Continuous Improvement Behaviours in Malaysian Manufacturing Companies

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Abstract

In this study, the Bessant's Continuous Improvement (CI) Maturity Model, as a means to measure the presence of continuous improvement culture, was tested for its validity and reliability in the context of Malaysian manufacturing companies. The CI Maturity Model has been validated in several different settings before but has yet to be investigated for its applicability in Malaysian manufacturing companies. A total of 321 survey responses were obtained and later analysed by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The findings confirmed that the CI Maturity Model showed adequate validity and reliability in the context of Malaysian manufacturing companies. The CI Maturity Model can be used by Malaysian manufacturing companies as a framework for developing continuous improvement culture.

Keywords
Continuous Improvement, Exploratory Factor Analysis, Confirmatory Factor Analysis, Maturity Model

1. Introduction

Continuous improvement is management philosophy that aims to provide customer satisfaction by continuously improving the quality of products or services and processes (Singh & Singh, 2015). Continuous improvement (CI) can be seen from two different perspectives (Corso, Giacobbe, Martini, & Pellegrini, 2007). First, it is a set of practices and processes originating an innovative flow to encourage an organisation to strive toward excellence. Second, it is a set of capabilities that make it possible for an organisation to learn, innovate and renew (Corso et al., 2007). In the first perspective is largely influenced by Imai (1986)'s works that puts emphasis on the process (i.e. method and tools) (Aloini, Martini, & Pellegrini, 2011). Meanwhile, the second perspective is based on Bessant et al. (2001)'s works that focus on the abilities to develop and consolidate in behavioural routines, and CI is construed as a learned and interiorised ability (Aloini et al., 2011; Corso et al., 2007).

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 (Boer & Gertsen, 2003). CI is increasingly seen as learning process, and the notion of CI as methods and tools is slowly losing its appeal (Aloini et al., 2011). In order to move away from too much focus on methods and tools, Bessant and Caffyn (1997) have proposed the Continuous Improvement (CI) Maturity Model. The CI Maturity Model is a well-accepted model that can be used as a valid methodology in analysing continuous improvement (de Jager et al., 2004; Jorgensen, Boer, & Laugen, 2006).

CI has become commonplace in many Malaysian manufacturing companies but the CI process is often beset with problems and difficulties to implement (Ali, Islam, & Howe, 2013). In order to make improvement, these companies first must be able assess their relative strengths and weaknesses in CI behaviours. Accurate knowledge of one's strengths and weaknesses is a good starting point for roadmap towards improvement.

The evolutionary framework of continuous improvement development mooted by Bessant and Caffyn (1997) have been taken up by other researchers such as Gonzalez and Martins (2016), K. J. Fryer and Ogden (2014), Valadão, Campos, and Turrioni (2013), Jurburg, Viles, Jaca, and Tanco (2015), Morais, Gomes, and Silva (2012), Jansmyr and Graas (2012), K. Fryer, Ogden, and Anthony (2013), Dabhilkar, Bengtsson, and Bessant (2007), and Jorgensen et al. (2006). 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 (de Jager et al., 2004; Jorgensen et al., 2006).

Whether the model can be generalised to Malaysian manufacturing companies has not been empirically investigated. There was a need to run the model against data from Malaysia 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 (Nguyen, 2015). This study, therefore, was carried out to investigate the validity and reliability of the CI Maturity Model in the context of Malaysian manufacturing companies.

1.1 CI Maturity Model

In this study, for the purpose of measuring continuous improvement, Bessant's CI Maturity Model was used as the basis. The model provides a specification for the particular behaviours which need to be acquired and embedded in the organisation in order to enable CI capability (Bessant & Francis, 1999). These are behaviours that are displayed by individuals and groups, and they serve as indicators of the core CI abilities present in the organisation. For example, the presence of the behaviour "throughout the organisation people engage proactively in incremental improvement" reflects, and is the result of, the organisation's continuous improvement ability to "generate sustained involvement in continuous improvement" (Caffyn, 1999). CI is not seen a binary state of yes or no but an evolutionary learning process, with a gradual accumulation and integration of key behaviours over time (Bessant & Francis, 1999). It is not easy to develop CI capability since it takes a long time to learn and institutionalise those behaviours. However, once the behaviours have been successfully adopted, they can be fully exploited as strategic competitive advantages that other organisations will find hard to imitate (Bessant & Francis, 1999).

According to the CI Maturity Model (Bessant & Caffyn, 1997; Caffyn, 1999), development toward a full continuous improvement capability is a five-step process. The five CI capability levels are shown in Table 1.

Table 1 Stages in the evolution of CI (Bessant et al., 2001)

	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 CI Maturity model assumes that CI capability level is supported by CI abilities, which in turn are supported by constituent behaviour, as shown in Figure 1.

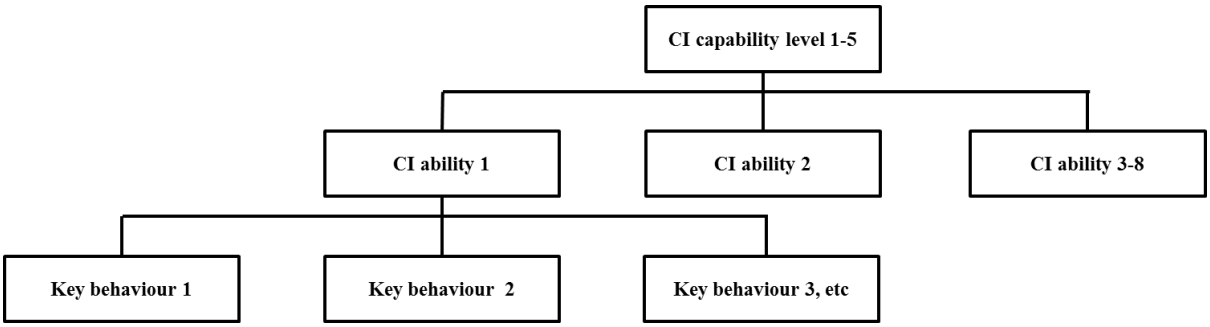

Figure 1 Behavioural model of continuous improvement capability (Bessant, 2003)

A company can move up its CI *capability level* by developing its CI *abilities*. CI *ability* can only be developed by making changes to its *constituent behaviours*. Altogether, the CI Maturity Model consists of eight CI abilities and thirty-four constituent behaviours (Corso et al., 2007).

2. Methodology

This study dealt with the presence of CI behaviours in Malaysian manufacturing companies. The presence of CI behaviours was determined by the use of survey questionnaires that were given to employees of manufacturing companies. The survey questionnaire was designed to measure the level of CI behaviours within a manufacturing company as perceived by its employees. Participating employees were asked to indicate to what extent they agree or disagree with thirty-four survey questionnaire items related to CI. The questionnaire items were adopted from CI survey described by Corso *et al* (2007), which is based on the Bessant's CI Maturity Model (Bessant & Caffyn, 1997; Bessant et al., 2001). The questionnaire items were first developed by an international research consortium, CINet, and had been used in the 2nd CI Network Survey (Corso et al., 2007; Dabhilkar et al., 2007; Jorgensen et al., 2006) that involved multiple countries in Asia, Australia and Europe. All questionnaire items (as shown in Table 2) were measured using a five-point Likert scale to indicate the level of CI behaviours.

Table 2 CI Maturity Model questionnaire items (Corso et al., 2007)

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
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

2.1 Sample and Data Collection

In this study, the population was defined as employees of manufacturing companies, either large or SME, which are located in Malaysia. Information regarding Malaysian companies was obtained by contacting the relevant entities in Malaysia such as Federation of Malaysian Manufacturers (FMM), Malaysian Productivity Corporation (MPC), or the various manufacturing trade associations operating in Malaysia. FMM database was borrowed from Universiti Teknologi Malaysia library to facilitate the search process.

2.2 Data analysis

Factor analysis was carried out to investigate the nature of relationships between observed variables and latent constructs. In this study, the survey questionnaire was based on the CI behaviours measurement model used by Corso et al. (2007) that consisted of thirty-four observed variables and eight latent constructs. However, the factor structure of CI behaviours measurement model had not been theoretically consistent. Review of previous works by Bessant and Caffyn (1997), Bessant *et al*., (2001), Jorgensen *et al*., (2006), Dabhilkar *et al*., (2007), and Corso *et al*., (2007) indicated that there have been different factor structures for the CI behaviours measurement model. There was no clear understanding on how and to what extent the continuous improvement behaviours (observed variables) would be linked to continuous improvement abilities (unobserved latent constructs) in the context of Malaysian manufacturing companies. In that case, exploratory factor analysis (EFA) was used. 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 constructs (Byrne, 2001). EFA adopted an exploratory approach in order to check how the observed variables are connected to the unobserved latent constructs; i.e. to figure out how many latent constructs are deemed adequate to account for co-variation among the observed variables

3.0 Results and Discussions

3.1 Descriptive statistics of respondents

The targeted participants of the survey were employees of manufacturing companies in Malaysia. In total, 3000 questionnaires were sent out, and 352 responses were eventually returned (effective return rate of 11.7%). However, 31 of them contained so many missing data that they had to be discarded, leaving only 321 responses to be analysed. Details of the responses are shown in Table 3.

Table 3 Profile of survey respondents

Categories		# of respondents	Percent
Size	Large	196	61.06%
	SME	125	38.94%
Regions	Northern Malaysia	147	45.79%
	Central Malaysia	82	25.55%
	Southern Malaysia	92	28.66%
Respondents' position*	Senior Management	161	50.79%
	Middle	126	39.75%
	Lower	30	9.46%
Type of manufacturing	Electrical & Electronics	124	38.63%
	Automotive	86	26.79%
	Metal	36	11.21%
	Wood&Paper	10	3.12%
	Plastics	7	2.18%
	Others	58	18.07%

*note: some respondents did not provide answer

3.2 Exploratory Factor Analysis

The factor structure of CI behaviours measurement model has not been theoretically consistent. Review of previous works by Bessant and Caffyn (1997), Bessant *et al*., (2001), Jorgensen *et al*., (2006), Dabhilkar *et al*., (2007), and Corso *et al*., (2007) indicated that there have been different factor structures for the CI behaviours measurement model. Since there had not been a strongly established model, a data driven EFA were used. EFA was carried so that the thirty-four observed variables can cluster themselves into an appropriate number of latent constructs (factors). Results of Bartlett' test of sphericity, as shown in Table 4, was significant (chi-square=7503; df=561; sig.=0.00), and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was larger than 0.70 (KMO=0.929), suggesting the suitability of using factor analysis.

The factor structure of the CI behaviours measurement model was very dependent on human behaviours. In the study of human behaviours, it is expected that there will be some correlations between those factors. Human behaviours can rarely be segregated into neatly packed factors that can work independently (Costello & Osborne, 2005). In EFA, there are two types of rotation methods; orthogonal (e.g. varimax) and oblique (e.g. promax). Orthogonal rotation is suitable when factors are assumed not to be correlated to one another, while oblique rotation is suitable when factors are assumed to be correlated (Brown, 2009). Since continuous improvement factors were expected to be correlated, the use of oblique was deemed suitable. The use of oblique rotation may give a more accurate and reproducible solution (Costello & Osborne, 2005). In this study, EFA was carried out using Principal Axis Factoring using Promax rotation for factor analysis. The EFA with thirty-four observed variables resulted in six constructs, accounting for 59.9% of total variance, as shown in Table 5.

Table 4 KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.929
Bartlett's Test of Sphericity	Approx. Chi-Square	7503.575
	Df	561
	Sig.	.000

Table 5 Results of total variance explained for CI behaviours items

	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings
Latent constructs	Total	*% of variance*	Cumulative %	Total	% of Variance	Cumulative %	Total
1	12.94	38.07	38.07	12.57	36.97	36.97	9.94
2	2.93	8.64	46.71	2.58	7.59	44.56	7.44
3	2.07	6.10	52.81	1.69	4.97	49.54	7.77
4	1.86	5.48	58.29	1.47	4.35	53.89	8.95
5	1.58	4.66	62.96	1.21	3.57	57.47	8.31
6	1.34	3.94	66.90	.84	2.47	59.94	1.12

A closer look at the inter-item correlations within the six latent constructs revealed that some questionnaire items were too highly correlated with each other. Some questionnaire items contained words that were similar and might have confused some survey respondents into giving more or less similar answer, indicating that some questionnaire items were redundant and thus were discarded. One of the latent constructs consisted of only two questionnaire items that did not correlate adequately, suggesting that they could not really form a meaningful construct. Thus, the construct was altogether discarded, leaving only five latent constructs which were given the following labels; *CI habit, focus CI, spread CI, lead the way, learn CI.*

3.3 Confirmatory Factor Analysis

CFA was performed to confirm the five-factor solutions for CI behaviours measurement model that was created by the EFA. The CFA was also carried out to measure the construct validity of the CI behaviours measurement model. In this study, the CFA was carried out on the same data that was used by EFA. Ideally, the data should be split into two separate independent samples, and the EFA and CFA should be done separately using the independent samples. However, the sample was not big enough to be split into two; thus EFA and CFA were carried out on the same data set. If the data set was split into two, the sample size would become too small and would cause instability of estimation during EFA and CFA. Prooijen and Kloot (2001) indicated that the use of same data for EFA and CFA was justified. EFA and CFA, if run on the same data, should arrive at the same conclusion unless there are some methodological errors (inappropriate applications of EFA, incomparability of EFA and CFA, and inappropriate applications of CFA). Besides, Prooijen and Kloot (2001) 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".

Results of CFA analysis are shown in Table 4 and Figure 2. The results indicated that there was a significant chi square (χ^2 (367) = 652.2, p=0.00) which could be interpreted as lack of fitness of the CI behaviours measurement model with Malaysia data. However, due its sensitivity to sample size (Yang, Watkins, & Marsick, 2004), chi square was not the only fit index used in this study; other alternative fit indices such as ratio χ^2/df, Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), standardized root mean square residual (SRMR) and Root Mean Square Error of Approximation (RMSEA) were also used. Each fit index has its own strength so the use of multiple fit indices can ensure a more balanced and substantive assessment of a measurement model (Cunningham, 2010; Kline, 2016). According to Hu and Bentler (1999), values of ratio χ^2/df less than two or three indicate a good model fit, values of RMSEA less than .08 indicate a reasonable fit, and values of CFI larger than 0.90 indicate an acceptable fit. Based on results shown in Table 6, there was adequate level of fitness of CI behaviours measurement model for Malaysia data.

Table 6 Fit indices for CI behaviours measurement model

	χ^2	ratio	RMSEA	SRMR	CFI	TLI
CI behaviours measurement model	χ^2(N=321, df=367)=652.2 p=0.000	1.77	.049	.0430	.946	.940

Table 7 shows that all the Cronbach's alphas were above the minimum limit of 0.70, thus confirming the internal consistency (reliability) of the CI behaviours measurement model. In addition to Cronbach's alphas, the composite reliabilities (CR) of all latent constructs were above 0.70, further confirming the reliability of the measurement model.

As suggested by Anderson and Gerbing (1998), the construct validity of the CI behaviours measurement model was determined based on the convergent and discriminant validity. Table 7 shows the standardised regression weights between the observed variables and the latent construct of CI behaviours measurement model. All estimates were statistically significant and above the minimum value of 0.50, therefore the convergent validity of the CI behaviour measurement model was confirmed. As shown in Table 7, all CRs were above the threshold value 0.70 while all AVEs were above 0.50. Since all CRs were higher than the related AVEs, the convergent validity of the CI behaviours measurement model was further confirmed. Meanwhile, data from AMOS 18 output were gathered and CR, AVE, MSV and ASV were calculated and shown in Table 8. A careful look indicated that discriminant validity was well established for the CI behaviours measurement model.

In this study, it was found that data from Malaysian manufacturing companies produced a factor structure of the CI behaviours measurement model that are different from the factor structures of previous works by Bessant and Caffyn (1997), Bessant *et al*., (2001), Jorgensen *et al*., (2006), Dabhilkar *et al*., (2007), and Corso *et al*., (2007). The outcome of EFA always mirrors the sample of observations. In another country, the outcome may be different but as far as Malaysian manufacturing companies are concerned, the CI behaviours were well represented by a five-construct measurement model with twenty-nine observed variables.

CI habit is characterised by constituent behaviour pattern that is similar to an early stage of Continuous Improvement Maturity Model shown in Table 3.5. 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.

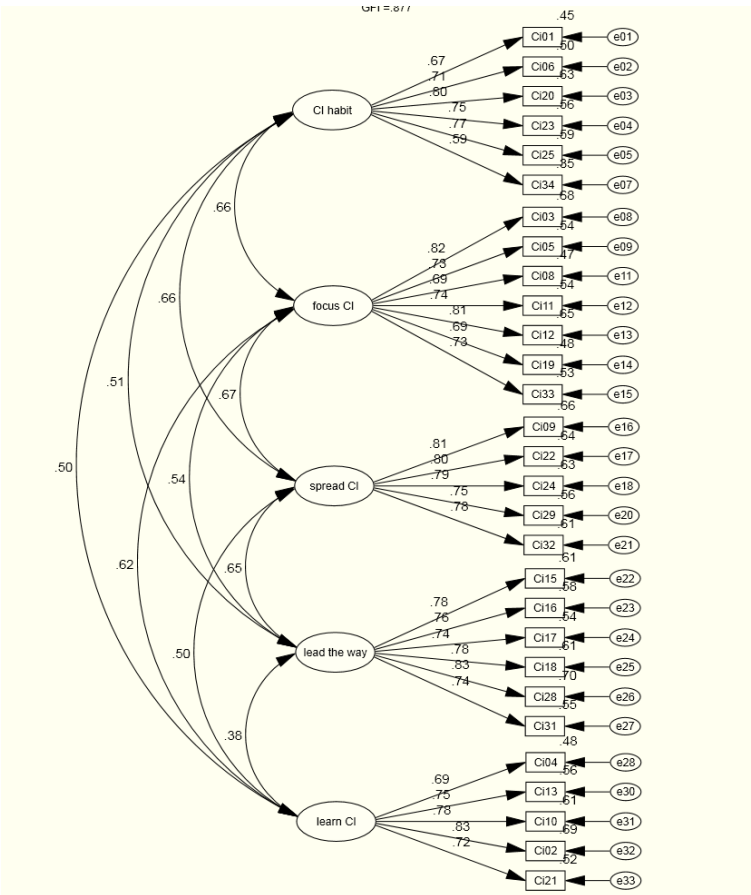

Figure 2 Confirmatory factor analysis for continuous improvement behaviours measurement model

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.

4. Conclusion and Future Work

In this study, the validity and reliability of CI Maturity Model in the context of Malaysian manufacturing companies was determined by running the model against data collected from selected companies in Malaysia. The findings suggested that the model was valid and reliable, thus can of practical use to Malaysian manufacturing companies.

The findings confirmed the generalisability of the CI Maturity Model. In other words, the model can be used in a situation that is different where it was originally developed. Practically speaking, Malaysian manufacturing companies can use the model as a guideline in order to develop their continuous improvement capability. For instance, the model can be used as a valid and reliable tool to measure the current status of continuous improvement

culture in a particular manufacturing company. The model can be used to pinpoint the strengths and weaknesses of the said company in term of continuous improvement, so that the company can take the necessary actions or can allocate the necessary resources to overcome the weaknesses.

Table 7 Standard regression weight of five constructs of CI behaviours measurement model

Latent constructs	Observed variables	Regression weight	α	CR	AVE	Convergent validity? (CR>AVE, AVE>.5)
CI habit	Ci01	.670	.860	.863	.514	yes
	Ci06	.705				
	Ci20	.797				
	Ci23	.749				
	Ci25	.766				
	Ci34	.594				
Focus CI	Ci03	.823	.897	.897	.555	yes
	Ci05	.732				
	Ci08	.686				
	Ci11	.738				
	Ci12	.806				
	Ci19	.691				
	Ci33	.729				
Spread CI	Ci09	.813	.890	.891	.619	yes
	Ci22	.797				
	Ci24	.793				
	Ci29	.752				
	Ci32	.779				
Lead the Way	Ci15	.784	.899	.900	.599	yes
	Ci16	.763				
	Ci17	.736				
	Ci18	.782				
	Ci28	.834				
	Ci31	.741				
Learn CI	Ci04	.690	.869	.869	.572	Yes
	Ci13	.750				
	Ci10	.778				
	Ci02	.832				
	Ci21	.723				

Table 8 MSV, ASV and square root of AVE of CI behaviours measurement model

Latent constructs	AVE	MSV	ASV	CI habit	Focus CI	Spread CI	Lead the Way	Learn CI	Discriminant validity?
CI habit	.514	.436	.344	.717					Yes
Focus CI	.555	.445	.386	.657	.745				Yes
Spread CI	.619	.445	.387	.660	.667	.787			Yes
Lead the Way	.599	.419	.277	.508	.536	.647	.774		Yes
Learn CI	.572	.378	.256	.502	.615	.499	.382	.756	Yes

However, the study was only based on a shap-shot of continuous improvement at a particular time, and may not be reflective of the long term culture of continuous improvement in Malaysian manufacturing companies. Therefore, a future research that uses a longitudinal approach should be carried out. Such a long term research can

collect data over a longer time period and can uncover more findings that are reflective of the true nature of continuous improvement behaviours in Malaysian manufacturing companies.

Acknowledgements

The authors wish to thank Universiti Teknologi Malaysia, and Ministry of Higher Education Malaysia for sponsorship and financial support for this study

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