

Review

An overview on the manufacturing strategy in China: Interpretations from 388 journal papers

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In the last decades, emerging economy has become eye-catching stars all over the world not only in real business practice, but also in academic research. Many people have been astonished by their surprisingly fast growth in countries like BRIC (Brazil, Russia, Indian and China). China has been regarded as one of the most promising super nations in the 21st century due to her double-digit growth rate in about 20 consecutive years. In China itself, lots of discussions have been undergone to argue if China can maintain such fast growth and how long she will sustain such growth rate. Authors of this paper have studied 388 papers related to Chinese manufacturing strategy published during 1994 down through 2007 and streamlined the main conclusions and interpretations in those 388 papers. About 30 kinds of manufacturing strategies have been summarized and rational suggestions have been presented for decision-makers in China and for fans who have keen interest in the economic development in China.

Keywords: Emerging economy, manufacturing strategy, executive review.

INTRODUCTION

With the rapid development of manufacturing in China, there are also latent crises at the same time. On the one hand, the cost advantages which originated from cheap labor force has been diminishing (Cai, 2006) by and by and expansions derived from low costs have been causing lots of social problems (Liu, 2006); on the other hand, countries like India, Mexico and Brazil have become new attractions for world industry transfer (Lin, 2005). Additionally, the over-emphasis on the introduction of capital and technology has weakened the innovative competence (Zou and Zhang, 2004) for the manufacturing development in China. China's manufacturing industry has been encountering numerous problems which require urgent alteration.

THE RESEARCH FRAMEWORK AND TRENDS ON CHINA'S MANUFACTURING STRATEGY

Research trends

Authors of this paper have made a careful study in the

research field pertinent to the manufacturing strategy in China since 1994. Papers containing the key words like "made in China", "Chinese manufacturing" are meeting the criteria for being singled out in this study. From the publicly released papers, 388 such articles have been randomly chosen as the Guinea pigs and a rough statistics has been made as can be seen in Table 1 which is a clear indicator that the research on China's manufacturing strategy has become hotter and hotter since 1994 (Table 1).

Research perspectives

Probing into these 388 papers, it is obvious that researches related to the manufacturing field in China can be concluded into the following 10 perspectives (as can be seen in Table 2). Broadly speaking, research in this sector can be divided into two main streams: international perspectives and domestic perspective:

Table 1. Numbers of Internal Research Papers on China's manufacturing during 1994-2007.

Key Idea	Year										
	1994–1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Total
"Manufacturing" is the key idea	650	189	327	413	687	1156	1124	1113	1340	1378	8377
Manufacturing industry (Core journals)	150	48	88	113	163	345	302	349	401	426	2385
Made in China	13	8	8	22	81	113	135	155	192	300	1027
Made in China(Core journals)	1	2	1	4	11	14	21	22	30	30	136
Papers Chosen in the research	21	3	11	12	25	74	68	54	60	60	388

Note: Core journals indicate the academic concerns for manufacturing in China; while other journals indicate the concerns for manufacturing in China from real business world. Sources: Journal collections website in China (<http://ckrd.cnki.net>)

Table 2. Main Themes of Internal Research Papers on China's manufacturing.

Research themes	Number of papers chosen	Percentage in total subjects (%)
Chinese Manufacturing strategy	124	31.9
Regional strategy for manufacturing development	47	12.1
Manufacturing strategy in Chinese Manufacturing industry	40	10.3
Manufacturing technology upgrading in China	31	7.9
World manufacturing development	28	7.2
Manufacturing strategy in Chinese firms	24	6.1
Labor force supplies in Chinese Manufacturing	21	5.4
Chinese manufacturing and foreign trade	15	3.8
Chinese manufacturing and FDI	14	3.6
Manufacturing and service	12	3.1
Total	366	94.3

Sources: Assorted and compiled by authors of this paper.

(1) For international perspective (the emphasis has been laid on the systematic overall positioning and the external environment): In this division, researches are mainly concerned with the horizontal comparison and vertical comparison. The former falls into the current situation of Chinese manufacturing and its position in the manufacturing sector of the world, while the latter (normally historical analysis) falls into the consideration about China's manufacturing development and its future trend for further development.

(2) Domestic perspective (the emphasis has been laid on the internal structure and the correlation among the internal factors in the manufacturing field): In this research branch, it mainly contains areas like regional distribution of manufacturing development in China, the real situation of the industry development, transfer of labor force and technological progress, etc. based on this research, normally the relevant strategies and tactics have been proposed.

Research Methodology

From the chosen articles, the authors have found that the

current research on Chinese manufacturing has been far from maturity and normality according to the requirements of rigid scientific and systematic research. The main problems that existed in the current research can be summarized as follows: research methodologies are simple and unitary. To be specific, there exist five analysis paradigms in the current research: argumentation only relying on words, simple index comparison, composite index calculation, metrological analysis and economic analysis. Researchers have mainly adopted such research paradigms from status quo analysis to gap analysis, then to policy interpretations and finally to suggestions for future policy stipulations. Only few of the articles have adopted more complicated research methodologies like simple comparison of indices, composite index calculations and metrological analysis. There isn't any article which has constructed economic models in their research (as can be seen in Table 3). To sum up, current research on Chinese manufacturing lack sufficient normative research based on concerning theories and lack empirical data to support. As per the rigid scientific research normality, research on Chinese manufacturing strategy is far away from maturity and normality.

Table 3. Research methodologies adopted in internal research on China's Manufacturing.

Methodology	Interpretation	Number of articles	Percentage in total (%)
Simple statement	Merely use words to express ideas and thoughts	315	81.2
Simple comparison of index	Simple index like productivity, etc.	25	6.4
Composite index calculation	e.g. Gini Coefficient, Herfindal coefficient, intra-industry trade index, etc.	18	4.6
Metrological analysis	Multi-factor regression, time series analysis, etc.	25	6.4
Economic models	Economic models (equilibrium analysis, game theory, deviated differential calculus equations)	5	1.22
Total		388	100

Source: compiled from literature review by the authors.

Table 4. Research stages of China's manufacturing and future Research.

Periods	First Period (prior 2000)	Second Period (2001–2003)	Third Period (2004–2006)	Fourth Period (after 2007)
Number of papers	Very rare	More	Numerous	Profusion
Research topics	Introduction of foreign industries like machinery and electronics	Status quo analysis, gap analysis and overall strategy	World factory, regional variance, industry upgrading, investment environment and FDI	Industry upgrading, innovation, service economy and FDI
Research methodology	Simple statement and index comparison	Simple statement and index comparison, exponential calculation	Normative empirical research is emerging	Normative empirical research is emerging, policy interpretation and analysis as well.

Source: compiled by authors based on literature review.

Division of research periods and future perspective

Looking back into the research on Chinese manufacturing strategy, it can be divided into four stages as can be seen in Table 4 (see Table 4 for more details). The first research period falls into the time span from 1994 to 2000. In this period, there were seldom research articles on Chinese manufacturing. The main themes in the existent papers were focusing on the introduction of certain manufacturing fields in foreign countries and took it as a benchmark to compare the situation in China; the second period falls into the time series from 2001 to 2003 and there were more research on Chinese manufacturing. The main ideas in this research period are the status quo analysis, gap analysis and recommendations for future overall manufacturing strategy; the third period covers the time from 2004 to 2006 during which numerous researches have emerged. Research themes cover a wide range of topics like the overall strategy of Chinese manufacturing, world

manufacturing center, labor force constraint, industry upgrading and innovation, etc. quite a number of consensus have been reached among researchers. The authors have predicted that since 2007, the research on Chinese manufacturing will go on to a new stage which is called the fourth period. In this period, normative empirical research and model construct analysis will become the mainstream and lots of hot topics will have been enhancing and emerging like innovation, service-oriented manufacturing and FDI in foreign countries.

THE OVERALL MANUFACTURING STRATEGY IN CHINA

According to a Chinese scholar called Shu'Zhang (2004), the manufacturing development in China can be seen from three aspects: industry strategy, enterprise strategy and specific strategy. We thought such view is not comprehensive enough to construct the manufacturing

development in China. Actually, manufacturing strategy can be researched from the macro-perspective (national level), the medium perspective (regional and industry level) and micro-perspective (enterprise level). Taking national level for example, issues to be considered should include things such as the right opportunity to choose, the regional distribution of manufacturing industry, industry structure, paths for achievement, ultimate objectives and the concerning policies to assure the achievement. To simplify it, from the national level, manufacturing strategy should answer questions like when, where, what and how (4Ws).

Constraints for the future development of Chinese manufacturing

The rapid development of Chinese manufacturing has benefited from the global manufacturing transfer (Gao, 2006), large consumption market and high quality but low cost of labor force (He, 2002; Li, 2003) and complete manufacturing systems inherited from history (Shi, 2002). But if China wants to maintain its tempo of manufacturing development in the future, there are some constraints that China has to encounter. To be specific, these constraints include:

(1) The low labor cost in China is disappearing: according to the research of China National Science Association and World Bank, from 2009 to 2010, China's low labor cost advantage will disappear and Chinese manufacturing will encounter serious problems (Wang, 2007).

(2) Severe constraints from energy and resources: the world supplies for energy and resources may not enable China to achieve an ideal development in its manufacturing industry (Chen, 2004).

(3) The world development trend is that more and more industries are escaping from manufacturing and transferring to new fields (Hu, 2004). According to Gang'Fan's research results, who is a Chinese researcher in Chinese manufacturing strategy, presently in Chinese manufacturing, scientific and technological personnel only takes up 1/6 of the total army of people in manufacturing and the investment in talents and capital fund in manufacturing in China is decreasing year by year, all these will influence the future development of manufacturing in China.

(4) Political mechanism is the biggest headache (Yi, 2004) for future development, or rather, the co-existence of industrial economy and knowledge economy due to historical and social reasons; education and research are not getting married with the business requirements; abnormal mechanism in education, science and technology research because of the intervention of the government and the unfair assessment on the development of science and technology (the assessment

mechanism on scientific and technological development in China only takes such as the criteria as the current science development, the precedence in foreign countries, the exaggerated reliability for qualitative assessment structure, the very rough and general statement of the assessment results and very severe lack of innovation).

(5) Other bottlenecks for lagging the manufacturing development in China: structural bottleneck, backward machinery and equipment, technological bottleneck, low productivity; institution bottleneck and backward systems in finance and public administration and international rule of the game as well as the constraints from world trade systems (Li, 2004), etc.

Development mode and channel options for Chinese manufacturing

The development mode and path option in Chinese manufacturing lies in two problems:

(1) Is it still sustainable and necessary for China to develop its labor-intensive industries?

2) Is it necessary for innovation and when and how can China achieve autonomous innovation?

According to Rostow (1960), labor-intensive industry was the best choice for countries that are just at the take-off stage for their economic development. For a long time in China, cheap and efficient labor force was once the most attractive competitive advantage for manufacturing development. Discussions about whether China will still maintain its labor-intensive industry never comes to a one consensus. Liu et al. (2004) took the view that China cannot upgrade its competitiveness in the world market if it continues to develop its labor-intensive industries since the extremely low productivity has closed the cost advantage from cheap labor force. If China sticks to develop its labor-intensive industries, China will never upgrade its position in the international division of labor. Zhang (2002) also advocated to the previous view from another perspective that if China takes into account the improvement of its labor force quality, it should not over-emphasize its competitive advantage in cheap labor force; otherwise it is very hard for China to upgrade its level in manufacturing development. On the contrary, other scholars thought it is necessary and beneficial for China to develop its labor-intensive manufacturing industry for the sake of wide and sufficient employment that labor-intensive industries have provided. Wu (2003) in his research has analyzed the contributions that manufacturing have made to the employment in China from 1978 to 2000. He thought though manufacturing industry takes up a bigger share in total industrial development, its contribution to employment is not significant enough. On the one hand, China should

develop its hi-tech industry; on the other hand, China can still develop its labor-intensive industries. These two strategies are not in absolute conflict at all. The transfer of labor force surplus in China requires further development of labor-intensive sectors. Zheng (2004) also supported this idea as he thought at present, China's further development calls for large number of capital investment, but the capital provision in China cannot meet such demand, and therefore, the development of labor-intensive industries will do good to the accumulation of capital and technology and thus enhance the technology transfer and industry upgrading. When looking into the previous two contradictory views, it is not hard to imply that as for industry upgrading and the development of hi-tech industry, these two schools of thoughts share the same view. The only difference lies in the specific issues as when and how China should give up its advantage in cheap labor force and how to upgrade its industry.

DISCUSSION ON THE CONCEPTION OF "WORLD FACTORY"

The issues concerning "World Factory" can be traced back to the 1990s with the statement that "China is a threat to other countries". In May 2001, Japanese government released a white book called "Facing the external economic policy in the 21st century." Later, editorial articles have been released in the newspaper of *Japanese economic news* and labeled China as "the new world factory" (Yang, 2004). Following that, discussions about "China is the new World Factory" has been spreading all over China in the academic field.

Historical trend and new connotation of the term "World Factory"

World factory has been experiencing a long odyssey and in this long journey, Great Britain, USA and Japan were once the World Factory. In 1860, the manufacturing capacity of Great Britain took up 40-45% of the whole world that marked UK as the first World Factory; in 1929, the manufacturing capacity of the USA took up 43.3% of the global total which marked USA as the second World factory defeated the UK. UK and the USA have become the World Factory with the overwhelmingly advantageous strength in the world manufacturing. After the World War II, Japanese manufacturing development substantially took up 15% of the world total volume in manufacturing in its booming period, which made Japan the third World Factory replacing the USA. Being a World Factory, Japan has changed the connotation of "World Factory", that is, the main indicators for World Factory are the domination and monopoly of key industries, key products and key spare parts.

With the globalization of world economy and the development of lateral and vertical division of labor, World Factory may have new connotations. These might be:

- (1) The manufacturing center with global R & D, global procurement and global marketing network (Comprehensive Development Institute, 2002).
- (2) Market share will no longer be emphasized but the influence and control in key processes in the industry value chain will take more weight in judging the competitive advantages (Zhang, 2003).
- (3) The organic integration of manufacturing, R & D, and operation.
- (4) Factors as the new competitive advantages like technology, management style, institutional environment and culture (Wang and Yue, 2005), etc.

Criteria to judge "World Factory": Is China the world factory?

The terms "World Factory", "World Manufacturing Base" and "World Manufacturing Center" are widely used interchangeably. Countries labeled with these terms are usually seen as manufacturing big shots. Actually, the connotations for these three terms should be different. "World Factory" is the initial form of industry clustering in the manufacturing development in the world; while "World Manufacturing Base" refers to those countries with high manufacturing capability but the manufacturing, R & D and marketing are separated. "World Manufacturing Center" refers to those countries with great competences and overwhelming advantages in integrating R & D, marketing, brand, manufacturing and operation as against other countries (Guo, 2004).

All in all, in the academic circle in China, China is not the world factory at all at its present development period. But the epoch provides such a golden opportunity for China to become a potential world factory if China takes great pains to modify, reform itself in industry structure, technology, marketing and other areas.

Channels for China to become the world manufacturing center

Whether China should become the world manufacturing center? No doubt, the academic circle unanimously agrees that China is now meeting a once-for-all-life opportunity to make a leap forward in its manufacturing development. Fan (2003) pointed out that being the world factory is a golden opportunity for China to make itself into an R & D center and the operations Center in the world. As for the concrete path to achieve such a goal, scholars have proposed numerous approaches. Only picking up some of the proposed approaches for instance:

- (1) Continue to enhance the development of traditional industry.
- (2) Pay attention to the combination of internal and external market.
- (3) Enterprises should pursue perfection in a certain field but not merely pursuing scale and size.
- (4) Achieve transformation from internal branding to manufacturing itself.
- (5) Specialization of industries and enhance the influence in the industry value chain (Fan, 2003).
- (6) Prior to a certain period for example 2010 (Wang and Yue, 2005), continue to exert the cheap labor force advantages (Fan, 2003).
- (7) Key industries like machinery, equipment and electronics should be further developed.
- (8) Realize informationalization and new industrialization.
- (9) Build global brands by adopting the global resources (Wang and Yue, 2005).

THE GLOBAL COMPETITIVENESS OF CHINESE MANUFACTURING

The study of international competitiveness has come from two main sources: one is Michael Porter's masterpiece *National Competitive Advantages*; the other is the annual assessment list on the national competitiveness conducted by LAUSANNE Management School in Switzerland. In academic field in China, researchers have adopted the following mainstream to study the national competitiveness:

- (1) International competitiveness has been judged according to the gaps between the host country and foreign countries in manufacturing;
- (2) From industry perspective, probe the international competitiveness in a certain industry.
- (3) Investigate the national competitiveness in the world market through unitary method or comprehensive method.

Since the reform and opening up in China, the 20 years of imbalanced development in different regions in China has enlarged the gap between different regions (Chen and Shi, 2000). This polarization in manufacturing development has arrested the attention of many scholars. To speak from the academic research perspective, researchers are mainly concerned about issues as "how big is the gap?" "What are the causes for such big gap?" And "how to narrow down the gap and solve the problem of polarization?" as from the aspect of research methodology, discussion about the gap measure of different areas is comparatively sufficient. For instance, scholars like Hou'kai WEI and others partially solved the problem of how to measure (Wei, 1997) the differences between different regions by adopting varied co-efficient; GIS method has been adopted to describe the evolution

of regional development (Meng et al., 2005) and discussions about whether there exists inverted U curve in Chinese manufacturing through model construction and empirical data. Reasons why inverted U shape curve exists has also been discussed. For example, Luo (2006) in his research tried to explain the inverted U shape curve through S aggregated curve. As for the causes why there are regional developments gaps and how to solve the problems remain theoretical discussions. Some causes have been listed as the main reasons to cause the imbalanced regional development, such as policy, geographic location, resources, population and factor endowment, but there are not enough empirical data to support their conclusions (Xu, 2006). Therefore, the strategies stipulated to solve the problem of imbalanced manufacturing development cannot achieve the pre-set objectives.

In future research, the following aspects should be strengthened:

- (1) In methodology, it is necessary to adopt virtual variables to analyze the outcome of the policy performance.
- (2) In policy design, attention should be laid on the feasibility and operationability of policies.
- (3) In specific policy, continuous attention should be placed on finance, fiscal, regional development, foreign trade, energy, resources and environmental protection, etc.

SERVICE-ORIENTED MANUFACTURING

The integration of manufacturing and service has already become a trend. A new manufacturing model has emerged as service-oriented manufacturing. According to historical experiences, every time when new manufacturing model appears, some countries will emerge as new stars and some will be kicked out in the world competition (Gao, 1994). Chinese manufacturing is just facing such a blessing and cursing crossroad. The discussions and researches about service economy has been emerged since the late 1990s though different countries have used different terms, for example, some called it new manufacturing, some called it service-based manufacturing, still others called it service-enhanced manufacturing (Crawford-Welch, 1991; Hess and Kemerer, 1994; Brown et al., 1994), etc. However, in essence, these terms are the same. The main tenet of these terms is to emphasize the importance of the role that service plays in the manufacturing process and service has been seen as the most important part for value-creation and value addition. In the early 21st century, concept of the integration of service and manufacturing emerged and stirred a whirl of research in academic field. This new concept has marked the beginning of new manufacturing mode (Cui and Zang,

2007; Xia et al., 2007; Wu, 2007; Xu, 2007; Liu and Li, 2007; Wang, 2007; Lin et al., 2007). Many cases have been studied and propagated worldwide. These empirical studies have enhanced the concept of new manufacturing mode and testified such a fact that there is no pure manufacturing mode, either in machinery and equipment sector, or in household electric appliances. The only way out is to integrate manufacturing with service so as to create additional value as the margin of profit from pure manufacturing is becoming thinner and thinner. The marriage between manufacturing and service has become a trend for firms to consider if they want to maintain and sustain the competitive advantage (Deng, 2002; Peng and Cai, 2002; Lin and Wu, 2006).

In general, research on the service-oriented manufacturing or service-embedded manufacturing has just aroused the attention of people either from academic circle or from business practices. It is only a newly-born baby in China and in the world. In theory, service-oriented manufacturing might provide an opportunity for China to probe, investigate and retrospect its manufacturing development. If China could grasp this opportunity, it might be a time for her to stand out as the World Factory (the fourth generation of world factory in the world with UK, USA and Japan as the antecedents). In reality, the integration of service and manufacturing can provide added value and create new value which may be possible to solve the potential problems China is facing in its manufacturing development. Further consideration and research are to be followed.

CONCLUSION AND RECOMMENDATIONS

Based on the skimmed reading of about 388 journal papers pertinent to Chinese manufacturing, the authors of this paper have concluded their research as follows. Discussions about Chinese manufacturing strategy should not merely remain on retrospect and summarization, but propose practical guidelines for the manufacturing development in the future. At the moment, Chinese manufacturing has been developing swiftly and academic research on it should not be lagged far behind. Special attention should be laid on the investigation of the sources and causes why manufacturing industry has been developing so fast and where it will go in the future while facing numerous new challenges. As for the future research on Chinese manufacturing strategy, the authors of this paper have proposed the following points:

(1) As regards research questions, future researcher in this field should answer such series of systematic questions as “when, where and which industry structure, what kinds of mode that manufacturing should be developed? What are the ultimate goals to be achieved?” as well as what are the legitimate issues to be stipulated to guarantee the smooth development of China’s manufacturing industry?

(2) As regards the research objectives, future research should put stress on the trends for future development, the attainable goals, development paths and milestones that can encounter in the course of development.

(3) As for the research methodology, empirical research methodology should be strengthened.

(4) As regarding research perspectives, future researcher should make an organic combination of macro and micro factors; the former mainly refers to the design and construct of systems, while the latter referring to practices at enterprise level.

(5) As for the research content, while probing the rights and wrongs of manufacturing development worldwide, attentions should also be placed on the innovation, industry structure upgrading, labor force interest, foreign direct investment (FDI), and financial issues.

(6) Research conclusions should be operational and practical; meanwhile they should contain profound interpretation on policies matters. Constructive recommendations should be proposed as guidelines for future development.

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