CHINESE MOTOR VEHICLE INDUSTRY:
TECHNOLOGY STRATEGY FOR THE FUTURE

by
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Submitted on August 5, 1988 in partial fulfillment of
the requirements for the Degrees of
Master of Science in Management and
Master of Science in Technology and Policy

ABSTRACT

The shifting comparative advantage and the development
logic of the world motor vehicle industry suggest a golden
opportunity for China to develop its motor vehicle industry
to the world level. While China has achieved some success in
building a domestic motor vehicle industrial base, it lags
far behind advanced countries in terms of product variety,
quality, and quantity.

A review of the history of the Chinese motor vehicle
industry has revealed that a fatal problem of the industry
is its fragmented structure due to governmental
compartamentalization. This structure prohibits economies of
scale, effectiveness of investment, and technology
development. Under current decentralization policy, the two
necessary conditions to rationalize the industry structure
are identified as further implementing market regime and
separation of ownership from management of state
enterprises.

Three strategies, or development paths are proposed for
different kinds of Chinese motor vehicle firms in terms of
scale and product scope (mix). The strategic choice between
high tech and high labor is also discussed with reference
to world level motor vehicle manufacturers. Finally, the
Beijing Jeep Corporation (BJC) is chosen as a case study of
learning occurred and change in human resource policies in a
joint venture context.

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Title: Lecturer, Sloan School of Management,
Research Director, International Motor
Vehicle Program, MIT

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Title: Assistant Professor,
Sloan School of Management
ACKNOWLEDGEMENTS

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Several dozen Chinese managers, engineers, and university professors were extremely hospitable and most generous with their time. They belong to the following organizations: China's National Automotive Industry Corporation (CNAIC), The Changchun No.1 Auto Works, Beijing Jeep Corporation (BJC), and Jilin University of Technology where I did my undergraduate work in the Department of Automotive
Engineering. I am especially grateful to Ms. Shen Xijin, Mr. Zhang Zheng and Mr. Cheng Yashun at CNAIC.

Special thanks also go to my teachers and friends both in China and in the United States; my wife Jing Chen for her care throughout the writing of the thesis; and my parents and brothers for their constant support.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Chapter/Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Abstract</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Acknowledgements</strong></td>
<td>3</td>
</tr>
<tr>
<td><strong>Table of Contents</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>List of Figures and Tables</strong></td>
<td>6</td>
</tr>
<tr>
<td><strong>Chapter 1. Introduction</strong></td>
<td>7</td>
</tr>
<tr>
<td>1.1 Motivations</td>
<td>7</td>
</tr>
<tr>
<td>1.2 Analytical Framework</td>
<td>17</td>
</tr>
<tr>
<td><strong>Chapter 2. Environmental Context</strong></td>
<td>20</td>
</tr>
<tr>
<td>2.1 The World Motor Vehicle Industry: A Century of Technology Transformations</td>
<td>20</td>
</tr>
<tr>
<td>2.2 The Chinese Government Policies</td>
<td>29</td>
</tr>
<tr>
<td>2.2.1 Science and Technology Policy</td>
<td>29</td>
</tr>
<tr>
<td>2.2.2 Economic Reform</td>
<td>36</td>
</tr>
<tr>
<td><strong>Chapter 3. Industry Level Analysis</strong></td>
<td>41</td>
</tr>
<tr>
<td>3.1 The Development of the Chinese Motor Vehicle Industry: The &quot;Auto Favers&quot;</td>
<td>41</td>
</tr>
<tr>
<td>3.2 Strategic Considerations</td>
<td>51</td>
</tr>
<tr>
<td>3.2.1 Government Compartmentalization and Industry Fragmentation</td>
<td>51</td>
</tr>
<tr>
<td>3.2.2 Scale vs. Scope</td>
<td>68</td>
</tr>
<tr>
<td>3.2.2.1 Scale Factor</td>
<td>68</td>
</tr>
<tr>
<td>3.2.2.2 Combination of Scale and Scope Factor</td>
<td>74</td>
</tr>
<tr>
<td>3.2.3 High Tech vs. High Labor</td>
<td>85</td>
</tr>
<tr>
<td><strong>Chapter 4. Firm Level Analysis: BJC as a Case Study</strong></td>
<td>94</td>
</tr>
<tr>
<td>4.1 Learning</td>
<td>94</td>
</tr>
<tr>
<td>4.1.1 Learning by People</td>
<td>94</td>
</tr>
<tr>
<td>4.1.2 Shortage of Personnel Prohibits Learning</td>
<td>96</td>
</tr>
<tr>
<td>4.1.3 Learning from the Japanese: Small Lot to Cut Inventory</td>
<td>100</td>
</tr>
<tr>
<td>4.2 Human Resource Management Policies</td>
<td>102</td>
</tr>
<tr>
<td>4.2.1 Strategic Issues</td>
<td>103</td>
</tr>
<tr>
<td>4.2.2 Operational Issues</td>
<td>111</td>
</tr>
<tr>
<td>4.3 Looking to the Future</td>
<td>115</td>
</tr>
<tr>
<td><strong>Chapter 5. Conclusions and Outlook</strong></td>
<td>121</td>
</tr>
<tr>
<td><strong>Bibliography</strong></td>
<td>128</td>
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# LIST OF FIGURES AND TABLES

<table>
<thead>
<tr>
<th>Figure/Table</th>
<th>Page</th>
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<tbody>
<tr>
<td>Figure 1. The Analytic Framework</td>
<td>18</td>
</tr>
<tr>
<td>Figure 2. Plant Scale/Product Scope Matrix</td>
<td>80</td>
</tr>
<tr>
<td>Table 1. Vehicle Production by Country, 1987</td>
<td>8</td>
</tr>
<tr>
<td>Table 2. China's Motor Vehicle Production (1955-1986)</td>
<td>9</td>
</tr>
<tr>
<td>Table 3. China's Motor Vehicles in Use (1965-1986)</td>
<td>10</td>
</tr>
<tr>
<td>Table 4. Chinese Auto Trade Balance, 1984-1986</td>
<td>12</td>
</tr>
<tr>
<td>Table 5. China Macroeconomic Indicators</td>
<td>16</td>
</tr>
<tr>
<td>Table 6. Chinese Mid-Load Truck Producers Data</td>
<td>53</td>
</tr>
<tr>
<td>Table 7. Chinese Light Truck Producers Data</td>
<td>54</td>
</tr>
<tr>
<td>Table 8. BJC Economic Performance</td>
<td>119</td>
</tr>
</tbody>
</table>
CHAPTER 1. INTRODUCTION

1.1 MOTIVATIONS

While the Chinese motor vehicle industry is at present nowhere close to the major players in the world motor vehicle industry on the level of production (See Table 1.) as well as technology, China presents the greatest potential in the world when you think about a country of one billion people being motorized to the same level as the United States.

In 1987, China produced 472,300 units motor vehicles. Compared with 222,288 units produced in 1980 (See Table 2.), this represents an average annual increase of 11.4 %, a high growth rate the Chinese motor vehicle industry has enjoyed for thirty years. The motor vehicle in use in China increased from 1.1 million in 1976 to 3.574 million in 1986 (See Table 3. ¹), indicating an average annual growth rate of 12.5 %. By the end of June 1986, 0.347 million motor vehicles were owned by private persons. This number was equal to about 10 % of vehicle in use in the nation, and

¹ The civilian motor vehicle in use in China reached 3.62 million units in 1987, according to Xinhua news.
## TABLE 1

**VEHICLE PRODUCTION BY COUNTRY, 1987**
(includes commercial vehicles)

<table>
<thead>
<tr>
<th>Country</th>
<th>Units Produced</th>
</tr>
</thead>
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<tr>
<td>Japan</td>
<td>12,249,174</td>
</tr>
<tr>
<td>USA</td>
<td>10,925,605</td>
</tr>
<tr>
<td>W. Germany</td>
<td>4,634,073</td>
</tr>
<tr>
<td>France</td>
<td>3,493,210</td>
</tr>
<tr>
<td>USSR</td>
<td>2,269,000</td>
</tr>
<tr>
<td>Italy</td>
<td>1,900,579</td>
</tr>
<tr>
<td>Spain</td>
<td>1,704,473</td>
</tr>
<tr>
<td>Canada</td>
<td>1,635,151</td>
</tr>
<tr>
<td>Great Britain</td>
<td>1,389,712</td>
</tr>
<tr>
<td>Belgium</td>
<td>1,196,174</td>
</tr>
<tr>
<td>S Korea</td>
<td>979,739</td>
</tr>
<tr>
<td>Brazil</td>
<td>928,422</td>
</tr>
<tr>
<td>Sweden</td>
<td>501,277</td>
</tr>
<tr>
<td>CHINA</td>
<td>472,300</td>
</tr>
<tr>
<td>Mexico</td>
<td>395,258</td>
</tr>
<tr>
<td>Yugoslavia</td>
<td>387,500</td>
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<tr>
<td>Poland</td>
<td>363,220</td>
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<tr>
<td>Australia</td>
<td>239,580</td>
</tr>
<tr>
<td>East Germany</td>
<td>277,000</td>
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<tr>
<td>Taiwan, China</td>
<td>224,184</td>
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<tr>
<td>Czechoslovakia</td>
<td>221,902</td>
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<tr>
<td>India</td>
<td>204,000</td>
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<tr>
<td>Argentina</td>
<td>193,316</td>
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<td>Netherlands</td>
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<tr>
<td>Portugal</td>
<td>94,770</td>
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<td>Hungary</td>
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### TABLE 2

**CHINA'S MOTOR VEHICLE PRODUCTION (1955-1986)**

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<td></td>
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<td></td>
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<tr>
<td>1957</td>
<td></td>
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<td>1958</td>
<td>57</td>
<td>75</td>
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<td>5,325</td>
<td>19,601</td>
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<td>98</td>
<td>569</td>
<td>21,294</td>
<td>4,146</td>
<td>22,440</td>
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<td>5</td>
<td>290</td>
<td>3,169</td>
<td>423</td>
<td>3,592</td>
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<td>1962</td>
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<td>311</td>
<td>9,160</td>
<td>1,363</td>
<td>9,423</td>
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<td>20,500</td>
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<td>27,542</td>
<td>6,787</td>
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<td>11,516</td>
<td>50,570</td>
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<td>302</td>
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<td>599</td>
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<td>20,300</td>
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<td>1968</td>
<td>279</td>
<td>1,599</td>
<td>19,076</td>
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<td>40,616</td>
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<td>18,585</td>
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<tr>
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<td>12,750</td>
<td>83,616</td>
<td>25,548</td>
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<td>661</td>
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<td>82,102</td>
<td>21,609</td>
<td>108,393</td>
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<tr>
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<td>15,086</td>
<td>88,070</td>
<td>23,667</td>
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<td>23,540</td>
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<td>1978</td>
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<td>1982</td>
<td>4,030</td>
<td>15,326</td>
<td>164,330</td>
<td>42,541</td>
<td>206,871</td>
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<tr>
<td>1983</td>
<td>6,046</td>
<td>18,247</td>
<td>199,363</td>
<td>62,263</td>
<td>261,626</td>
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<tr>
<td>1984</td>
<td>6,010</td>
<td>16,553</td>
<td>265,194</td>
<td>85,348</td>
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<td>1985</td>
<td>5,707</td>
<td>20,747</td>
<td>351,003</td>
<td>114,069</td>
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<td>1986</td>
<td>10,765</td>
<td>25,271</td>
<td>228,304</td>
<td>71,821</td>
<td>372,125</td>
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</table>

(1) Includes buses and other types of vehicles.

*CHINA AUTOMOTIVE TECHNOLOGY AND RESEARCH CENTER*
### TABLE 3

**CHINA'S MOTOR VEHICLE IN USE (AS OF JUNE)**

<table>
<thead>
<tr>
<th>Year</th>
<th>Car &amp; Light Buses</th>
<th>Trucks Gas</th>
<th>Trucks Diesel</th>
<th>Total Motor Vehicles</th>
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<td>30,124</td>
<td>188,909</td>
<td>22,160</td>
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<tr>
<td>1966</td>
<td>30,665</td>
<td>202,871</td>
<td>24,481</td>
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<td>31,742</td>
<td>205,964</td>
<td>23,122</td>
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<td>1968</td>
<td>31,551</td>
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<td>24,461</td>
<td>246,197</td>
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<tr>
<td>1969</td>
<td>35,914</td>
<td>252,068</td>
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<td>281,112</td>
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<tr>
<td>1970</td>
<td>50,851</td>
<td>334,143</td>
<td>37,303</td>
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<td>1971</td>
<td>47,994</td>
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<td>44,207</td>
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<td>1972</td>
<td>59,519</td>
<td>514,209</td>
<td>49,835</td>
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<td>1973</td>
<td>71,998</td>
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<td>64,779</td>
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<td>1976</td>
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<td>903,464</td>
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<td>143,014</td>
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<td>286,775</td>
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<td>1984</td>
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<td>1,741,649</td>
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<td>761,086</td>
<td>2,305,432</td>
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<td>2,813,377</td>
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(1) Includes buses and other types of vehicles.

CHINA AUTOMOTIVE TECHNOLOGY AND RESEARCH CENTER
about the same as the number of motor vehicles in all state-run transportation companies.\textsuperscript{2} One has to appreciate the speed of building up the number of privately owned motor vehicles by considering the fact that just four years before, that number was exactly zero, because the government did not allow private ownership of motor vehicles until 1982. While the growth rate of domestic motor vehicle production is high, it still could not satisfy the increasing demand. Prices of motor vehicle products soured. Foreign imports flooded in, especially in 1984 and 1985 (See Table 4.), which were partially responsible for the mounting trade deficit two years ago. Despite some rationalization measures, the industry is further fragmented. More new establishments sprung up to further increase the already large number of existing motor vehicle manufacturers, which in 1986 was one hundred and sixteen.

The Chinese government recently demonstrated its determination to promote its motor vehicle industry. Several steps have been taken. First was the decision made on May 29, 1987 by the State Council to change the function of China National Automotive Industry Corporation (CNAIC), from the national "firm" managing the motor vehicle sector in detail, to a "federation" serving the motor vehicle enterprises by information sharing, by coordinating their

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<th>Exports</th>
<th>Deficit</th>
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<td></td>
<td></td>
<td>Units</td>
<td>Value (k$)</td>
<td>Units</td>
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<td>Parts</td>
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<td>1986</td>
<td>Vehicles</td>
<td>229,948</td>
<td>2,180,335</td>
<td>n.a.</td>
</tr>
<tr>
<td></td>
<td>Parts</td>
<td>297,392</td>
<td></td>
<td>n.a.</td>
</tr>
</tbody>
</table>

Source: Year Book of China's Foreign Trade, 1985, 1986
activities, and by making recommendation to the governments in the processes of decision making. This change aimed at decentralization. Second important step was the decision, announced shortly after the first one, to establish the State Council Coordinating Group for Promoting Motor Vehicle Industry, headed by Vice Premier Yac Yilin. These moves were made not only because there exists a striking discrepancy between the backwardness of the industry and the increasing domestic demand for product variety, quality, and quality, but also because the examples set by Japan and Asian NICs have demonstrated that the motor vehicle industry can play a strategic role in national economic growth.

The Chinese government reassured the world that the "open-door" policy still applies to the motor vehicle industry and that foreign investment and assistance in technology transfer are still welcomed. This is because lessons learned from the last decades exclude the "do-it-alone" option, although experiences over the past ten years in terms of the introduction of foreign technology have not been uniformly positive.

Meanwhile, a heightened interest in the Chinese motor vehicle industry is emerging among the world major motor

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vehicle manufacturers. In a conversation with a high level executive at a major American auto corporation, I was told that his firm has sent about four hundred people to China every year for the past several years looking for business. In return, more than one thousand Chinese visitors have come to visit his firm in the United States each year for the same purpose. Since the third transformation in the world motor vehicle industry in late 1970s\textsuperscript{5} introduced by the Japanese, motor vehicle producers in North America and Europe have increasingly been interested in overseas production in developing countries, including China, to regain competitive edge. China's attractiveness lies in its potentially vast market and its low cost in labor. Now, the interest in China is being elevated by the intensified global competition in the motor vehicle industry. In North America, for example, a flood of Japanese transplants and new entrants with low cost foreign production bases are competing with American firms in a market that has shown little growth. This has resulted in a serious overcapacity problem; M.I.T.'s International Motor Vehicle Program estimates automotive assembly overcapacity in North America at 4 million units by the year 1990.\textsuperscript{6} This conservative estimate represents roughly 37\% of 1990 capacity.

\textsuperscript{5} Altshuler et al., Chapter 2.

\textsuperscript{6} O'Donnell and Hussey, p.16.
China promises an opportunity for the motor vehicle industry. China's rapid economic development (See Table 5.) may suggest that one of the world's largest homogeneous motor vehicle market may come to be true much sooner than many people might have anticipated. How this opportunity can be translated into reality presents a real challenge to the Chinese.

The key issue is technology: the motor vehicle industry is a highly technology-intensive industry. This is so not only because of the sophistication of knowledge involved in vehicle designs and fabricating components, but also because of the complexity in designing managerial systems to control the quality and cost of production, 7 and the increasing difficulty involved in the organization of the activities of the industry due to its size and its trend toward internationalization. 8

How can a strategy to technologically transform the Chinese industry to world class be devised rapidly? What opportunity exists for foreign participation? The purpose of this thesis is to shine some light on these strategic issues. Limited by the time and scope of the work, it does not

7 Jack Baranson, p.41.
8 Womack, Multinational Joint Ventures in Motor Vehicles.
<table>
<thead>
<tr>
<th>Year</th>
<th>GNP (Rmb bn at 1986 prices)</th>
<th>GNP per caput (Rmb at 1986 prices)</th>
<th>Population (bn)</th>
<th>Merchandise exports $ bn</th>
<th>Merchandise imports $ bn</th>
<th>Current account $ bn</th>
<th>Consumer price inflation %</th>
<th>External debt $ bn</th>
<th>Reserves excl. gold $ bn</th>
<th>Exchange rate (av) Rmb per $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1982</td>
<td>548.1</td>
<td>1.423</td>
<td>1.025</td>
<td>21.1</td>
<td>16.9</td>
<td>5.8</td>
<td>1.9</td>
<td>5.7</td>
<td>11.3</td>
<td>1.893</td>
</tr>
<tr>
<td>1983</td>
<td>608.4</td>
<td>1.515</td>
<td>1.358</td>
<td>20.7</td>
<td>18.7</td>
<td>4.5</td>
<td>2.1</td>
<td>2.1</td>
<td>14.6</td>
<td>1.476</td>
</tr>
<tr>
<td>1984</td>
<td>725.8</td>
<td>1.786</td>
<td>1.91</td>
<td>23.9</td>
<td>23.9</td>
<td>2.5</td>
<td>7.2</td>
<td>6.3</td>
<td>15.1</td>
<td>2.03</td>
</tr>
<tr>
<td>1985</td>
<td>870.1</td>
<td>2.109</td>
<td>1.403</td>
<td>25.1</td>
<td>38.2</td>
<td>-11.4</td>
<td>2.7</td>
<td>2.7</td>
<td>12.7</td>
<td>3.65</td>
</tr>
<tr>
<td>1986</td>
<td>938</td>
<td>2.609</td>
<td>1.702</td>
<td>30.9</td>
<td>42.9</td>
<td>-6.5</td>
<td>6.7</td>
<td>6.7</td>
<td>11.3</td>
<td>3.97</td>
</tr>
<tr>
<td>1987</td>
<td>1022</td>
<td>3.209</td>
<td>1.072</td>
<td>40</td>
<td>43.9</td>
<td>2</td>
<td>7</td>
<td>2.5</td>
<td>14.3</td>
<td>3.72</td>
</tr>
</tbody>
</table>

Source: The Economist's Intelligence Unit Country Report
intend to forecast China's domestic demand for motor vehicles and simply assume that China has a need to develop a world-class domestic motor vehicle industry. Nor does this thesis set out to formulate a comprehensive strategic plan for the Chinese industry to implement. There are many other very important issues in the motor vehicle industry that will not be even touched here at all.  

Nevertheless, it is hoped that this exercise will provide useful information and analysis for decision makers in the industry and for people who share similar interests.

1.2 Analytical Framework

The meaning of the term "technology", as used in this thesis, is broad. It refers not merely to the package of product designs, process and production techniques-- "hard" technology. Managerial and organizational system innovations -- "soft" technology, in a sense-- will also be included.

The technology strategy for the development of the Chinese motor vehicle industry is discussed in an analytical framework described in Fig. 1. The thesis will start in Chapter 2 with what we refer to as the environmental context of the Chinese motor vehicle industry. Here there are two levels of analysis. The first is a review of the development logic of the world motor vehicle industry. This is useful

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For example, the need for China to form capacity to manufacture small passenger cars will not be discussed.
FIGURE 1. THE ANALYTICAL FRAMEWORK
because the history of the world motor vehicle industry offers a variety of approaches for China to choose from, and learning from forerunners is always a good idea for newcomers. The second part of our analysis will be at country level, indicating the policy environment under which the Chinese motor vehicle industry operates. Chapter 3 will focus on the industry level. Some strategic considerations on macro organization and management will be presented after a description of the industry development contour. The fourth level of analysis, the firm level, will be the subject of Chapter 4. Beijing Jeep Corporation will be the enterprise chosen for case studies. A description of its complicated problems and an evaluation of its performance and experience in the last several years will lead to some considerations for micro level management of firms, as well as for interaction between Chinese and foreign companies. Chapter 5 will conclude the thesis.

In addition to public domain information collection and analysis, case study was used as the primary methodology for research because it responds to the complexity of managing technology and the motor vehicle industry. The case study involved visits to six organizations in China and interviews with 30 managers, engineers, and university professors.
CHAPTER 2. ENVIRONMENTAL CONTEXT

2.1 The World Motor Vehicle Industry: A Century of Technology Transformations

The evolution of the world motor vehicle industry in its first century has gone through a series of distinct phases. Each phase has been marked by a dramatic technological transformation in which a distinctive combination of technology dimensions—product and process technologies, human skills, tools, and organizational arrangements—is utilized. This history provides a fascinating collection of alternative approaches to motor vehicle manufacturing. Its implications for designing a technology strategy for the Chinese motor vehicle business will be discussed in the following chapters.

Phase one: European Custom Building

The first phase of the world motor vehicle industry began with the introduction of the automobile in the mid 1880s. The concept of the product was different for every manufacturer. Highly skilled craftsmen and flexible machinery were used to fashion a limited number of

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¹ Much of this section draws on Altshuler et al., Chapter 2, "A Century of Transformations." and Womack.
one-of-a-kind elegantly designed products for the rich. The production organization was decentralized and flexible. Most "components builders" were, in fact, small machine shops already in business to serve other industries.

Phase Two: American High Volume Standardization

The first technology transformation was introduced by Henry Ford in 1908. From the one-of-a-kind products of the European phase, Ford shifted to one product, the Model T. Dedicated machinery combined with largely unskilled workers on the shop floor were favored in the mass production model. The organization structure was highly vertically integrated. Taylor's "scientific management" concept was used to routinize complex assembly operations and reduce them to their simplest components. Ford's technology transformation greatly exploited economies of scale and brought the costs of manufacturing down to a level that many more consumers could afford. Many small producers, unable to match Ford's low costs, were forced out of business.

Two critical issues were overlooked by Ford. He failed to develop a suitable organizational structure for the giant enterprise and he failed to meet the increasing demand for product variety. In contrast, immediately after Alfred Sloan took control of General Motors in 1920, he introduced the divisional organization with centralized technical and
financial staffs. His organizational structure was subsequently copied by large manufacturing enterprises across the world. His "product for every pocket" philosophy was implemented with success by varying the product's external appearance and letting buyers choose among "hang on" options for each model, but retaining high scale production of same power trains and other mechanical components using dedicated plants and tools. With these innovations, the American motor vehicle manufacturers achieved an extraordinary dominance of the world market. They maintained their dominance until around 1950. By the late 1950s, Western Europe automakers began to challenge the United States in small car manufacturing.

Phase Three: European Dedicated Differentiation

The success of European producers in developing highly differentiated products to serve international markets after World War II established the second technological transformation in the world motor vehicle industry. The fragmented European market and diversified consumer needs due to uneven income were the driving forces for the development of this strategy. The differentiated cheap, small cars, turned out by high scale production systems, essentially Fordist, learned through American direct investment, and by low paid European labor, were sent to the U.S. where they started at the bottom of the market.
When European wages were no longer much lower than American wages, Japanese cars rapidly replaced European cars at the bottom of the American market. After a short crisis, the Europeans quickly moved up market to export luxury cars which emphasized many technical features such as fuel injection systems and sophisticated suspensions. Consumers paid a high premium for these expensive features.

Phase Four: Japanese Flexible Differentiation

The world motor vehicle industry is currently in the midst of its fourth major technological transformation. Japanese success in designing and implementing a new type of production system accommodates three objectives: high quality, low cost, and great flexibility. By introducing the flexible manufacturing system, the Japanese completely revolutionized the traditional concept of economies of scale. They made small slot production possible so that motor vehicle producers could be more responsive to customer needs. In so doing, the Japanese gave the example of a "follower" pursuing a "catching up" strategy and developing into a number one player in the world motor vehicle industry.

A study by Cusumano (1985) documented the details of this fascinating technological development process in the Japanese automobile industry, particularly at Toyota and
Nissan. Womack offered an enlightening comparison between the problems the Japanese motor vehicle producers faced in the late 1940s and the problems the Chinese motor vehicle producers face today, and a review of how the Japanese strategy turned all of their weaknesses into advantages in the development of their new production system. Japanese firms tackled their deficiencies in product and component technology in the early 1950s by entering into a wide range of technology licensing and joint venture agreements with Western firms. Womack noticed that "the key to these ventures from the Japanese perspective was the development of a very comprehensive learning system involving large amounts of company manpower in order to transfer all aspects of the acquired knowledge into the Japanese parent firm." What's more, because of the Japanese lifetime employment system, Japanese companies continue upskilling the workforce, an investment many Western firms find very hard, if not impossible, to make because of high employee turnover rates. The Japanese production system philosophically represents a shift of focus from only on machines to a system which includes both man and machine, and a shift of focus from on individuals to groups. This philosophy is reflected by the work team in the plant, the development team for new products, and the component supply group.

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2 The Development of the Chinese Motor Vehicle Industry: Strategic Alternatives and the Role of Foreign Firms, p.8.
Notice that in world motor industry history, a successful transformation not only has always brought new product improvements in quality, differentiated attributes, and/or price reductions to consumers, but also has always resulted in a miracle in terms of the commercial performance of the firm that initiated the transformation, and a rapid accumulation of wealth within the industry. This wealth is shared on the outside as well, because of the linkage effect of the motor vehicle industry with other industries.

It is interesting and important to ask why these transformations occurred. What forces encouraged the emergence of new technological arrangements that replaced or modified old practices? Phrased differently, under what conditions can new transformations come about? There are many possible answers. Perhaps the first one can be found by observing the environmental factors within which the motor vehicle industry operates. The world is continuously changing both politically and economically, consumers' demands and needs are continuously upgrading, motor vehicle manufacturers are forced to improve their products and performance. The one who can introduce better practices and/or technological transformation will win better market position. This is the external explanation. Perhaps the internal reason is that new technologies developed inside the motor vehicle industry by the research and development organizations, or transferred from other
industries, have made major transformations in the motor vehicle industry possible. What's more, perhaps shifting comparative advantages between different countries in terms of factor costs allowed new players in some countries to develop rapidly. After they reached a certain financial and technological level, and obtained a certain share of the world export market, they became notable players on the world stage. Within this process, they were able to try new ways of doing things, ways that old players could not or did not initiate under their internal and external limitations.

Phase Five: What Comes Next?

Japanese producers have enjoyed an extraordinary success with their development strategy and production system in the past twenty years and have maintained dominance of the motor vehicle industry over the past eight years. However, the Japanese are now suffering from the rising yen. The wage level of the Japanese workers has surpassed that of American workers. Though Japanese transplants in the United States are taking an increasing share of the market that may soon equal Chrysler's, they face intensified competition. Is there a logical successor to the Japanese system?

Entering 1980s, two new factors in the world motor vehicle industry have emerged that can have great impact on the
future direction of the industry.

First, a number of new entrants to the motor industry from developing countries are developing sizable domestic industry and now exporting inexpensive cars to the developed countries primarily because of an acceptable or good product quality resulted from technology transfer from advanced automakers, and a low cost due to low wages and large scale production. The multiple availability of technology sellers has put the developing countries in a much better bargaining position today in purchasing technology than before. More new players are coming. Will they eventually replace the old motor vehicle producers and become major competitive players in the world industry? This remains to be seen.

The second emerging factor is that the advanced motor vehicle producers, through individual and increasingly cooperative effort, are rapidly developing new technologies, for example, automation, flexible manufacturing systems (FMS), and new managerial systems, which continuously demature the motor vehicle industry, increase productivity, and in the long run tend to lower the labor cost as well as total costs.

This second factor tend to counter-balance the advantages that developing countries can gain predicted by the traditional "product cycle" theory. It may permit the old
players to maintain competitive power by counter-balancing the first factor mentioned above. While it is impossible to predict to what extent and for how long the second factor will have effect in keeping old players to be competitive in the market, and what governments will do responding to the shifting comparative advantage, one thing is certain that the world industry structure will evolve to one with much less concentration in terms of player dominance in 1990s. Here clearly we see an opportunity existing for the advanced countries and developing countries to cooperate to utilize the advantages of both sides. This is exactly what's happening through various forms, such as technology licensing, joint ventures, low cost site manufacturing and components sourcing.

Womack\(^3\) made some projections on the future of motor vehicle production systems. A new system might place a much greater emphasis on flexibility, with one unit lot sizes and total product customization capability. Or perhaps it will combine the Ford and Toyota models on a world scale, with many joint ventures and strategic alliances designed to extract economies of scale while maintaining low-wage production sites.

\(^3\) A Century of Transformations, or The Progression of Best Practice. p.10.
2.2 THE CHINESE GOVERNMENT POLICIES

2.2.1 Science and Technology Policy

Since 1949 there have been three significant periods regarding technology policy which have been characterized by the import of massive amounts of foreign technology, primarily in the form of "turnkey" plants.

The first period during the early 1950s, was marked by the import of heavy industrial plants, steel, coal and electric power and heavy machinery, primarily from the Soviet Union and Eastern Europe.

In the 1950s, the government set out to build a domestic industrial foundation by acquiring complete manufacturing plants and other heavy industry. One hundred and fifty-six large industrial projects were built with the direct assistance of the Soviet Union. 4 In the motor vehicle sector, the Changchun No.1 Auto Works and Beijing Motor Works (BMW), the parent company of Beijing Jeep Corporation (BJC) were just two among these 156 large projects. We will talk more about Changchun No.1 and BJC later on.

Because of the economic blockade of the West, Soviet aid was

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crucial and the USSR responded with one of the largest programs of economic aid and technology transfers in history. The 1957-1958 period, the "Great Leap Forward," brought about a new policy emphasizing smaller-scale industrialization and fewer imports from abroad. The strategy of "walking on two legs" called for the development of both agriculture and industry to remedy the previous dichotomy between the two.

The second period of technology import came in the first part of the 1960s, when China imported chemical fertilizers, synthetic textiles, and oil refinery plants, primarily from Western Europe, following the cancelling of its contracts and the withdrawal of the Soviet technicians in the early 1960s. This period marked a shift from the transferring of complete plants and heavy industry toward the acquisition of information and prototypes. Then, after the outbreak of the Cultural Revolution in 1966 and under the xenophobic influence of the Gang of Four, all contracts were cancelled and the importation of foreign technology to China was suspended. Based on the principle of self-reliance, Chinese policy during the Cultural Revolution focused on small-scale

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industry for which, it was then believed, there was no need for sophisticated technology from foreign countries.

1970 ushered in a new phase in the history of technology transfer to China. Marking a definite policy shift from the beginning of Cultural Revolution, many contracts were signed with more than a dozen countries, including Japan, Western Germany and the United States. By the end of 1977 transactions worth a total of $3,960 million had been signed. Those transactions involved the import of chemical fertilizers, synthetic textiles, petrochemicals, oil drilling equipment, steel, aircraft and ships from Western Europe, Japan and increasingly from the United States.

Since 1978 one of China's top priorities has been to promote her science and technology capabilities, and this has become one of the "Four Modernization" areas. The National Science Conference held in March 1978 in Beijing announced an ambitious goal: to catch up with the West by the year 2000. Science and technology was recognized as one of the "productive forces" at the Conference, a radical change in the thought of China's leaders. "Catching up in an all-round way" was a slogan for the scientific and technological society.

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By late 1980, paralleling the overall readjustment of the industrial structure of nation's economy, political and economic leaders and some senior scientists began to realize that the existing difficulties in terms of catching up the West had been underestimated. This recognition was obtained partially by the emerging exchange activities between China and the West during that period. They began to question the "catching up in an all-round way" strategy. The conclusion was that China could not afford the luxury of scientific research on wide-ranged subjects and that attempting to compete at the frontiers of science was much too costly.

In 1982, the guiding principle that "economic development relies on science and technology; science and technology should be geared to the needs of economy" was adopted. A move away from basic research, though still ensuring its moderate development, and an increased focus on applied R and D have been emphasized instead. Some of the original exaggerated expectations have been scaled down. China's leaders decided that a more realistic target would be to attain Western technological levels of the 1970s and 1980s by the year 2000. Apparently the objective has been shifted from pursuing technical advance on the world level to applying technology to the development of China's economy and ensuring the quadrupling of the nation's GNP by the year
2000. In the motor vehicle industry, the Changchun Automotive Research Institute was merged at that time with the design division at Changchun No.1 Auto Works to strengthen the tie between research and production.

Another significant aspect of the evolutionary process of China's science and technology priorities, marked by then Premier Zhao Ziyang's speech on this matter on October 9, 1983, is the focus on the "new global technological revolution." A large scale propaganda campaign on the global technological revolution and its implications for China was carried on late in 1983 and in 1984. The major points of Chinese leaders' view on this revolution are reflected by the following:

"A new technological revolution is currently taking place in the world. This presents both an opportunity and a challenge to the economic development of our country. We should seize this opportunity and make selective use of the new scientific and technological achievements so as to accelerate our modernization and narrow the economic and technological gap between China and the developed countries. Here, the key is for China to proceed from its reality and formulate a correct strategy for technological development."  

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Numerous reports in the Chinese press testified that rapid progress in the four key emerging areas of technology—computers and microelectronics, information technology, material science, and biotechnology—was critical for China's future. The following comparison was made: after World War II, Great Britain centered its industry on coal-mining, railways, and iron and steel. It failed to keep up in the fields of information and other new technologies, and subsequently ran into great problems. Japan, on the other hand, imported conventional technology on a large scale after the war and reached an advanced level by the middle of the 1960s. Then it turned to new and developing technology, and in a little over 10 years it had reached an advanced level in most of these new sectors. Therefore, China should import conventional technologies and turn to high technology competition, otherwise she would be left permanently behind the West in the four key areas of technology.

It was also argued that China could skip some stages of development and move forward quickly. In the machine industry, for instance, machinery development should be aimed at combining with newly developed electronic technology; optical fibre digital communications and satellite technology could be used to develop China's communications network; in metallurgical and chemical industries, computer control technology could be adopted;
and the potential development of biotechnology might make it possible for China to avoid entering the so called "petroleum agriculture" mechanization.

Several consequences resulted from this "new technology revolution" push. Five were positive: this propaganda of the new global technological revolution raised a sense of urgency to promote China's science and technology; it convinced the people of the necessity of removing any barriers to the implementation of the policy; it called for an increased research and development effort; it facilitated the process of putting young intellectuals in administrative positions; and it served as a new injection to the reforms of the economy.

However, the propaganda apparently had some negative impact on China's modernization program as well. It created an illusion. While some political, economical and scientific leaders were still sober-minded, many forgot that China's technological level was several decades behind the level of advanced countries, and that the nation not only faced the new technological challenge, but more urgently, it still had to catch up in conventional industries, including machine building industry in general and motor vehicle industry in particular.

While the large scale import of technology from the West
continued, less attention was paid to the importance of an indigenous R and D base and China's technology assimilation abilities in the whole process of choosing, transferring, adapting, developing, and applying technologies.

2.2.2 ECONOMIC REFORM

Although technology purchase from foreign countries was carried out on a large scale since 1949, the door to China was not wide open to Westerners until the late 1970s when Deng Xiaoping launched China's economic reform program in the modernization drive aiming at increasing economic efficiency by introducing incentives to enterprises and their employees. Technology transfer through different channels especially joint ventures is encouraged. One hundred percent wholly owned foreign enterprises are also welcomed. Sweeping changes in legal structure have taken place to attract foreign investment. This reform had and still has a great impact on Chinese industrial sectors. Before the reform, the Chinese enterprises functioned pretty much like branches of governments. The power of decision making on production, sale, material procurement, personnel (e.g. recruiting and firing) and financial issues (e.g. technology investment or raising wages) did not belong to the enterprises at all. All the enterprises had to do was to fulfil the production plans, whatever they were, set up by the particular government that directly controlled the
enterprise. This could be either the central government, or government at the province or city level. In those days, the enterprises did not need to worry about whether their products could be sold, or what would happen if they ended up with a loss. If they did earn a profit, they had to hand in every cent of this profit to the government directly controlling them. If they wanted to buy some equipment, they had to apply for governmental approval. Investment decisions were made by the government, and investment money was provided by the government. Under the old system, factory management had no need for a technology strategy or for a research and development function.

In 1979, the "responsibility system" was introduced to activate the basic production units—enterprises. The enterprise was made responsible for handing over to the state a profit every year according to a contract. After state production quotas were filled, the enterprise could produce for customers of its own choosing. Part of the profit thereby generated, after taxes were paid, was to be used for upgrading plant and equipment, part for the collective welfare of all employees, and part for bonus payments to individuals. These decisions were made by the enterprise management.

This reform, started in the agriculture sector as "family contract system", to a large extent solved the food problem
for the one billion Chinese, a great achievement by any standards. Village and township manufacturing and trade enterprises also emerged, with annual output increasing at 20 percent a year. Some fabricate motor vehicle components targeting both domestic and world market. China's leader Deng has called the village and township enterprises phenomenon "our greatest success-- and it was one we had by no means anticipated." When the focus of the reform moved to the cities, it was much more difficult to accomplish because of the complexity of problems accumulated through many years in the industrial sectors and resistance to change. The basic trend has been decentralization, the same idea used in the countryside. But the key problem lies in that, on one hand, decentralization gives more decision making power to the firms and the planned portion of the economy is decreased, but on the other hand, there is still no price signal from the market to lead firms to make rational decisions on resource allocation.

Today's China is in a period of transition from the old regime to a new one that nobody has ever defined. The coexistence of the planning and market, coexistence of administrated price and market price, affect decisions that every firm and individual has to make everyday. For the motor vehicle industry, in the material procurement area, for example, the same steel sheet can have different price

tag on it, and the same is true for the same motor vehicle produced. It can be either the official "plan price" or the market "out-plan price".

Nonetheless, the reform has spurred growth that was unthinkable just a few years ago. Most persuasive of all, the growth is seen in economic statistics. In 1987 the economy grew by 9.4 per cent, following a 7.8 per cent gain in 1986 (See Table 5). Industrial output grew even faster—up 16.5 per cent last year. China's latest five-year plan calls for a 7.5 per cent annual growth rate, but many expect at least 9 per cent growth in 1988.

This reform has created disparities in income within China. Some private entrepreneurs, traders, and private taxi drivers easily earn more than $3,500 a year, while many peasants still live in poverty. While this thesis will not forecast China's domestic demand for motor vehicles, the rapidly accumulating wealth of a small segment of the Chinese population clearly represents a bright future for the passenger car business, since although the percentage of Chinese who get rich early may be small, the absolute number can be very large.

With consumer demand far outstripping the ability of Chinese factories to supply goods, inflation is mounting, hitting 7 per cent in 1987 and 11 per cent in the first quarter of
1988 in China's cities. Even in the face of surging inflation and uneven development across the vast country, it is very unlikely to turn back. Recently, China's Party leader Zhao Ziyang said, problems emerged from the process of reform can only be solved in the process of further reform. Apparently, China's leaders have chosen to accept the consequences of inflation rather than stifle growth, and have decided that it's best to take the blow all at once and rationalize prices quickly.

Driven by a sense of urgency, Zhao declared ambitious plans to open up China's entire coastal area to foreign investment and export-oriented industry. Within three to five years they want to transform two southern provinces, Guangdong and Fujian, into market economies. By 1991, Zhao said in the recent 13th Party's Congress in October 1987, only 30 per cent of the economy will be controlled by China's central plan. China is also permitting some state enterprises to issue shares and will experiment with a rudimentary system of stock and bond trading soon in seven cities.
CHAPTER 3 INDUSTRY LEVEL ANALYSIS

3.1 THE DEVELOPMENT OF THE CHINESE MOTOR VEHICLE INDUSTRY: THE "AUTO FEVERS"

Before 1949, there was no motor vehicle manufacturing capability in China. There were only about 50,000 motorized vehicles of all sorts in the vast land mass and 24 motor vehicle repair factories located in eight big cities on October 1, 1949 when the People's Republic of China was established.

Nineteen fifty-three marked the birth of both Chinese motor vehicle industry and of large scale motor vehicle technology transfer from foreign countries to China. With the technical assistance from the USSR, on July 15, 1953, the Chinese started building their first motor vehicle manufacturing plant in Changchun, Jilin Province, Northeastern China. Setting up the Changchun No.1 was a decision made between Soviet leader Stalin and Chinese leaders Mao Zedong and Zhou Enlai in 1950 when Mao and Zhou visited Moscow. As we mentioned earlier, the Changchun No.1 project was one of the 156 key industrial projects assisted by the USSR in early 1950s. Everything from plant layouts, product designs, \(^1\) and production techniques to management
system was modeled after the practice at the Soviet "Zis" plant.\textsuperscript{2} All machinery was imported from the USSR and East European countries. The plant was to have 13 principal workshop. Among them were engine, chassis, and main assembly shops, a foundry, a forging shop, a pressing shop, and a heat treatment shop. Its designed capacity was 30,000 units "Liberation" truck a year. Construction was rapidly completed and the plant turned out the first 4-ton (payload) "Liberation" truck in three years, thanks to the full support in terms of human, financial, and material resources from the central government and the whole country. To accelerate learning, several hundred Chinese were sent to the USSR and trained in the "Zis" plant for a six months or a one year period. At the same time, many Russian experts were working at Changchun No.1 offering technical assistance. Highly vertical integration was and still is a striking characteristic of the enterprise. At that time, a high level of vertical integration was the only choice because a national industrial base did not exist, and developing a nation-wide suppliers system was neither economical nor possible. No.1's production reached about 15,000 units in 1958; this was about equal to the production volume of 1953 at Nissan and Toyota in Japan.\textsuperscript{3} The Chinese

\textsuperscript{1} The "Liberation" truck, which was the same as Soviet Zis 150.

\textsuperscript{2} It is said that the Zis 150 product design came from the U.S. in 1930s to the USSR.

\textsuperscript{3} The total production of trucks and cars at Nissan in 1953 was 14,593 units; at Toyota 16,496 units. Cusumano, P.75
was not far behind the Japanese at that time. Both Nissan and Toyota started their postwar transition from truck building to the manufacture of a variety of small cars. The No.1, however, produced the same truck for thirty years. Changchun No.1 did not make the move to make passenger cars on a large scale until recently. This is because, for a long time, the consumer of the motor vehicles in China was the state only. Priority was given to meeting demand from defense sector, key industrial projects, and governmental organizations.

Essentially, the USSR transferred a Fordist motor vehicle manufacturing system (a turnkey plant) to China, and thus helped China skip temporarily the first phase of world motor vehicle industry development-- the craftsman phase-- and enter the second phase directly. In 1958, however, the mode of production of phase one was adopted by many small scale motor vehicle manufacturing operations in China.

Changchun No.1 in late 1960s and early 1970s transferred the Fordist manufacturing system learned from the USSR to China's second large scale motor vehicle manufacturer-- Shiyian No.2, located in Hubei Province.

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4 Changchun No.1 began to make "Red Flag" passenger cars using craftsman technique for high ranking governmental officials in 1958 at a very small scale. Altogether, 1,516 units were made by 1980 when the No.1 stopped producing the "Red Flag"s.
During the 1958 Great Leap Forward period, Mao's model of mass-movement in his revolution theory was applied to industrialization. The Chinese motor vehicle industry was not immune from this mass-movement. An increasing demand for motor vehicle products was translated into a proliferation of small scale motor vehicle manufacturing facilities, which marked the first "auto fever" in China.

Most plants evolved from motor vehicle repair operations. There was little new investment; old plant and equipment and general machinery were exclusively used without technology transformation. Nanjing Auto and Beijing Motor works (then both motor vehicle repair and component factories) switched to the manufacture of military trucks and Jeeps, respectively. The 2.5 ton light truck made by Nanjing Auto, modeled after Soviet "Gaz 51", was named as "Great Leap Forward", a symbol of the time it was born. Shenyang Auto (light truck producer), Shanghai Auto (started to make passenger car SH760A in 1964), and Jinan Auto (producing 8 ton heavy duty truck "Yellow River" with a diesel engine) were among those factories built in the late 1950s by local governments.

A first attempt to rationalize the Chinese motor vehicle industry was made in 1964, when about 20 motor vehicle manufacturers were existing in China. The Chinese National Automotive Industry Corporation (CNAIC) was established
under the Ministry of Machine Building Industry. The idea was to centralize. The CNAIC had a second name "China's Auto Trust" then, and it targeted the goal of national motor vehicle monopoly. Under CNAIC, four regional branches, three specialized corporations, and two general motor vehicle plants (not affiliated with those regional branches) were established. The four branches Auto Corporations were located in Changchun, Beijing, Nanjing, and Chongqing. The specialized corporations included the Bearing Manufacturing Branch Corporation, the Material Supply Corporation, and the Sale Corporation. The two general motor vehicle plants were in Jinan and Wuhan. The CNAIC, however, was short-lived. It disappeared in the tumultuous political events of the "Four Clean-ups" campaign in 1965 and the Cultural Revolution in 1966.

In the mid-1960s, the relationship between China and the USSR began to deteriorate and the national priority was shifted to building defenses against a potential military attack from the North. Three motor vehicle enterprises—Shiyian No.2 Auto, Sichuan Auto, and Shanxi Auto—were born under this political environment. The plants were located in remote mountainous areas in the central China where the population was sparse and there was zero local industrial infrastructure. There were neither railways nor roads. When constructors entered these regions, the local mountain men who had never seen an automobile before were scared when
they saw an "auto" mobile moving with 4 wheels in front of them. Products to be built were cross-country vehicles, light pay load (2.5 metric ton "East Wind" EQ 240) at No.2, and heavy-payload (5-6 metric ton) at Sichuan and Shanxi, exclusively for the military.

The philosophy of self-reliance of Chinese leaders after the Soviets withdrew their technical assistance was reflected from the construction of Shiyan No.2 Auto, which started in September 1969. Unlike the No.1 Auto in Changchun that was built entirely with imported equipment, 98% of the No.2 Auto's 20,000 pieces of equipment were made in China, many were newly developed, including many automatic production lines, also an indication of the progress made during its first two decades of the new China in the machine manufacturing industry. The design for Shiyan No.2 plant layout and its construction was contracted to Changchun No.1. And No.2's product design was done by the Changchun Auto Research Institute. Technology knowhow and management system were provided by Changchun No.1 and key technical and managerial personnel was transferred from there. No.2's management team was trained at No.1 plant to learn how to manage large scale motor vehicle manufacturing before they started their work at Shiyan.

Shiyan No.2 serves as an excellent example of domestic technology transfer in the Chinese motor vehicle industry.
In June 1975, the first EQ 240 vehicle was turned out.

The first case of international technology transfer from a Western country to China's motor vehicle industry was a technology licencing agreement from France in 1965 which allowed Sichun Auto to produce cross-country heavy duty vehicles. Four models were introduced with a payload ranging from 6 metric ton, 12 metric ton, 25 metric ton, to 50 metric ton. Imported technologies included patents, product blueprints, manufacturing technology and tooling, technical documents, and assembled vehicles, one for each model.

In the early 1970's, motor vehicle production still was not able to satisfy demand. Many motor vehicle factories that did not survive during the first rationalization were reborn and the number of motor vehicle factories was again significantly increased. This marked the second "auto fever" in the development of the Chinese motor vehicle industry history.

In order to meet the increasing demand, it was decided that Shiyan No.2 should shift from serving the military to the civilian sector. In October 1978, the production of the second model at Shiyan No.2-- "East Wind" EQ 140 Truck (Payload 5 ton)-- was begun. No.2's successful introduction of "East Wind" EQ 140 brought about competition to the Chinese motor vehicle marketplace, pronounced obsolescence
of Changchun No.1's "Liberation" truck CA 10, forced
Changchun No.1 to start an effort to upgrade its product,
which involved a major technological transformation of the
whole plant.

The arrest of the "Gang of Four" in 1976 brought about the
end of the ten-year-long Cultural Revolution. The "Four
Modernizations" program was implemented, which also
coincided with the further proliferation of motor vehicle
factories. By 1978, the number of Chinese motor vehicle
manufacturers reached one hundred thirty. The total units of
motor vehicle production of that year was only 149,062. (See
Table 2.)

Among the more than one hundred motor vehicle enterprises
controlled by provincial and municipal governments, there
were only five enterprises that had a relatively decent
product and technology. These enterprises and their products
were Nanjing Auto/NJ130 (2.5 ton truck), Beijing Motor
Works/BJ212 (4x4 Jeep), Beijing No.2/BJ130 (light truck),
Jinan Auto/NJ150 (8 ton truck), Shanghai Auto/SH760A (small
passenger car). Their production system essentially called
upon craftsmen skill to produce a single product, unlike the
first phase of European production, in which craftsman
skills were used to produce a one-of-a-kind product. All
other factories controlled by provincial and municipal
governments duplicate at a very small scale products at
Changchun No.1, Shiyan No.2, and those factories mentioned above.

In May 1982, a near-ministry-level bureaucracy—the China National Automotive Industry Corporation (CNAIC) was reborn to rationalize the Chinese motor vehicle industry. Its goal is to bring the scattered industry under the management of one body to raise the effectiveness and efficiency of the industry. As the national motor vehicle complex, CNAIC is responsible for research, production, and sale of vehicles, engines, special-purpose vehicles, motorcycles, parts and accessories, and technical services. It also handles import and export of vehicles, parts, and so forth. CNAIC also is responsible for production of military vehicles. After implementation of "adjustment" policy, the number of motor vehicle manufacturers was decreased from seventy three in 1981 to thirty seven in 1983. CNAIC pushed the whole industry to establish horizontal linkages by organizing seven associated companies each with a specialty. While those companies crossed business and provincial lines, most firms within associated companies are loosely connected without financial commitment.

To speed up technological renovation of Chinese motor vehicle industry, CNAIC made several technology import deals with foreign motor vehicle manufacturers, such as Steyr-

5 Business China, June 8, 1983, p.88.
Daimler-Puch Ag of Austria (heavy-duty truck), Isuzu Motors of Japan, Iveco of Italy (light-duty vehicle), Daihatsu Motor and Suzuki Motor of Japan (mini-buses). In addition, the form of joint ventures is preferred as a better way of acquiring not only this "hard" technology, but also management techniques. Beijing and the AMC of the U.S. set up joint venture to make jeeps, Shanghai and Volkswagen of West Germany Santana cars, and Guangzhou and Peugeot of France light trucks.

CNAIC also launched a big effort to convince the central leadership that the motor vehicle industry can be a very important strategic industry in the national economy. As a result, the idea of regarding the motor vehicle industry as a pillar industry of national economy was written into the "Recommendations by the Party on the Seventh Five-Year Plan". Discussions were started among the decision makers at both the country and the industry level as to what should be a viable strategy for the Chinese motor vehicle industry.

In 1984, 316,367 units motor vehicles were made in China. In addition, as many as 147,506 units were imported. This still could not meet the demand. Therefore, from the fourth quarter of 1984, the third "auto fever" swept China. By 1985, the number of motor vehicle producers in China was increased to about eighty. All the provinces except Tibet were lobbying to start motor vehicle business. What was new
was that all the provinces and municipalities were making contact independently with foreign automakers to buy technology or to set up joint ventures. Their needs are diverse: Local enterprises are urgently seeking technology and equipment in nearly every facet of production, including forges and foundries, precision machining of small parts, and manufacturing needs ranging from production of soft trim and electrical systems to larger parts such as axles, engines, transmissions and even final assembly.

Unfortunately, CNAIC's tone of centralization did not form a harmony with the national trend of decentralization. Many local government leaders became more vocal in arguing that the motor vehicle industry should not be monopolized by CNAIC. The result was that before CNAIC's mission was fulfilled, CNAIC itself in June 23, 1987, was reduced to an industry federation performing coordination functions.

3.2 Strategic Considerations

3.2.1 Government Compartmentalization and Industry Fragmentation

As a result of a long-term effort, China has established a base in its domestic auto industry. It is fragmented and backward, however, by world standards. In 1986, China had
116 motor vehicle plants, which belong to 22 different provinces, municipalities, and autonomous regions, and 8 different ministries, but only two truck producers can be considered as world-scale facilities: The Changchun No.1, whose highest output was 90,000 vehicles reached in 1985; and the Shiyan No.2, in Hubei province, which produced 120,000 units in 1987, primarily 5-ton trucks. Aside from No.1 and No.2, only two other plants produced as many as 20,000–30,000 units, and many produced less than 2,000 units. (See Tables 6 and 7.)

The component industry is similarly dispersed. There are about 2,000 small firms making motor vehicle parts. Most of them were evolved from metal processing facilities during the three "auto fevers" in China's motor vehicle industry history. Big assembly plants such as No.1 and No.2 are more than 90% vertically integrated. No.1 and No. 2 produce their own castings, engines, brakes, transmissions, and other parts. Many of the smaller motor vehicle assemblers also have their own component production facilities. This self-reliance and isolation is deeply ingrained in the motor

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6 Changchun No.1's production has far surpassed its originally designed capacity of 30,000 units. In 1986 and 1987, Changchun No.1 produced less than 1985 because of its effort in plant technological transformation and introducing upgraded CA-141 5-ton "Liberation" truck with a gasoline engine.

7 Notice that the data in the two tables are only for a single product. Many factories produce two or more products in addition to those shown in the tables.
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<thead>
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<th>Firm Name</th>
<th>Year Organized</th>
<th>Units Made</th>
<th>Share of Dom. Total (%)</th>
<th>Profits F Assets (%)</th>
<th>Profits Sale (%)</th>
<th>F Assets T Capital per Person (k yuan)</th>
<th>F Assets W Capital Total Costs (%)</th>
<th>F Assets Labor Costs (%)</th>
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Source: The 1986 Year Book of The Chinese Motor Vehicle Industry;  
* calculated by author using data from The 1986 Year Book of The Chinese Motor Vehicle Industry;  
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Source: The 1986 Year Book of The Chinese Motor Vehicle Industry;  
* calculated by author using data from The 1986 Year Book of The Chinese Motor Vehicle Industry;  
** estimate by author.
vehicle industry, but it comes at a cost of gigantic diseconomies of scale. Many small firms produce only for their locality. They often suffered from lacking technology, capital, and some critical raw material input.\(^8\)

What are the reasons behind the persistent industry fragmentation that rationalization measures were not able to overcome? The most important reason is government compartmentalization.

An article in the "The China Business Review" \(^9\) offered a description about the Chinese bureaucracy system.

"There exists a fragmented, segmented, and stratified bureaucracy below the highest top Chinese leaders. This Chinese system consists of a bewildering number of national agencies, as well as provincial and local units. Each has command over a distinctive set of resources and is charged with a specific mission that gives it a measure of autonomy. Each is nested in a particular functional hierarchy that includes certain superior units from which it can receive instructions and several subordinate units that it can lead, a unit tends to disregard injunctions from agencies outside

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\(^8\) Weil, p.34.

its command hierarchy." 10

"Each unit has a jealously guarded 'rank' or 'level': supra-ministry, ministry, supra-bureau, bureau, department, and so on. Rank-consciousness pervades the Chinese bureaucracy, and agencies are loath to respond to units below or equal to their rank, or outside their chain of command. To obtain cooperation from a higher ranking unit outside its chain-of-command, the petitioning unit must either have an informal personal connection (guanxi) with the target unit or offer some resource that the target unit seeks. This is one source of the ubiquitous bargaining that characterizes the Chinese system." 11

Some ministries directly manage most of the State-owned enterprises in their sector. Others manage only the most important enterprises in their sector, leaving the remaining enterprise under more decentralized control. Still others do not manage any enterprises directly. These ministries usually confine their roles to overall planning and balancing, supervision, and setting policy, rather than direct administration of plants.

In addition to ministries, several national corporations with the rank of ministries are responsible for key

10 ibid.
11 ibid.
factories. Before the China National Automotive Industry Corporation (CNAIC) changed its status in 1987, it was this kind of national corporation.

"Adding to the complexity of the system is its perpetual uncertainty. Relations between a ministry and its enterprises are continually being modified, as are the number of superior agencies that have a command relationship (lingdao guanxi) over a particular subordinate unit."  

The first governmental entity to control the motor vehicle industry in China was the Motor Vehicle Bureau set up under the Ministry of Machine Building Industry in the early 1950s. At the beginning, the only motor vehicle manufacturer was Changchun No.1, so the Motor Vehicle Bureau was in fact No.1's Beijing office which made decisions for the Changchun No.1. Later on, the picture of the Chinese motor vehicle industry was complicated by the multiplication of levels in the governmental apparatus behind the new motor vehicle enterprises. The point of control of an motor vehicle operation can be the central government (through the Motor Vehicle Bureau), or the provincial or municipal government (mostly through their Machinery Bureaus). It can be other ministries parallel with the Ministry of Machine Building as well-- for example, the Ministry of Transportation. It may also be military. Although public ownership applies to all

12 ibid.
the motor vehicle assemblers and most component manufacturers, they seldom talk to each other because the line of control differs.

There are several reasons for the many ministries, provinces and municipalities to enter the motor vehicle industry.

First, a legitimate reason for entering the auto business is the lack of supply in both variety and quantity; the motor vehicle products that those ministries, provinces, and municipalities need are not all offered by automakers controlled by the Ministry of Machine Building. Therefore, the Ministry of Transportation set up factories to produce buses used for urban passenger transport, and Ministry of Sanitation produces ambulance vans, for example.

Second, the industry is universally believed to be profitable. The average profit-sale ratio of China's 13 mid-load truck producers in 1985 was 13.7%. The average profit-sale ratio obtained by light truck manufacturers in 1985 was 17.46%, slightly higher than the mid-load truck segment. Notice that the profit level of Chinese motor vehicle manufacturers are higher than that achieved by their counterparts in most advanced countries. This is probably because of higher prices and lower costs.

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Third, the Chinese economic system use the gross output value as an economic indicator, which measures the "final" value of the products produced by a firm instead of value "added" by the firm's operation. This indicator is the result of multiple counting, and can be very misleading. An assembler of motor vehicles can report much higher gross output value than its actual value added, because the value generated by suppliers is also counted into the assembler's gross output value. This fact, although merely due to accounting practice, surely have attracted city, province, and ministry leaders to get into motor vehicle business, because their credibility is partially based on the gross value output of factories under their jurisdiction, and higher gross output value at an auto plant and its linkage effect on related industries could make the gross output value of their city, province, or ministry much higher.

Fourth, motor vehicles have been in short supply in China for a long time, motor vehicle product can be used to trade for other things needed. To certain extent, making automobiles is like making a kind of hard currency in a economy of shortage. Being in motor vehicle business, especially assembling motor vehicles is considered prestigious.

Fifth, doing a craftsmen level assembly of motor vehicles
is not difficult; millions of Chinese auto repair workers do it every day.

Sixth, motor vehicle industry creates employment opportunities, and it spurs growth of regional economy.

Although the factories controlled by Ministry of Machine Building through the Motor Vehicle Bureau (later changed to CNAIC) have held the biggest share in terms of domestic motor vehicle "gross output value", the share has been declining. In 1982, motor vehicle enterprises under the jurisdiction of the Ministry of Machine Building took a 79.5% share of the gross output value of the whole industry. In 1984, this share decreased to 71.2%, and in 1985 further changed to 68.3%. This means that in the eyes of the Chinese central leaders, other motor vehicle factories not controlled by the Ministry of Machine Building has been collectively playing a more and more important role in the motor vehicle industry, and hence in the national economy. And this probably is one of the reasons why provincial, municipal, and ministry leaders have become more and more vocal in defending the right for them to stay in motor vehicle business.

14 The reason to use this indicator is simply due to unavailability of a better one. Besides, here we are interested in the "share", not the "value" itself.

A lasting cry in the Chinese motor vehicle industry is the lack of investment. The accumulated total investment in Chinese motor vehicle industry since 1949 is only 10 billion Renminbi (It equals U.S.$ 2.7 billion based on current exchange rate.). On the other hand, the Chinese have spent an equivalent of 26 billion Renminbi (U.S.$ 7 billion) on imported vehicles, 2.6 times of accumulated total investment in the industry.\textsuperscript{16} While the main reason for the small investment in the industry is due to the central government policy since 1949 that has made railroad transportation a priority over road transportation, government compartmentalization also contributes to the fragmentation and dispersal of the already limited investment. Each ministry and province has a certain power in terms of the amount of money it can spend on investment without obtaining the central government's approval. They are all interested in investment in the motor vehicle industry, but their financial resources are limited. These limited resources, together with an absence of a capital market and a traditional intention to have something owned only by themselves has guaranteed that their auto manufacturing operation could not be set up on a large scale. The dispersal of investment has significantly hindered potential investment returns. More than 100 small

motor vehicle assemblers possess 50% of fixed assets of Chinese motor vehicle assembly factories, while only 15-25% of domestic motor vehicles are produced by them. The fixed assets at No.1 and No.2 hold about 20% of Chinese motor vehicle assemblers' total, while 50% of domestic motor vehicles are turned out by No.1 and No.2. Therefore, if the same amount of investment was concentrated in building large scale plants, like No.1 and No.2, the Chinese motor vehicle industry could have been able to turn out 870,000 units a year instead of about 470,000 units a year.

Government compartmentalization and bureaucracy is also responsible for the problems existing in the area of motor vehicle imports. During 1984-1985 China spent about U.S.$4 billion to import a total of 560,715 units motor vehicles in 269 different models from various countries (See Table 4.), China's foreign exchange reserves decreased from $16.3bn in October 1984 to $11.3bn at the end of March 1985. It is rather ironic that the Chinese have money to buy imports but no money to invest in domestic motor vehicle industry. The reason is that those imports were bought mostly by provincial and municipal level governments individually. With the implementation of the "open-door" policy and multiple channels for trade, China lacked a unified administrative organ to govern import of motor vehicles. The
"Hainan car scandal" 17 fully exposed the chaos in automobile imports at the time.

An fatal problem due to the government compartmentalization and industry fragmentation is the low and scattered R and D spending, which leads to the low technology capability of the Chinese firms. The product development ability of Chinese firms is weak. Most vehicles produced in China are still based on Russian or Eastern European designs from the 1950s. The World Bank estimates that the fuel consumption of China's trucks is several times greater per ton-kilometer than that of vehicles manufactured in developed countries, partly because of poor road conditions, but also because of obsolete design characterized by low compression ratios in gasoline engines, and the absence of turbo-charger and fuel injection systems. 18 Plus, there are few diesels, which have taken over truck motive power in almost all developed countries.

The USSR helped the Chinese to set up first automobile plant. After the Russians withdrew their technical assistance in the late 1950s and early 1960s, the Chinese had to work on their own in terms of product design and

17 Hainan island officials abused their special status to import foreign cars at large scale using foreign currency. They resold their imports to inland for Chinese currency at very high price to gain huge profits.

18 Weil, p.29.
process innovation. China set up in the early 1950s the Changchun Automotive Research Institute and the Changchun Motor Vehicle College, both parallel with the Changchun No.1 and directly under the jurisdiction of the Ministry of Machine Building Industry, in an effort to implement a technology strategy to promote the Chinese Motor Vehicle Industry. The key people at the three organizations, Changchun No.1, Changchun Automotive Research Institute, and Changchun Motor Vehicle College, were trained in either the United States or the USSR. The Changchun Motor Vehicle college was a merger of all the automobile-related departments-- e.g. the internal combustion engine and the motor vehicle chassis design-- in three universities, namely Shanghai Jiaotong University, Huazhong University of Technology, and Shandong University of Technology. Later on, The Changchun Motor Vehicle College was renamed as Jilin university of Technology (JUT). Engineers working in the Chinese motor vehicle industry today are graduates primarily from either JUT or Qinghua University, one of the best engineering schools in China, which refused to merge its automotive engineering department into JUT in early 1950s. Qinghua has been under the Ministry of Education while JUT under the Ministry of Machine Building Industry. The close geographic location of Changchun's three motor vehicle related organizations presented a tremendous advantage in technology transfer and development within these organizations. This advantage, however, was not fully
utilized. Before the economic reform, there was little incentive for factories to improve products, hence their interest in research and development was very limited. The research institute was largely task-driven. By trial and error and reverse engineering, the Changchun Institute designed many products and components. Actually all important new products in China's market-- No.2's main product "Dongfeng" (East Wind) 5-ton truck and BJC's BJ-212 4x4 Jeep, for example-- were turned out by this institute. However, many designs and ideas did not even come out of the door of laboratories, because there were no close links between the research institute and the manufacturing factory floors, and because the factory floor did not generate much demand for research results. The work of the research institute was evaluated according to whether or not it completed the tasks assigned from above, not by how many designs were implemented in manufacturing. What's more, their research department is totally separated from the product design department and there is no integration between the two when a new project arises. The research department was and still is only interested in publishing research papers, while the design department is conducting reverse engineering. Clearly, the research personnel should involve the design process in injecting new research findings into new product design. Moreover, the design and product development process should involve every element of the value-added chain, especially the manufacture, to
increase the frequency of improvement made on existing products.

In the early 1980s, the central government decided to link technology research to economic development. After that, the Changchun Automobile Research Institute was decentralized and no longer directly under the control of the Ministry of Machine Building. Instead, it was merged with the Product Design Section at Changchun No.1 Auto Works, and was put under the administration of Changchun No.1. The combination of close to one thousand engineers at Changchun Research Institute with the Changchun No.1 Auto Works makes Changchun No.1 by far the strongest motor vehicle manufacturing base in terms of technological capability in China today. This combination contributed to the success story at No.1 in 1984 and 1985 when the "Liberation" truck was finally upgraded after thirty years.

The gain from No.1, however, may have come at the expense of other automobile manufacturers, which are not equipped with research and development facilities. Before the combination of the Changchun Automotive Research Institute and Changchun No.1, Changchun Institute's task was to provide technical support for the whole industry, at least theoretically. After the merger, however, the interest of Changchun
Institute in serving the whole industry will surely decrease. This will leave many small firms without technological help when they need it.

Shiyan No.2, using their own accumulated capital through selling their popular "East Wind" trucks, built a modern technical research center of its own at Shiyan. Shiyan's technological development is rapid thanks for the technical seeds that were planted by Changchun No.1 in the 1960s and 1970s. While No.2 does not have many senior technical professionals as No.1, a large number of relatively young engineers who graduated from Qinghua University and Jilin University of Technology have been promoted to important positions and have become key people there. The relatively young age of No.2's major technical and managerial personnel and its relatively high upward mobility reflects a shortage of personnel at No.2 in its starting years. Although a large number of technical people were assigned to the No.2 project in the 1970s and eventually stayed there, because of its remote location, the personal interest of technical professionals in working at No.2 is not high. All the same, young people with ambition and fresh ideas really are given an opportunity to do things, and they accomplished a great deal there.

In recent years, small assemblers and component manufacturers have considered skipping some stages to catch
up technologically by obtaining assistance from abroad. Chinese visitors to big auto firms in developed countries today are not necessarily from big firms. Chinese firms owned by different governments sometimes talk with the same foreign firm competing for a project, but the Chinese firms do not talk to each other. Some duplication of imports of technology has resulted. A recent example is the import of passenger car engine technology and production facility.

The point is that a technology sharing mechanism is needed in the technology strategy for the Chinese motor vehicle industry. Government compartmentalization and industry fragmentation prohibits the technology development as well as the existence of technology sharing.

3.2.2 Scale vs. Scope

3.2.2.1 Scale Factor

The motor vehicle industry has long been recognized as an industry where tremendous economies of scale exist, i.e. the average costs of manufacturing a motor vehicle product at a plant will decrease as the scale of production (measured as units per year) increases. High quality motor vehicle manufacturing requires that at least certain level of fixed assets investment in plant and equipment, in tooling, and
in research and development facilities should be made up front. This means that motor vehicle manufacturing involves a higher fixed total cost than many other industries, say garment and agriculture. Decreasing unit fixed cost by increasing units produced is the source of economies. A scale that is too high will lead to an increased unit cost. This is because diseconomies of scale also exist which come from production congestions and complexity in management and administration. The second part of the problem, the diseconomies of scale due to administration complexity, is human-related, and manager-dependent, which is hard to quantify. Because of this, to find an optimal scale for a plant analytically is impossible. But it is not difficult to imagine that technology level of the plant, managerial ability, skill level of workforce and management/worker relationship can all influence the optimal plant scale. Typically, a two shift passenger car assembly plant in advanced countries produces 250,000 units a year, which means roughly one unit per minute. For truck producers, 100,000 units a year can be considered as world level scale.

As we mentioned earlier, among over 100 motor vehicle assemblers in China, only two truck producers (Changchun No.1 and Shiyan No.2) have reached world level in terms of scale. Most firms produce only a few thousand units. In search of further economic reasons for the fragmented and small scale nature of the industrial structure, which we
believe is the most important barrier to the development of the industry, we are interested in comparing unit costs among mid-truck producers with plant scales in a hope to see correlation between plant scale and unit cost. This information, however, is not publicly available. We know neither plant scale (capacity of a facility) nor unit cost of a given Chinese auto plant. We have to resort to other information instead. We will compare production volume (capacity utilized) with profits-sale ratio, assuming that capacity is fully utilized because of motor vehicle shortage. High profits-sale ratio means low unit cost.

We immediately noticed that in 1985 in the mid-load truck segment, higher volume producers Shiyan No.2 and Changchun No.1 attained much higher profits-sale ratio than other small volume producers. Shiyan No.2 reaped 28.1% of sale as profits; Changchun No.1 26.7 % (See Table 6.) None of other eleven mid-load truck producers profited more than 16% of their sales (See Table 6.). Several explanations can be offered for this striking differential in profits among mid-load truck producers. One explanation is the learning-curve effect -- No.1 and No.2 plants have achieved higher level of learning on how to make trucks more efficiently through their accumulated volume of production over their manufacturing history. Perhaps it is because of the difference in employee skill and manufacturing facilities.
Perhaps it is the result of difference in R and D capability\textsuperscript{19}. Nevertheless, it is very hard to reject a hypothesis that higher profit (and lower unit cost) level achieved by No.1 and No.2 can serve as an indication of the existence of economies of scale.

The scale factor is widely recognized as one of the entry barriers in the motor vehicle industry. But for the case of China, the scale factor is not an entry barrier, at least for now, because the minimum scale required for making profit in the Chinese motor vehicle business is extremely low. The evidence is that all the motor vehicle firms in China, large and small, are making money. Small mid-truck producers, for example, made in 1985 profits at levels that vary between 8\% to 15\% of sale.\textsuperscript{20} (See Table 6.) The scale factor seems only affect Chinese motor vehicle firms' performance in terms of how profitable they can be.

Let's explore the reasons why there is an extremely low minimum scale that allows the Chinese motor vehicle firms to make profit.

\textsuperscript{19} Both No.1 and No.2 have an in-house R and D base.

\textsuperscript{20} Except Linghe AIC, the third largest mid-load truck manufacturer, which in 1985 profited only 3.2\% of sale by making 4,748 units.
First of all, investment in fixed assets (plant and equipment, technology hardware) in the Chinese motor vehicle industry is very low, especially in the small firms, so the fixed costs due to depreciation and interest costs are low. Most Chinese motor vehicle assemblers got into the business from auto repair workshops. They did not start with a "greenfield". Old plants and equipments were used with little technological innovation. Some assemblers evolved from general machine shops when there was nothing else they could do with those fixed assets, so the opportunity cost of using those fixed assets to make motor vehicles was precisely zero. Not only do they reuse old facilities, they also depreciate them very, very slowly. Rate of fixed assets depreciation in the Chinese motor vehicle industry is officially set as 3% to 5% a year. In addition to the low investment in fixed assets and low depreciation, many Chinese managers are not aware that interest rates are also part of investment costs. This situation is changing, though, because the Chinese government is also reforming investment policy. Many enterprises can no longer get money from the government. They have to borrow from banks for which they need to pay interest.

Second, those small assemblers make little, if any, investment in research and development capability. So the fixed cost due to investment in R and D facility is zero for many small firms.
Third, although automobiles made by those small firms are generally low in quality, this does not necessarily lead to low price for two reasons. First reason is scarcity. Buyers who have no access to better products have to pay the same or, quite often, higher prices for low quality products. Second, some provinces have local monopoly policy to "protect" and "promote" their provincial auto industry. In those provinces, automobile buyers are required to buy products made within the province, in spite of the low quality. And higher prices are set to promote local assemblers that buyers have to pay. Considering this high price charged by some small producers, we are more confident to believe that their relatively low profit-sale ratios compared with big producers do suggest the existence of economies of scale.

The next question to ask is that, since big firms with high scales are more profitable, why don't those small firms move up-scale by increasing their capacity?

Before the reform, there was little incentive to make higher profits because higher profits meant neither higher income for the employees nor more money for reinvestment. Firms had to hand in all the profits to the governments controlling the firms. Second explanation is that, to many Chinese motor vehicle producers, the diseconomies of scale due to
administration difficulties may overweigh the economies of scale at a much lower scale level than that prevailing in the Western auto firms. In other words, the optimal scale for many Chinese managers is much smaller than that for their Western counterparts simply because of these Chinese managers' inability of managing large scale industrial enterprises. For those incompetent managers high scale means burdens and chaos in production, which can result in higher unit cost.

3.2.2.2. Combination of Scale and Scope Factors

In this section, we want to offer strategic analysis for the Chinese motor vehicle industry in terms of utilizing economies of scale.

The solution proposed by some Chinese planners is to rationalize the Chinese auto industry by merging the entire Chinese industry into three groups, one led by Changchun No.1, a second led by Shiyan No.2, and the other is the heavy-duty truck group. In terms of passenger car production, No.1 group will produce a standardized large car, No.2 group will produce a standardized small car, both targeting at world scale. Domestic competition in China will be eliminated, to be replaced by competition with foreign auto makers in foreign markets.
This is essentially a strategy to bring the Chinese motor vehicle industry from currant combination of Fordist and craftsman to the pure Fordist model.

This strategy will win if there is a very stable market demand (unchanged year after year) for the products that those three manufacturers will make. In today's world, however, it is very unlikely that will be the case. The idea of taking the advantage of economies of scale by high volume production of one product is often constrained by the size of market for the product and the firm's share of that market. When the market share for the product is small, or uncertain due to consumers' changing taste, firms find themselves in a very difficult position to commit to high volume production of the product. Motor vehicle manufacturers are certainly interested in resolving this issue.

Cusumano (1985), Womack (1987) reviewed what happened in Japan when Japan was to embark on motorization: In the early 1950s, Japan's domestic market was tiny and highly fragmented. Competition in this fragmented market was intense because each of the major conglomerate groups saw the motor vehicle industry as a prime opportunity for growth. MITI proposed to rapidly rationalize the industry into a few firms concentrating on a few standardized
products. This, it was argued, would permit rapid increases in scale which would in turn permit the introduction of automated machinery and rapid reductions in production costs. This soon became the actual policy of MITI. It unveiled an ambitious program to merge the entire industry into two groups, one led by Toyota and the other by Nissan. One group was to produce a standardized large car. The other group was to produce a standardized small car. Direct competition within Japan would have been eliminated, to be replaced by competition with foreign auto makers in foreign markets.

In fact, the MITI plan was never implemented because of the intense resistance of the conglomerate groups. Toyota developed a highly flexible manufacturing system to keep plant scale high but product scale low. A wide range of products is turned out from the same assembly line to respond to market demand (through the kanban system). The Japanese way to resolve the scale problem under intense domestic competition was proved powerful in international competition as well.

The victory of the Toyota system in the increasingly competitive environment stimulated us to rethink the traditional concept of economies of scale. How to keep plant scale high (dictated by economics) and "product scale" low (dictated by the market) at the same time? The answer by
Toyota's manufacturing system is to increase the product scope. It actually utilizes a combination of economies of scale and economies of scope. Economies of scope stresses the saving from the possibility of producing different products to share the same production facility and administration, or of even conducting different business to share the other parts of the value-added chain, e.g. R and D, or marketing and sale. Clearly, economies of scale alone cannot explain the reason for the Japanese success completely. In terms of scope, Toyota's system is like the European differentiation model; in terms of scale (plant scale), it is Fordist.

Is this system good for China? Definitely. One product should not be produced only by one firm, because some domestic competition is necessary. The best demonstration is that Changchun No.1's old "Liberation" truck, which had a national monopoly, was produced for thirty years without significant improvement until the emergence of Shiyan No.2's new product "Dongfeng" rendered it obsolete. Total elimination of domestic competition is very dangerous in the long run. So far, no firm that is competitive internationally has emerged from a country without domestic competition, no matter what industrial sector. Market uncertainty (especially export market) also makes producing a single product at large scale very risky.
But we cannot conclude that the Chinese motor vehicle industry should adopt the Toyota system now simply because Toyota system is good. We also need to consider cost; the gain from the Toyota system does not come free. An assembly system that produces one single product is inevitably simpler than a system that is required to accommodate, say, five products. A complicated system means a higher level of technology and a higher level of fixed assets investment cost. As a developing country, China lacks financial resources. The workforce may be not ready for a highly flexible manufacturing system. And more important, China cannot afford the unnecessary over-competition that went on in the 1950s in Japan. Over-competition is costly and harmful: nobody could develop under limited resource. Japan was different in 1950s in that Japanese conglomerates groups were strong financially. As a result, over-competition did not kill the industry. China's National Automotive Industry Corporation (CNAIC) now is reduced to a body of coordinating, advising, and long term planning. The shift to decentralization runs into a danger of over-competition. China should not adopt the Japanese practice--every firm produces about the same spectrum of different products.

Now, let me propose three kinds of strategy for firms in the Chinese motor vehicle industry, considering both the benefit and cost of the Japanese system.
First kind of strategy is what we call a "continues transition" strategy from Fordist to an ideal position which is located at about the mid-point between Fordist and Toyota style in the Plant Scale/Product Scope Matrix (See Fig. 2.21) This development path is designed for the existing and potential big firms, such as Changchun No.1 and Shiyan No.2. The position identified by dotted line is ideal for those firms because it has several advantages easier (not easy, just easier) for those big firms to capture. First, significant cost advantages from Fordist plant scale. Second, a flavor of flexible manufacturing environment made possible by a medium level product scope, which is essential to foster domestic competition to certain degree, to offer a role for the R and D engineers to play, and to train a highly skilled, self-motivated workforce. The product and process engineers should face a continued challenge from the factory floor, to solve problems, and improve products and processes constantly as in Japan, instead of upgrading once every thirty years. The reason why this strategy is offered to firms like Changchun No.1 and Shiyan No.2 is because they have possessed the experience in high volume production.

A second kind of strategy is offered to mid firms that are not familiar with mass production. Their path should be to

21 In building Fig. 2, the author took Fig. 38, The Future Direction of Manufacturing Practice, in Krafick (1988) as a reference.
move from the current position, which is at up left corner in the Fig. 2, to somewhere between "Craftsman" and Fordist, i.e. flexible specialization, or differentiation (See Fig. 2.). The expectation that someday the world will use a single kind car-- a "World Car" or light truck--has no ground simply because as income rises, the demand for variety will increase instead of decrease. Given the increasing demand for the product features, there should be some Chinese motor vehicle assemblers to pursue the European product differentiation strategy. Production volume can be medium or small. Here labor content is much higher than the large scale, mass production plants, and China's labor cost advantage can be put into full play. What's more, China has a comparative advantage in small-scale manufacturing of motor vehicles, even to the level of nearly customized manufacturing, because it is impossible for the Europeans, the Americans, and the Japanese to automate a highly differentiated, nearly customized operation and simultaneously, to achieve low costs. China can do it if China has the technology. Human capital is imperative in pursuing this strategy. A large number of well trained engineers, craftsmen and artists will be needed in this kind of operation, to design and manufacture a variety of cars including luxury, elaborate vehicles with greater speed range and comfort to target the overseas upper-end market. In fact, the construction of Hongqi (Red Flag) at Changchun No.1 is more or less this kind of highly engineer/craftsmen
intensive operation, except the fact that differentiation of the Red Flag has been close to zero. (Changchun No.1 has used craftsman techniques to produce a single product.)

This strategy will also emphasize distribution in its value-added chain. Marketing and service become key element for success. If the care and sophistication of making Chinese artistic work can be emulated in luxury car and special purpose motor vehicle production, the Chinese can really differentiate their products, and win a better export market position.

The third strategy is designed for the firms that are not good at either of the those two kinds of operations, but good at general machine processing. They can play an important role in the Chinese motor vehicle industry by entering component manufacturing targeting at the world market. A system with a large number of component suppliers that can produce export quality components is badly needed in China, which will be crucial to permit the Chinese motor vehicle industry to take-off in next ten to twenty years.

In devising a viable strategy for the Chinese motor vehicle industry, we have to find a way for the Chinese motor vehicle enterprises to obtain from advanced foreign motor vehicle producers both technology hardware (machinery and equipment) and technology software (knowhow). In the past
several years, CKD (complete knock downs) assembly of foreign made components was once thought by some Chinese decision makers as a quick way to gain export market, and then to earn foreign currency to purchase technology. The experience of BJC, a joint venture between AMC and Beijing Motor Works shows that was wrong simply because, when the CKDs are shipped to China, the price BJC pays for those CKDs needed for assembling one jeep is already higher than the price for the assembled jeep in the world market. After putting the CKDs together, it is impossible for BJC to sell the jeeps to the export market.

To get the quality of a component to the world level should always be easier than upgrading a whole vehicle to export quality. By gaining export parts markets it might be possible for Chinese motor vehicle enterprises to gain three advantages—

A. The components enterprise could obtain foreign investment for the necessary tools.

B. The components enterprise could obtain foreign technology through licenses and knowhow.

C. The Chinese assembler firms could buy some of the components in order to develop new, "Chinese" designs for finished units. This is the most practical way for big
firms, Changchun No.1 and Shiyan No.2 for example, to develop their vehicle design for domestic and export markets.

This strategy is a "rolling snow ball" strategy: starting with relatively easy component to accumulate learning as well as hard currency, importing key technology hardware and software as financial condition permits, incorporating the technology imported with local condition and accumulated learning, and then moving to tackle more and more technology-intensive components with higher value added gradually.

Fortunately, the international economic trend is moving towards the direction that makes pursuing this strategy today extremely attractive. The fact is that the increasing Japanese yen and NICs currencies relative to the U.S. dollar has made manufactured goods from Japan and NICs more expensive in the North American market. There are two implications. First, the American motor vehicle firms that source components from Japan and NICs have found the cost increasing. They may look for establishing new sourcing bases with lower wages. China can be a candidate. The Chinese government has chosen to peg the Chinese currency to the dollar. This is a good news to American firms because of the less exposure to the risk due to exchange rate volatility. Second, the goods made in Japan are loosing
competitiveness advantage in the export market. Japanese motor vehicle firms may seek the opportunity of producing components in China to regain the competitive advantage.

There are a number of difficulties involved in implementing this strategy, though, because everybody wants to make fully completed cars and trucks for the glamour, prestige, and profitability (and sometimes, easiness in just putting components together). Firms tend not to be willing to accept a position under the assemblers' control. But that is OK. One supplier can serve several assemblers to gain the economies of scale. In doing so, no single assembler can control the supplier who demands freedom so desperately.

In terms of markets to be served, all those three strategies will aim at both domestic and international markets. The number one reason to seek international markets is for technology and quality considerations. Gaining success in export market will require firms to produce high quality products.

3.2.3. High Tech vs. High Labor

A very important strategic choice in any industrial endeavor, is the labor and capital (machines and technology equipment) ratio. This is especially true for developing
Among firms in the Chinese motor vehicle industry, Shiyang No.2 has the highest capital/labor ratio with a capital value per employee of RMB 31.09 thousand yuan (U.S. $8.36 thousand), Changchun No.1's capital per employee is RMB 10.17 thousand yuan (U.S. $2.73 thousand), about one third of Shiyang No.2's level.

Let's compare the fixed assets (at cost) per estimated labor hour among Shiyang No.2, Toyota, and the American firms-- GM, Ford, and Chrysler.

To simplify the comparison, assume Shiyang No.2's fixed assets per employee is 30 thousand Chinese yuan. Calculated on a cost basis, Shiyang No.2's fixed assets per labor hour in 1985 was 0.65 Chinese yuan. Converted to U.S. dollars, this is only $0.17. What, then, is Toyota's fixed assets per labor hour? Toyota's fixed assets per labor hour increased rapidly from $12 in 1965 to $25 in 1970, $32 in 1975, $43 in 1980, and $69 in 1983 (4.5 times that of Shiyang No.2), all in 1983 dollar values 22. The same measurement for the American average is $16 in 1965, $20 in 1970, $19 in 1975, and $28 in 1983 (164 times Shiyang No.2's in 1985).

The 2.5 times difference between the fixed assets per labor

hour at Toyota and American firms in 1983 was due to higher labor productivity at Toyota instead of more capital being used to produce 1 vehicle at Toyota. In fact, in 1983, the amount of fixed assets required to produce 1 vehicle was roughly comparable at Toyota and American firms.\(^{23}\) According to cusumano, Toyota's labor productivity (vehicles per employee) matched and then passed the American "Big Three" even at a lower levels of investment. In fact, Toyota workers in 1965 produced 1.5 times as many vehicles each per year, with merely 80% as many fixed assets per labor hour as at the American automakers.\(^{24}\) But we can say that the 5.75 times increase of Toyota's fixed assets per labor worked from 1965 to 1983 was achieved both by removing unnecessary labor and by adding capital per vehicle produced, because from 1965 to 1983, the amount of fixed assets to produce 1 vehicle at Toyota increased from U.S. $3,799 to $10,075 (at 1983 dollar values), representing a 2.7 folds increase, and the vehicle produced per employee increased 3 times during the same time period.\(^{25}\)

What does the remarkable differential on the fixed assets per labor hour between Shiyan No.2 and world leading automakers mean? Why does it exist? At Shiyan No.2 and Changchun No.1, which are considered as "Chinese Fordists"

\(^{23}\) ibid., p.212.

\(^{24}\) ibid., p.208.

\(^{25}\) ibid., p.396.
in our discussion, the Chinese are basically using much
greater portion of manpower to produce motor vehicles. Is it
reasonable?

If one only considers economics, this ratio seems to be just
fine. The production function theory says that, the ratio
between capital input and labor input should be equal to the
ratio of the cost of labor to the "rental" cost of capital.
Given the fact that labor cost in China is only about 1/100
of that in the U.S., assuming the rental costs of capital in
the two countries are the same, 26 a Chinese auto production
system should then "ideally" employ 100 times more workers
and 100 times less capital than an "ideal" American
counterpart according to economics. Now we see this theory
at work in the case of the Chinese motor vehicle industry.
In fact, due to low wages, the labor cost as a percentage of
total vehicle cost in the Chinese medium and light truck
plants are about 10% 27 (See tables 6 and 7.), which is
still very low compared with 20% - 30% for auto producers in
advanced countries.

While economically the ratio of capital to labor prevailing
in the Chinese industry is legitimate, technologically it is

26 Actually the "market" rental cost of capital in China
should be higher in light of the scarcity of foreign hard
currency and advanced precision machineries.

27 Estimated by the author, assuming a fairly high wage --
150 yuan per month.
definitely not viable. You simply can't assume that you can use any labor-capital ratio you want by substitution between capital and labor to make motor vehicles with specifications and quality accepted by today's consumers and to remain efficient!

Did Shiyuan No.2 achieve better fixed assets productivity (i.e. using smaller amount of fixed assets to produce more motor vehicles) in 1985 than the world leading automakers by employing more labor? The amount of fixed assets divided by vehicle produced at Shiyuan No.2 in 1985 was about RMB 16 thousand yuan 28 (U.S. $ 4,300), about the level at Toyota in early 1970s, and was 40% of that for world leading producers in 1983. However, considering great discrepancy between Shiyuan No.2 and world leading producers in product mix, and inevitable error due to unavailability of an exchange rate based on purchasing power parity, we really cannot say that fixed assets at Shiyuan No.2 was much more productive, compared with Toyota and American automakers. Therefore, what the comparison really reveals is that the huge difference in fixed assets per labor hour worked between Shiyuan No.2 and world leading producers was primarily due to the low labor productivity at Shiyuan No.2. The direction of improvement at Shiyuan No.2 should be in removing unnecessary workers while only further adding key equipment as fixed assets at present production volume.

28 Estimated by the author.
Womack (1987) estimated that labor productivity (number of vehicles per employee) is about 1/60 of that of Japanese firms. The Chinese must make every effort to increase the capital-labor ratio by primarily increasing labor productivity.

Notice that Japanese firms, notably Toyota, paid great attention on increasing labor efficiency even when their wage level was low compared with the U.S. firms. Based on the data from 1965 to 1983, the amount of fixed assets Toyota used to produce 1 vehicle was always lower than American auto firms, but Toyota's fixed assets (at cost) per labor hour in 1970 was 1.25 times higher than the American "Big Three" while average annual wages and benefits per employee at Toyota were 61% of Ford. By 1983, Toyota's fixed assets (at cost) per labor hour reached $69, 2.46 times of the American "Big Three", when wages and benefits was 78.9% of Ford.29

After labor productivity is significantly improved, big Chinese motor vehicle enterprises, such as No.1 and No.2, which pursue the first type of strategy described about should try to reach a higher capital-labor ratio. Firms pursuing a differentiation strategy to target niche market

can use lower capital-labor ratio, but plants at both types should increase the in capital content from the present level. However, the Chinese should not try to set a targeted capital-labor ratio as high as at Western firms, even the big enterprises. The Chinese need to design and develop a Chinese manufacturing system that will use more labor than its Western and Japanese counterparts.

The reason why the Chinese motor vehicle industry can only increase capital content gradually, and the target of increase cannot be very high are simply because China as a developing country would want to use more labor to substitute capital to the extent possible. It cannot afford the luxury of purchasing a high-tech auto industry (i.e. high level of automation) without making every effort to use its tremendous human resource including the very inexpensive labor force. This is not only an economic and managerial problem at the firm level, but also a public policy and strategic planning issue at the country level.

The managerial and organizational aspect of the problem is by no means less important. Actually, much can be done in the area of management and organization even before or simultaneously with the introduction of higher technology hardware, to obtain substantial performance gain. Recently, researchers in the International Motor Vehicle program at M.I.T. have found evidence that some Western
automakers have over-trusted the magic of and overinvested in highly automated machinery, and have ignored the importance of human factor in the production system. John Krafck's excellent thesis shows the lack of relationship so far between "high-tech" and productivity.³⁰ There is growing awareness that investing heavily in high tech in the hope to get rid of bad labor-management relations is unlikely to achieve its designer's expectations. In contrast, integration of technology and human resource management strategies-- what Shimada and MacDuffie called "humanware" -- really can make a difference in achieving high productivity and quality.

While a production system emphasizing "humanware" is in a sense "fragile" compared with the "robust" ³¹ traditional American production system, the "robust" traditional system places a ceiling on the performance gains that can be achieved by improving human resource effectiveness-- a ceiling which is not in place in the Japanese system. The Chinese production system has the need to learn from Japan and to draw lessons from the U.S. to include human resource planning early in the system design.

³⁰ Krafck, p.115.
³¹ Shimada and MacDuffie, p.27.
These points will be examined in detail in the fourth Chapter of this thesis, which is a case study of the Beijing Jeep joint venture.
CHAPTER 4. FIRM LEVEL ANALYSIS: BJC AS A CASE STUDY

4.1 Learning

4.1.1 Learning by People

People are the most important element in a successful technology transfer. Recently, there is a growing awareness among Chinese decision makers that technology transfer is not limited to purchasing product designs and machinery; one must also acquire know-how: the way to do things right. To a large extent, it is only through people that this know-how can be acquired and made effective. This awareness has been gained through painful experience in purchasing "black-box" type hardware and in operating joint ventures in recent years. This chapter analyzes the problems involved in transferring know-how by means of a joint venture.

For a Chinese enterprise involved in a joint venture, learning from the foreign source is perhaps the prime motivation to establish the venture. Therefore, it is desirable to have adequate skilled technicians, managers, and professionals from the investing firm to work together with their Chinese counterparts in the whole process of technology transfer. The human resource management policies in use at the joint venture should ensure the smooth flow of
technology.

At the Beijing Jeep Corporation (BJC), a joint venture between American motors (Now Chrysler) and the Beijing Motor Works, the joint venture contract required that AMC supply "experienced, highly skilled experts", and selected BJC employees be sent to AMC for technical training. But partially because of the cost involved in maintaining large numbers of American managers in China, BJC keeps a very small group of American managers. AMC invested close to $16 million --- $8 million as the capitalization value of the AMC's technology, plus $6 million for the Cherokee assembly line and about $1.5 million a year in living costs for the nine Americans. At different stages of the venture's development, 26 AMC temporary trainers came to BJC on loan. Most of them were to train 149 Chinese workers who now perform the welding, painting, assembly, and quality control jobs for the new Cherokees. Among the experts invited to China were repair workers to help train the Chinese to enhance the after-sale service.

The language barrier between the two sides was cited as a very pressing problem at the beginning of the venture. To overcome it, American experts and professors from foreign language institutions in Beijing were called in to give intensive English courses primarily to BJC's Chinese engineers and technicians who had taken some English courses
before. About 500 people took the courses. Some of these people became interpreters and assistants to the American trainers. After the American trainers completed their work at BJC (mostly several months) and returned to the U.S., the assistants became BJC's own experts. Taking the advantage of being a joint venture, by the end of 1986, BJC has organized 77 Chinese managers, engineers, and technicians into 21 groups to visit the United States to learn from AMC's home operation.

4.1.2 Shortage of Personnel Prohibits Learning

Although BJC claims that there are 426 people at BJC who have had some technical training, BJC's indigenous technological capability is not very strong, compared with Changchun No.1 and Shiyun No.2. Its old product, the BJ-212, was reverse-engineered by the Changchun Automotive Research Institute in 1960s, when the Institute had the responsibility of serving the entire Chinese motor vehicle industry. After that, the BJ-212 like other Chinese vehicles; received little if any additional engineering to improve its performance. The local technical personnel did not have a chance to learn know-how through doing.

In 1980s, the central government ordered the factory to design and develop a second generation BJ-212. This task was later on also stated in the joint venture contract as a main
task of BJC. But a shortage of technical personnel has inhibited this redesign as well as learning more generally. A relatively "easy" way to solve this problem would be to move technical people from No.1 and No.2 to BJC. However, this is almost impossible under the current situation of government compartmentalization. No.1 historically was controlled by the Ministry of Machine Building in the central government while BJC's Chinese parent company was controlled by Beijing City government. The Ministry of Machine Building could move technical professionals from No.1 to No.2 at a large scale, but migration of technical professional from No.1 to the Beijing plant was rare.

To provide a solution to the "shortage" of technical and managerial personnel, BJC's management for the first time decided to recruit talent through open bidding outside BJC. This was a challenge to China's existing system of lifelong tenure and rigid assignments to jobs. Strong resistance was expected, because approximately 80% of the Chinese workers work at the same work station or "post" in the same workshop in the same factory from the time they are hired until the time they retire.

Soon after BJC's hiring plan was announced through the press in July 1984, more than 800 candidates applied. Among these, 100 were selected after examinations. However, most units where those selected belonged refused to give them
permission to transfer.

BJC's management had to resort to the support of the Party leadership at a higher level. In October, the Industrial Department in the Party Committee of Beijing City distributed a document ordering that the units for which those 100 technical and managerial professionals originally worked permit them to move to BJC. The result was that only 40 or so were transferred by December. To get the rest to come to fill the position, The Industrial Department of the Party Committee made a second decision: the professionals appointed by BJC could leave for BJC even without the completion of the transfer paperwork. Apparently, the completion of the paperwork required the cooperation of those units, which were resisting the order from above.

The result of the second decision was that 26 more technical specialists came to BJC. In January 1985, a new persuasion campaign was started. Organizations involved in this collective action included the Industrial Department of the Beijing Party Committee, the Beijing Center for Personnel and Talent Exchange, the Ministry of Labor and Personnel, and National Center for Personnel and Talent Exchange. After three years and two months of effort (Feb 1988), they had completed transfer procedures and paperwork for 20 workers in the group of 26. Nobody knows when this work will end.
A recent article in the People's Daily (Overseas Edition) revealed that some unit leaders take a very negative attitude toward joint ventures with foreign firms. In fact, many people appointed by BJC are not "key persons" in their original units, according to BJC's personnel manager Shao Ligong. He remembers one unit leader saying "Personnel mobility is OK if the requests are not from joint venture companies." Some units asked joint venture companies to pay them 50 to 200 thousand Chinese yuan to cover the "damage" to their units because of the persons leaving. Other units only agreed to let people go temporarily on loan for which 300 Chinese yuan should be paid to the units monthly.

An recent article in the China Daily calling for job mobility concluded: "There are four advantages in encouraging the flow of talent: It is advantageous to the State, to the units which contribute the talent, to the units which receive the talent, and to the nurturing of the talent itself." And this is the real point, although ways need to be found to help the units which contribute the talent. With little chance for a different job than the one he has been assigned to, the Chinese technical specialist loses the opportunity to apply his talent to full advantage and to broaden his knowledge and skill. While more and more Chinese work unit managers realize the need to promote job mobility to better match people's skills and training in the
work they are doing, the difficulties in implementing this change can be understood by recognizing the barriers to mobility created by the Chinese de facto social insurance system--housing, food, and education subsidies are all linked to one's working "unit", and there is a fairly high wage differential between BJC and purely state-run enterprises. Except for temporary and short-term transfers, Chinese work unit managers are loathe to let go of well-educated employees. Finding a replacement can sometimes take years. The restrictions preventing talented employees from leaving a work unit are matched by restrictions on entering one.

4.1.3 Learning from the Japanese: Small Lot Size to Cut Inventory

BJC's pressing workshop has 31 pieces of stamping equipment, which are used in the pressing process for 553 different body parts. Most of these are used for the BJ-212, while other are for BJC's parent company, the Beijing Motor Works (BMW). After the pressing process, the parts are sent to the body workshop for welding, grinding, sanding, and painting of the vehicle body. Historically, there was a huge inventory between pressing and welding to ensure availability of enough parts for welding. The inventory for every part was typically one and a half months or even two months. Thus there was not only a pressure on the storage
area and parts handling equipment, but also a waste from work-in-process capital and from parts rusting.

In search for an optimal process plan including rational hardware use, travelling orders, and timing to ensure smooth production and minimize inventory costs, BJC's management learned to use fairly small lot sizes. According to the size of part to be pressed and the work-in-process capital involved, BJC divided the 553 different pressed parts into three categories with lot size that can be used for different length of time.

Although total set up times increased, effort was made to speed setup actions. In consequence inventory was reduced one third from 1984 to 1985. The body storage area was reduced from 3,032 square meters to 2,012 square meters, and work-in-process capital was reduced from more than 4,000,000 yuan to 2,910,000 yuan. At the same time BJ212 production volume was increased from 17,118 units in 1984 to 21,262 units in 1985.

While a great improvement has been made at BJC, its standard plan still leaves a large margin in terms of the timing between pressing and welding compared with the Just-in-Time practice of the Japanese auto makers. According to Cusumano, at Toyota, "workers in machine processing, body manufacturing, and assembly went back to previous stations
and took only those parts or materials they needed and could process immediately. Second, workers produced only what the next station required...". At BJC, body parts in one Category are pressed two to three days in advance, parts in second Category four to five days in advance, and parts in the third more than six days in advance. Apparently buffer stocks are retained for insurance to prevent the breakdown of one machine in the pressing process from disrupting the entire plant.

Tardiness of suppliers is cited as an external reason to have the buffer stocks. In early 1984, monthly storage for parts of 12 kinds including body pressings, frames, and windshields reached 23,424 items, 1,952 items per kind on average, or enough to supply the assembly line for 27 working days. Among these, engine hoods and fenders could be used for 37 to 42 days. A storage area of 3251 square meters was not enough for a production scale of only 16,800 units in 1983. A large amount of parts and work-in-process had to be piled up in open areas, even outside by the road. However, the big inventory did not keep production smooth. In order to fill the monthly production quota, overtime was necessary at the end of each month.

4.2 Human Resource Policies

Human resource management is at the center of the Chinese
economic reform. Increasingly, learning human resource
management practices and policies from the West and the
Japanese are considered by China's decision makers as
another aspect of technology transfer. The logical
connection between human resource management practices and
overall performance in the auto industry has been
demonstrated in several studies recently conducted in the
International Motor Vehicle Program at MIT. \(^1\) The
best performance in the world automobile industry comes from
an integration of hardware technology, manufacturing policy,
and human resource management strategies, and not from
hardware technology alone. \(^2\)

Human resource management policies and practices at BJC have
been undergoing a drastic change for the last 4 years.

This section will examine and evaluate the changes in human
resource management practice at Beijing Jeep Corporation.

4.2.1 Strategic Issues

Effective human resource management policy and practices
must be responsive to changes in the business environment
including the political/economic system, technology, and
social values. They must also accommodate to the highest

\(^1\) See Katz et al., Shimada and MacDuffie.

\(^2\) See Krafckik, Shimada and MacDuffie.
degree possible the interests and needs of the employer, the workers involved, and the broader society in which the employment relationship is based.\(^3\)

One of the implications of Chinese economic reform to the human resource management system is that wages are now part of production cost, and thus affect profits and hence the bonus for everybody in the enterprise. The management under the new policy has begun to have, for the first time, an incentive to lower the cost of labor and to increase productivity.

As a response to the economic reform, the trend in China's human resource management practice is fostering greater individual initiative, linking pay and other rewards more closely to performance, stressing merit criteria in selection and promotion decisions, reviving the role of unions and the Workers' Congress, and allowing greater autonomy to enterprise managers in the use of profits.

At BJC the human resource management task is further complicated by the need to accommodate the interests of all parties involved, and consider not only existing domestic variables and problems, but also the interests of the foreign investing firm—AMC.

\(^3\) Kochan.
A group of human resource management professionals at BJC is included in the Department of Enterprise Engineering to perform human resource functions. Two men co-direct the department, one Chinese and one American. This two-man, two-nationality, shared leadership arrangement is also found in four other functional areas, namely the Department of Manufacturing Technology, the Department of Supply and Sale, the Department of Accounting, and the Department of Production. The only head in the Department of Quality Control was and still is an American. The position of Presidency rotates between the two nationalities every three years. The first President Don St. Pierre, was from AMC.

Ideally, human resource planning should be started at the earliest stage of the investment or strategic decision-making process and at three levels: firm, industry, and country. It should be embedded in the basic business strategies of the firm and the industry. It should be an integral part of the country's strategies for economic development and international trade.4

While human resource issues were made part of the agenda of issues discussed by the Americans and the Chinese in negotiating the joint venture contract, it is unlikely that the two sides went farther than deciding they should hire 4,000 workers at the very beginning. There is reason to

4 ibid.
believe that BJC pursued the human resource management policy change incrementally. The reasons are as follows.

The ideology of equality is deeply rooted both in the Chinese culture and the socialist ideology. Any human resource policy change of one enterprise (e.g. on how to reward employees) becomes a very sensitive issue industry-wide or even country-wide, because of its indirect "externality" effect on other enterprises. Enterprises are not entitled to make changes without governmental approval. Therefore, there was a conflict between the need to design human resource management policies at the earliest stages of joint venture decision-making process, and the reality of the inability of making any significant policy changes at the firm level as long as there was uncertainty on future government policy.

There was evidence, however, on the high executive level of a commitment to making human resource management issues their priority. For example, the recruitment plan had to be approved by the Board. At the fourth Board meeting held on 6 Feb 1985, a proposal was made to increase the number of production workers at BJC. The reason was that BJC then faced two tasks: it not only had to keep the existing BJ-212 line running, but it also had to transform the whole plant technically to prepare for the CKD assembly of Cherokees. This proposal, however, was not approved. The
decision of the Board was that the total number of workers--4,000--would not be increased. Another example of executive commitment was the Employee Education Commission headed by the then Vice-president of BJC--Mr. Chen Xulin. 5 Interest in investing in training and education was shared by both sides. Different training programs and many special technical lectures were offered which were tailored to the various needs of workers and managers at different levels.

The BJC, joint venture between AMC and BMW, employed BMW's 4000 workers, less than 40% of then total work force of the BMW. The Workers' Union at BJC representing the 4,000 workers signed a labor contract with BJC's management. While the Chinese government has the interest of employing more workers as every government has, in the case of BJC, attention was paid primarily to setting up a productive auto manufacturing facility. BJC also took over 100% of BMW's vehicle assembly capability, where BMW's profit largely came from, leaving components manufacture to the BMW. As one can imagine, many problems were created at BMW because of this. BMW's management next door faced the difficulty of finding 1500 jobs for the workers who did not work in the component supply sections. 6 The wage differential between BJC (high) and BMW (low) compounded the pressure on BMW's management as

5 He has been the new President of BJC since Don St. Pierre finished his term early this year.

6 Laying them off was not possible in China, because of the de facto lifetime employment policy.
well as the local government. At BMW, the morale was low, one third of key technical employees wanted to leave, because they believed that there would be no hope if they stayed at BMW. Li Hui, 50, and his son Li Yingxi, 24, were both employed at the old Beijing Motor Works Plant. When BJC was set up, Yingxi was chosen for the Cherokee operation, but his father remained in the old section of the factory. After 20 years of loyal work, the old man felt hurt and rejected. He also could not understand why his son earns 160 yuan a month, while his own salary is only 130 yuan; in the old days, salaries were based almost entirely on seniority.\(^7\)

To pass the period of crisis, the BMW's management designed and implemented, with the support of local government, a plan of revitalizing BMW. Human resource management strategy was an important element of BMW's plan which emphasizes the communication and the mutual respect between the management and workers, workers' participation in decision making, a combination of monetary reward and spiritual appraisal --- a traditional way of raising moral in Chinese organizations. It was reported that BMW's plan worked. During the period of 1984 - 1987, BMW upgraded its products --- BJ-122 and BJ-222 light truck series, and increased profits 41% annually.\(^8\)

\(^7\) China Reconstruct.

An important human resource objective of the Chinese government is to treat the managerial training and skill development roles of the foreign firm as a form of technology transfer, seeking to find ways, with the help of Americans, to motivate their workers to increase productivity and build a showcase of management practices for the nation.

AMC's joint venture with the Chinese, although small, was the largest technological foreign investment since the implementation of China's open door policy. Foreigners interested in investing in China and taking a wait-and-see position watched the BJC case closely. Human resource practices were also carefully watched. BJC's American managers were dissatisfied by the attitude of the Chinese managers toward the discipline and productivity of Chinese workers. This dissatisfaction elevated human resource management issues to a level that negatively affected the image of doing business in China and the general investment climate.

Foreign executives are interested in the response of the central government towards these problems. The Chinese government took this very seriously. An effort was made in the legislature to "allow the foreign investors to operate in China in a way the same as international
practice" Most notably, the State council's "Provision of the State Council for the Encouragement of Foreign Investment", promulgated on October 11, 1986, and effective immediately, renewed its promise that foreign investment enterprises in China can manage their own affairs. Within the scope of its approved contract, a foreign-investment enterprise can formulate its own production and operating plans, raise and use its funds, procure materials, sell products, and determine its own wage standards and incentives. The Provisions reaffirm and expand the ability of all foreign investment enterprises to hire and fire workers.

Although the Chinese president of BJC, Chen Xulin, has the authority to dismiss workers, he hesitates to do so until broader national reforms in the personnel systems are in place. Right now, if he fired people, more trouble could follow: he might be accused of making serious mistakes later on, and practically, where would he get competent people to replace the incompetent? 9

No doubt, BJC has served as an experimental site for new policies and practices. The problems and difficulties of implementing new policy change were experienced first by the BJC management, and after that, many practices were implemented on a wider scale, and many became governmental

9 China Reconstruct.
policy. Through BJC, the whole country learned how to do business with foreigners.

4.2.2 Operational Issues

Since 1949, factory workers have been guaranteed life time employment starting from their first day at factory. About three years ago, this practice was changed at BJC and some other Chinese enterprises. New workers are recruited by BJC on a contract bases. The BJC management likes this contract system, because contracted workers work harder and are more "disciplined" compared with the workers who were recruited before the implementation of the contract system. BJC also implemented a procedure to evaluate the performance of all managers at BJC. Opinions of all employees of those managers were collected and sorted by the personnel management office. Appointment decisions, which are not lifelong any more, were then made by the corporate executive meeting.

Wage rates in China seem to be extremely low by U.S. standards, but several things need to be considered. Housing is provided either by the government at only a nominal fee or by the enterprise itself. Public transportation is crowded but cheap. In fact, many Chinese have more money saved than they can easily spend, although this is beginning to change now that an increasing variety of consumer goods is being produced, and also inflation is picking up. A
characteristic of the compensation policies in American industrial enterprises is the close link between the job performed, its presumed skill content, and the level of pay (whether time or piece rate). Such a close link is entirely foreign to Chinese practices. Wage differentials in China do not vary widely among workers, technicians, and managers. In the Chinese enterprises, there is a sharp formal distinction between job promotions and wage raises. This has led in practice to a loose link between position and pay.

The reform of the compensation structures and policies at BJC is centered at linking pay to position in an effort to allow compensation to reflect the employee's contribution. In 1985, a new structured pay system was implemented to replace the original grade system, which had been there since the birth of the state-run auto maker. The new system consists of two parts—fixed pay and variable pay. The fixed portion includes "base pay" and "seniority pay"; the variable portion includes "position pay" and "efficiency pay". "Base pay" is very complex, an inheritance from the original grade system. This portion is largely evolved from one's past wage, relating to employee's work history and past employers. Anticipating the resistance to removing this, BJC's management decided to keep it for now, whether it is reasonable or not. When the time is ripe, this portion will be based on skills only. Seniority pay increases with a workers' years of service, and reflects the accumulated
contribution of workers to BJC, which balances the possible declining income when aged workers' physical condition prevent them from performing certain jobs.

The "position pay" was a creation of BJC. The human resource professionals at BJC divided all job positions at BJC into three series: 1. production workers series, in which 102 types of job positions that 1440 workers held were classified to "four posts" and "eight grades"; 2. non-production workers series, in which 70 types of job positions involving 1587 people were classified to "eight posts" and "eight grades"; 3. management and technical professionals series, in which "seven posts" and "eight grades" resulted from 54 types of positions held by 1584 people.

The "position pay" reflects the level of complication, working condition, and requirement for technical competence in a specific position. This portion changes as employee's title, post", and type of work change. This "position pay" varies to the extent in which the highest grade people receive compensation 5.3 times higher than that of lowest grade.

A significant change took place after the implementation of the "position pay". Originally many workers requested to leave from line posts to non-production posts, because
easier work did not result in less pay. Now they request to go back. Traditionally, there is a very popular point of view in China that production work (doing physical work) is harder and management work is easier, so when the bonus system was introduced in the economic reform, many people argued that only production workers were eligible for full bonuses. In general, bonuses for managers are less than for workers. Managers could receive only 60% to 85% of production worker bonuses. BJC's position pay will surely entitle the "high grade" managers to receive at least the same position compensation as the "high grade" line workers, if not higher. The last part of the new wage package—efficiency pay—floats with several factors, including the overall economic performance of the BJC and an individual's work efficiency.

In general, in an overseas investment situation, the investing firm's control over labor costs and the tendency for the host country or firm to ask for a higher wage are likely to produce disputes between the two parties. This has not been the case for BJC because the government does not prefer creating very big worker wage differentials between BJC and other purely state-run enterprises.

American executives at BJC are in favor of measures to increase the wage difference within BJC between managers and workers, between technical workers and non-technical
workers, and between the educated and the less educated.  

4.3 Looking to The Future

Whereas many problems still remain at BJC—notably foreign-exchange and localization problems—the two parties, after four years cooperation, seem to have achieved a certain trust and mutual understanding.

American executives are happy about their relations with the Chinese. In the area of human resource management, the two sides now also have more common language. Talking about motivating workers and staff, Mr. St. Pierre advocates employee participation, saying that the management should take time to explain corporate strategies to the workers, and to listen to their opinions and suggestions concerning ways to improve the current situation. St. Pierre also calls for mutual respect between management and workers. He downplays the effect of simple punishment, saying that it could only work for a short period of time. The Chinese managers now have an increasing awareness that BJC's management style should feature the characteristics of a joint venture. Any tendency toward managing it more or less like a state-run enterprise should be carefully avoided.

10 Currently, the salary of highest level Chinese manager in the BJC is believed to be less than three times more than the workers' average.
Regarding human resource management system, what is most suitable for the Chinese motor vehicle industry today? With a wide spectrum of policies and practices in human resource management in existence across the world, China can learn from those experiences in designing its own policies and practices for the future. China also gained some experience from experimentation after the arrival of the open-door policy. The key element today is an assessment of the fit of alternative models derived from Western-style systems (including the Japanese system) with the Chinese workforce, culture, and economic policies. One expects that hybrids can be characteristic of both the Chinese motor vehicle manufacturing system and its human resource management. Some elements of Japanese human resource practices, team concept and worker participation for example, have close connections with the traditional Chinese culture, and could be conceivably implemented even before the introduction of advanced technology to obtain a positive outcome. Some features of Japanese practice—for instance participation, stable employment, and promotion of production workers to "team leader" and to managerial positions, can even find their mirror images in socialist philosophy, and have largely been characteristic of the Chinese human resource system for a long time. Chinese decision makers should not abandon those practices and take the American system as the only model for them to learn from in their modernization drive.
What direction is the Chinese industrial relation system going? Different hypotheses may be made, based on different observations. In the Chinese press, Taylor's scientific management theories are discussed frequently as positive models; firing workers and termination of labor contracts are heard of now more often than they were a year ago. From this one might conclude that China will adopt the practice of traditional American firms. One may also conjecture that China will not go too far, since the slogan "workers are still the masters of enterprise" still makes editorial headlines.

Some questions can now be raised. Since American and Japanese practice represent different models and philosophies, to what extent can American managers at BJC help the Chinese develop a human resource system that will incorporate the advantages of the Japanese system? Since a viable human resource management policy in China demands integration of the world's best practices in human resource management with the specific Chinese situation, can those American managers at BJC transfer the world's state-of-the-art practice to the Chinese?

It seems that the issue is more one of cooperation and mutual learning rather than of transfer of a workable "product design." Nobody has an effective "product design"
for China yet. The establishment of BJC as a joint venture offered new economic opportunity for the parties involved. To capture the benefit, a joint effort will always be needed in formulating strategies and practices, including designing the future of human resource management policies.

BJC's operation has recently earned a good profit (See Table 8.). This is partially because BJC faces no competition in the domestic market, and it can set price almost as it wishes with approval from the government. The Cherokees assembled by BJC are purchased primarily by the Chinese governmental organizations. The government has actually been guaranteeing BJC's profits since a crisis in 1986 when the line was shut down for two months for lack of foreign exchange for imported CKDs. BJC is in fact immune from the competition and risk usually encountered by Western business. The venture's American parent firm is earning three profits from BJC. The first is the profit derived from selling CKD shipments to the venture. The second is one third of the profit from the value added in the assembly process, because American equity share in the venture is one third. The third is one third of the profit from manufacturing the BJ-212. The BJ-212 product line was brought by the Chinese to the venture when the venture was set up, and since then the product has not changed much.

Both sides might, of course, accept this situation for the
### TABLE 8

**BJC ECONOMIC PERFORMANCE**

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<thead>
<tr>
<th></th>
<th>1983 Before JV</th>
<th>1984 Before JV</th>
<th>1985</th>
<th>1986</th>
<th>Total After JV</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Set by Contract</strong></td>
<td>15,000</td>
<td>15,000</td>
<td>16,000</td>
<td>46,000</td>
<td></td>
</tr>
<tr>
<td><strong>Actual Output</strong></td>
<td>17,855</td>
<td>16,418</td>
<td>21,262</td>
<td>24,087</td>
<td>61,767</td>
</tr>
<tr>
<td>BJ 212</td>
<td>16,418</td>
<td>21,000</td>
<td>22,555</td>
<td>59,973</td>
<td></td>
</tr>
<tr>
<td>Cherokee</td>
<td>0</td>
<td>262</td>
<td>1,532</td>
<td>1,794</td>
<td></td>
</tr>
<tr>
<td><strong>Sale (million yuan)</strong></td>
<td>0.29</td>
<td>253.51</td>
<td>358.45</td>
<td>483.68</td>
<td>1,095.64</td>
</tr>
<tr>
<td><strong>Profits (million yuan)</strong></td>
<td>71.56</td>
<td>36.00</td>
<td>47.40</td>
<td>48.49</td>
<td>131.89</td>
</tr>
<tr>
<td><strong>Profits AT (m yuan)</strong></td>
<td>36.00</td>
<td>47.40</td>
<td>41.15</td>
<td>124.54</td>
<td></td>
</tr>
<tr>
<td><strong>Total Employees</strong></td>
<td>10,110</td>
<td>3,715</td>
<td>4,043</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: BJC publications.
long term. However, it is very unlikely that this will be the case. Now that AMC is part of Chrysler, Chrysler may take steps to make change. Already, the Chinese government has pushed strongly towards localization, since practically, China is importing the Cherokees on net. If changes are demanded by both sides, the easygoing atmosphere will soon be replaced by pressure for reducing costs and by tension created by internal income redistribution. The effectiveness of BJC's industrial-relation system in managing conflicts will then be put to a test.

China was isolated from the rest of the world for a long time. It is not surprising to see that time is needed for the parties involved to understand each other's motivations and interests, and to adapt to new roles and relationships. To establish a long-term relationship, the American and Chinese executives and the union leaders (now functioning as workers representatives) need to engage in an open dialogue in a straightforward manner in order to address strategic issues of the joint venture. Considerable amounts of education, learning, and problem-solving skill development are needed for all the parties involved. Consultation and participation, as good avenues to that end, should be organized in greater scope and depth.
CHAPTER 5. CONCLUSIONS AND OUTLOOK

The world motor vehicle industry is characterized by increasing technology complexity, internationalization, and competitive rivalry. The shifting comparative advantage and the industry development logic suggest a golden opportunity for China to develop its motor vehicle industry to the world level. While this thesis discusses primarily the internal side of the Chinese motor vehicle industry, one should never forget that strategy formulation requires investigation of all alternatives in a global framework, searching for opportunities in international alliance, international division of labor, and world market, instead of being confined to domestic opportunities only. In addition, in its effort to improve internal management, China should compare all models of managerial practices in the world motor vehicle industry, to find best fit with China.

Although China has achieved some success in building a domestic motor vehicle industrial base, it lags far behind advanced countries in terms of variety, quality and quantity of its motor vehicle products, and in terms of capability in product development. Our review of the history of the Chinese motor vehicle industry, characterized by the three "auto fevers" and our analysis of its development path have revealed that a fatal problem in the Chinese motor vehicle
industry is its fragmented structure, which prohibits realizing economies of scale and effectiveness of investment, and hinders technological development. In order for China to catch up with the world major motor vehicle manufacturers, the Chinese industry demands a structure change.

The basic reasons for fragmentation are: A, multi-interests in motor vehicle business entry from an array of compartmentalized governmental entities (ministries, provinces, and municipalities) and B, a lack of centralized management in the past when "central planing" was the dominant regime, and a lack of market today when the policy emphasizes decentralization. Under the central planing regime CNAIC was unable to achieve its goal of rationalizing the motor vehicle industry by administrative measures. Given the prevailing decentralization policy today, reduced to a coordinating federation, CNAIC is further away from a position to accomplish that.

Two things are necessary right now to rescue the industry from being further fragmented, to facilitate structure change. These two also constitute two necessary conditions for the Chinese motor vehicle industry to take off. The indication of taking off is competitiveness in the world export market, and possession of an ability of technological development.
I. First is a market system under Chinese decentralized economy. While seeking a marriage between market and a socialist economy with public ownership being dominant is not an easy job, this has to be done since one simply cannot run any industry in an environment with neither planing nor market! The sooner a market system is fully developed, the sooner the formation of a healthy industry structure will be under way, and the earlier the Chinese motor vehicle industry can take off.

An urgent task for the market regime is to abandon the on-going dual-price system, which is creating corruption and a crowd of middle-men in a black market trying to profit instantly between "plan price" and "out-plan price" for motor vehicles, components, as well as material for fabricating the components. The existence of a market price system reflecting the relation between supply and demand is the key for market regime, and is indispensable for Chinese motor vehicle firms to get signal on consumers' needs under today's decentralization policy, and to make rationalized decision on resource allocation. Of course, implementation of the market price system will involve all industrial sectors, require courage, as well as caution, and preparation for short-term inflation.

To ensure competition which will result in industry
reorganization, all the barriers set up by some provinces on trade of motor vehicle products across provincial boundaries should be removed. Regional protectionism is against the national interest in fostering a strong competitive domestic industry, and should not be allowed. Financial market, now is in experimental stage, should be developed to allow enterprises under different jurisdiction to merge.

The Government has taken some steps to ensure assimilation of foreign technology and to emphasize the relation between R and D and factory floor activities. Market competition will further stimulate R and D. Technology market should be further developed to encourage technology transfer.

II. Second necessary condition is to push forward the separation of ownership from management of state enterprises. The government of all levels should stop interfering the day-to-day operation of enterprises, give the management enough decision making power, and allow the management of enterprises to choose how to run the enterprise based on market opportunities instead of to which governmental entity they belong, no matter it is the Ministry of Machine Building Industry, or Beijing City government, or the military. After the separation of ownership from the management, through market competition, all the firms, large or small, will eventually find the best position in the market for them in terms of what to produce,
where to sell, and make or buy, grow or shrink.

Along with the increasing content of market economy in China, especially the creation of the financial market, and the reform of governmental organizations, the author would expect that, sooner or later, it will be possible for different Chinese ministries, provinces, municipalities, foreign firms, and some Chinese individuals, together with the military, to put their financial resources together to invest in a high scale motor vehicle firm. They will all hold stocks on the firm, and the Board of Directors will control the firm while letting the management handle its day-to-day operations.

The role of the government in the market regime will still be vital. It needs to develop new tools of indirect macroeconomic management. It will ensure the function of the market regime, and regulate the industry to minimize the negative aspects of the market and decentralization, e.g. through licensing and approval process to avoid too much waste from building simultaneously too many of the same project, and through financial measures to discriminate firms and promote key projects. The government need to learn from the experience of developed countries in building up a competitive motor vehicle industry, especially to learn from Japan and NICs in using promotion and protection measures, e.g. industrial policy and import
controls, to foster domestic motor vehicle industry to a level at which it can aggressively enter the international competition.

The author proposed three strategies for the firms of three kinds in the Chinese motor vehicle industry, namely, "continues transition" strategy for the existing and potential big firms, differentiation strategy for mid level firms, and component strategy for small firms.

All the strategies involve technology transformation of existing facilities. The rapid technology development in motor vehicle industry, in material and electronics, for example, compounds the financial difficulties that China faces in purchasing new technologies from developed countries. China should explore more financial avenues. Now, Taiwan is among the highest in foreign currency reserve in the world. Is it possible to utilize the financial resource of Taiwan to develop motor vehicle industry of the mainland? Besides joint venture with foreign firms, which is a good way to introduce both technology and capital for assemblers as well as component makers, all the Chinese motor vehicle firms with component manufacturing capability should also consider component exports to accumulate capital as well as learning.

In terms of joint venture with foreign firms, a fresh
look at what's going on in the world, especially in Asia will raise the sense of urgency for the Chinese. For instance, Mazda designed Ford Festiva will be made by Kia of South Korea and sold to the U.S. In order to grasp the opportunity provided by shifting comparative advantages, not only between Asia and the West, but also between China and Asia NICs, both foreign companies and Chinese firms should have a longer term consideration moving beyond the narrow terms of the current investment debate, consisting of demands from Chinese firms for nearly 100% local content and immediate, "guaranteed" exports to the West and from Western firms for quick investment returns and immediate repatriation of profits. It does not take a genius to figure out that if China offers a set of too crucial conditions for picking up a partner, it is impossible for China to find a world level competitive partner, simply because somebody else may want to offer better terms to the firm, or the firm doesn't see the need to take high risk with the Chinese. Firms that agree with China's terms may not be first class motor vehicle producers themselves, and may not have the technology (including managerial system as we defined before) China needs.
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