International Journal of Research in Entrepreneurship & Business Studies
eISSN-2708-8006, Vol. 2, issue. 4, 2021, pp. 1-12
https://doi.org/10.47259/ijrebs.241

Factorial Analysis of the Critical Success Factors of Continuous Improvement (CI) Techniques in the Companies from Sohar Industrial Estate, Oman

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Citation: Al-Qayoudhi, S.A., Pria, S. & Prasad, V.V. (2021). Factorial Analysis of the Critical Success Factors of Continous Improvement (CI) Techniques in the Companies from Sohar Industrial Estate, Oman. *International Journal of Research in Entrepreneurship & Business Studies*, 2(4), 1- 46.
https://doi.org/10.47259/ijrebs.241

Received on 24th Aug. 2021
Revised on 15th Sep. 2021
Published on 4th Oct. 2021

Abstract

Purpose: The research objectives were to analyze the role of continuous improvement (CI) techniques in manufacturing in Oman in the CI process and to investigate the crucial factors of CI and the application techniques of CI that have been implemented by the manufacturing companies during the CI process.

Design/methodology/approach: A survey questionnaire was developed with the baseline of CI practices used by manufacturing companies in Oman and a convenient sampling method was used to collect the data. 146 filled-in questionnaires were collected from 75 manufacturing units out of the entire Public Establishment database. The data was tabulated, compiled. The robustness was tested along with the ranking tests and the factor analysis using SPSS and AMOS.

Findings: The results reveal that the Omani manufacturing companies using structured CI programs had lesser product recalls, leading to increased overall sales, decrease in processing time. Further, it is also revealed that the CI culture and Employee Performance Measurement and Review are instrumental in translating into company savings.

Research limitations/implications: This research was limited to the Sohar Industrial estate only. As there are nine industrial estates in Oman, the research can be undertaken to study the CI practices adoption in all the other industrial estates as well.

Social Implications: Countries from all over the world are facing numerous challenges due to COVID-19. The paper will help the manufacturing companies in decision making towards the process improvement.

Originality / Value: There were not many studies on continuous improvement practices within the Omani manufacturing industry and this paper examines the status of CI implementation in manufacturing companies in Oman.

Keywords: Continuous Improvement Practices, Manufacturing Industry, Critical Success Factors, Company Success Factors, Sultanate of Oman.

Introduction

A budget is a planning tool used for allocating resources of an organization to several different functions (Abdallah, 2018). A budget is a method for controlling the financial performances and ensuring the achievement of the administrative and financial goals of the company (Etale and Idumesaro, 2019). One of the most important techniques used for planning and controlling jobs within an organization is budgeting and budgetary control.

CI can be defined as a culture meant for sustained improvement aiming at removing the wastage in the entire organizational setup and the processes. It is also defined as a group of systematic processes – well organized but with constant changes, involving all the concerned within the organization towards productivity, quality, with effectiveness (Jurburg et al., 2017).

Organizations need CI, the advancement of CI technologies and the introduction of CI in the organizations has led to improvement in quality, production, and reduction in wastage. A few of such most popular CI technologies are Balanced Scorecard, Lean Manufacturing, Lean Six Sigma/Six Sigma (Haddas et al., 2014). The popularity of CI tools in general and Kaizen in particular also has been caused by increasing the effective usage of such applications and the related tools (Glover et al., 2014). The organizations can remain competitive in a market by implementing CI to fulfill the customer demands in effective ways using the applied leading to improved organizational performance (Aleu & Van Aken, 2016; Galli, 2018).

The global market environment has intensified the competitiveness of supply and uncertainty in consumer demand. Global competitiveness has forced all businesses simply its processes to gain more profits through adopting the latest technologies. These changes have made permanent traces in the manufacturing industry. To face the demands faced by today's global market, manufacturing companies must strengthen production and relationships with vendors, as well as implement performance enhancement programs in all facets of their operations (Singh and Singh, 2017). Further, to stay competitive in this ever-changing world, businesses must figure out innovative solutions that enable them to be both competitive and flexible at the same time, helping them to adapt quickly to new demands. Total quality management (TQM) is an approach that aims at achieving customer satisfaction, and the organizational culture (Bakator et al., 2018). TQM is considered the most important tool used to accomplish efficiency and quality is the power required to attain the efficiency for CI (Al-Qayoudhi et al., 2017).

Organizations must determine the extent of activities that are critical to them. They must concentrate on the most critical factors rather than mismanaging resources on less important or non-essential factors. As a result, an effort has been made to evaluate the success factors of continuous improvement and determine the direct and indirect interaction between these factors. The manufacturing sector of Oman can have a steady growth depending on the improvement of the competitive status of the net exports. This is indeed an active process. In Oman, the implementation of such trade policies is done by the Oman Ministry of Commerce and Industry.

Oman's economy is experiencing a tough time as the oil prices drop on one hand whereas the COVID-19 pandemic on the other. The inflation rate and prices movement were reported to be very high during March 2021, i.e. 3.4 percent (compared to 1 percent reported in 2020). In this situation, it is becoming obligatory for such companies involved in production to minimize the cost of production whereas augmenting productivity. During 2018, the performance indicators readiness for future production, drivers of production ranked 45 out of 100 in 2018, while the target for 2030 to be set up for 2030, in the top twenty countries (Oman Observer, 2020; World Economic Forum, 2018).

Statement of Research Problem

There is no detailed study carried out on the continuous improvement practices prevailing in the manufacturing industry of Oman. This paper throws light on the status of the CI implementation in manufacturing companies of Oman. This paper also analyses the details such as the introduction of CI, the tools and the Critical Success Factors (CSF) adopted, to what extent CI practices were implemented, and the benefits reaped through such introduction, etc. Thus, the prime objective of the study was to 'investigate the best applications/techniques of continuous improvements among manufacturing companies in Oman'.

Research Questions

The study focuses on the following questions:

1. How do the CI techniques adopted in manufacturing companies in Oman help in the continuous improvement process?
2. What are the best crucial factors of CI and the application techniques of CI that have been implemented by the manufacturing companies during the CI process?

Research Objectives

In line with the above research questions, the following research objectives were defined:

1. To analyze the role of CI techniques in manufacturing in Oman in the CI process.

2. To investigate the crucial factors of CI and the application techniques of CI that have been implemented by the manufacturing companies during the CI process.

Literature Review and Hypothesis Formulation

Continuous Improvement (CI) is powerful to boost efficiency, and qualitative performance and Maletič et al. (2012) confirmed the impact of CI on maintenance performance.

During the past two decades, manufacturing businesses have been rapidly changing and operating in a highly competitive market, giving importance to lean thinking. Lean thinking leads the way to define the value of the actions in the best way, applying these activities continues to be effective. Lean thinking shows the way to achieve greater efficiency in less time with less equipment, less manpower, and respond to customer requests more (Womack and Jones, 2017). Lean production is defined as the systems that provide enterprises with a competitive advantage and aim to achieve efficient production by reducing unnecessary resources usage (Adalı & Isik, 2017).

The lean manufacturing process is a major initiative to eliminate wastages from manufacturing operations but it is not easier to introduce in the manufacturing sector as several stakeholders with conflicting interests are involved (Salonitis & Tsinopoulos, 2016). Lean manufacturing is a continuous process that influences both the process and people but the main challenge is in the implementation as utmost guidance is required during the change journey process. successful lean transformation depends on the guidance of the top management and the leadership, and other factors called critical success factors (Alefari, et al., 2017). The lean approach not only involves a change of process but also the creation of a new culture consisting of management strategies applicable to the entire organization (Improta et al., 2018).

Visual Management (VM)

Visual Management (VM) is apprehensive of the practices to draw information about the production part of the companies as it has become an essential component of the lean management practice for CI and is gaining attention from the stakeholders (Jaca et al., 2014). According to Kurpjuweit, et al. (2019) VM works only when all the managerial hierarchy gets involved and the top management implements VM, failing which there will be a break in implementation.

Employee Engagement (EE)

Employee Engagement (EE) is a crucial factor in the successful implementation of any new dynamic changes in an organization's performance (Weerasooriyan, et al., 2017). Employee engagement refers to the commitment and drives to go beyond the call of duty towards the organization's goals, whereas employee satisfaction refers to contentment (Madan & Srivastava, 2015). In other words, Employee engagement is an employee's willingness and ability to contribute to company success by freely giving the extra effort on an ongoing basis. It represents the extent to which employees put discretionary effort into their work (Ghuman, 2016).

Leadership (Lea)

Leadership acts as the foundation based on which the employee engagement employees in CI initiatives purely lies. It is one of the critical factors which links the management and the employees towards the introduction of the lean process (Dombrowski & Mielke, 2013). Senior management commitment is a vital factor, in defining a clear vision towards acquiring sufficient finance, and strategic leadership. Although the transformation of the lean process is required at the production unit, senior management takes the lead of such transformation as the management commitment and support impact such initiatives (Alefari, et al., 2017).

Risk Management (RM)

The Centre of any organization's strategic management is risk management. RM is the process through which organizations systematically identify risks associated with their activities to achieve the goal of achieving ongoing benefits in each activity and the light of all activities (Karami et al., 2020). Risk Management (RM) plays a vital role in eliminating the negative impact if any, within the organization as there are various type of risks emerges (Fadzil et al., 2017). RM is a structured strategy used by industries to minimize the probability of unexpected major risks from reducing profits as it entails optimizing the likelihood and implications of good outcomes thus mitigating consequences of negative events to project goals (Ferede et al., 2021). Risk Management can be achieved effectively, only if the risks are identified well and classified correctly (Ahmed, 2018).

International Journal of Research in Entrepreneurship & Business Studies
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Hypotheses

After going through the review of literature, the following hypothesis was derived:

1. (a) Implementation of Visual Management (VM) practices have a significant influence on the company's savings.
   (b) Implementation of Employee Engagement (EE) practices has a significant influence on the company's savings.
   (c) Implementation of will has Leadership (Lea) practices have a significant positive influence on the company's savings.
   (d) Implementation of Risk Management practices has a significant positive influence on the company's savings.

Research Model

From the above discussion, the proposed research model was derived as shown in Figure 1 and used in the study. The model proposed by Al-Qayoudhi et al. (2021) for the continuous improvement practices was used which include visual management, employee engagement, risk management, and leadership practices, to predict the company's savings. Hence, the model uses the company's savings as the final dependent variable. Also, the constructs and the related are shown in Table 1.

Table 1 Constructs

#	Variables	References
1	Visual Management (VM)	Jaca et al. (2014), Kurpjuweit, et al. (2019)
2	Employee Engagement (EE)	Weerasooriyan, et al. (2017), Madan & Srivastava, (2015), Ghuman, (2016)
3	Leadership (Lea)	Dombrowski & Mielke, (2013); Alefari, et al.,2017
4	Risk Management (RM)	Fadzil et al., (2017), Ferede et al. (2021), Ahmed, (2018), Karami et al. (2020)

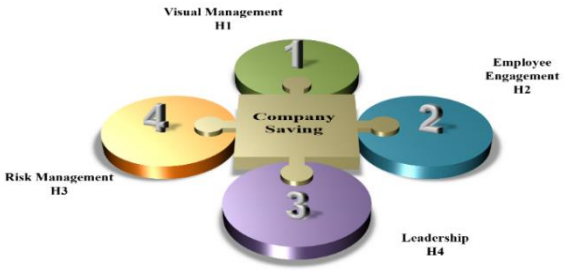

Figure 1 The Research Model Diagram

Research methodology

The above-mentioned instruments were adopted contextualizing to Omani manufacturing industries and were used in this study. The survey questionnaire was developed with the baseline of CI practices used by manufacturing companies in Oman. Other than the demographic information and company success factors, the questionnaire had statements related to the experience of CI tools and techniques by the manufacturing companies. Twenty Critical Success Factors (CSFs) identified through the review literature were used to obtain the responses. They were as follows:

1. Management support lead to CI
2. Detect the deviations from the standards
3. Distribution of responsibilities
4. Best solution
5. Flow of information
6. Top management supports employees
7. Professional training
8. Spirit and cooperation
9. Meaningful work
10. Creativity

11. Kaizen team leader
12. The change journey
13. Value to the customers
14. Effective communication
15. Gemba commitment
16. Effective RM team
17. Reliability and profitability
18. Treat the risk efficiently
19. Value-added activities
20. Roles and responsibilities towards risk

A convenient sampling method was used in the study to collect the data. 146 completely filled-in questionnaires were collected from 75 manufacturing units out of the entire Public Establishment database. The data was tabulated, compiled. The robustness was tested along with the ranking tests and the factor analysis using SPSS and AMOS. Bartlett's test of sphericity and Kaiser-Meyer-Olkin test were also undertaken to carry out factor analysis.

From the test of reliability, the Cronbach alpha score was observed to be 0.81 which shows the data qualifies (Nunnally, 1960).

Findings

Table 2 Demographic Profile

	Category	Freq.	Percentage
Sex	Men	83	56.8
	Women	63	43.2
Age	18 – 25 years	13	8.9
	> 25 – 35 years	88	60.3
	> 36 – 45 years	40	27.4
	> 46 – 55 years	4	2.7
	> Over 55 years	1	0.7
Official Position	Top Management	21	14.4
	Managerial	16	11.0
	Supervisory	39	26.7
	Technical	70	47.9
In the present cadre for	0 – 5 years	75	51.4
	Over 5 – 10 years	45	30.8
	Over 10 - 15 years	15	10.3
	Over 15 – 20 years	9	6.2
	Over 20 – 25 years	2	1.4
Department	Commercial	23	15.8
	Quality Control	12	8.2
	Production (mfg.)	26	17.8
	Logistics	7	4.8
	Finance and Accounts	14	9.6
	Marketing	6	4.1
	Sales	4	2.7
	Regulatory Control	1	0.7
	Others/ Misc.	53	36.3
Total number of employees	0-100	39	26.7
	101-300	25	17.1
	301-500	18	12.3
	501-1000	29	19.9
	> 1000	35	24.0

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Table 3 CI Practices and Critical Success Factors

Critical Success Factors used by the companies	VM only	6	4.1
	EE only	6	4.1
	RM only	28	19.2
	Lea only	19	13.0
	EE & Lea	14	9.6
	VM, RM & Lea	6	4.1
	VM, EE, RM & Lea	67	45.9
Duration of the use of CI tools and techniques	0 – 5 years	60	41.1
	Over 5 – 10 years	45	30.8
	Over 10 – 15 years	26	17.8
	Over 15 – 20 years	7	4.8
	Over 20 – 25 years	1	0.7
	Over 25 years	1	0.7
	Never used CIs	6	4.1
CIs initiative	Site related	50	34.2
	Corporate related	82	56.2
	No specific initiative	14	9.6
Average Sales	Hiked	98	67.1
	Remains same	37	25.4
	Dropped	11	7.5
Average Cycle time	Minimized	85	58.2
	Increased	27	18.5
	No change	34	23.3
Products Recalled	Some of them recalled	67	45.9
	None	48	32.9
	N.A.	31	21.2
Type of Products	Metals/Ore	11	7.7
	Construction Materials	13	9.0
	Tiles & Marbles	2	1.4
	Chemical compounds	6	4.2
	Electricals	4	2.8
	Oil & Gas	38	26.6
	Food & Beverages	3	2.1
	Stationery related	1	0.7
	Plastics	1	0.7
	Glasses	2	1.4
	Others	65	43.4

It can be seen from Table 2 that the samples cover all kinds of demographics whereas CI practices and CSF details were shown in Table 3. It is also noted that some of the questions had multiple responses.

From Table 3, the following observations were made:

67.1% of respondents reported that the sales got improved whereas 25.4% claimed that their sales figures remain the same. 7.5% of respondents found to report that their sales got dropped during the reported period.

58.2% of respondents reported that the cycle time got minimized and 18.5% reported it got increased while 23.3% said that there is no change in average cycle time.

45.9% respondents reported of recalling a few of their products while 32.9% of respondents reported that none of their products were recalled and 21.2% kept silent.

International Journal of Research in Entrepreneurship & Business Studies
eISSN-2708-8006, Vol. 2, issue. 4, 2021, pp. 1-12
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Factor analysis and regression analysis were used to predict company savings from CI practices. 35.6% of respondents reported that their company bagged more than 10,000 Rials annual savings through continuous improvement. 32.4% reported that their company got less than 10,000 rials savings. 21.9% reported savings of more than 10,000 Rials and less than 25,000 Rials whereas 11% reported savings of more than 50,000 Rials.

Table 3 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.942
Bartlett's Test of Sphericity	Approx. Chi-Square	2879.390
		190
	Sig.	.000

The p-value is less than 0.05. So the null hypothesis gets rejected. Hence the factor analysis is valid. Further, the KMO coefficient (0.942) is more than 0.5, which shows that variables are exactly suitable for Factor analysis.

Principal Component Analysis - Stage I

Though 20 variables could be extracted, only those factors were extracted whose eigenvalue was more than 1.

Table 4 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	Var %	Cum %	Total	Var %	Cum %	Total	Var %	Cum %
1	12.798	63.991	63.991	12.798	63.991	63.991	8.110	40.550	40.550
2	1.316	6.580	70.571	1.316	6.580	70.571	6.004	30.021	**70.571**
3	.943	4.713	75.284						
4	.680	3.400	78.685						
5	.519	2.593	81.278						
6	.482	2.410	83.688						
7	.449	2.244	85.932						
8	.401	2.005	87.937						
9	.338	1.691	89.628						
10	.321	1.607	91.235						
11	.257	1.283	92.518						
12	.243	1.217	93.735						
13	.219	1.093	94.828						
14	.209	1.045	95.874						
15	.188	.939	96.812						
16	.163	.816	97.628						
17	.151	.755	98.383						
18	.130	.651	99.034						
19	.118	.591	99.625						
20	.075	.375	100.000						

Extraction Method: Principal Component Analysis

The variables with an eigenvalue greater than one were retained as 40.55 % of the variance was explained by factor 1 and 30.02 % of the variance was explained by factor 2 and the two factors together show a cumulative variance explanation of 70.57 %.

Stage II

In stage II varimax rotation method was used. The factor matrix gives the loading of each variable to each factor. Table 5 shows the rotated factor loadings of the factors. All the 20 CSFs have been reduced to two factors, viz. F1 and F2. These two factors were:

F1 – Continuous Improvement Culture

F2 – Performance measurement and review

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Table 5 Rotated Component Matrix

Variables	Component	
	1	2
Management support lead to CI	0.755	
Professional training	0.583	
Spirit and cooperation	0.784	
Meaningful work	0.786	
Creativity	0.821	
Leadership practices	0.740	
Kaizen team leader	0.808	
Change journey	0.784	
Value to customers	0.791	
Effective communication	0.821	
Gemba commitment	0.615	
Reliability and profitability	0.646	
Management support		0.859
Deviation from standards		0.759
Flow of information		0.721
Employees responsibilities		0.812
Best Solution		0.726
Value-added activities		0.622
Effective RM team		0.661

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization
[a]Rotation converged in 3 iterations

Table 6 Continuous Improvement Culture (F1)

#	Variables	Factor loading	Eigen value	Percentage Variance
1	Management support lead to CI	0.755	**8.110**	**40.550**
2	Professional training	0.583		
3	Spirit and cooperation	0.784		
4	Meaningful work	0.786		
5	Creativity	0.821		
6	Leadership practices	0.740		
7	Kaizen team leader	0.808		
8	Change journey	0.784		
9	Value to customers	0.791		
10	Effective communication	0.821		
11	Gemba commitment	0.615		
12	Reliability and profitability	0.646		

Table 7 Performance Measurement and Review (F2)

Sno	Variables	Factor loading	Eigenvalue	Variance %
1	Management support	0.859	**6.004**	**70.571**
2	Deviation from standards	0.759		
3	Flow of information	0.721		
4	Employees responsibilities	0.812		
5	Best Solution	0.726		
6	Value-added activities	0.622		
7	Effective RM team	0.661		

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Regression score derived from factor analysis

After the factor analysis, a model to predict the company savings from continuous improvement practices was derived by using regression analysis as shown in Table 8. The obtained factor scores for the above two composite factors were used in the following multivariate analysis of multiple regression.

Model Fit

Table 8 Regression Analysis

Model Summary

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate
1	.899[a]	.808	.805	.56658

[a] Predictors: (Constant), Performance Measurement Review, Continuous Improvement Culture.

The overall variance was explained by 80.9% i.e., the correlation between the independent and dependent variables seemed to be high.

ANOVA

Model	Sum of squares	df	Mean square	F	Sig.
Regression	193.081	2	96.541	300.751	.000[b]
Residual	45.905	143	0.321		
Total	238.986	145			

[a] Dependent Variable: Company Savings

[b]Predictors: (Constant), Performance Measurement Review, Continuous Improvement Culture

From the ANOVA table, it was checked that the p-value < .05, which indicated that the model was acceptable.

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	2.781	.047		59.304	.000
Continous Improvement Culture	1.054	.047	.821	22.391	.000
Performance Measurement Review	.471	.047	.367	10.006	.000

[a]Dependent Variable: company savings

'Continuous improvement culture' (F1, β=0.821, p=0.000) and 'Performance Measurement and Review' (F2 β=0.367, p=0.000), were significant at the 0.05 level and positively related to Company Savings. Based on the unstandardized B value, the obtained regression equation was given as:

Company Savings = 2.781 + 1.054 * Continuous improvement culture + 0.471 * Performance measurement and review

Continuous Improvement Culture holds the highest standardized coefficients (8.21), which means this Continuous Improvement Culture is the most important factor associated with Company Savings.

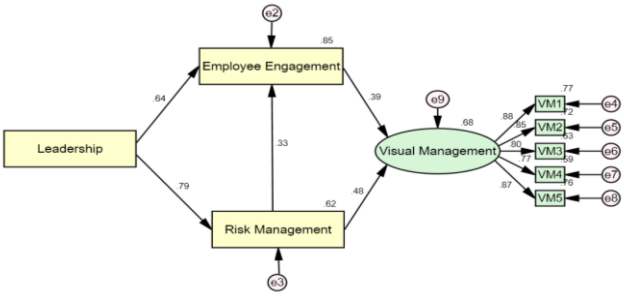

Figure 2 Successful Practices and Strategies of Continuous Improvement (CI)

This structural equation model explores the relationship between Employee Engagement, Leadership, Risk Management, and Visual Management over the successful practices and Strategies of Continuous Improvement (CI).

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Table 9 Model Fit Indices

Index	
Sig. (P value)	.074
CMIN/DF	1.758
Goodness of Fit Index (GFI)	.955
Adjusted Goodness of Fit Index (AGFI)	.910
Normed Fit Index (NFI)	.972
Comparative Fit Index (CFI)	.987
Root Mean Square Error of Approximation (RMSEA)	.042

The model fit is non-significant as the p-value = .074 > .05 which indicates that the model fits perfectly. Further, CMIN/DF value is also 1.758 which accepts the model fit. The goodness of fit index is the proportion of variance for estimating population covariance is 0.955 > .95 which indicates the good model fit. Also, the AGFI value is .910 > 0.90 which approves the good model fit. Moreover, the NFI value is 0.972 > 0.95 which also confirms that the model is a good model fit. CFI value is .987 > 0.90 which describes that this model as a good model of fit (Hu and Bentler, 1999). The RMSEA lies between 0 and 1 and RMSEA < .06, which indicates a better model of fit (Brown and Cudeck, 1993).

Table 10 Regression Weights

			Estimate	S.E.	C.R.	P
Risk Management	<---	Leadership	.704	.046	15.446	***
Employee Engagement	<---	Leadership	.640	.052	12.205	***
Employee Engagement	<---	Risk Management	.372	.059	6.359	***
Visual Management	<---	Risk Management	.105	.021	4.997	***
Visual Management	<---	Employee Engagement	.076	.019	4.099	***
VM1	<---	Visual Management	1.000			
VM2	<---	Visual Management	.882	.064	13.853	***
VM3	<---	Visual Management	.851	.069	12.351	***
VM4	<---	Visual Management	.810	.070	11.593	***
VM5	<---	Visual Management	.939	.064	14.580	***

From Table 11, it can be seen that the unconstrained estimates of all items are significant at .001 level which explains that Leadership Influences Risk Management and Employee Engagement at .001 level. Risk Management Influences Employee Engagement and Visual Management at .001 level. Employee Engagement influences Visual Management at .001 level. Each unstandardized regression coefficient represents the amount of change in the dependent or mediating variable for each one-unit change in the variable predicting it.

Table 11 Standardized Regression Weights

			Estimate
Risk Management	<---	Leadership	.786
Employee Engagement	<---	Leadership	.636
Employee Engagement	<---	Risk Management	.331
Visual Management	<---	Risk Management	.476
Visual Management	<---	Employee Engagement	.388
VM1	<---	Visual Management	.877
VM2	<---	Visual Management	.848
VM3	<---	Visual Management	.796
VM4	<---	Visual Management	.766
VM5	<---	Visual Management	.871

It shows the correlation between the factors measured and the observed variables. It also indicates that VM1, VM2, VM3, VM4, and VM5 are reliable indicators of the variable Visual Management; Leadership is the reliable indicator for Risk Management and Employee Engagement; Risk Management is the reliable indicator for Visual Management and Employee Engagement; Employee Engagement is the reliable indicator

for Visual Management. With all the positive coefficient measures it is confirmed that in this model all the paths have a good model fit.

Table 12 Squared Multiple Correlations

	Estimate
Risk Management	.617
Employee Engagement	.846
Visual Management	.684
VM5	.758
VM4	.587
VM3	.633
VM2	.719
VM1	.770

Conclusion

It is identified that all the considered CSFs influenced the management decision towards the implementation of continuous improvement in the companies. These CSFs were acknowledged by the manufacturing companies in Oman, which confirms that CI tools are essential elements of business strategy within this sector. Organizations that incorporate CI into their production, and the related quality control systems will have a competitive edge.

Numerous market advantages have been identified (such as reduction in the cost of products sold and cycle time, etc.) in several manufacturing industries. Thus, the results reveal that the Omani manufacturing companies using structured CI programs had lesser product recalls, leading to increased overall sales, decrease in processing time. Further, it is also revealed that the CI culture and Employee Performance Measurement and Review are instrumental in translating into company savings. The overall sales raised, while the average processing time had declined.

Acknowledgment

This paper is the outcome of the research carried out with the funding from The Research Council, Oman (TRC) – Ministry of Higher Education Research & Innovation of the Sultanate of Oman under the Block Funding Program vide No. TRC/BFP/SHCT/01/2019.

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