International Academy for Quality

An Organizational Development Study of the Impact of Culture Factors on the Implementation of the Six Sigma Methodology in Southern China

Presentation Contents

The Phenomenon

- Tendency 1
  - Some companies completed Six Sigma, some continued with it, and some abandoned it
- Tendency 2
  - Some integrate with other initiatives, and some carry it as a brand name
- Operation incompatibility and cultural incongruity
- Six Sigma looks to be losing momentum in the market

Introduction:
The Research Problem

- Can Six Sigma be successful by simply rolling out its methodology?
- How does Six Sigma perform in another culture?
- Issues between Six Sigma and innovation
- Critical Success Factors (CSFs) of Six Sigma
- The impact of organizational culture factors
- Six Sigma implementation issues in Chinese enterprises

- Mixed Methods Research
- Examine research topic by employing OD theory and models of culture
- Investigate relationship of cultural factors to process and outcome
- Three stages of data collection and analysis:
  - Exploratory interviews
  - Questionnaire survey
  - Post-study interviews

Literature and Research Hypotheses

What is Six Sigma?

- A rational and metrical standard
  - e.g., 3.4 Defects Per Million Opportunities (DPMO)
- Focused on infrastructure
  - team, method and tools
- Combines method and expertise training
  - DMAIC method, and black belts & green belts
- Builds process capability and cultural change

Key Elements of Six Sigma

- Project and team management
- Share goals, establish attitude and convictions
- Employee empowerment to enhance quality
- Performance measurement
- Process repeatability and control
- Focus on tangible outcomes
  - Financial, quality, process, and efficiency results

Six Sigma Guidelines Emphasize

International Academy for Quality

- Objectives
  - Prioritized policies and goals: financial saving, quality level, process improvement, and efficiency

- Activities
  - Programs to educate corporate mindset, new values, teamwork, employee involvement and skills

  - Plans for training in quality method, practices and tools, and for providing rewards and qualifications

- Actions
  - Execute activity plans on business, operation, and employee levels

Implementing Six Sigma

- Successful Six Sigma implementation is positively related to:

  H1: Setting clear Six Sigma *objectives*

  H2: Following the prescribed Six Sigma planned *activities* for organizational development

  H3: Following the prescribed Six Sigma *actions* for implementation

Outcomes and Investigation

- Six Sigma implementations seek to achieve two outcomes:
  - Building a Six Sigma culture, and
  - Achieving efficiency outcomes
- Investigation:
  - Assess how existing organizational culture and Chinese culture influence success in achieving these two outcomes
  - Examine Six Sigma implementation as an example of organizational change

- *Change Process Theory* suggests focusing on contextual elements of culture which influence change initiative, such as:
  - characteristics of information generation and transmission process
  - individual propensity to change
  - social influence factors

- *This study will focus on the social influence factors of* organizational and Chinese culture

Change & Organizational Culture

- 5 Selected Dimensions of OCP (Six Sigma BOK)
  - *Supportiveness*: Promotes project and team dynamics, and establishes new cultural values
  - *Performance*: Helps achieve process excellence and control
  - *Rewards*: Builds up Six Sigma infrastructure
  - *Competitiveness*: Achieves quality culture and adds competitive advantage
  - *Innovation*: Brings in Six Sigma for change, growth, and outcome

- Successful implementation of a Six Sigma quality culture is positively affected by:

    H4: A *Supportive* culture

    H5: A *Performance Oriented* culture

    H6: A culture that *Rewards Outcomes*

    H7: A *Competitive* culture

    H8: An *Innovative* culture

Six Sigma Efficiency Outcomes

- Successful achievement of Six Sigma efficiency outcome is positively related to:

    H9: A *Supportive* culture

    H10: A *Performance Oriented* culture

    H11: A culture that *Rewards Outcomes*

    H12: A *Competitive* culture

    H13: An *Innovative* culture

Change and Chinese Culture

- 3 Selected Dimensions of CVS (Six Sigma BOK)
  - *Integration*: Contributes to team spirit, quality work, and inter-disciplinary cooperation
  - *Confucian work dynamism*: Executes prioritized projects and core process stably and adequately, and being effective
  - *Personal*: Establishes positive attitude, develops interesting work, and monitors progress diligently.

Chinese Values and Six Sigma

- This study focused on effects of organizational culture
  - Do Chinese values represent an effect over and above the effect of organizational culture?
- Chinese values were included primarily as control variables
  - No formal hypotheses were posed

Methods, Measures, and Sample

- Objective: To help shape research program and hypotheses
- Interviews of Six Sigma experts
  - Southern China (Hong Kong)
    - Three interviews
  - Eastern China (Shanghai)
    - Four interviews
- Result: Provided support for planned survey design

- Quantitative survey of Six Sigma professionals
  – Invitations emailed out by Six Sigma societies to their members, and Six Sigma individuals

- Online survey in two waves to avoid potential common method bias
  – Survey invitations: 1713
  – Surveys completed: 116   (6.8% response rate)

Survey Demographics - Individuals

Age Group	%
21-30	19
31-40	37.1
41-50	33.6
51-60	8.6
Over 60	1.7

Six Sigma Exp.	%
0-5 yr.	67.2
6-10yrs.	20.7
11-20yrs.	4.3
Over 20yrs	0
N.A.	7.8

Six Sigma Status	%
Green Belt	39.7
Black Belt	31.0
Master Black Belt	8.6
Academician	12.9
Others	7.8

Occupational Role	%
Engineering	19.8
Managing	54.3
Both	25.9

Gender

	%
Male	78.4
Female	21.6

International Academy for Quality

Survey Demographics - Companies

Industry	%
Manuf.	56.9
Non-Manuf.	43.1

Employees	%
1-100	44
101-1000	21.6
1001-5000	11.2
5001-10000	1.7
10000+	3.4
N/A	18.1

HQ Location	%
HKG	59.5
CN	3.4
Worldwide	37.1

Operations Location	%
HKG	56.9
CN	31.9
Worldwide	11.2

Product or Service	%
Products	53.5
Services	33.6
OTHERS	12.9

22

Survey Demographics - Ownership & Six Sigma Status

Organization Type (all in Hong Kong)	Completed (N=25) or Ongoing (N=67)	Abandoned (N=24)
1. Mainland State-owned Enterprise (SOE)	3	2
2. Mainland Private-owned (POE)	9	1
3. Foreign-owned Enterprises (FOE)	31	7
4. Public-listed Corporation (PLC)	16	4
5. Private-Limited Corporation (PCL)	15	2
6. Small- and Medium- Sized Enterprise (SME)	14	6
7. Private Unlimited Corporation (PUC)	0	0
8. Non-Government Organization (NGO)	2	1
9. Quasi-Government Organization (QGO)	2	1

International Academy for Quality

Part A: Reasons

1. Management lacked "constancy of purpose"
2. Management preferred to use multiple methodologies
3. Strategic objectives and Six Sigma were not compatible
4. Six Sigma did not yield financial results as expected
5. Six Sigma projects were too expensive
6. Six Sigma quality methods were too rigorous to adopt
7. Six Sigma did not fit organizational culture
8. Resistance was seen in different levels of employment
9. Training demands were not realistic to the employees
10. Education of new knowledge was not a core value of the organization

Part B: Respondent Answer

Reason	Disagree	Neutral	Slightly Agree/ Agree	Strongly Agree	Agree Total Response
1	4	5	13	2	15 (63%)
2	7	6	11	0	11 (46%)
3	8	8	6	2	8 (33%)
4	5	8	10	1	11 (46%)
5	5	7	10	2	12 (50%)
6	3	9	11	1	12 (50%)
7	5	2	13	4	17 (71%)
8	4	4	13	3	16 (67%)
9	3	6	13	2	15 (63%)
10	2	12	6	4	10 (42%)

- Conduct EFA using pilot data for new scales:
  - Six Sigma Objectives, Activities, Actions
  - Outcomes of Six Sigma Quality Culture, Efficiency
- Conduct CFA using final data
- Conduct logistic regression to test H1-H3
  - Or, to determine why companies continue/abandon Six Sigma initiative
- Conduct regression to test H4-H13

Measure of Six Sigma Objectives, Activities, & Actions

	Objectives	Activities	Actions
1. Improve business competitiveness	.79		
2. Build status of quality organization	.74		
3. Achieve enhanced quality	.74		
4. Increase organization's leading role in industry	.67		
5. Enhance organization's problem solving ability	.66		
1. Training to enhance employee involvement		.83	
2. Quality workshops for educating employees		.80	
3. Training Six Sigma method – DMAIC, as mindset		.77	
4. Rewards and recognition for performance		.65	
5. Activities to build Six Sigma values		.64	
1. Communicate effectively			.86
2. Establish positive attitude			.82
3. Employee empowerment			.76
4. Benchmarking			.62
5. Stakeholders management			.62

Note: Cronbach's Alpha
1. Six Sigma Objectives = .80; 2. Six Sigma Activities = .91; 3. Six Sigma Actions = .89

Measure of Six Sigma Outcomes

Factors	Quality Culture	Efficiency
1. People's knowledge of quality services / products	.86	
2. Corporal team spirit	.78	
3 .Corporal continuous improvement culture	.75	
4. Open recognition as a quality management body	.58	
1. Cost reduction		.82
2. Bottom line results		.73
3. Cycle time improvement		.69
Note: Cronbach's Alpha 1. Quality Culture Outcome = .86, 2. Efficiency Outcome = .83		

- Organization Culture Profile (OCP):
  - Supportiveness α = .86
  - Performance Orientation α = .87
  - Emphasis on Rewards α = .89
  - Competitiveness α = .84
  - Innovative α = .81

- Chinese Value Survey (CVS)
  - Integration α = .82
  - Confucian Work Dynamism α = .75
  - Personal Factor α = .86

- CFA shows all measures are distinct

Stage 3 – Post-Survey Interviews

- Objective: To aid in interpretation of research findings
- Compared results with real-world knowledge and experience of Six Sigma experts:
  - 2 academics,
  - 2 consultants
  - 3 practitioners

Results

Independent variable	B	S.E.	Wald	Sig.	Exp(B)
Organization Type			7.41	.39	
Chinese State-owned Enterprise	.28	1.83	.02	.88	1.32
Chinese Private-owned Enterprise	2.81	1.15	.00	1.00	16.61
Foreign-owned Enterprise	2.34	1.70	1.90	.17	10.42
Hong Kong Public-listed Corporation	1.29	1.66	.60	.44	3.62
Hong Kong Private Limited Corporation	2.17	1.88	1.32	.25	8.72
Hong Kong Small- and Medium Enterprise	.61	1.61	.15	.70	1.85
Hong Kong Non-government Organization	-1.03	1.94	.28	.60	.36
Industry	-1.27	.75	2.85	.09	.28
Employee Size	.00	.00	.41	.52	1.00
Objectives	1.10	.46	5.78	.02	2.99
Activities	.40	.38	1.16	.28	1.50
Actions	-.06	.42	.02	.88	.94
Constant	-6.83	2.97	5.28	**.02**	.00

Model χ^2 = 25.61 p. < .05

Pseudo R^2 = .37

N = 116

Note: There are nine variables under Organization Type. Type 9 (Hong Kong Quasi-government Organization) is used as a reference, and no respondent chose Type 7 (Hong Kong Private Unlimited Corporation) in the survey.

- Logistic regression of Six Sigma factors and completion show:

  H1: Objectives - supported

  H2: Activities – *not supported*

  H3: Actions – *not supported*

- Interpretation of findings:
  – Companies have clear objectives significantly affect continuous and successful Six Sigma implementation
  – Companies do not have clear objectives are likely to abandon Six Sigma

33

Six Sigma Outcomes

Independent Variables	Quality Culture	Efficiency
Employee Size	.06 (.53)	-.17 (-1.50)
Industry	.02 (.17)	.27 (2.66)**
Organization type	.07 (.67)	.08 (.73)
Organizational Culture Profile Variables		
Supportiveness	.42 (2.35)*	.44 (2.57)*
Performance	-.11 (-.51)	-.32 (-1.49)
Reward	-.12 (-.58)	.06 (.33)
Competitive	.40 (1.70)	.31 (1.39)
Innovation	-.36 (-2.19)*	-.19 (-1.24)
R²	.17	.25

Note: *N* = 92. Standardized coefficients reported (*t* values in parentheses).
*p < .05. **p < .01. ***p < .001.
Note: All Chinese Value Survey variables were non-significant, and dropped from the final analysis due to sample size

- Regression of culture's (OCP) effects on Six Sigma outcomes
- CVS dimensions not significant
  - Dropped from final model due to small sample size

Six Sigma Outcomes

- Supportive culture has positive and significant impact on *both* quality culture and efficiency

- Innovative culture has <u>negative</u> but significant impact on quality culture, but *not significant* on efficiency

- Manufacturing industry has advantage on efficiency

Summarizing Hypotheses

Six Sigma Quality Culture	
H4: Supportiveness	✔️
H5: Performance Oriented	❌
H6: Rewards Outcomes	❌
H7: Competitiveness	❌
H8: Innovation	➖ ✔️

Six Sigma Efficiency	
H9: Supportiveness	✔️
H10: Performance Oriented	❌
H11: Rewards Outcomes	❌
H12: Competitiveness	❌
H13: Innovation	❌

Significant results were found in the *opposite* direction as expected ⁉️

Discussion

- Setting clear change objectives critical
  - A lack of clear objectives is associated with abandoning of Six Sigma
  - The type of change objective doesn't matter
- Six Sigma Activities and Actions not critical
  - This suggests *change implementation theory* perspective not very useful in this case

Chinese Values and Six Sigma

- Chinese culture does not appear to represent a barrier to Six Sigma
  - Non-significant results suggest that if there is an effect, it is a very small one
  - Two guanxi factors (reciprocation, face, and tradition) predicted, did not observe in survey.
- Instead, it is organizational culture which matters

Organizations and Six Sigma

- A Supportive culture is important if a company is to attain a Six Sigma culture and to achieve efficiency outcomes

- Six Sigma also appears to be better at enhancing efficiency in manufacturing organizations
  - Less effective in service organizations

Innovation Culture & Six Sigma

- Unexpected and controversial finding:
  - An Innovation culture appears inconsistent with achieving a Six Sigma culture
  - An Innovative culture focuses on flexibility, experimentation, and risk taking
  - A Six Sigma culture focuses on measurements, control, and procedural consistency

Post-Survey Interviews

Survey Findings	Comments by Experts
Clear objectives	All agreed with findings; part of management support
Quality Culture	Most agreed with findings; "open-recognition" opinion divided
Efficiency Factors	All agreed with findings
OCP Supportive Culture	All agreed with findings
OCP Innovative Culture	New finding, opinion divided. Must identify differences be innovation and innovative culture
CVS Cultural Characteristics	Most agreed with findings; Chinese culture not an obstacle to accepting new methods

Interviewees:
- Two Academics
- Two Consultants
- Three Practitioners

- OCP and CVS focus on soft factors only
  - Scientific and engineering variables excluded
- Retrospective data possibly subject to recall bias
- Low response rate (6.8%) in online survey
  - If sample is significantly representative
- Survey data only from Southern China only
  - If CVS more important in less developed areas of China?

- Setting objectives at beginning is important
  – Six Sigma Activities and Actions not important
- Six Sigma better fits manufacturing
- Chinese culture not inconsistent with Six Sigma
- Supportiveness important for Six Sigma implementation

Appendices

Variable	Mean	St. Dev	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Six Sigma Objective	5.50	.68	.80												
2. Six Sigma Activities	5.05	1.09	.34**	.91											
3. Six Sigma Actions	5.07	.92	.42**	.56**	.89										
4. [i]CVC – Integration	5.20	.98	.49**	.27**	.48**	.82									
5. [i]CVC – Confucian	4.95	.88	.43**	.21*	.41**	.53**	.75								
6. [i]CVC – Personal	5.18	.90	.46**	.21*	.33**	.72**	.66**	.86							
7. [ii]OCP – Supportiveness	5.19	.97	.45**	.31**	.52**	.71**	.45**	.56**	.86						
8. [ii]OCP – Performance	5.35	.99	.38**	.20	.39**	.68**	.39**	.62**	.78**	.87					
9. [ii]OCP – Rewards	5.05	1.07	.42**	.32**	.44**	.67**	.51**	.65**	.70**	.73**	.89				
10. [ii]OCP – Competitiveness	5.26	.99	.48**	.31**	.48**	.70**	.48**	.70**	.70**	.80**	.80**	.84			
11. [ii]OCP – Innovation	4.90	.97	.46**	.21*	.51**	.61**	.59**	.62**	.60**	.63**	.67**	.72**	.81		
12. Outcome – Efficiency	5.13	.99	.41**	.38**	.44**	.33**	.35**	.34**	.37**	.26*	.23*	.32**	.17	.83	
13. Outcome - Quality Culture	5.03	.95	.27**	.33**	.24*	.17	.10	.16	.32**	.20	.18	.23*	.04	.57**	.86

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Note: N = 92.

Cronbach's alpha coefficients on diagonal.

[i]CVC = Chinese Value Characteristics, by a shortened version of the Chinese Value Survey (Bond, et. al., 1987)

[ii]OCP = A shortened version of the Revised Organizational Culture Profile (Sarros, et. al., 2005; cf. O'Reilly III, et. al., 1991)

Organization Culture Profile (OCP)
(O'Reilly et al., 1991)

Supportive Culture
1. Being team oriented
2. Sharing information freely
3. Being people oriented
4. Collaboration

Performance Orientation
5. Having high expectations for performance
6. Enthusiasm for the job
7. Being results oriented
8. Being highly organized

Emphasis on Rewards
9. Fairness
10. Opportunities for professional growth
11. High pay for good performance
12. Praise for good performance

Competitive Culture
13. Achievement orientation
14. An emphasis on quality
15. Being distinctive – being different from others
16. Being competitiveness

Innovative Culture
17. Being innovative
18. Quick to take advantage of opportunities
19. Risk taking
20. Taking individual responsibility

(20 items selected out of total 54 items)

Chinese Value Survey (CVS)
(Bond et al., 1987)

Integration Factors

1. 隨和 Harmony with others
2. 團結 Solidarity with others
3. 不重競爭 Non-competitiveness
4. 信用 Trustworthiness
5. 保守 Being conservative
6. 貞潔 Chastity in women

Confucian Work Dynamics

7. 儉 Thrift
8. 耐力（毅力） Persistence
9. 禮尚往來 Reciprocation of greetings, favors, and gifts
10. 穩重 Personal steadiness and stability
11. 要面子 Protecting your "face"
12. 尊敬傳統 Respect for tradition

Personal Factors

13. 勤勞 Industry (Working hard)
14. 謙虛 Humbleness
15. 忠於上司 Loyalty to superiors
16. 學識（教育）Knowledge (Education)
17. 廉潔 Resistance to corruption
18. 文化優越感 A sense of cultural superiority

(18 items selected out of total 40 items; cf. Fields, 2002)