Global Supply Chain Management and the Chinese Megalopolis

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It is a pleasure to be here and I thank you for the invitation to speak. I also want to thank Prof. Muzhi Zhou for inviting me on this trip and all of the others who worked hard to make the trip a reality. Prof. Zhou is a very good man and I have great respect for his research regarding China.

For today's meeting, I have prepared over 100 PowerPoint slides. It is the American way of doing things through Microsoft PowerPoint!

China is a vast country with abundant human resources. Today, China is undergoing a rapid amount of change as its people build a modern, high performance economy. Given continued rapid economic growth along with population concentration, China is moving into an age unprecedented in human history, the age of the Megalopolis.

In 20 minutes today, I will talk about several very large research areas; however, I will reduce these to a few simple words, including how I believe these research topics fit with the Chinese Megalopolis policy.

A great author in Western thought named Edward Gibbon once wrote, "All that is human must retrograde if it does not advance." He developed this idea based on extensive study of history.

It is my personal belief that technological progress is a fundamental aspect of human nature that must be encouraged. Without it, living standards fall and civilizations collapse.

Industrial progress depends on innovation. Practicing and studying innovation is an important part of what we do at the Massachusetts Institute of Technology. MIT has a long history of being open, and we innovate for the world.

The essence of innovation is the blending of ideas with the science and practice of engineering. This is what needs to happen to get something done and to advance. As with all disciplines, I see many opportunities for innovation in the city planning process as countries face the challenge of unprecedented population concentrations in urban areas.

For me it is a great honor to be able to make this speech today, and to experience the Chinese Megalopolis firsthand.

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The agenda for my talk today is in four parts:

First, I will be talking about my research at MIT.

Although I have a Master's degree in Public Administration, I have not formerly worked as a city planner. However, I feel that my research has direct implications for the Megalopolis. Of course, there are a number of famous researchers and professors at MIT, who make this area of study their life-long career and who are experts in policy. In the future, we hope to have these people involved in the Chinese Megalopolis study.

Next, I will provide a brief definition of the supply chain.

My last topic will be the M Language. Specifically how it relates to data integration for the Megalopolis.

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First topic, my research at MIT

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For my entire life, I have had an interest in research. Even when I was in corporate management (business), I worked hard to find the time to conduct research and to write.

Since my first job, I was drawn to the idea of using mathematics in a practical way for making decisions. It has been an area of great satisfaction, and sometimes an area of great frustration for me!

Overall, this area is called

- Management Science ,Operations Research, and Marketing Science
  - Applying mathematics to real-world problems

There are been some very famous people in city planning who applied mathematics to design the city. For example, Prof. Jay Forrester from MIT wrote a famous and controversial book titled *Urban Dynamics*.

A second research area, very practical in nature, is:

- Supply Chain Management
  - Application of statistics and modeling for decision-making

This involves the movement of goods and services within a free-market economy. For many universities in the United States, this is a big area of study. At some universities, the faculty have changed the department name from "School of Management" or "School of Business" to "School of Supply Chain Management!"

Besides supply chain research, I have a number of publications in planning and scheduling for a manufacturing plant. This is often called:

- Manufacturing Systems
  - Production planning and scheduling

My specialty in this area is in:

- Process Manufacturing

Involving food manufacturing among other things.

My current work is in the area of computer science, specifically

- Information Technology and Infrastructure

This involves new types of the Internet. Sometimes we call these

- Semantic technologies or data interoperability.

Finally, for almost 20 years I intensely studied the Concord grape! I am a worldwide expert in this area.

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The specific work that I do at MIT involves the following four areas. I think all relate to the Megalopolis in some way.

For some of these areas I do administrative work along with research. Among other things, this involves guiding the research direction of each initiative to ensure a practical result. My role concerning the Megalopolis project within MIT will most likely be administrative.

Each year, I supervise between one and six students for the Master of Engineering thesis. They make many contributions to these MIT initiatives. MIT places a strong emphasis on research and one-on-one education. In this way, it is like many of the academic traditions that originally started in Asia many years ago.

Of course, the first initiative is the:

- The Chinese Megalopolis (administration and supply chain)
  - a new effort at MIT initiated by Muzhi Zhou, Visiting Professor
  - goal - create a multi-disciplinary groups within MIT
  - contribute to the research for infrastructure and technological components of the Megalopolis

Since I was born and raised on a farm in Northern Ohio (United States), I have a life-long interest in agriculture. We are staring a new program at MIT to explore many innovative technologies in the field of agriculture:

- Agricultural Systems Productivity (admin. and research)
  - apply new sensing, data, modeling, and spatial technologies
  - transform agriculture into a data-driven activity using new information technologies
  - greater supply chain integration

Another area of my current research involves a new type of Internet. This is the:

- The Data Center Program (admin. and research)

And the result is a new computer language for the Internet called "M."

The final area of my work involves RFID. This means Radio Frequency Identification Technology. It is a replacement for the bar code. In January 2007, I published a book on this topic. The publisher is *Springer-Verlag* of Berlin and New York.

Mathematics, agriculture, data, and RFID all relate to the Megalopolis in some way. There is much other research at MIT in urban planning and design, civil engineering, environmental studies, business, biology and health, and supply chain. MIT has something like 200 major research centers, each as part of an academic department. For example, I work for the Laboratory for Manufacturing and Productivity, which is part of the department of mechanical engineering.

There is a great deal of knowledge at MIT.

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These are just a few of the web sites that contain information about research at MIT. You will find these interesting. There is a tremendous amount of information located here.

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The first topic

II. Definition of Supply Chain

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Though there are a number of definitions, I think this is a simple way to describe the meaning of "supply chain."

"To create a competitive advantage through purchasing, manufacturing, and distributing products and services, which provide superior value to our customers."

From the Council for Supply Chain Management Professionals (CSCMP)

Essentially, this means the movement of goods and services to the consumer. Since the city involves streets, highways, stores, manufacturing, and offices, it is the manifestation of the supply chain.

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This diagram shows a supply chain. It deals with the flow of pharmaceutical products from raw materials, through manufacturing, and then to wholesalers and pharmacies.

This is similar for many types of products. Cities must maintain the roads, the transportation infrastructure to facilitate the flow of goods and services. This also includes warehousing. Flow of goods is never consistent, and so inventory stored in warehouses represents an important part of supply chain management.

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As an example, in 2001, I conducted a supply chain study of raw fish movement in Japan along with a Japanese student. We looked at the role of the Internet as a new development for the raw fish market.

This slide shows an outline of the research. There is a paper and presentation on this topic posted on my personal web site, www.ed-w.info.

This is very interesting research. I became so interested that I began to each sushi!

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This table shows one of the major issues relating to the raw fish supply chain.

In summary, there are many, many intermediate steps between the fresh fish at the port and final delivery to stores or consumers. We examined ways that eCommerce, specifically the Internet, could make this supply chain more efficient. This involved a look at technology in addition to Japanese culture.

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To build on this point, the raw fish supply chain in Japan is one of the most complex in the world. We looked at ways to eliminate steps and reduce cost. This has many advantages.

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The supply chain has many implications for the Chinese Megalopolis. What we saw yesterday, a planned urban development that included a Wal-Mart, is but one example of how supply chains affect the city.

In summary

- An optimal supply chain will reduce energy requirements, specifically demand for petroleum
- Space planning will improve, better utilization of land
  - example: optimal number of square meters devoted to retailing and warehousing

This is an especially interesting research area that my colleague, Dr. Stanley B. Gershwin has developed:

  - *Predicting Real Estate Prices Using Travel Budgets and Urban Spatial Diffusion*

He is very interested in doing more research in this area as related to China.

- Improved flow of consumer goods to the people of China
  - less waste, fewer cases of obsolescence, better customer service
  - establishing a modern consumer market
  - improved product safety

- Reduce Global Warming and Pollution

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The next area of discussion relates closely to supply chain. It involves the flow data between computers.

We call this area:

III. The M Language

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The problem with computing systems is that data is growing very rapidly. Some have estimated data growth at a rate of 40% - 60% per year. Compounded, there is an explosion of data available for cities and business to make decisions.

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For 2004, shipments of storage devices equaled **four times** the space needed to store every word ever spoken during the entire course of human history.

I find this amazing!

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This raises two questions:

What are you going to do with all of your data?

How can you harness all of this data to make better decisions?

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A simple example highlights this point. This involves three types of data in a city.

Weather data

Data on traffic levels

Data on where construction takes place. In Cambridge, MA, we seem to have road construction all of the time!

None of this data is integrated. This means that you cannot combine data quickly to make decisions.

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The essence of our work is to create a new type of Internet that can combine data quickly, and to apply mathematics to make a decision.

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The name of our new type of Internet is simply the “M Language.”

With this approach, we build data “atoms” that can re-combine in different ways.

The data has the ability to “self identify.” This is an innovation in computer science.

The next three slides contain just a few details about the M Language.

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The original goal of the M Language was to build a network of mathematical models. These could be applied with little effort to solve everyday problems in management and public administration. In many ways, the idea was to become the “Henry Ford” of modeling. By providing the platform to assemble and apply models quickly, the M Language builds on the ideas of standardization and mass production first established by Henry Ford.

With a network of models, over 50 years of modeling experience could be captured in something like a library on the Internet. In this way, M might be a replacement for packaged software. The advantage of M is flexibility in application.

To provide a financial incentive, models could be bought and sold using an exchange that is like eBay. In this way, model builders could post their work for others to use at a fee.

While developing the computer standards and protocols for the M Language, we found that industry was much more interested in achieving data

interoperability. This near-term priority shifted the work of the MIT Data Center toward using the M Language to facilitate the free exchange of data between companies. The current approaches that are most common utilize Electronic Data Exchange (EDI) or hub translators that accomplish point-to-point translations of data between different formats. Both are expensive and have limitations.

Technically speaking, M is a synthetic language that involves translation of data at the edge of computing systems. A simple analogy for this approach is the use of Adobe Acrobat to create .pdf files. Any file can be converted into .pdf format and then sent to another computer containing an Adobe Acrobat Reader. In this way, the .pdf format serves as a universal intermediary. The M Language works on the same principle. Linguistics have long advocated a synthetic language approach for doing translation. Esperanto is an example as applied to free-form text.

Something like the M Language must develop to deal with the huge amounts of data being generated in supply chains. Some project that

"the number of deployed sensors will dwarf the number of personal computers by a thousand fold in 2010"
Ferguson, Glover, Sanjay Mathur and Baiju Shah (2005), "Evolving From Information to Insight," *Sloan Management Review* 46:2, p. 52.

This development will unleash huge amounts of data that must be connected. The M Language is a means of achieving data connections.

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From a computer science perspective, the M Language is an open system that works with existing data standards including those of the W3C (World Wide Web Consortium).

M allows for computer-to-computer communication when the target is unknown and solves the "many-to-many" problem where data in various formats from many different sources must be sent to a target computing systems using altogether different data formats.

Finally, the M Language is a way to deal with semantics that is different from previous Artificial Intelligence approaches.

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Our vision for the development of the internet is comprised of three stages.

The first stage is the “Web of Information.” This is the World Wide Web and the use of HTML to build web pages.

The second stage is the “Web of Things.” This involves RFID (Radio Frequency Identification) as a means of linking physical objects together through the Internet.

The third stage in the “Web of Abstractions.” This involves the M Language and achieving data interoperability in practice.

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RFID (Radio Frequency Identification) is another important topic in information technology and supply chain management.

This picture shows an RFID tag on a pallet of Coke.

It involves placing a computer tag on an object that can communicate via radio waves. The technology is a replacement for the bar code.

This will provide even more data information for cities and supply chains!

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I have published a new book on the subject that I think you will find very interesting.

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IMPLICATIONS FOR THE MEGALOPOLIS

- Data will drive the city of the future
  - Better space planning, modeling of diffusion
  - Control of traffic, Intelligent Transportation Systems

- Rapid economic growth will accelerate the need for improved information technology infrastructure

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IV. Conclusion: The Chinese Megalopolis

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REASONS FOR GLOBALIZATION

- During the past 50 years costs have decreased:
  - transatlantic phone calls now cost 90% less
  - ocean freight is 50% cheaper
  - air travel is 80% less expensive

The New Geography: How the Digital Revolution is Changing the American Landscape (Joel Kotkin, Random House, 2000)

- Strategic Thinking, "The Big Picture"
  - Global markets and networking become very important
- Innovation and implementation

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MIT INVOLVEMENT WITH MEGALOPOLIS

- Many professors and researchers at MIT are interested in the idea of the Megalopolis
- Study of a city is a multi-disciplinary subject, something that MIT specializes.
- We are interested in integrating with the team to produce a comprehensive report on megalopolis policy and technology. This is a long-term project.
- We are interested in knowing the research areas of greatest benefit
- If you are in the United States, you are always welcome to visit MIT in Cambridge, MA

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Thank you!

Questions?