

Six Sigma Implementation in China: Successes and Challenges



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Zhen He's Short Bio



- Professor and deputy dean, College of Management and Economics, Tianjin University, China
- Academician of IAQ(International Academy of Quality)
- The recipient of NSFC (National Natural Science Foundation of China) Outstanding Young Scholars and the recipient of the New Century Excellent Talents project, Ministry of Education of China
- Chairman of Six Sigma Expert Steering Committee under China Association for Quality
- Main research interests include quality management and control, Six Sigma and Lean Production. Published over 100 journal papers.

Agenda

1. Introduction

2. Literature review

3. Methodology

4. Data analysis and results

5. Future development of Six Sigma

6. Conclusion



Introduction

1 Introduction

- Six Sigma or Lean Six Sigma is identified as a **systematic process improvement approach**
- It has been **widely implemented in a variety of industries** for many years.
- **Many success stories** of Six Sigma implementation in China

Six Sigma in China



- **Motorola (China)** Started Six Sigma in **early 1990's**.
- **Motorola(China)** started the **first phase BB development** from **1996**.
- **Lenovo** implemented Six Sigma in **2001**.
- More and more companies are implementing Six Sigma.
- Many companies have reached good results through Six Sigma including **Haier, AVIC, Baosteel, TISCO** etc.

CAQ's Effort on Six Sigma



天津大学
Tianjin University

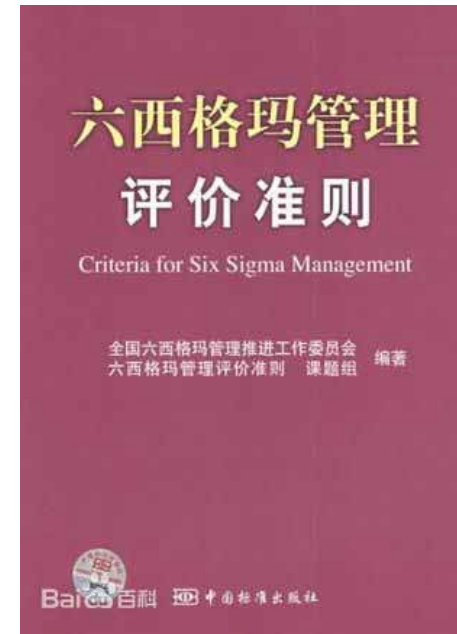
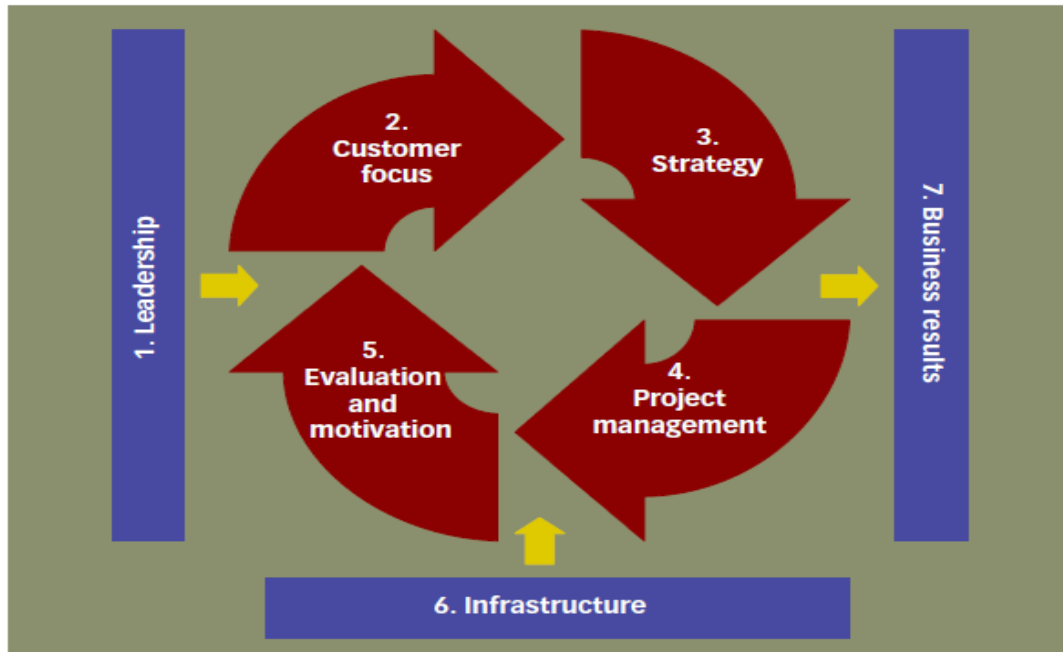


- China Association for Quality(CAQ) established **China Council for the Promotion of Six Sigma (CCPSS)** in **Sept. 2002**.
- Expert Steering Committee under CCPSS was found in **May 2004**.
- Annual Six Sigma Conferences were successfully held.
- CCPSS has annual BB and GB examination and certification.
- A set of **criteria on Six Sigma/ Lean Six Sigma maturity assessment** was developed in 2007.

Purposes of Six Sigma Maturity Assessment

1. Improve their Six Sigma deployment performance through understanding the big picture of Six Sigma management from strategic to operational level.
2. Benchmark best practice and clearly understand where their companies stand.
3. Locate areas for improvement through gap analysis.
4. Identify their strength and share successful story with others.
5. Pinpoint specific steps to close the gap.

Assessment infrastructure / FIGURE 1



The criteria consist of seven categories, 26 items and 47 areas for assessment

Table Categories, items and areas for assessment

Categories(with points)	Items(with points)	Areas
1 Six Sigma Leadership (100)	1.1 Organization vision and core values (20)	a. Vision b. Core values
	1.2 Executive leadership (80)	a. Visible resource support b. Participation in Six Sigma
2 Six Sigma and Business Strategy (80)	2.1 Six Sigma strategy development (40)	a. Strategy development process b. Six Sigma and organization strategy alignment
	2.2 Six Sigma strategy deployment (40)	a. Deployment process b. Key performance metrics
3.Customer Driven & Customer Satisfaction (80)	3.1 VOC and respond (40)	a. VOC and respond
	3.2 Customer satisfaction (40)	a. Customer satisfaction metrics b. Customer satisfaction measurement

4 Six Sigma Infrastructure (230)	4.1 Six Sigma deployment structure (40)	<ul style="list-style-type: none"> a. Structure b. Objectives, responsibilities and resource allocation
	4.2 Six Sigma management system and procedures (40)	<ul style="list-style-type: none"> a. Six Sigma management system and procedures
	4.3 Six Sigma training system (30)	<ul style="list-style-type: none"> a. Training system and management b. Body of knowledge c. Contribution of training to Six Sigma projects
	4.4 Communication and employee involvement (30)	<ul style="list-style-type: none"> a. Communication b. Exchanging with outside organization c. Employee involvement
	4.5 Data management (30)	<ul style="list-style-type: none"> a. Quality and availability of data b. Data processing system
	4.6 Information system and sharing (30)	<ul style="list-style-type: none"> a. Support of information system b. Knowledge management and sharing
	4.7 Six Sigma in supply chain (30)	<ul style="list-style-type: none"> a. Deployment in supply chain b. Deployment in Strategic partners

5 Six Sigma Project Management (170)	5.1 Project selection (30)	a. Opportunity identification b. Project selection procedure
	5.2 Project team (30)	a. Team building b. Team work
	5.3 Problem solving procedure and tools (40)	a. Problem solving procedure b. Problem solving tools
	5.4 Project plan and execution (40)	a. Project plan b. Project process review
	5.5 Project evaluation (30)	a. Project evaluation
6 Evaluation and Motivation (100)	6.1 Performance evaluation system (40)	a. Team performance assessment b. Assessment people in charge of Six Sigma deployment
	6.2 Motivation (60)	a. Award and recognition b. Career development

7 Business Results (240)	7.1 Customer satisfaction results (40)	a. Customer satisfaction results
	7.2 Financial results (60)	a. Financial results
	7.3 Human resource development (40)	a. Talents cultivation b. Employee satisfaction
	7.4 Internal business process improvement results (40)	a. Internal business process improvement results
	7.5 Supply chain improvement results (30)	a. Supply chain improvement results
	7.6 Corporate culture transition results (30)	a. Corporate culture transition results b. Corporate social responsibility

Success Stories of Six Sigma Implementation

1. Bao Steel
2. Haier
3. TISCO
4. AVIC Beijing Institute of Aeronautical Materials
5. Bluestar of ChemChina

- Started to implement ESI (Enterprise System Innovation) in 2001. Based on ESI, Bao Steel began to deploy Lean Six Sigma in 2002.
- In 2002 , Bao Steel started Lean Six Sigma projects in Hot Rolling Factory and reached 150M RBM savings within 6 months.
- In 2011, every BU within Bao Steel have implemented Lean Six Sigma.
- From 2003-2006, the savings owing to Lean Six Sigma projects reached 3.264B RMB.

- Haier started Six Sigma in 2004. In July 2005, the first phase of Six Sigma projects were finished.
- Since 2005, Haier has conducted more than 2000 Six Sigma projects with hard savings of more than 300M RBM.
- Haier started DFSS to innovate its product/process design in 2013.

Motivation of the study

- What are the CSFs for Six Sigma ?
- What are the core practices of Six Sigma?
- What's the relationship between Six Sigma and Innovation?*
- How Six Sigma support business performance?
- What is the future development of Six Sigma

*Zhen He, Yujia Deng, Min Zhang, Xingxing Zu, Jiju Antony (2015), An empirical investigation of the relationship between Six Sigma practices and organizational innovation, *Total Quality Management & Business Excellence*, DOI: 10.1080/14783363.2015.1092866



2

Literature review



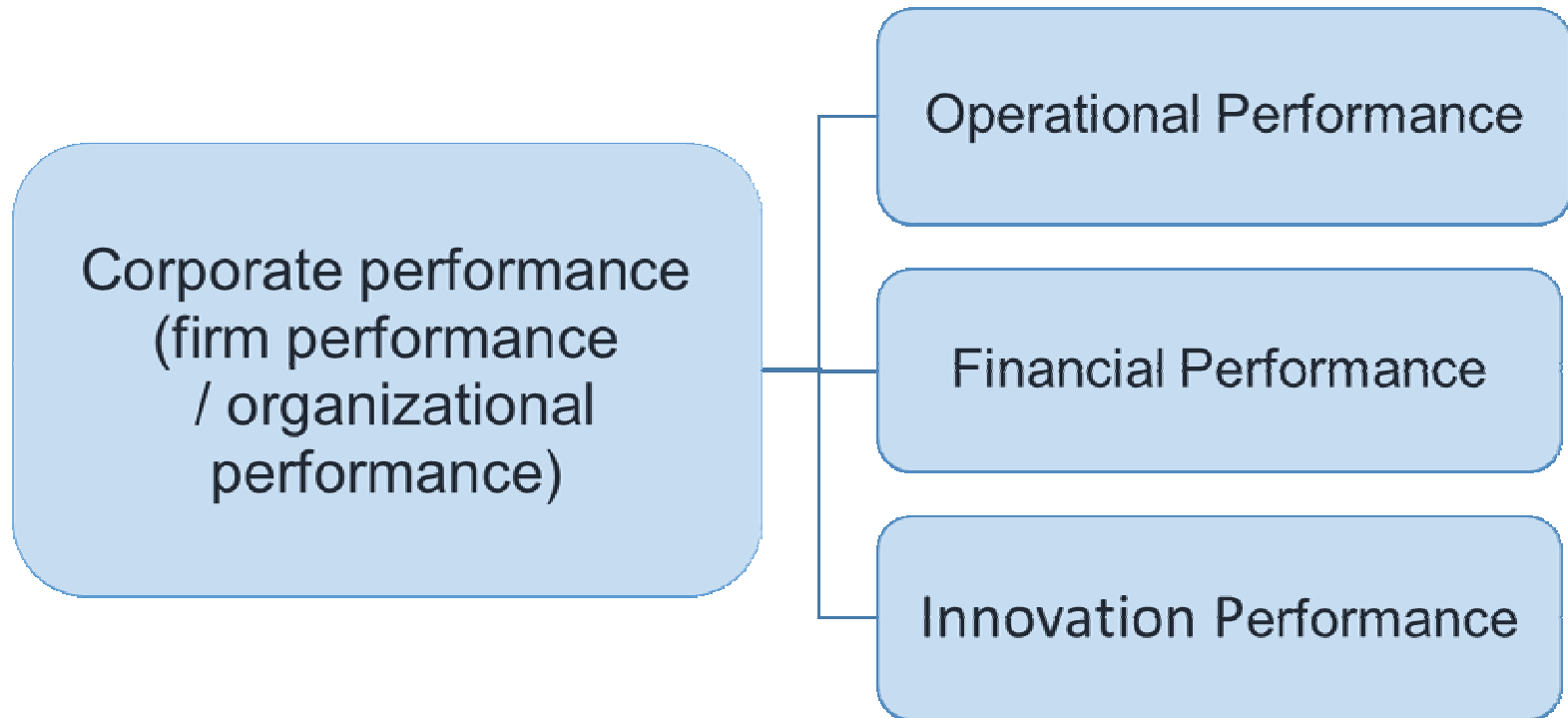
2.1 Six Sigma practices

Categories	Practices	Related constructs
Management practices	Top management support and commitment (TMSC)	Top management support (Zu et al., 2008), Leadership (He, 2009), CEO's will (Choi et al., 2012), Leadership management (Schroeder et al., 2008)
Infrastructure practices	Six Sigma role structure (RS)	parallel-meso structure & improvement specialists (Schroeder et al., 2008), Six Sigma role structure (Zu et al., 2008), Infrastructure (He, 2009)
	Customer Relationship (CRS)	customer-oriented metrics (Schroeder et al., 2008), customer relationship (Zu et al., 2008), customer focus (He, 2009)
	Information & data system (IDS)	Statistical control and feedback (Flynn et al., 1995), information system (Lee & Choi, 2006), information utilization (Choi et al., 2012)

2.1 Six Sigma practices

Categories	Practices	Related constructs
Core practices	Six Sigma structured improvement procedure (SIP)	Methodology tool and application (On, 2006), Six Sigma structured improvement procedure (Zu et al., 2008), structure method (Schroeder et al., 2008)
	Six Sigma focus on metrics (FOM)	Result (On, 2006), Six Sigma focus on metrics (Zu et al., 2008), customer-oriented and financial performance metrics (Schroeder et al., 2008), focus in metrics (Habidin & Yusof, 2012)
	Design for Six Sigma (DFSS)	Product/service design (Zu et al., 2008)

2.2 Corporate performance



2.3 Research model and hypotheses

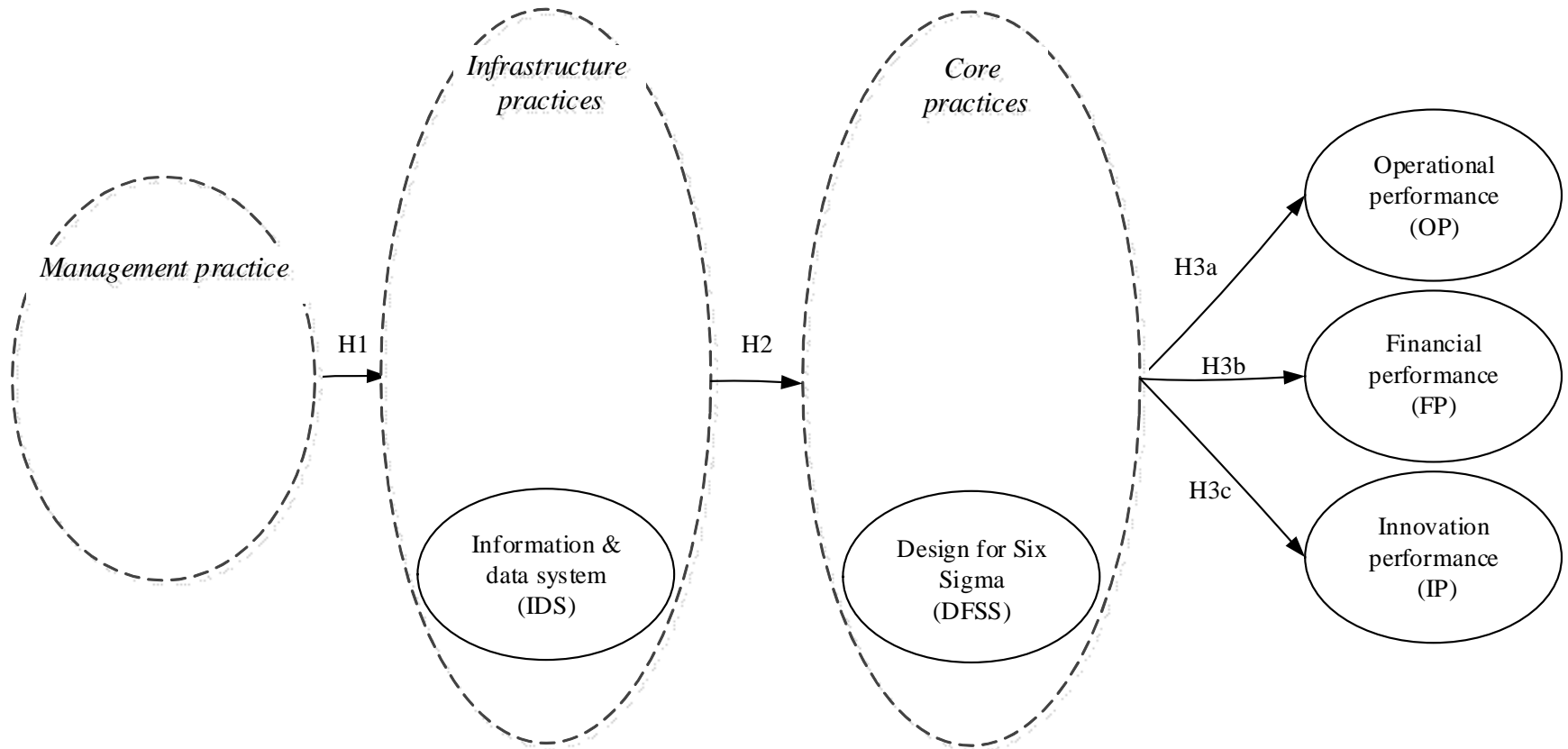


Figure 1 Research model

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Methodology



3.1 Survey Instrument

Basic information about respondent's characteristics

- Roles in Six Sigma implementation
- Received Six Sigma training or not

Basic information about the firms

- Industry
- Annual revenue
- Number of employees
- Ownership
- Duration of Six Sigma implementation

Measure constructs of Six Sigma practices and corporate performance

- Seven-point Likert scales
- Items adapted from the related literature

3.2 Sample and data collection

- Delivered **425** questionnaires
- Finally received **263** responses (**37** were deemed invalid)
- **226** questionnaires (53.2% effective response rate) referring to **141** firms were analyzed
- Data were **aggregated** by calculating the **average of the multiple respondents for some of the firms**
- Based on a **sample of 141 manufacturing or service firms** implementing Six Sigma in China



3.1 Demographic Results

	Number of respondents	Percent (%)
Industry		
Manufacturing industry	135	95.7
Service industry	6	4.3
Annual revenue (Y, Million RMB)		
$Y \geq 400$	105	74.5
$20 \leq Y < 400$	25	17.7
$3 \leq Y < 20$	7	5.0
$Y < 3$	4	2.8
Number of employee (X)		
$X \geq 1000$	113	80.1
$300 \leq X < 1000$	21	14.9
$20 \leq X < 300$	7	5.0
$X < 20$	0	0
Ownership		
State-owned enterprises	111	78.7
Non state-owned enterprises	30	21.3
Duration of implementation (Z, years)		
$Z \leq 3$	57	40.4
$Z > 3$	84	59.6
Total	141	100.0

4

Data analysis and results

4.1 Measurement model

- The analysis of measurement models confirms that the instrument in this study has **satisfactory reliability and validity**.

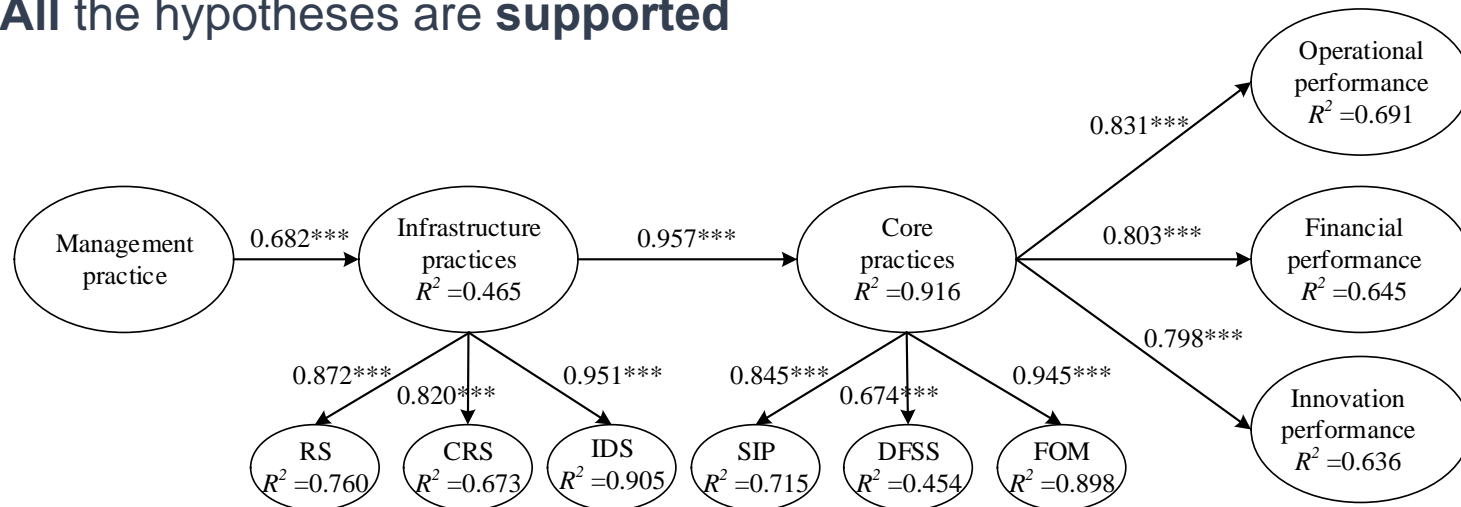
	Items	Cronbach's α	CR	AVE	FP	IP	QP	FOM	DES	IMP	IDS	RS	CRS	LS
FP	4	0.924	0.925	0.756	0.869									
IP	4	0.869	0.874	0.635	0.787	0.797								
QP	4	0.895	0.897	0.685	0.689	0.646	0.828							
FOM	5	0.920	0.921	0.699	0.741	0.746	0.791	0.836						
DES	5	0.940	0.941	0.761	0.597	0.719	0.425	0.664	0.872					
IMP	5	0.924	0.925	0.712	0.565	0.566	0.756	0.845	0.440	0.844				
IDS	3	0.839	0.846	0.648	0.752	0.760	0.740	0.840	0.662	0.799	0.805			
RS	3	0.838	0.842	0.641	0.600	0.540	0.704	0.796	0.507	0.792	0.831	0.801		
CRS	4	0.878	0.880	0.647	0.711	0.601	0.654	0.716	0.543	0.640	0.781	0.721	0.804	
LS	3	0.805	0.863	0.614	0.510	0.540	0.575	0.588	0.472	0.631	0.576	0.635	0.599	0.784

Notes: Diagonal bold elements are the square roots of average variance extracted. Off-diagonal elements are the correlations, and all correlations are significant at $p < 0.001$.

Table 3 Reliability and validity tests

4.2 Structural model

- Uses **structural equation model** to test the hypotheses
- A **good model fit** (specifically $\chi^2=1282.822$, $df=768$, $\chi^2/df=1.670<3$; $SRMR=0.067<0.08$; $RMSEA=0.069<0.08$, $CFI=0.896$, $TLI=0.889$)
- **All the hypotheses are supported**



*** Path coefficient is significant at the 0.001 significance level ($P<0.001$)

Figure 2 Hypotheses testing results

Discussion



- All the hypotheses are supported
- Six Sigma is a systematic and rigorous methodology for problem solving
- All the Six Sigma practices are interdependent
- Top management should have their strategic goals and develop procedure to achieve these goals through Six Sigma.

Challenges

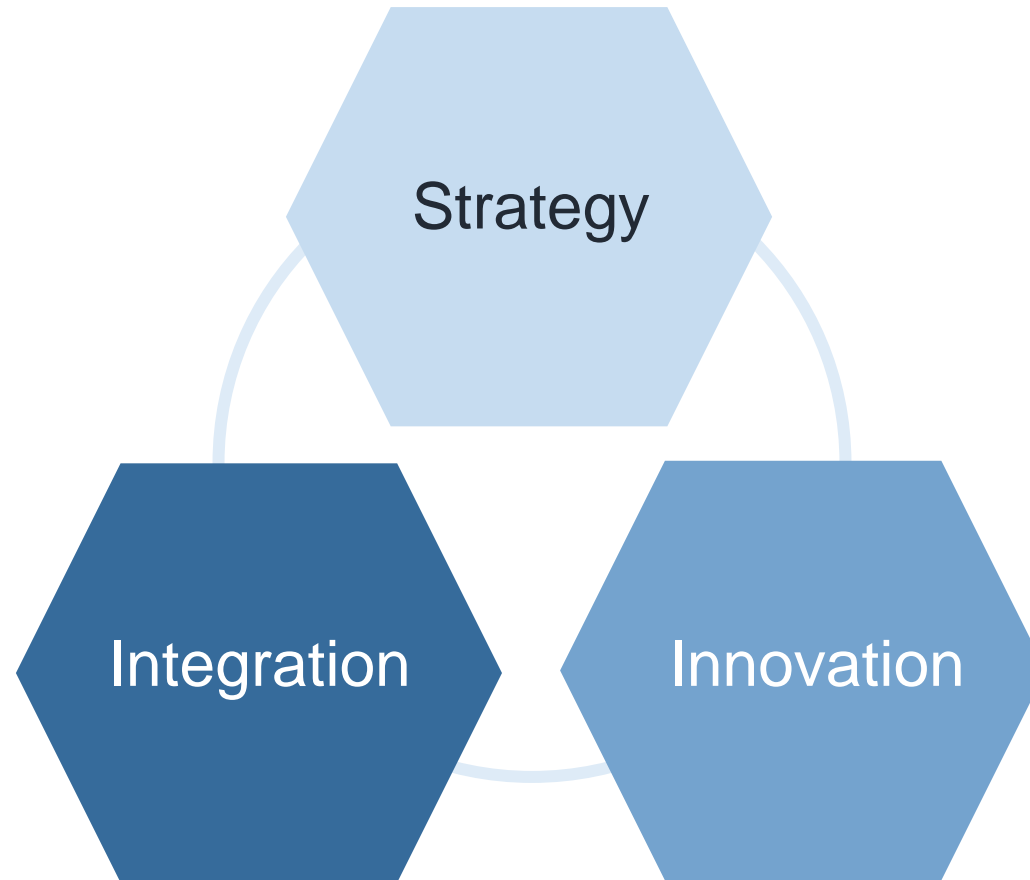
1. Lack of high-level management commitment
2. Not well established Six Sigma Infrastructure
3. Culture barrier (cross functional team work, data driven, customer-orientation etc.)
4. Suppliers involvement in Supply chain
5. Poor project management
6. Belts people not Motivated
7. Company-wide involvement not enough
8. Visible results from Six Sigma implementation

5

Future Development of Six Sigma



Future development of Six Sigma



Strategy



- Six Sigma deployment should be aligned with business strategy
- Six Sigma is a powerful tool for achieving business strategic goals through continuous improvement project
- AVIC (Aviation Industry of China) and TISCO (Taiyuan Iron and Steel Company) are very good examples of Six Sigma with strategy management.

Integration

- Six Sigma is Integrated with many management theory and methods such as lean production, quality management systems, performance excellence model, supply chain management, theory of constraints and so on.
- Corporations are now implementing what is labeled as Lean Six Sigma.
- In China more companies claim their initiative to Lean Six Sigma instead of Six Sigma.



Innovation

- Six Sigma Widely used for developing new products and services that reach new and broad market; that is, for innovation (Box & Woodall, 2012).
- Go beyond its old metric meanings
- Metric is nonessential aspect of the Six Sigma process improvement and product design frameworks and is now doing more harm than good. (Montgomery & Woodall ,2008)

6 **Conclusion**

Conclusion

- A proposed model was tested by data from 141 firms implementing Six Sigma in China.
- The results support the view that Six Sigma practices are positively related to corporate performance.
- Six Sigma is a systematic and rigorous methodology for problem solving
- All the Six Sigma practices are interdependent
- Top management should have their strategic goals and develop procedure to achieve these goals through Six Sigma.

道可道，非常道；名可名，非常名

--老子《道德经》

-The way that can be told of is not an unvarying way; The names that can be named are not unvarying names.

-Tao Te Ching ; Lao Zi

Thank you!
Q & A

