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VALIDITY AND RELIABILTY STUDY OF LEARNING ORGANISATION IN NEW ZEALAND MANUFACTURING COMPANIES

Affandi Mohd-Zainal[1*], Shari Mohd Yusof[2], Jane Goodyer[3]

[1]Faculty of Mechanical Engineering,
Universiti Teknologi Malaysia,
81310 UTM Johor Bahru, Johor, Malaysia

[2]Razak School of Engineering and Advanced Technology,
Universiti Teknologi Malaysia,
Kuala Lumpur, Malaysia

[3]School of Engineering and Advanced Technology,
Massey University,
Palmerston North, New Zealand

ABSTRACT

In this study, the dimensions of learning organisation questionnaires (DLOQ), as a measuring tool for the presence of learning organisation culture, was tested for its validity and reliability in the context of New Zealand manufacturing companies. The DLOQ has been validated in many different contexts before, but more studies are still needed to provide more evidence to the generalisability and robustness of the DLOQ. This study was carried out to investigate if the DLOQ can indeed measure the culture of learning organisation in New Zealand manufacturing companies as accurately and consistently just like in the other situations in which the DLOQ has been tested before. A total of 169 survey responses were analysed. As the results of confirmatory factor analysis (CFA) and item analysis, it was found that DLOQ had demonstrated adequate construct validity and reliability to be used as a way to measure the learning organisation culture in New Zealand.

Keywords : *Learning organisation, confirmatory factor analysis, New Zealand.*

1.0 INTRODUCTION

Organisational learning can be seen as a strategy by which an organisation can face off with competitors in an increasingly dynamic and constantly changing competitive surrounding. Organisational learning is a strategy that can be used to obtain desirable outcomes such as increased performance, higher productivity, and continuing competitive edges [1-3]. It is the ability of an organisation to learn, much like a human being, that makes the difference in a competition. A crucial point of an organisation's ability to learn is the process of acquiring knowledge, utilizing knowledge and storage and transfer of knowledge. Disseminating knowledge to as many people as possible is crucial. It is through this way that knowledge does not disappear whenever people leave the organisation. So, it is all about how an organisation learns that will be the determining success factor against its competitors.

*Corresponding author: affandi@utm.my

Looking at all those benefits associated with organisational, it is important that an organisation explores the possibility of transforming itself into a learning organisation. However, the concept of learning organisation is still poorly understood, and there has been no consistent way to measure the presence of learning organisation culture within an organisation. Nonetheless, there is a measuring tool known as The Dimensions of Learning Organisation Questionnaire (DLOQ) that has been developed and proven to adequately measure the learning organisation culture [4]. The DLOQ has also been validated in many different contexts such as the United States, Colombia, China, Taiwan, Korea, Iran and Rwanda [5-16]. However, more studies are still needed to provide more evidence to the generalisability and robustness of the DLOQ in various different settings. In the context of New Zealand manufacturing companies, there is a need to investigate whether the DLOQ can be suitably applied as study on this has yet to be done.

This paper presents an empirical study that investigated the validity and applicability of the DLOQ in the context of New Zealand manufacturing companies. This study was necessary in order to find out if the DLOQ can measure the intended culture of learning organisation in New Zealand accurately and consistently just like in the original context in which the DLOQ was developed. Essentially, the study attempted to answer this question; is the DLOQ a valid and reliable instrument to measure the culture of learning organisation in New Zealand manufacturing companies?

2.0 LITERATURE REVIEW

Organisational learning has been researched in a range of academic disciplines, giving rise to different contributions and conceptions of problems [17]. Easterby-Smith [17] stated that organisational learning can be looked from six different disciplines; management science, sociology and organisational theory, strategy, production management, psychology, and cultural anthropology. The production management perspective, for instance, looks at how organisational learning can contribute toward increasing productivity, market share, and/or profitability. An organisation is assumed embedded in a very competitive environment, and how the organisation keeps its competitive edge is an indication of its organisational learning capability [17]. In the end, organisational learning is primarily about increasing knowledge for the purpose of making a meaningful improvement.

2.1 How does an organization learn?

An organisation does not learn. It is the individuals that make up the organisation that act as learning agents, and the nature of organisational learning is very much shaped by individual learning [2, 18]. While individual learning is a prerequisite for organisational learning, it does not always contribute to organisational learning. As a result, the sum of learning acquired at the organisational level is often not as much as the sum of learning by individual members of the organisation [19]. Knowledge that is generated from learning only resides with members of the organisation and can easily be lost from the organisation if members decide to leave. However, it can be kept secured within the organisation if there are appropriate mechanisms to preserve it. What is needed for individual learning to be translated into organisational learning is an organisational memory system where all individual learning can be stored and later shared with everyone else in the organisation [19, 20]. Organisational memory refers to such things as routines, standard operating procedures (SOPs), documents, or job instructions that can be used to control behaviours of the organisation or members of the organisation [21].

2.2 Differences between organisational learning and learning organisation

The word learning organisation is sometimes used interchangeably with organisational learning [22]. However, the two concepts are not exactly the same. In a nutshell, organisational learning is seen as

a process, whereas a learning organisation is a form of organisation. Tsang [23] explained that "organisational learning is a concept used to describe certain types of activity that take place in an organisation while the learning organisation refers to a particular type of organisation in and of itself". It is simply the difference between ``becoming" and ``being" [23]. In short, a learning organisation is the type of organisation that has excellent organisational learning capabilities [23].

Organisational learning is seen as occurring naturally in an organisation, and is seen as a natural state of an organisation [24]. For instance, a simple error correction and detection (as a form of single-loop learning) can happen almost naturally. In contrast, a more advanced level double-loop learning (a hallmark of a truly learning organisation) needs serious management efforts to develop over time.

In order to generate competitive edge against its competitor, a company cannot afford to ignore organisational learning. However, organisational learning, in the form of a naturally occurring learning process (i.e. single-loop learning), may not be adequate to sustain lean implementation. What makes good organisational learning (i.e. double-loop learning) are serious efforts on the part of management to intervene and prescribe the correct way for the company to learn. A company that is not committed toward building a learning organisation may not be able to sustain competitive edge for long.

2.3 Theoretical framework

This study was based on learning organisation model developed by Watkins and Marsick [25]. This model consists of seven dimensions or imperative actions that characterise an organisation journeying towards the concept of the learning organisation. Those seven dimensions are creating continuous learning opportunities, promoting inquiry and dialogue, encouraging collaboration and team learning, empowering people toward a collective vision, establishing systems to capture and share learning, connecting an organisation to its environment, and providing strategic leadership for learning. The brief descriptions of the dimensions are shown in Table 1.

Table 1: Watkins and Marsick's Seven Dimensions of the Learning organisation [26]

Dimension	**Description**
Continuous learning	Learning is designed into work so people can learn on the job; opportunities are provided for ongoing education and growth
Inquiry and dialogue	People express their views and listen and inquire into the views of others; questioning, feedback, and experimentation are supported
Team learning and collaboration	Work is designed to encourage groups to access different modes of thinking, groups learn and work together, and collaboration is valued and rewarded
Embedded system	Both high- and low-technology systems to share learning are created and integrated with work, access is provided, and systems are maintained
Empowerment	People are involved in setting, owning, and implementing joint visions; responsibility is distributed close to decision making so people are motivated to learn what they are held accountable for
System connection	People are helped to see the impact of their work on the entire enterprise, to think systemically; people scan the environment and use information to adjust work practices; and the organization is linked to its community
Strategic leadership	Leaders model, champion, and support learning; leadership uses learning strategically for business results

This model has several advantages over other models. First, in this model, the variable of a learning organisation has been defined in a clear and inclusive manner [27]. Second, the model can be used to adequately cover all levels of learning within an organisation; individual, team and

organisational level [27]. Third, the model not only highlights the necessary dimensions for building a learning organisation but also specifies the relationships between those dimensions in a neat theoretical framework. [27]. Finally, its proposed seven dimensions of a learning organisation are very action-oriented and thus have practical consequences [27]. The model proposes measurable actions to be carried out in order to develop a learning organisation [27].

Therefore, the model was selected for this study, and it was used as a way to measure the presence of learning organisation culture in New Zealand manufacturing companies.

3.0 RESEARCH METHODOLOGY

This study uses a cross-sectional self-administered survey. This type of survey is appropriate for a number of reasons. It could provide both descriptive and analytical information about learning organisation dimensions in the selected manufacturing companies. In this study, all potential respondents received the same set of questions and answered the questions anonymously at their leisure without interference from the researcher, thus probable bias could be prevented to make sure the responses obtained are as objective as possible.

3.1 Sample and data collection

In this study, the population is defined as employees of manufacturing companies which are located in New Zealand. Information regarding New Zealand companies that were obtained from database Kompass NZ. Each company that had been identified earlier was sent with the survey instruments. The survey instruments were sent to company human resources manager, or equivalent, in a self-addressed stamped envelope; including a cover letter from the researcher that specifies the purpose of research, the confidentiality of the participants and the researcher's contact details. The human resource manager, or equivalent, was specifically asked to distribute the questionnaire to employees from different levels of the company (i.e. senior management, middle management and lower management), and different job categories commonly found in a typical manufacturing company (i.e. marketing/sales, operation/production, R&D/technical support, logistics, and general administration). The selection of participants from different job areas and hierarchical position is to ensure adequate representation of different subgroups in the sample so that the results can be generalised.

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3.2 Instrumentation

The survey instrument is primarily in the form of close-ended questions. It is based on the Dimension of Learning Organisation Questionnaire (DLOQ) developed by Watkins and Marsicks [25]. The original DLOQ consists of forty-three items with six-point Likert scale. It covers the seven dimensions of learning organisation; creating continuous learning opportunities (seven items); promoting inquiry and dialogue (six items); encouraging collaboration and team learning (six items); establishing systems to capture and share learning (six items); empowering people to have a collective vision (six items); connecting the organisation to the environment (six items); and providing strategic leadership for learning (six items). In this research, however, the original version forty-three-items DLOQ was not used. Instead, a simplified version developed by Yang [28] was used. The simplified version consists of only twenty-one items (i.e. three items for each dimensions of learning organisation), but with better psychometric properties [28]. The simplified DLOQ version is recommended as a means to investigate the relationships between learning organisation and other entities sucn as organisational performance or organisational capability [28]. The simplified DLOQ is more concise and more suitable for this research, and thus was used with a five-point Likert scale (i.e. from one for strongly disagree to five for strongly agree). The detailed questions are listed in Table 2.

Table 2: Survey questionnaire

Dimensions	**Questions**
Continuous learning	In my company, people help each other learn.
	In my company, people are given time to support learning.
	In my company, people are rewarded for learning.
Inquiry and dialogue	In my company, people give open and honest feedback to each other.
	In my company, whenever people state their view, they also ask what others think.
	In my company, people spend time building trust with each other.
Team learning and collaboration	In my company, teams/groups have the freedom to adapt their goals as needed.
	In my company, teams/groups revise their thinking as a result of group discussions or information collected.
	In my company, teams/groups are confident that the company will act on their recommendations.
Embedded system	My company creates systems to measure gaps between current and expected performance.
	My company makes its lessons learned available to all employees.
	My company measures the results of the time and resources spent on training
Empowerment	My company recognizes people for taking initiative.
	My company gives people control over the resources they need to accomplish their work.
	My company supports employees who take calculated risks.
System connection	My company encourages people to think from a global perspective.
	My company works together with the outside community to meet mutual needs.
	My company encourages people to get answers from across the company when solving problems.
Strategic leadership	In my company, leaders mentor and coach those they lead.
	In my company, leaders continually look for opportunities to learn.
	In my company, leaders ensure that the company's actions are consistent with its values.

3.3 Data Analysis Technique

In this study, Confirmatory Factor Analysis (CFA) was used in order to determine the construct validity of the DLOQ in the context of New Zealand manufacturing companies. CFA is best used whenever a researcher, based on review of theories and/or empirical works, is already aware of how the observed variables are related to the unobserved latent variables [29]. In CFA, the researcher postulates a factor structure, based on the existing theories or empirical results, that connects the observed variables to the unobserved latent variables, then tests the postulated factor structure statistically. Since the DLOQ has been widely confirmed in previous empirical works as a structure with seven latent variables, with each latent variable measured by three observed variables, then the use of CFA is appropriate to test if the same DLOQ model could also fit data collected from New Zealand manufacturing companies.

The reliability of the DLOQ in the context of New Zealand manufacturing companies was checked by using internal consistency method (Cronbach's alpha). For instance, with regards to the DLOQ, the Cronbach's alpha is employed to explain the degree of internal consistency for a set of observed variables, assuming that they measure one unobserved latent variable. Cronbach's alpha will be computed based on the number of observed variables used for each unobserved latent variable and the average correlations of each observed variable with other variables. Cronbach's alpha value of 0.70 or above is normally accepted as an indication of good reliability [30]. It is

worth to note that if the Cronbach's alpha is too high (i.e. more than 0.90), it could also mean that some of the measured variables are redundant and can be dropped [31] .

In addition to reliability, the DLOQ was also checked for its convergent validity. Convergent validity is determined by checking if the factor loadings (i.e. the relationships between observed variables and unobserved latent variables) are significantly different from zero. Convergent validity can be tested during confirmatory factor analysis; if the factor loadings between observed variables and their corresponding unobserved latent variable are more than 0.5, then there is an adequate level of convergent validity for the measurement model. Additionally, another method to measure convergent validity is by examining the values of composite reliability (CR) and average percentage of variance extracted (AVE). Composite reliability is computed from the sum of factor loadings, squared for each unobserved latent variable and the sum of the error variance terms for an unobserved latent variable. The AVE is calculated as the mean squared factor loading and a value less than 0.50 indicates the proportion of unexplained variance that remained in the observed variables is greater than the variance explained by the latent factor structure. If AVE is more than 0.50 and less than CR, then there is adequate convergent validity for the measurement model.

The DLOQ was also checked for its discriminant validity. Discriminant validity is established if the variance-extracted percentages for any two latent variables are both greater than the square of the correlation estimate between those two latent variables [32]. There are two values that are related to the squared correlations between latent variables; average share variance (ASV) and maximum shared variance (MSV). Discriminant validity can be determined by examining the values of AVE, ASV and MSV. If both MSV and ASV are less than AVE, then there is an adequate level of discriminant validity. Additionally, discriminant validity can also be checked by comparing the square root of AVE for each latent variable with the correlations between that latent variable and all other latent variables; i.e. the square root of AVE should be larger.

All data analyses were carried out using software SPSS 18.0 and AMOS 18.

4.0 RESULTS

4.1 Descriptive statistics of New Zealand survey respondents

A total of 2200 questionnaires were sent to randomly chosen manufacturing companies throughout New Zealand. At the end of 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 and not used at all since they were either not complete or contained so many missing data. In the end, there were only 169 usable responses obtained from either large companies or small-and-medium sized companies. The remaining usable cases also contained some missing values but the missing percentages were low and there was no indication of systematic pattern of missing values (Little MCAR χ^2 =992.2, df=1059, sig=0.929). Subsequently, the missing values were imputed using the expectation maximization (EM) method that was available in the Missing Value Analysis in SPSS 18.0, and the usable responses were used in subsequent data analysis. Details of the survey responses are shown in Table 3.

4.2 Confirmatory factor analysis results

In this study, the DLOQ model was assessed on how well it fitted the observed data. This assessment was done by checking the *p* value of the normal theory χ^2 test. The χ^2 is the test whether or not there is a significant difference between the matrix of implied co-variances and the matrix of empirical sample co-variances. Significance level $\alpha = 0.05$ was usually used; if the probability exceeds the α level, then it can be concluded that there is no significant difference between the matrix of implied co-variances and the matrix of empirical sample co-variances, and thus the

DLOQ model is a good depiction of the observed data obtained from New Zealand manufacturing companies.

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%

If the use of χ^2 is too problematic, then there are additional ways that can be used to assess how well a model fits the observed data. These additional ways are goodness of fit indices that can be categorised into two types; absolute fit indices and incremental fit indices.

Absolute fit indices measures the extent to which a model reproduces the observed data [33]. Examples of absolute fit includes χ^2 statistic itself, the root mean square error of approximation (RMSEA) which represents the model fit in a population, the standardized root mean square residual (SRMR), which is the average difference between corresponding elements of the sample and model-implied correlation matrices [33], and the goodness-of-fit index (GFI), which measures the amount of variance and covariance in the observed matrix that is explained by the estimated matrix [29].

Incremental fit meanwhile assesses how much proportionate improvement in goodness of fit that a model can achieve when compared with a more restricted baseline model [33]. Examples of incremental fit indices are Comparative fit index (CFI) which measures the degree of fit between the hypothesized and null measurement, and Tucker Lewis index (TLI) which is the relative fit index that compares the model being tested to a null measurement.

In this study, multiple fit indices were used. Each index has its own strength that measures specific aspect of the model, so the use of multiple indices give more substantive assessment of the model [33, 34]. In this study, goodness of fit was determined first by χ^2 statistics, and its corresponding *p* values, and followed by RMSEA with its confidence interval. The choice of RMSEA was because it is the least affected whenever non-normality exists [33, 34]. The other indices are the incremental fit type indices such as CFI and TLI. Additional absolute fit type index such as SRMR was also used.

Results of the CFA are shown in Table 4 and Figure 1. As shown in Table 4, the χ^2(N=169, df=168)=255.9 was statistically significant (p=.001), thus indicating a lack of fit. However, the model can be holistically evaluated by looking at other fit indices too. Alternative fit indices such as CFI, and TLI were all above 0.90, indicating a good fit. Small magnitude of residuals (RMSEA = 0.056, and SRMR = 0.0461) were also indicative of model fit. As shown in Figure 1, the factor loadings of each observed variables on the seven latent variables also provided additional evidence of the fitness of the DLOQ model. All factor loadings of the observed variables were greater than

the threshold value of 0.50. The results indicated that the construct validity of the DLOQ model in the context of New Zealand manufacturing companies was confirmed. The findings from this study were also comparable with those obtained from other studies using the DLOQ as shown in Table 5.

Table 4: Fit indices for learning organisation dimensions measurement model

	χ^2	RMSEA	SRMR	CFI	TLI
LO dimensions measurement model	χ^2(N=169,df=168)=255.9 p=0.00	.056	.0461	.957	.946

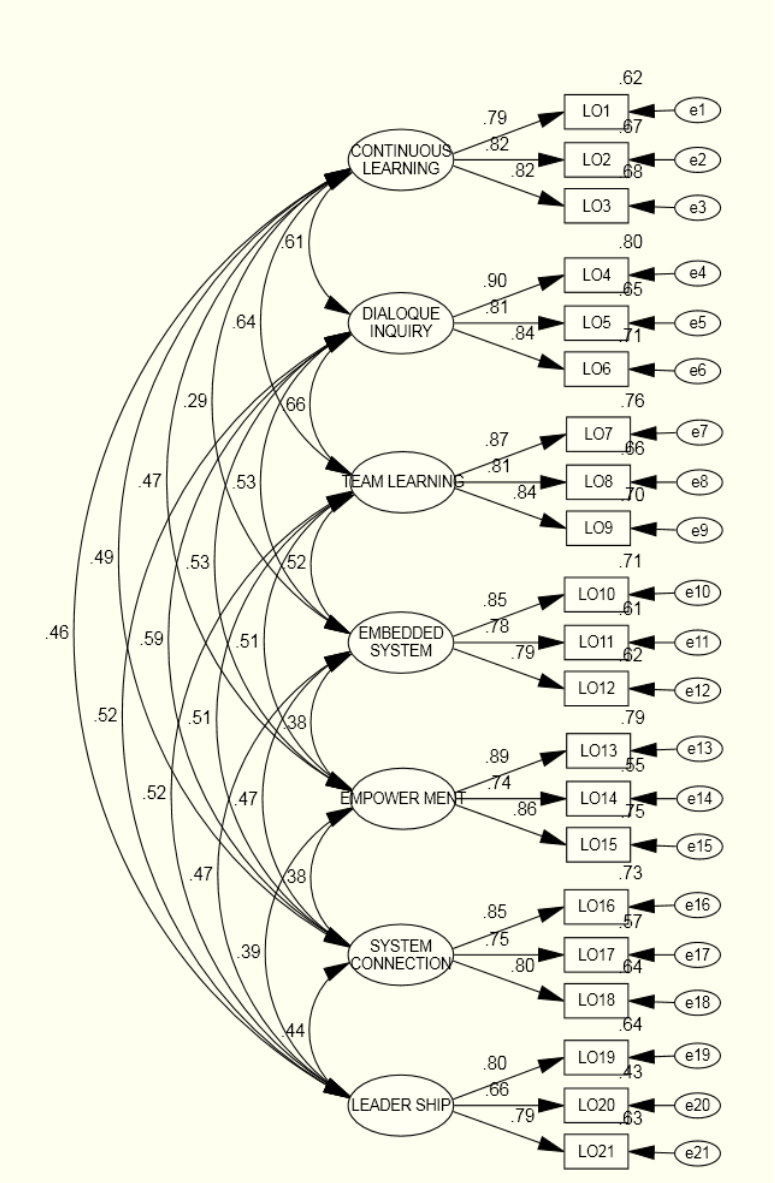

Figure 1: Confirmatory factor analysis for learning organisation dimensions measurement model

4.3 Reliability of the DLOQ

Table 6 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 0.79 to 0.88. As all Cronbach's alphas were above the threshold limit of 0.70, the internal consistency (reliability) of the measurement model was confirmed. The results of the analysis confirmed that the seven-variable learning organisation dimensions measurement model exhibited a measure of high internal consistency when used with New Zealand manufacturing companies' data. The results were also comparable with results from other studies.

Table 5: Fit indices of the measurement model

Fit indices	**Current study**	**Song et al [9]**	**Zhang et al [35]**	**Lien et al [8]**	**Ellinger [5]**	**Yang et al [27]**	**Mbassana [11]**
χ^2	255.9	920.1	632.6	830.2	328.5	617.4	369.8
df	168	168	167	168	157	168	168
RMSEA	0.056	0.054	0.077	0.076	0.073	0.08	.053
TLI	0.946	0.99	0.85	0.92	0.91	0.89	0.98
CFI	0.957	0.99	0.88	0.93	0.94	0.91	0.98

Table 6: Reliability of the DLOQ

Sub-scale	**Cronbach's alpha**					
	Current study	**Song et al [9]**	**Zhang et al [35]**	**Lien et al [8]**	**Ellinger [5]**	**Yang et al [27]**
Continuous learning	0.85	0.74	0.80	0.72	0.81	0.71
Dialogue & inquiry	0.88	0.80	0.78	0.89	0.86	0.78
Team Learning	0.87	0.78	0.78	0.86	0.85	0.79
Embedded System	0.84	0.76	0.82	0.71	0.85	0.75
Empowerment	0.87	0.78	0.82	0.75	0.84	0.68
System Connection	0.84	0.79	0.84	0.89	0.87	0.75
Leadership	0.79	0.84	0.85	0.91	0.89	0.83

4.4 Convergent and discriminant validity of the DLOQ

As shown in Table 7, the DLOQ measurement model also exhibited acceptable level of convergent validity since the standardised regression weights between observed variables to their respective latent variables were all significant with values above the threshold limit 0.50. Convergent validity was also proven based on the values of composite reliability (CR) and average variance extracted (AVE) for each unobserved latent variables; all CRs were larger than the corresponding AVEs, and all AVEs were above 0.50.

Table 7: Standard regression weight of seven variables of learning organisation dimensions measurement model

Latent variables	**Observed variables**	**Regression weight (factor loading)**	**CR**	**AVE**	**Convergent validity? (CR>AVE, AVE>.5)**
Continuous learning	LO1	.790	.852	.658	Yes
	LO2	.820			
	LO3	.823			
Dialogue & Inquiry	LO4	.896	.886	.722	Yes
	LO5	.806			
	LO6	.845			
Team Learning	LO7	.870	.878	.707	Yes
	LO8	.815			
	LO9	.836			
Embedded System	LO10	.845	.845	.646	Yes
	LO11	.779			
	LO12	.786			
Empowerment	LO13	.890	.872	.696	Yes
	LO14	.742			
	LO15	.864			
System connection	LO16	.853	.845	.646	Yes
	LO17	.755			
	LO18	.800			
Leadership	LO19	.802	.796	.568	Yes
	LO20	.659			
	LO21	.791			

As shown in Table 8, the DLOQ measurement model also exhibited an adequate level of discriminant validity; all AVEs were larger than both maximum shared variance (MSV) and average share variance (ASV), and square root of AVE for all latent variables were larger than their corresponding correlations with other latent variables.

In this study, the seven-factor DLOQ measurement model was tested against data collected from selected New Zealand manufacturing companies. The DLOQ measurement model was found to have demonstrated adequate evidence of construct validity and reliability. The fit indices of the DLOQ measurement model were comparable with the fit indices of the same DLOQ model that was used in several earlier studies. The seven-variable DLOQ measurement model also exhibited high internal consistency (reliability) that was comparable with results from previous studies. The DLOQ measurement model also exhibited adequate convergent and discriminant validity.

Finally, from theoretical point of view, the results of data analysis of the DLOQ measurement model suggested that the measurement model was valid and reliable to be used in the context of New Zealand manufacturing companies. It can be applied with the same accuracy and

consistency in New Zealand as in the United States where the model was first developed. These findings add more evidence to the generalisability and robustness of the DLOQ, as well as the overall accuracy and validity of the theory of the learning organisation developed by Watkins and Marsick [25].

Table 8: MSV, ASV and square root of AVE of learning organisation dimensions measurement model

Latent variables	**AVE**	**MSV**	**ASV**	**Continuous learning**	**Dialogue & Inquiry**	**Team Learning**	**Embedded System**	**Empowerment**	**System connection**	**Leadership**	**Discriminant validity?**
Continuous learning	.658	.407	.256	.811							Yes
Dialogue & Inquiry	.722	.437	.330	.607	.850						Yes
Team Learning	.707	.437	.317	.638	.661	.841					Yes
Embedded System	.646	.278	.201	.288	.527	.520	.804				Yes
Empower ment	.696	.283	.199	.471	.532	.506	.376	.834			Yes
System connection	.646	.350	.234	.490	.592	.514	.466	.378	.804		Yes
Leadership	.568	.267	.217	.462	.515	.517	.466	.389	.436	.753	Yes

Notes: Square root of AVE on diagonals

From the practical point of view, the study suggests that learning organisation theory can be applied in managing operations in a manufacturing company. The study has shown that the validity and reliability of the DLOQ model is backed by sound empirical data, and thus can clear up doubt among manufacturing practitioners on how to go about transforming their organisations into a learning organisation. The process of transforming into a learning organisation is no doubt very difficult and challenging but the DLOQ model can become a guide to begin the process. In the beginning stage, the DLOQ can be used to measure the level of learning organisation dimensions that are present in the said organisation. This can be the starting yardstick in the process of building a learning organisation; the management of the said organisation can identify which learning organisation dimensions are lacking and should be given the first priority in order to build a learning organisation.

5.0 CONCLUSIONS

Learning organisation is an organisation that is good at organisational learning. From operation management point of view, organisational learning has been noted as a leverage that can be used to stay competitive and stay ahead of one's competitor. Therefore, a New Zealand manufacturing company should begin to develop its own dimensions of learning organisation in order to stay

competitive. However, in order to become a learning organisation, it needs to first measure its own level of learning organisation culture. The process of measuring the level of learning organisation can be done by using the Watkins and Marsicks' DLOQ model. Afterall, the study has shown that the DLOQ model is valid and reliable for usage in the context of New Zealand manufacturing companies.

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