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Short-Form version of the Benchmark Resilience Tool (BRT-53)

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Abstract

The Benchmark Resilience tool (BRT-53) is an organisational-level resilience quantification methodology which assesses behavioural traits and perceptions linked to the organisation's ability to plan for, respond to and recover from emergencies and crises. The BRT-53 is a survey with 53 questions (items) that yields a 13 scale profile or organisational resilience based on 13 theoretical constructs. Items are drawn from the BRT-53 to create two shorter forms of the tool using two different methods for comparative purposes. The first method involves the selection of items based on the 13 theoretical constructs used in the development of the original tool. This shortened index is called the BRT-13A. The second method derived 13 items from the theoretical constructs using statistical correlations of the items within each construct. This shortened index is called the BRT-13B. The scores from each short-form index were computed into overall resilience scores that were then compared with the overall resilience scores generated from the BRT-53. The results of these comparisons found that both the BRT-13A and BRT-13B produced valid and reliably similar results to the BRT-53. The BRT-13B proved to be slightly more valid and reliable than the BRT-13A and is recommended over the BRT-53 as the short-form version significantly decreases the likelihood of survey fatigue and low response rates with very little sacrifice to survey validity or reliability.

Keywords: resilience; short-form; organizational performance; quantification methodology

1 Introduction

Organisational resilience is an organisation's ability to plan for, respond to and recover from emergencies and crises (Bell, 2002; Brand and Jax, 2007; Comfort, 1994). As some organisations are more resilient than others (Hamel and Välikangas, 2003), the identification of common characteristics among resilient organisations has yielded a body of literature that supports several theoretical constructs that contribute to resilience. Increasing organisational capacities within these different theoretical constructs of resilience are predicted to improve organisational survival following different types of crises. Utilising these theoretical constructs of resilience, the Benchmark Resilience Tool (BRT-53) was developed to benchmark an organisational resilience, regardless of industry sector or organisational size (McManus, 2008; Stephenson, 2010; Stephenson et al., 2010).

Given the importance of resilience for organisations, there are surprisingly few tools for the measurement of its theoretical constructs. Of the few tools that have been developed, resilience is assessed from specific perspectives such as size, industry or other particular aspects of the organisation. For example, the CERT Resilience Management Model (CERT-RMM) (Caralli, Allen, Curtis, White, and Young, 2010), the Resilient Institute's (2012) Resilience Diagnostic, and the Magus Indexer (Magus Toolbox Limited, 1990) are all designed with a specific theoretical framework and end-user in mind. The CERT Resilience Management Model (CERT-RMM) (Caralli et al., 2010) is targeted towards organisational resilience from an information and communication technology (ICT) security perspective. The Magus Indexer (Magus Toolbox Limited, 1990) was developed for use by organisations with at least 100 people. In other work, the Resilient Institute's (2012) Resilience Diagnostic is more focused on the resilience of the individuals in the organisation as opposed to the resilience of the whole organisation. Other resilience measurement tools include those by the Stockholm Resilience Centre for the resilience of socio-ecological systems (Stockholm Resilience Centre, 2003) as well as the Community and Regional *Resilience Institute's (CARRI)* measure of community resilience (CARRI, 2007). These methodologies, while effective within their respective domains, are not broadly applicable to the majority of organisations and lack the ability to compare

across domains and organisational sizes. Consequently, as an alternative to these highly specialised tools, the BRT-53 was designed to be used to measure resilience in a wide range of organisations, regardless of size or industry sector. Additionally, the BRT-53 can be used in concert with some of the other resilience measurement tools mentioned such as the Resilience Institute's Resilience Diagnostic (2012). The BRT-53 can be deployed using different media formats (e.g. online or as a paper questionnaire) and as a self-administered questionnaire is convenient for respondents to use. Results from the use of the BRT-53 can then be used as a starting point for the organisation to investigate how they can improve their resilience.

The focus of this paper is on the development and validation of a short-form of the BRT-53. The authors' focus on the BRT-53 as a tool for the measurement of organisational resilience stems from their experience using the tool in the greater Christchurch region following the 2010-2011 series of devastating earthquakes (Kachali, In Press; Stevenson, 2011; Whitman et al., In Press). This deployment of the tool brought to light some challenges of the BRT-53 in its current form as well as opportunities for improvement. One of the challenges of using the BRT-53 was the length of the survey questionnaire (53 items) especially when coupled with questions designed to investigate other phenomena such as effects of the earthquakes in the greater Christchurch area. This led to survey respondents reporting the combined questionnaire as being too long. Consequently it was recognised that a short-form of the BRT-53 would improve usability and response rates even when used on its own.

In this paper, the Benchmark Resilience Tool (BRT-53) is introduced and its theoretical basis is discussed. Then, a short-form methodology is developed and assessed through measures of reliability and validity, taking statistical and theoretical considerations into account for the selection of representative items. Finally, the application, advantages and limitations of the short-form survey are outlined.

The BRT-53 development and model

The Benchmark Resilience Tool (BRT-53) tests the practical application of the theoretical constructs identified as making up organisational resilience. The basis of the BRT-53 was developed from the qualitative work of McManus (2008) who investigated the resilience of organisations in New Zealand. McManus (2008) identified 15 indicators of organisational resilience grouped under three factors. Stephenson (2010), building on the work of McManus (2008), then developed a quantitative methodology that measured the indicators of organisational resilience. This later work of Stephenson (2010a) and Lee et al (in press) led to the current form of the BRT-53. Using exploratory factor analysis (EFA) techniques, 53 items are constrained by 13 theoretical constructs defined as "indicators" that are found to be constituents of a two-factor model of organisational resilience. The two latent factors are named: *adaptive capacity* and *planning*. The indicators within each of the factors and the number of items per indicator are illustrated in Table 1. Table 1 also shows the Cronbach's Alpha values for each of the indicators.

Table 1 - Structural breakdown of the factors of organisational resilience, showing the indicators, the number of questions per indicator, and the internal reliability of the 13 indicators used to form the latent variables. From the table it is evident that all reliabilities are 0.68 or higher, indicating strong internal reliability.

Organisational Resilience Factor	Indicator Code	Indicator Description	Items	Cronbach's Alpha
Planning	P1	Proactive Posture	5	0.70
	P2	Recovery Priorities	4	0.82
	P3	Planning Strategies	4	0.68
	P4	Participation in Exercises	3	0.79
	P5	Capability & Capacity of External Resources	4	0.74
Adaptive Capacity	AC1	Internal & External Situation Monitoring & Reporting	7	0.82
	AC2	Capability & Capacity of Internal Resources	3	0.72
	AC3	Staff Engagement & Involvement	2	0.71
	AC4	Silo Mentality	4	0.76
	AC5	Information & Knowledge	5	0.75
	AC6	Leadership, Management & Governance Structures	6	0.83
	AC7	Innovation & Creativity	3	0.72
	AC8	Devolved & Responsive Decision Making	3	0.73

Adapted from Stephenson (2010)

All the items within the BRT-53 model are 4-point Likert-scale questions that assess the organisations' agreement with individual statements. Because each indicator contains a different number of items, all the indicators were equally weighted before being used to calculate the

adaptive capacity and planning factor scores. As pointed out earlier, the BRT-53 is a self-administered questionnaire that provides organisations with an indication of their performance for each of the 13 areas of organisational resilience. The difference in results from use of the BRT-53 at different times makes it possible for organisations to assess themselves and make improvements. A detailed discussion of the development process, the theoretical basis for the 13 resilience constructs, and results from the original development of the BRT-53 are found in Stephenson (2010) or Lee (*In Press)*.

2 The need for a short-form version

As part of continual development of the BRT-53, deployment in the greater Christchurch area following the 2010-2011 series of earthquakes showed that a practical limitation of the 53-item scale was a significant commitment in time and energy for the respondents. For instance, for some respondents the number of items alone made them reluctant to use the tool. Other respondents felt that some of the items were redundant. Yet other survey respondents advised that a shorter, more targeted version would likely encourage participation. The BRT-53 also saw relatively high item omission rates or item inapplicability for small- to medium-sized organisations (SMEs). For example, some of the items in the BRT-53 ask about how different departments in the same organisation work together. Respondents from some small- to medium-sized organisations pointed out that their organisations were not arranged into multiple distinct departments. In addition, the BRT-53 proved difficult to deploy in conjunction with additional lines of questioning (e.g. to assess impacts of disaster on organisations) as this led to even longer surveys. As short-form versions have previously been developed to decrease survey time and improve response rates without significant losses in data validity and reliability (Goldberg et al. 1997; Jenkinson et al. 1997; Ware and Sherbourne 1992), the development of a short-form version of the BRT-53 was found to warrant further analysis.

3 Short-form validation and reliability

The quality of a questionnaire survey, and consequently the short-form version can be evaluated by analysing its validity and reliability (Perry, 1996). Validity concerns the content of the concept being measured; or in other words, is the concept described the one being measured? For the purposes of this paper, two forms of evidence are used assess validity. The first is by measuring the correlations of indicator, factor and overall scale scores generated from different measures (Allen and Meyer, 1996; Francis, Brown and Philipchalk, 1992). The second is through the reliability of the overall scale as well as the constituent factors. Reliability is the consistency of the tool, evaluated by measuring a concept at various times and then analysing the internal consistency of the items. Reliability can be established by comparing with other validated methods of measurement of an equal or a higher level. For instance, the reliability of a short-form survey can be tested by comparing results to those of an already existing standardised and validated questionnaire (Dworkin et al. 2009). Cronbach's alpha (Cronbach, 1951), a measure of the homogeneity of a group of items in a questionnaire is often used for evaluation of internal consistency (Santos, 1999). Other short-form versions of questionnaires that have been developed and tested using one or other of the above techniques include the General Health Questionnaires (GHQ-12, GHQ-28) (Goldberg et al., 1997), the Medical Outcomes Study SF-36 (Ware Jr and Sherbourne, 1992) and the Parkinson Disease Questionnaire PDQ-8 (Jenkinson, Fitzpatrick, Peto, Greenhall, and Hyman, 1997).

4 Methods

The methodology to constrain the number of items began by analysing the 13 indicators' internal reliabilities from Stephenson (2010) and Lee et al. (In Press). This was done because the BRT-53 is constructed using the equally weighted scores from 13 indicators, and the indicators exhibited high internal reliabilities, as shown in Stephenson (2010). Therefore, single items from each indicator should be accurate approximations of the theoretical constructs, and adequate representations of the two factors they constrain. Raubenheimer (2007) advises that when using exploratory factor

analysis (EFA) for item selection, each indicator should have a minimum of three items. This is to ensure consistency and validity. Two methodologies, theoretical and statistical, were tested to determine which item from each indicator was most representative.

The first method involved selecting items that best approximated the theoretical nature of each construct's critical components. A single item from each indicator was selected through a discussion panel of 7 researchers. Prior to selection, each construct was outlined, and its major components defined. The most appropriate item per indicator was then selected by the research team who were all familiar with the model's theoretical constructs. This first short-form version developed was defined as the *BRT-13a*.

The second method used for item selection was based on the statistical correlation of each item to the overall construct score. The data used for this determination were the same data used in the development of the original BRT-53. All items were correlated to their respective indicator's average score, and the highest correlating item to the indicator's average score was selected. This second short-form version was named the *BRT-13b*.

While the BRT-*13a* and BRT-*13b* were arrived at using different selection criteria, for 6 of the 13 indicators the items in both short-forms were identical. For the remaining 7 indicators that were represented using different items, the item-indicator correlations were compared to assess the differences between the two methods. The overall item-indicator differences between the item-selection methods were found to be relatively minor. As shown in Table 2, the differences between the items selected in BRT-*13a* and BRT-*13b* do not exhibit large differences in their correlation to the indicator scores from BRT-53.

Table 2 - The correlations between the item and the corresponding indicator calculated from BRT-53 are shown for both the short-form surveys.

Factor	Indicator Code	BRT-13A to BRT-53	BRT-13B to BRT-53	Difference
Planning	P1	0.740	0.740	0.000
	P2	0.861	0.861	0.000
	P3	0.772	0.776	0.004

	P4	0.794	0.794	0.000
	P5	0.845	0.876	0.031
Adaptive Capacity	AC1	0.762	0.816	0.054
	AC2	0.842	0.842	0.000
	AC3	0.882	0.882	0.000
	AC4	0.695	0.743	0.048
	AC5	0.755	0.813	0.058
	AC6	0.797	0.831	0.033
	AC7	0.832	0.832	0.000
	AC8	0.671	0.777	0.106
	Average	0.788	0.814	0.026

For both short-form versions, BRT-*13a* and the BRT-*13b*, overall scores of organisational resilience were computed using the same method used to compute scores for the BRT-53. The overall resilience scores for both short-forms were then compared to the results generated from the BRT-53 and analysed for differences. The results were also then compared at the factor level.

Three datasets were used to compare the effectiveness of the BRT-*13a* and the BRT-*13b* in approximating the BRT-53: the Auckland dataset, the Hurunui dataset and the Canterbury dataset. These datasets were collected from organisations from three regions in New Zealand under different contexts. Also, the organisational industry sectors represented in each of the sample sets varied. The Auckland dataset was the original dataset, and served as the basis for the BRT-53. The other 2 datasets were collected following the development of the BRT-53.

For all three datasets, cases with missing values were removed to exclude any potential bias from missing value replacement methodologies. While it was observed that smaller organisations, most especially organisations within the primary industries, were more likely to omit items and consequently more likely to be excluded from the analysis, no significant change in the sampled population's organisational size distribution was observed following case removal.

5 Results

The first deployment, the Auckland dataset, was completed in 2009 by organisations in the Auckland region. The questionnaire was deployed to 1009 organisations, receiving responses from 249

individuals from 68 organisations (Lee et al., In Press; Stephenson 2010). Over 70% of the responding organisations were from three sectors: property and business services, manufacturing, and wholesale trade. The remaining sample represented 10 different sectors. In terms of disaster context, the responding organisations were not in the aftermath of a significant regional crisis.

Overall resilience scores for each organisation were generated from the BRT-53, the BRT-*13a* and the BRT-*13b*. The distributions of these scores were assessed against normal distributions using Q-Q plots. The distributions of both short-forms show relatively similar shapes and locations as shown in Figure 1. Scores from the BRT-*13a* showed higher case variance and therefore the tails of the distributions were accentuated. Consequently, use of the BRT-*13a* may lead to slightly more polarised results for organisations whose organisational resilience scores fall within the extreme bands of the distributions. The effect of the distortion increases with distance from the mean and extreme organisational resilience values are amplified when using both short-forms. However the discrepancy between these expected and observed organisational resilience values is small and the distributions are not significantly distorted. The BRT-*13b* short-form appears to replicate the shape of the population's distribution more accurately.

The second deployment, the Hurunui dataset, was completed in 2010 by organisations in the Hurunui District, an area largely populated by the primary producer sector. Of the 1002 organisations contacted, 71 organisations responded; respondents were instructed to return one response per organisation. Over 80% of sampled organisations were from three sectors: primary industries, retail trade, and accommodation and food services. Of that, the primary industries comprised 59% of all sampled organisations, by far the most represented sector. The remaining sample subset comprised eight other sectors. Organisations in the district had recent disaster experience, with drought conditions found in many areas of the district for multiple years and some recovering from two major flooding events that occurred in 2008.

Again, the two short-form survey results were compared against the full questionnaire using the distributions of each scales' overall resilience scores. As shown in Figure 2, the distributions of both the BRT-*13a* and BRT-*13b* show similar shapes, and differentiating a superior methodology is difficult to judge visually. Likely due to the small sample size, the populations from the BRT-53, BRT-*13a*, and BRT-*13b* do not exhibit normal distributions. Similar to what was observed in the Auckland dataset, the BRT-*13a* and BRT-*13b* may potentially reward organisations that showed higher scores, however the discrepancy between the distributions is small.

The third deployment, the Canterbury dataset, was completed in 2011 for organisations that were sampled following the 4 September 2010 Darfield earthquake on the South Island of New Zealand. These organisations had already been contacted immediately following the event and the deployment of the BRT-53 was the second of three data captures designed to assess the Darfield earthquake's impact on organisations in the affected region. After case deletion, 66 organisations remained from those that took part in the BRT-53 questionnaire; each organisation completed one instance of the questionnaire.

As shown in Figure 3, for Canterbury the distributions of the BRT-*13a* and BRT-*13b* appear to match closely that of the BRT-53. Dissimilar to the results from the Hurunui dataset, the residuals for both the BRT-*13a* and BRT-*13b* populations when compared to BRT-53 are more normally distributed for the Canterbury dataset. Additionally, the BRT-*13b* may exhibit a slight negative bias when compared to the results of the BRT-53. Differences between the two short-form results are difficult to determine visually.

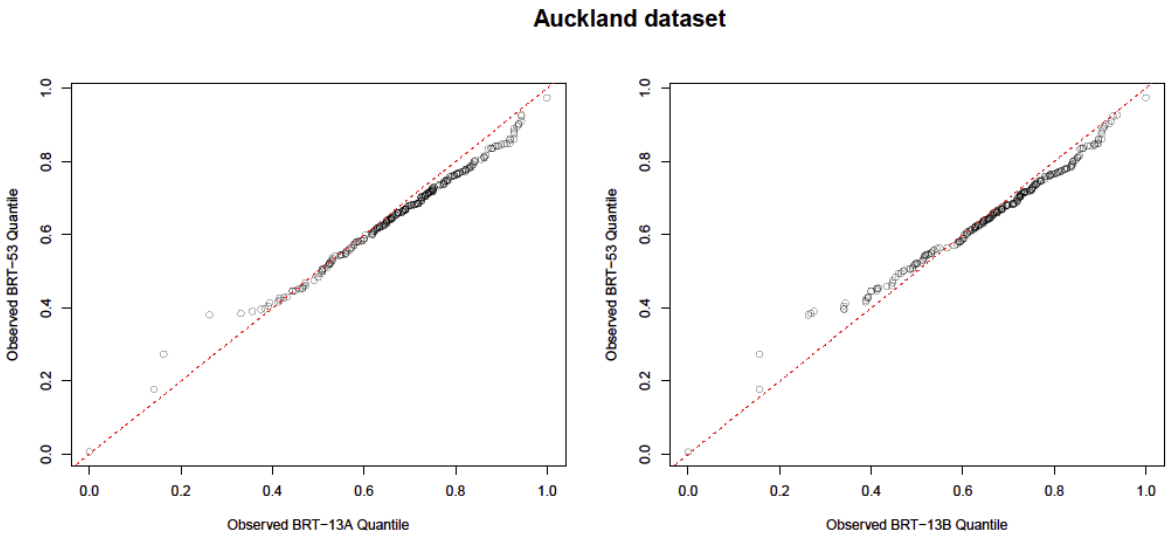

Figure 1 - Quantile-Quantile plots of overall resilience scores generated from the Auckland dataset comparing the BRT-*13a* and BRT*13b* scales to the BRT-53 scale. The Q-Q plot on the left shows the quantile scores from the BRT-53 compared to the quantile scores of the BRT-*13a*. The Q-Q plot on the right shows the BRT-53 quantile scores to the BRT-*13b* quantile scores. For both plots, the dotted red reference line shows a perfect distribution match. Points above the line signify left skew approximations for the corresponding short-form and points below the line signify right skew. The Auckland dataset was the original dataset from which the BRT-53 was defined and developed.

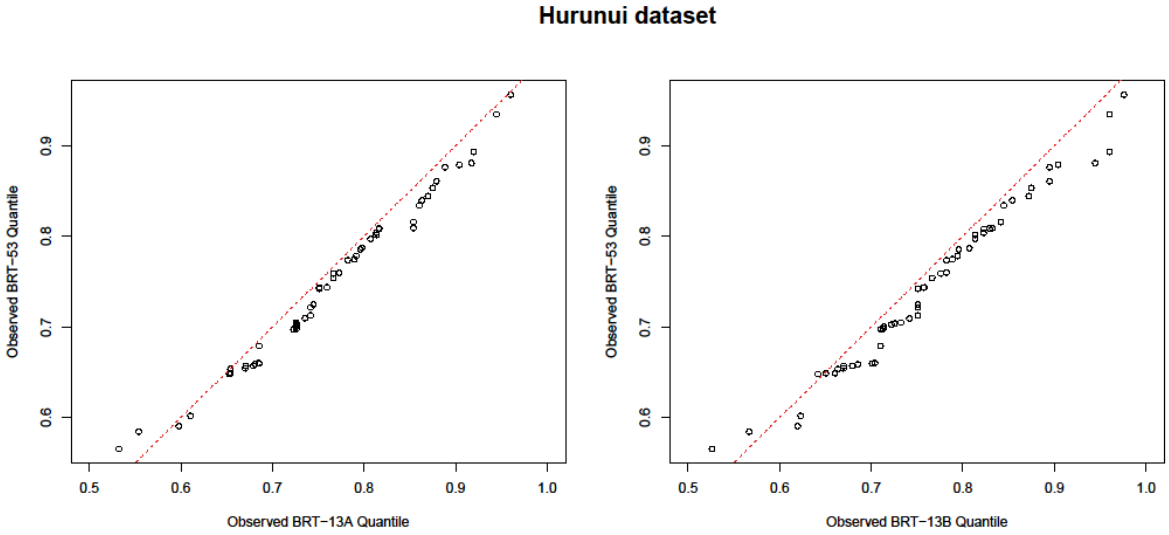

Figure 2 - Quantile-Quantile plots of overall resilience scores generated from the Hurunui dataset comparing the BRT-*13a* and BRT*13b* scales to the BRT-53 scale. The Q-Q plot on the left shows the quantile scores from the BRT-53 compared to the quantile scores of the BRT-*13a*. The Q-Q plot on the right shows the BRT-53 quantile scores to the BRT-*13b* quantile scores. For both plots, the dotted red reference line shows a perfect distribution match. Points above the line signify left skew approximations for the corresponding short-form and points below the line signify right skew. The Hurunui dataset was the second dataset used to test the BRT-53 on rural organisations.

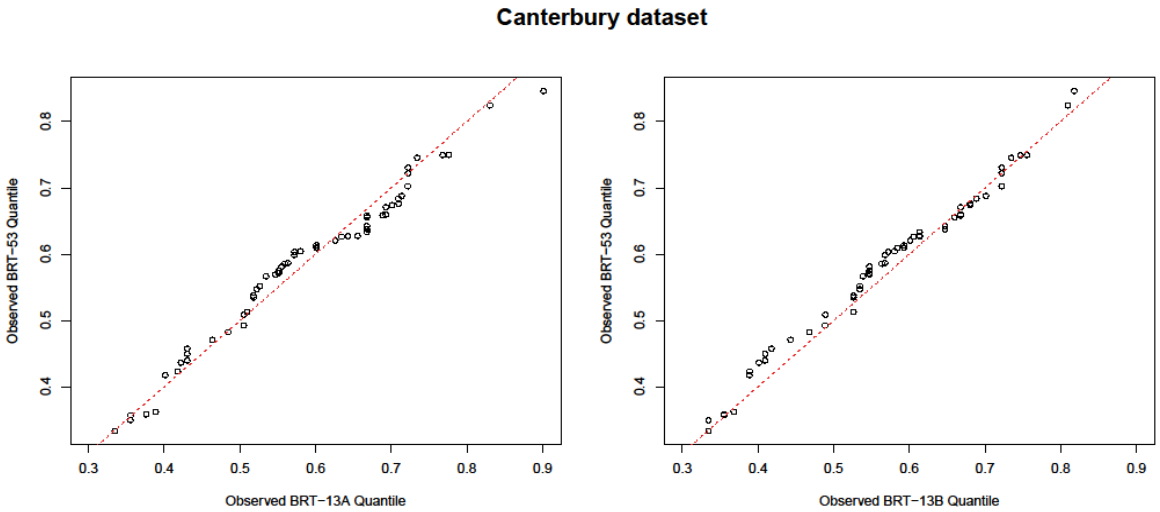

Figure 3 - Quantile-Quantile plots of overall resilience scores generated from the Canterbury dataset comparing the BRT-13a and BRT13b scales to the BRT-53 scale. The Q-Q plot on the left shows the quantile scores from the BRT-53 compared to the quantile scores of the BRT-13a. The Q-Q plot on the right shows the BRT-53 quantile scores to the BRT-13b quantile scores. For both plots, the dotted red reference line shows a perfect distribution match. Points above the line signify left skew approximations for the corresponding short-form and points below the line signify right skew. The Canterbury dataset was the third dataset used to test the BRT-53 on organisations, date were collected following the 4 September 20102 Darfield earthquake.

The short-form methodologies appear to closely approximate the full questionnaire for all three datasets. In every case for both short-form versions, the distributions of organisational results were very similar in both shape and location. To determine the most accurate approximations, the results from the two short-form versions were assessed based on their correlation to the BRT-53.

Correlations between the BRT-53 and the short-forms (BRT-*13a* and BRT-*13b*) were assessed at the overall resilience score and the factor (adaptive capacity and planning) levels. As shown in Table 3, the BRT-53 and BRT-*13a* strongly correlate and are significant for all datasets for the overall resilience score. The internal structure of the BRT-*13a* index was consistent with the results of the BRT-53 as the BRT-*13a* adaptive capacity and planning factors correlated significantly to the BRT-53 factor results in all three datasets. The BRT-*13b* was also highly correlated to the BRT-53 overall resilience score, again with all *r* values exceeding 0.9 and significant. Compared to the performance of the BRT-13a, the BRT-*13b* overall resilience score showed stronger correlations to the BRT-53 for 2 of the 3 datasets. However, in terms of factor correlations to the BRT-53, the results were mixed

and determining the better correlating short-form for factor resolution is difficult. Complete results can be found in **Error! Reference source not found.**.

Table 3 - BRT-53 to BRT-*13a* and BRT*13b* factor and model correlations for all datasets using Spearman Rank Order Correlations with significance levels of p<.0005.

	Auckland		Hurunui		Canterbury	
	BRT-53 to BRT-13A	BRT-53 to BRT-13B	BRT-53 to BRT-13A	BRT-53 to BRT-13B	BRT-53 to BRT-13A	BRT-53 to BRT-13B
Planning Factor	0.9194	0.9323	0.9024	0.8868	0.9389	0.9361
Adaptive Capacity Factor	0.9181	0.8358	0.9377	0.9606	0.8486	0.9293
Overall Resilience	0.9401	0.9892	0.9536	0.9418	0.9582	0.9684

The verification of the internal reliability of the summary score was assessed to assist in judging the more appropriate short-form version. The reliabilities of the overall resilience score and its constituent factors for the BRT-53, the BRT-*13a* and the BRT-*13b* were assessed using Cronbach's Alpha. The BRT-53 gained values of 0.95 for all datasets, which reflects very high internal reliability. Again for all three datasets, the internal reliabilities for the two factors within the BRT-53, planning and adaptive capacity, gained values of at least 0.88 and 0.89 respectively. Consistent with test construction theory (Gulliksen 1950; Lord and Novick 1968), the shortened scales (the BRT-13a and the BRT-13b) recorded lower reliability coefficients than the longer scale (BRT-53) from which it was derived. Even so, the BRT-*13a* recorded alpha coefficients between 0.84 and 0.87 and the BRT-13b 0.85 and 0.88, which is highly reliable for a 13-item scale (Gulliksen 1950; Lord and Novick 1968). The Cronbach alpha values generated for the two factors within the BRT-*13a* and the BRT-*13b* were also lower than what was observed in the BRT-53. The planning factor scored between 0.65 and 0.74 for the BRT-*13a* and 0.67 and 0.75 for the BRT-*13b*, which is low relative to the BRT-53 values, but reliable for a 5-item scale (Francis, Brown and Philipchalk, 1992). For both short-form versions, the adaptive capacity factor results were highly reliable for an 8-item scale. The BRT-*13b* showed

consistently higher, but relatively minor improvements in reliability coefficients to the BRT-*13a*. All results from the reliability tests can be found in Table 4.

Table 4 - Cronbach's alpha values of both short-forms derived from the different datasets.

		Cronbach's alpha		
Factor	**Scale**	**Auckland**	**Hurunui**	**Canterbury**
Planning	BRT-13A	0.73	0.65	0.74
	BRT-13B	0.75	0.67	0.74
	BRT-53	0.89	0.88	0.94
Adaptive Capacity	BRT-13A	0.79	0.79	0.83
	BRT-13B	0.82	0.87	0.86
	BRT-53	0.94	0.95	0.96
Total Resilience	BRT-13A	0.84	0.85	0.87
	BRT-13B	0.85	0.86	0.88
	BRT-53	0.95	0.95	0.97

6 Discussion

From previous deployments of the BRT-53 survey, it was found that when the BRT-53 was used as a module measuring organisational resilience within larger questionnaires assessing the impacts and effects of disaster, the long survey led to low response rates and high item omission frequencies. High omission rates presented a number of challenges in terms of missing value analysis and significantly limited the interoperability of data. Due to these challenges, a short-form version offered numerous practical advantages.

In limiting a 53-item questionnaire to a short-form 5-minute survey, single items were used to represent the theoretical constructs, a technique that has been employed with success in several other cases (Campbell et al. 1976; Coates et al. 1987; Dworkin et al. 2009; Jenkinson et al. 1997; Nelson and Borkovec 1989; Spitzer et al. 1981; Stewart and Hays 1988). To decrease survey length and fatigue, short-form versions often sacrifice two things: comprehensiveness and precision of measurement. In this study, it was decided that the analysis of two methodologies that placed more importance on either theoretical comprehensiveness or measurement precision was necessary to determine which version was most successful. The BRT-*13a* was developed with a methodology that focused on the comprehensiveness of the theoretical constructs through the selection of the most

theoretically representative items per indicator. The BRT-*13b* was developed to attain the most precise total overall resilience score possible by using the strongest correlating items possible. Both short-form versions were designed to produce factor scores and overall resilience scores that could be compared to the results of the BRT-53.

In testing the more appropriate version, three populations from different locations, disaster contexts, and comprised of different types of organisational sectors and sizes were sampled in New Zealand. For all three datasets, both short-forms showed highly similar distribution shapes and localities to that of the BRT-53. Both short-forms produced reliable results and correlated strongly to the BRT-53 overall resilience scores as well as for the two factor scores (adaptive capacity and planning). While both short-forms performed very similarly across all three datasets, the BRT-*13b* showed stronger reliabilities to the BRT-*13a* and therefore is slightly more precise in representing the BRT-53. Furthermore, the overall resilience scores for the BRT-*13b* were more highly correlated to the BRT-53. Therefore, the BRT-*13b* proved to be the more successful short-form version of the BRT-53. The complete list of items contained in the BRT-*13b* are shown in Table A1 in the appendix.

6.1 Limitations

The original BRT-53 model was developed through results derived from organisations within three contextually distinct areas of New Zealand. One dataset was derived from an area that had no recent experience with natural hazards and was heavily urbanized while the other two datasets were derived from both rural and urban areas with recent natural hazard experiences. Therefore, while the results of the BRT-*13a* and BRT-*13b* showed close associations with the results of the BRT-53, comparisons between different sample sets is at this stage unconstrained and analysing the differences between sample groups is not advised. Furthermore, because all sample sets were derived from organisations within New Zealand, the BRT-53 and both BRT-13 versions should be tested in other countries to better understand potential differences in the interpretation of single items. Further deployment of the BRT-53 or BRT-13 short-forms would help constrain these contextually driven variables.

7 Conclusions

It should be noted, from the results discussed above, that both BRT-*13a* and BRT-*13b* can be used in place of the BRT-53. However, BRT-*13b* shows slightly higher values for Cronbach's Alpha than BRT-*13a* and is therefore the most appropriate short-form version of the BRT-53. The preliminary results presented in this paper show that using the BRT-*13b* would be an accurate representation of the BRT-53. The short-form version significantly decreases survey fatigue by reducing the total items considerably while still providing reliable and valid single value indices for organisational resilience as well as for the latent factors: planning and adaptive capacity. Further research is required to determine the BRT-*13b*'s response and item omission rate as well as the test – re-test reliability.

The quantification of organisational resilience is a highly sought-after metric. For practitioners, identifying organisational characteristics that relate to resilience provides the starting point for increasing resilience. However, the current methodology for quantifying organisational resilience is time and energy expensive for the individual and a more concise method increases the application of the tool and may provide for more frequent assessments over time. By creating a short-form version of the BRT-53 tool, the usability for the end-user is increased, along with the likelihood of first-time users to participate. Researchers interested in the results should see increased response rates during surveys as well as decreased omission rates and survey fatigue. In addition, for organisations interested in quantifying their resilience, the short-form version facilitates a more rapid and less costly assessment process. The short-form version would also readily support repeated measurement of resilience over time to determine the effectiveness of any resilience development programme.

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Appendix

Table A1 - BRT-13b item list with corresponding indicator code

Factor	Indicator	Item
Planning	P1	We are mindful of how a crisis could affect us
	P2	We believe emergency plans must be practised and tested to be effective
	P3	We are able to shift rapidly from business-as-usual to respond to crises
	P4	We build relationships with organisations we might have to work with in a crisis
	P5	Our priorities for recovery would provide direction for staff in a crisis
Adaptive Capacity	AC1	There is a sense of teamwork and camaraderie in our organisation
	AC2	Our organisation maintains sufficient resources to absorb some unexpected change
	AC3	People in our organisation "own" a problem until it is resolved
	AC4	Staff have the information and knowledge they need to respond to unexpected problems
	AC5	Managers in our organisation lead by example
	AC6	Staff are rewarded for "thinking outside the box"
	AC7	Our organisation can make tough decisions quickly
	AC8	Managers actively listen for problems