AN ANALYSIS OF THE CHINESE HIGH-SPEED RAIL FROM THE AMERICAN PERSPECTIVE

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Abstract

High-speed rail is a great means of transportation in the world and a controversial subject in China and the United States. There are many socio-cultural, environmental, economic, technological and political issues related to the construction of high-speed lines. Safety and cost are serious concerns for each country. The paper discusses the result of surveys and interviews that the undergraduate research group of Bridgewater State University conducted in China and the United States in summer 2011. From a different prospective, the paper compares and analyzes the attitudes of the Chinese and American peoples towards high-speed rail, and discusses the issues the Chinese high-speed rail and possible causes of the 7.23 Accident.

Introduction

On February 8, 2011, the White House released a plan to invest another $53 billion into a high-speed rail network covering 80% of the population in 25 years. The Obama administration committed $8 billion in 2009 to begin work on 13 planned corridor lines. China is the world's #1 builder in high-speed rail operation miles, driving speed, technology and integration capabilities. China has already spent about $400 billion on high-speed rail and boasts nearly 8,358 miles of high-speed rail lines that comprise 1/3 of the high-speed rail share in the world. The "Harmony" train made in China records the speed of 302.6 miles/hour (484.16 km/hr). However, there are serious safety, cost and technology concerns with the Chinese high speed rail system. There are also socio-cultural, environmental, economic and political issues and controversies of building high-speed rail lines in the U.S. and in China.

As a new professor of management at Bridgewater State University, I consider myself (Dr. Chien Wen Yu) very fortunate to have received a grant from the BSU Undergraduate Research Office and External Affairs Office to take undergraduate students with me to China for 3 weeks to do research on high-speed rail at Beijing Jiaotong University and Shanghai Normal University. Beijing Jiaotong University, a top-ranked university specializing in programs of railways and high speed rail, has an exchange program with Bridgewater State University. Based on the nature of the research, I assembled a diversified undergraduate research team that consists of Neala Menz, Corrine Hunter, Yuan Ying Chen and Pamela Farias. We stayed in Beijing for 2 weeks from July 3 to 16, 2011. On July 16, we took the newly opened high speed

rail from Beijing to Shanghai and personally experienced the train ride. We continued the research in Shanghai from July 16 to 23. Our high speed rail research trip ended in Shanghai and the group departed Shanghai in the afternoon of July 23, 2011. In the evening of July 23, the fatal and tragic 7.23 Accident happened, when the bullet train D301 (electric multiple unit) crashed into another high-speed train D3115 in the Wenzhou area of Zhejiang Province, which was under the supervision of the Shanghai Railway Bureau. At least 40 people died and 192 others injured in the accident.

The following report is the result of our research, including 374 surveys/questionnaires, discussions with 2 student groups and their professors, interviews of 3 well-known professors and experts on Chinese high speed rail, as well as on-site conversations with a Chinese high-speed rail engineer and a Japanese railway track manufacturer who were riding the same high-speed train. The report is divided up in two parts; the first part is the survey and our explanation of the results obtained; the second part is our own research analysis and evaluation of both the 7.23 Accident in China and high-speed rail construction in relation to China and the rest of the world. Doing the high-speed rail research while the 7.23 Accident happened in China, we have a better feel for addressing safety and other issues regarding the country's fast-expanding high-speed rail network. The purpose of this paper is to present, in an organized manner, all of the information we have collected between literature research, surveys, interviews, and group discussions. This is the first of several papers each group member will be contributing. Each of the papers will contain further analysis and use this information as a reference.

Methodology

A 9-question survey was used to measure participants' attitudes towards the high-speed rail. The original survey was written in English, but was translated into Mandarin to be sure that participants would have no trouble in understanding and responding to the questions. Participants in the U.S. were collected for the survey by independent researchers using a variety of methods, including the distribution of surveys to friends, family, and acquaintances; approaching random participants in public areas; distributing the survey online. Most participants in China were selected at random and approached either on Beijing Jiaotong University campus ("student" group) or in Beijing South Train Station and Shanghai Hongqiao Train Station ("migrant" group). The remaining participants were in student discussion groups that also answered interview questions.

Survey Results

What is the most important factor for your transportation needs?

Countries	convenience	speed	comfort	price	Total
US	42	34	21	46	143
China	132	48	33	15	228
Total	174	82	54	61	371

How often do you travel long-distance?

Countries	weekly	monthly	quarterly	yearly	Total
US	28	30	32	53	143
China	22	42	112	55	231
Total	50	72	144	108	374

What do you travel for?

Countries	business	vacation	visiting family	study	Total
US	19	55	50	15	139
China	12	79	53	78	222
Total	31	134	103	93	361

What would you choose?

Countries	airline	bus	high-speed rail	regular speed rail	Total
US	76	8	47	12	143
China	21	20	109	76	226
Total	97	28	156	88	369

How would you price the high-speed rail ticket compared to airline tickets?

Countries	higher than airline	lower than airline	Total
US	24	93	117
China	15	206	221
Total	39	299	338

How would you price the high-speed rail ticket compared to regular rail tickets?

Countries	higher than regular rail	lower than regular rail	Total
US	117	10	127
China	189	25	214
Total	306	35	341

Do you feel the high-speed rail meets your needs?

Countries	yes	no	Total
US	94	48	142
China	184	47	231
Total	278	95	373

Do you think the high-speed rail will be the main transportation of the future?

Countries	yes	no	Total
US	86	56	142
China	198	32	230
Total	284	88	372

Do you support building the high-speed rail?

Countries	yes	no	Total
US	130	13	143
China	220	11	231
Total	350	24	374

Survey Conclusions

In terms of transportation needs, American and Chinese respondents tended to have very different answers, with Chinese participants focusing primarily on convenience, while American participants having a wider range of needs. However, the majority of participants from both countries felt the high-speed rail met their needs. This indicates that people in both countries perceive high-speed rail as an effective mode of transportation. Another point of comparative interest between American and Chinese participants is the question about the high-speed rail's viability as the transportation of the future. Chinese respondents overwhelmingly agreed (85.7%) with its viability for the future, whereas American respondents were more reserved (60.1%). This shows that despite supporting the high-speed rail, American participants have less faith in its implementation. There was also a noticeable discrepancy in responses regarding which long-distance method of travel the respondent would prefer. American respondents chose mostly airline (53.1%), with high-speed rail taking a distant second (32.9%). By contrast, Chinese respondents gravitated towards the high-speed rail (47.2%) with regular-speed rail taking a closer second (32.9%).

History of High-Speed Rails

For a rail system to be considered high-speed in China or Europe, it must travel at 200 km per hour (125 miles per hour). As for the U.S. it must only travel at a mere 145 km per hour (90 miles per hour). No matter where they are located, the high-speed rails are a way for people to travel long distances in a significantly shorter amount of time, without having to step on an airplane. The trains have become a preferred technology in many countries to improve the transport between major cities.

The desire for more efficient and convenient travel by railway has been around for centuries. High-speed railways began around 1933 when Europe and the U.S. created the streamliner trains, which at 80 mph (130 km/h) were the fastest transportation option in the world. World War II stopped the development of any more railways, when the countries geared all resources towards the war. Italy had to stop its development of the ETR 200, a train that reached 126 mph (203 km/h) and had routes from Milan to Florence at the beginning of the war. After the war, high-speed trains became important once again, especially in countries where a lot of railway tracks were destroyed during the war. Japan built a high-speed train in 1957, and now decades later the design has been improved to achieve the speed of 135 mph (217 km/h). It provided services between Tokyo and Osaka. Due to the train design and speed, the nicknamed "bullet train" was born. Today, there are train systems that can travel over 200 mph (320 km/h) due to aerodynamics, lighter trains and longer turns. Maglev or magnetic levitation is one of the many changes in the technology that high-speed rails use. China was criticized for using maglev over other technologies, on the grounds that maglev requires new tracks which are highly expensive. Spain, Germany, the United Kingdom and France currently have the largest high-speed train networks in Europe.

Official Statistics of China's High-Speed Rail

According to the National Bureau of Statistics of China, during the 11th 5-Year-Plan of Chinese Railways, Chinese railway infrastructure construction investment is about 1.98 trillion RMB (National). By 2010, the total operation mileage of Chinese high-speed railways reached 8,358 km, which is the longest in the world. The Chinese Ministry of Railways plans that the total size of high-speed railway will stretch 13,000 km by 2012. On December 3, 2010, the experimental operation of the high-speed rail (HSR) between Beijing and Shanghai reached 484.16 km/h (302.6 mph); it's faster than any other HSR in China and all other trains elsewhere in the world. For safety considerations, however, the Chinese Ministry of Railways has designated a top speed of 350 km/h (219 mph).

The Beijing-Shanghai HSR is the newest and highest standard HSR in China so far. The Chinese invested 220 billion RMB on this program. And it only took 39 months for the Chinese

to build this 1,318 km (820 mile) long HSR. On July 1, 2011, the 90th anniversary of the Chinese Communist Party, the Beijing-Shanghai HSR started operating. Every day, there are 90 high-speed rails run between Beijing and Shanghai. The HSR offers two different speeds to passengers: 300 km/h (188 mph) and 250 km/h (156 mph). The 300 km/h HSR only takes 4 hours and 48 minutes, while the 250 km/h HSR takes 7 hours and 56 minutes from Beijing to Shanghai. As one would expect, the tickets for these two kinds of HSR differ in price. The lowest price for the 300 km/h HSR is 555 RMB (about $90) and the highest is 935 RMB (about $150) whereas, the lowest price for the 250 km/h HSR is 410 RMB (about $66) and the highest is 650 RMB (about $105).

Pros of the High-Speed Rail in China

There are many positives to the use of high-speed rails, as opposed to airlines. One reason being, that airports take up a lot space because of the vast amount of land needed for planes to be stored and for runways used in landings and takeoffs. Taking the train is often more convenient as well, since the airports are located further away, which means more taxi cabs, gas and parking costs. One of the students we interviewed in Shanghai pointed out that another convenience is not being required to arrive two to three hours ahead of time, in contrast to a flight. Passengers at train stations do not have to take as much time to get through, because they do not have to follow airport protocol. It is only necessary to arrive about an hour ahead of time for precaution and any delays. At Chinese train stations, the security checks are minimal, and this reduces the time needed for arrival in advance.

The high-speed rail technology is also much better for the environment, for many reasons. The engines are most often run on electricity, which is a much cleaner source of energy than was previously the case with coal. Also since the trains reduce the need for cars, there is less fuel needed and less polluting emissions from separate individuals. This is also important because most people in China cannot afford a car, so they usually use public transportation, bike or walk.

The transportation system is becoming more and more important, because the government is trying to disperse the population more evenly throughout the country. According to Tom Callarman, a professor of China Europe International Business School, 60 percent of the population lives in the Eastern Corridor of China, and since there are so many people in this area it creates a high demand for transportation. One of the most important objectives for the Chinese is development of the western part of the country, and building more trains opens up the country for more commuting workers. The rails will help the economy by making more jobs accessible by migration, and new jobs within the transportation system will be created, as lines are developed. Jefferey Hayes writes, “Chinese officials believe improved passenger and freight services are also crucial to development.” (Hayes, 2011) Li Heping, a researcher at the China

Academy of Railway Sciences, told the state news agency Xinhua, "China's railway service has long fallen short of demand", Li asserts, "There are two solutions: building more railways and raising the train speed."

High-speed rail has become China's "iron diplomacy". The high-speed rail is a very helpful media for building good relationships between China and its neighbor countries. "In the next 10-15 years, China plans to extend the high-speed rail network to 17 countries, and ultimately may even be in London and Singapore, connecting with Beijing", Xinhua News reports (Wang, 2011). The China's "iron diplomacy" has been extended to Africa and even the Americas. China has signed an agreement to build "high speed rail" with Argentina, Bulgaria, Thailand and Laos, as well. Also, by connecting Europe and Asia, China is dreaming of an "Iron Silk Road". It is good for international trade between these two continents, and there are plenty of resources in western China that can be more fully used.

Cons of the High-Speed Rail in China

The building of the high-speed rail system in China has caused an array of issues. It is no surprise that it has been the source of much controversy and debate. The Ministry of Railways, which is the department in charge of building the rail, created an immense debt in order to build extensive railway lines throughout China. They now owe Chinese banks approximately 276 billion dollars (Mims, 2011). The question on everyone's mind is how they are going to recuperate the money, when the tickets are so expensive that most common people in China cannot afford them. The line between Beijing and Shanghai, which just opened in early July of this year, has had very few trains leave the station in full or even somewhat full capacity. Professor Zhao Jian at Beijing Jiaotong University, an expert on the high speed rail, says there is no way that the high speed rail can be economically feasible. Amid the cost of building and keeping up with operational expenses it seems profit will be unattainable. The slab tracks used for this system require the use of a digital machine for installation which makes the cost even higher than the building of any other type of tracks. At the very best, all they can hope for is to break even.

The airlines are the high-speed rail's biggest competition. However, in their rush to build as many tracks as possible, planners ignored the customer service which the airports are known for. If a passenger were to lose their ticket, there is no way for the railways to know whether or not you were on the train; therefore, they can neither give you any type of refund, nor look up whether you actually bought a ticket to offer future service. According to Helen Zhang of International Affairs Office at Shanghai Normal University, a group leader of a French summer study tour at Shanghai Normal University misplaced her high speed rail tickets for the whole group at the time of departure, and so she had to purchase 10 totally new tickets. Unfortunately, she found the tickets after boarding the train, but it was already too late. If the same thing

happens at an airport, they can look up your information with your passport and then let you get on another flight without making another ticket. At the same time, requirements for buying a ticket for the train are very similar to buying a ticket for a flight. For instance, foreigners must provide their passports and visas for identification, and they put the passport number on the ticket. In order for citizens to buy a ticket online, they need to use an outdated system that was not designed exclusively for the high-speed rail. It is a general site for anything related to the railway system. This makes the site hard to navigate, and the purchase of a ticket for the train becomes an even harder task.

In order to build the high-speed rails, they had to build on land that belonged to local farmers. The farmers do get paid for the land that they lost, but they still lose part of their livelihood. That is less land for them to harvest. The trains run on electricity which cuts down air pollution, but there is no way to cut the noise pollution. Bearing in mind that the line between Beijing and Shanghai includes mostly farm land, noise pollution can affect the citizens' everyday lives.

Most students we interviewed in China view the rail as luxury and would not be willing to pay the high prices. They often say that the rail is mainly used by business people and the wealthy. One student, with an English name Summer, said she thinks that high-speed rail is too expensive and that if she is in a hurry she would rather use the airlines. She also said if she wanted a leisurely trip, she would choose the regular-speed rail. Since more people would prefer a cheaper option and are staying away from the high-speed train, the Ministry of Railways is reducing the number of direct routes that are available for regular-speed trains. This is forcing people to use the high-speed rail, because it is their only option to get where they need to go.

In February 2011, the Minister of Railways, Liu Zhijun was removed from his position and detained due to accusations of corrupt activities, after serving since 2003. According to the Xinhua News Agency report, Liu was being investigated for a "severe violation of discipline". The reports are vague about the exact charges against the Minister. There have been many investigations into the people working in governmental departments, as China fights against corruption. The railway has not been changed much in the past, which is strange considering it is a very powerful operation. The Ministry of Railways owns all the land around the railways and is in control of millions of passengers and cargo yearly. The ministry is being investigated more thoroughly for any other leaks in the organization. For now, they replaced the Minister with Sheng Guangzu, who is changing the underlying emphasis of high-speed projects. Liu Zhijun focused mainly on making the trains fast and building as many as possible. Sheng Guangzu is focusing on safety in running the trains and on controlling the debt related to the quick and excessive building of the previous minister.

There have been ongoing disputes between China and many other foreign countries over the intellectual property rights. China has contracts with several foreign companies such as, Siemens (Germany), Alstom (France) and Bombadier (Canada) for their leading technology in

high-speed trains. One of the most vocal companies against the China Ministry of Railways is the Japanese company, Kawasaki Heavy Industry Ltd. They traded their design of the rail system they had created, and China has used foreign technology as a base to build their own versions. The objection raised by the Japanese companies now is that the Chinese are patenting and exporting their technology to other countries, and the charge is that this is an infringement on property rights. They also say that this is a violation of the agreed upon contract, which said that the Chinese companies could only produce within the country. According to an article in the *Wall Street Journal*, Kawasaki executives "cite a few tweaks to the exterior paint scheme and interior trims and a beefed-up propulsion system for faster speed," but beyond that the trains are mostly the same as those of the foreign partners. However, China differs on the subject. They agree that they did use a similar design to begin with, but they have innovated and improved the train, creating their own intellectual property which they should rightfully be able to distribute (Norihiko Shirouzu, WSJ on November 17, 2010). Spokesmen for Chinese Railways notes that "the CRH380A has a derailment factor of only 0.13, compared to 0.73 for the CRH2 , and air resistance at the front of the train is more than 15 per cent less". The CRH2 referred to is the train that the Chinese developed with Japanese partners, and the CRH380A is the version that was created later (LexisNexis, 2011). This debate continues, as China discusses extending the high-speed rail system further in their country and around the world.

Spring Festival Travel (Chunyun)

Many people argue that if the high speed rail can solve the serious problems of *Chunyun*, which means the Spring Festival travel season. *Chunyun* usually starts about two weeks before the Chinese Lunar New Year and last for about 40 days. It's a very typical phenomenon in the east coast of China that during *Chunyun*, millions of people stay and wait in the railway stations for taking a rail. Because the east coast is the most developed part in China, many people migrate to the east coast for working and studying. The population of the east coast is 60% of the whole population in China. When the Lunar New Year comes, all the migrants are going back home and celebrate the New Year with their families. Every year during *Chunyun*, people have difficulty of purchasing railway tickets, since the demand is much larger than the supply; they have to wait in a long line in the railway stations for the tickets. The rails are so full during *Chunyun* that passengers need to stand on the aisles and even in the toilets. Many people e injured or killed due to dangerous rail traffic. Transport during this peak season becomes a challenge for Chinese transportation systems.

The Chinese government expects that the high-speed rail can alleviate the *Chunyun* problems. Firstly, the high-speed rail is faster than the regular-speed rail, so it can transport more people in the same period of time. A piece of news from Xinhuanet reports the statistics from the China Ministry of Railways that during the 2011 *Chunyun* over 210 million people were transported by railways, 10 million people more than 2010. Secondly, the high-speed rail

offers more ways to purchase tickets, such as purchasing from the window in the station, the self-purchase machine, through phone call, or online. Thirdly, the high-speed rail is safer. The News from Xinhuanet also reports that during the 2011 *Chunyun,* the rates of traffic accident, death, and injury decreased by 27.4%, 24.2%, and 29.2% (Xinhuanet). Many people disagree that the high-speed rail can solve the *Chunyun* problems. The ticket prices of high-speed rail are almost three times of that of the regular-speed rail. Many people, especially migrants, think the high-speed rail ticket is so expensive that they can't afford it by their low income. Sara Wang, a student of Shanghai Normal University, thinks that the high ticket price limits migrants' transportation and that the high-speed rail is not helpful on the *Chunyun* problems. Most migrants can't accommodate such a fast rise in their transportation fares, so the regular-speed rail is still their first choice. Moreover, because of the operation of the high-speed rail, many regular- speed rails are canceled. As a result, during *Chunyun* the regular-speed rail might be more popular and crowded.

Impressions of the Newly Opened Beijing-Shanghai High-Speed Train

The high-speed rail from Beijing to Shanghai was the latest railway to be built in China. It was strange that even though they required our passport numbers and printed them on the tickets, no form of identification was needed after the purchase when boarding the train. There was not an actual person checking our tickets; we just inserted the tickets into a machine. This raises the risks of someone stealing them and impersonating you. Once we were seated, the trains were more spacious than an aircraft when it came to legroom. But when it came to storing our luggage, the space was limited. The problem was that anything bigger than a carry-on could only be stored on a first come first served basis. The seats had trays like those on an aircraft, and this was a luxury considering we were seated in the economy class. Each car of the train provided hot water, bathrooms and silks; and the sinks were both in the toilet area and outside of it, next to large mirrors. The train we were on had a total of eight cars. There was a dining car with about four tables and a bar, where food and beverages were available for sale. The dining room could have been more spacious considering the total number of passengers that the train can accommodate. Most of the passengers did not buy food and meals on the train. They ate the food that they had brought with them, such as instant noodles that could be easily prepared with the hot water on the train.

Generally speaking, the ride was smooth and comfortable, despite some small and frequent power disconnections. At first we were scared, since we thought they were those power outrages that had stranded passengers for hours on the track before. According to the on-site engineer of China Southern Railway Corporation Limited who was riding and supervising on the train, the disconnections are natural and normal occurrences. The high-speed rail runs with the power provided through overhead cables from different power companies in different cities and

provinces of China. When the high-speed train passes each city or province, the power supplier changes, and the train feels the changes of the connections and disconnections.

The land between the two cities was mostly farmland, and this would explain the lack of passengers getting on the train at the stops between Beijing and Shanghai. Some stations look new, but they also seem empty, without much light, and with few services for passengers. Only a few local residents and farmers got on the train, and not long after they started eating their instant noodles. The five and half hour trip felt much shorter, especially with the thought in mind that without the high-speed rail it would have taken us about thirteen hours, which was the time needed for our flight from New York to Beijing.

No True Economic Competition

As a mode of long-distance transportation, the high-speed rail has a lot of theoretical competitions. Regular-speed trains, airplanes, long-distance buses, and cars all provide the same service. However, the infrastructure of a particular country may place some constraints on the degree of true competition faced by high-speed rail. In the case of China, highways are a recent development, and there are now as many high-quality superhighways across China as there are across America. But they are built primarily to transport goods, and car ownership in China is very low. This gives cars and buses a much smaller operating zone, and the high-speed train only truly competes with the regular-speed rail and airplanes.

As far as competition with the regular-speed rail goes, it should be noted that both the regular-speed and the high-speed railroad systems are built and operated by China's Ministry of Railways. Because of this, they are not in true economic competition, and the plan is for both lines to work together to more efficiently transport both people and goods. It is also difficult to properly evaluate any competition between the two lines, because many people who take the slower trains simply cannot afford to take the high-speed railway, even if they would prefer to.

For these reasons, the high-speed railway in China primarily competes with the state-owned and privately-owned airlines. In fact, according to Professor Thomas Callarman, flights within China have already suffered a 20% drop in demand due to the operation of the high-speed rail. However, the high-speed rail is currently suffering in this competition, because compared to the available airplanes, it is not very convenient. For example, passengers can only purchase high-speed rail tickets up to ten days in advance, making it difficult to plan trips ahead of time. Also, since all luggage must be stored on the same car that you ride in, there are some significant limits on how much luggage you can bring with you. Despite these inconveniences, however, our surveys indicated that most respondents would prefer to take the high-speed rail, followed by the regular-speed rail.

The biggest problem with the high-speed rail, therefore, is that it is more unreliable currently than airlines in China. It has suffered many electrical problems, power outrages and other malfunctions, often leaving passengers stranded on the rail for hours while it is fixed. Earlier in the month of our visit, a storm-induced power failure caused a 90 minute delay on the new Beijing to Shanghai line, where passengers were left without lights and air-conditioning. On the night of July 23, 2011, a bullet train (electric multiple-unit) crashed into another high-speed train in Wenzhou area of eastern China, killing at least 40 people and injuring 192 others. This accident raises yet again safety concerns about the country's fast-expanding rail network. Once this safety problem is resolved, it is likely that high-speed rail will be in close competition with airlines.

Flawed Signaling and Human Error vs. Secret Japanese Technology for "7.23 Accident"

Bad weather was initially blamed for the cause of the 7.23 Accident. A lightening strike knocked power to an older generation bullet train D3115 (Hangzhou to Fuzhou), when it was traveling from Hangzhou, the capital of eastern Zhejiang Province, to the city of Wenzhou. The disabled train was then hit from behind by a second generation high-speed train D301 (Beijing to Fuzhou), forcing four rail cars off a bridge. Many questions concerning the cause of the 7.23 Accident, the electrical problems, and the power outrage were raised: "Is the lightening strike the only reason for the crash?" "Why are there so many power outrages?" "Why can the German, French and Japanese bullet trains resist lightening and storms?" "Why was the signal light green, when it was supposed to be red for accident and emergency?" "Is there a problem for the design and technology?" "Why was the second train D3115 ahead of the first train D301?" "Was there any human error in train dispatching and control?" "Is there any emergency mechanism?" "Is the accident a natural disaster or a railway transportation fault due to safety management defects?"

Flawed signaling and human error have also been suggested as causes for the high-speed rail wreck near Wenzhou. Although it was new to high speed rail, Hollysys Automation Technologies Ltd of Beijing was the central supplier of the signaling systems, circuits and software installed to stop trains automatically. It is believed that the signaling technology branded as proprietary to Hollysys contained circuitry tailor-made by Hitachi Ltd. of Japan. Hitachi's contractual arrangement with Hollysys was only to supply the manufactured parts to specifications provided by Hollysys. Hollysys did not pay for a technology-transfer deal, in which Hitachi would share all secret and technical details. Hitachi was always concerned that the special circuitry design might be reverse-engineered and stolen. Since Hitachi only supplied a primary part of the Automatic Train Protection (APT), without the secret "black box" circuitry design, this made the gear both harder to copy and hard to understand. Installation of the Hollysys signaling components did not always go smoothly, according to one Europe-based engineer who worked on the job. Technical problems arising from incomplete knowledge of

Hitachi's "black box" were not addressed by Hollysys. Referring to the "tragic" Wenzhou accident, Hollysys Chief Executive Wang Changli reiterated that Hollysys equipment was not to blame (Areddy & Shirouzu, WSJ on October 3, 2011).

On December 28, the China State Council finally released the long-waited "7.23" accident report and cited two causes for the accident. The first cause was the error of the railway management and signaling technology. The China Railway Signal & Communication Group Corp. (CRSC) made mistakes in its research and design of the train signaling system while the Ministry of Railways violated regulations when it did not adequately examine the system during the bidding process and subsequent inspections. The second cause was the human error that the employees of the Shanghai Railway Bureau made repeated mistakes in operations while the signaling problem for the high-speed trains was occurring. Three government officials who held major responsibilities for the accident were former minister of railways Li Zhijun, former railway ministry chief engineer Zhang Shuguang as well as former China Railway & Communication Group Corp. Chairman Ma Cheng who died of a heart attack in the weeks following the train accident. Fifty-four other officials who were also held responsible for the accident were either fired or demoted. As a rule, the 7.23 Accident report was supposed to be released within 60 days of the accident, but delayed for 5 months till December 28, 2011. The accident report concluded with such simple explanations for the causes for the accident. One would wonder why the report was delayed for such a long time. It is likely that the reason for delay would remain unknown to the public. The causes for the accident seemed to be discussed internally for a long period of time before the release of the accident report. Issues related to the accident would be more involved and complicated than what the report stated.

China Ministry of Railways - "Mr. Big Iron" and "the 7.23 Accident"

China has the most advanced high-speed rail technology and equipment hardware system in the world, but it also has the world's most backward management and software system. Given this combination, the result is accidents and various kinds of problems. Because of the government railway monopoly and lack of competition, there is no close supervision, standard regulation or fair market-system in planning, building and managing railways. Under a regular market system, all the financing, the planning and bidding on projects, and the hiring and management of personnel must be fair, transparent and conducted through strict competition and supervision. In China, the construction of railways is only partially a market-system that is controlled by China Ministry of Railways. On the one hand, the Ministry of Railways is the state organization in railway supervision and administration; on the other hand, it serves as a private enterprise, builder and operator of railways. It has become a multi-faceted entity and an independent power house, where it is impossible for outside companies to compete with it. It is also difficult for the State Council and People's Congress in China to supervise and control it. All the financing, management, distribution of profits and construction projects are decided

by China Ministry of Railways internally. The Ministry of Railways is so powerful in China that people have nicknamed it "Mr. Big Iron".

Under the Ministry of Railways, many railway investments, product designs, and manufacturing and construction companies are selected without market-system competition and management supervision. According to its 2010 Annual Report released on July 14, 2011, the total debt of Ministry of Railways is 1.89 trillion RMB ($304.8 billion) with an increasing rate of 45.14%. The capital/debt ratio is 57.44% with an increasing rate of 4.38%. Last year's profit after tax was 15 million RMB ($2.4 million) with a decreasing rate of 99.45%. The accumulated loss for the Ministry of Railways is 77.2 RMB ($12.4 billion). During the first quarter of last year, the Ministry of Railways already suffered a loss of 3.76 billion RMB ($606.4 million) (National Bureau of Statistics of China, 2011). Even with such a high capital/debt ratio, the Ministry of Railways still issued low-interest bonds and continued to plan bond financing by taking advantage of low-cost public resources. With such a staggering debt, they cut corners and borrowed from the government at extremely preferential rates.

With regard to the faulty traffic-signal design, investigations are being conducted at the Beijing National Railway Research & Design Institute of Signal and Communication which is a unit of China Railway Signal & Communication (CRSC). The faulty signaling systems were assembled by Beijing-based Hollysys, one of the few companies that China Ministry of Railway tapped to handle such work. From the initial days of the high-speed railway program, Ministry of Railways turned to Chinese firms like Hollysys, rather than foreign expertise. The Ministry of Railways rules effectively forbid foreign companies from bidding (Areddy & Shirouzu, WSJ on October 3, 2011).

In addition to the signal equipment and technology, all the high-speed trains are produced by two state-owned manufacturers: China Southern Railway (CSR) Corporation Limited and China Northern Railway (CNR) Corporation Limited. Both CEOs and most of the board members served as party secretaries and members at the Ministry of Railways or other government railway companies previously. There is not too much competition between the two state-owned companies. The high-speed trains produced by China Southern Railway are based on the Japanese Kawasaki Heavy Industry's technologies, whereas the trains produced by China Northern Railway are based on the German Siemens' technology. The two companies have manufacturing facilities in different parts of the country, and differ in design and technology to balance the power and development of the Northern and Southern regions of the country. They look like competitors to the outside world, but they are not true competitors. They are the state-owned manufacturing monopolies possessing too many domestic and international orders and contracts to fill at this time.

Chinese railways have spanned several historical stages of development in constructing and expanding high-speed rail lines so rapidly. The foreign high-speed rail technology has to be purchased from foreign competitors and digested quickly with home-made improvements and

innovations. However, the key technology and important safety and management experience have not been acquired from the foreign companies. Most of the Chinese railway lines may not have any contingency plans for the electrical problems and accidents. The Japanese Shinkansen (bullet train) started operations in 1964; the French TGV started operations in 1981; the Germen ICE started operations in 1991. During many years of development, there have been big and small problems and accidents: power failures in France, fires caused by power failures in Germany, and signal problem caused by typhoons and rainstorms in Japan. However, these events occurred during the start-up and breaking-in of the systems, before heavy use of high-speed rail. Such events can actually help improve technology and lead to more training of technical and management personnel. Valuable safety lessons can be drawn from these events.

In each above foreign country, a good contingency plan has been developed for any problems and accidents. However, in less than seven years, China has built a bullet-train network larger than the ones that Japan, France and Germany took decades to construct. China is only about halfway through a 15-year plan to build a total of nearly 10,000 miles of high-speed track connecting 24 major cities. Developing the network so fast, the Chinese signal and train manufacturing and contract companies have not drawn any lessons from foreign countries and have slipped on the advanced technology and safety-minded priority. Among other things, the Ministry of Railways chose not to install lightening rods and surge protectors on some high-speed rail lines even as an industry association recommended doing so on major infrastructure projects.

China Ministry of Railways "Mr. Big Iron" has become too big and powerful. It needs to be converted into an agency for railway supervision and administration only. The other functions of financing, bidding, managing of projects, and the construction of railway lines should be left to the market-system and competitors. Different companies and industries should be invited to participate in research, construction projects, and competition with each other on high speed rail projects. At the same time, high-speed rail network for the country should be reevaluated and the pace of development should be slowed down after safety is established. "Speed" in rail development must not be the priority anymore, but safety must be. Any new high-speed rail lines must be given a long period of breaking-in, by running empty cars or freight trains for testing, so as to avoid any rush opening of new lines.

Conclusion

The many controversies surrounding the high-speed rail system in China should be expected with such new technology. However, they also serve as a warning that such a new technology requires a lot more study and experience, before we can truly begin to understand it. The 7.23 Accident serves as a big warning and lesson to the government in supervising and expanding the high speed rail network. Safety and human life is valued the most as a country is

becoming more modernized and civilized. The dialogue about the high-speed rail, including discussion of its faults, benefits, and general impacts on China, needs to remain open. If this happens, it is likely that the high-speed railway will eventually find success in China, due to the domination of railroads as a method of long-distance transportation in China.

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