

Six-Sigma in Asia

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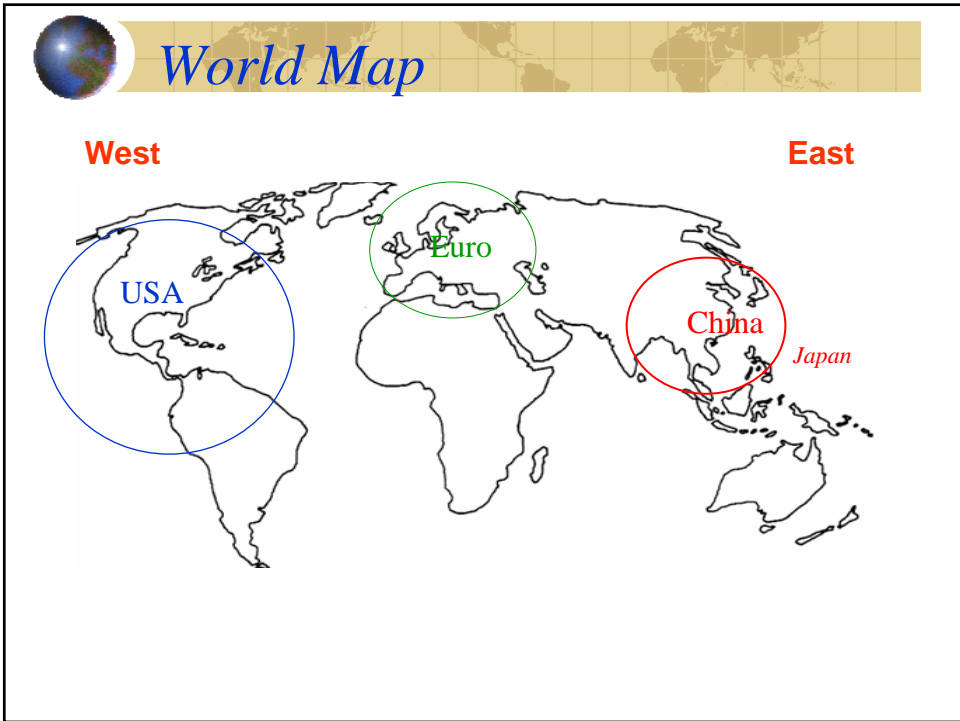
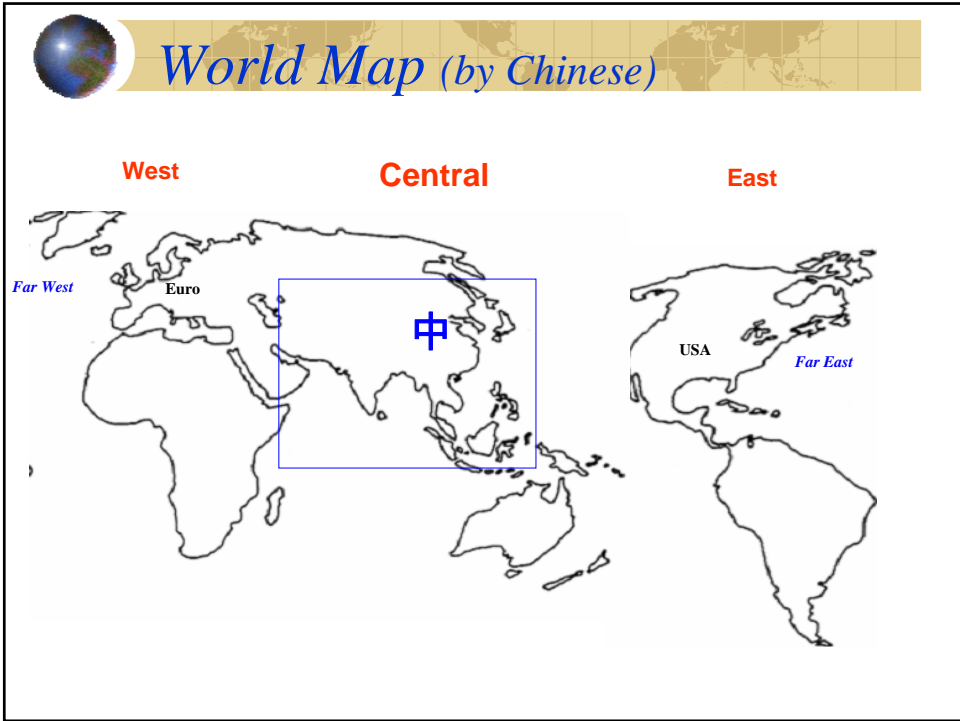


World Map

West

East

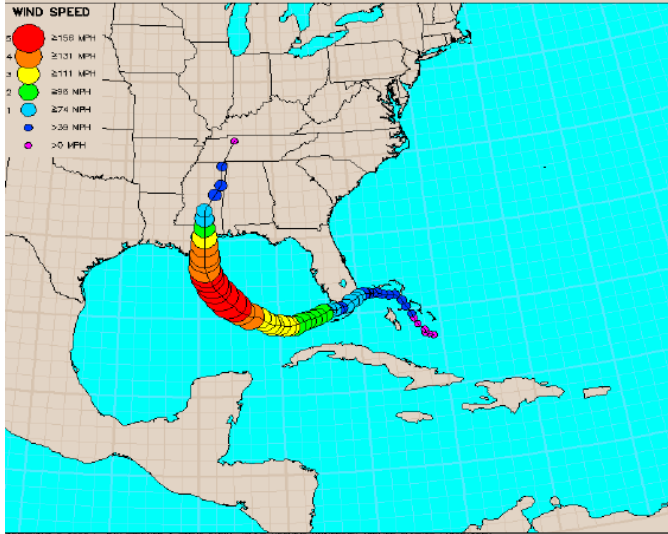






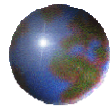
Hurricane Katrina

21:00 Tue August 23, 2005 to 15:00 Tue August 30, 2005 UTC



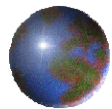
911





*The Unexpected Happens
—Be Prepared*

Thatcher's Law



*Develop a standard
procedure/process when
unexpected happens!*



Question posed to two groups of PhD students

- A small shop is opening to serve a local market with specialty film products. They expect to employ one shift of between 10 and, if they are successful, 25 manufacturing employees. At the moment they are in the early planning stages. They know the machines they wish to use and have leased a facility. They are wondering how to organize the work.
- How could you help them?

Source: Parker and Wall, 1998



Finding

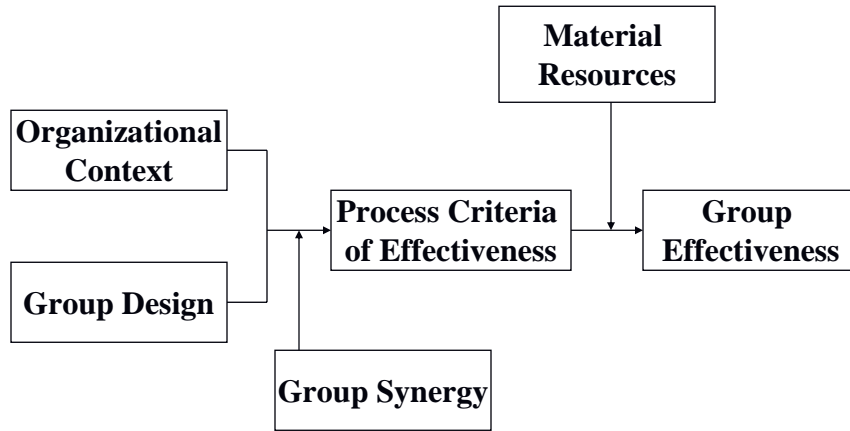
- Two groups,
- In the same situation,
- Trying to increase productivity,
- Try to answer the same question,

- In completely different ways.

How are HR and OR different?



Different Models – HR



Hackman, 1984



Different Models: OR

$$\text{minimize } z = \sum_{i \in F} \sum_{j=(n_{\min}+1)}^{n_{\max}} c_j x_{ij}, \quad (3)$$

$$\text{subject to: } \sum_{j=1}^n x_{ij} = 1 \quad \forall i \in I, \quad (4)$$

$$\sum_{i=1}^m t_i x_{ij} \leq T \quad \forall j \in J, \quad (5)$$

$$x_{ik} \leq \sum_{j=1}^k x_{hj} \quad \forall k \in J \text{ and } \forall i \in I \text{ and } \forall h \in P(i), \quad (6)$$

$$x_{ij} = 0, 1 \quad \forall i \in I \text{ and } \forall j \in J. \quad (7)$$

Baybars, 1986



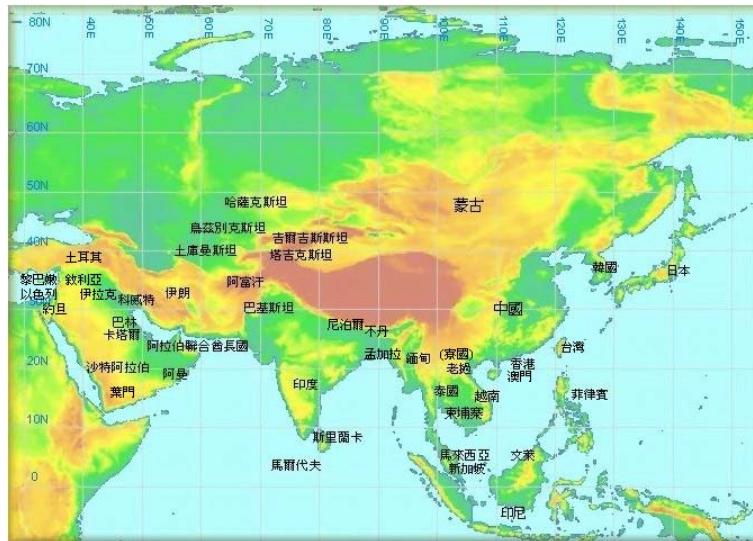
Different People

OR people prefer good answers. They are uncomfortable with the ambiguity of HR/OB models. They have little patience with solutions that do not lead to predictable outcomes. They want to be 'Right'.

HR/OB people prefer good questions. They are uncomfortable with the inherent limitations of mathematical assumptions. They have little patience for solutions to situations that never exist. They want to be 'Real'.



Asia: What do you know?





What Do You Know About Asia?

- Northern Asia (1)
 - Russian
- South-Central Asia (14)
 - Afghanistan, Bangladesh, Bhutan, **India**, Iran, Kazakhstan, Kyrgyzstan, Maldives, Nepal, Pakistan, Sri Lanka, Tajikistan, Turkmenistan, Uzbekistan
- South-East Asia (11)
 - Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, **Singapore**, Thailand, Timor-Leste, Viet
- Western Asia and Middle East (18)
 - Armenia, Azerbaijan, Bahrain, Cyprus, Georgia, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, **Saudi Arabia**, Syria, Turkey, United Arab Emirates, Yemen
- Eastern Asia (?)
 - **China**, **Hong Kong***, **Macau***, **Japan**, **Korea**, **Taiwan**



Asia: Year 2004

	World	USA	Asia
Area (1000 Km ²)	147800	9372.61 (6.3%)	44000 (30%)
Population (in Million)	6389.3	293.03 (4.5%)	3875 (60.6%)
Population Density (per Km ²)	43	31	88
GDP (in Billion US\$)	40,887.8	11,734.3 (28.7%)	
Per Capita GDP (US\$)	6,393	39,959	

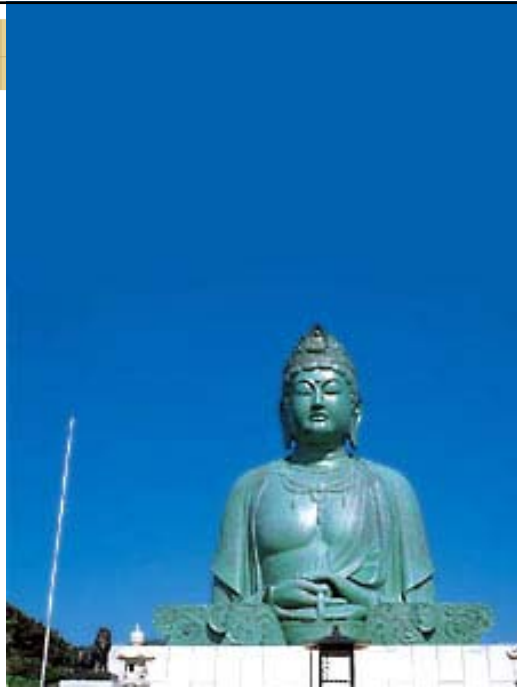


- Son:
“Daddy, where does baby come from?”
- Father:
“China, mostly.”



Asia—More

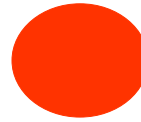
- Most areas are very religious (especially Buddhist and Islamism)
- Weak Economics in the past—this was significantly changing in the past 10 years.





What do you know about Asia : Recent Major Economics/Industry?

- One Sun—Japan
- Four (4) Tigers
 - Hong Kong
 - Korea
 - Singapore
 - Taiwan
- One Dragon—China
- One Elephant—India
- Others



Year 2004

	World	USA	Japan	China	India
Area (1000 Km ²)	147800	9372.61	377.80	9600 (6.5%)	2980 (2%)
Population (in Million)	6389.3	293.03 (4.5%)	127.3 (2%)	1300.1 (20%)	1086.6 (17%)
Population Density (per Km ²)	43	31	337	135	365
GDP (in Billion US\$)	40887.8	11734.3 (28.7%)	4587.4 (12%)	1649.4 (4%)	691.9 (1.5%)
Per Capita GDP (US\$)	6,393	39,959	35,902	1,273	637



An Update remark

As of May 2006

- China is the 2nd largest oil customer in the world
- India is the 6th!!!



Four Tigers: Year 2004

	World	USA	Taiwan	Hong Kong	Singapore	Korea
Area (1000 Km ²)	147800	9372.61	36.18	1.09	0.65	99.26
Population (in Million)	6389.3	293.03	22.6	6.92	4.2	48.2
Population Density (per Km ²)	43	31	625	6,337	6,461	486
GDP (in Billion US\$)	40887.8	11734.3	322.2	165.7	106.8	680.1
Per Capita GDP* (US\$)	6,393	39,959	14,271	24,082	25,191	14,144

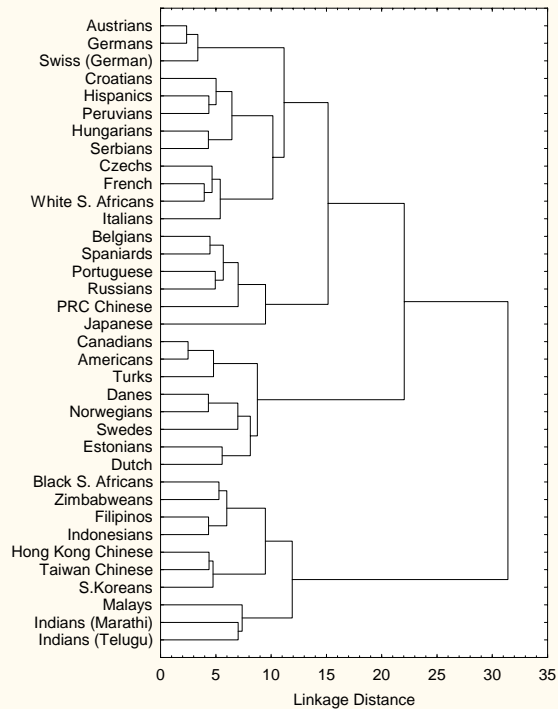
* cf. Japan (\$35,902); China (\$1,273) and India (\$637).



Cultures

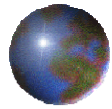
(J of Cross-Cultural Psychology 2004)

- Cross-cultural comparisons of personality traits
- Data: 28,000 respondents to 240 item questionnaire
 - Summarized in 30 traits, called facets
 - a profile of facets for each of 36 cultures
- nearby cultures often have similar profiles

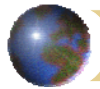


For Each Country

- When did six sigma come to your nation, and when did it become popular? and how? and why?
- What type of companies use Six Sigma in your nation? what are the leading users?
- How would academia fit into this six sigma program, if there is? what are the leading academia (University) programs?
- How would six sigma compare with other Quality programs (such as, TQM, Taguchi Method etc).
- What do you see about the future of six sigma in your nation?
- Any other general observations and comments?



What is Six Sigma?



Key Components

- **Process**
 - Known vs Unknown

- **Tool/Methodology**
 - Known vs Unknown

- **Execution**



Process Mining

- Process: A standard procedure
- How to Wash your hands?
 - ▣ Five Steps Approach
- When your company faces problems, is there any formal procedure to follow?



正確洗手五步驟

2. 取清潔劑搓洗指尖、指縫、手心、手臂，至少20秒

WET



1. 脫下手中飾物，手沾濕

RUB



POUR



3. 在流動的自來水下，沖淨雙手。

HOLD



4. 捧水沖洗水龍頭。

WIPE



5. 用乾淨的紙巾擦乾雙手，以用過的擦手紙關緊水龍頭。



Procedure

- 1) Define your goal as clear as possible
- 2) Use SPC technique (historical data) to understand the process
- 3) Identify controllable / uncontrollable factors
- 4) Use DOE technique to find the “optimal” setting for potential improvements
- 5) Run confirmation experiments

Define → Measure → Analysis → Improve → Control



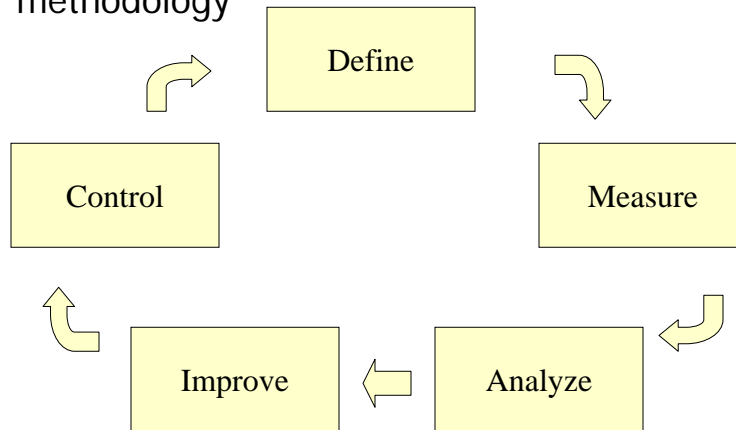
Six Sigma's DMAIC Method

- **Define:** Select problem and perform cost-benefit analysis
- **Measure:** Translate the problem into a measurable form, gather data and assess the current situation
- **Analysis:** Identify influence factors and causes that determine the critical to quality (CTQ) characteristic's behavior
- **Improve:** Design and implement modifications to the performance of the CTQs.
- **Control:** Adjust the process management and control system to ensure improvements are sustainable



Six Sigma Project Process

- Rigorous, data-driven and customer-focused methodology



Seven Core Principles of Six Sigma Methods

- Improvement actions are based on causal modeling
- Inquiry alternates between discovery and justification
- Problems are defined in precise operational terms
- Problems are quantified if possible
- A data based diagnosis precedes attempts at solving the problem
- Idea generation is daring and imaginative
- Hypotheses must be tested against empirical data.

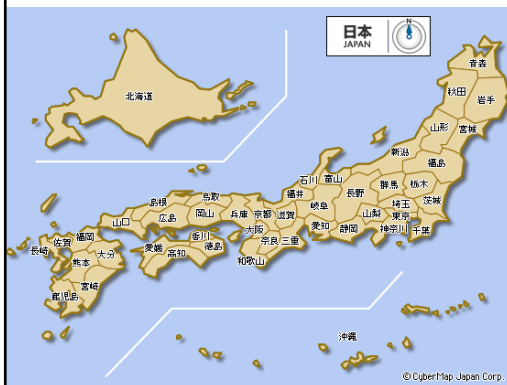


Japan: Year 2004

	World	USA	Asia	Japan
Area (1000 Km ²)	147800	9372.61	44000	377.80
Population (in Million)	6389.3	293.03	3875	127.3
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Per Capita GDP (US\$)	6393	39,959		35,902



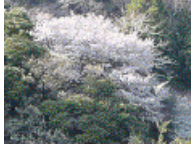
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GDP (in Billion US\$)	11734.3	4587.4
Per Capita GDP (US\$)	39,959	35,902



Sakura and Samurai



Six-Sigma in Japan

- Popular since 1997
 - Economical Depress in 1990's, eager to learn USA approaches
- Companies Adapted 6 σ :
 - Kodak; Sony; Shimano; Toshiba; GE-Yokokawa.
 - Anti-6 σ : Toyota; Nissan.
- Academic Fit
 - Not much.
- Compared to Other Quality Programs
 - TQM remains dominated
- Other Remarks
 - Six Sigma in Japan is not as popular as other areas.



Japanese TQM and Six Sigma: aim

Japanese TQM	American Six Sigma
"CUSTOMER FIRST" has been recognized an important concept in the long history of TQM.	Michel Harry's remarks on a conference. "TQM would be effective approach if stockholders could wait a long time, however recent stockholders are eager to obtain financial immediately" (Magire(1999)).
Customer satisfaction at high level	Profit
High level customer satisfaction brings profit.	To obtain profits, pursuing customer satisfaction and cost reduction
Customer satisfaction at high level	Profit at high level
Deployment of customer requirements thoroughly and precisely	Separated from the regular organization that has an advantage for drastic change
Keywords: thoroughly and precisely Management by Policy, Quality Function Deployment (QFD) Daily management Japanese TQM has few specialized tools for cost reduction.	Project selection is a key to obtain profits. All projects are selected in terms of profits to aim profit, where pursuing high-level customer satisfaction is an option to attain the financial success. One of the key issues to attain success is project based activity that is separated from the daily works.



Organizational structure of Japanese TQM and Six Sigma

Item	Japanese TQM	Six Sigma
Aim	Primal aim is to attain high-level quality. Profits are brought by high-level quality	Primal aim is to obtain profit. Attaining high-level quality is an approach to obtain profits.
Cost reduction	Not first priority. Sometimes it is tackled by general tools of quality improvement	Basically, the major issue is cost reduction, that is a typical subject of Black Belt projects.
Organization structure	Based on the daily routine works.	Standardized structure of organization has been prepared.
Driving force	Management by policy, Daily management, cross functional management, Quality circles	Aligned structure: Champion, Master Black Belt, Black Belt, Green Belt.
Guidelines for improvements	Problem solving QC story, Task achieving QC story	DMAIC (Define, Measure, Analyze, Improve and Control), Design for Six Sigma
Concepts	Importance of commitment by top management, Process approach, Customer first	
Advantages	Better to align the existing quality system, such as ISO 9001, organizational structure	Easy to implement a drastic change



India: Year 2004

	World	USA	Asia	India
Area (1000 Km ²)	147800	9372.61	44000	2980
Population (in Million)	6389.3	293.03	3875	1086.6
Population Density (per Km ²)	43	31	88	365
GDP (in Billion US\$)	40887.8	11734.3		691.9
Per Capita GDP (US\$)	6393	39,959		637



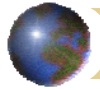
India: Year 2004



	USA	India
Area (1000 Km ²)	9372.61	2980
Population (in Million)	293.03	1,086.6
Population Density (per Km ²)	31	365
GDP (in Billion US\$)	11734.3	691.9
Per Capita GDP (US\$)	39,959	637*

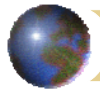
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Map not to Scale



India ...

- **70% of Indian's population lives in rural areas**
 - 600,000 Indian villages with 700 million occupants
 - Infrastructural issues undermine seamless connectivity
- **Rural literacy rates under 50%**
 - Literacy rates are even lower for women
- **Sharing is a social good**
 - Govt. sponsored kiosks support mediated access



Six-Sigma in India

- Popular since 1997, by 2002 it is very much so!
- ISI training programs since 1998
- Companies Adapted 6 σ :
 - GE—Corp; GE—Lighting; GE—Medical; Tata Motors; Samtel Group; Standard Chartered Banks.
- Academic Fit
 - Black Belt (BB) is comparable to MS in Applied Stat.
- Compared to Other Quality Programs
 - Bigger Impact than ever
- Other Remarks
 - Bright future (the next coming years)



China: Year 2004

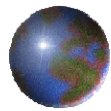
	World	USA	Asia	China
Area (1000 Km ²)	147800	9372.61	44000	9600
Population (in Million)	6389.3	293.03	3875	1300.1
Population Density (per Km ²)	43	31	88	135
GDP (in Billion US\$)	40887.8	11734.3		1649.4
Per Capita GDP (US\$)	6393	39,959		1,273



China: Year 2004



	USA	China
Area (1000 Km ²)	9372.61	9600
Population (in Million)	293.03	1300.1
Population Density (per Km ²)	31	135
GDP (in Billion US\$)	11,734.3	1,649.4
Per Capita GDP (US\$)	39,959	1,273

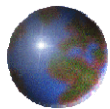


Culture Behind Forbidden City

The Largest and The Smallest
uniqueness of Forbidden City
Meeting Emperor

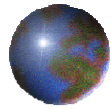


Great Walls



Culture behind Great Wall

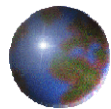
Invade/Expand Your Territory vs
Protect Your Own Land



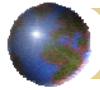
1911—Republic of China

*World War II
(1941—1949)*

*Cultural Revolution
(1966—1976)*

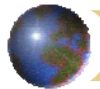


Olympic 2008 at Beijing



Six-Sigma in China

- Popular since 2000
- Hahn and Lin short courses in 2001.
- Companies Adapted 6 σ :
 - GE Global; most manufacturing and some financial companies.
- Academic Fit
 - Only about short courses on methodologies
- Compared to Other Quality Programs
 - Taguchi Method was very popular, and some TQM.
- Other Remarks
 - More on Lean and Innovations.

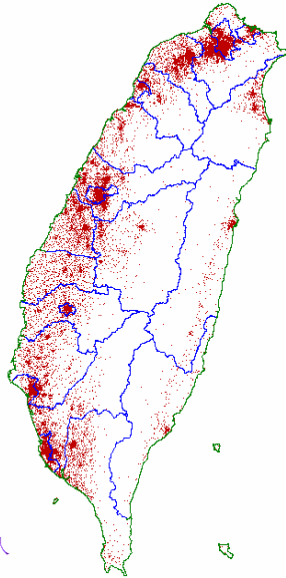


Taiwan: Year 2004

	World	USA	Asia	Taiwan
Area (1000 Km ²)	147800	9372.61	44000	36.18
Population (in Million)	6389.3	293.03	3875	22.6
Population Density (per Km ²)	43	31	88	625
GDP (in Billion US\$)	40887.8	11734.3		322.2
Per Capita GDP (US\$)	6393	39,959		14,271



Taiwan: Year 2004



1 dot = 1000 人

	USA	Taiwan
Area (1000 Km ²)	9372.61	36.18
Population (in Million)	293.03	22.6
Population Density (per Km ²)	31	625
GDP (in Billion US\$)	11734.3	322.2
Per Capita GDP (US\$)	39,959	14,271



Six-Sigma in Taiwan





Six-Sigma in Taiwan

- Introduced in 1997; Popular since 2002
- Lin's Short Course in 2002
- Companies Adapted 6σ:
 - ASUS; MITAC; Ford
 - 東元電機、大同公司、台鹽實業、亨將精密工業、實英實業、耀華電子、今台電子、大東紡織、功學社.
- Academic Fit
 - Not much
- Compared to Other Quality Programs
 - See next Table
- Other Remarks
 - A bright future—although most manufacturers have been moved to China



6σ as compared with Others

Tool	Process								
	Define 界定	Measure 衡量		Analyze 分析	Improve 改善		Control 管制		
6 Sigma	選定題目	課題明確化 與設定目標		方策之擬定	最適 策之 追究	最適策 之實施	確認效 果	反省及 今後之 計劃	效果之 維持
QC Story (狩野紀昭)	團隊處理 方式	敘述 問題	實施及 確認真 正肇因	界定及 確認真因	確認 改正 行動	實施永 久性 改正行動	防止在 發生	表提團隊	
8D法	狀況評估		問題分析	決策分析		潛在問題分析			
KT法	1. 成立品管圈 2. 發覺問題， 決定 專案		3. 現況 分析	4. 思考對策	5. 選擇最佳方案 6. 方案實施		7. 效果確認 8. 標準化 9. 撰寫報告書 10. 成果發表		



Hong Kong: Year 2004

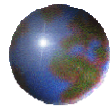
	World	USA	Asia	Hong Kong
Area (1000 Km ²)	147800	9372.61	44000	1.09
Population (in Million)	6389.3	293.03	3875	6.92
Population Density (per Km ²)	43	31	88	6337
GDP (in Billion US\$)	40887.8	11734.3		165.7
Per Capita GDP (US\$)	6393	39,959		24,082



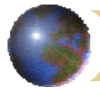
Hong Kong: Year 2004



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GDP (in Billion US\$)	11734.3	165.7
Per Capita GDP (US\$)	39,959	24,082



Hong Kong: Now and Then



Six-Sigma in Hong Kong

- Popular since 2001
- HK Productivity Council (HKPC) in 2000
- Companies Adapted 6 σ :
 - AIG (financial) International Bank; ASTEC Electrics (Emerson Group); Nokia; Johnson; Bosch Automation.
- Academic Fit
 - Not much (HKSQ)
- Compared to Other Quality Programs
 - More concrete approach, but not real new!
- Other Remarks
 - Blooming area!
 - Very "scary" certification process.



(South) Korea: Year 2004

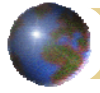
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(South) Korea: Year 2004

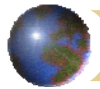


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GDP (in Billion US\$)	11734.3	680.1
Per Capita GDP (US\$)	39,959	14,144



Six-Sigma in Korea

- First case reported in 1996
- Very popular since 2002
- Companies Adapted 6σ:
 - Samsung SDI; Samsung Electrics; LG Electrics; LG Chemistry; LG Caltex; POSCO.
 - Samsung Life Insurance; KT; Korea Rail; SKT; Kookmin Bank.
- Academic Fit
 - Not much, but many Professional Consulting Companies.
- Compared to Other Quality Programs
 - Not much difference, but more focus on “hand-on” procedure.
- Other Remarks
 - Big Impact to improve the way people think & work.



Singapore: Year 2004

	World	USA	Asia	Singapore
Area (1000 Km ²)	147800	9372.61	44000	0.65
Population (in Million)	6389.3	293.03	3875	4.2
Population Density (per Km ²)	43	31	88	6461
GDP (in Billion US\$)	40887.8	11734.3		106.8
Per Capita GDP (US\$)	6393	39,959		25,191



Singapore: Year 2004



Singapore—A *Fine City*.

	USA	Singapore
Area (1000 Km ²)	9372.61	0.65
Population (in Million)	293.03	4.2
Population Density (per Km ²)	31	6461
GDP (in Billion US\$)	11734.3	106.8
Per Capita GDP (US\$)	39,959	25,191



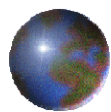
General Observations

- Popularized because of the successfulness from USA.
- Not much on methodology development, more so on culture change.
- There is more IE involvement, than Stat involvement.
- Impact to Statistics (next page)
- Major difficulties (especially in Japan)
 - Six Sigma is viewed as an old wine in a new bottle.



Indonesia ...

- **During the 1990s, Indonesia had an aggressive ICT policy**
 - Created intranet/internet connections btw universities, government labs & other research centers
- **Concern about universal access leads to launch of e-mosque program**
 - Greater mosque density than tele-density; Centrality of mosques in daily life & education process
 - Provides cultural context for computing
 - New government rules & roles



Does Six Sigma Work in China?

What do you know about China?
People vs system (connection vs law)



Different Culture

- Example on the assumption of the front-line workers
 - USA workers
 - Not very Smart
 - Follow the rules well
 - Asia workers
 - Extremely Smart
 - Does not follow the rule much



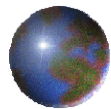
Impact to Data Sciences

- Visibility of Statistics
 - a powerful tool for problem solving
 - a powerful thinking process
- More jobs for statisticians (more so on statistical applications)
- Not much on scientific research yet (fundamental statistics), as compared to general research



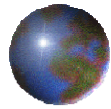
Quality Assurance

- Crosby's Zero Defective
- Feigenbaum's TQM
- Juran's Trilogy
- Deming's 14 Points
- Japanese TQM Style
- Quality Circle
- Tagushi Three-Stage Design
- Kaizen
- ISO-9000 Criteria
- Baldrige Criteria
- Six Sigma
- What's Next?????



Beyond Six-Sigma, what's next?

A systematic innovation
procedure/process



*A scientific (systematic)
approach (procedure/process)
to problem solving*

- Strategy
- Procedure
- Process
- Methodology
- Criteria



Recent News In Beijing-Labor Day

**Golden Holiday
from May 1st to
May 7th**

**Tourist in all hot
sights from
domestic cities**

**Crowds
everywhere**

