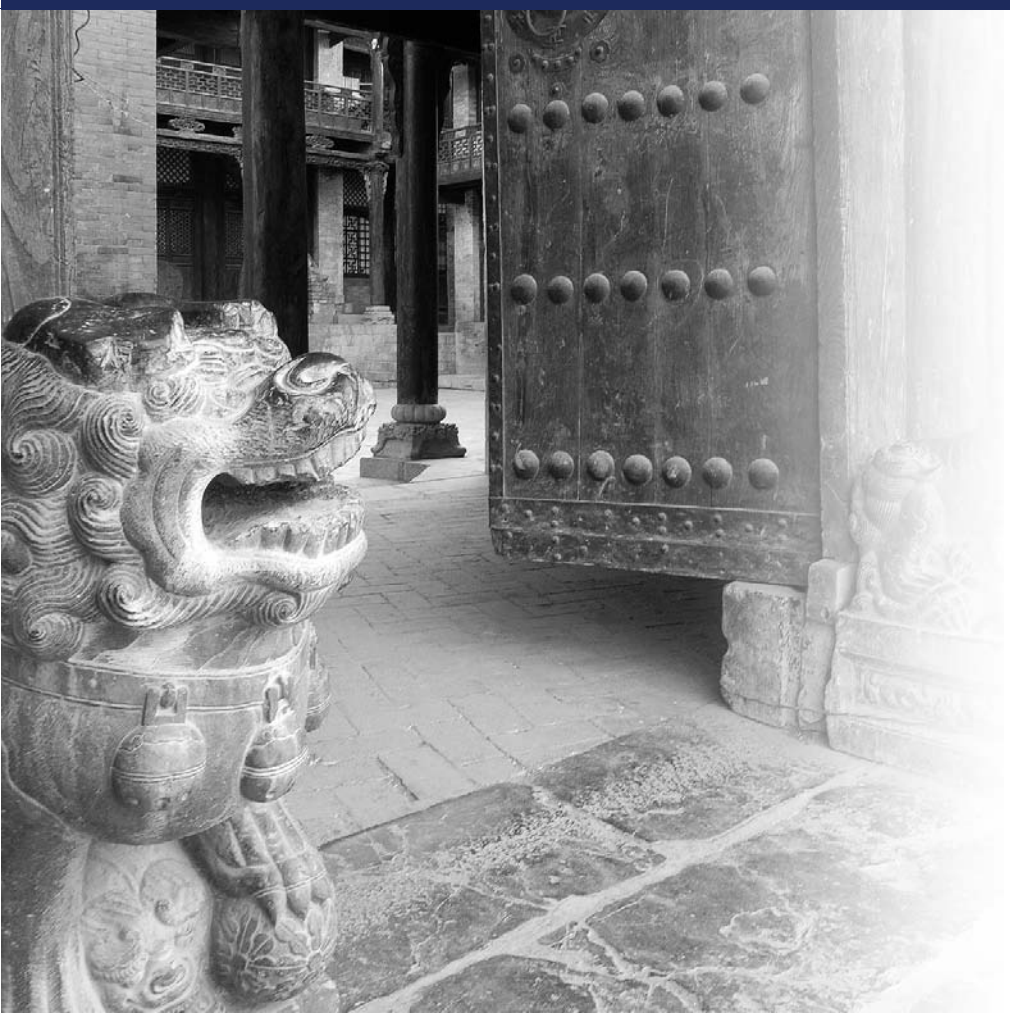
InterChina Insight

Assembled for Failure: The Machine Tool Component Sector in China

White Paper

By **Long Nanyao** | June 27 , 2013



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Summary

- China's machine tool industry went through a very difficult period in 2012 because of the substantial contraction of the lower-end segment, with its excessive over-capacity, and insufficient capacity in the high-end category.

- One of the reasons of the backward status of China's machine tool sector results from the continuous neglect of development of the components and parts industries. Because of this China is heavily dependent on imports of key components.

- Despite some progress, it will take another couple of decades for the Chinese machine tool components industry to become competitive in the high-end segment, mainly because it lacks a solid industrial foundation and suffers from the industry's outdated structure, and inadequate values and work attitudes. We consider different 'work attitudes' a key issue: professional pride and a long term industrial career view are key success factors in the machine building industry which relies to such a high degree on the 'know how' or savoir faire of its employees, from basic operators, to installers, to application and service engineers etc. For China to develop a competitive machine tool industry, important structural and social/behavioral changes are required, which will be difficult and require many years.

- China will remain the world's largest machine tool market for the next decades. Advanced western suppliers (both OEMs and key components manufacturers) will continue to dominate the high-end market segment for the next couple of decades.

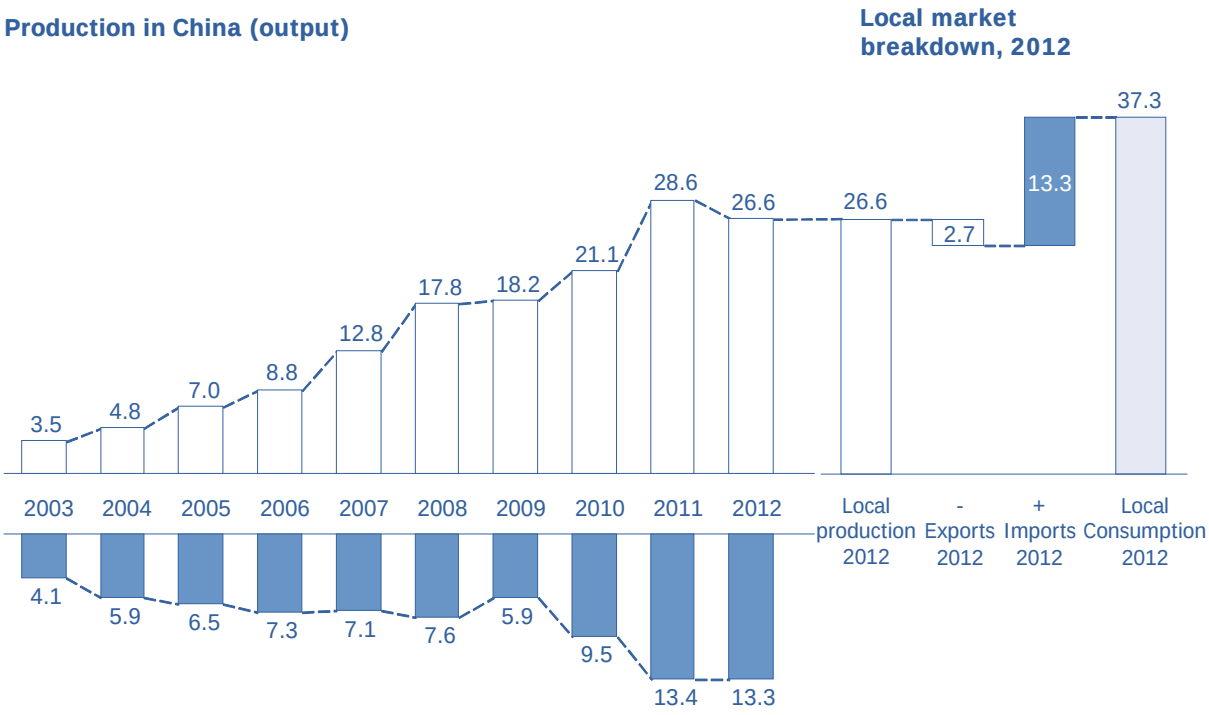
- Chinese and international companies active in this sector (producers of both machine tools and their components) will have to keep the following in mind in order to gain and maintain competitiveness in the Chinese market: Benchmark mainly with other international competitors (incl. Taiwan). In some specific cases Chinese competitors could be relevant however.
  - Focus on services (including spare parts), client requirements and client support, product adaptation etc., rather than on local production. Consider gradual transfer to China of product development capacity and production adaptation to the local market, while keeping the core of R&D in the home country.
  - Be careful when transferring production to China, as it might be very difficult to achieve international quality. In addition there might be limited or no sustainable cost advantages, unless product design (and quality) is adapted to component choices which are available in China.
  - If 'closeness to market' is important, consider alternative solutions for R&D and/or assembly (or if necessary production), such as Taiwan, Korea or Malaysia (FTA). Consider hybrid solutions with dedicated production and R&D capacities in the home country and support/client teams in China.

Overview: The Chinese Machine Tool Industry in 2012

The year 2012 was unusually tough for China's domestic machine tool sector. After years of high growth (with the exception of 2009 when the global financial crisis was at its worse), the industry experienced a slowdown in the second half of 2011, and then plunged into a major downturn during 2012. According to official statistics (which in our view are probably overly positive), China's metalworking (metal-cutting and metal-forming) machine tools sector only achieved a turnover of USD 26.6 billion, a bit below 2011. Despite this, in terms of value China remained the world's largest metalworking machine tool manufacturer (accounting for 30% of the global total) and largest consumer (accounting for 45% of the global total).

China remained heavily dependent on imported machine tools in 2012, with the imports accounting for 35.73% of total consumption, slightly higher than in the previous 3 years. Imports were mainly of high-end products that local suppliers are unable to provide. It is also important to note that the sector's dependence on imports actually was higher than shown by the graph, since superior local-made machine tools usually use expensive imported parts and components for key functions (to be discussed in later sections).

Snapshot of the Chinese machine tool market, USD



Source: CMTBA; InterChina research

China's machine tool industry may have been considerably worse off in 2012 than the official statistics suggest. Our recent investigations found that the turnover of many local machine manufacturers dropped substantially due to a drop in domestic demand. Based on our information at least two major Chinese machine companies suffered revenue reductions of 40% in 2012 compared to a year earlier. In our view, the sales of the domestic metalworking machine tools sector may have fallen by at least 20~30% from 2011.

The main reason for the disastrous conditions of the machine tool industry is the slowdown in China's economic growth over the past few years. As manufacturing industries are going through an up-grading process, demand for low-end machines is shrinking while new demand for higher-grade machine tools is only gradually taking shape. The machine tools boom of the recent decade mainly reflected demand for the cheap lower-end machine tools that local suppliers were well placed to provide. So the transition to higher quality would naturally cast a pall over the domestic machine tools market.

Despite the Chinese government's ambitious plans for upgrading the manufacturing sector and the recent revival of infrastructure investment meant to stimulate domestic demand, new market opportunities for the machine tools industry may not materialize very quickly, so the market may remain flat, at least during 2013.

China's metal-forming machine tools segment (with Jier as the most prominent Chinese press machine builder, very active in the automotive industry) is relatively competitive. The real weakness lies in the metal-cutting segment, which accounted for about 70% of aggregate revenue for the metalworking machine tools sector in 2012.

Major MT Parts and Component Supplies

General status

While China can boast of some basic breakthroughs (although in many cases still far away from commercialization) in machine tool designing and manufacturing in the past decade, such as advanced large 5-axis machining centers and milling machines, there is little reason for such optimism over the machine tool components sector.

China has long emphasized the OEM sector and neglected components. Similar to the automotive components sector, China's machine tool components have been neglected for decades. The government realizes now that the underdevelopment of the components sector is holding back development of the machine tools OEM sector, and has worked out a series of preferential policies to foster development of components. However, the impotence of the machine tool components sector remains unchanged.

Local parts suppliers can provide conventional products with less technology content, such as machine body, normal cutting tools, jigs and clamps, chip collecting devices, and so on. Some local companies can supply inexpensive numerical control devices and other key components for low-end NC machine tool OEMs. For the better local-made NC machine tools, however, machine OEMs still rely heavily on imports of core parts and components, such as more advanced NCs and servo systems, high-speed electro-spindles, ball screws, linear rolling guides, NC turrets, tool magazine robotic arms, high-speed safety protection devices, and so on. These key components would account for at least 60~70% of the total production cost of locally made NC machine tools.

China imports many parts and components (see the table below) for its own machine tool production, apart from buying from the foreign-invested enterprises with factories in China. The slow down in local production is probably the main reason for considerable decrease in imports of components in 2012.

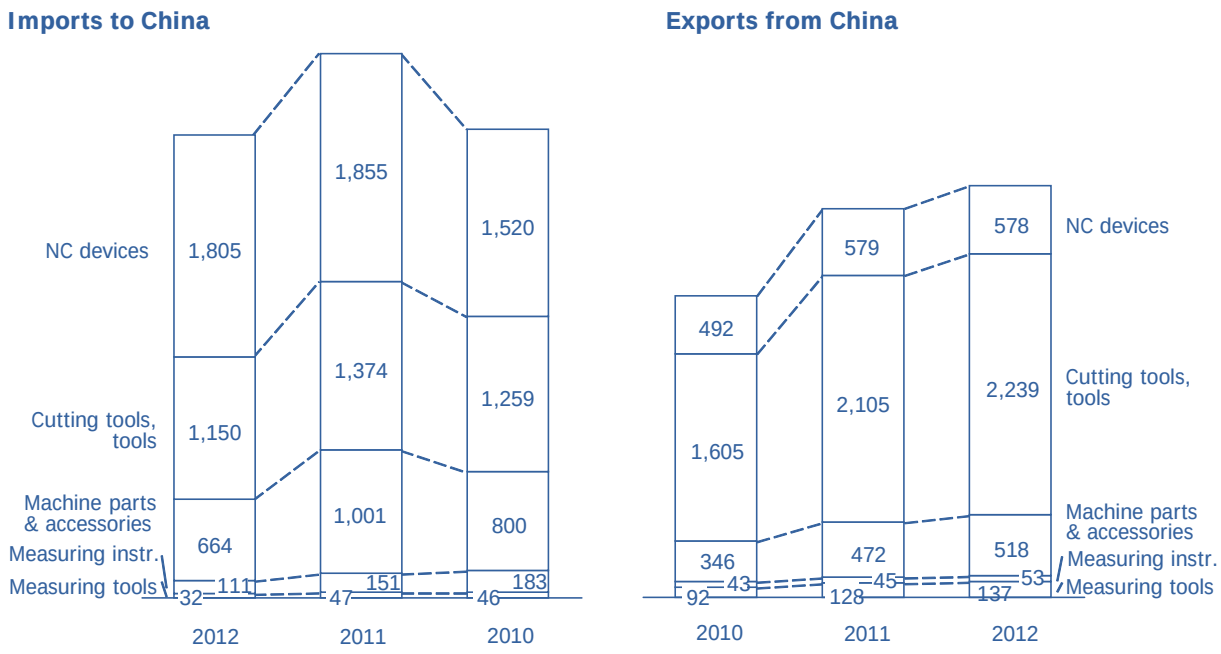
Component and Major Part Suppliers

According to official sources, 274 enterprises in China produce various kinds of machine parts and accessories, with total production of USD 5.73 billion in 2011, up 39% over 2010. *(These 274 companies most likely do not include the foreign invested companies, although we have not been able to have this confirmed.)* As for key parts and components for metalworking machine tools, another industry source said that by 2010 there were 70~80 local dedicated suppliers in China with fixed assets surpassing RMB 10 million. These local suppliers can be categorized into four types: those affiliated with universities and research institutes; component branches under major machine tool OEMs; privately owned enterprises typically found in Jiangsu and Zhejiang provinces; and foreign-invested companies (such as Siemens, NSK, THK, etc.). Most of local components suppliers are labor-intensive and focus on conventional products, with weak R&D capacity and limited production scale. Persistent structural inefficiency prevents local suppliers from innovating or upgrading their technology due to their isolation from machine OEM builders, since they typically operate without collaborating with their downstream OEM clients.

Only a few foreign-invested suppliers have production facilities in China to supply higher-end machine tool parts and components for both the domestic and export markets. They tend to lack large-scale production capacity and real R&D capacity, but nonetheless provide higher-end components to China's "medium-high-end" machine tools segment, while accounting for an important share of China's machine components exports. Exports of components, excluding tools, are relatively modest at around 1 Billion US$ in 2012.

Apart from the specialized components suppliers mentioned above, a few large local machine tool makers, such as Dalian Machine Tool and Shenyang Machine Tool, still retain components production facilities as subsidiaries. But most local machine makers have already spun off their original parts production as part of restructuring in the past few decades. Some Taiwan companies (such as Hiwin, ABBA, TBI, and GTEN) also are active in mainland China's machine tools components market.

Imports and Exports of Machine Tool Parts and Components, 2010 – 2012, USD m



Source: China Machine Tool & Tool Industry Year book 2012; China Customs.

Government Policy and Market

The government claims it supports development of local capacity in designing and manufacturing advanced core parts and components for high-end machine tools.

However, policy support in the form of encouraging introduction of foreign advanced technologies, establishment of joint ventures with foreign component suppliers, allocating resources for relevant R&D projects, has generally been ineffective.

The government maintains a tariff exemption policy for imports of advanced NC systems and 7 kinds of key components for higher-end NC machine tools for which China has no production capacity, such as NC devices, high-speed electro spindles (for machining centers), ball screws, NC power driver turrets, NC rotary tables, linear rolling guides and automatic tool changers.

Some local industry experts complain that this tariff policy favoring foreign suppliers impedes local component suppliers' efforts to upgrade. But domestic market demand is the main influence since many machine tool clients demand that key parts and components of locally produced machine tools they consider purchasing, be imported from certain foreign suppliers (e.g. specific CN controls). This reflects concerns over the unreliable quality provided by local components suppliers. Clients subject to public bidding procedures commonly include requirements for imported key components in their tendering documents.

Government-set targets

China's official 12th 5-Year Plan (2011~2015) recognizes the underdevelopment of the machine components sector, especially for advanced core parts, as a major bottleneck constraining further development of the machine tools industry. The plan cites the need to vigorously upgrade the components sector and sets a goal of "significantly increasing" the domestic market share of NC systems from the current 20% to 50% by 2015 and the core components for the medium- and high-end NC machine tools from the current 5% to 20% by 2015. (Locally-made NC machine tools are to account for 70% or more of the domestic medium- and high-end market by 2015.)

Major Products Categories

The following sections will present the general status of the selected component product categories which are essential for NC machine tools.

Spindles

China's spindle sector is divided into electro spindle functional parts, mechanical spindle functional parts, rotary tables, other spindle components (including milling heads and diamond boring heads), accessories, and other spindle components. The China Machine Tool & Tool Industry Yearbook 2012 shows that revenues for spindles within the machine tool and tool industry reached USD 218.47 million in 2011 (compared to USD 237.55 million in 2010), of which only USD 126.46 million was related to metalworking machines. However, it should be noted that the statistics only covered major enterprises which are in regular contact with the relevant industry association.

Electro spindle has become more popular in China in recent years. Local manufacturers of grinding and engraving machines are increasingly shifting to using electro spindles, largely supplied locally. One expert estimates the market size for electro spindle units for higher-grade, local-made NC machine tools at more than 15,000 sets in 2010, mainly supplied by foreign companies via imports.

China launched R&D projects on electro spindles as early as in the 1960s, and started developing the utility-type electro spindles for large NC milling machines, machining centers and NC turning machines in 1998. By 2010, there were more than 70 local enterprises producing electro spindles. Except for a few old enterprises with SOE origins such as Luoyang Bearing, Anyang Rabbit (Laigong), and Wuxi Machine Tools, most local suppliers were small-sized, privately owned enterprises.

Luoyang Bearing Science & Technology Co., Ltd, the main local electro spindle supplier, originated as the state-level entity Bearing Research Institute. It took

pride in its initial achievements in developing and supplying electro spindle units for local-made machining centers, high-speed milling machines and turning machines. Beijing Machine Tool Institute uses Fanuc motors to assemble high-speed electro spindle units (20,000 rpm and 24,000 rpm). Beijing Research Institute of Mechanical & Electrical Technology and the Shanghai No.2 Machine Tool Works assembled high-speed spindles using Rexroth motors. Recent newcomers include Hanchuan Machine Tool Group, Jining Best Precision Screw Manufacturing, Shenyang Blue Silver Industry Automation, etc.

China reportedly has been quite successful in producing low-power electro spindles for lower-end grinding machines and engraving machines, where the local suppliers dominate. Some local suppliers can supply electro spindles (largely using variable-frequency drives instead of servo drives) for lower-end NC milling machines, turning machines, and machining centers produced by domestic machine builders. However, China depends on imported electro spindles with advanced properties and high power for building medium- and higher-grade NC machines. These imported electro spindles accounted for more than 90% of China's high-end market in 2010.

Major foreign suppliers include Kessler, GMN, Gamfior, Fischer, Fanuc, Siemens Weiss, Omlet, IBAG, Setco, and so on. China's growing demand and heavy use of machine tools with high-speed electro spindles requiring intensive maintenance services have prompted several foreign electro spindle suppliers, such as Siemens and Kessler, to set up plants in China to provide prompt maintenance and repair services.

Some local machine tool producers have benefited from joint venture projects. Beijing No.1 Machine Tool Plant successfully built up the capacity for producing high-speed spindle units with full technology support from its JV partner Okuma, and has already started supplying their JV, which produces vertical, horizontal machining centers and CNC turning machines. Shenyang Blue Silver established a JV company (named as WMZ-SY) with DVS (Germany) in 2011 to produce NC machine tools and electro spindles.

In summary, China is still very weak in designing and manufacturing modern electro spindle units and is unable to provide various essential services. Local experts list 3 major factors hindering the development of the electro spindle sector: weak capacity for producing high-quality bearings with sufficient stability; weak capacity for supplying lubricating grease for high-speed electro spindles and a lack of domestic capacity to develop and supply drive control systems and magnetic encoders. The digital communications interface between servo drivers and NC systems also remains a difficult problem for local spindle suppliers. Most local-made higher-grade NC machine tools use imported NC systems with digital interface that are not open to local electro spindle suppliers, so local OEMs usually have to import spindles and motors together with the NC systems.

According to industry sources, currently less than 10% of China-made NC machine tools were equipped with electro spindles, compared with 90% in some developed countries. Considering that China produced 272,100 NC machine tools in 2011, the future market potential for electro spindles is very promising.

Rolling functional parts

The term "rolling functional parts" used in China's machine tool industry refers to various rolling machine parts with functions of driving, positioning, guiding, and indexing. Ball screws and linear rolling guide assemblies are the main components included in rolling functional parts.

The production capacity for rolling functional parts is scattered across China. According to the official sources, there are up to 77 rolling functional parts manufacturers in China, but many of them are very small. Among the 77 companies, 37 belonged to the rolling parts sub-association under CMTBA, which accounts for more than 90% of total output of rolling functional parts. Only a few local companies operate on a somewhat larger scale, such as Nanjing Technical Equipment Manufacturing (or Yigong China, claiming to be the largest rolling function parts supplier in China, with annual capacity of more than 100,000 sets), Guangdong HTPM (with capacity similar to Nanjing Yigong), Shandong Best Precision,

Shaanxi Hanjiang Machine Tools, Guangzhou Minjia, Shanghai Xionglian, Dalian Golden CNC Group, and so on.

According to the rolling function parts sub-association, the sector turned out 285,911 sets (or RMB 421 million in value) of ball screws and 138,001 sets (or RMB 138.03 million) of linear rolling guide assemblies in 2011. However, these figures might be just the aggregate production of a few major manufacturers, and the actual total output (not available) should be a bit larger. The sector reportedly experienced a 35% decline in output in 2012.

Status of local suppliers

The development of China's rolling functional parts sector started in the early 1960s. Over a half century, it gradually acquired certain production capacities. At the same time, China is not so weak in making grinding machine tools (as compared with other types of metal-cutting machines), and in this segment (as well as in NC engraving machines) the domestic parts rolling functional parts suppliers dominate. Industry authorities recently claim to have made significant progress in processing technologies for large heavy-load rolling functional parts, including the high-rigidity heavy-load linear rolling guide assemblies using cylindrical bearings, and have managed to displace some imports.

However, China's rolling functional parts industry still has a long way to go to catch up with its counterparts in developed countries (including Taiwan), especially in the higher-end market segment. China manufacturers lag behind strong global competitors such as NSK, THK, Rexroth, BLIS, and so on, especially in achieving high speed, high/extra-high precision, high levels of stability and reliability, and low noise. In the medium-level segment, the gaps are smaller, but China's productivity in producing rolling parts is far lower than in industrial countries.

Many local industry experts say the main bottleneck hindering the development of the rolling functional part's industry is the lack of fundamental and theoretical research. Without support from such research, the sector cannot achieve breakthroughs in advanced technology. Researchers in relevant universities and institutes, however, are reluctant to focus on the rolling parts sector because it is so small that such projects could not possibly obtain sufficient government funding.

In the 1960s and 1970s, the development of the machine core functional parts sector was given equal priority with development of the machine tools OEM sector, and the rolling functional parts sector grew in a relatively smooth way. However, since then both the government and manufacturing industry as a whole have devoted efforts on the OEM sector while neglecting core parts. The Taiwanese started rolling functional parts development at least 20 years later than the Mainland Chinese, but have already left their mainland counterparts far behind.

The local rolling parts sector also suffers from inefficient management and enterprise development. Unlike their foreign counterparts, local rolling component suppliers typically have paid much more attention to acquiring new and advanced manufacturing equipment rather than installing adequate testing equipment and capacity in their plants. A few major local suppliers have some testing equipment, but most smaller ones lack any means for testing product life and reliability. According to one official source, detailed information presented in many local suppliers' product brochures is based on theoretical formulas rather than an actual testing process. It is really hard to imagine how a rolling functional parts manufacturer could provide the right products for an ever-upgrading market without sufficient testing instruments and capacities.

Other limitations stem from upstream industries such as a lack of suitable raw materials and the backward status of China's hot working technologies. Local suppliers are still unable to provide several kinds of basic rolling elements such as high-precision steel balls with large diameters, Si3N4 ceramic balls with high precision and high-pressure load capacities, and precision rollers with special sections required for the high-speed and heavy-load operations.

Reliance on foreign suppliers

Will technological progress help the industry out?

China's mass media typically report on progress in technology with such enthusiasm and pride they sometimes exaggerate the significance of the achievement.

In one recent case, the authorities and the industry excitedly celebrated their success in supplying six sets of locally-made ball screw assemblies used in the docking rings of China's Shenzhou-8 spacecraft, which successfully docked with the Tiangong-1 space station and then separated in November 2011. This was surely a success story, since such docking missions demand high rigidity, precision, impact strength, dynamic properties, and reliability under extreme conditions.

However, that does not mean China's ball screw sector is strong when it comes to commercialization stage. As a formerly centralized, planned economy, China still has strong administrative capacity to mobilize national resources for important scientific and national defense projects, in which all participants from both research units and enterprises can work in a highly devoted, efficient way. In the case of normal commercial production, however, the work conditions, motivations and people's work attitudes are totally different and in most cases do not achieve satisfactory results.

As an example, one local supplier prided itself on being China's first producer of a 5-axis machining center, claiming advanced properties comparable to imported high-end products. In the end, the machine was found idled somewhere for many years mainly for show, and commercialization never began.

Local rolling functional parts suppliers thus remain uncompetitive, especially in the higher-end segment. Client surveys in 2010 showed that locally made ball screws and linear rolling guide assemblies only accounted for 25~26% of orders from domestic manufacturers of medium-high-end machine equipment, while imports accounted for 74~75%, including those from Bosch-Rexroth, Blis, A. Mannesmann, Korta, NSK, THK, Kuroda, SBC, etc., and a number of Taiwanese suppliers.

Industry sources showed that about half of the imported rolling functional parts were of Taiwanese origin. The major Taiwanese manufacturers, such as Hiwin, PMI, ABBA, TBI, and GTEN, have been very active in supplying the mainland China market since the 1990s. In recent years about 50% of locally made machine tools used Taiwanese rolling functional parts. Hiwin and PMI, encouraged by strong local market demand and promising potential, are said to be considering setting up production facilities in the mainland.

Some people would argue China can use overseas acquisitions to secure western advanced technologies and shed its weak status. We do not agree with this vision, since the absence of the necessary institutional structures, and work values will surely prevent China from assimilating the acquired technology and deriving innovative capacities for future technological updates.

The traditional institutional structure and people's values and work attitudes are the main obstacles blocking the industry's further development (this topic will be further extended in the later section of this article), not the technology level itself.

A few foreign companies with production capacities in China, such as NSK and THK, also are producing medium- and high-end rolling functional parts and the related sub-components for both the domestic and export markets. THK started selling its rolling parts in China early in 1987, and established its first wholly owned plant in Dalian in 1994. Then THK set additional 2 plants in Wuxi and Liaoning respectively producing rolling functional parts. In 2009, THK established the R&D center in Dalian, in order to develop the new products adapted to the China market. NTN from Japan established a JV (Shanghai Laien) with its local partner Shanghai Rabbit in Shanghai in 2006, producing precision ball screws and linear rolling guide assemblies, mainly for the export market. Since 1995, NSK has established 12 bearing production bases in China, located in Kunshan, Shenyang, Suzhou, Changshu, Zhangjiagang, Gongzhuling, Hefei (new project underway), and so on, for the machine, automotive, and other industries.

AC linear motors have been increasingly used as an alternative for ball screws in driving functions in recent decades. China started developing linear motor technologies in the 1970s and the progress was slow. Currently there are very few enterprises in China producing AC linear motors for the machine tools industry (the major producer is Harbin Electric, currently listed in NASDAQ). Many local experts believe that local demand for linear motors will grow quickly in China because of their simplified mechanical design and enhanced efficiency, while also believing that AC linear motor technologies are

unlikely to overwhelmingly replace ball screws since the latter also have their own merits.

Control systems

One of most prominent development trends in China's machine tool industry in the recent decades has been the continuous growth of market share for NC machine tools, compared with conventional machines. In 2012, of a total of 797,118 units of metal-cutting machine tools produced in China, 205,695 units (25.8%) were NC machines. The control systems were supplied by both foreign and local companies, but the foreign suppliers dominate the high-end market and local manufacturers mainly concentrate on supplying the lower-end market.

By 2011 there were 24 local NC system producers operating in China, such as Guangzhou GSK, Wuhan Huazhong (HNC), Shanghai Capital NC, Beijing Aerospace NC, Beijing Catch, Nanjing Washing, Beijing CTB, Nanjing XFD, Jiangsu Renhe, Shenyang Golding (Gaojing), Dalian Golden CNC, and so on. The sector's performance in 2010 and 2011 is presented in the table below:

The official breakdown of statistics for control systems in 2012 is not yet available. But according to one industry source, the sector also suffered from a drop in output (-35.8%) in 2012, which was in line with the overall gloomy status of China's machine tool industry as a whole in the past year. Another source indicated that China's NC device sector suffered the worst performance in 2012 compared with other components sectors, with its production volume (in units) dropping by 62.75 percent from 2010.

With a slight y-o-y increase, China imported USD 1.87 billion of NC devices in 2011. The figure far exceeds local production, reflecting China's very heavy dependence on imported NC devices—normally the high-end ones with much higher prices. (Note that the import figure here did not include NC devices imported together with the machines.)

During the past 5-Year Plan period (2005~2009), China's NC system sector has progressed with strong government support. The most important achievement was the advanced 5-axis NC system developed by Wuhan Huazhong, which was claimed

Production of China's control systems sector in 2010 and 2011

(Refers only to the 24 domestic enterprises, and excludes foreign invested companies in China)

	2011		2010	
	Production (in units, sets)	Output (in million USD)	Production (in units, sets)	Output (in million USD)
NC devices	**189,293**	**155.26**	**160,074**	**124.58**
Economic type	164,098	93.52	140,357	78.70
For 3-axis and 4-axis	24,639	53.45	19,215	39.62
For 5-axis and above	556	8.31	502	6.28
Servo drive	**427,037**	**154.18**	**395,161**	**134.94**
Spindle drive	27,453	40.42	27,099	38.69
AC servo feed drive	349,443	105.11	317,815	87.77
Stepping motor drive	50,141	8.65	50,247	8.47
Motor	**350,070**	**110.95**	**342,269**	**100.08**
Spindle motor	38,650	41.60	34,592	35.22
AC servo motor	295,354	67.25	291,111	62.75
Stepping motor	16,066	2.10	16,566	2.11

Source: China Machine Tool & Tool Industry Yearbook, 2011 and 2012

as a successful breakthrough "filling a domestic vacancy" and "breaking the overseas technology blockades". According to one industry official, about 300 units of local-made 5-axis machine tools equipped with Wuhan Huazhong's new advanced control systems are being used by the defense industry and other key industries. In CCMT (China CNC Machine Tool Fair) 2012, Wuhan Huazhong exhibited its HNC-8 series of high-property NC systems, characterized by full-digital fieldbus technology, multi-channel and multi-axis properties with high speed and high accuracy. It was claimed that the major technical indicators of these HNC-8 systems were already on a par with imported high-end NC systems. Other major local suppliers, such as GSK, Shenyang Golding, and Dalian Golden, also reportedly introduced new, more advanced control systems.

Despite those achievements, China's control system suppliers have never succeeded in the domestic market. In recent years local suppliers have accounted for only about 35% of the domestic medium-end NC systems market, while more than 95% (or even 98% according to other sources) of the high-end market is firmly controlled by foreign systems suppliers. In fact, many local clients of China's indigenous machine tools require they be equipped with Siemens, Fanuc, or other imported systems, no matter what breakthroughs are claimed by local NC system suppliers.

Both government and industry understand the wide gap between local and foreign systems suppliers. According to a recent discussion with the vice general manager of one major machine tool manufacturer in north China, local systems suppliers lag 20-30 years behind their overseas counterparts. The vice GM of another major local machine OEM in northeast China told us he thought the biggest gap is in "software," including various customized services. Even though Siemens 840D is popular in China, Chinese OEMs and their customers could only understand and utilize a fraction of the system's full functions. This raises doubts over whether Chinese control systems suppliers are really able to turn out high-end systems comparable to advanced foreign suppliers. Even if they could develop some new series, sufficient customization and commercialization remain formidable challenges, as is the case in many other industries in China.

Based on the opinions from some local industry experts, the major weaknesses and problems with the local control systems suppliers are summarized below:

- A very weak generic technology level and R&D capacity mean fewer advanced product functions, especially in the aspects of high speed, high precision, multi-channel controllers, dual-axis synchronization control, and so on.
- Poor development and manufacturing capacities result in an insufficient product series and product range, while a lack of standardization hinders the supply of complete system sets to the market, etc.
- Insufficient end-product application verifications, both in terms of sample size and time duration, so the results of product reliability tests are unconvincing.
- Poor communications and coordination among the local NC systems companies, their key component suppliers, their OEM clients, and the end users of the NC machines. Most local suppliers know little about the machine building process and the OEMs' or the end users' concrete requirements, so they cannot provide satisfactory services to clients.
- A serious lack of competent expert talent and technicians.
- Heavy dependence on imports of key components, such as AC servo devices, while it is difficult to obtain the updated product information and necessary technical details from foreign suppliers.

Because of the fast increasing demand for more advanced NC systems in China's machine tool industry and the limited capacities of local suppliers, China is highly dependent on imported NC systems, especially in the high-end segment. According to CMTBA, about 65% of medium-end NC systems and more than 95% of high-end ones supplied to the

local machine tool manufacturing sector were imported in 2010. The most popular foreign brands are Fanuc and Siemens, while Mitsubishi, Fidia, and Fagor have much smaller shares but are also active in China's market. Fanuc established a JV in Beijing in 1992 focused on Fanuc NC product sales and services in China, where it has already set up 17 branches and service centers. Siemens established its production JV in Nanjing in 1996, producing NC control systems for both domestic and export markets.

According to industry sources, China will boost investment in its automotive, shipbuilding, construction machinery, aviation and aerospace industries in coming years, which will generate great demand for NC machine tools. It is estimated that by 2015 China's NC machine tool sector will require more than 400,000 sets of NC systems (excluding the systems imported together with the machines) a year, of which high-end systems will account for about 60%. The total value of China's NC systems market will surpass RMB 9.2 billion, and overseas advanced NC systems suppliers will be the major beneficiaries of this huge market potential.

Conclusions

The Future of the Chinese Component Industry-a long and slow march

Over the last 2 decades, China has become the world's No.1 machine tool consumer and importer and thanks to its huge market demand. The local industry has made considerable progress in developing production scale, technology improvements and upgrades.

On the other hand, the huge demand for lower-end machines kept the enterprises busy rushng to deal with ever increasing orders while they neglected to build up their technological foundations and cultivate innovation capacities for the future market. Only recently have the local machine tool and key components companies begun to better understand how far they lag behind their overseas counterparts and to recognize that their lack of fundamental technologies, basic processing techniques and other 'soft skills' (such as customer focus, branding, etc.) are constraining their ability to upgrade in response to market changes.

China's machine tool key parts sector suffers from the common and chronic failings of many other manufacturing industries in China: high fragmentation, low productivity, little coordination with downstream and upstream sectors, inability to provide solutions to clients or services for the full product life, inadequate soft skills building, a lack of fundamental and theoretical research, excess price competition which results in low profit rates that cannot support sufficient R&D/innovation efforts and long-term development strategies, big gaps in the high-end segment compared to world advanced levels, heavy dependence on foreign technologies and imported core sub-components, insufficient promotion of green manufacturing, an absence of internationally competitive brand names, and so on.
The fundamentally backward status of China's machine tools and components industry and other manufacturing industries originates from the isolation from the West in the 1950s and was exacerbated by institutional ills inherited from the planned economy. These weaknesses generated problematic policies and growth models while adversely influencing values and behaviour.

Based on discussions with several top-level managers of local major machine tool companies, the most basic difference between western countries and China is in work attitudes. Unlike employees of foreign companies, workers and technicians in China tend not to take pride in their jobs, because production line work is not lucrative or prestigious. Most Chinese workers lack the motivation to perfect their jobs or the desire to optimise their skills through learning. One manager also told us that when some of his technicians were sent to Japan for training, they did change and gradually start to work and behave in a more efficient and effective way, as if they had absorbed the Japanese company's culture and values. But after returning to China, they soon lost the initiative and enthusiasm they had developed in Japan, returning to their original state of indifference. "In China, we don't have the right environment to foster and keep the workers' tenacious pursuit of professionalism," as one manager commented.

There is a simple chain of cause and effect. To become a globally competitive power, China's machine industry must rebuild its industrial foundations and establish R&D capacities. That will depend on people. Good values and work attitudes constitute the most basic soft strengths of an economy and its industries, and lacking those, all the government plans and business expectations of achieving the world's best technology level will remain empty talk. Establishing the right values and work attitudes will be a long and difficult process, which must be supported by effective institutional changes and political reform in line with China's economic reform…"

Some western observers have concluded that China's machine tool industry is catching up quickly in line with the government-set objectives and becoming a major threat to western suppliers. We do not support this claim. Only in the lower-end machine segment has China gained certain growth momentum. This is not true of the high-end segment where international players will continue to dominate.

Although in the short term demand for machine tools will likely remain flat, in the longer-term, however, China's development momentum will continue to support the world's largest market for machine tools.

China is just now re-orienting and upgrading its equipment manufacturing industry, while the market demand for machine tools is shifting from quantity to quality. Domestic demand for lower-end machine tools will drop, while that for higher-end machine tools and key components will rise. Since local suppliers will be unable to catch up in the high-end segment for the next 20 years or so, foreign high-end machine tool and components suppliers will continue to dominate and enjoy more market opportunities.

Implication for International Companies

Implications for Machine Tool OEM's

The expected evolution of China's machine tool component industry has important implications for foreign machine tool OEMs:

- Basically, the name of the game in terms of regulatory framework, increasing quality requirements, costs structure, etc. is not expected to change at least in the next 5 – 10 year.

- Many foreign players with assembly operations in China have basically already achieved the end game in their business model in China. It won't get better than this.

- Companies that do not want to meddle with their original machine design should not consider to set up factory in China. Local assembly / production will not provide cost advantages and very limited additional other advantages. In addition, because of different work attitudes, staffing, at all levels, might be challenging. Such companies however may consider a factory elsewhere in Asia (Taiwan, Korea, Malaysia etc.), or a pure CKD assembly plant in China (based on the rationale of customer proximity, but not on cost savings).

- Companies that are considering to design a machine from scratch and tailor it towards the Chinese market in terms of price, features, functions, etc, can consider a local factory set up. Most likely it will be difficult to source higher-end components locally in the next 5 – 10 years, but they can target their new design towards the tolerance values of local component suppliers, in order to increase local content and achieve cost savings.

Implications for Components Suppliers

There is currently limited foreign investment in the production of machine tool components. Although the actual number of 'investments' is not that low (in the absence of any reliable statistics, our estimations stands at around 40-50 foreign invested component companies, including from Taiwan and Hong Kong), but most of the operations are small and limited to assembly and customer support. Total value of the investment is unlikely to exceed 200 Million US$.

Given that we do not expect any major change in the competitiveness of local players, while at the same time there will be a clear shift to higher-end and more reliability, the main strategic actions for component suppliers are as follows:

- Focus on imports to China, to both foreign OEMs and Chinese OEMs, whereas a strict customer prioritization needs to be applied.
- Strengthen the front-office, application development, product adaptation to the requirements of the China market, while in principle production stays in the home country, as does the bulk of the R&D.
- In some cases local production or assembly might make sense: e.g. if volumes are considerable, if logistics costs and/or import duties impact profitability, if there are frequent product changes which require a close integration of manufacturing with product development etc…. In any case decision for local assembly and especially full production should carefully assess the sustainability of cost advantages, and the availability of quality components and materials.

Note: While we have tried to ensure the maximum consistency in the data presented in this study, the reality is that the statistical information for the machine tool component sector is very incomplete, chaotic and contradictory, more so than in most other industrial sectors in China. This statistical gap reflects the historic neglect and lack of attention on behalf of the industry authorities and government as far as the component sector is concerned.

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