

AN EMPIRICAL RELATIONSHIP BETWEEN SIX SIGMA AND CHANGE MANAGEMENT WITH REFERENCE TO SOFTWARE COMPANIES.

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Abstract

Six sigma is a disciplined, reduces defects, improves customer satisfaction and yields higher net income in an organisation. The study focuses on six sigma implementation and change management in software companies. The various phases of implementation of six sigma define phase, measure phase, analysis phase, improve phase and control phase are studied against the independent variables of change management. It was concluded that control phase has high influence on change management of the organisation.

1. SIX SIGMA

According to Lin et al. (2009) Six Sigma was initiated by Motorola in the 1980s. Hayler and Nichols (2006) defined Six Sigma as “use of facts and data to reduce process variations, thereby enabling organizations to deliver consistent, high quality services to customers.” The two key methodologies used in Six Sigma are DMAIC and DMADV. DMAIC stands for define, measure, analyse, improve, and control. In the define phase organizations define the problems, key process characteristics are identified, studied and benchmarked in the measure and analyse phases. In the improve phase solutions are created and implemented for a better or optimized performance.

The control phase then ensures that the problem does not appear again. In software companies mostly, DMAIC is used because software usually adopts Six Sigma to improve processes rarely to create new ones. Harry and Schroeder (1999) defined Six Sigma as ‘a disciplined method of using extremely rigorous data gathering and statistical analysis to pinpoint sources of errors and ways of eliminating them’. However, according to Antony and Banuelas (2002) Six Sigma employ statistical and non-statistical tools and techniques to minimize process variation and enhance process performance and competence. Linderman et al. (2003) also considers the importance of statistical as well as non-statistical tools and defined Six Sigma as: ‘Six Sigma is an organized and systematic method for strategic process improvement and new product and service development that relies on statistical methods and the scientific method to make dramatic reductions in customer defined defect rates’.

However, as (Antony and Banuelas, 2001) described in business world the term Six Sigma is defined differently, “Six Sigma is business strategy used to improve business profitability, to improve the effectiveness and efficiency of all operations to meet customers’ needs and expectations.” In views of Hahn et al. (2000) Six Sigma is a product and process quality enhancement approach based on statistical tools and discipline. Other researchers take Six Sigma as a management strategy requiring cultural changes (Sanders and Hild, 2000). Schroeder et al. (2008), after a detail study of literature and consulting many practitioners defined Six Sigma as “Six Sigma is an organized, parallel-meso structure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives.”

Many studies have discussed the meanings, concepts and value of Six Sigma in today’s competitive business environment (Brady & Allen, 2006; Folaron, 2003. As (Goh, 2002) identified that in comparison with other quality assurance strategies like of ISO or QS, Six Sigma is a lot more receptive to client satisfaction.

2. FEATURES OF SIX SIGMA

A clear focus on achieving measurable and quantifiable financial returns from any six sigma project. An increased emphasis on strong and passionate management leadership and support. A special infrastructure of “**champions**,” **master belt**”, **black belts**, **green belts** etc. to lead and implement the six sigma approach. A clear commitment to making decision on the basis of verifiable data rather than assumption or guesswork.

3. METHODS

Six sigma generally follow two project methodologies by DEMING’S PLAN DO-CHECK-ACT CYCLE. It has five phases each breathe acronyms

4. DMAIC- is used for project aimed at improving an existing project.

DMADV is used for projects aimed at creating new product or process designs

4.1DMAIC

The DMAIC project methodology has five phases:

- **DEFINE** the problem, the voice of the customer, and the project goals, specifically.
- **MEASURE** key aspects of the current process and collect relevant data.
- **ANALYZE** the data to investigate and verify cause-and-effect relationships. Determine what the relationships are, and attempt to ensure that all factors have been considered. Seek out root cause of the defect under investigation.
- **IMPROVE** or optimize the current process based upon data analysis using techniques such as design of experiments, poka yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to establish process capability.
- **CONTROL** the future state process to ensure that any deviations from target are corrected before they result in defects. Implement control systems such as statistical process control, production boards, visual workplaces, and continuously monitor the process.

4.2DMADV

The DMADV project methodology, also known as DFSS ("Design For Six Sigma"),[14] features five phases:

- **DEFINE** design goals that are consistent with customer demands and the enterprise strategy.
- **MEASURE** and identify CTQs (characteristics that are Critical To Quality), product capabilities, production process capability, and risks.
- **ANALYZE** to develop and design alternatives, create a high-level design and evaluate design capability to select the best design.
- **DESIGN** details, optimize the design, and plan for design verification. This phase may require simulations.
- **VERIFY** the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

5. CHANGE MANAGEMENT

Change management is a systematic approach to dealing with change, both from the perspective of an organization and on the individual level.

A somewhat ambiguous term, change management has at least three different aspects, including: adapting to change, controlling change, and effecting change. A proactive approach to dealing with change is at the core of all three aspects. For an organization, change management means defining and implementing procedures and/or technologies to deal with changes in the business environment and to profit from changing opportunities.

6. CHANGE MANAGEMENT IN SOFTWARE

In an information technology (IT) system environment, change management refers to a systematic approach to keeping track of the details of the system (for example, what operating system release is running on each computer and which fixes have been applied).

Successful adaptation to change is as crucial within an organization as it is in the natural world. Just like plants and animals, organizations and the individuals in them inevitably encounter changing conditions that they are powerless to control. Adaptation might involve establishing a structured methodology for responding to change requests in the business environment or establishing coping mechanisms for responding to changes in the workplace (such as new policies, or technologies).

Change management is an important part of project management. The project manager must examine the proposed change and determine the effect the change will have on the project as a whole before allowing the change request to be implemented.

7. SIX SIGMA AND CHANGE MANAGEMENT

Implementing six sigma in software companies is a strategic process which requires management support and ability to manage people in the organization.

One common thread with nearly all change initiatives is resistance to change. The Six Sigma tools and processes, including DMAIC and DFSS, can provide direction for the change, but alone they cannot ensure that you will succeed. Role of change agents play a vital role in implementing six sigma and overcoming resistance. Here the change agents are champions, black belt professionals. The change agents must be efficient in bringing the change.

They must

1. Build awareness and desire for change management competency within the team of Six Sigma Professionals
2. Develop the knowledge of change leadership and change management.
3. Must be proficient at the practical application of tools and processes for managing change.
4. Reinforce change management competency with the team

8. REVIEW OF LITERATURE

1. **Mohamed Gamal Aboelmaged (2010):** Six Sigma quality: a structured review and implications for future research. The major findings are Six Sigma research is growing rapidly, covering various disciplines and domains with a great focus on Six Sigma tools and techniques.
2. **Dr. Rick L. Edgeman, Dr. David Bigio, Thomas Ferleman (2005):** Six Sigma and Business Excellence: Strategic and Tactical Examination of IT Service Level Management. The comprehensive study aims at six sigma and business excellence. The main goal if six sigma is the goal is to advance a public or private sector entity on the path to excellence.
3. **Huey-Der Chu (2014):** International Journal of Information Technology and Business Management: JITBM & ARF. 2006 This paper presents a framework that integrates Six Sigma Concept to improve the IS service process
4. **Michael Holm Larsen, Mogens Kuhn Pedersen, Kim Viborg Andersen (2006):** IT Governance: Reviewing 17 IT Governance Tools and Analysing the Case of Novozymes A/S. The paper analyses the challenges of the adopted IT Governance arrangements and mechanisms. Finally, the paper point to future development directions in order to further unfold the potential of IT Governance at Novozymes A/S.
5. **Weiyong Zhang, Xiaobo Xu (2008):** Six Sigma and Information Systems Project Management the study states that Previous information systems (IS) research has significantly improved the success rate of IS projects, but the result is still far from satisfying. The effort to advance IS project management theories continue.
6. **Mark E. Johnson, Michele Boulanger (2012).** This is the fourth article in a series reviewing statistical standards published under the auspices of the International Organization for Standardization Technical Committee 69 on Applications of Statistical Methods.
7. **Rune Todnem:** Organisational Change Management: A Critical Review: Journal of Change Management. The purpose of this article is, therefore, to provide a critical review of some of the main theories and approaches to organisational change the article concludes with recommendations for further research.
8. **Dirk Stelzer, Werner Mellis:** Success Factors of Organizational Change in Software Process Improvement: Software Process Improvement and Practice. This paper assesses the relative importance of these factors and compares the findings with the results of previous research into organizational change in software process improvement.
9. **Rafa E. Al-Qutaish And Khalid T. Al-Sarayreh(2008):** Applying Six-Sigma Concepts to the Software Engineering: Myths and Facts: Parallel And Distributed System. Applying Six-Sigma Concepts to the Software Engineering: Myths and Facts. This study intends to tell about the myths and facts of applying six sigma in software engineering.
10. **Suzanne de Treville & Norman M. Edelson & Anilkumar N. Kharkar & Benjamin Avanzi (2012):** Constructing useful theory: The case of Six Sigma. The study we evaluate Six Sigma through the lens of literature on theory development to explain why the Six Sigma constructs, assumptions, and causal relationships are inconsistent with theory development principles.

9. OBJECTIVES

1. To identify six sigma practice in software companies.
2. To analyses change management factor in software companies.
3. To find the influence of six sigma implementation on change management factor.

10. HYPOTHESIS

1. The factor of change management does not differ significantly.
2. There is no relationship between occupational details of employees and their change management perception.

11. RESEARCH METHODS

This study is based on primary data and secondary data. Primary data was collected from 100 IT professionals. Questionnaire was designed to collect data on relationship between six sigma implementation and change management in software companies. Variables in the questionnaire were selected based on the previous studies. The questionnaire was randomly distributed to software professionals working in IT organization. A total of 100 employees in IT sector responded to the survey.

A quantitative research design was employed beginning with the literature review to guide the design of the interview questionnaires. The study focused on IT professionals who were trained in six sigma. Questionnaire contained five main parts such as personal data, reward system, external resisting factors, and internal resisting factors, factors overcoming resistance and having a total of 11 items. Items were measured using Likert scale. After obtaining the responses from software employees the primary data are systematically transformed in to quantified data. The application of both univariate and multivariate statistical technique analyses the primary data. The parametric T-test and a linear multiple regression analyses are subsequently used to verify the object and test the hypothesis.

12. ANALYSIS AND DISCUSSION

Six sigma and its respective implementation through the different phases like define phase, measure phase, analysis phase, improve phase and control phase are considered as independent variable. Whereas the change management variables reward, financial performance, organizational resistance, global bench marking and opinion of employees are considered as dependent variables. In this situation the researcher exploited linear multiple regression analysis and following results are obtained.

The application of linear multiple regression analysis (CM1)

- 1) Influence of six sigma implementation on rewards
- 2) The application of regression analysis between six sigma implementation and change management brought the following results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Standardized Coefficients	t	Sig.
1	.850(a)	0.723	0.72	0.59132					
Regression					214.205	.000(a)			
(Constant)								-2.112	0.035
DP1							0.078	1.877	0.061
MP1							0.355	7.821	0.000
AP1							-0.300	-6.219	0.000
IP1							0.237	7.096	0.000
CP1							0.571	11.278	0.000

From the above table it is found that $R=.850$, $R^2=.723$, Adjusted $R = .720$ and standard error estimated as $=.591$. This leads to verification of regression fit with explanatory power (R^2) 72.3 per cent. The F value is 214.205 is statistically significant at 5 per cent level and all the implementation factors DP (Beta =.078, T=1.87, P=.061), MP (Beta=.355, T=7.82, p=.000), AP (Beta=-.300, T=-6.219, p=.000) IP (Beta=.237, T=7.096, p=.000) CP (Beta=.571, T=11.27, P=.000) are statistically significant at 5 per cent level, therefore it can be concluded that six sigma implementation is statistically significant in creating influence on rewards.

The application of linear multiple regression analysis (CM2)

1. Influence of six sigma implementation on financial performance.
2. The application of regression analysis between six sigma implementation and change management brought the following results.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Standardized Coefficients	t	Sig.
1	.863(a)	0.745	0.741	0.43511					
Regression					238.992	.000(a)			
(Constant)								2.269	0.024
DP1							0.222	5.602	0.000
MP1							0.063	1.454	0.147
AP1							0.041	0.890	0.374
IP1							-0.027	-0.829	0.408
CP1							0.617	12.692	0.000

From the above table it is found that $R=.863$, $R^2=.745$, Adjusted $R = .741$ and standard error estimated as $=.435$. This leads to verification of regression fit with explanatory power (R^2)74.5 per cent. The F value is 238.992 is statistically significant at 5 per cent level and all the implementation factors DP(Beta=.222,T=5.602,P=.000), MP(Beta=.063,T=1.454,p=.147), AP(Beta=.041,T=.890,p=.374) IP(Beta=-.027,T=-.829,p=.408) CP(Beta=.617,T=12.692,P=.000)are statistically significant at 5 per cent level, therefore it can be concluded that six sigma implementation is statistically significant in creating influence on financial performance.

The application of linear multiple regression analysis (CM3)

1. Influence of six sigma implementation on organizational resistance.
2. The application of regression analysis between six sigma implementation and change management brought the following results.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Standardized Coefficients	t	Sig.
1	.627(a)	0.393	0.386	0.56825					
Regression					53.117	.000(a)			
(Constant)								11.146	0.000
DP1							0.150	2.449	0.015
MP1							0.065	0.964	0.336
AP1							-0.308	-4.311	0.000
IP1							0.071	1.432	0.153
CP1							0.656	8.749	0.000

From the above table it is found that $R=.627$, $R^2=.393$, Adjusted $R = .386$ and standard error estimated as $=.568$. This leads to verification of regression fit with explanatory power (R^2)39.3 per cent. The F value is 53.117 is statistically significant at 5 per cent level and all the implementation factors DP(Beta =.150,T= 2.449 ,P=.015), MP(Beta=.065,T=.964,p=.336), AP(Beta=-.308,T=-4.311,p=.000) IP(Beta=.071,T=1.432,p=.153) CP(Beta=.656,T=8.749,P=.000) are statistically significant at 5 per cent level, therefore it can be concluded that six sigma implementation is statistically significant in creating influence on organizational resistance.

The application of linear multiple regression analysis (CM4)

1. Influence of six sigma implementation on global bench marking.
2. The application of regression analysis between six sigma implementation and change management brought the following results.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Standardized Coefficients	t	Sig.
1	.800(a)	0.639	0.635	0.40712					
Regression					145.303	.000(a)			
(Constant)								7.049	0.000
DP1							0.311	6.588	0.000
MP1							0.004	0.086	0.932
AP1							-0.020	-0.372	0.710
IP1							0.167	4.375	0.000
CP1							0.459	7.942	0.000

From the above table it is found that $R=.800$, $R^2=.639$, Adjusted $R = .635$ and standard error estimated as $=.407$. This leads to verification of regression fit with explanatory power (R^2)63.9 per cent. The F value is 145.303 is statistically significant at 5 per cent level and all the implementation factors DP(Beta =.311,T= 6.588 ,P=.000), MP(Beta=.004,T=.086,p=.932), AP(Beta=-.020,T=-.372,p=.710) IP(Beta=.167,T=4.375,p=.000) CP(Beta=.459,T=7.942,P=.000) are statistically significant

at 5 per cent level, therefore it can be concluded that six sigma implementation is statistically significant in creating influence on global bench marking.

The application of linear multiple regression analysis (CM5)

1. Influence of six sigma implementation on opinion of employees.
2. The application of regression analysis between six sigma implementation and change management brought the following results.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	F	Sig.	Standardized Coefficients Beta	t	Sig.
1	.830(a)	0.688	0.684	0.47194					
Regression					181.001	.000(a)			
(Constant)								2.281	0.023
DP1							0.152	3.458	0.001
MP1							0.131	2.720	0.007
AP1							0.120	2.346	0.019
IP1							-0.050	-1.419	0.157
CP1							0.530	9.869	0.000

From the above table it is found that $R=.830$, $R^2=.688$, Adjusted $R = .684$ and standard error estimated as $=.471$. This leads to verification of regression fit with explanatory power (R^2)68.8 per cent. The F value is 181.00 is statistically significant at 5 per cent level and all the implementation factors DP(Beta=.152,T=3.458,P=.001), MP(Beta=.131,T=2.720,p=.007), AP(Beta=.120,T=2.346,p=.019) IP(Beta=-.050,T=-1.419,p=.157) CP(Beta=.530,T=9.86,P=.000) are statistically significant at 5 per cent level, therefore it can be concluded that six sigma implementation is statistically significant in creating influence on opinion of employees.

13. FINDINGS AND CONCLUSIONS

The empirical analysis revealed that six sigma implementation has significant influence on various factors of change management such as rewards, financial performance, organizational resistance, global benchmarking and opinion of employees.

Six sigma implementation entirely changes the management policies conducive to the optimistic work environment and increasing organizational productivity. The perfect quality maintenance and reduction of human error to meet out the global benchmark of competition are the main outcome of infusing six sigma with change management.

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