personal Use Cars (PUCs) in China

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ABSTRACT

An engineering and marketing study was undertaken to determine the design and vehicle attributes of Personal Use Cars (PUCs) that will be most attractive to the future private owner in China. Affordability, operational cost, performance, design, features, ergonomics, cultural preferences, road and parking infrastructure and environmental protection were investigated in this study. Population growth and distribution, transportation infrastructure, economic growth, family status and social/cultural factors were used to help develop prospective consumer-based models to predict potential market growth of this vehicle segment in China through the year 2010. These models were supported by several market surveys carried out on upper income families in the urban and rural areas of China's eastern regions. Several cultural differences were identified between Asia and Western country families such as the Chinese families desire to accommodate grandparents or other relatives in many personal trips. It is predicted that the most desirable car will be in the B-C class size, equipped with a 1.3-1.6 L EFI engine, a manual transmission and a closed-loop emission control system. The development of an economical, continuously variable automatic transmission is recommended for this vehicle. A gasoline engine is currently preferred over a diesel engine. However, this preference will shift when the life-cycle cost of fuel exceeds 20% of the total vehicle ownership costs. A 4-door hatchback car with an up-sloped tail design (not fastback) is the most desired configuration since it facilitates the entry of occupants and goods. Another desirable design is one that blends commercial and private vehicle features. Ford "global" prototype and new production vehicles are illustrated which closely match the specifications and design of the vehicle developed in this study. The operational cost of the PUC should not exceed 15% of the family income, which will require an average fuel economy of 6-7 L/100 Km, low use taxes and maintenance costs. The most desired options include air conditioning, power steering and a radio. The future trend is that used PUCs from the eastern regions will be sold to less affluent customers in the central and western regions. The fact that many of these vehicles could be used for another 10-20 years will require that the PUC be designed for easy repair and reusability. It is projected that a PUC, priced in the range of US \$9,800 - \$12,100 (80,360 to 99,200 RMB) (not including taxes), could reach a market level of 469,000 units in model year 2005 and comprise about 20% of the car market. However, even though the economic models predict this level of growth, a lack of road infrastructure, an increasing level of congestion, limited parking, increasing environmental problems and other factors will significantly limit the use of PUCs in China's major urban areas. The primary market growth for PUCs will be in rural communities, small cities (less than one million people) and suburban areas. The collective purchase and use of cars in villages is expected to become a major growth opportunity in the future.

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INTRODUCTION

Automobiles were first introduced in China during 1901. Lineshi, a Hungarian, was the first registered owner of a vehicle in China and the second was Cixi, the queen mother of the Qing Dynasty. By 1902, there were already 1899 vehicles in Shanghai, most of which were private cars. In 1913, Ford started to sell Model T cars in China. On June 12, 1924, Mr. Sun Yat Sen, the former President of the Republic of China, wrote a letter to Mr. Henry Ford to invite him to China to help develop China's automotive industry. This led to the increased distribution of Ford Model T's, Model A's and tractors to China.

A car was a product that only the very wealthiest persons in China could afford prior to 1949. The private ownership of cars was discontinued in 1949 when the People's Republic of China was established. The government regulated car ownership and personal ownership was not permitted.

The First Auto Works, formed in 1953, was the first domestic Vehicle Company in China. FAW acquired the ability to design and produce trucks by 1958. The first vehicle designed and produced for the Chinese market was a luxury car called the "Red Flag".

China's policy of national reformation and openness in 1978-1980 made cars publicly accessible. By 1980, China's annual vehicle output was only about 222,300, of which 5,418 were cars. At this time, an open government policy was established and emphasis was placed on the development of a PUC market. This policy was strengthened in 1991 when it was proclaimed that "the Government encourages the purchasing of private automobiles and the introduction of cars into the family."

The establishment of Shanghai Volkswagen Automotive Corporation in 1985 marked the first mass production of cars in China. Although these cars have been available to private owners, they have been purchased primarily by government organizations, taxi companies and businesses.

China and the emerging countries of the Asia Pacific region enjoyed a high level of economic growth up to 1998. The average GDP increase was 11.9% from 1991 to 1995 and approximately 9% from 1996 to 1998. Although China's growth rate has slowed, it is projected that China's economy will continue growing at an average rate of about 7% from 2000-2010.

The transportation industry is one of the fastest growing sectors of the Asian economies. Even though the problems faced by each country are different, they all have common transportation concerns. Many emerging Asia Pacific countries have determined that the development of a domestic automotive industry is key to their economic development. Furthermore, it is understood that the growth of the private or personal use car market is necessary for a successful vehicle industry. Lu Fuyuan, the former Vice Minister of the Ministry of Machinery Industry of China, emphasized that, "if the conversion of the

automotive market from government to private owners does not occur, the automotive industry in China will not have a promising future.”

The Chinese government has designated the automotive industry as one of its pillar industries, which is of key importance to the economic growth of China. China's vehicle production has increased by an average of 18% per year from 1981 to 1995 and the rate of increase has declined from 1995 to 1998. However the economic climate is improving which will encourage private ownership of vehicles. The rate of increase is expected to bounce back and remain in the range of 8-10% for many years to come.

The automotive industry is an enterprise with highly intensive capital and technology requirements. It has the characteristics of high added value and close associations with other industries. It motivates customers to consume more and triggers consumption among relevant industries and tertiary industries. The historical experience of developed countries indicates that the establishment of a successful automotive industry is an important launch-point for the revitalization of the national economy.

Ford's Model T and the Volkswagen Beetle helped make it possible for the average family in the West to own a PUC in 1910-1930 and 1950-1970 respectively. Today, cars are considered common commodities that are affordable and available to nearly every person in the mature market countries.

TECHNICAL APPROACH

The objective of this study was to carry out a comprehensive, systems analyses to help determine the attributes of Personal Use Vehicles (PUCs) that will be acceptable to the future Chinese consumer. The guiding principles were to focus on the needs of the consumer, to determine the ability of China's infrastructure to support PUCs, and to approach this study with a "clean sheet of paper." The technical approach was as follows:

- Develop prospective models for China's economic growth and the future buying power of Chinese families
- Undertake an engineering and marketing study to determine the design and vehicle attributes of PUCs that will be most attractive to the future private owner in China.
- Determine the minimum base price at which the vehicle can be sold while insuring a reasonable profit for business sustainability.
- Develop business models to estimate the PUC affordability of Chinese families in the year 2005 and predict market volumes for the PUC as a function of vehicle cost for the same year.
- Carry out market surveys to determine the future needs and priorities of the customer for purchase of a PUC.
- Determine the potential effects of external influences on the future success of the PUC market including road, parking and service infrastructure, fuel cost environmental protection, and availability, taxes, and government regulations.

THE CURRENT VEHICLE MARKET IN CHINA

Figure 1 ("Information Profile", SAIC, 1997 and "Automotive Industry Research", No 2, P26, 1999) compares the total number of in-use passenger vehicles to the total number of in-use vehicles for the period of 1985-1998. Passenger vehicles include cars, taxis, vans and buses while total vehicles include passenger vehicles, trucks and special-use vehicles. Figure 2 ("Automotive Industry Research", No 2, P26, 1999 and "Automotive Industry Research", 1997) shows the number of in-use privately owned passenger vehicles as compared with total number of the privately owned vehicles from 1985 to 1997. Privately owned vehicles are registered by individuals and are used for both private businesses and personal transportation. Up to now, China still does not have national statistical data for personal use cars that are privately owned and used only for personal transportation purpose. By the end of 1997, privately owned vehicles represented about 30% of the total number of vehicles in China. It can be noted from Figure 2 that the percentage of privately owned passenger vehicles in the privately owned vehicle sector increased from 6.8 in 1985 to 53.4 in 1997.

Figure 1. Total Number of In-Use Passenger Vehicles Compared to All In-Use Vehicles in China During 1985-1998

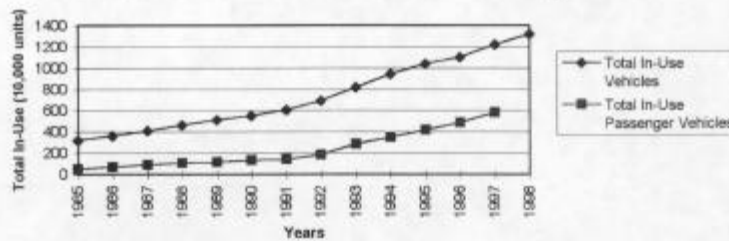
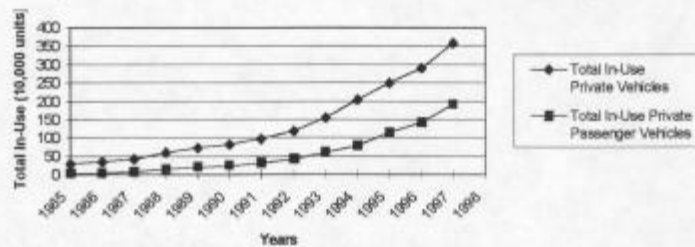


Figure 2. Total Number of Privately Owned Passenger Vehicles Compared to All Privately Owned Vehicles in China During 1985-1997



In 1998, the actual vehicle production capacity of the eight largest vehicle companies in China was approximately 1,050,000 vehicles, but the actual production was only about 521,000, which is 50% of the actual capacity ("Automotive Industry Research", No 4, P18, 1998, "Automotive Industry Research", No 2, P7, 1999 and "Automobile Information", No 1, P1, 1998). This, however, does not imply that the potential car market is not big enough to accommodate more vehicles but some obstacles such as purchase cost, transportation infrastructure, road use taxes, loan availability and government policies have reduced the number of potential customers.

For example, the tax rate for cars is more than the vehicle cost in some Chinese cities. Before 1998, the Shanghai government implemented a policy to charge private car purchasers a one-time license fee ranging from 100,000 to 160,000 RMB to discourage the purchase of privately-owned vehicles and lessen pressure on the city traffic system.

The economic development in China is very different from region to region. The Chinese government has divided the country into three regions on the basis of their economic strength. They are the eastern most developed region, the central developing region and the western less-developed region. Provinces, autonomous districts and municipalities for each region are listed in Table 1. Table 2 shows the comparison of the economic growth of these three regions.

Table 1. District Distribution in China's Three Economic Regions

REGIONS	ECONOMIC LEVEL	PROVINCES, MUNICIPALITIES & AUTONOMOUS DISTRICTS	TOTAL
Eastern	More developed	Beijing, Tianjin, Shanghai, Hebei, Liaoning, Shandong, Jiangsu, Zhejiang, Fujian, Guangdong, Hainan	11
Central	Developing	Heilongjiang, Jilin, Shanxi, Henan, Hubei, Hunan, Shaanxi, Sichuan, Jiangxi, Anhui	10
Western	Less developed	Inner Mongolia, Tibet, Xinjiang, Ningxia, Guangxi, Guizhou, Yunnan, Qinghai, Gansu	9

Table 2. A Comparison of Regional Economic Growth in the Three Regions

ECONOMIC BENCHMARKS	EAST	CENTRAL	WEST
GNP Ratio: 1994/1980	19.9	16.2	15.8
Average Annual Rate of Industrial Development (1985-1994) Relative to that of the Western Region	1.42	1.06	1.00
Percentage of Total Industrial Production (1985) (%)	46.3	40.9	12.8
Percentage of Total Industrial Production (1993) (%)	68.8	23.3	7.9
Percentage Increase of Small Business (1990 to 1995) (%)	48.0	29.2	16.5
Percentage Increase in Capital Investment (1982 to 1992) (%)	21.7	16.1	18.3
Percentage of Total Capital Assets (1993)	58.3	28.8	12.9
Distribution of 100 Richest Counties (1995)	98	2	0

The vehicle purchasing power depends mainly on the economic strength of these regions. Tables 3 (China Bureau of Statistics, Internet Home Page at www.stats.gov.cn and China Annual Statistics-1996) and Table 4 ("Shanghai Auto", No 4, P41-43, 1996) show the regional percentages of China's GDP and regional distribution of total cars in use respectively. It is easy to see that they correlate to each other very well.

Table 3. Regional Percentage of China's GDP (%)

Year	Eastern China	Central China	Western China
1990	51.1	37.0	11.9
1992	53.6	34.7	11.7
1994	54.9	33.7	11.4
1997	55.3	34.5	10.2
Average	53.7	35.0	11.3

Table 4. Regional Distribution of In-Use Cars in China (%)

Year	Eastern China	Central China	Western China
1990	61.0	28.1	10.9
1992	58.1	29.8	12.1
1994	59.5	29.2	11.3
Average	59.5	29.0	11.4

In order to have a better understanding of the differences in the vehicle types among these three regions, Shanghai Jiaotong University students were employed to determine the current distribution of compact, mid-size and full-size/luxury vehicles in several representative cities in eastern, central and western China. Photographs were taken of vehicle traffic on the main roads of these cities at 5-minute intervals and later analyzed to help develop a database for this statistical study. Each photograph was taken to allow vehicle counts over 40-meter sections of the road. The Xiali, Santana and imported models such as the Buick, Taurus, Camry and Mercedes were taken as representative of compact, mid-size and full-size cars, respectively. These results are presented in Table 5.

The investigation confirmed that the number of cars in the eastern region is much higher than in the central and the western regions. Beijing and Shenzhen had the highest numbers of full-size cars. The vehicles chosen by the taxi companies in these cities have a great influence on the vehicle distribution.

FUTURE TRENDS IN CHINA

SPSS software was used to help predict future regional and national growth trends for population, economics and the vehicle market using published data from the State Statistical Bureau (China Annual Statistics-1996). Our projected data agree well with those published by Chinese government organizations.

Table 5. Distribution of Vehicle Types in Chinese Cities (1997)

REGION	CITY	Cars (Units)				Mini & Medium Buses	Others	Total
		Compact (A-B)	Mid-Size (C)	Full-Size (D) & Luxury	Total			
Eastern Region	Beijing	57	73	26	156	90	40	286
	Tianjin	47	56	5	108	148	10	266
	Shijiazhuang	47	31	3	81	33	13	127
	Dalian	7	72	7	86	22	5	113
	Shenyang	2	48	4	54	12	10	76
	Nanjing	8	24	7	39	13	30	82
	Hangzhou	53	26	4	83	25	12	120
	*Shanghai	0	92	11	103	16	15	134
	Jina	23	38	14	75	72	11	158
	Shenzhen	20	70	24	114	37	18	169
	Hainan	46	17	12	75	33	20	128
Average		28	50	11	89	46	17	151
Central Region	Harbin	37	37	16	90	32	35	157
	Changchun	14	12	10	36	6	3	45
	Taiyuan	2	6	9	17	41	7	65
	Zhenzhou	1	17	5	23	48	6	77
	*Wuhan	14	13	8	35	14	12	61
	Changsha	8	12	4	24	3	17	44
	Xi'an	50	12	5	67	19	4	90
	Chongqing	40	30	6	76	33	29	138
	Hefei	15	20	2	37	3	1	41
Average		20	18	7	45	22	13	80
Western Region	Lanzhou	8	11	5	24	19	13	56
	Guizhou	5	15	4	24	21	13	58
	Xining	0	6	4	10	41	7	58
	Yinchuan	1	21	4	26	28	7	61
	Tianshui	5	11	2	18	21	13	52
	Urumqi	45	15	18	78	49	1	128
Average		11	13	6	30	30	9	69

* These two cities have developed good elevated freeway systems to reduce the inner-city traffic flow, therefore the sampling conditions of these two cities differed from those of other cities. The numbers shown in the Table 5 for these two cities may not be used for direct comparison with those obtained from other cities in the Table.

Population Growth and Distribution - China's population growth has a direct influence on the Chinese economy, especially on the average national income (ANI) and gross domestic products (GDP) per capita. Tables 6 provides a forecast of national and regional population growth in China up to the year 2010.

Table 6. Regional Projection of Population Growth in China (Millions)

YEAR	1996	1997	1998	1999	2000	2001	2002	2003
Eastern	454.7	460.4	466.2	471.9	477.7	483.5	489.2	495.0
Central	561.2	568.3	575.4	582.5	589.6	596.7	603.8	610.9
Western	197.1	199.9	202.6	205.4	208.2	211.0	213.8	216.6
Total	1213.0	1228.6	1244.3	1259.9	1275.5	1291.2	1306.8	1322.5
YEAR	2004	2005	2006	2007	2007	2009	2010	
Eastern	500.7	506.5	512.3	518.0	523.8	529.5	535.3	
Central	618.0	625.1	632.2	639.3	646.4	653.5	660.6	
Western	219.4	222.2	224.9	227.7	230.5	233.3	236.1	
Total	1338.1	1353.8	1369.4	1385.1	1400.7	1416.3	1432.0	

Economic Forecast - Tables 7, 8 and 9 provide projections on China's national and regional economy in terms of major economic parameters. Published 1990 prices and the deflation indices between years were used as the base for these projections (China Annual Statistics-1996).

Table 7. Projected Economic Growth - China

YEAR	At Current Prices					At 1990 Prices				
	GNP	GDP	NI	Per Capita GDP	ANI	GNP	GDP	NI	Per Capita GDP	ANI
	(RMB 100 Million Yuan)			(RMB Yuan)		(RMB 100 Million Yuan)			(RMB Yuan)	
1996	66032.1	66906.5	37673.2	5433.6	3059.5	34380.4	36113.6	25172.8	2932.9	2044.3
1997	78076.2	79241.1	43753.7	6356.2	3509.6	37569.3	40036.2	27420.2	3211.4	2199.5
1998	91298.0	92790.5	50769.8	7352.5	4022.9	41015.7	44272.0	29859.7	3508.0	2366.0
1999	105697.4	107554.5	58866.3	8420.0	4608.4	44735.6	48820.8	32505.9	3822.0	2544.7
2000	121274.6	123533.2	68212.2	9556.1	5276.7	48746.0	53682.8	35374.3	4152.7	2736.4
2001	138029.5	140726.6	79004.6	10758.4	6039.8	53065.9	58857.8	38482.2	4499.6	2941.9
2002	155962.1	159134.7	91473.5	12024.7	6912.0	57717.6	64345.9	41848.0	4862.2	3162.2
2003	175072.4	178757.5	105887.3	13352.6	7909.4	62717.4	70147.1	45492.1	5239.8	3398.1
2004	195360.4	199595.0	122559.0	14740.2	9051.0	68095.5	76261.4	49436.5	5631.9	3650.9
2005	216826.1	221647.2	141853.9	16185.3	10358.6	73876.1	82688.9	53704.9	6038.2	3921.7
2006	239469.5	244914.1	164198.1	17686.2	11857.4	80087.9	89429.4	58323.5	6458.0	4211.8
2007	263290.6	269395.6	190088.8	19240.9	13576.6	86762.2	96482.9	63320.5	6891.0	4522.5
2008	288289.4	295091.9	220106.0	20847.7	15550.1	93932.7	103849.6	68726.7	7336.8	4855.4
2009	314465.9	322002.8	254926.4	22505.0	17817.0	101636.6	111529.4	74575.6	7794.9	5212.1
2010	341820.1	350128.5	295339.5	24211.0	20422.4	109913.8	119522.3	80903.4	8264.9	5594.4

(GNP - Gross National Product, GDP - Gross Domestic Product, NI - National Income, ANI - Average National Income)

Table 8. Projected Per Capita GDP Growth – China's Three Economic Regions

Year	Per Capita GDP (Unit: RMB Yuan)					
	At Current Prices			At 1990's Prices		
	East	Central	West	East	Central	West
1997	9919.0	4709.6	4205.9	4854.3	2368.3	2081.8
1998	11642.8	5466.6	4866.6	5324.7	2570.7	2258.7
1999	13500.6	6279.8	5573.9	5822.8	2784.7	2445.5
2000	15487.2	7147.2	6326.1	6347.9	3009.6	2641.7
2001	17598.2	8066.9	7121.1	6899.2	3245.0	2846.7
2002	19828.9	9037.0	7957.3	7476.0	3490.4	3059.9
2003	22175.3	1055.7	8833.1	8077.3	3745.4	3281.2
2004	24633.3	11121.4	9746.9	8702.9	4009.4	3510.2
2005	27199.0	12232.4	10697.2	9351.4	4282.2	3746.6
2006	29868.8	13387.2	11682.6	10022.6	4563.4	3990.1
2007	32639.2	14584.3	12701.9	10715.6	4852.6	4240.2
2008	35506.7	15822.4	13753.7	11429.8	5149.6	4496.6
2009	38468.3	17100.0	14836.8	12164.7	5454.0	4758.8
2010	41520.8	18416.0	15950.1	12919.6	5765.4	5027.5

Table 9. Projected ANI Growth – China's Three Economic Regions

Year	ANI (Unit: RMB Yuan)					
	At Current Prices			At 1990 Prices		
	East	Central	West	East	Central	West
1997	4684.0	2293.9	2400.9	3169.2	1513.9	1434.4
1998	5361.6	2575.3	2761.2	3425.2	1592.0	1526.1
1999	6138.2	2891.2	3176.3	3702.3	1674.2	1624.1
2000	7028.3	3245.7	3654.6	4002.3	1760.6	1728.8
2001	8048.6	3643.7	4205.8	4327.1	1851.7	1840.6
2002	9218.2	4090.6	4841.0	4678.8	1947.5	1960.0
2003	10559.3	4592.3	5573.4	5059.6	2048.3	2087.6
2004	12097.0	5155.8	6417.7	5472.0	2154.5	2224.0
2005	13860.5	5788.6	7391.2	5918.7	2266.4	2369.7
2006	15883.2	6499.5	8513.9	6402.6	2384.1	2525.4
2007	18203.2	7298.0	9808.8	6926.7	2508.1	2691.8
2008	20864.8	8195.2	11302.6	7494.6	2638.8	2869.6
2009	23918.4	9203.2	13025.9	8109.9	2776.3	3059.8
2010	27422.1	10336.1	15014.2	8776.6	2921.3	3263.0

Several conclusions were developed regarding the development of China's PUC market, using data developed from the historical development of the automotive industry in Western countries and the economic projections developed above and other sources (Li Hong, "Economic Analysis of China's Automotive Industry", 1993):

- Wealthy families will begin purchasing PUCs when the ANI exceeds US \$500 (RMB 4,100 at 1990 prices, assuming a 8.2 exchange rate of RMB to the US dollar).

- The PUC market will begin to expand rapidly when the ANI reaches US \$800-1,000 (RMB 6,560-8,200 at 1990 prices, 8.2 exchange rate of RMB to the US dollar).
- The automotive industry will become the pillar industry of that country when the average per capita GDP exceeds US \$3000 (RMB 24,600 at 1990 prices, 8.2 exchange rate of RMB to the US dollar).

The World Bank forecasts that China's per capita GDP will reach US \$850 in 2005, which is close to our forecast of US \$736 (RMB 6,038 at 1990 prices, assuming a 8.2 exchange rate of RMB to the US dollar). Using 1990 prices as the base, the per capita GDP and ANI for China in 2010 will be US \$1008 and US \$826, respectively. These numbers are relatively low, indicating some rich families will own PUCs, however the national automotive industry can not become a pillar industry until somewhere around 2015.

The projected per capita GDP and ANI for the eastern region in 2010 will be higher than those of China as a whole. They are US \$1,557 and US \$1,057, respectively. These data suggest that the automotive industry still can not become a pillar industry in the entire eastern region. However, the ANI will reach a level that will allow many average families to purchase PUCs. The statistical models predict that Shanghai, Jiangsu, Zhejiang, Fujian, Guangdong and Hainan will be the fastest developing areas in the eastern region of China. The per capita GDP of Shanghai exceeded US \$3,000 in 1997, creating the automotive industry as the top pillar enterprise in that city.

Vehicle Market Forecast - Table 10 provides a forecast for the total numbers of in-use vehicles and cars up to the year of 2010, as based upon models developed using published statistical data (China Annual Statistics-1996). Using the data in Table 10, we also projected the market demands for cars and all vehicles for the same period of time. The market demands were determined by adding the replacement vehicles to the new vehicles. The new vehicle demand was calculated by determining the difference between this year and last year's numbers for the total in-use vehicles, which can be obtained from Table 10. The replacement vehicle demand is the product of last year's number of the total in-use vehicles and the vehicle scrap rate. Different scrap rates were used for the vehicle and the car in different periods of time. The results are shown in Table 11.

Table 10. Projected Total In-Use Vehicles and Cars (10,000 units)

Year	1996	1997	1998	1999	2000	2001	2002	2003
All Vehicles	1138.7	1276.9	1431.9	1605.5	1800.2	2018.3	2262.9	2537.1
Cars	314.8	366.3	426.0	495.1	575.2	668.0	775.5	900.1
Year	2004	2005	2006	2007	2008	2009	2010	
All Vehicles	2844.3	3188.8	3574.9	4007.7	4492.8	5036.5	5646.1	
Cars	1044.5	1211.8	1405.7	1630.3	1890.5	2192.1	2541.5	

Table 11. Projected Market Demands for All Vehicles and Cars (10,000 units)

Year	1996	1997	1998	1999	2000	2001	2002	2003
All Vehicles	184.22	206.53	231.53	259.56	299.01	335.19	375.76	421.23
Cars	60.66	70.37	81.63	94.68	112.28	130.19	150.96	175.01
Year	2004	2005	2006	2007	2008	2009	2010	
All Vehicles	472.20	529.33	593.36	665.15	745.61	835.80	936.90	
Cars	202.89	235.19	272.61	315.98	366.22	424.45	491.91	

These numbers are in good agreement with those of the China State Information Center which projects that by the year 2000, China's total vehicle volume will reach 18 to 21 million units, while the vehicle market demand will be in the range of 2.5 to 3.0 millions. The total number of in-use cars will be 6.0 to 7.0 millions while the car market demand should be 1.2 to 1.3 million by the same year. By the year 2010, these numbers were projected to increase to 44 to 50 million, 6.0 to 7.0 million, 22 to 27 million and 3.5 to 4.4 million, respectively.

China is becoming one of the world's largest automotive markets. The vehicle customer structure and preference for the types of vehicles are changing with the development of China's economy. Tables 12 ("China Auto Information", No 615) and Table 13 ("China Auto Information", No 621) provide projections of these changes. Our projections in Table 12 show that B-C size cars now comprise about 70% of the total car market in China and their dominance will remain at these levels for many years to come. The optimum engine displacement will be in the 1.3-1.6 L range for these vehicles.

Table 12. Trends in Automobile Demand by Vehicle Class in China (% of Total)

Year	Subcompact (A) (< 1.0 L)	Compact (B) (1.0-1.6 L)	Mid-Size (C) (1.3-1.8 L)	Full Size (D) (>2.0 L)
1997	27.0	10.9	57.5	4.6
1998	27.1	14.1	54.2	4.6
2000	26.5	21.2	46.8	5.5
2005	25.1	28.7	40.6	5.6
2010	24.5	33.8	36.3	5.4

Table 13. Projected Trends for the Use of Automobiles in China

Year	Governmental Organizations, Enterprises	Business	Taxi, Rental	Personal
1997	18.9	38.0	23.5	19.6
1998	17.2	37.5	23.2	22.1
2000	15.2	36.7	22.1	26.0
2005	12.8	34.4	20.4	32.4
2010	10.3	31.3	18.9	39.5

Table 13 provides projected trends for the use of automobiles in China. The purchase of vehicles for personal use will increase from a current level of about 22% to nearly 40% of the total market in 2010.

Transportation Infrastructure – It will be necessary to accelerate the development of China's road infrastructure to achieve these forecasts. For example, the vehicle population in China increased by 220% between 1990 and 1997, while total road length only increased by 20% in the same period.

Many of China's cities have significantly fewer roads than cities in the mature markets. For example, Shanghai is one of the most congested cities in the world. The ratio of road to city area is only 3.8%, compared to Los Angeles where this ratio is 25%.

The shortage of parking spaces in China's big cities is also a big problem that will need to be addressed. It is estimated that the existing parking areas in Beijing can meet only about 10% of the demand. Many residential and shopping areas in some big cities don't have parking spaces within close proximity. The annual rent for a parking spot in downtown Shanghai is approximately 6,000 RMB. However, the cost of buying a parking spot for one car in the same region can be as high as 250,000 RMB.

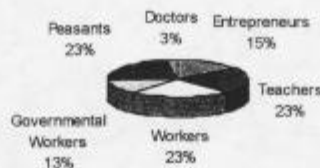
MARKET STUDY OF THE PROSPECTIVE CHINESE CUSTOMERS

Background on Families Surveyed - Several investigations and surveys were performed to better understand China's PUC market with a focus on the eastern region.

1. PUC Market Survey of 500 Families in the Eastern Region

The professional distribution of the families surveyed is shown in Figure 3.

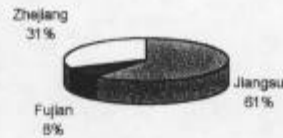
Figure 3. Professional Distribution of Families



2. PUC Market Survey in Rural Areas of the Three Provinces in the Eastern Region

We believe that the rural areas in China's eastern region are becoming a very important PUC market. Therefore, 968 families in Zhejiang, Jiangsu and Fujian Province were investigated, representing 3887 people. The distribution of the families surveyed is shown in Figure 4.

Figure 4. Regional Distribution of Families Surveyed (968 Total)



3. PUC Market Survey in Five Rich Cities and Counties

Five groups of students from Shanghai Jiaotong University were sent to Nanhui and Fengxian County of Shanghai Municipality, Wenzhou and Yiwu City in Zhejiang Province and Jiangyin City in Jiangsu Province to meet car owners and potential future car purchasers. Twenty-five families, classified as rich by Chinese standards, were surveyed in each area.

Affordability and Expense Preference - Tables 14 and 15 present the 1997 gross income and primary family expenses for the families surveyed in the five counties and cities, respectively. Figure 5 shows the 1998 family income distribution of the three provinces. Figure 6 reveals the future major purchase priority from the 500 family survey.

Table 14. Family Gross Income in 1997

No.	Gross Income (Yuan)	Nanhui (%)	Fengxian (%)	Wenzhou (%)	Yiwu (%)	Jiangyin (%)
1	Below 10,000	4	0	0	7	20
2	10,000 - 20,000	28	24	3	19	36
3	20,000 - 30,000	24	60	7	20	28
4	30,000 - 50,000	40	16	10	18	12
5	50,000 - 65,000	4	0	50	16	4
6	Above 65,000	0	0	30	20	0

Table 15. Major Expenses of Family

No.	Consumption Type	Nanhui (%)	Fengxian (%)	Wenzhou (%)	Yiwu (%)	Jiangyin (%)
1	Housing	33	42	35	36	36
2	Car	37	6	35	28	12
3	High-End Commodity	7	23	11	18	16
4	Family Support	19	19	14	13	28
5	Others	4	10	5	5	8

Figure 5. Distribution of Family Income by Province (1998)

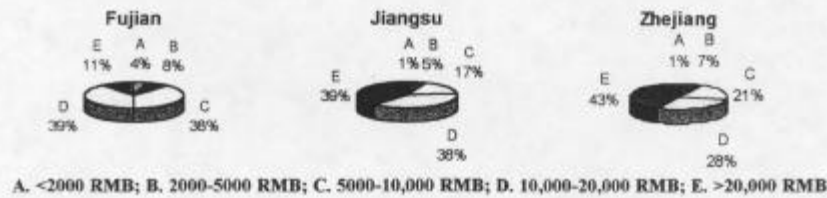
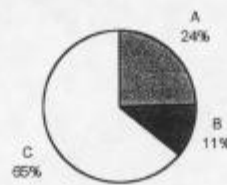


Figure 6. Most Desired Future Major Purchases



A. Electronic Goods; B. Car; C. Home

Eighty percent of the families surveyed in Wenzhou have an annual family income of 50,000 and above (Table 14). These families are already able to afford a car with a price of about 80,000 RMB and above. Most (50-77%) of the families surveyed in Jiangsu, Zhejiang and Fujian have more than 10,000 RMB annual income (Figure 5). These families incomes are relatively lower than those in Shanghai, Beijing and Guanzhou. However, more than 90% of the families in Fujian and Zhejian have motor vehicles. One main reason is that the public transportation in these two provinces is less developed compared to that in Jiangsu Province where only 50% of the families surveyed own a motor vehicle.

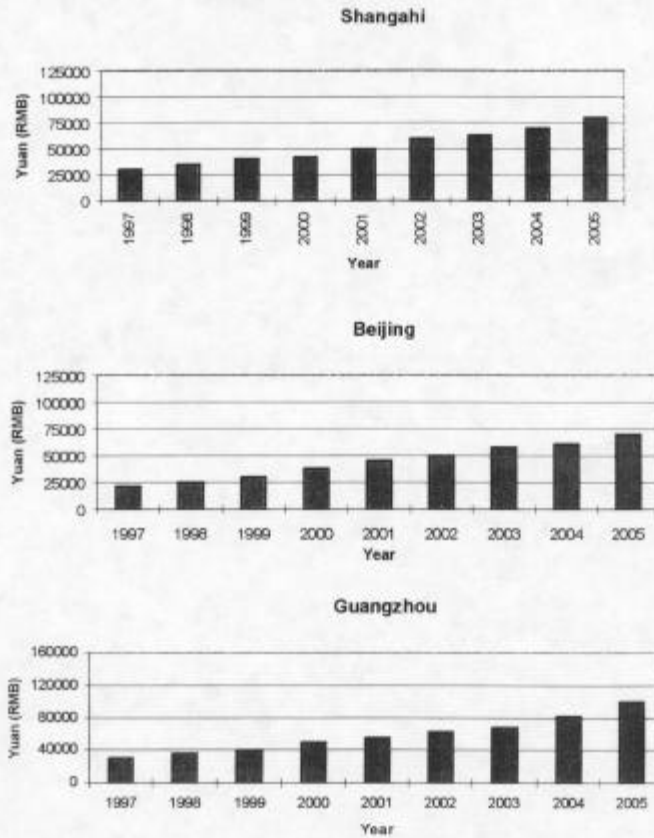
About 65% of the 500 families investigated in the eastern region (Figure 6) selected housing as their top priority of expense compared to 11% for cars. The percentages for housing and cars are quite comparable in the survey in Nanhui and Wenzhou where the income levels are relatively high (Table 15). It appears that housing will remain as the top expense priority for some years before the purchase of PUCs can reach the top of the expense priority list of the average family in the eastern region.

The students of Shanghai Jiaotong University also traveled to three well-known rich villages in the eastern region to investigate how the residents are collectively purchasing and using cars. These three villages are Huaxi Village and Dongbei Village in Jiangsu Province and Qizhong Village in the suburb of Shanghai Municipality. The Huaxi Village bought 50 to 150 cars collectively to be shared by all the villagers. Each family in the village can use the car free for a certain number of kilometers each year. The cars are

managed and maintained by the village administration. The villagers share all the costs. It appears that this pattern of car ownership is becoming more popular in the rural areas of the eastern region. The administrations of Dongbei and Qizhong Village organized the vehicle purchase, maintenance and after-sales service for their villagers collectively through Citron. The villagers still have the ownership of the cars.

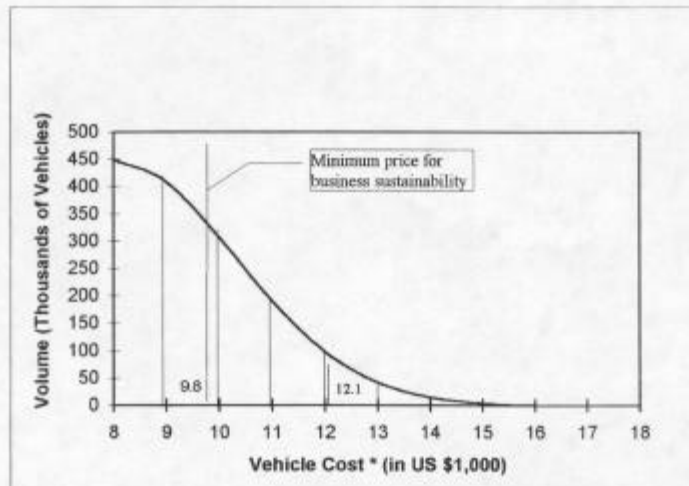
PUC affordability and Market Volume - An American (age group 25-34) with an average annual income of US \$34,390 spends about US \$2,600 every year on the purchase of vehicles (Hanna, 1997). If the average time of the ownership of the vehicle is 6.0 years, he or she will spend US \$15,600 on new vehicles. The ratio of the new vehicle price to the annual income is 0.45. This estimate reflects the expense pattern in the US. In China, car loans are becoming available and people may keep using their vehicles for more years. It is, however, required by the Chinese Government that cars be scrapped after 9 years in service. Another factor that will also have great effects on the ability of a Chinese family to purchase a PUC is that most Chinese people save money for long time for the purchase of expensive merchandise. It was therefore projected that when a Chinese family makes the decision to purchase a vehicle, they would spend the equivalent of approximately 1.05 times their yearly annual income. This factor can be used with the projected income of families in Shanghai, Beijing and Guangzhou (Figure 7) to estimate the ability of these families to afford a PUC in year 2005. This analysis indicates that the average family in Shanghai, Beijing and Guangzhou will be able to afford a vehicle in the price range of 81,900-101,850 RMB (\$9,988 - \$12,421).

Figure 7. Projected Yearly Income of Families in Shanghai, Beijing and Guanzhou



A similar analysis was carried out for China in the year 2005. The market volume was determined from the people's ability to pay and their priority for purchase. Figure 8 shows the predicted market volume for the PUC as a function of vehicle cost. The minimum vehicle price to insure business sustainability was established to be \$9,800, as based upon a sales volume of 200,000 units/year for one PUC model. This model shows that a PUC priced in the range of US \$9,800-\$12,100 (80,360-99,200 RMB)(one standard deviation statistical range) (not including sales taxes) could reach a market level of 469,000 units in model year 2005 and comprise about 20% of the total car market.

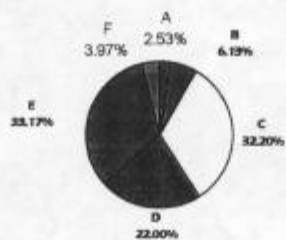
**Figure 8. Predicted Market Volume for the PUC (Year 2005)
as a Function of Vehicle Cost**



Most Desirable Vehicle Types and Attributes - The vehicle brand preference for the 500 families surveyed in the eastern region is summarized in Figure 9. It is notable that almost 87% of the families would buy a Santana, an Audi, or an imported vehicle if they were financially ready to purchase their first PUC. This indicates that families are willing to pay more for a vehicle that provides value and social status. The survey results from the five counties and cities also support this conclusion (see Table 16). Most families prefer a vehicle such as a Santana or better, with the exception of Fengxian County where the average annual family income is relatively low compared to the other cities or counties, leading to an apparently higher demand for Alto.

Table 17 shows the vehicle attributes desired by the families surveyed in the five counties and cities. Functionality, styling, price, comfort and safety were top customer wants. The results from the 500 family survey in the eastern region (see Figure 10) indicate that comfort and economy were the most important vehicle attributes.

Figure 9. Vehicle Type Preference (based on current vehicle choices)



A. Alto; B. Charade; C. Santana; D. Audi
 E. Imported Vehicles; F. Pick-ups and Others

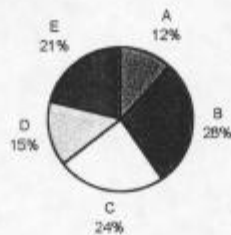
Table 16. Brand Preferences for PUCs in Selected Communities

No.	Name of Brand	Nanhui (%)	Fengxian (%)	Wenzhou (%)	Yiwu (%)	Jiangyin (%)
1	Alto	16	41	7	0	5
2	Charade	0	5	0	10	5
3	Citreon	3	0	7	2	5
4	Jetta	3	0	3	0	0
5	Santana	46	9	53	47	50
6	Audi	0	27	3	10	10
7	Red Flag	16	9	7	24	15
8	Other Car	16	9	17	7	10

Table 17. Most Desired Attributes and Features for the PUC

No.	Features and Attributes	Nanhui (%)	Fengxian (%)	Wenzhou (%)	Yiwu (%)	Jiangyin (%)
1	Practical and Convenient	17	18	22	10	19
2	Style	15	14	17	10	10
3	Transports 4-5 Persons	12	5	6	8	12
4	Large Trunk	5	0	1	52	2
5	Compact Structure	4	0	1	5	6
6	Good Fuel Economy	11	14	7	8	10
7	Safety	6	10	18	8	10
8	Adaptability to Diverse Roads	3	1	2	8	3
9	Good Performance on Freeway (120km/h)	3	1	0	6	2
10	Good Service	3	4	10	10	10
11	Good Function and Easy Maintenance	9	15	9	12	7
12	Low Price	12	18	7	10	9

Figure 10. Relative Importance of Various Vehicle Attributes



A. Reliability; B. Comfort; C. Economy; D. Style; E. Safety

Social and Cultural Factors - It is important to recognize that the traditional family in China has certain cultural and social differences from families in Western countries. These differences need to be taken into account for the development of the Chinese PUC. The Chinese family structure has been changing from one of traditional big families to small families, with one or two children. The young Chinese families have a much closer

relationship with their parents than in the Western countries. It is expected by 2010 that the parents of young successful families in the 25-45 age group will have PUCs. Therefore, the vehicle will often need to accommodate the children and/or grandparents.

There are other cultural differences that should be fully considered. A fastback design sometimes does not meet Chinese aesthetic standards. This design infers "having no children". It is also considered unlucky.

Table 18 shows the survey results from the five counties and cities for vehicle color preference. Black is the favorite color followed by red and blue.

Table 18. Most Desired Vehicle Colors

No.	Color	Nanhui (%)	Fengxian (%)	Wenzhou (%)	Yiwu (%)	Jiangyin (%)
1	Black	60	46	30	52	36
2	White	0	0	17	9	20
3	Red	20	38	30	18	24
4	Gray	4	8	13	3	4
5	Blue	16	8	10	18	16

PUC DESIGN AND DEVELOPMENT

From the investigations and surveys in the eastern region regarding potential customers wants for the PUC, it can be concluded that there will be basically three ways for Chinese families to use the PUC:

1. Most salaried workers in big cities will live in the suburbs or small towns around the city. They will drive to the nearest inner city public transportation and then use convenient public transportation to travel to their work places. Whole families will regularly drive to nearby towns or areas for sightseeing or other activities during the weekends and holidays.
2. Salaried workers, in small to medium-size cities, will mostly live in the city. They will drive to their work places, which are usually in the suburb or nearby towns around the city. During the weekend and holiday, the PUC will be used for shopping or traveling to nearby towns.
3. Rich peasants will use their cars for going to work, taking children to their schools and going to nearby towns or cities to do shopping and banking and visit friends.

From these patterns of PUC use and the statistical data presented in this paper, the basic requirements for the design and development of the PUC can be summarized as follows: