CONTINUOUS IMPROVEMENT BEHAVIOURS IN NEW ZEALAND MANUFACTURING COMPANIES

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ABSTRACT

In order to develop culture of continuous improvement that moves away from too much focus on methods and tools in continuous improvement, Bessant's Continuous Improvement (CI) Maturity Model was developed. The model is about developing specific sets of behaviours and abilities with regards to continuous improvement. The model has been validated and reliably tested in different settings such as manufacturing companies and public sectors in several different countries. However, the model's validity and reliability have not been tested in the context of New Zealand manufacturing companies. This study was carried out to address the research gap in term of the validity and reliability of the CI maturity model in New Zealand manufacturing companies. A total of 169 survey responses were obtained and later analysed by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The findings from the analyses suggested that the CI Maturity Model had demonstrated adequate validity and reliability when compared against data from New Zealand manufacturing companies. The CI Maturity Model can be used by New Zealand manufacturing companies as a means to measure the presence of continuous improvement culture and as a framework for developing continuous improvement culture.

Keywords: *Continuous improvement, New Zealand, exploratory factor analysis, confirmatory factor analysis, maturity model*

1.0 INTRODUCTION

According to Singh and Singh [1], continuous improvement is a management philosophy that aims to provide customer satisfaction by continuously improving the quality of products or services and processes. Corso, et al. [2] looks at continuous improvement from two points of view. Both views can have different impacts on the development of continuous improvement, even though they can also complement each other [2]. These two perspectives are largely influenced by two different paradigmatic sources; in Imai [3] and Bessant, et al. [4]. Imai and Bessant are two leading researchers in the field of continuous improvement whose ideas can be very different from one another.

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In the first view, influenced by Imai [3], continuous improvement is a set of practices and processes originating an innovative flow to encourage an organisation to strive toward excellence. In the first perspective, the emphasis is on the process (i.e. method and tools) [5].

The second view, influenced by Bessant, et al. [4], it is a set of capabilities that make it possible for an organisation to learn, innovate and renew. The focus of the second perspective is on the abilities to develop and consolidate in behavioural routines, and continuous improvement is construed as a learned and interiorised ability [2, 5].

Boer and Gertsen [6] found that, up to early 1990s, many published works on continuous improvement were biased toward Imai's approach where the focus was mostly centred on process perspective and specific shop-floor operational activities. Imai's approach lacks focus on the behavioural aspects of continuous improvement. Bessant, et al. [4] criticised this approach, highlighting three problems; first, it is often prescriptive and fails to cover implementation; second, when it does explore implementation, it tends to assume a correlation between usage of tools and performance improvement, and neglects the other elements of behaviour building; third, it assumes a binary split between having or not having continuous improvement, rather than seeing it as an emerging and learned pattern of behaviour which gradually develops over time.

Since 1998, the number of works related to Imai's approach (i.e. the so-called 'hard' perspective) has been on the decline, while work under the category of the Bessant's approach (the 'soft' perspective) has significantly increased [6]. Continuous improvement is increasingly seen as learning process, and the notion of continuous improvement as methods and tools is slowly losing its appeal [5].

Aloini, et al. [5] concluded that since mid 1990's there have been several new trends in the area of continuous improvement. First, continuous improvement is no longer confined to routine activities (e.g. shop-floor activities) but also non-routine activities such as product innovation, or administrative processes. Second, continuous improvement is no longer limited to one's own work area, but also collaborative efforts across several work areas. Third, there is increased attention to such issues as implementation, success/failure factors, role of action learning and experimentation. Fourth, there is an increased tendency to integrate continuous improvement and organisational learning.

In order to move away from too much focus on methods and tools, Bessant and Caffyn [7] have proposed the CI Maturity Model. The model involves evolutionary processes that an organisation has to go through to build specific sets of behaviours and abilities with regards to continuous improvement.

The model has been similarly used and adapted in many different setting such as Brazil manufacturing companies [8], United Kingdom public sector [9], Brazil automotive sector [10], Spain manufacturing companies [11], and manufacturing companies in Australia, Italy, Netherlands, Spain, Sweden, and United Kingdom [12]. However, the model has never been tested in the context of New Zealand manufacturing companies. Whether the model can be generalised to New Zealand manufacturing companies has not been empirically investigated. Therefore, there was a research gap that need to be filled.

This study was carried out to run the model against data from New Zealand in order to verify its validity and reliability since some researchers argue that due to national specificity of a country, a model that is applicable in one country may not but equally applicable in another country [13]. Therefore, the objective of this study was to to investigate the validity and reliability of the CI Maturity Model in the context of New Zealand manufacturing companies; whether the CI Maturity Model can demonstrate as adequate validity and reliability as in other settings.

Since the nature of this study was essentially explanatory with testing of hypotheses, the above-mentioned research objective is followed by a research hypothesis that are presented in section 3.

2.0 CI MATURITY

This study was carried based on the theoretical framework of Bessant and Caffyn [7]'s CI Maturity Model. The evolutionary framework of continuous improvement development mooted by Bessant and Caffyn [7] have been taken up by other researchers such as Gonzalez and Martins [8], Fryer and Ogden [9], Valadão, et al. [10], Jurburg, et al. [11], Morais, et al. [14], Jansmyr and Graas [15], Fryer, et al. [16], Dabhilkar, et al. [12], and Jorgensen, et al. [17]. In addition, the CI Maturity Model has been noted as valid and well-accepted method that can be used to analyse culture of continuous improvement [17, 18].

The model explains that for an organisation to develop continuous improvement capability, there must be specific behaviours attained and entrenched in the organisation Bessant and Francis [19]. These behaviours are displayed by individuals and groups, and serve as indicators of the continuous improvement capabilities present in the organisation. Once the continuous improvement behaviours have been successfully developed over time, they can be fully exploited as strategic competitive advantages that other organisations will find hard to imitate [19]. According to the CI Maturity Model, development toward a full continuous improvement capability is a five-step process [7, 20]. The five-step process is shown in Table 1.

Table 1:Stages in the evolution of continuous improvement [4]

	CI Capability Level	**Characteristic behaviour pattern**
1	Pre-CI	Problems are solved randomly; No formal efforts or structure for improving the organisation
2	Structured CI	CI or an equivalent organisation improvement initiative has been introduced; but CI activities have not been integrated into day-to-day operations
3	Goal-oriented CI	All the above plus: Formal deployment of Strategic Goals; Monitoring and measuring of CI against these goals
4	Proactive/empowered CI	All the above plus: CI responsibilities devolved to problem solving unit; High levels of experimentation
5	Full CI	All the above plus: Extensive and widely distributed learning behaviour; Systematic finding and solving problems and capture and sharing of learning

The capability level is determined by CI abilities which in turn are determined by the corresponding CI ability constituent behaviours, as shown in Figure 1.

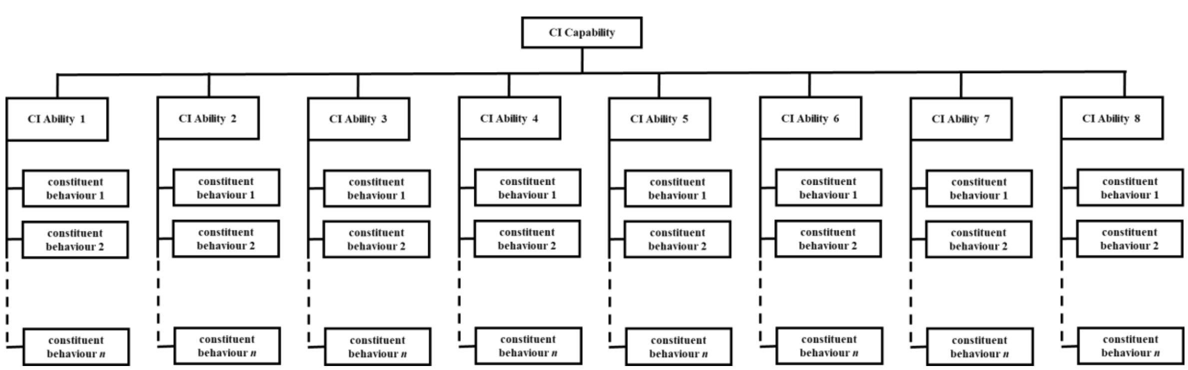

Figure 1: Behavioural model of continuous improvement capability

Based on research by Corso, et al. [2], there are eight different CI abilities. Each ability is supported by several constituent CI behaviours, as shown in Table 2. A company can move up its continuous improvement capability level by developing its continuous improvement abilities. Continuous improvement ability can only be developed by making changes to its constituent behaviours. In short, enhanced continuous improvement capability is a result of developed continuous improvement abilities, which in turn are due to evolvement of constituent behaviours over time. As members of the organisation develop the constituent behaviours, continuous improvement maturity will develop, and eventually full continuous improvement capability level is reached. For example, as shown in Table 2, if there is high evolvement level of behaviour "a continuous improvement or equivalent formal improvement system has been introduced to involve all employees in ongoing improvement", then it can lead to a higher level of CI ability of "understanding CI", which in turn can contribute toward higher level of CI capability. Similarly, other behaviours can also evolve over time, and consequently the corresponding CI abilities also develop. Combined development of CI abilities over time result in increased level of CI capability.

Theoretically, the progression towards full continuous improvement capability requires acquiring and embedding of constituent behaviours, and is basically a learning process [19]. This progression takes time and requires a lot of learning and fine mechanisms to ensure continuous improvement behaviours can develop [19].

3.0 METHODOLOGY

3.1 Survey questionnaire and data collection

This study was carried out by means of survey questionnaires that were sent to the selected manufacturing companies in different parts of New Zealand. Kompass NZ business directory was used to gather the relevant information about New Zealand manufacturing companies. Companies were selected from the database based on few criteria such as location, type of manufacturing and number of employees. The selected survey participants were asked about their perception of the level of continuous improvement behaviours in their respective manufacturing companies. The survey questionnaire consisted of thirty-four items related to continuous improvement behaviours. The survey participants were asked to indicate to what extent, on a five-point Likert scale, they agree or disagree with the thirty-four items. The items were adopted from continuous improvement survey used by Corso, et al. [2], which is based on the Bessant's CI Maturity Model [4, 7]. Details of the survey questionnaire are shown in Table 2.

3.2 Data analysis

This study was carried out to test the validity of the CI maturity model in the context of New Zealand manufacturing companies. In the Corso, et al. [2]'s work, the thirty-four items of continuous improvement behaviours cluster themselves around eight different continuous improvement abilities, as shown in Table 2. Therefore, the following hypothesis was formulated;

H1: the CI maturity model factor structure consists of eight reliable and valid CI abilities

In order to determine the exact factor structure of continuous improvement behaviour based on New Zealand data, an exploratory factor analysis (EFA) was carried out. EFA is a data driven process that can be used to generate a factor structure that spells out the how the items of continuous improvement behaviours (observed variables) are connected to continuous improvement abilities (latent variables); i.e. to figure out how many latent variables are deemed adequate to account for co-variation among the observed variables. EFA was deemed appropriate since EFA should be used whenever a researcher has no prior knowledge about the linkages between the observed and the unobserved latent variables [21].

EFA was followed by confirmatory factor analysis (CFA). CFA was carried out to substantiate the factor structure generated by EFA. Using CFA after EFA is appropriate since it is a logical progression in exploratory modelling [22]. With CFA, there will be a more rigorous test on the plausibility of the factor structure where measurement errors, modification and fit indices are taken into consideration [22]. Statistical analyses were carried out using SPSS 18 and AMOS 18 software. The softwares were used because of their availability and ease of use.

Table 2: CI Maturity Model questionnaire items [2]

No	**Constituent behaviours (observed variables)**	**CI abilities (latent variables)**
CI 01	A continuous improvement or equivalent formal improvement system has been introduced to involve all employees in ongoing improvement	understanding CI
CI 02	Appropriate organisational mechanisms are used to deploy what has been learned across the organisation	Learning organization
CI 03	Before embarking on initial investigation and before implementing a solution, individuals and group assess the improvement they proposed against strategic objectives to ensure consistency	focusing CI
CI 04	Everyone learns from their experience, both good and bad	Learning Organization
CI 05	Everyone understands what the company’s or their department’s strategy, goals and objectives are	focusing CI
CI 06	Ideas and suggestions for improvement are responded to in a clearly defined and timely fashion – either implemented or otherwise dealt with	getting CI habit
CI 07	Improvement activities and results are continually monitored and measured	CI of CI
CI 08	Improvement is an integral part of the individuals’ or groups’ work, not a parallel activity	getting CI habit
CI 09	Individuals and groups are effectively working across internal (vertical and lateral) and external divisions at all levels	shared problem solving
CI 10	Individuals and groups at all levels share (make available) their learning from all work and improvement experiences	Learning Organization
CI 11	Individuals and groups monitor / measure the results of their improvement activity and their impact on strategic or departmental objectives	focusing CI
CI 12	Individuals and groups use the organisation’s strategy and objectives to focus and prioritise their improvement activities	focusing CI
CI 13	Individual seek out opportunities for learning/personal development (eg active experimentation, setting own learning objectives)	Learning Organization
CI 14	Managers accept and, where necessary, act on all the learning that takes place	Learning Organization
CI 15	Managers at all levels display leadership and active commitment to ongoing improvement	leading the way

Table 2: CI Maturity Model questionnaire items [2] (continued)

No	Constituent behaviours (observed variables)	CI abilities (latent variables)
CI 16	Managers lead by example, becoming actively involved in the design and implementation of systematic on-going improvement	leading the way
CI 17	Managers support experimentation by not punishing mistakes but by encouraging learning from them	leading the way
CI 18	Managers support improvement process by allocating sufficient time, money, space and other resources	leading the way
CI 19	Ongoing assessment ensures that the organisation's processes, structure and reinforce improvement activities	aligning CI
CI 20	People initiate and carry through to completion, improvement activities – they participate in the process	getting CI habit
CI 21	People and teams ensure that their learning in incorporated into the organisation by making use of the mechanism provided for that	Learning Organization
CI 22	People are oriented towards internal and external customers in their improvement activity	shared problem solving
CI 23	People make use of some formal problem finding and solving cycle	understanding CI
CI 24	People understand and feel ownership of the company's processes	shared problem solving
CI 25	People use appropriate tools and techniques to support their improvement activities	getting CI habit
CI 26	People use measurement to shape the improvement process	getting CI habit
CI 27	Relevant information activities involve representations from different operational levels	shared problem solving
CI 28	My company makes available sufficient resources (time, money, personnel) to support the continuing development of the company's improvement system	CI of CI
CI 29	Specific improvement projects are taking place with customers and/or suppliers	shared problem solving
CI 30	My company articulates and consolidates (captures and shares) the learning of individuals and groups	Learning Organization
CI 31	My company recognises in formal but not necessarily financial ways the contribution of employees to continuous improvement	leading the way
CI 32	My company uses supplier and customer feedback as a means to improving company performance	shared problem solving
CI 33	When a major organisational change is planned, its potential impact on the organisation's system is assessed and adjustments are made as necessary	aligning CI
CI 34	When something goes wrong the natural reaction of people at all levels is to look for reasons why rather than to blame the individuals involved	understanding CI

4.0 RESULTS AND DISCUSSIONS

4.1 Descriptive statistics of respondents

A total of 2200 questionnaires were sent to the selected manufacturing companies throughout New Zealand. At the end of the data collection stage, the final count of returned responses were 180, thus the effective rate of return was 8.2% only. Out of 180 responses received, 11 of them were discarded since they were either not complete or contained too many missing data (more than 10%). The remaining usable cases also contained some missing values but missing percentages were low. There was no systematic pattern of missing values (Little MCAR χ^2 =992.2, df=1059, sig=0.929), and subsequently the missing values were imputed using the expectation maximization (EM) method that was available in the Missing Value Analysis in SPSS 18.0. Details of the survey responses are shown in Table 3.

4.2 Exploratory Factor Analysis

Bartlett' test of sphericity was significant (Chi-square = 3461.5; df = 561; Sig. = 0.00), and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was larger than 0.70 (KMO = 0.922), suggesting the suitability of using factor analysis. EFA was later carried out using Principal Axis Factoring using Promax rotation for factor analysis. Initial round of EFA resulted in five-variable structure that accounted for about 56.1% of total variance, as shown in Table 4.

Table 3: Profile of New Zealand survey respondents

Categories		**# of respondents**	**Percent**
Size	Large	35	20.71%
	SME	134	79.29%
Regions	North Island	104	61.54%
	South Island	65	38.46%
Respondents' position	Senior Management	78	46.15%
	Middle	69	40.83%
	Lower	22	13.02%
Type of manufacturing	Textile	25	14.79%
	Food	61	36.09%
	Metal	15	8.88%
	Wood&Paper	7	4.14%
	Petroleum	7	4.14%
	Machinery	10	5.92%
	Plastic	27	15.98%
	Others	17	10.06%

Table 4: Results of total variance explained for continuous improvement behaviours

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings
Latent variables (factors)	**Total**	***% of variance***	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**
1	13.09	38.51	38.51	12.66	37.25	37.25	8.84
2	2.38	7.01	45.52	1.94	5.73	42.98	9.32
3	2.09	6.15	51.67	1.68	4.95	47.94	8.68
4	1.87	5.50	57.17	1.48	4.36	52.30	9.22
5	1.73	5.10	62.28	1.29	3.81	56.11	7.27

As shown in Table 5, all continuous improvement behaviours clustered themselves nicely into five separate latent variables (factors). A closer look at the inter-item correlation revealed that item Ci30 and Ci10 were very highly correlated; thus one of them was considered redundant. Item Ci30 was later discarded and not used anymore.

As a whole, EFA of continuous improvement behaviours measurement model using New Zealand data resulted in five-variable structure. The five variables were the CI abilities that were applicable in the context of New Zealand manufacturing companies. They and their corresponding constituent CI behaviours were different from the eight CI abilities discovered by Corso, et al. [2]'s study as shown in Table 2. In fact, many other studies on continuous improvement behaviours such as Bessant and Caffyn [7], Bessant, et al. [4], Jorgensen, et al. [17], and Dabhilkar, et al. [12], also did not produce the same or consistent factor structure of continuous improvement behaviour. Nonetheless, the five-variable structure was an honest reflection of the data obtained from New Zealand manufacturing companies based on the EFA that was carried out. The five CI abilities were given the following names; *CI habit, focus CI, spread CI, lead the way, learn CI.*

In the context of New Zealand manufacturing companies, these five CI abilities would be the determining factors that contributes towards their CI capability level. The first CI ability, *CI habit* is characterised by constituent behaviour pattern that is similar to an early stage of continuous improvement development. It refers to the relatively easy steps taken by a company who wants to embark on the long journey toward full capability continuous improvement. *Focus CI* is a continuous improvement ability that is related to the strategic planning of an organisation. It is characterised by continuous improvement activities that are carried out according to the overall organisation's strategies. It calls for a strategic policy deployment as well as continuous monitoring and measurement activity to ensure continuous improvement activities are heading in the right direction. *Spread CI* is the ability to move continuous improvement activities across different departments so as to give operational and strategic advantages to the organisation. Development of this type of continuous improvement ability requires proper strategic planning on the part of management. *Spread CI* is also characterised by people who work naturally across departments whenever the need arises, and not only when directed to do so. This calls for adequate managerial competence to encourage people to work proactively together instead of reactively. *Lead the way* is a continuous improvement ability that is characterised by high level of experimentation. The cost and risky nature of an experiment is tolerated since it is for solving a problem and even if the experiment fails, there is still a valuable lesson that can be learned. *Learn CI* is when people learn lessons from their continuous improvement activities and share the lessons with everyone else. This continuous improvement ability calls for appropriate strategies to capture and transfer the lessons to everyone in the organisation.

Table 5: Pattern matrix of CI behaviours

Latent variables (factors)					
	1	***2***	**3**	**4**	**5**
Ci01		.835			
Ci06		.701			
Ci20		.664			
Ci23		.631			
Ci25		.694			
Ci26		.697			
Ci34		.817			
Ci03	.355				
Ci05	.612				
Ci07	.802				
Ci08	.657				
Ci11	.596				
Ci12	.747				
Ci19	.834				
Ci33	.584				
Ci09					.933
Ci22					.749
Ci24					.789
Ci27					.595
Ci29					.582
Ci32					.633
Ci15				.680	
Ci16				.546	
Ci17				.702	
Ci18				.742	
Ci28				.745	
Ci31				.768	
Ci04			.817		
Ci14				.722	
Ci13			.506		
Ci10			.786		
Ci02			.812		
Ci21			.711		
Ci30			.861		

Notes: Extraction Method: Principal Axis Factoring. Rotation Method: Promax with Kaiser Normalization. Rotation converged in 6 iterations

4.3 Confirmatory factor analysis

Due to the small sample size, EFA and CFA were carried out on the same data set. In an ideal situation, the sample should have been split into two for separate EFA and CFA. However, the sample size was not big enough, and splitting it into two would create unstable estimation during EFA and CFA. Besides, Prooijen and Kloot [23] justified EFA and CFA on the same data; arguing that both analyses, if run on the same data, would arrive at the same conclusion, barring some methodological errors. Prooijen and Kloot [23] suggested that "if CFA cannot confirm results of EFA on the same data, one cannot expect that CFA will confirm results of EFA in a different sample or population".

CFA was carried out based on the five-variable structure generated by the EFA. The initial CFA resulted in a reasonable fit with the data, but the loading factor for item Ci03 was too low (0.51). Convergent validity test showed that average variance extracted (AVE) for variable *focus CI* was less than 0.50 which was due to item Ci03. Item Ci03 was later removed in order to get a better convergent validity. A new CFA without item Ci03 was carried out and the results of the new CFA are shown in Table 6 and Figure 2.

The fitness of the model was poor as shown by the significant chi square (χ^2 (454) = 584.3, p=0.00). However, chi square (χ^2) is usually not the only measure of fitness due to its sensitivity to small sample size [24]. Because of that, additional alternative indices were also used. Other indices such ratio χ^2/df, Root Mean Square Error of Approximation (RMSEA), standardized root mean square residual (SRMR), Comparative Fit Index (CFI), and Tucker-Lewis Index (TLI) have their own strengths and weaknesses; nonetheless, altogether they provide a more balance assessment of the fitness of a model [25, 26]. Ratio (χ^2/df) of less than two or three indicates a good fit [27]. Additionally, good fit is also confirmed if RMSEA is less than 0.5 [28], SRMR less than 0.80 [27], CFI larger than 0.90 [29], and TLI larger than 0.90 [29]. As shown in Table 6, the continuous improvement behaviours measurement model exhibited adequate fitness when ran against New Zealand data.

Table 6: Fit indices for CI behaviours measurement model

	χ^2	ratio	RMSEA	SRMR	CFI	TLI
CI behaviours measurement model	χ^2(N=169, df=454)=584.3 p=0.000	1.28	0.041	.0551	.954	.950

Table 7 shows the Cronbach's alpha for sets of observed variables that load onto individual unobserved latent variables. The observed variables seemed to correlate together with reasonable Cronbach's alpha, ranging from 0.870 to 0.896. As all Cronbach's alphas were above the threshold limit of 0.70, the internal consistency (reliability) of the continuous improvement behaviours measurement model was confirmed. In addition, Table 7 also shows the values of composite reliability (CR). The CRs for all unobserved latent variables were above 0.70, further confirming the reliability of the continuous improvement behaviours measurement model. The results of the analysis confirmed that the seven-variable continuous improvement behaviours measurement model exhibited a measure of high internal consistency when used with New Zealand data.

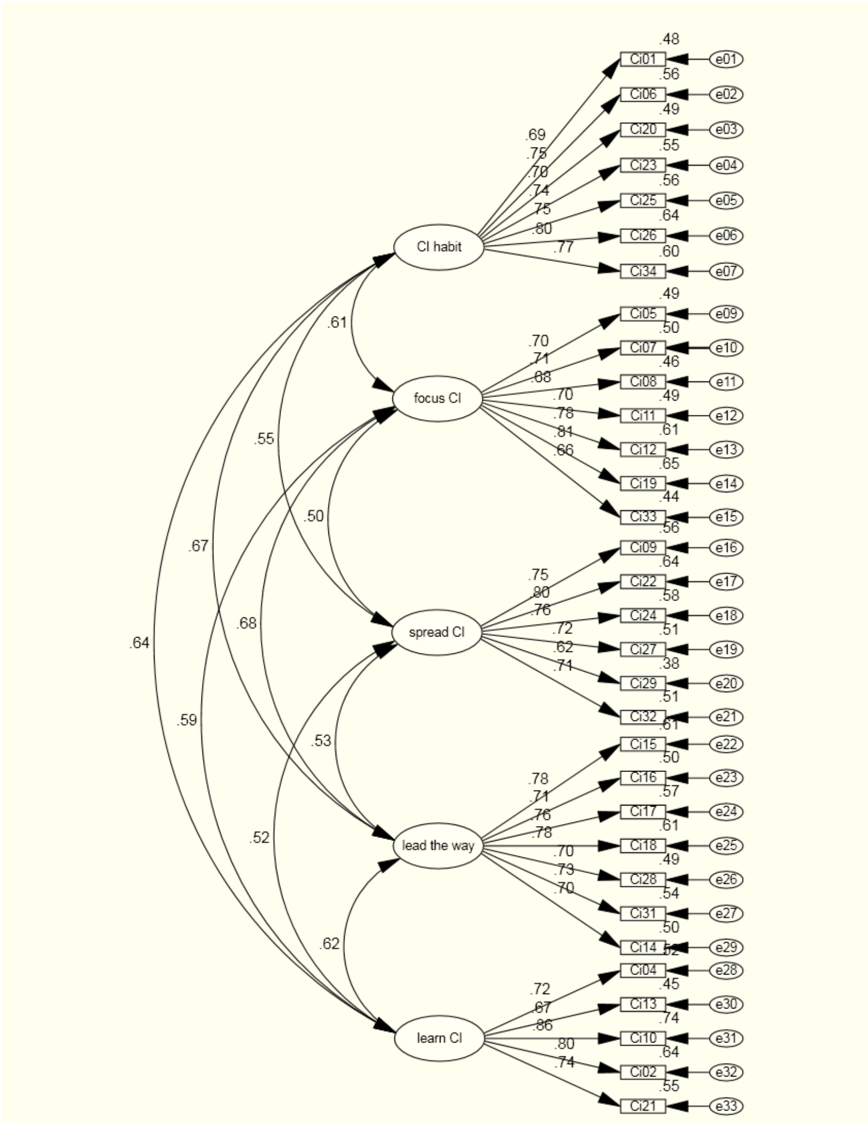

Figure 2: CFA for CI behaviours measurement model

The next step was to check for the convergent validity of the continuous improvement behaviours measurement model. This was done by, first, examining the regression weights between observed variables and unobserved latent variables in the continuous improvement behaviours measurement model. Table 7 shows the standardised regression weights (also known as factor loading) from the observed variables to the unobserved latent variables. All estimates were statistically significant and above the threshold limit 0.50, thus indicative of convergent validity. In addition, convergent validity was further checked by comparing composite reliability (CR) and average variance extracted (AVE). Table 7 shows the CR and AVE for each unobserved variables. All CRs were above the threshold value 0.70 while all AVEs were above 0.50. All CRs were larger than the corresponding AVEs, thus confirming the convergent validity of the continuous improvement behaviours measurement model.

Table 7: Reliability and Convergent validity of the CI behaviours measurement model

Latent variables	Observed variables	Regression weight	α	CR	AVE	Convergent validity? (CR>AVE, AVE>.5)
CI habit	Ci01	.694	.896	.896	.553	yes
	Ci06	.749				
	Ci20	.701				
	Ci23	.742				
	Ci25	.745				
	Ci26	.799				
	Ci34	.772				
Focus CI	Ci05	.699	.878	.883	.519	yes
	Ci07	.706				
	Ci08	.676				
	Ci11	.699				
	Ci12	.780				
	Ci19	.809				
	Ci33	.662				
Spread CI	Ci09	.747	.870	.871	.531	yes
	Ci22	.802				
	Ci24	.762				
	Ci27	.717				
	Ci29	.618				
	Ci32	.713				
Lead the Way	Ci15	.780	.893	.893	.545	yes
	Ci16	.707				
	Ci17	.755				
	Ci18	.783				
	Ci28	.702				
	Ci31	.733				
	Ci14	.704				
Learn CI	Ci04	.723	.871	.873	.581	Yes
	Ci13	.673				
	Ci10	.858				
	Ci02	.800				
	Ci21	.744				

The final step was to check for the discriminant validity of the continuous improvement behaviours measurement model. This was done to ensure that observed variables were correlated primarily to their latent variable and not highly correlated with observed variables in other latent variables. Discriminant validity was determined by comparing the AVE for each latent variable with the corresponding squared correlation between that latent variable and other latent variables. The corresponding squared correlations between latent variables were represented by two measures; maximum shared variance (MSV) and average share variance (ASV) values. In any case, to obtain discriminant validity, the AVE must be larger than both MSV and ASV. As shown in Table 8, all AVEs were larger than the corresponding MSV and ASV, suggesting the discriminant validity is achieved. Additionally, discriminant validity for a particular latent variable can be also confirmed by looking at the square root of AVE for that latent variable and the related correlations between latent variables; if the square root of AVE for that latent variable is larger than the related correlations, then there is an adequate level of discriminant validity. Table 8 shows the matrix of correlations between different latent variables with square root of AVE on the diagonal. All latent variables showed acceptable discriminant validity since all square roots of AVE are larger than the correlation between each pair of latent variables.

Table 8: Discriminant validity of CI behaviours measurement model

Latent variables	**AVE**	**MSV**	**ASV**	**CI habit**	**Focus CI**	**Spread CI**	**Lead the Way**	**Learn CI**	**Discriminant validity?**
CI habit	.553	.445	.382	.744					Yes
Focus CI	.519	.458	.359	.611	.720				Yes
Spread CI	.531	.299	.276	.547	.500	.729			Yes
Lead the Way	.545	.458	.394	.667	.677	.533	.738		Yes
Learn CI	.581	.410	.355	.640	.594	.519	.624	.762	Yes

5.0 CONCLUSION

In this study, CI Maturity Model was tested against data collected from New Zealand manufacturing companies. Findings of the study suggested that the CI Maturity Model is valid and reliable. The findings add the existing body of knowledge by providing evidence for the generalizability of the CI Maturity Model; that it can be applied in a setting different from where it was originally applied. From practical point of view, the model can be used as guideline for a New Zealand manufacturing company that wants to develop its continuous improvement capability. The model, as a starting point, can be used to measure the current status of continuous improvement culture in the company. The model can be used to identify the strengths and weaknesses of the company in term of continuous improvement; the appropriate actions can then be taken and the necessary resources can be allocated accordingly to further develop the company's continuous improvement capability.

Since this study was based on snap-shot at one particular time, the findings of the study could be of limited usage and applicability. However, future research using a longitudinal approach can address this limitation. A longitudinal study that collects data over three to five year periods may provide some advantages, especially when measuring the trend of continuous improvement behaviours. This research was also based on cross-sectional quantitative study that lacked in-depth investigations into the presence of continuous improvement behaviours. Future research should design in-depth qualitative case studies that involve field observations, document analysis as well as unstructured interviews with employees of manufacturing companies. In-depth case studies can uncover information that is not normally retrievable by quantitative cross-sectional survey or short case study interviews.

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